MARIN COUNTY

HOSE TENDER OPERATIONS

A Joint Project of

Marin County Fire Chiefs Association

MARIN MUNICIPAL
WATER DISTRICT

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The fire service in Marin County historically has relied on the local water distribution and hydrant system almost exclusively as the water supply for fire suppression activities. Until recently, the alternative to the water distribution system was the use of water tenders; there only being three in Marin County, one in Novato and two in West Marin. These units are primarily used for wildland fire suppression activities. Hard suction hose use for drafting from pools, ponds and the Bay are rarely carried on engines in the urbanized areas of Marin County. The adoption of the Hose Tender Program by the Marin County Fire Chiefs Association will provide an additional water supply alternative that has proven itself highly effective in other areas implementing similar programs.

This reliance on the hydrant system is most likely founded in the following realities:

1. The system is usually more than adequate for routine fires.

2. Alternative supplies such as swimming pools, lakes, creeks and the Bay are difficult or impossible to use with existing equipment.

The advent of 1000 GPM plus pumpers and large diameter hose has allowed departments to maximize use of hydrants and it is a rare fire at which significant water supply problems limit firefighters.

The near total reliance on the hydrant system has until recently posed a serious potential problem. If the system failed for any reason, a back up water supply would be very difficult to generate in a timely way. Equipment designed to work well with the hydrant system is limited in other applications.

Recent events in the Bay Area have demonstrated the vulnerability of municipal water systems.

<u>LOMA PRIETA EARTHQUAKE</u>

One of the hardest hit areas in this earthquake was the Marina District in San Francisco. This area was built on poorly compacted fill over bay mud. In addition to numerous cases of structural collapse, the entire water system in the district failed. San Francisco has two systems for distribution of water for firefighting. One system provides water for domestic use and fire hydrants. The other system provides water exclusively for firefighting. Both systems failed in the Marina District during the Loma Prieta Earthquake. A fire started in a partially collapsed structure and spread to nearby buildings. Fire department companies were unable to control the fire because of lack of water. The fire neared conflagration proportions until a combined effort of firefighters, civilians and military personnel using a fire boat, numerous engines and a hose tender pumped water from the Bay at St. Francis Yacht Club several blocks to control the fire.

OAKLAND/BERKELEY HILLS FIRE

This fire started near the highest elevations of the Oakland hills and burned down into heavily built up residential areas. The latter stages of the fire was a structural conflagration more than an "Urban Wildland Interface" fire. The water systems in the higher elevations of the fire area were typical "high level" or "pressure" systems.

These systems serve elevations above that which the "gravity" system is capable of supplying water. Water is pumped by electric powered pumps from the gravity system uphill to water tanks. The water tanks supply water to customers and hydrants at higher elevations. Seven of these systems failed during the fire leaving all hydrants dry in the area served by the given tank.

In other areas of the fire, the water system was simply overwhelmed. This occurred in the Rockridge District. This is an older neighborhood of medium to larger closely spaced homes. The water system was primarily older four inch mains. A combination of firefighting by firefighters and civilians and broken plumbing in burned structures so depleted the available supply that for all practical purposes hydrants were useless. A strike team leader from San Francisco requested the response of a hose tender from his department. The tender laid 1/2 mile of 5 inch hose from a hydrant on a 20 inch water main up into the Rockridge District and stopped the spread of fire along a perimeter several blocks wide. This area was almost exclusively burning structures with very little wildland involvement.

EARTHQUAKE POTENTIAL IN MARIN COUNTY

In 1982, the California Department of Conservation published a document entitled "Earthquake Planning Scenario for a Magnitude 8.3 Earthquake on the San Andreas Fault in the San Francisco Bay Area". The following information is excerpted from that document.

"The areas of predicted intensity 9 (extremely strong shock. Partial or total destruction of some buildings) include most of the low-lying lands surrounding San Francisco and San Pablo Bays."

"Intensity 8 (very strong shock) shaking is predicted...because of their proximity to the fault most of the San Francisco and Marin peninsulas."

"Impairments to water transmission lines, local storage reservoirs and pumping plants, as well as the local distribution systems will affect water availability and pressure."

"Plans for firefighting need to be coordinated with water agencies and alternative sources of water planned for in critical areas."

The following conclusions may be reasonably drawn from this study:

1. The eastern side of Marin County along San Francisco and San Pablo Bay, especially built up areas on fill over bay mud are vulnerable to major damage during a severe earthquake. Failure of the water distribution system in these areas is likely.

2. The entire county is vulnerable to some damage during a severe quake on the San Andreas or Rogers Fault when the epicenter is nearby.

3. All components of the water storage, treatment and distribution system are subject to failure in an earthquake. Water for firefighting may not be available from municipal sources for days or weeks following a major earthquake.

VULNERABILITY OF THE MARIN MUNICIPAL WATER DISTRICT SYSTEM TO MAJOR POWER FAILURE

While gravity flow plays an important role in much of the districts system, a significant portion is dependent on large electric powered pumps to move water from one facility to another.

Examples:

1. Water from Nicasio Reservoir is pumped to the San Geronimo Treatment Plant.

2. Treated water from San Geronimo is pumped over White's Hill to Ross Valley and San Rafael.

3. Most district "High Level" or pressure zone systems are dependant on electric pumps to supply water to the elevations above that served by the "gravity system". Approximately 10% of district customers are served by "high level" systems.

Water district engineers estimate that after two days without power, portions of the system would be without water. Southern Marin is least vulnerable, Ross Valley has some gravity backup and San Rafael, Terra Linda and Marinwood are totally dependent on electric powered pumps.

LIMITATIONS OF "HIGH LEVEL" OR "PRESSURE ZONE" SYSTEMS

Within the Marin Municipal Water District, approximately 80-90% of the customers receive water from the "gravity system". Water from the treatment plants flows by gravity or is pumped to large Transmission and Distribution tanks. The distribution system then supplies water to hydrants and customers up to approximately 250 feet above sea level. The pressure available in the gravity system falls below the acceptable 40 psi at 250 feet of elevation. Above that elevation, pumps lift water to independent tanks placed above customers in a given "pressure zone". The extra elevation of the independent tanks supplies water at acceptable pressure to customers in the hilly "pressure zone".

All high level systems are vulnerable for the following reasons:

1. The tanks have a limited capacity. Most hold less than 150,000 gallons.

2. The pumps that supply the tanks are designed to refill slowly overnight, not to supply high fire flow situations. Most of these pumps are of a capacity of less than 300 GPM.

3. The pumps are electric powered. When a power failure occurs, the pumps are out of service.

4. At the upper elevations of these systems, the tanks are near the same elevation as the hydrants. This provides little "head" pressure to supply the hydrants.

5. Water main sizes are often small because these systems serve a limited number of customers.

Given the nature of the topography and residential development in Marin County, many of the neighborhoods serviced by high level systems are also high risk wildland interface areas. This poses the possibility of a situation similar to that which happened in Oakland: a wildland fire spreads into structures, heavy water consumption drains the high level tank, pumps are overwhelmed or lose power, hydrants go dry.

<u>INADEQUATE FIRE FLOW</u>

Almost every jurisdiction has an area or facility where the normally available flow is simply not adequate for a major fire. Most often this is the result of a combination of factors:

1. Older, small water mains
2. High building density
3. New development overtaxing the existing water supply

Examples:

1. "Downtown" areas of older cities and towns.
2. Large churches, schools, etc. in neighborhoods otherwise occupied by single family dwellings.

3. Large new homes built in older neighborhoods with small homes. In some cases, these newer homes can have four to five times the square footage of the existing homes.

<u>REVIEW</u>

Water supply for firefighting in the Marin Municipal Water District may be interrupted or be inadequate for the following reasons.

1. Earthquake
2. Major electric power failures
3. Inherent vulnerabilities of "high level" systems
4. Simple inadequate flow for certain situations

Following the Oakland fire and the many reports of widespread failures of the water system, the Marin County Fire Chiefs Association and the MMWD jointly assessed the water system in regard to possible improvements. It was quickly discovered that most components of the system could not be measurably improved without major rehabilitation and great expense.

Two projects surfaced as practical and within the available fire flow budget.

1. Hydrant installation. Study of the water main distribution system revealed many locations that "wharf" style hydrants could be upgraded or new hydrants could be installed. Improvements in spacing, flow and system alternatives were realized with this project.

2. Hose tenders. San Francisco developed hose tenders to deploy an "Above Ground Water System" in the event of an earthquake causing water main failures. The tenders have been used successfully during an earthquake, a forest fire threatening San Francisco water facilities in the Sierra and during the Oakland Fire. Chief Steve Bogel of the Sausalito Fire Department proposed the joint purchase and outfitting of three hose tenders for Marin County. The MMWD would supply the hose and appliances and the fire departments would provide the apparatus and staffing. The proposal was approved. The Hose Tenders are operated by:

Sausalito
Corte Madera
San Rafael

The tenders are modified Type I pumpers (the pumps are still operational but the water tanks have been removed).

The basic complement of hose and appliances is as follows:

- 5000 feet, 5 inch hose (100 foot lengths with Storz couplings).
- Five "portable hydrants" (5 inch Storz inlet x one 5 inch Storz outlet and two 2 1/2 inch outlets).
- Three 400 GPM portable floating pumps.
- Two 2 1/2 inch x 5 inch Storz siamese appliances.
- Hard suction hose with a floating strainer.
- Two sets of heavy duty LDH Hose Bridges (have capacity of up to a 40 ton vehicle with dual rear wheels).
- An assortment of fittings and adapters.

The principal mission of the hose tender is to quickly lay a large diameter supply line from any available source of water to the point (or points) of need and provide water at sufficient pressure to operating engines.

Examples:

Earthquake -- An earthquake causes water main breaks in a low lying industrial park. Water district personnel shut down mains. A fire starts in an earthquake damaged sprinklered warehouse. Nearby hydrants and the buildings sprinkler system are dry. A hose tender could supply water to the sprinkler system or engines by laying five inch hose to the bay or to that portion of the water system that is undamaged.

Power Failure -- A major area wide power failure occurs. After several days some of the smaller independent high level tanks run dry. A fire starts in a home near the top of the high system several thousand feet from a functioning hydrant. A hose tender could lay a five inch hose line from the last hydrant on the gravity system and pump water to the fire scene.

Wildland Fire -- A wildland fire burns into a neighborhood of single family homes serviced by one or more "high level" systems. The homes are threatened and several become involved in fire. Firefighters and homeowners put a tremendous strain on the water system fighting the wildland fire, the structure fires, protecting homes and wetting down roofs. Hydrants that normally flow 300 to 500 GPM are now flowing 100 GPM or less. The fire moves on and threatens homes along adjacent streets. Strike Teams are assigned ahead of the fire and find hydrants dry or nearly so. Wildland fuels are heavy and engine tanks will be quickly drained protecting homes. A water tender shuttle is not practical due to response times and the difficulty of traveling on narrow winding streets. A hose tender could lay a five inch supply line placing "portable" hydrants (manifolds) at strategic locations. Supply would be obtained from downhill in the gravity system or from a nearby "high level" system unaffected by the fire. Engine companies could then supply pumps from the portable hydrants or attach attack hose lines directly. 1000 GPM or more could be supplied without depending upon hydrants in the immediate area.

Local Water Supply Inadequate for Large Fire -- A church fire occurs in an older neighborhood of single family dwellings. The fire spreads quickly and ignites an exposed rectory on the same property. Firefighters arrive to find he church heavily involved, the rectory starting to burn and several homes exposed. Several large diameter supply lines are laid by first and second alarm companies. Master streams and 2 1/2 inch hand lines are deployed. The local water system is capable of supplying 1000 GPM. This is quickly depleted. When additional streams are attempted, engines are incapable of supplying them. Companies lay lines to additional nearby hydrants but find the system simply incapable of providing much more than 1000 GPM. A hose tender could lay a five inch supply line from a hydrant on a large main several thousand feet from the scene and supply an additional 1000 to 1500 GPM to operating companies.

Certainly most or all of these operations could be performed by multiple Type I engine companies. The advantages of the hose tender are:

1. One tender can lay up to 5000 feet of five inch from point to point. Multiple companies attempting this will have difficult negotiating over and around each others hose lay.

2. Hose coupling compatibility may be a problem if the companies attempting this evolution do not have compatible couplings.

3. Five or six Type I engines would be completely stripped of supply hose. These companies would be severely limited thereafter.

4. If a static water source is chosen for supply, the hose tenders carry equipment specifically designed to maximize this source.

5. A hose tender can be operated by two of three firefighters. Multiple engines will require much more staffing.

6. The five portable hydrants can be placed inline rather than commit pumpers in line. In some situations, this would be advantageous from a safety and operational standpoint.

Key to success of a hose tender operation is a reliable alternative water supply within a reasonable distance. The following sources should be considered:

1. <u>Earthquake</u> -- Earthquakes present a double edged sword for firefighters. They break water mains <u>and</u> damage buildings, including gas and electric service, starting fires. Other water distribution facilities, including tanks, may also be damaged.

   Historically the buildings and mains incurring the greatest damage are located in low lying areas built on fill over mud. Two water sources should be considered in these cases.

   A. The water mains are usually intact at some point back up the system in firm ground. Water District personnel will be attempting to isolate leaks but keep service available where they can. By consulting water district personnel and visually flow testing hydrants, sufficient flow may be found in hydrants within several thousand feet of the scene.
   B. Low lying fill areas are usually fairly near the bay. Preplanning will reveal those areas with reasonably accessible water. Remember the influence of tides.

2. <u>Power Failure</u> -- The major immediate effect of a power failure on the water system will be loss of the ability to pump water from one point to the other. This will most quickly cause failure of high level systems as the tanks are quite small. In general it will be extremely important to keep track of the status of the system with water district personnel. They will know what parts of the system are dry and what areas still have water. The following sources should be considered when power failures occur:

   A. The gravity system.
   B. Transmission mains.
   C. Swimming pools.

Again, the importance of knowing the current status of the system is paramount.

3. <u>High Level System Failure</u> -- A high level system failure will place all hydrants in a given "pressure zone" out of service or nearly so. These systems supply mostly homes at higher elevations. Many of these zones are in wildland urban interface areas. Alternatives include:

   A. Swimming pools.
   B. Gravity system hydrants below the pressure zone.
   C. Parallel pressure zone hydrants unaffected by the failure.

   Again, water district personnel will be of great assistance in locating serviceable hydrants.

4. <u>Inadequate (although normal) Flow</u> -- This situation can occur in both gravity and high level systems and is simply the result of the combination of main size, available pressure/flow and distance combining to restrict flows to below necessary quantities. Once all the available flow from a given system is in use, simply connecting to another hydrant on the same system will worsen rather than improve the situation. Additional water supply must be obtained from a source that will not further tax the already overburdened system. Alternatives:

   A. Hydrants on transmission mains.
   B. Hydrants on other systems.
   C. Static water sources.

DESCRIPTION AND RECOMMENDATIONS FOR ALTERNATIVE WATER SUPPLIES

<u>Transmission Main Hydrants</u> -- Transmission mains connect major water system facilities (treatment plants, distribution tanks, etc.) and have few if any connections between the facilities. Transmission mains are the "Freeways" of the water systems. The mains are usually 14 inch or larger. Hydrants connected to transmission mains are usually high flow and perhaps even more important, unaffected by high demand in a given location. Listed below are most of the transmission main hydrants within the MMWD system.

Southern Marin Line Upper Tank
Southern Marin Line Road
Southern Marin Line Road
Upper Overhill Road, 100' S of Tambay Dr.

133-135 Alto Tiburon Hwy Alto

Bayview Ave. & Belvedere Dr.	Alto
Belvedere Dr. & South Knoll Road	Alto
Opposite 134/136 Belvedere Dr.	Alto
16 Knoll Lane	Alto
33 Reed Blvd.	Alto
Summit Drive & Redwood Ave., Near Tanks	Corte Madera
80 Summitt Drive	Corte Madera
790 Bolinas Road	Fairfax
Broadway & Pacheco Ave.	Fairfax
Pine Mt. Tunnel Rd. 1400' from Tunnel	Fairfax
Sir Francis Drake Blvd., opposite Taylor Dr.	Fairfax
34 Willow Avenue	Fairfax
125 E. Sir Francis Drake Blvd.	Greenbrae
135 E. Sir Francis Drake Blvd.	Greenbrae
565 Sir Francis Drake Blvd.	Greenbrae
College Ave. & Stadium Way	Kentfield
College Ave. @ Woodland	Kentfield
Crown & Upland	Kentfield
McAllister Ave. & Berens Drive	Kentfield
McAllister Ave. & Lancaster Ave.	Kentfield
Stadium Ave., SW corner of Kent School	Kentfield
Stadium Way, Kent School, 250' E of 3917 H St.	Kentfield
Nicasio Transmission Main	Lagunitas
Nicasio Transmission Main	Lagunitas
Nicasio Transmission Main	Lagunitas
Nicasio Transmission Main	Lagunitas
S. Eliseo Dr. & Sir Francis Drake Blvd.	Larkspur
Cnr. Larkspur Landing Cir. & E. Sir Francis Drake Blvd.	Larkspur
Larkspur Landing Cir., Near NE corner of 601 (Bermans)	Larkspur
Larkspur Landing Cir., Near NE corner of 1401	Larkspur
Larkspur Landing Cir., @ Lincoln Village Cir.	Larkspur
Opposite 300 Larkspur Landing Cir. (Marin Airporter)	Larkspur
3 E Sir Francis Drake Bl., Ent. to Ferry Terminal	Larkspur
15-17 Underhill Dr.	Larkspur
613 Appleberry Dr.	Marinwood
711 Appleberry Dr.	Marinwood
358 Blackstone Dr.	Marinwood

Idylberry Rd. & Mt. Hood Ct.	Marinwood
Idylberry Rd. & Mt. Shasta Dr.	Marinwood
1284 Idylberry Rd.	Marinwood
Johnstone Dr., End	Marinwood
Las Gallinas Btwn Ninestone Ct. & Blackstone Ct.	Marinwood
Opposite 371 Miller Creek Rd., on island	Marinwood
Opposite 435 Miller Creek Rd., on island	Marinwood
Opposite 489 Miller Creek Rd., on island	Marinwood
547 Miller Creek Road	Marinwood
Opposite 558 Miller Creek Rd., on island	Marinwood
Opposite 610 Miller Creek Rd., on island	Marinwood
Ashford Ave. & Lomita Dr.	Mill Valley
Camino Alto & MV Middle School	Mill Valley
40 Camino Alto	Mill Valley
180 Camino Alto	Mill Valley
205 Camino Alto	Mill Valley
260 Camino Alto	Mill Valley
290 Camino Alto	Mill Valley
Escalon Dr., Near 17 Overhill Road	Mill Valley
7 Escalon Dr.	Mill Valley
237 Shoreline Hwy.	Mill Valley
244 Shoreline Hwy.	Mill Valley
Tiburon Blvd., Near Blackfield Dr.	Mill Valley
Lagunitas Rd. (In front of Ross School)	Ross
Lagunitas Rd. 300' East of Thomas Ct.	Ross
Shady Lane & Ames Ave.	Ross
160 Camino De Herrera	San Anselmo
375 Fawn Drive	San Anselmo
Creamery Rd. & Orchard Way	San Geronimo
Bonnie Banks @ Bayvieview Drive	San Rafael
28 Bonnie Banks @ Bayview	San Rafael
39 Castlewood Dr.	San Rafael
655 Del Ganado Road (Shopping Center)	San Rafael
99 Elizabeth Way	San Rafael
Fifth Ave. & A St.	San Rafael
Fifth Ave. & B St.	San Rafael
Fifth Ave. & C St.	San Rafael
Fifth Ave. & Court St.	San Rafael

Fifth Ave. & D St.	San Rafael
Fifth Ave. & E St.	San Rafael
Fifth Ave. Betwn. E & F Sts.	San Rafael
Fifth Ave. & Eye St.	San Rafael
Fifth Ave. & F St.	San Rafael
Fifth Ave. & Grand Ave.	San Rafael
Fifth Ave. & Irwin St.	San Rafael
Fifth Ave. & Lincoln Ave.	San Rafael
Fifth Ave. & Nye St.	San Rafael
Fifth Ave. & Tamalpais Ave.	San Rafael
1925 Francisco Blvd.	San Rafael
2031 Francisco Blvd.	San Rafael
2111 Francisco Blvd.	San Rafael
2171 Francisco Blvd.	San Rafael
148 Highland Ave.	San Rafael
Highway 101 between Lucas Valley Rd. & Miller Creek Rd.	San Rafael
Jensen Way @ Fifth Ave.	San Rafael
4-10 Knight Drive	San Rafael
32-36 Knight Drive	San Rafael
1893 Lincoln Ave. (Btwn. Prospect Dr. & Fair Lane)	San Rafael
Locust Ave. & Magnolia Ave.	San Rafael
77 Locust Ave.	San Rafael
Los Ranchitos & Red Rock	San Rafael
82-88 Marina Blvd.	San Rafael
Mission Ave. & Belle Ave.	San Rafael
135 Montecito Road	San Rafael
Palm Ave., East of Dominican Library	San Rafael
N. Redwood Dr., 300' SE of PG&E	San Rafael
Redwood Drive (Utility Easement)	San Rafael
Redwood Hwy, Frontage Rd., @ Fairchild Semiconductor	San Rafael
Redwood Hwy, Frontage Rd., Near 5 Mitchell Blvd.	San Rafael
Redwood Hwy, Frontage Rd., Near Paul Dr.	San Rafael
Redwood Hwy, Frontage Rd., Near Smith Ranch Rd.	San Rafael
Redwood Hwy, Frontage Rd., North of Joseph Court	San Rafael
120 N. Redwood Dr.	San Rafael
165-185 Redwood Dr. (Parking lot)	San Rafael
N of 195-199 Redwood Dr. (Parking lot)	San Rafael
W of 195-199 Redwood Dr. (Parking lot)	San Rafael
4460 Redwood Hwy, Frontage Road	San Rafael
66 & 68 Scenic Ave.	San Rafael
Smith Ranch Rd. @ Silveira Pkwy	San Rafael
Summit/Deer Park/Highland	San Rafael
Summit & Fairway	San Rafael

Summit & Montecito	San Rafael
315 Summit Ave.	San Rafael
Opposite 360 Summit Ave.	San Rafael
4000 Bridgeway	Sausalito
Bridgeway to Colma	Sausalito
Circle Road & Cayford Dr.	Tiburon
31 Circle Road	Tiburon
Reed Ranch Rd. @ Tiburon Blvd.	Tiburon
Tiburon Blvd., Near 3 Lagoon Road	Tiburon
204 Trestle Glen Tr.	Tiburon

<u>SWIMMING POOLS</u>

Marin County has well over 9000 swimming pools. The average single family home pool has a capacity of 20,000 gallons. This means that there is 180 million gallons of water stored in swimming pools in Marin County. Unfortunately most pools are not visible from the street nor accessible for normal engine drafting. The best method for utilizing this source of water is usually a portable pump, either directly to a hose and nozzle or into an engine pump.

1. Directly to a hose and nozzle. This method is the simplest and provides firefighters with a quick way to supply one or two small hose lines. The only equipment necessary is the pump, hose and a nozzle. These items can be deployed and left behind if necessary without committing an engine. This is an excellent technique for protecting structures during wildland fires. Smooth bore nozzles make the most of this method as most portable pumps have limited pressure capability. (The portable floating pump on the hose tender have a high pressure capability of 120 GPM at 65 psi).

2. To supply an engine pump. This method maximizes the volume potential of a portable pump. Example: The portable pumps on the hose tenders will pump 400 GPM plus at 10 psi. If all three pumps are discharging full volume through 3 inch hose into a siamese and then into five inch hose to an engine pump, 1000 GPM plus can be pumped to any required location. If volumes this high must be pumped from swimming pools, more than one pool should be used if possible so that flows may be sustained for as long as possible.

3. Lakes, creeks, the Bay. These can be viable sources of supply. However, the following must be considered:

A. Accessibility -- In many areas water deep enough to pump from is some distance from fire apparatus drivable surfaces. Standard fire engine drafting equipment usually includes two ten foot sections of hard suction and a strainer. This is simply not adequate for most of the shallow water line in Marin County.
B. Tide -- At low tide many areas are dry that earlier were covered with several feet of water. This must be considered.
C. Volume -- Many small creeks would have to be dammed to provide enough depth and volume for fire department pumping equipment.

HOSE TENDER OPERATIONS

Hose Tender Operations can be divided into three areas:

- Water supply operations at the source.
- Hose lay operations

  A. Single
  B. Dual
  C. Relay

- Fire scene operations.

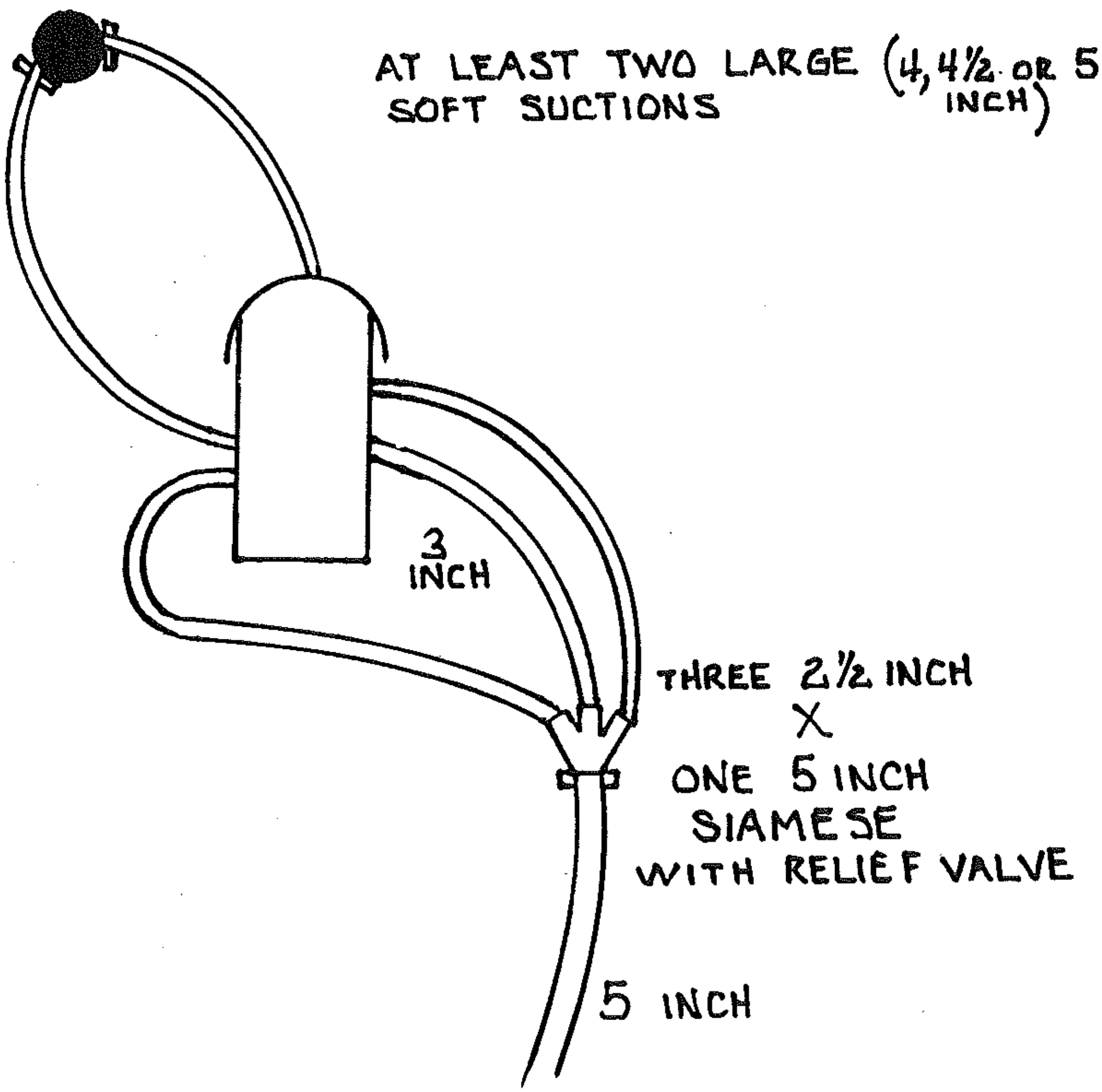
1. Water Supply Operations -- A fire serious enough to necessitate deployment of a hose tender is probably a major emergency. Routine operations have failed to control the fire. The fire probably will require high flows for considerable duration. Every effort should be made to secure a reliable high flow water source that is independent of the source already in use at the fire.

   A. Hydrants -- If at all possible a hydrant used for supplying a hose tender operation should be on a different water system from the system in use at the fire scene*. Examples:

      - High System in Use: Drop downhill and use a gravity system hydrant.
      - Gravity System in use, inadequate flows: Use a transmission main hydrant

   * Water district personnel can be extremely helpful in assisting firefighters to determine the capacity of alternative sources.

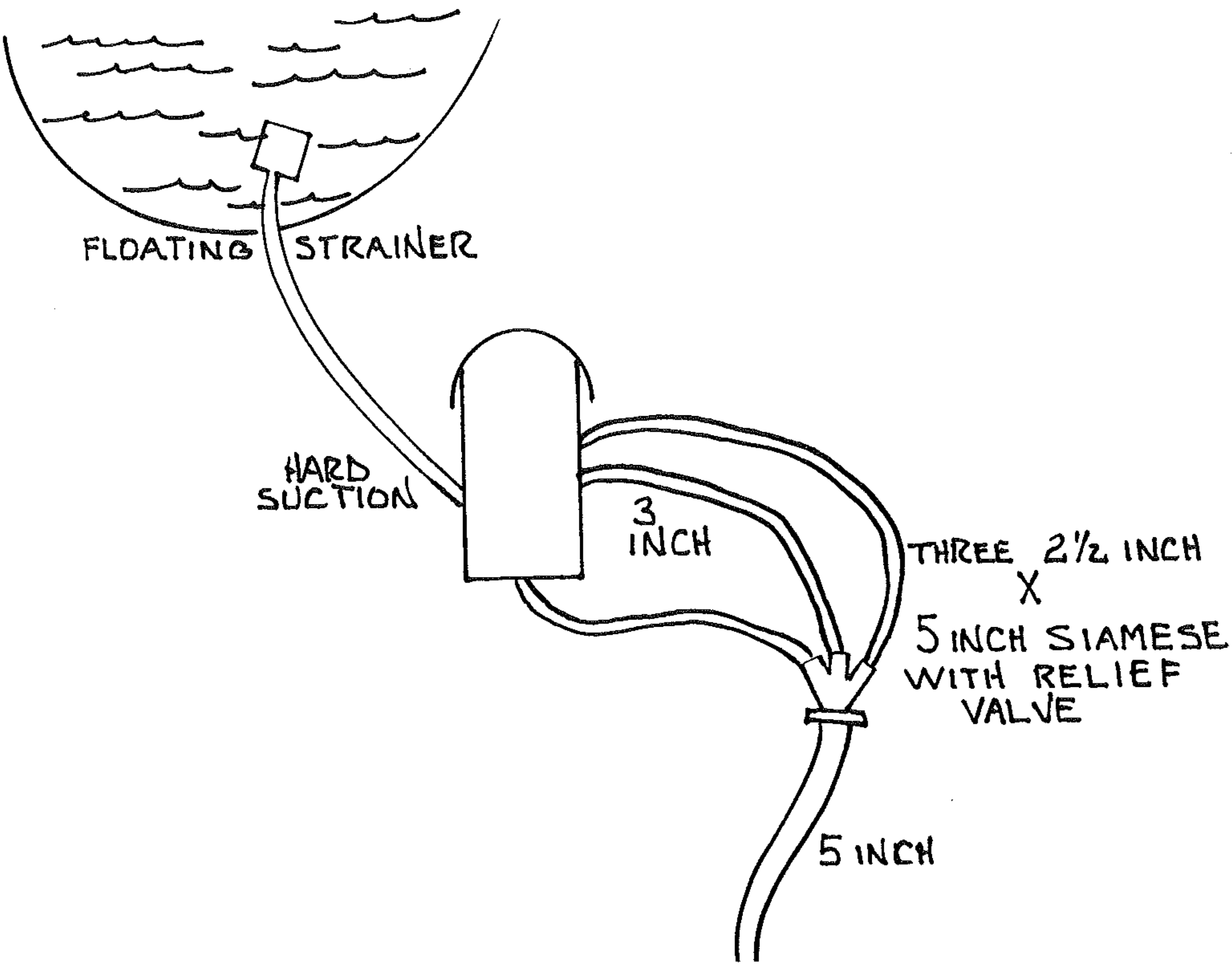
SUGGESTED HYDRANT CONNECTION



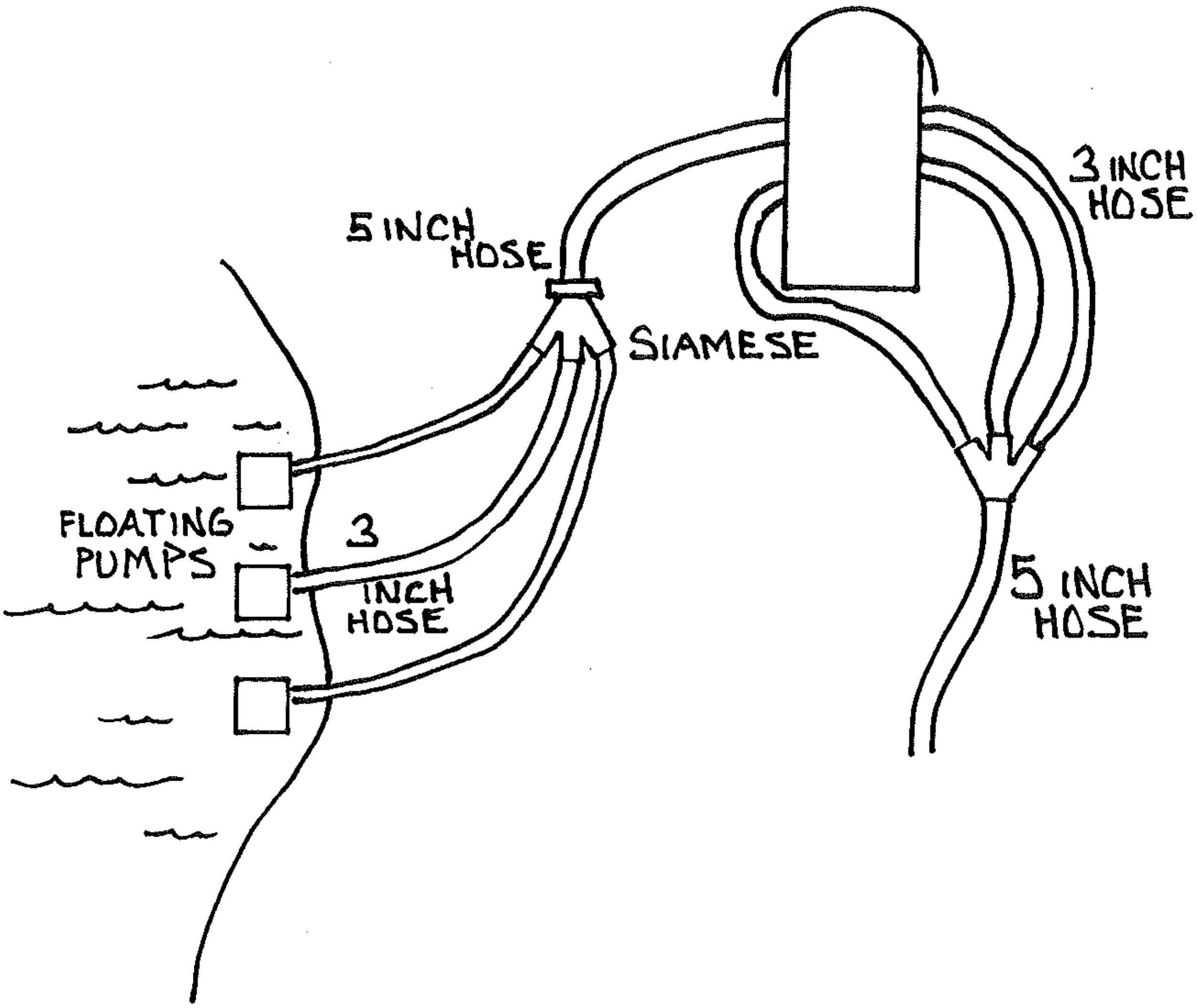
* NOTE: If the engine pumping to the hose lay has a large diameter discharge, it may be used in lieu of the siamese with the three discharge lines.

STATIC WATER SOURCES

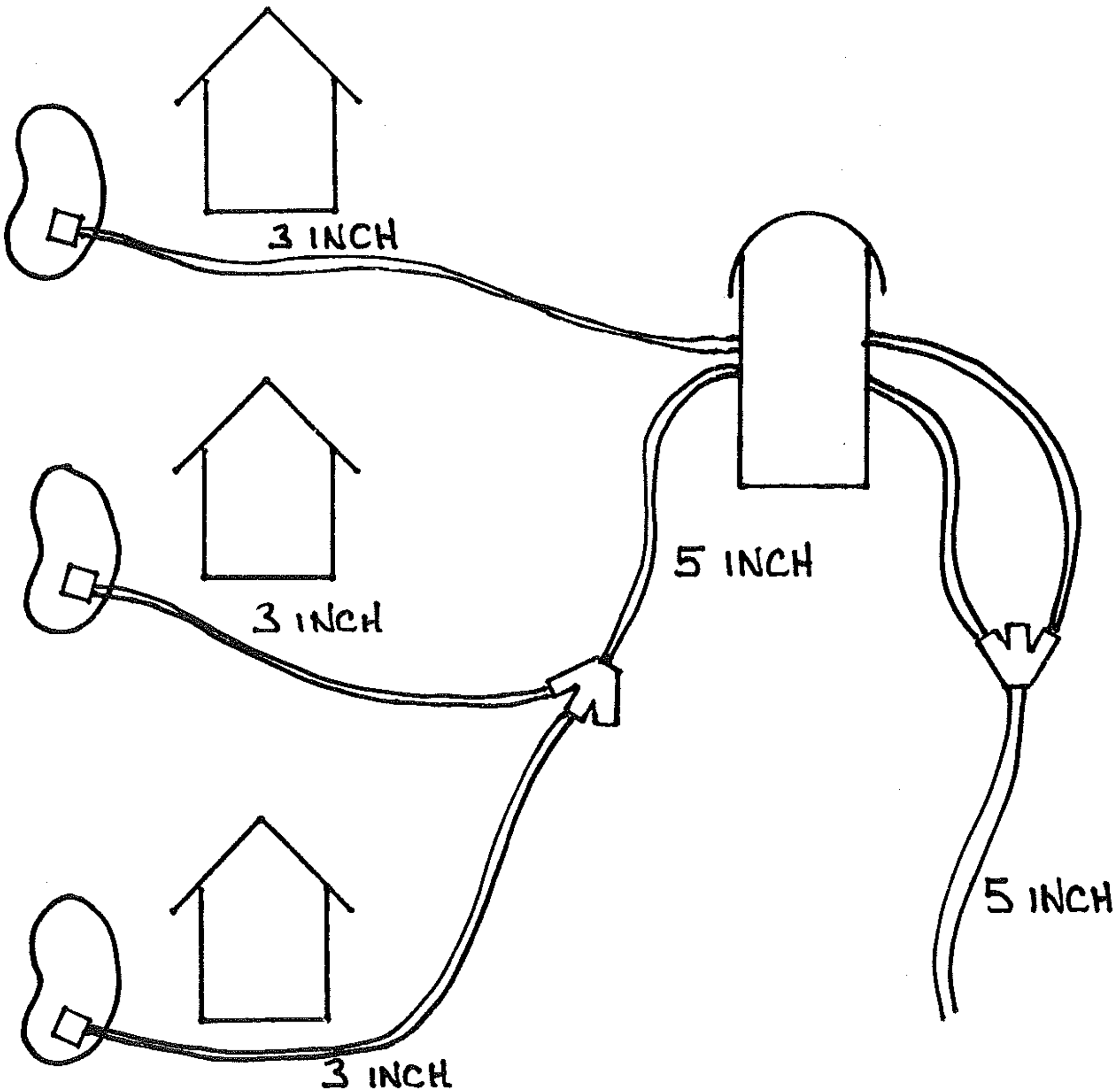
If a static source is accessible and not subject to extreme depth (tidal) changes, standard drafting procedures can be used:



If a static source is not accessible or subject to depth changes, a Floto Pump supply can be established

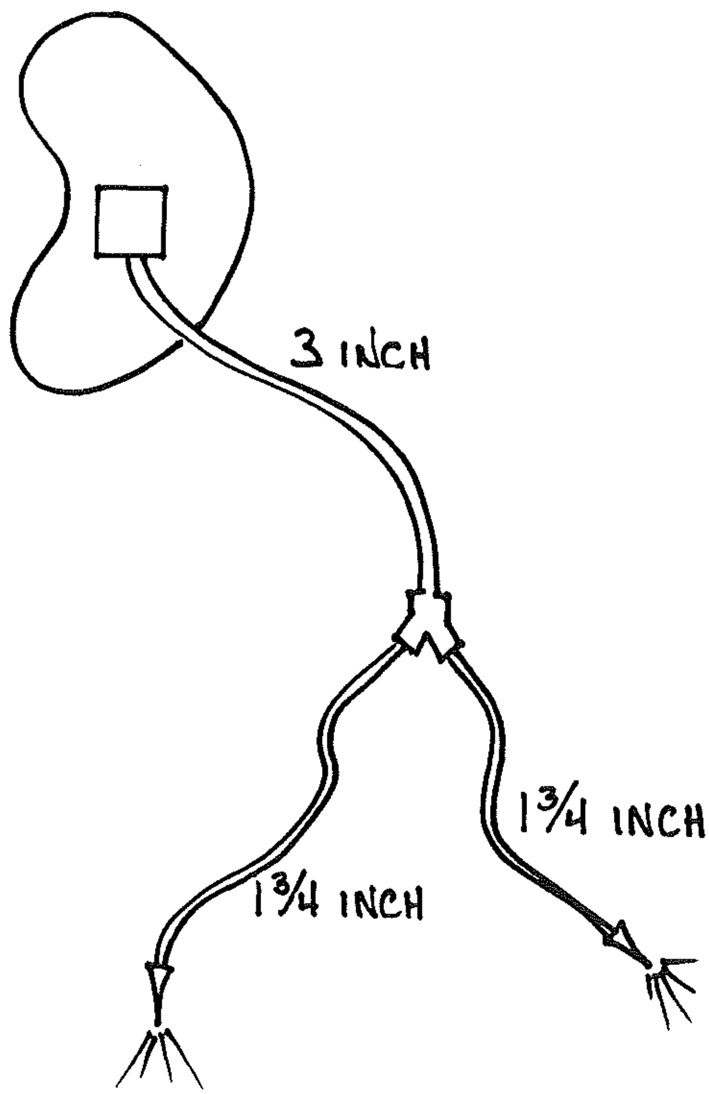


This evolution is capable of producing flows in excess of 1000 GPM.



MULTIPLE POOLS MAY
BE NEEDED

If the situation requires that Floto Pumps be used directly to a hose and nozzle use 3 inch, 1 3/4 inch with smooth bore nozzles to maximize the pump capability.



FLOATING PUMP OPERATION

The Darley "Dolphin" floating pump carried on the hose tenders is powered by a 12 horsepower Briggs and Stratton engine. Fuel is regular low lead with no mixing of oil and gas required.

<u>Performance</u>

430 GPM @ 10 PSI
250 GPM @ 45 PSI
120 GPM @ 65 PSI

The pump has a single choke, throttle, stop control and is pull rope start. The control is a horizontal sliding bar positioned:

Stop Throttle Choke

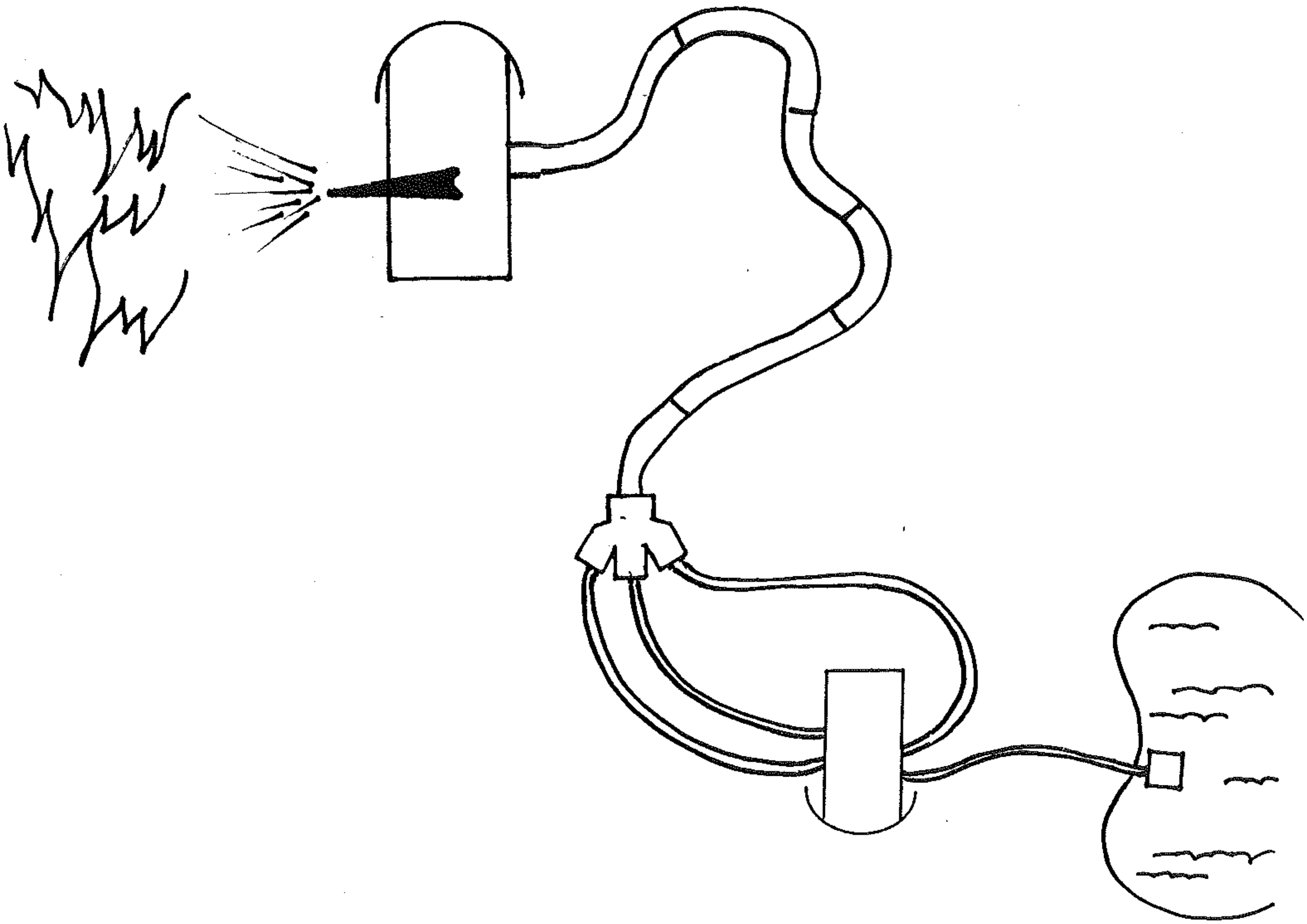
To start:

A. Connect hose line
B. Move control to choke
C. Start with pull rope
D. Move control to idle

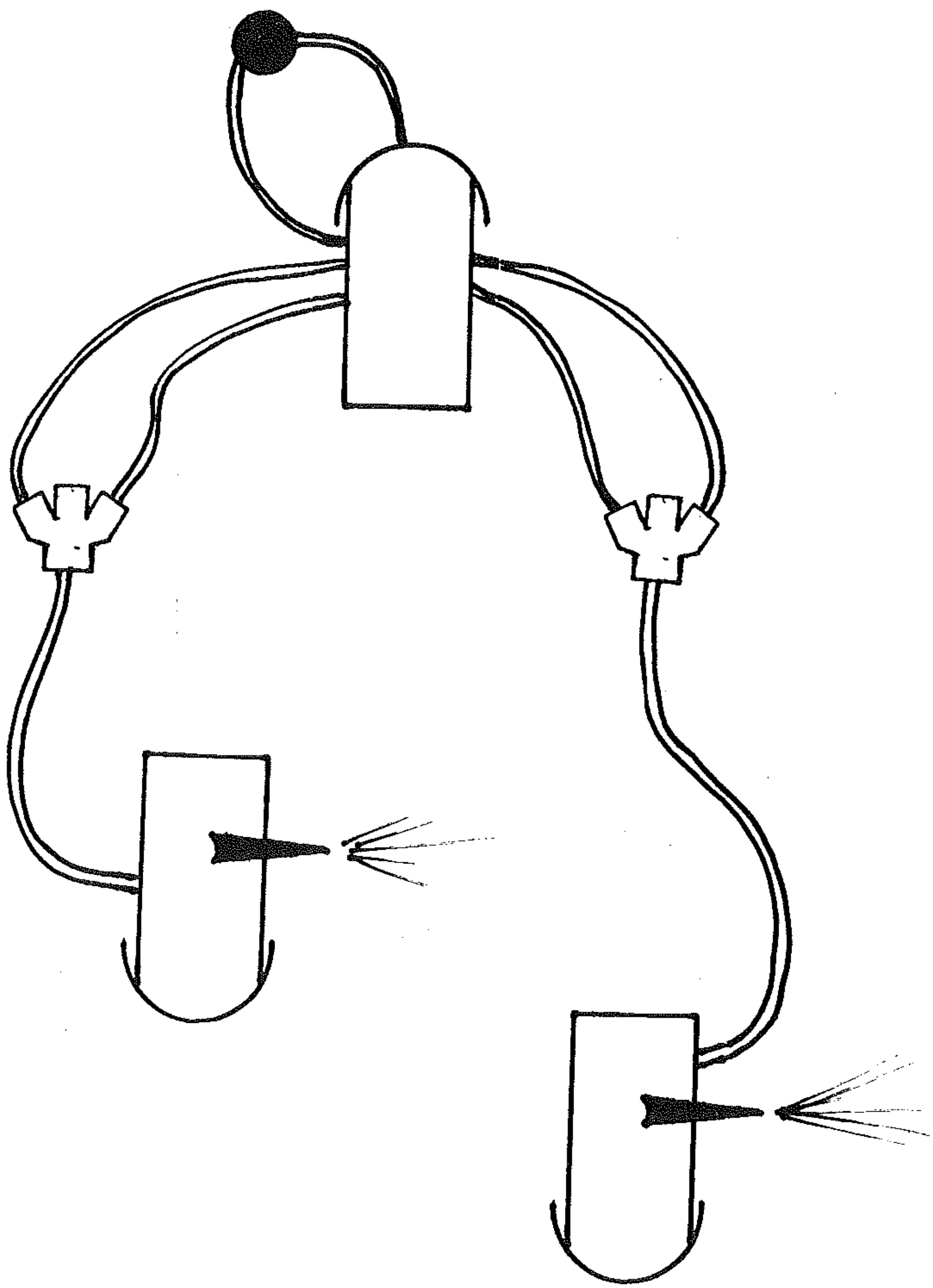
NOTE: WHEN MOVING FROM CHOKE TO THROTTLE, THE CONTROL MUST PASS FULL THROTTLE TO IDLE. IF THE CONTROL IS JUST MOVED FROM CHOKE TO THROTTLE, THE ENGINE WILL GO TO FULL RPM.

E. As soon as the engine is running smoothly, place the pump in the water if it was not in the water when started.
F. Move the control up to slow speed and allow the pump to prime.
G. Move the control to full throttle.

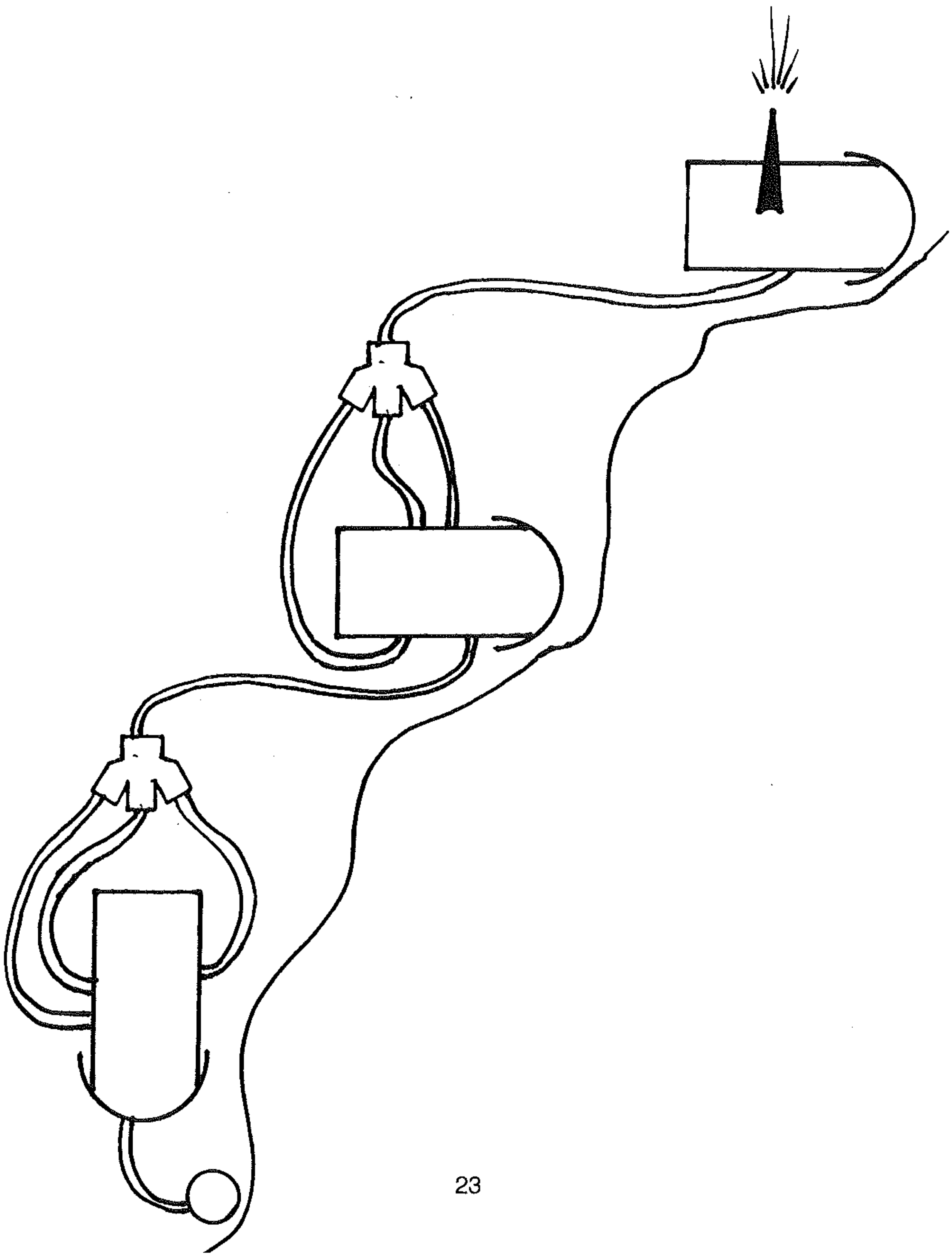
2. Hose Lay Operations -- In most cases a simple single layout from the source to the fire (or vice versa) will be the best choice.



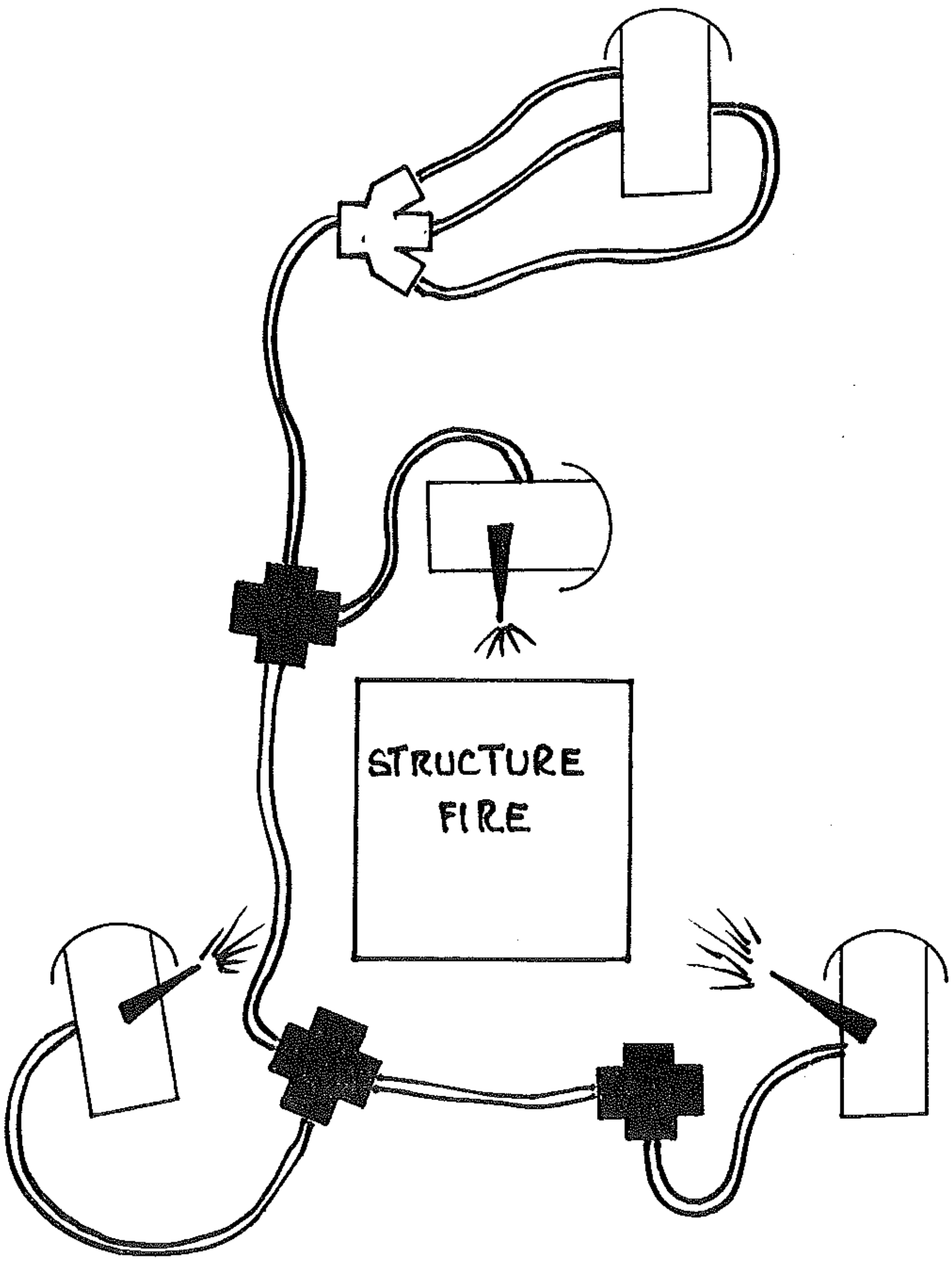
Dual Layout -- If the fire situation is extreme and the water supply very substantial, a dual layout could be considered.



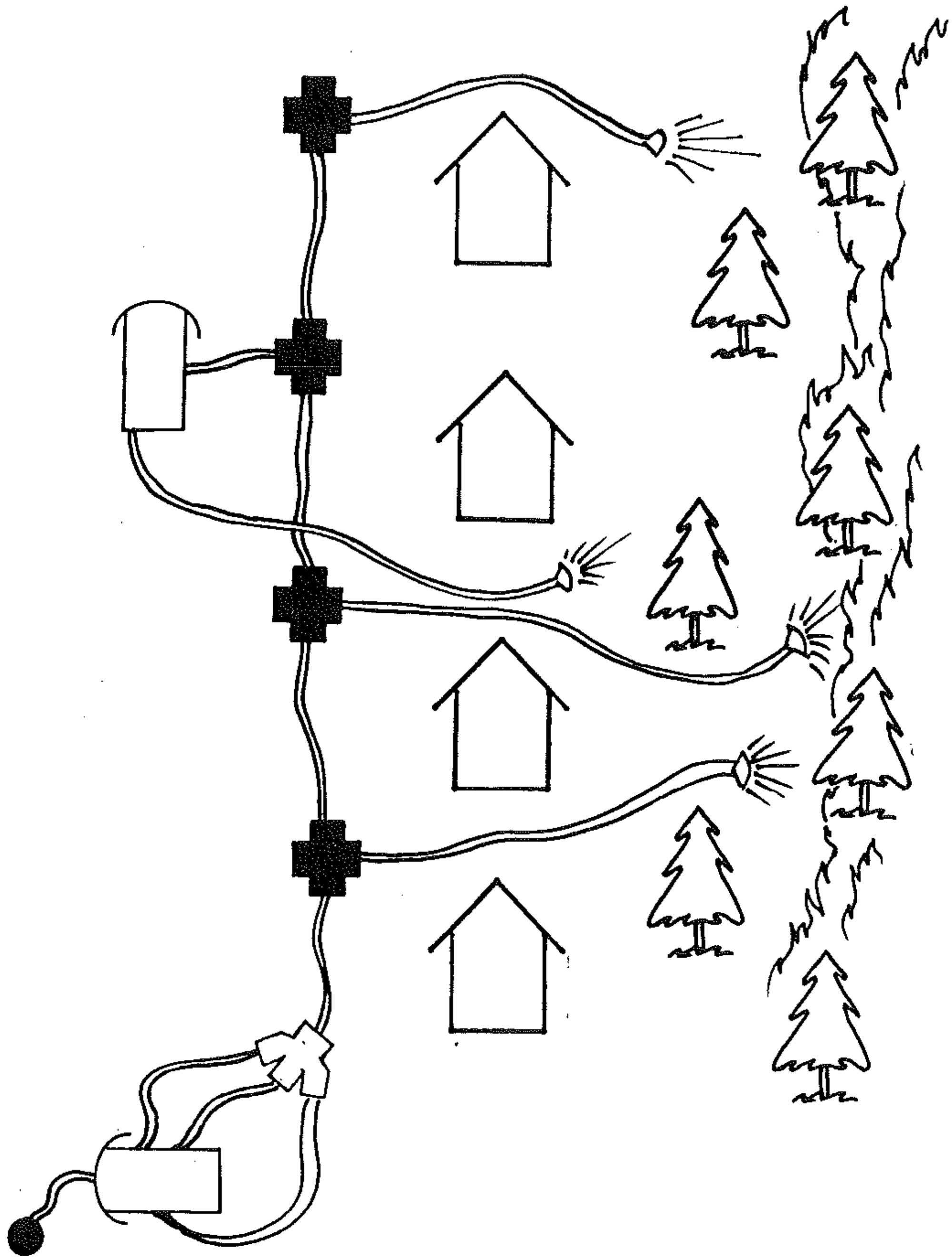
Relay -- In the case of a long layout or extreme elevation change with a high flow requirement, a relay may be considered.



Portable Hydrants -- In the event that water sources are needed at multiple points along the hose layout, "portable hydrants" or manifolds can be installed. The manifolds have one 5 inch Storz inlet with one valved 5 inch Storz outlet and two 2 1/2 inch valved outlets.

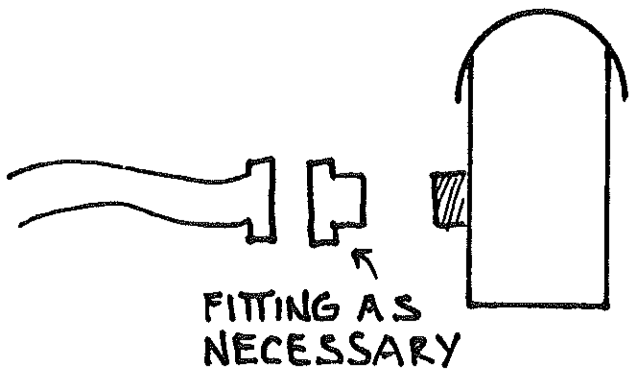


WILDLAND FIRE THREATENING STRUCTURES

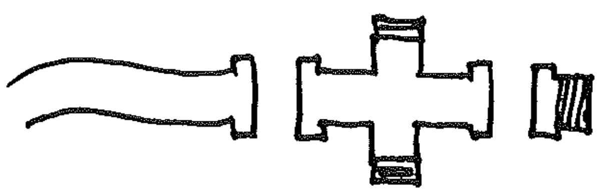


At a fire scene where the water supply is needed at only one location, several choices exist.

A. Connect the five inch hose directly to a pumper at the scene



B. Connect the five inch hose to one portable hydrant. Adapt the five inch Storz outlet to 4 1/2 inch male thread. This creates the equivalent of a standard "steamer" hydrant at the scene that any engine company can connect to.



PUMP OPERATIONS AND HYDRAULICS

Most hose tender operations will involve relay pumping. The length of the hose lay and quantity of water moving are the exceptional aspects of these operations.

Five inch hose holds approximately one gallon of water per foot. A 3,000 foot hose lay would contain 3,000 gallons of water weighing almost 25,000 pounds. If the operation involves pumping 1,000 GPM, 8,000 pounds of water per minute is being moved 3,000 feet. Obviously the potential for damage and injury from excessive pressure or water hammer is great. Several procedures will minimize this potential.

1. Maximum Pump Pressure -- The five inch hose manufacturer has stated that the hose may be pumped at as much as 290 PSI. In order to provide a safe margin of error, 200 PSI should be the maximum pressure pumped during hose tender operations.

2. Relief Valves -- The portable hydrants and siamese valves on the hose tenders have built in adjustable relief valves that will relieve excess pressure to atmosphere. Placement of these valves in the hose lay protects the hose, pump and water system. Relief valves on both the suction and discharge sides of engine pumps supplying or being supplied by hose tender operations should be employed.

3. Avoidance of Water Hammer -- If thousands of pounds of water is abruptly stopped anywhere in a hose lay; great forces will be exerted on every component of the layout. The force of a water hammer created during a large diameter hose relay operation can burst hose, crack pump casings and break water mains. The key to prevention of water hammer is the SLOW OPENING AND CLOSING of all valves.

Friction Loss in Five Inch Hose

GPM	500	750	1000	1250	1500	2000
F.L. per 100 Feet	2	4	6	10	14	25

Based on the above figures, five inch hose can move the following flows (approximate).

750 GPM	-	5,000 Feet
1000 GPM	-	3,200 Feet
1250 GPM	-	2,000 Feet
1500 GPM	-	1,400 Feet

Conclusion:

The three Marin County hose tenders provide an alternative ability to access water supplies during both routine operations and catastrophic emergencies. The scenarios and suggested evolutions in this document are limited by the author;s knowledge and imagination. The combination of the equipment available on the hose tenders, training and the ingenuity of fire service personnel will most certainly add up to a higher degree of fire protection in Marin County.

REQUESTING AND DISPATCHING HOSE TENDERS

The Departments having hose tenders (Sausalito, Corte Madera and San Rafael) will immediately dispatch a tender with a minimum of two personnel upon receiving a request from any fire agency in Marin County or the Marin Municipal Water District. The tenders are now included on the Countywide Mutual Aid Matrix. To request a tender, contact the County Communications Center. Comm. Center will then dispatch the closest available tender. If a hose tender is committed to an incident, it is suggested that a second tender be requested to provide back-up equipment and additional personnel familiar with hose tender operations.