PHOENIX REGIONAL STANDARD OPERATING PROCEDURES	
Policy Name: **WATER SUPPLY AND FIRE STREAM MANAGEMENT**	Policy Number: **M.P. 202.12E**
This policy is for internal use only and does not expand an employee's legal duty or civil liability in any way. This policy should not be construed as creating a duty to act or a higher duty of care, with respect to third party civil claims against employees or the Phoenix Fire Department (PFD). Remedies for violations of this policy, if proven, are limited to administrative disciplinary action against PFD employees.	
Related Policies: 201.01, 201.01C, 201.06, 202.02C 202.04, 202.05	
Other Reference: UL Fire Safety Research Institute (FSRI), NFPA 1700	
Date Implemented: 03/2022-R	Review Date: 03/2026

PURPOSE

To provide guidelines for determining water supply needs and selecting the most effective hose line size or sizes based upon initial and ongoing size-up and fire ground factors.

OVERVIEW

Adequate water supply during fire attack operations has a critical impact on fire control outcomes. Water on the fire as quickly as possible improves the tenability of potential victims and improves conditions for firefighters to operate. An uninterrupted water supply is necessary to sustain effective water volumes during a fire attack in all critical tactical positions. An ineffective fire attack with inadequate water volume leads to delayed fire control, increased risk to firefighters and victims, and greater fire loss.

HYDRANT WATER SUPPLY

First due engine companies approaching the scene with any evidence of a working fire should secure a water supply. Exceptions to this guideline may include:

- Known or highly suspected rescue requiring a full crew
- Unsure of actual fire location in multi-unit residential or commercial building complex
- Fire in a high-rise building

Hillside or remote custom homes, junkyards, re-cycle or mulch facilities, high fire-load occupancies, and limited hydrants require pre-planning for unique hose-lays, drafting from canals, or extremely long supply lines.

Adequate water supply lines must be considered to all tactical positions that fire companies are working from. This includes interior or exterior fire attacks from hose lines and/or master streams. The number of supply lines and configuration of forward and key pumpers in any tactical position

will be determined by the water supply needs established by the incident action plan. This can be accomplished through "big water" evolutions, tandem pumping, and/or relay pumping operations. These will be determined by hydrant/water supply availability and the distances between the water supply and position of the fire attack.

Supply lines must be laid with consideration for access problems they create. When possible, lay the supply hose along the hydrant-side of the roadway and cross over at the fire if necessary. Slow down when laying lines, faster speeds result in excess hose on the roadway. Slower speeds also provide several advantages:

- Reduces the risk of striking pedestrians or vehicles or firefighters.
- Provides time for the Company Officer to size-up and evaluate critical fire ground factors.
- Provides time for the Engineer to appropriately spot the apparatus.

PUMPED WATER

After initial arriving companies have established an adequate water supply, subsequent arriving companies should stage in a manner to be easily assigned as a key pumper in critical tactical positions. Providing key pumpers on hydrants enhances fire ground safety in several ways:

- Ensures an uninterrupted water supply
- Provides volume when needed for extremely long supply lines (e.g., apartment's, re-cycling facilities or areas with limited water mains & hydrants)
- Ability to pump water through the forward pumper in the event of mechanical failure

Pumped water supply (Humat Valve Operation) is critical when large volumes of water are required in any tactical position. This provides for adequate water volume in attack operations including engine company mounted master streams, ladder pipes, or multiple high volume (2" and/or 2.5") attack lines are in operation.

Generally, first alarm companies should lay their own supply lines when establishing any tactical position before pumped water is considered/needed. In most cases, an unsupported forward supply lay of 500 feet of 4" supply line can flow 800 GPM. Most initial attack operations, including engine mounted master stream operations can be adequately supplied without pumped water for initial fire attack operations.

In most cases, the need for pumped water occurs once initial fire attack operations have been established. Command and/or Sector Officers should address the need for pumped water as ladder pipes or multiple Engine Mounted Master Streams are ordered into operation.

MASTER STREAM SUPPLY LINES

When establishing supply lines for master stream operations it is necessary to provide standard "big water" hose evolutions to provide adequate water volumes for ladder companies. Aerial apparatus typically can flow 1000 gpm per deck gun. Most aerial platforms have 2 deck guns

(capable of 1000 gpm per deck gun). Aerial platforms or aerial ladders should be considered 1000 plus gpm appliances.

Standard "big water" evolutions include a forward and key pumper, 2 supply lines between the forward and key pumper, and pumped water by the key pumper supplying the 2 supply lines. The forward pumper must be positioned as close to the ladder company as possible to diminish the length of supply line from the forward pumper to the ladder company inlets. The "big water" evolution can be conducted in a few different manner's dependent on available apparatus. The most efficient manner includes the forward pumper completing a forward lay from the hydrant to the ladder company. The key pumper then completes a reverse lay from the forward pumper to the hydrant with a second supply line.

ATTACK HOSE LINE CHOICE

The objective of the attack hose line choice is to provide enough water volume and reach to overcome the heat energy and heat release rate of the fire or an adequate flow to effectively cool and protect exposures.

BASIC ATTACK HOSE LINE PLACEMENT

When operating in the offensive strategy, fire attack hose lines of adequate water volume should be used to put water on the fire and/or onto burning compartment surfaces as quickly as possible. They should also be used to control access to hallways, stairways, or other vertical and horizontal channels through which people and fire travel.

- The first water stream should be placed to extinguish and/or cool the most endangered interior compartments from the most advantageous position (interior or exterior) to best impact tenability of victims and/or firefighters conducting rescue efforts.
- When no victims are present, the water stream should be placed on the fire with adequate volumes to attempt to suppress the fire and attempt to limit the spread to exposures.
- When immediate exposures are present, water streams should be directed on the exposures as early as possible.
- Back up hose lines should be deployed to protect a means of egress when necessary (always bear in mind the presence of Fire personnel operating in opposing positions).
- Back up lines should be of the same or greater water volumes when possible.

When a change from offensive to defensive operation occurs, crews should pull hand lines out of the fire building only if safe to do so. Do not delay exiting the building for the sake of salvaging a few feet of hose and a nozzle if conditions are deteriorating rapidly unless the line is needed for crew protection during egress operations.

FIRE STREAM CHARACTERISTICS AND CONSIDERATIONS

Fire companies must consider the characteristics of fire streams and choose the most effective nozzle and stream for the volume of fire and the size of the fire compartment(s).

Solid or straight stream:

- Greater penetration
- Greater reach
- Greater striking power
- Greater cooling of interior surfaces
- Greater cooling of exposed spaces
- Less steam conversion

Fog pattern (narrow, medium, wide)

- Shorter reach
- Smaller water droplets
- Greater air entrainment
- Greater steam production
- Most effective in confined spaces such as attics

The current hose and nozzle packages that are carried on Phoenix Fire Engine Companies include:

- 1 ¾" hose line with automatic nozzles (x2 minimum)
    - Hose lengths include:
        - 150' crosslay
        - 200' crosslay
    - 100' to 150' front bumper line
- Automatic nozzle (75 psi nozzle pressure for 70 to 200 GPM)
    - 2" hoseline with smooth bore nozzles (x1)
    - Hose length:
        - 200' crosslay or rear mount depending on apparatus configuration
    - Smooth bore nozzles with 1 1/16" tip (260 GPM at 60 psi nozzle pressure)
- 2 ½" hose line with smooth bore nozzles (1 or 2 depending on apparatus configuration)
    - Hose length:
        - 200' rear mount (1 or 2 depending on apparatus configuration)
    - Smooth bore nozzle with 1 3/16" tip (265 GPM at 40 psi nozzle pressure)
    - Blitz Monitor with solid bore or peripheral tips (up to 500 GPM)

FIRE STREAM CONSIDERATIONS – OFFENSIVE STRATEGY

An offensive fire attack should be centered on knocking the fire down and cooling the interior spaces to improve tenability for victims and improve working conditions of searching firefighters. When an initial attack does not control the fire completely, some considerations must be made. It must be determined if the fire simply requires more water to overcome the heat energy and/or does the fire attack additionally need to come from alternate position(s) (either interior or exterior)?

Through fire behavior research it has been clearly identified that fire is most effectively extinguished by water on the interior surfaces of a burning compartment, room, or space to cool the interior temperatures initially and then water on to the burning fuels directly. This is most effectively done with a straight or solid bore stream to keep the water droplets from the hose stream as large as possible. This limits the potential for steam production and creates cooling of the interior environment that tends to contract the hot gases. This is most effective in smaller residential spaces that allow for better water application on the interior surfaces from the most advantageous position. The same principals are true for commercial occupancies however due to size and complexity; it becomes significantly more difficult.

For fires that begin on the exterior of a building or occupancy, the fire attack should begin on the exterior fire and move to the interior. If an interior attack is initiated without controlling the exterior fire, the interior fire will continue to be fed from that exterior fire. A simultaneous fire attack on the exterior and interior spaces is the most effective means when possible.

Early identification of the direction of a flow path at a structure fire allows Firefighters to determine the best method of fire attack to work within the intake portion of the flow path, rather than against it. This may not always be possible and when the only option for Firefighters is to make a fire attack from the exhaust portion of the flow path, extreme caution must be taken. Considerations for changing the ventilation profile may change the direction of the flow path and create favorable conditions to begin a fire attack. It's critical that any changes that impact the ventilation profile are well coordinated.

UL-FSRI Fire Flows from High Pressure to Low Pressure
https://www.youtube.com/watch?v=O8s3Q57TZtE

UL-FSRI Flow Path and Suppression Must Be Considered Together
https://www.youtube.com/watch?v=B7k7_F2lowg

When wind conditions are present, it is safest to initiate the fire attack with the wind at the back of Firefighters. When wind driven conditions are present during an interior fire attack, extreme caution must be taken to control the ventilation intake, if on the windward side. Uncontrolled ventilation intake during wind driven conditions has created deadly conditions for Firefighters across the country. It must be identified and avoided.

UL-FSRI Keep the Wind at Your Back
https://www.youtube.com/watch?v=G3hF14iNec8

Backing up an initial fire attack is an important consideration. Backing up an initial attack must be conducted with hose streams/water volumes that match or exceed the initial hose line.

Beware of hose lines that have been operated in the same place for long periods. Fire conditions change during the course of fire operations (most things will only burn for a limited time) and the effect of hose line operations must be continually evaluated. If the operation of such lines becomes ineffective, move, adjust, or redeploy them.

Beware of the limitations of operating nozzles through small openings in to confined spaces such as attic spaces, truss lofts, cocklofts, or mansard style roof. The mobility of such streams is limited, and it is generally difficult to get water on the interior surfaces. Fire streams from above a confined space makes it very difficult to get water on the underside and structural components for the most effective surface cooling. Sometimes buildings or conditions will require fire companies to breach walls/floors to apply water to a burning space. It is important to realize the potential limitations.

Basement fires are most effectively extinguished when the water is applied from the same level as the fire. Basements with man-door access allow for the most effective water application on the interior surfaces from as steep an angle as possible, in the same manner as any other interior space. Basements with no exterior access or partial access from ground level windows creates a challenge for water application. Water must be applied from the most advantageous exterior position, through the windows (when possible) to cool the interior environment to allow interior access. If no exterior access is possible, extreme caution must be exercised as the only access to the lower level/basement will be through the flow path (chimney) from the floor above. All possible actions must be exercised to attempt to cool the interior environment prior to making access.

UL-FSRI - Initiate Your Firefight on the Same Level as the Fire
https://www.youtube.com/watch?v=OVQFRzpVr9Y

UL-FSRI - Basement Fires: don't get caught in the flow path exhaust
https://www.youtube.com/watch?v=3YiLLsWuOxg

Company Officers and Sector Officers must assume responsibility for the effectiveness of their fire streams. These officers must maintain an awareness of where fire streams are going, their effectiveness, and then report the general operational characteristics back to the Sector Officer or Command. Company Officers must understand and be competent with the nozzle characteristics and features of the operating nozzles to get the most effective volume and stream while operating on the fireground.

FIRE STREAM CONSIDERATIONS – DEFENSIVE STRATEGY

When master streams are needed for large volumes of water to slow fire growth, extinguishment, or to protect exposures, they must be used with deliberate understanding of their strengths and challenges. Master streams should be used for large volumes of fire or to protect exposures that require large volumes of water to do so. They can certainly provide up to 1000+ gpm. That can

provide significant surface cooling however that comes with powerful striking force and significant water weight (1000 gpm = 8,340 pounds of water per minute and 139 pounds of water per second). This can have adverse effects on structural stability immediately and over time.

Exterior master streams should not be used with interior operations in the same structure or occupancy depending on the building type. The exception to this would be a defensive strategy while protecting exposures from interior positions at structure fires where these tactics are applicable from the perspective of risk management. It is possible to flow master streams in the fire occupancy while working with handlines from interior positions to protect exposures in other occupancies after a thorough size up and determination of structural stability. Command and Sector Officers must closely coordinate any exterior master streams with interior operations or personnel operating nearby.

Master streams may be useful in knocking down a large body of fire in a segment of a structure where the intent is to operate in offensive positions after significant knockdown is achieved. Command and the Sector Officers must evaluate the structure's stability in these situations. This evaluation should occur after the master streams are shut down and BEFORE committing crews to interior positions. When there is any question as to the stability of the structure crews should not be deployed to interior positions.

When there is a change in strategy from Offensive to Defensive, Command must prioritize hand line operations. Large volume hand lines such as 2.5" and 2" lines may be used to protect exposures from defensive positions outside of the hazard zone. Smaller (1 ¾") hand lines should be shut down after changing to a defensive operation. Pump operators should close the discharges to these lines to prevent well-meaning firefighters from trying to use hand lines where they are ineffective and allow Firefighters to creep into the hazard zone. Command and sector officers must maintain all members in positions outside the collapse zone and prevent firefighters from moving into unsafe positions.