INCREASING THE WATER SUPPLY CAPABILITIES OF A RURAL FIRE DISTRICT

EXECUTIVE DEVELOPMENT

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Abstract

The Williams Rural Fire Protection District (WRFPD) recognizes the fact that in the event of a large-scale fire, the Fire Department does not have adequate capabilities to provide and maintain a continuous water supply to the fire scene. The purpose of this research project was to research information to aid in formulating a plan that could be used to upgrade the Williams Rural Fire Protection District's water supply resources and to reduce refill and travel time of the water tankers.

This project utilized both historical and action research methodology. Historical research was used to determine: (1) what other rural fire departments were doing to facilitate their water supply resources; (2) what funding may be available through government or private grants; (3) what assistance the state fire marshals may provide local rural fire departments in this matter; (4) and what the acceptable national standards are. Action research was used to develop a plan in order to formulate and implement a low cost, efficient water supply program.

The procedures used were: (1) surveying rural fire departments nationwide; (2) surveying all of the state fire marshals; (3) interviewing local fire officials; (4) reviewing various forms of literature including trade magazines, training manuals, and equipment manufacturer's literature; (5) local water resource site inspections.

This research resulted in the development of a plan to: (1) identify and acquire usage of water resource sites; (2) identify the type of equipment and material to be used; (3) develop an acceptable budget for labor and material; (4) provide for funding.

Recommendations included: (1) developing water resource sites supported by dry hydrants, large-capacity water tanks, and pumping stations; (2) identifying the water resource sites, both at the physical location and through mapping programs that would include the computer aided dispatch (CAD) system; (3) recognizing a Water Supply Officer as a major part of the District's Incident Command System; (4) the development of a new water supply training program utilizing all available resources; (5) replacing two older- model water tenders.

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Introduction

The Williams Rural Fire Protection District (WRFPD) has an urgent need to increase its water resource ability, while decreasing the delivery time, to the scene of large-scale fires. Presently, the WRFPD is deficient in this area. Like many other rural fire departments, the WRFPD recognizes its deficiencies, but due to a small budget, it cannot immediately rectify this problem. Fortunately, through public education, the people who reside in the District, are very fire conscious and are sufficiently aware of mandatory fire regulations. However, new residents who have migrated from areas where wildland fires are not a major concern, pose a problem until they can be educated. Dry lightning strikes, combined with high winds, can start and spread a fire in a very short period of time, creating a major life-and-property-threatening problem. Therefore, a continuous, sufficient water supply is of the utmost necessity to combat all types of hostile fires.

The primary purpose of this research project was to assist me in developing a plan that would increase our Fire District's capability to provide and maintain an adequate fire suppression water supply throughout our community while remaining within its present budget constraints. Additionally, this project may provide some valuable information to other departments that are planning to increase their water resource capability.

One of the objectives was to find out what other fire departments have done to successfully increase their water supply capabilities, and if their procedures would in any way benefit our department or other departments with similar water supply problems and fiscal limitations. Another objective was to research whether the federal government and/or state governments were providing assistance to small fire departments.

In order to find the answers to these questions, both historical and action research methods were utilized. Questions (Appendix A) needed to be answered by the surveyed fire departments in order to gather the following information:

1. **What water resources were available to them;**
2. **Number of water tenders;**
3. **Capacity of water tenders;**
4. **Average turn-around time of water tenders;**
5. **Use of dry hydrants;**
6. **Number of dry hydrants;**
7. **Number of water storage tanks;**
8. **Capacity of water storage tanks;**
9. **ISO rating of department or district;**
10. **Square miles in fire district;**
11. **Population served;**
12. **Plans for future upgrading;**
13. **Funding source(s) for upgrading;**
14. **Benefits derived from recent upgrading.**

The following information (Appendix B) needed to be obtained from the 50 State Fire Marshals (or their counterparts):

1. **What assistance, financial or otherwise, they may provide to increase water supply capabilities of fire departments in their respective state;**

2. What knowledge they may have of rural fire departments in their state which have recently taken on a project to improve their water-delivery capabilities;

3. Their thoughts on how rural fire departments can economically increase their water supply;

4. Their awareness of any funding from the government or through grants for this type of project.

Background and Significance

The WRFPD is a Special District funded by voter-approved taxes and governed by a Board of Directors. The Williams Fire Department is an all-volunteer department that consists of twenty-five members, eighteen of which are firefighters and seven are emergency medical personnel. The fire department has two triple-combination pumpers, one of which carries one thousand gallons of water, the other five hundred gallons of water. Additional apparatus include two older military brush rigs, each with one thousand gallon water tanks, one rescue apparatus with a one thousand gallon wa ter tank, and one thirty-five hundred gallon water tender. These fire apparatus provide the department with the capability of delivering seven thousand gallons of water on the initial attack. Seven thousand gallons of water combined with an additional three thousand gallons of water responding on our automatic aid apparatus is a sufficient quantity to extinguish ninety-five percent of the structure fires within our District, NFPA (1989). Our major concern is not that we wouldn't have enough water to extinguish the single structure fire, but rather control the wildland fire that could ignite several structures at the same time.

For example, one summer afternoon with temperatures in the high nineties and humidity below twelve percent, a rancher ignited a grass field while cutting his hay. The primary responsibility of the Williams Fire Department was to protect the seven homes and twelve other structures while the Oregon Department of Forestry (ODF) concentrated on controlling the wildfire. Six of the seven homes were saved and the wildfire was contained to less than twenty-five acres. The stop of this fire was largely attributed to five things: (1) a fast air-attack policy by the ODF utilizing retardant-carrying air tankers and helicopters with water buckets; (2) easy access to the largest pond in our fire district which was capable of supplying a sufficient quantity of water for a draft site and the helicopter buckets; (3) an in-place auto-aid and mutual aid program; (4) low wind velocity; (5) and good communications. Without any one of these factors, it was estimated (by the Oregon Department of Forestry) that several thousand acres and more than thirty structures would have been lost. It was agreed by all officers present when critiquing the fire, that it was the ready availability of a quality water resource that greatly enabled the firefighters to control and extinguish this fire rather quickly .

It was fate, not master planning or pre-planning, that the fire and the water resource sites were in close proximity to each other. We fully realize that we cannot rely on fate, and that we, as fire service professionals, must take the initiative to provide the best water supply possible throughout the entire community. Unfortunately, we did not take action to implement a water resource program immediately after that fire. Timing is everything, and asking for community support to fund a water resource project would have been more favorable while the fire was fresh in their minds. This project will require significant

public education and public support in order to be successful. The WRFPD has an active fund-raising organization in place, and is officially called the Williams Fire Department Support Group (WFDSG) which will play a major roll in this project.

The problem-solving methodology studied in the Executive Development will be used extensively to aid in the planning and implementation of a quality, efficient Water Resource Program for the Williams Rural Fire Protection District.

Literature Review

National Standards and Recommendations

Two standards published by the National Fire Protection Association were used to a great extent in the research of this paper, NFPA 1231 "Standard on Water Supplies for Suburban and Rural Firefighting" 1989 Edition, and NFPA 1922 "Standard for Fire Service Self-Contained Pumping Units" 1994 Edition.

NFPA (1989), chap. 1, defines an Adequate and Reliable Water Supply as: "A supply that is sufficient every day of the year to control and extinguish anticipated fires in the municipality, particular building, or building group served by the water supply". This definition confirmed our concerns that our Fire District needed to take immediate steps to increase our water supply capabilities.

NFPA (1989), chap. 5, deals with determining minimum water supplies. This chapter recommends that the local fire departments conduct surveys to determine the size, occupancy and construction classification of the structures in their district. With this information in hand it would then be possible to calculate the minimum water

requirements they would need by using the formulas and tables published in this standard.

NFPA (1989), chap. 6, identifies Water Supply for Firefighting purposes. Water can be supplied from a wide variety of sources, either man-made or natural. The important thing is that the water resources shall be useable and accessible throughout the year regardless of the weather. Chapter 6 also deals with transfer of water from the supply source to the scene of the fire. This can be done by using water tenders (tankers), large diameter hose (minimum 3.5" inside diameter), irrigation piping, helicopters, portable piping, helicopters, pumper relays, railroad cars, etc. Regardless of the method, safety must be foremost in our minds. Be especially aware of roadway and bridge weight limitations. Chapter 6 of this standard also addresses the need for erecting a sign at each of the water resource points for identification purposes. NFPA (1989), Appendix B-1-2 thru B-1-2.4 of this standard addresses the need for, and duties of, a Water Supply Officer. Appendix B-1-2.6 emphasizes the need for a written water usage agreement between the owner of the water resource site and the fire department before a fire develops. Appendix B-1-2.7 also states that the water supply officer should maintain a water map showing the location and amount of water available at each water resource site. Appendix B-1-12 indicates that the fire chief, the training officer and the water supply officer should develop standard operating procedures for hauling water to fires. Another important segment of this standard, as shown in Appendix B-5, deals with the use, construction, installation, and maintenance of dry hydrants. NFPA (1989), Appendix C, deals with water hauling. Appendix C-1 states: "Tankers are necessary for most rural departments and may be a big asset to a department having a weak municipal-type water system". This section of

Appendix C makes it clear that purchasing a water tanker is far safer and superior to obtaining makeshift equipment that was not designed for emergency service. Section C-1-9 of Appendix C supports this recommendation.

NFPA (1994) "Standard for Fire Service Self-Contained Pumping Units", identifies this type of unit as one that is "designed for support of firefighting or fireground water supply operations". This unit is self-contained because the pump and power source, along with necessary suportive equipment, are kept together as a single unit. Chapter 1 of this standard further states: "The pumping units covered in this standard are not intended to replace or supersede pumpers or initial attack fire apparatus that carry water and equipment for structural firefighting".

NFPA (1994) informs us that in the 1st edition of this standard, earlier units did not conform with automotive apparatus standards and some pumps had a larger capacity than the pumps on fire apparatus.

NFPA (1994), chap. 2, provides information on the general construction and safety requirements for this type of unit. These self-contained units may be designed to be mounted on a trailer or skid loaded on another vehicle. "Pumping units not permanantly mounted on a trailer or equipped with their own wheels shall be equipped with fork lift slots and lifting eyes", NFPA (1994), section 2-3.1. Section 2-5.7 of this standard requires that a minimum 4" reflective striping shall be affixed to the perimeter of the trailer. Other safety features include: (1) proper weight distribution (section 2-2); (2) providing for fenders and ground stabilizer jacks (section 2-5.1); (3) providing for, and mounting wheel chocks (section 2-5.2); (4) brake requirements (section 2-5.3); (5) step and hand rail

requirements (section 2-5.4); (6) oscillating or rotating emergency lights when responding as an emergency vehicle (section 2-5.6).

NFPA (1994), chap. 3, discusses the pump requirements for self-contained pumping units. Section 3-1.2 requires that the firefighting supply pump shall have a minimum rating of 500 gpm (gallons per minute) and that the manufacturer shall certify pump is capable of pumping 100 percent rated capacity at 150 psi (pounds per square inch). Section 3-4 states that the pump shall be of the centrifugal type and shall be capable of being disassembled for inspection and replacement parts.

NFPA (1994), chap. 4, provides information on the engine requirements for self-contained pumping units. "An engine shall be provided that will develop sufficient horsepower to drive the pump and all connected accessories when engaged at not over the maximum input speed rating of the pump and not in excess of the engine's loaded speed rating".

Magazine Articles

Perry (1995) writes that if your community does not have a municipal water system, "the fire department can develop a water system by using dry hydrants and shuttle tankers".

Loeb (1997) states: "You must remember that you can't extinguish large fires with small-fire tactics, but you can extinguish small fires with large-fire tactics". Loeb also indicates that without a good water supply you're in trouble, especially at the big fire.

Shriver (1994) states:

> **Dry hydrants are the primary source of water in rural Wayne County,**

Ohio. Wooster Township Fire Department has 22 dry hydrants in their district and there are over 80 throughout the county, which makes our fill sites rather well-established.

Regardless of the number of good fill sites at your disposal, it still takes time to put a good water shuttle into operation.

Shriver further mentioned his department's need to improve their shuttle time. His department, not unlike many others, did not have the luxury of spending $150,000-$200,000 for a new tanker. They found a 15-year-old water truck that was used in the oil fields that fit their needs because it had a large power take-off driven vacuum pump. This innovative type of thinking allowed them to draft at a quicker rate.

Stevens (1996) reported on the cost difference of increasing the tank size when one rural department looked into purchasing a new pumper. " A 1,000 gallon tank would increase the cost $150 to $800 more than a 750 gallon tank. A 1,250 gallon tank cost $300 to $960 more, and a 1,500 gallon tank would cost $600 to $1,100 more". However, for each 250 gallons of additional water, the department would have to sacrifice 33 cubic feet of compartment space. This department chose not to take on the extra water.

Cottet (1995) makes us aware that:

The faster you can unload a tanker, the more gallons per minute you transport. Two factors are involved. One is the size of the outlet and the second is the method of operating the control valve. In recent years, we have witnessed a trend to provide larger openings, starting at 10"square quick dumps and going to 16" square units. The increased size

has resulted in more rapid delivery rates, which maximizes the performance of the crew.

A second area of improvement has been to provide dump valves on both the sides and rear of tankers to make them remote-control operated. This allows a tanker to pull along beside the dumptank and unload instead of being required to back up. With air, electric or hydraulic controls, the driver can discharge water without leaving the cab.

Cooper and Kastner (1992a) write:

Although rolling stock was evolving to meet local needs, and at a relatively low cost, the water supply survey made it painfully obvious that the time spent designing and modifying trucks was only a first step. To provide truly effective fire protection, the Red Rock (NY) Volunteer Fire Company had to have water where it was needed and supplies that were dependable regardless of the season.

A survey was conducted by the fire department to identify eight water resource sites. Topographical maps were used very successfully to help locate them. After identifying these water sources, they felt that the installation of drafting basins was the most inexpensive way to accomplish their goal of 2,000 gallons per minute flow. The Red Rock Fire Company realized that during the construction of the prototype basin, using volunteer labor for the construction of additional basins would be too taxing on the people involved. Projected expenses for the installation basins was $15,000. This money was acquired through a state grant along with an additional $15,000 for large diameter hose and fittings. At the time of this writing (1992), Red Rock had an additional

six water basins in service. Knowing that water was now readily available to them greatly improved the morale of the firefighters.

Cooper and Kastner (1992b) cite the following reasons that the Red Rock Fire Company chose to install water basins as opposed to dry hydrants for their water supply:

1. Hydrants can be easily damaged;

2. Connecting the suction to the engine is more difficult;

3. Dry hydrants can easily become clogged due to an increased water velocity when using smaller pipe;

4. More maintenance is required on dry hydrants than on drafting basins;

5. Suction size and type of fittings are not a concern when using a drafting basin. This is extremely important when mutual aid companies use the draft site.

Cooper and Kastner indicate that the costs of installation of a dry hydrant versus a drafting basin are fairly comparable. The excavation expense is the same, whether digging a ditch for a small-diameter water line for a dry hydrant or a large-diameter water line for a drafting basin. The 15-inch ADS supply pipe used in a drafting basin costs $5.25 per foot compared to $5.80 per foot for 10-inch FDR 26 dry hydrant supply pipe.

Training Manuals

The International Fire Service Training Association (IFSTA) publishes fire service training manuals which I found most helpful during my research.

IFSTA (1992), chap. 9, p. 178, states: "To be most effective in transporting water, tankers must be kept moving in a shuttle. This calls for organization and facilities such as

nurse tankers or portable tanks that permit supply tankers to be unloaded quickly".

IFSTA (1992) further states that when drafting from a static source, position the pumper as close to the source as safety will permit and always use noncollapsible hose.

IFSTA (1988) chap. 7, p. 176, directs that positioning of tankers at the fill site is most important. The driver should always be aware that maneuvering an empty tanker is much easier than one that is full. Additional arriving tankers should never block other units or the fill site. Tankers should be filled one at a time at the fill site. This procedure will allow the tanker to be filled faster and prevent traffic jams. "The fill site officer should call for tankers from the staging area as needed, with the highest fill and dump rate given priority". IFSTA (1988) chap. 7, p. 156, indicates that "medium-size tankers (1500-3500 gallons) will generally have the best gallon per minute capability and will be more efficient for hauling water". IFSTA (1988) chap. 1, p. 22, states:

> **The ability to provide adequate water supplies on the fire ground hinges on proper training. Drills must be conducted with all the apparatus, new techniques mastered, and most importantly, procedures learned so they become a natural sequence at a fire.**

IFSTA (1988) Appendix D, p. 236, provides information which may be used as a basis for forming Standard Operating Procedures (SOPs) for water supply operations.

New York State Office of Fire Prevention and Control (n.d.), Unit III, p.76, states: "A Tanker Shuttle has the ability to deliver an adequate water supply to the scene. If properly planned, it can be put into operation quickly. If automatic mutual aid is used,

it has the ability to deliver large quantities of water to the scene". The factors that can limit the effectiveness of a tanker shuttle are: (1) long distances; (2) poor road conditions; (3) condition of the apparatus; (4) the efficiency of the apparatus; (5) the number of tankers; (6) the type and size of the tankers. Unit I, p. 6, lists the available resources for the state of New York which include:

- **1,823 Fire Departments**
- **2,909 Fire Stations**
- **132,814 Firefighters**
- **6,090 Engines**
- **2,064 Tankers**
- **639 Aerial Ladders**
- **290 Platforms**
- **2,443 Miscellaneous Vehicles**
- **936 Ambulances**
- **Over 2,300,000 Feet of Large Diameter Hose**

The author further states: "We have big pumpers, large diameter hose, large tankers with quick dumps and port-a-tanks. In spite of this, we still have trouble moving water and buildings continue to burn down". It is the intention of their training program to address this problem and improve operations.

Text or Reference Book

Carlson (1995), In chap. 16 of this text (Fire Chiefs Handbook), the author states:

The key to shuttle operations is to keep all units moving. Any time a Mobile Water Supply Apparatus (MWSA) is stopped, it is not transporting the needed water supply. The best way to minimize downtime is to improve loading and unloading times, and then to make sure the units are not obstructed after they are loaded or unloaded. Numerous items of assistance in this area include quick couplings on hose and tank inlets; sufficient large fill openings; filling stations and apparatus; properly placed large vents; stream shapers for pumping directly from outlets into portable tanks; large unloading valves; jet dumps; sufficient air movements across the top of the tank (baffle openings); and remotely controlled unloading valves and vents. The two major concerns in shuttle operations are the distance from the source to the fire and the number and carrying capacity of the Mobile Water Supply Apparatus.

Carlson mentions that the construction of a MWSA should place an emphasis on construction and safety. Tank capacities must never overload the chassis, and often a department should consider the advantages of a smaller MWSA that has a lower center of gravity and has better transport capabilities than a larger vehicle.

Manufacturer's Publication

Schlumberger Industries (n.d.) has published an informational pamphlet titled "Dry Fire Hydrant and Water Delivery Systems". The author states five beneficial reasons for using dry hydrants:

1. Improves Fire Protection. Fire tankers would reduce travel time during water shuttle operations;

2. Lowers Insurance Rates. This is possible if you meet all of the Insurance Services Organization's (ISO) criteria to lower your present rating (Water Supply counts for 40 percent maximum of your total rating);

3. Conserves Treated Water Supply. Dry hydrants are usually installed near ponds or other natural water resource locations. Water treatment is expensive and treated water is becoming more scarce.

4. Conserves Energy. Reduces the use of vehicle fuel during water shuttle operations.

5. Promotes Economic Development. An area that has better fire protection and lower insurance rates would be more attractive to developers and home buyers.

Procedures

The procedures for completing this research paper commenced in August 1997 at the National Fire Academy during my Executive Development class in August, 1997. During this class, it was impressed upon the students to "research, develop, and implement a project that would benefit your community". I chose a project that I felt was long overdue for implementation, increasing the water supply capabilities of our fire district.

The literature review portion of my research project began when, as part of our class, our instructors familiarized us with the material available at the National Fire Academy's Learning Resource Center (LRC). With the aid of the LRC staff, I was able to

find several informative magazine articles which I used as part of my research.

Immediately upon my return from the National Fire Academy, I met with the Williams Fire Department Support Group. At this meeting I requested the need for them to raise money for the purchase of dry hydrants explained how dry hydrants would increase the district's water supply capabilities. The members agreed that this was a worthwhile cause and committed to assist with the funding.

A Water Supply Committee was formed consisting of department members including myself, Assistant Chief, Deputy Chief, and two Captains. The following assignments were given to these committee members:

Funding . . . . Chief

Logistics . . . . Captain

Water Resource Allocation . . . . Captain

System Installation . . . . Assistant Chief

Training . . . . Deputy Chief

The next step was to select and prioritize water a resource site for immediate development. The intent was to: (1) provide a prototype; (2) increase public support; and (3) provide an immediate water resource site where needed. The site selected was in a high growth area and 3-½miles from our water fill site. Although the water source was excellent, the lift was 22-feet, which is too high for our drafting capabilities. It was then decided to install a pumping station midway between the water source and the road. This required getting approval from the Josephine County (OR) Department of Public Works. After several meetings, with Ed Cramp (a Public Works supervisor), approval for an

easement to construct a structure suitable for housing the district's electric-powered pump and other related equipment was agreed to. Public works also agreed that they could possibly assist with the off-road parking pad needed during filling operations. Excavation at this site is scheduled for early spring (weather permitting). Even though a complete water supply plan had not been developed, or the study completed, the Water Supply Committee agreed to take this first step to increase our water supply. Waiting for full funding was not necessary because the electric pump and motor had been acquired previously from the state surplus warehouse. We also had a 20-foot length of hard suction to use at this site that the department had acquired previously. The committee agreed that no further construction would take place until a full study was completed and a plan developed.

As part of my research, two questionnaires were mailed out. The first questionnaire was sent to four fire chiefs from each of the fifty states (Appendix A). The National Directory of Fire Chiefs and Emergency Departments (1993) was used to aid in the selection process of which departments were to be surveyed. The criteria used in the selection process determined that the department had to be both rural and volunteer. All of the fire departments selected from the directory had a code confirming that they were a volunteer department. Selecting which ones were rural departments was not always possible, especially in the eastern states which are more developed than the western half of the country. Of the 200 surveys sent out only 68 (34%) were answered. Fourteen were undeliverable. The purpose of this survey was to; (1) find out what other departments of similar size, and with similar problems, were doing to provide an adequate water supply;

(2) see what benefits, if any, departments experienced when up-grading their water supply capabilities; and (3) explore whether there is a funding mechanism our department could take advantage of. Although the response was less than anticipated, the information received provided insight as to how other rural, volunteer departments were meeting their water supply needs.

The second questionnaire (Appendix B), was mailed to the 50 state fire marshals (or their equivalent). Of the 50, only 27 (54%) responded. The results of this survey clearly indicated that rural water supply was not their area of responsibility and that most did not provide their departments with any assistance, financial or otherwise. This is not to say that nothing was gained from this survey, as I did receive some valuable information from various state fire marshals. This information will prove most beneficial during the training phase of our water supply program. The results of the above surveys are in Appendix C.

Chief Bret Fillis, Applegate Fire District 9, Jackson County, Oregon was interviewed on November 7, 1997. I asked Chief Fillis what he was doing to improve the water supply in his district and he then showed me his department's drafting vehicle which was fabricated by volunteer firefighters. It is mounted on a military 1952 Dodge 4x4 pick up. The large International, propane fueled, auxiliary engine drives a centrifical pump capable of delivering water at the rate of 1200 gallons per minute. This apparatus is self-contained and carries 24 feet of lightweight suction hose; a floating dock strainer; 100-feet of 4-inch hose; and 200 feet of 3-inch hose. For quick set-up and break-down, Storz fittings are used. Chief Fillis also told me that he is a great believer of underground water storage tanks as a secondary resource, and after a visit to one of his 6 stations, where he showed me

a dry hydrant that was connected to a buried storage tank.

During an interview, on December 1, 1997, with Captain Randy Benetti, Rural Metro Fire, Grants Pass, Oregon, when I inquired as to what his department is doing to supply water in their district, he showed me their department's trailer-mounted, self-contained drafting unit. This unit was also fabricated in-house by department members. It can supply 4200 gallons per minute utilizing a Rainbird irrigation pump powered by a 390 Ford engine. Captain Benetti said that this drafting unit was very beneficial during the wildfire conflagrations and other large fires that their department fought and is easily towed with a standard pick up truck.

On January 8, 1998, I interviewed Greg Gilpin, Assistant District Forester of the Southwest Oregon District, Oregon Department of Forestry. In the past, Mr. Gilpin and his staff have been most helpful in aiding rural fire departments in our area,and during the course of this interview, I asked him if there was any assistance he could provide toward increasing our water supply capabilities. We received his committment to supply us with a 10,000 gallon tank when it becomes available. Because of federal regulations requiring service stations to replace their buried steel gasoline tanks, Forester Gilpin receives these tanks free of charge by the contractors who would otherwise have to make arrangements for their disposal. He also committed to assist in the cleaning and burial of this large tank at the Williams Fire Station. The tank will be utilized as a water source with a dry hydrant connection. Oregon Department of Forestry also provides grants to small fire districts, but unfortunately, dry hydrants do not meet the criteria set forth in this program. I asked Forester Gilpin if he would screen federal excess property for us, specifically, a 1000- gallon

military water tender is needed to replace our 1952 vintage brush rig, and he agreed to this request and offered any further help if needed.

Assumptions and Limitations

Various limitations were encountered in the preparation of this research paper. I expected at least a 70% response to the questionaire mailed (with SASE) to the selected fire chiefs nationwide. I should have realized that when dealing with volunteer departments, many do not maintain office hours (if they have an office at all), and many of them do not remain in their present positions for a great length of time. This became apparent when surveys marked "undeliverable" by the post office were returned.

I was equally surprised to see that only 54% of the state fire marshals answered the survey. Six of those were also undeliverable due to address changes. However, the correct addresses were easily obtained and the questionaires remailed. Also, many of those who did return the surveys provided little or no information.

I would have liked to do some personal interviews with fire officials from different areas, but this was not an option due to the limited manpower in our district.

Definitions

Air Tanker **A fixed-wing aircraft capable of hauling and dropping water or fire-retardant chemicals on a fire. Primarily used to combat large wildland fires.**

Brush Rig **A vehicle used primarily to fight brush and grass fires. It should be able to pump and move at the same time. This vehicle is self-contained (water, pump, tools and equipment). Ideally it would have 4x4 or 6x6 capabilities for off-road driving.**

Drafting A process to draw water from a static water source by using a pump working under negative pressure.

Drafting Basin An underground tank or basin that is arranged to ease the efforts required when drafting from a static source. This usually requires a 15-inch pipe to provide water from the static source to the basin.

Dry Hydrant A non-pressurized pipe system that can be installed at a permanent water source as a means of filling tankers by drafting.

Pumping Station A fixed pumping structure designed to draft water from a static water supply and pump water during filling operations. This station has a pump powered by either an electric motor or fuel-supplied engine. If an electric motor-driven pump is used, generator hook-up capabilities are required.

Tanker A vehicle capable of hauling and dumping water for firefighting operations. This vehicle should have a minimum capacity of 1,000 gallons.

Tender Same as a Tanker. Usually geographical location dictates which terminology is appropriate. Western firefighters use the terminology "Tender" to eliminate confusion when Air Tankers are being used.

Water Site A selected site that is capable of providing an adequate water supply for fire suppression purposes regardless of climatic conditions.

Water Site Officer A person designated to assist the Water Supply Officer at fires. The Water Site Officer remains at the water resource site to control the filling and shuttle of Tankers.

Water Supply Officer A person designated to assure that water resources are available and operational prior to, during, and after fire operations.

Results

The intent of this survey was to identify what other departments were doing to provide their district with an adequate water supply, and to determine whether it would be practical for the WRFPD to adopt their procedures. This survey would let our department know where it stood in comparison to other departments across the nation. Finally, since it is the intent of our fire district to implement a Water Resource Plan using the information acquired during this research project, we asked if they were aware of any available funding.

Answers to Research Questions

Questionnaire (Appendix A) to Fire Chiefs:

Question 2. Purpose: To Compare the WRFPD with other departments (Table 1).

Note: WRFPD has a No. 8 ISO Rating.

Table 1.	N=200	S=59	S=68
ISO RATING	RESPONSES	%	%
<6	5	8.5%	7.3%
6	6	10.2%	8.8%
7	9	15.3%	13.2%
8	7	11.9%	10.3%
9	31	52.5%	45.6%
10	1	1.7%	1.5%
DID NOT ANSWER QUESTION No. 1	9	N/A	13.2%

Results: 60.3% (69.4% when using S=59) of those surveyed have a higher rating than the WRFPD.

Question 3. Purpose: To sample the size of the various districts (Table 3).

Note: Area of WRFPD = 32 square miles.

Results: The area that the WRFPD protects is comparable to the majority of the departments sampled.

Question 4. Purpose: To compare the various population sizes addressed in this survey, with the population of the WRFPD (Table 2).

Note: The population served by WRFPD = 3,000.

Table 2.	Na=200	S-61	S=68
POPULATION	DEPARTMENTS	%	%
<500	9	14.8%	13.2%
500-1000	7	11.5%	10.3%
1001-2500	23	37.7%	33.8%
2501-5000	11	18%	16.2%
>5000	11	18%	16.2%
DID NOT ANSWER QUESTION 4	7	N/A	10.3%

Results: 53% (64% when using S-61) of the departments surveyed have a smaller population than the WRFPD. This also indicates that more than half of the rural departments serve a population of less than 2500.

Question 5. Purpose: To determine how much of their district is not protected by a hydrant system.

Results: Insignificant. The amount would not affect Table 2.

	N=200	S=63	S=68
SQUARE MILES	**NO. OF DEPARTMENTS**	**%**	**%**
<50	28	44.4%	41.2%
50-100	15	23.9%	22.1%
101-300	7	11.1%	10.3%
301-500	11	17.5%	16.2%
501-1000	2	3.2%	2.9%
>1000	0	0%	0%
DID NOT ANSWER Q. 3 & 5	5	N/A	7.4%

Question 6. **Purpose: To determine what water resources rural fire departments are relying on (Table 4).**

Table 4.	N=200	S=68
TYPES	**NUMBER**	**%**
Lakes	20	29.4%
Ponds	41	60.3%
Creeks	31	45.6%
Rivers	27	39.7%
Other	22	32.4%
Single Resource	12	17.6%
Two Resources	21	30.9%
Three Resources	17	25%
Four Resources	12	17.6%
Five Resources	4	5.9%
>Five Resources	2	2.9%

<u>Results:</u> 48.5% of the fire departments evauated rely on 2 or less water resources. Most departments rely on ponds and creeks for their water supply.

<u>Question 7.</u> Purpose: To sample the average turn-around time of the water tenders (Table 5). S = 58 (number of departments sampled that use water tenders).

Table 5.	N=200	S=58
TURN AROUND TIME	NUMBER	%
<5 Minutes	1	1.7%
5-10 Minutes	9	15.5%
11-15 Minutes	14	24.1%
16-20 Minutes	15	25.9%
21-30 Minutes	8	13.8%
> 30 minutes	11	19%

<u>Results:</u> Only 41.3% of the departments surveyed are able to shuttle water in less than 16 minutes.

<u>Questions 8 & 9</u> Purpose: To determine how many tenders, and their capacity, that the 68 reporting departments are using, and the most popular average size (Table 6).

Table 6.	N=137	S=137
WATER CAPACITY	NUMBER	%
1000-2000 gallons	91	66.4%
2001-3000 gallons	27	19.7%
3001-4000 gallons	12	8.8%
4001-5000 gallons	6	4.4%
>5000 gallons	1	0.7%
No Tenders	0	0.0%

<u>Results:</u> **The smaller size tenders are more widely used.**

<u>Question 9.</u> **Purpose: To determine the number of departments using dry hydrants (Table 7).**

Table 7.	N=200	S=68
NO. OF DEPARTMENTS	NO. USING DRY HYDRANTS	%
68	37	54.4%
NO. OF HYDRANTS IN SERVICE	NO. USING DRY HYDRANTS	AVERAGE PER DEPT.
113	37	3

<u>Results:</u> **Dry hydrants are being used by more than 50% of the sampled departments.**

<u>Question 10.</u> **Purpose: To determine the average number of dry hydrants being used per department (Table 7.).** **<u>Note:</u>** **All hydrants averaged 6 inches in size.**

<u>Results:</u> **Average per department = 3.**

<u>Questions 11 & 12.</u> **Purpose: To see if other departments are using pumping stations at their water sites and how they are powered.**

<u>Results:</u> **Pumping stations are only used by 8 (11.8%) of the 68 departments surveyed. The survey revealed that these 8 departments had a total of 17 pumping stations in service. Of these 17, 7 were powered by electric, 5 by gasoline and 5 by diesel fuel.**

<u>Questions 13 & 14.</u> **Purpose: To determine how many departments sampled by this survey are using water tanks (Table 8.); the average number per department (Table 9); and their capacity (Table 10.).**

Table 8.	N=200	S=68
NO. OF DEPTS. SURVEYED	NO. OF DEPTS. WITH TANKS	%
68	17	25%

Table 9.	N=200	S=17
NO. OF TANKS IN SERVICE	NO. OF DEPTS. WITH TANKS	AVERAGE NO. PER DEPT.
59	17	3.47

Table 10.		N=200		S=17
1000-2000 gal.	2001-3000 gal.	3001-4000 gal.	4001-5000 gal.	>5000 gal.
19 (32.2%)	10 (16.5%)	3 (5.1%)	13 (22%)	14 (23%)

<u>Results:</u> 25% of the departments surveyed rely on water tanks (Table 8). The number of tanks per department averages to be 3.47 (Table 9). The tanks vary in size (Table 10).

<u>Questions 15 & 16.</u> Purpose: These questions were asked to give insight as to what action other departments may be taking to improve their water supply.

Table 11.	N=200	S=68
NO. OF DEPTS. SURVEYED	NO. PLANNING TO UPGRADE	%
68	32	47.1%

Table 12.		N=200		S=32
DRY HYDRANTS	TANKERS	WATER TANKS	PUMPING STATION	OTHER
17 (53.1%)	10 (31.2%)	3 (9.4%)	1 (3.1%)	1 (3.1%)

Results: Almost half of the departments are planning to upgrade their water supply system (Table 11); and more than half of the departments surveyed use dry hydrants (Table 12).

Question 17. Purpose: To determine what benefits departments may have experienced when they upgraded their water supply system.

Results: Only four departments responded to this question. It was the intention of 2 of the 4 responding departments to have their ISO rating lowered as a result of their efforts. The other 2 indicated that they have not experienced any benefits yet.

Question 18. Purpose: To determine how departments are financing their water supply projects.

Results: Seven departments responded to this question. Two of which have applied for grants (type of grant not stated), 2 by fund raisers and 3 departments would use their tax supported budgets to upgrade.

Question 19. Purpose: To ascertain how many departments have an organization that helps them rais funds.

Results: Only 3 of the 68 responding departments indicated that they had an organization that was dedicted to raising funds for their department.

Question 20. Purpose: To find out if any one had any new or innovative ideas.

Results: There were no new ideas offered.

<u>Questionnaire (Appendix B) to State Fire Marshals</u>:

The desired results from this survey was to determine: (1) to what extent the various state fire marshals were involved in helping fire departments under their jurisdiction; (2) if the state fire marshals were aware of any projects that any department in their state may be doing to improve their water delivery capabilities; (3) if the state fire marshals had any ideas on how rural communities could economically increase their water supply capabilities; and (4) if they were aware of any funding sources for this type of project.

This questionnaire was mailed to all of the 50 state fire marshals. Of the 50, 27 (54%) replied. Table 13 shows the percentage of YES answers per question.

Table 13.		N=50	S=27
QUESTION NO.	YES	NO	YES (%)
1.	9	18	33.3%
2.	11	16	40.7%
3.	16	11	59.3%
4.	8	19	29.6%

<u>Results:</u> Answers to Question No. 1 indicated that one-third of the state fire marshals provide some type of assistance.

Question No. 2 indicates that 40.7% of the state fire marshals know of departments in their state that are taking action to improve their water supply capability.

The answer to Question No. 3 indicates that the majority of the state fire marshals sampled in this survey have ideas for ways departments can improve their water supply capabilities.

State fire marshals that were aware of funding sources responded to Question No. 4 by providing the information listed below. The following states do have funds or grant money available for improving fire protection in their state:

<u>Illinois</u> **Community Development Block Grants;**

<u>Indiana</u> **"Build Indiana Funds" (from lottery money);**

<u>Iowa</u> **State "Service Sharing Grants";**

<u>Missouri</u> **Department of Conservation - Forestry Division;**

<u>New Hampshire</u> **1. Americorps Program;**

2. Farmers Insurance Low Interest Loans;

<u>Tennessee</u> **Community Development Block Grants;**

<u>Texas</u> **Texas Community Development Program;**

<u>Virginia</u> **Virginia Department of Forestry - Dry Hydrant Program;**

Virginia Farm Bureau Safety - Dry Hydrant Grant Program;

<u>West Virginia</u> **Insurance Premium Tax provides $22,000 financial assistance to each department per year for improving fire protection;**

<u>Wyoming</u> **Forestry Grants - (307-777-7586 for information).**

Discussion

When the National Fire Protection Association publishes a standard, they do it for a reason. When they published standard 1231 on Water Supplies for Suburban and Rural Firefighting NFPA (1989), there had to be a need for this information, and there is. While doing this research, it became quite apparent that a lot of small, rural, volunteer fire

departments are a lot worse off than ours. Of the 68 departments surveyed, 32 (47.1% have an ISO rating of 9 or higher (Table 1, p. 22). Up to 40% of the ISO evaluation is based on the fire department's ability to provide a constant water flow for a given time. However, achieving a lower ISO rate should not be the reason for developing a quality water supply system, and our main concern is the protection of life and property, and that is hard to do without water.

I feel that if a small volunteer fire company like the Red Rock (NY) Volunteer Fire Company (not department), Cooper and Kastner (1992), can find a way to construct six water cisterns in their community, then we can also find a way to increase our water sources.

The first step is to determine how much water you will need to adequately protect your community. There are formulas for determining how much water you will need, NFPA (1989), chap. 5, to control or extinguish a structure fire, but my concern is protecting several structures that are threatened by a wildfire. I believe the same as others do, Loeb (1997), that it is smart to hit small fires with a lot of water before they get out of control.

Perry (1995) states that "a fire department can develop a water system by using dry hydrants and shuttle tankers". This is confirmed in the results of the survey sent to the chiefs (Appenix A) which shows that 54.4% of the surveyed departments are using dry hydrants and that all of these departments have at least one water tanker. The amount of training that departments receive in water shuttle operations wasn't addressed on the questionnaire and I wish it was. "The ability to provide adequate water supplies on the fire

ground hinges on proper training", IFSTA (1988), p. 22. "The key to shuttle operations is to keep all units moving", Carlson (1995). The survey to the chiefs (Appendix A, p. 25, Table 5.), reveals that 50% of the departments surveyed require 11 to 20 minutes of shuttle time. However, 19% require more than 30 minutes to perform this task. Additional training might help reduce their turn-around time providing there is a plan in place.

The results of this study did not reveal any surprises or innovative ideas as I had hoped for.

When trying to find ways of adequately funding a water resource program, I was anticipating that someone would reveal a federal program that would provide assistance in this area. Bottom line, I feel the federal government could, and should, provide monies for such a program. It was nice to see that some states have grant money available for fire departments, and it is my desire that, eventually, they all will.

Recommendations

The Williams Rural Fire Protection District's Board of Directors should support this program implementing a Water Resource Reserve Fund as part of their budget. These monies could not be spent for anything else so there would always be some money available for improvements to our water resources.

Work with the county government and encourage them to require the developers to provide an adequate water supply in areas where they are working. See if your county public works will provide you some assistance when it comes to excavating for water system installation. Write your Congressman or Representative and ask them to research for some

funding; Red Rock received $30,000 that way, Cooper and Kastner (1992).

The WRFPD is anticipating acquiring a used tanker in the near future. With information obtained from this study (Appendix A, p. 25, Table 6.), we will look at purchasing a smaller one than originally planned. The idea is to "keep them moving", Carlson (1995) and the faster refill time, travel time, and unloading time of a smaller tanker should accomplish that. Along these same lines, I would recommend upgrading our 3500 gallon water tanker by installing a larger quick dump on it, Cottet (1995). This would enable us to unload faster.

I will also recommend installation of dry hydrants as soon as funds are available and the water site established. Dry hydrants seem to be working well, and some departments are installing a lot of them, Shriver (1994). Over 50% of the departments surveyed are also using them as a water resource. This study also shows that 25% of the departments have water tanks available as a means of supplying water. The WRFPD will definitely be taking advantage of the misfortunes of the service station owners who are required to replace them. I strongly recommend that other departments consider researching this option. After reading the Red Rock article on the advantages of installing water cisterns at water sites, Cooper and Kastner (1992), I will be recommending that we locate an appropriate site and install at least one.

My next recommendation is the establishment of a Water Supply Officer, NFPA (1989), Appendix B-1-2. This person will play an important roll within our organization. He will take a lot of pressure off the Incident Commander, who will no longer have to worry about the delivery of water. He will be equally valuable performing maintenance

and record keeping for the department's water supply system.

Training, as always, will prove to be the backbone of the program. I recommend that the Training Officer should be given a substantial amount of support in developing lesson plans that will complement the Water Resource Program. Any time an additional water site is operational, make sure everyone visits the site and practices filling the tanker.

Finally, I recommend that you sell your program to the public. This is not only good for public relations, but you will be surprised how much outside support you will receive. There are a lot of retirees who have a significant amount of knowledge and expertise who will be more than willing to help.

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APPENDIX A

Dear Fire Chief;

My name is Bob Hartsell. I am the Fire Chief for the Williams Rural Fire Protection District. We provide fire protection for a 32 square mile area in and around the town of Williams, Oregon. Williams is located in the southwest portion of the state and is primarily a logging community.

Enclosed is a survey that I would greatly appreciate your taking the time to complete and return. The purpose of the survey is to find out what other communities are doing to provide an adequate water supply for fire suppression purposes.

The results of this survey will be instrumental in the implementation of our Fire District to upgrade our present water delivery capabilities, and also to be an available resource for other departments to use, as well as being an integral part of my National Fire Academy research paper.

Due to the limited time frame allowed to gather the information and write the research paper, it would be desirable to have your reply by January 15, 1998.

Thanking you in advance for helping me with this project and my research paper.

Respectfully,

Robert N. Hartsell
Fire Chief

SURVEY OF RURAL WATER SUPPLY PROGRAMS

Name of Department___________________________Population Served

1. Does your department rely on non-hydrant water delivery for fire suppression?
Yes [ ] No [ ]

IF YOU ANSWERED NO TO QUESTION #1, YOU NEED NOT ANSWER THE REST OF THIS SURVEY. THANK YOU FOR YOUR ASSISTANCE.

2. What is your ISO rating? ISO____.

3. How many square miles in your fire district? __________square miles.

4. What is the population that you protect? __________people.

5. What portion is <u>not</u> protected by a hydrant system? __________square miles.

6. What are your water resources?
lake [ ] ponds [ ] creek [ ] river [ ] other_____________________________.

7. What is the average turn around time for your water tenders? _________minutes.

8. How many tenders do you have in the following capacities?
1000-2000_____, 2001-3000_____, 3001-4000_____, 4001-5000_____, >5000____.

9. Do you use Dry Hydrants? Yes [ ] No [ ]

10. If yes, how many?______. size ______inches.

11. Do you have any fixed pumping stations for filling fire apparatus?
Yes [ ] No [ ]

12. If yes, how many? electric powered ______, gas powered ______.

13. Do you have water storage tanks for rural fire suppression in your district?
Yes [ ] No [ ]

14. If yes, how many 1000-5000_____, 5001-10000_____, >10000_____ Capacity?

15. Do you intend to upgrade your present rural water delivery capability in the near future? Yes [ ] No [ ]

16. If yes, how? ____

____

____

____

____.

17. If you recently up graded your rural water supply delivery system, what benefits(s) Did your district see? ____

____

____

____

____.

18. How would you receive funding for upgrading your rural water supply system?
present taxes [ ], 1-year levy [ ], serial levy [ ], fund raisers [ ], grants [ ], other [ ] ____.

19. Does your fire department have a support group or ladies auxiliary for fund raising? Yes [ ] No [ ]

20. Do you have any other ideas for a rural fire district to improve their water delivery capabilities? ____

____

____

____

____.

IF YOU WOULD LIKE A COPY OF WHAT DIRECTION OUR FIRE DISTRICT TOOK TO IMPROVE OUR RURAL WATER DELIVERY CAPABILITIES AS A RESULT OF THIS SURVEY AND RESEARCH PAPER, PLEASE INDICATE BELOW.

NAME:
AGENCY:
ADDRESS:

APPENDIX B

State Fire Marshal
State of Oregon

Dear Chief;

My name is Bob Hartsell. I am the Fire Chief for the Williams Rural Fire Protection District. Our department provides fire protection for a 32 square mile area in and around the town of Williams, Oregon. Williams is located in the southwest portion of the state and is primarily a logging community.

I am doing a research paper for the Executive Officer Program at the National Fire Academy and would greatly appreciate your assistance by answering the following questions.

1. Does your office provide assistance, financial or otherwise, to fire departments within your state to help increase their water supply ie; stationary water tanks, pumping stations, dry hydrant systems, etc.?

____
____
____
____
____.

2. Has any department in your state recently taken on a project to improve their water delivery capabilities in the non-hydrant rural areas?

____
____
____
____
____.

3. Do you have any other thoughts on how rural communities can increase their water supply?

____
____
____
____
____.

4. Are you aware of any funding available, either government or through grants for this type of project?

____
____
____
____
____.

Due to the limited time frame allowed to gather the necessary information and write the research paper, it would be desirable to have your reply by January 15, 1998.

Thanking you in advance for your professional assistance.

Respectfully,

Robert N. Hartsell
Fire Chief