ENHANCED RURAL FIRE WATER REGULATIONS

WORKING DOCUMENT

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2026-Rev. 4

BLACK FOREST FIRE & RESCUE PROTECTION DISTRICT

11445 Teachout Rd.
Colorado Springs, CO 80908
719-495-4300

Developed / detailed by Scott Lacey, PE, CSP, (DBA Lacey Fire Protection Engineering) with support of the Black Forest Fire Rescue Protection District and other El Paso County, Colorado fire districts. Funding assistance provided by Black Forest Fire & Rescue Protection District. This document is protected by copyright.
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Scott Lacey PO Box 3049 Waxahachie, TX 75168 info@LaceyFPE.com
Registered PE in AZ and AR

ABSTRACT

There are numerous discrepancies and missing criteria within nationally recognized codes and standards along with regionally adopted codes. Such items include but are not limited to:

- Calculations of available water supply including quantity and pressures.
- Hydrant spacing for rural residential properties including long driveways
- Spacing and distances of water sources such as cisterns
- Specific and standardized criteria for the installation and use of water supplies including cisterns, ponds, dry-hydrants, connections, etc.
- Criteria for filling, maintenance, and identification of cisterns or other water sources.

As such, these documents refer to the authority having jurisdiction (AHJ) to establish missing or conflicting criteria. The purpose of this document is to establish written guidelines to better serve the developers, individual builders, and the community. Through adopting this regulation, jurisdictions can standardize their criteria which will greatly enhance consistent approaches, mutual aid response, and overlap of jurisdictions criteria. Although other codes & standards were used as basis to establish the criteria of this document, variations and enhancements have been made.

It is important to recognize that fire does not care if you live in an urban subdivision with large water mains and hydrants throughout, or in a rural area separated from your neighbors. In fact, fires are generally larger in rural areas and will require considerably more water. This is due to several factors, including delayed notification as there may not be neighbors to report the flames coming out of the attic or windows until well involved. There may be longer response times once a fire is reported as we often move to these outer areas to get away from everyone. The number of personnel that arrive within the first few minutes can also be lower in rural areas. As such, the argument is clear that having quick access to a reliable water source in a rural setting is often more important in saving lives and saving property. As such, well established regulations for reliable water are essential.

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References to these documents are provided to identify where another code may make reference to criteria that may be applicable or have been modified in this regulation by the AHJ as permitted by these other documents.

Significant changes in this and recent revisions:

- We have tried to identify significant changes with red underline.
- Added Parcel Split provisions in Section 5.6.
- Alternative water source provisions for individual properties in Section 5.7.
- Flipped Sections 6 and 7 in June of 2026 from an earlier review version. Also expanded Section 4 criteria.
- Provided alternative subdivision provisions in Section 7 with restrictions as identified.
- Clarified solar power could be used for tank monitoring with appropriate trouble notification.
- Clarified other options could be provided for protection of piping and connections satisfying certain requirements. This included removing “retaining wall” and providing “protective pipe barrier”.
- Modified distance to a dry-hydrant connection to be 8’ to accommodate front suction bumper hoses.
- Increased triggers for internal eductors to >60,000 gallons or three or more cisterns in Section 7.
- Minimum 8” pipe and fittings for interconnection and equalization of water levels at multiple tanks.
- Expanded Section 9 for commercial occupancies
- Clarified options / requirements for snow pole marking of fire hydrants & colors with examples in Appendix “A”.

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Table of Contents

1 ADMINISTRATION 5
- 1.1 OVERVIEW 5
- 1.2 EXCEPTIONS & LIMITATIONS 7
- 1.3 WATER SUPPLY GENERAL PROVISIONS 8
- 1.4 REFERENCED CODES & STANDARDS 9
- 1.5 TERMS AND DEFINITIONS 9
- 1.6 COMMON VALUES 13
- 1.7 ACCESS AND LOCKS 13
- 1.8 MAINTENANCE 14

2 PERMITS, SUBMITTALS, INSPECTION, COMMISSIONING 14
- 2.1 PERMITS 14
- 2.2 DESIGN SUBMITTALS 15
- 2.3 INSPECTIONS 15
- 2.4 COMMISSIONING 17

3 PROPERTIES HAVING A MUNICIPAL WATER SUPPLY AVAILABLE 17
- 3.1 GENERAL 17

4 PROPERTIES WITHOUT MUNICIPAL WATER SUPPLY 19
- 4.1 GENERAL 19
- 4.2 SHARING OF WATER SOURCES 20

5 INDIVIDUAL RESIDENTIAL PROPERTY REQUIREMENTS 22
- 5.1 GENERAL 22
- 5.2 WATER SUPPLY RELIABILITY 23
- 5.3 WATER SUPPLY SOURCE 23
- 5.4 WATER QUANTITY 24
- TABLE 5.4 26
- 5.5 FIRE FLOW REQUIRED BASED ON QUANTITY OF WATER 28
- 5.6 PARCEL SPLIT PROVISIONS 29
- 5.7 ALTERNATIVE WATER SOURCE – INDIVIDUAL PROPERTY 30

6 RESIDENTIAL SUBDIVISION – CREDITABLE HYDRANT PROTECTION 32
- 6.1 GENERAL 32
- 6.2 WATER SUPPLY RELIABILITY 32
- 6.3 WATER SUPPLY SOURCE 33
- 6.4 WATER QUANTITY 34
- TABLE 6.4 35
- 6.5 FIRE FLOW REQUIRED BASED ON QUANTITY OF WATER 37

7 RESIDENTIAL SUBDIVISION – OPTIONS WHEN ACCEPTABLE 39
- 7.1 GENERAL 39
- 7.2 WATER SUPPLY RELIABILITY 41
- 7.3 WATER SUPPLY SOURCE 41
- 7.4 WATER QUANTITY 41

8 RESERVED 43

9 COMMERCIAL PROPERTIES 43
- 9.1 GENERAL 43

10 CISTERN DESIGN AND SIZING REQUIREMENTS 46
- 10.1 GENERAL 46
- 10.2 CISTERNS INCORPORATING A DRAFTING EDUCTOR 47
- 10.3 TANK FILLING, LEVEL GAUGES, AND MONITORING 48
- 10.4 LOCATION 50
- 10.5 SIZING 51
- 10.6 CONNECTIONS 52
- 10.7 CONSIDERATIONS WITH FLOW DEMANDS 54

11 DRY HYDRANTS FOR WATER SOURCES OTHER THAN CISTERNS 55
- 11.1 GENERAL 55

12 DEDICATED PRIVATE FIRE MAINS 56
- 12.1 GENERAL 56

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12.2 PIPING AND MATERIALS 57
12.3 IDENTIFICATION OF FIRE HYDRANTS 60
12.4 HYDRAULICS AND CALCULATIONS 63
12.5 ACCOUNTING FOR ENTRAPED AIR IN FIRE MAIN 64
13 SIGNS, IDENTIFICATION & TRACKING OF WATER SOURCES 65
13.1 GENERAL 65
13.2 REVIEW AND ACCEPTANCE 67
14 FIRE LANES AND LOADING 67
14.1 GENERAL 67
14.2 LOAD CRITERIA 68
14.3 GRADE / SLOPE 68
15 MAINTENANCE OF WATER SOURCES AND DELIVERY SYSTEMS 68
15.1 GENERAL 68
15.2 SNOW REMOVAL 70
15.3 FREQUENCY 70
15.4 TESTING VOLUME AND PRESSURES 70
15.5 NEW INSTALLATIONS AND COMMISSION TESTING 72
15.6 SUMMARY OF INSPECTION, TESING, AND MAINTENANCE 72
APPENDIX A – SUPPORTIVE INFORMATION 75
APPENDIX B – CONCEPT DRAWINGS & IMAGES 85
DETAIL #1 SITE PLAN PRIVATE HYDRANT CONCEPT 87
DETAIL #2 CISTERN TANK PLACEMENT WITH ASSOCIATED PIPING 88
DETAIL #3 CISTERN SIGNAGE AND CONNECTION PLACEMENT 89
DETAIL #4A BASIC CISTERN CONFIGURATION 90
DETAIL #4B CISTERN WITH INTEGRATED EDUCTOR 91
DETAIL #5 INLET FIRE HYDRANT FOR FIRE TRUCK TO PRESSURIZE 92
DETAIL #6 PRIVATE FIRE HYDRANT – SERVED BY SYSTEM 93
DETAIL #7 DRAFTING EDUCTOR MOUNTING INSIDE CISTERN TANK 94
DETAIL #9 END VIEW AND BARRIER WALL – INDIVIDUAL PROPERTY 95
APPENDIX C – FIRE MITIGATION 97
APPENDIX D – CALCULATION FORMS & CHECKLISTS 99
PROPERTY CALCULATION WORKSHEET - BLANK 101
DETAIL #8 SITE PLAN FOR AREA CALCULATIONS & MITIGATION 104
PROPERTY CALCULATION WORKSHEET - EXAMPLES 105
MUNICIPAL FIRE WATER EVALUATION FORM 109
REDUCED LEVEL OF PROTECTION ACHNOWLEDGEMENT 111
RURAL WATER DESIGN CHECKLIST – INDIVIDUAL RESIDENCE 113
RURAL WATER DESIGN CHECKLIST - SUBDIVISIONS 117
RURAL WATER INSPECTION CHECKLIST 121
RURAL WATER TESTING CHECKLIST 123
RURAL WATER MAINTENANCE CHECKLIST 125
RURAL WATER COMMISSIONING CHECKLIST 127
APPENDIX E – LOCAL FIRE AUTHORITY AMENDMENTS / DEVIATIONS 129

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1 ADMINISTRATION

1.1 OVERVIEW

1.1.1 This document has been developed to provide guidance with regards to water supplies, access to water supplies, and access to structures that support rural fire fighting operations.

1.1.2 Values and criteria established in this document are generally based around recognized criteria of various codes, standards, and insurance guidelines. There is no guarantee provided that the criteria outlined by this document will control all fires. In fact, it has been proven that with the right fuel and wind conditions no amount of water, equipment, or resources will stop some fires. This document has been prepared and adopted by this jurisdiction in an effort to provide a compromised balance of cost, water quantity, distribution, and credits. The mitigation of property and stewardship by the community to recognize, respect, and control the fire risk will provide the best protection from fire.

1.1.3 Unless otherwise accepted in writing by the Authority Having Jurisdiction (AHJ), the applicable criterion of this document shall be followed. Users shall review Appendix E for local amendments or revisions to this document. Verify the AHJ does not have a separate Appendix E document or file. Where the criteria of this document cannot be readily achieved and alternative means are presented and acceptable to the fire authority, the alternatives shall be clearly documented. Appendix C provides a "Reduced Level of Protection Acknowledgement" form that can be used.

1.1.4 Other codes / documents such as the Colorado Wildfire Resiliency Code go into details of hazard classifications, structural hardening, and mitigation requirements. This document incorporates criteria and intended enhancements of these other documents in establishing the criteria for the water supply requirements. As such, this document is intended to work with and support other documents objectives.

1.1.5 This document is intended to support and provide clarity for items that are otherwise not specifically addressed in other adopted or referenced codes / standards or are in conflict between the various codes / standards. Unless specifically identified otherwise in this document, the codes and standards identified in 1.4 shall be utilized in the order indicated.

1.1.6 Where another code or standard makes reference similar to "as directed by the AHJ" or "the AHJ shall be permitted to", this document is intended to provide the position of the AHJ. This document also uses the term "fire authority" interchangeably as the AHJ.

1.1.7 Individual projects often incorporate unique conditions that may not have been foreseen in the development of codes, standards, or this document. The AHJ shall have final authority to establish the interpretation and application of the criteria outlined within this and other indicated documents.

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1.1.8 Developers / owners may present alternative means and methods as outlined by the International Fire Code, 104, as adopted. However, any alternative shall satisfy the minimum intent of codes, standards, and this document or provide a betterment to the fire authority and the community. The AHJ shall have the authority to establish whether such minimum criteria have been satisfied. *[Where performance-based designs are provided, they should follow the guidance of the SFPE Engineering Guide to Performance-Based Fire Protection, and the Code Official's Guide to Performance-Based Design Review. The AHJ may need to obtain the outside resources of qualified technical assistance to assess the technical validity of performance designs.]*

1.1.9 To determine compliance with this regulation, the AHJ is authorized to require the owner or owner's authorized agent to provide a technical opinion and report. A technical opinion and report shall be provided without charge to the jurisdiction.

1.1.10 The AHJ reserves the right to communicate and discuss a project with other parties in evaluating and providing protection to a property or the community. This may include other county, building, fire, water, or traffic officials. This may also include insurance companies, appraisers, realtors, etc. with regards to necessary protection to better ensure coverage.

1.1.11 Items that still require clarity shall be brought to the attention of the AHJ.

1.1.12 Water supplies and hydrants developed under the criteria of this document, shall be permitted to be used for fighting fires in other than structures or for use during other emergency activities. *[NFPA 1142]*

1.1.13 Text that is located in *[italicized brackets]* is provided as commentary to provide an example or clarify the intent. This content is not mandatory but may be used as guidance to overall objectives of this document. See Appendix A for additional explanatory information.

1.1.14 The regulation uses {See App. E} to flag items that are most likely to have variations within Appendix E based on local jurisdiction criteria. Users are responsible to check Appendix E for local variations, but the regulation tries to flag items most likely to have variations.

1.1.15 Administrative provisions of the International Fire Code, Section 104, as adopted or the latest edition if not locally adopted, shall apply to this regulation.

1.1.16 Liability: The document provider (author and or agents), fire code official, member of the board of appeals, officer or employee charged with the enforcement of this code, while acting for the jurisdiction, in good faith and without malice in the discharge of duties required by this regulation, shall not thereby be rendered personally liable, either civilly or criminally, and is hereby relieved from all personal liability for any damage accruing to persons or property as a result of any act or by reason of an act or omission in the discharge of official duties.

1.1.16.1 Adoption and use of this regulation entitles the jurisdiction to provide input, guidance, and recommendations for its development in addition with the other participating jurisdictions. Together the participating jurisdictions and the provider form the body for the development of the regulation. The provider is hereby acting as an agent for the jurisdiction and the body in its development, writing, and updating.

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1.1.17 Any subdivision, individual property, or commercial property where the water supply provisions have been identified and accepted in writing by the fire authority prior to the implementation of this regulation may remain. Properties that have been submitted and are in review need to be coordinated with the fire authority to ensure minimum feasible provisions (connections, access, signage, etc.) are incorporated. As a minimum, water supplies shall be provided in accordance with minimum provisions established or adopted by the jurisdiction, county, or state prior to implementation. Properties that have not yet been submitted must comply with the provisions of this regulation, unless agreed to otherwise by the fire authority.

1.1.18 Combustible building materials including lumber, plywood, foams, etc. shall not be brought onto a property until after the accepted water supply has been installed, inspected, and commissioned, and an acceptable compacted fire lane has been provided.

1.1.19 Permits for building construction shall not be issued until wildland mitigation has been completed based on credits taken for water supplies.

1.1.20 The AHJ shall be authorized to not issue construction permits and/or issue a stop work order until mitigation activities satisfy water supply calculations and/or credits.

1.1.21 Failure to mitigate in accordance with water supply calculations prior to starting building construction work shall result in a stop work order until such time as additional water is provided to satisfy moderate – high intensity conditions. Such conditions shall be perceived as a failure to maintain, and increased water supply shall be provided prior to resuming building construction activities.

1.1.22 A property owner, homeowners association, developer, or other responsible party shall notify the fire department immediately upon identification that a water supply is out of service or can no longer provide the required water.

1.1.23 If any provision of this document is found to be invalid, illegal, or unenforceable in whole or in part, such provision shall be deemed modified to the minimum extent necessary to make it valid and enforceable. The remaining provisions shall remain in full force and effect.

1.2 EXCEPTIONS & LIMITATIONS

1.2.1 Sheds, animal shelters, barns, feed storage, equipment lean-too, or similar structures that comply with limitations of this section are not required to have a water source within 900’ of a water source. *[Structures that can be controlled by tank water.]*

1.2.2 Structures and areas of condensed combustibles, including those exempt from a water source indicated above, are still required to have an accepted fire lane and parking area within 300’ of all parts of the hazard for fire truck access to the hazard.

1.2.3 Accessory structures shall not be occupied for overnight stays unless evaluated and meeting the same requirements of residential spaces based on applicable credits and conditions of this document. If residential sprinkler credits were utilized, all residential buildings other than RV’s shall be protected with sprinklers.

1.2.4 Campers and RV’s parked within 50’ of the primary structure and utilized for sleeping for more than 14 contiguous days on property shall be included within the encroachment areas calculated or moved to a distance > 50’.

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1.2.5 Hazardous materials other than lubricants or fuels in accepted containers and only for the purpose of gas-powered tools, lawn mowers, tractors, vehicles, grills, and other home use, and not exceeding 30 gallons of flammable liquid or 150 pounds of propane, are not required to be within the distance of a water supply to the acceptable parking area, but are required to be within the hose lay distance from the accepted parking area. Hazardous materials other than as listed are required to be within the hose lay distance of a water source and in accordance with the IFC Chapter 50.

1.2.6 The accumulation of trash, lumber, dead yard materials, inoperable vehicles, inoperable recreation vehicles, or other combustible hazards as determined by the AHJ are not exempt from water supply distances. *[IFC 304]*

1.2.7 Brush, trees, and combustible materials shall be in accordance with Mitigation and Defensible Space criteria of Section 1.5. *[Combustible materials such as wood sheds, wood piles, etc. that are not hardened to resist ignition should be kept at least 30' from primary structures to limit fire spread, and 50' per encroachment area. CWRC]*

1.2.8 Hazards otherwise regulated by the International Fire Code are not exempt.

1.3 WATER SUPPLY GENERAL PROVISIONS

1.3.1 In accordance with IFC 507.1 and NFPA 1142, 7.1, an accepted water supply (municipal type or cistern) capable of supplying the required fire flow for fire protection shall be provided to premises on which facilities, buildings, or portions of buildings are constructed or moved. *[Where the referenced documents may not provide specific guidance on how the water is to be provided, this regulation does.]*

1.3.2 NFPA 1142, Chapter 4 provides means to calculate minimum water supplies for structures. This method has numerous variables making it difficult to accurately calculate, especially for blank lots, sheds, detached garages, etc. In accordance with Section 4.1.3, this document outlines criteria easier to interpret and apply while also taking into account local AHJ conditions. *[The equations of NFPA 1142 were utilized in validating the general quantities in Section 5 for similar values using different formulas.]*

1.3.3 Tanks including cisterns or accepted reservoirs shall be capable of providing the required flow as established in this document. *[IFC 507.2; NFPA 1142, 7.1.1]*

1.3.4 Tanks shall be installed in accordance with NFPA 22 unless otherwise accepted. Appropriate construction permits shall be obtained prior to installation.

1.3.5 See Section 10.5.6 for nominal vs. actual water supply criteria.

1.3.6 Sources of water shall be protected by a defensible space of at least 40' adjacent to a non-wooded area, or 50' when adjacent to a wooded area of established trees/brush. *[CWRC]*

1.3.7 Fire-flow requirements of this document have been established and accepted by the AHJ based on the allowances of other documents. *[IFC 507.3, NFPA 1142, and LDC]*

1.3.8 Where provided, private fire mains and fire hydrant systems shall comply with this document, NFPA 24, and as otherwise accepted. *[IFC 507.5]*

1.3.9 Fire hydrant spacing shall be based on criterion as identified in this document and Section 12. Hydrant spacing shall include the following considerations.

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1.3.9.1 Spacing from a fire hydrant / water source to an accepted parking area at a protected structure.

1.3.9.2 Distance between hydrants along the roadway.

1.3.9.3 If there are large common areas that would be vacant of hydrants for structures, the AHJ is permitted to require additional protection for such areas. *[IFC 507.5.1]*

1.4 REFERENCED CODES & STANDARDS

1.4.1 The following documents shall be used in the order presented and as applicable.

1.4.2 This document

1.4.3 International Fire Code (IFC) – as adopted

1.4.4 International Building Code (IBC) – as adopted

1.4.5 International Residential Code (IRC) – as adopted

1.4.6 Colorado Wildfire Resiliency Code (CWRC) – as adopted

1.4.7 Land Development Code of El Paso, Colorado – as adopted

1.4.8 NFPA 1142 – Standard on Water Supplies for Suburban and Rural Fire Fighting – Latest Edition

1.4.9 NFPA 1140 – Standard for Wildland Fire Protection – Latest Edition

1.4.10 NFPA 22 – Standard for Water Tanks for Private Fire Protection – Latest Edition

1.4.11 NFPA 24 – Standard for the Installation of Private Fire Service Mains - Latest Edition

1.4.12 NFPA 25 – Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems – Latest Edition

1.5 TERMS AND DEFINITIONS

1.5.1 Unless otherwise indicated, definitions are to be based on standard definitions identified in the codes / standards above. The following are some common definitions and explanations for terms used and as intended in this document. These are grouped by relationship rather than alphabetically.

1.5.2 **Accepted** – The term Accepted is used in lieu of approved. "Accepted" implies acknowledgement of receipt and basic compliance, while "approved" signifies a full review, verification, and formal sanction. Compliance with codes, standards, regulations, etc. are the responsibility of the owner / designer / installer. The function of an AHJ review and inspection is to perform spot reviews and observations for general compliance with the applicable criteria. This typically does not involve a "full" review of all designer specifications, manufacture installation instructions, etc. Where the term "approved" is identified in a regulation it shall mean "accepted".

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1.5.3 **Authority Having Jurisdiction (AHJ)** – Refers in this case to a governing body(s) who will approve design and installation. This could be a county governing body, building code official, fire department/fire district/fire authority official, or similar. An insurance representative may be considered an AHJ to the building owner if their conditions must be satisfied such as to eliminate risk to obtain insurance coverage. This term is extended to include a jurisdictional administrative body such as a fire advisory board or third party. The fire authority (fire marshal, inspector, deputy chief, chief, building official, etc.) may at their discretion solicit input from their advisory board or a third party of their choosing.

1.5.4 **Shall** – Is a mandated requirement.

1.5.5 **Area** – As used in this document, the area of a structure, accessory structure, or exposures within 50' of primary structures is the sum of the roof-line area of the largest floor in addition to the exterior areas of additional floors above grade and basements. Where basement walls are non-combustible of brick/cement (without foam forming) the interior dimensions may be used. An open-air pergola / patio roof-line shall be included within this area when meeting the criteria of an accessory structure. A crawl space that is not intended for occupancy, provides less than 6' clearance, and is not readily accessible for storage is excluded. *[This criteria is intended to capture the combustible fuel load to establish minimum anticipated fire water needs.]*

1.5.6 **Accessory Structure / Exposure** – A building or structure used to shelter or support any material, equipment, chattel, or occupancy. As utilized for calculating water supply, this is the sum of roof area for exposures within 50' of the primary residence, or the sum of accessory structures that form an area larger than the primary residence. *[CWRC; NFPA 1140]*

1.5.7 **Gallons Per Minute or gpm**. This refers to the volume of flowing water.

1.5.8 **Pounds per Square Inch or psi**. This refers to the available pressure of water such as to overcome friction loss and changes in elevation. Gauge psi unless otherwise indicated. Guage pressure is relative to the surrounding air, absolute pressure is impacted by elevation / altitude vs. sea level. *[Example, air pressure at 8,000 ft elevation is ~10.9 psi vs. 14.7 psi at sea level. This reduced pressure on the water's surface impacts drafting.]*

1.5.9 **Static Pressure** is the current pressure in psi within a system without flowing water, or with normal domestic flow within a municipal system.

1.5.10 **Residual Pressure** is the pressure remaining in a water main during a high flow condition, such as an open hydrant or fire water being used.

1.5.11 **Friction Loss** is a factor that impacts the pressure of water over a distance based on the size of pipe and roughness within the pipe. The harder water must work to move through a pipe is an example of higher friction loss. High flows of water in smaller pipes must overcome greater friction loss. Lower flows or larger pipes/hose will result in lower friction loss. Steel pipe that will rust inside will have a higher friction loss than plastic smooth pipe. Fire hose in general has a very high friction loss.

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1.5.12 **Elevation Pressure** or **Feet of Head** - Refers to the pressure that is required to push water uphill, or can be the pressure gained by water going downhill. Elevation pressures can have a significant impact on water distribution. Drafting water from a water source lower than the pump level also has a considerable impact on overall system pressures.

1.5.13 **Protective Pipe Barrier** – Will often be a retaining wall or other formation that provides protection for all pipe serving fire truck connections, provides an area for identification signs to be mounted, provides for mounting of electronic equipment monitoring where required, provides protection from pedestrians / vehicles / bicyclists / skate boarders / climbing children or other potential hazards to piping or those that could be hurt by the exposed or protruding components. The pipe barrier must be clearly detailed in plan review and is subject to acceptance of the fire authority.

1.5.14 **Accepted Parking Area** – Refers to an accepted area where fire trucks would park to engage in a structural or other fire operation, 40'-60' from structure. This will often be the parking area in front of a house, business, or other structure. This must be a clear area with an accepted compacted surface to support the weight of a fire truck under all-weather conditions and allows for operations around the fire truck. This parking area must provide for clear hose and walking path to all points / sides of the structure that does not exceed 300' from the apparatus parking area (unless accepted otherwise). This parking area must have acceptable fire lane access from an established roadway and provisions for turning around of a fire truck. Unless otherwise accepted, the parking area of a truck shall not exceed 60' to at least one part of the primary structure. {See App. E}

1.5.15 **Fire Lane** – Refers to an accepted drive from an established roadway to an acceptable parking area. This fire lane must satisfy compaction, width, turning radius, grade (slope), height clearance, dead-end / turnaround, and other criteria that will provide fire truck access.

1.5.16 **Defensible Space** – An area either natural or man-made, where material capable of allowing a fire to spread unchecked has been treated, cleared or modified to slow the rate and intensity of an advancing wildfire and to create an area for fire suppression operations to occur. *[CWRC]*

1.5.17 **Mitigation** – Refers to the proactive measures taken to minimize the destruction caused by wildfires. Mitigation prepares for the possibility of a fire occurring. This includes hardening structures with non-combustible roofs, walls, decks, fences within 8' of structures, etc. Fine screens on all vents to keep embers out of attics. Flame arrestor screens on wood-burning fireplaces. Maintaining a minimum 30' defensible space around structures. Clearing over-growth trees and plants so that fires stay along the ground, trimming lower tree branches to limit fire spread up into the tree crowns. Properties in compliance with Low Intensity criteria of the Colorado Wildfire Resiliency Code will generally satisfy this intent. See Appendix C and CWRC for additional information. Also see Fire Intensity Classifications in this section. Wooded areas increasing a fires intensity shall require additional fire water for firefighting operations to limit spread to structures.

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1.5.18 **Low Fire Intensity Classification** - Low Fire Intensity Classification is identified in areas with light to medium surface fuels, such as grasses, shrubs, and scattered low-density vegetation. These fuels are often discontinuous, which limits flame propagation but can sustain burning under moderate weather conditions. Fires in this class may occur on gentle to moderate slopes, where topography begins to influence the rate of spread. Low Intensity allows for tree crowns that are maintained at least 10' away from the house, minimum of 10' crown (drip line) spacing between trees, with no more than 10 trees per acre The AHJ shall identify the classification. See CWRC. *[Third-party reports may be used by the AHJ.]*

1.5.19 **Moderate Fire Intensity Classification** - Moderate Fire Intensity Classification is identified in areas with moderate to heavy fuel loads, such as dense shrubs, small trees, and accumulated ground fuels. Fires in this class present continuous horizontal and vertical fuel arrangements, allowing flames to reach up to 8’ in length. Fire behavior is notably influenced by moderate to steep slopes, often accelerating the spread. The AHJ shall identify / accept the classification. See CWRC. *[Third-party reports may be used by the AHJ.]*

1.5.20 **High Fire Intensity Classification** - High Fire Intensity Classification is identified in areas with heavy, continuous fuel loads, such as dense forest canopies, thick understory growth, and heavy dead/downed material. Fires in this class frequently occur on steep slopes, often exceeding 40 percent, where topography dramatically increases the rate of spread and severity. Flame lengths can exceed 30’, and both short- and medium-range spotting are common, particularly in windy conditions. Direct suppression by ground crews is typically ineffective. The AHJ shall identify the classification. See CWRC. *[Third-party reports may be used by the AHJ.]*

1.5.21 **Encumbrances** – An encumbrance is a legal restriction that can be applied to a property deed outlining the conditions of water supply requirements, credits applied, required maintenance, and conditions for failure to maintain. *[Such conditions for failure to maintain could include rights for the jurisdiction to access the property and provide services by a contractor in order to achieve compliance with and then having the charges assessed in a lien against the property.]*

1.5.22 **Subdivision –** Per this document, a subdivision consists of the division of a lot, tract, or parcel of land into two or more lots, plats, sites, or other divisions of land for the purpose, whether immediate or future, of sale or building development. *[In general, as used and intended in this regulation, a Subdivision would typically apply when land is purchased with the specific intent of subdividing for development. Subdivisions will generally be protected in accordance with Section 6 or 7. Parcel splits may be treated as subdivisions as determined by the fire authority.]*

1.5.23 **Parcel Split** – Per this document a parcel split is when a property owner or family trust has held property for a considerable period of time and is now intending to divide the property out of necessity, such as due to property taxes. Depending on the size of the split, the property may fall under the criteria of Section 5 for individual properties, Section 5.6 for Partial Split provisions, or Sections 6 / 7 for Subdivisions. The fire authority is authorized to establish the appropriate conditions while ensuring adequate fire water is provided and consistent with other properties and hazards.

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1.6 COMMON VALUES

1.6.1 The following is a summary of common dimensions and values utilized within this document. Users are responsible for verifying applicability and exceptions to each condition were referenced within the document. Verify all criteria in Appendix E for any local jurisdiction deviations.

1.6.2 Water connection to an accepted parking area for attack fire truck: 900' {See App. E}

1.6.3 Spacing between hydrants: Maximum of 900' {See App. E}

1.6.4 Distance from an accepted parking area to any part of the primary structure: 40'-60' {See App. E}

1.6.5 Hose lay from truck to furthest part of a structure by an accessible walking route: 300', unless accepted otherwise. {See App. E}

1.6.6 Fire Lane: [See Section 14]

1.6.6.1 Driveway compacted width of 20' including turning radius to support fire truck. Pavement / asphalt / gravel designated driveway shall be a minimum 14' wide. Turns on driveways will need to be wider depending on radius to accommodate a 40' truck. {See App. E}

1.6.6.2 20' Compacted clear working area along driveway and at parking area or adjacent to any other structure or fire hazard for operations. *[This compacted area must still support the fire truck weight under all conditions and cannot have a drop-off, cut could be compacted gravel, etc. and not asphalt s long as it supports the weight.]* {See App. E}

1.6.6.3 Dead end roads shall not exceed 150' unless accepted turnarounds are provided.

1.6.6.4 Weight Load: Unless accepted or directed otherwise, all fire lanes and accepted parking areas shall support a minimum of 50,000 lbs. This includes driveways and roads with turns and drop-offs in all weather conditions. Roads that are expected to have heavier equipment (tenders, ladders, etc.) shall be designed for the intended loads. {See App. E} *[3,000 gal Tanker GVW ~52,000 lbs; 4,000 gal ~ GVW ~72,000 lbs.]*

1.6.6.5 Clear Height of trees, etc.: 13'-6" over entire compacted width.

1.7 ACCESS AND LOCKS

1.7.1 All fire protection equipment covered under this document shall be readily accessible to the fire authority and other responding agencies. Also see IFC Section 104.

1.7.2 Unless otherwise accepted by the AHJ, any locks used to secure or protect equipment shall be of the following type: {See App. E}

1.7.2.1 Keyed breakaway style. *[These locks prevent general tampering but are designed to be broken with a hammer or wrench in an emergency.]*

1.7.2.2 The shackle shall not be covered in a way to prevent fire personnel from readily breaking the shackle. This does not preclude protection from snow/ice as long as the lock can be readily accessed to breakaway the shackle if necessary.

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1.7.3 Where required by the fire authority, a key box shall be provided. This box shall maintain a key to the fire protection equipment at all times. *[Such boxes are similar to a realtor box, or often of a Knox brand as determined by the fire authority. The fire authority maintains the key to this box which allows them to gain access for inspections and testing of the equipment. Those performing inspection, testing, & maintenance must also have access to systems.]*

1.7.3.1 The key box shall be provided by the owner based on specific criteria of the fire authority for brand and key code.

1.7.3.2 The key box shall be mounted and located as determined by the fire authority.

1.7.3.3 The property owner or assigned representative shall be responsible to ensure the lock is regularly lubricated and operated to avoid rust or corrosion. *[Coordinate with fire authority to open box.]*

1.7.3.4 Any fire protection equipment such as cisterns or hydrants that are behind locked gates are subject to acceptance of the AHJ and shall be provided with means for quick fire authority access through the gate.

1.7.4 Directional signage shall be provided to clearly identify fire equipment that is hidden or not readily visible to responding fire personnel.

1.8 MAINTENANCE

1.8.1 Where any device, equipment, system, condition, arrangement, level of protection, or any other feature is required for compliance with the provisions of this document or other referenced documents or otherwise installed shall thereafter be continuously maintained in accordance with this code, applicable referenced standards, and manufacturer recommendations. Also see IFC 109.

1.8.2 All equipment shall be inspected, tested, and maintained to ensure it is readily accessible, available, and functioning as designed and intended at all times of the year.

1.8.3 In addition to codes, standards, and manufacturers' recommendations, Section 15 of this document summarizes common maintenance requirements or acceptable deviations.

1.8.4 The fire authority is authorized to ensure compliance with the requirements of this document in accordance with the International Fire Code (IFC), including Section 104 Duties and Powers of the Fire Code Official.

2 PERMITS, SUBMITTALS, INSPECTION, COMMISSIONING

2.1 PERMITS

2.1.1 Fire protection for subdivisions, commercial properties, or when otherwise determined by the AHJ shall be prepared and sealed by a fire protection engineer registered in the state of the project.

2.1.1.1 Individual single-home water supplies may not require design documents sealed by a registered engineer as long as all necessary information, design, and details are provided in a format acceptable by the AHJ. Consult with the AHJ prior to design.

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2.1.2 Unless exempted by the AHJ, a construction permit is required prior to the installation of a cistern or other water source that is required to satisfy the requirements of this regulation.

2.1.3 Permit fees as established by the local AHJ shall be paid at the time of design submittals.

2.1.4 Permits shall be utilized to document the location of a water source, provide for plan review services to ensure compliance with regulations, inspections during and after installation, and ensuring final commission testing.

2.1.5 The AHJ is authorized to require a use permit to facilitate annual inspections and tracking of fire protection water sources. *[Jurisdictions will typically establish if they will provide annual inspections, require a third-party, or allow both options. All inspections should be at the expense of the owner to provide inspection and service of systems associated with fire protection water sources. Such inspections are to ensure that the systems are maintained, full of water, and ready for emergency use.]*

2.1.6 As part of evaluating compliance with this regulation, the AHJ may utilize the services of third party acting as an agent / officer to the AHJ to perform plan reviews, inspections, or other technical support. The AHJ is authorized to require the cost of such services to be paid by the owner or owner's authorized agent. The AHJ may establish the payments to be made to the jurisdiction or directly to the third party.

2.1.7 Plan reviews, permits, and inspections shall be as established by the AHJ, and in accordance with IFC Section 105, 106, 107, 108 and 109 when adopted. See Appendix D for general design checklists to be used with submittals. Systems specifically covered by this regulation may be identified below or in Appendix E.

2.2 DESIGN SUBMITTALS

2.2.1 All design concepts must be submitted and accepted by the fire authority.

2.2.2 Complete submittals with drawings, calculations, product data, dimensions, elevation views, etc. are to be submitted and accepted prior to the start of any work.

2.2.3 Materials and equipment should not be ordered until all acceptance is granted. Materials ordered prior to acceptance are at risk of the owner, and the fire authority shall not be liable.

2.2.4 Incomplete submittals may be returned without review and subject to additional fees.

2.3 INSPECTIONS

2.3.1 All systems will require inspections during the installation and following installation.

2.3.2 Tanks shall be inspected and tested in accordance with NFPA 22, or this document for items that are more restrictive.

2.3.3 Private fire mains shall be inspected and tested in accordance with NFPA 24 and 25, latest editions unless otherwise identified in this document.

2.3.4 At minimum, the following inspections are required.

2.3.4.1 Prior to installation when the hole is dug.

2.3.4.2 Placement of the tank/pipe.

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2.3.4.3 After any anchoring is attached and prior to fill.

2.3.4.4 Following installation, the tank(s) shall be filled to full (within 3" top of tank at manway) and tested for the following. Disable any automatic tank fill functions. If the tank has an isolation valve (provided on gravity feed systems) the valve shall be closed. Photo documentation of tank level using a measuring stick (wood/pipe) through tank manway.

2.3.4.4.1 With the tank isolated, check and document the water level 14-20 days following filling in paragraph above. If there is any drop in tank level, inspection and repairs shall be provided. *[This exceeds the 2-hr testing of NFPA 22 to ensure there is no tank leakage.]*

2.3.4.4.2 Once the tank has passed the leak test above, and upon underground fire main gravity piping being fully installed and pressure tested, open the gravity feed isolation valve. Refill the tank as necessary to full and document level with photos. Inspect and document the tank level at 2-hrs and again at 7 days for any change in water level. Any identified drop in tank level will need to be reported to the fire authority and inspected / repaired. *[Trapped air may need to escape. The 2-hr test is to verify critical leakage and/or trapped air being released. Refill tank level if it drops in the 2-hr test and start test over.]*

2.3.4.5 Private fire mains shall be hydrostatically tested for leaks at a minimum of 200 psi for 2-hrs and other criteria of NFPA 24. Ensure that pipe is protected from freezing during pressure testing and not fully buried.

2.3.5 The owner / installer is responsible for obtaining pictures during the installation. These shall include but are not limited to the following:

2.3.5.1 Holes for cisterns and trenches which includes measuring devices showing the depth.

2.3.5.2 All sides of each cistern showing that there is no damage prior to installation.

2.3.5.3 Pipe, fittings, valves, hydrants, etc. to be installed in the ground and prior to bury.

2.3.5.3.1 If pressure testing of pipe is required, fittings are generally required to be exposed to observe leakage prior to covering. See NFPA 24 for specific pipe requirements.

2.3.5.4 Pipe restraints / thrust blocks in accordance with NFPA 24.

2.3.5.5 Backfill material(s) used per engineer / manufacturer.

2.3.5.6 Tank anchoring as required by design.

2.3.5.7 Any piping, fittings, attachments that will be buried.

2.3.5.8 Pipes and fittings inside of the tank(s) to show that all equipment is installed and secured as designed, and that the tank is clean of dirt and debris.

2.3.5.9 Tank fill leak test and gravity piping leak tests identified in Section 2.3.4.4.

2.3.6 The owner shall submit installation photographs to the AHJ to be maintained as part of the installation records.

2.3.7 The owner shall maintain copies of all installation documents and photographs for transfer to future owners.

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2.3.8 The AHJ shall be notified at least 10 days prior to any necessary inspections. *[Often inspections can be performed with less notification. However, due to shift schedules of inspectors' appropriate time to coordinate may be required.]*

2.4 COMMISSIONING

2.4.1 All systems will require commission testing to verify that proper access, threads, valves, drains, etc. are provided.

2.4.2 Systems that require specific flow rates and pressures will require performance testing and verification.

2.4.3 Unless agreed to and coordinated in advance, the owner / contractor is responsible for providing all necessary and calibrated equipment to conduct such tests.

3 PROPERTIES HAVING A MUNICIPAL WATER SUPPLY AVAILABLE

3.1 GENERAL

3.1.1 Individual properties, new subdivisions, or commercial properties that are within or immediately adjacent to a municipal water system shall satisfy the criteria of Section 3 unless otherwise accepted. This requires that if a municipal water supply is readily available / feasible and can support the needs of the property then it shall be utilized for fire protection water. Such service shall comply with applicable sections of this document. *[Where a municipal water supply is available adjacent to where new structures are to be constructed, and the water company can and would support the new structure or hazard, then this option needs to be pursued. The option to utilize a cistern or drafting water source should be a last resort option. Turnover of water for bacteria and safety must be evaluated.]*

3.1.2 For single and duplex residential structures, a municipal water supply per this section shall be capable of delivering a minimum of 1,000 gpm at a minimum hydrant pressure of 20 psi for individual residential properties. *[See later for quantity requirements. The AHJ should evaluate and consider if the municipal system can support new development vs the benefit, cost, and maintenance challenges of alternative water sources now and into the future.]* {See App. E}

3.1.3 Water supply flow demands for commercial businesses shall satisfy the requirements as identified in Section 9.

3.1.4 Minimum water supply calculations shall be performed in accordance with Sections 5, 6, 7, and 9 to establish the minimum quantity (gallons) of water that is required to be provided by the municipal water supply. These calculations take into account structure size, acreage, number of lots, sprinkler credits, mitigation hazards, etc.

3.1.5 The AHJ shall be permitted to reduce or increase the minimum delivery requirements above as determined by the particular site, resources, hazards, or other factors.

3.1.6 Minimum flows, pressures, and duration for commercial buildings or higher hazards shall be as identified in Section 9 or otherwise determined by the AHJ.

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3.1.7 Residential fire hydrants are to be spaced and located such that the distance that a fire truck must travel to reach the parking area that would be used to engage in a structural fire (house, barn, commercial business, other structure) does not exceed a hose distance of 900'. Due to limited hose lengths carried on trucks, a fire authority may reduce this distance. *[The 900' distance is clarified from criteria of 1,000' to a "structure" by other codes / standards. This document requires 900' to an accepted parking area vs. the measurement to the structure. This is provided for clarity of intent of the actual truck path with loops to accommodate connection to the water source and at the truck, and where the truck will park vs a potential unrealistic path through landscaping to a structure. Flows and friction loss requirements may reduce this distance based on hazard.]* {See App. E}

3.1.8 Fire hydrant spacing along a residential roadway shall not exceed 900'.

3.1.9 Fire hydrant spacing for commercial structures shall be spaced in accordance with the adopted IFC with fire hose and fire lane access in accordance with the adopted IFC.

3.1.10 All fire hydrants shall be clear of landscaping and to be readily visible and accessible with a minimum of 48" clear space from all sides of the hydrant.

3.1.11 Fire hydrants shall be color coded as required by the AHJ to distinguish a municipal hydrant from a non-potable drafting hydrant.

3.1.12 Fire hydrants shall be provided with reflective snow markers and colored pressure / flow indicating rings in accordance with general criteria of Section 12.3, and coordinated with the municipal water provider.

3.1.13 Driveways to reach a house, structure, or business must have an accepted fire lane in accordance with Section 14.

3.1.14 The property owner / developer shall submit necessary documentation and obtain a Municipal Fire Water Evaluation by the local water utility company(s). Unless otherwise provided by jurisdiction or water supplier, use Municipal Fire Water Evaluation form in Appendix D. Following review by water utility, the completed form shall be provided to the fire authority as part of evaluating acceptable water sources.

3.1.15 If the criteria of this section cannot be achieved with the available water system, then the requirements for protection without municipal water supply of Section 4 shall apply and be followed.

3.1.16 Municipal systems shall be installed in accordance with nationally recognized standards including those of the American Water Works Association (AWWA) and state codes.

3.1.17 Private water systems that will be used for both domestic drinking water and fire fighting shall comply with AWWA criteria and NFPA 24. Pipe material and all components shall be suitable for domestic drinking water usage.

3.1.18 It shall be ensured that an adequate continuous water flow, or turnover, must be achieved within a potable water distribution system to ensure healthy and safe water is provided. *[Low domestic usage on water mains can create water quality issues.]*

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4 PROPERTIES WITHOUT MUNICIPAL WATER SUPPLY

4.1 GENERAL

4.1.1 Where a municipal water supply is not feasibly available, or it has been accepted by the AHJ to not utilize a municipal water supply, then all provisions of this regulation associated with alternative sources of reliable and acceptable water shall be utilized as applicable.

4.1.2 The fire authority may require documentation from a municipal water company to validate that it is not feasible to tie into their system. Any cost to produce such documentation shall be at the expense of the developer / owner. See Appendix D for Municipal Fire Water Evaluation form.

4.1.3 Unless otherwise accepted by the AHJ, new subdivision developments are intended to be provided with fire hydrants to satisfy the requirements for creditable hydrant protection under the insurance criteria utilized by Verisk Underwriting Solutions / ISO.

4.1.4 Individual properties shall be provided with water supplies in accordance with Section 5.

4.1.5 For the purpose of this regulation, where a property will be subdivided into multiple smaller properties, the fire authority shall establish the differentiation between Individual Properties (Section 5), Parcel Split Provisions (5.6) or Subdivisions Sections 6 & 7). *[Such classification may include consideration of number of lots, infrastructure provided for the properties (such as roads, utilities) restrictions/deeds, common areas, and other such factors. Example: An individual owner who owns the land or as part of a trust is dividing their property into five partials would likely fall within the intent of Section 5.6 for Partial Split provisions. A developer who is purchasing or has purchased a property with the intent to sub-divide would be considered a subdivision. The objectives of this regulation are to ensure adequate water supplies are provided for each property or group of properties. Properties that will incorporate common areas and/or homeowner associations will typically fall within a subdivision as the level of protection is intended for all parties of that association or subdivision.]*

4.1.6 The fire authority shall be permitted to require a water evaluation to establish an applicable Public Protection Classification (PPC). *[This evaluation is to ensure that all new subdivisions can achieve water supply criteria acceptable for a rating as determined by the fire authority based on long-term water supply goals.]*

4.1.6.1 Where a jurisdiction has identified a written goal for PPC ratings, that goal shall be used as the target for all new developments.

4.1.6.2 Under no circumstances shall the water supply result in a level lower than the jurisdiction's current applicable rating, or 8b if a previous evaluation has not been performed or otherwise identified in long-term planning goals.

4.1.6.3 Such studies will require a formal request through Verisk Underwriting Solutions / ISO by the fire authority.

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4.1.6.4 The developer shall be responsible to assist Verisk Underwriting Solutions and / or the fire authority with engineering support, drawings, and other information to evaluate roadways and routes of travel, water source locations, quantity of water, flows, distances, traffic studies, maintenance provisions, inspection responsibility, etc. to validate the proposed water source(s).

4.1.6.5 Unless otherwise agreed to by the fire authority, any and all fees for such studies shall be at the expense of the developer requesting a reduction or alternative level of protection than otherwise identified by Section 6, 7, or Section 5 if applicable for alternative water sources.

4.1.6.6 Terms and fees shall be identified and agreed to in writing prior to the start of the study. *[This evaluation shall be used as a basis in establishing if Section 6 criteria is required or Section 7 criteria will be accepted. It may also be utilized for other alternative approaches requested by a developer to ensure community goals are not impacted. Payment for such studies may be required in advance of such study being performed and independent of the study results.]*

4.2 SHARING OF WATER SOURCES

4.2.1 Where water sources will be shared between properties such as the following conditions, such agreements shall be documented per this section.

4.2.1.1 Sharing of cisterns by individual properties per Section 5.

4.2.1.2 Sharing of a water source between subdivisions per Section 7.

4.2.1.3 Dependance on a separate private or public municipal water source in which the property owners to be protected are not a paying domestic usage customer, otherwise entitled to the hydrants and water of the water source.

4.2.2 Any cistern or rural water source used to satisfy fire protection requirements must have a written agreement, easement, encumbrance, or other legally acceptable document that allows the fire authority and responding mutual-aid agencies to use the water source for emergency operations.

4.2.3 The agreement at a minimum shall identify:

4.2.3.1 The owner or responsible party to be protected by the water source.

4.2.3.2 The owner or responsible party providing the water source.

4.2.3.3 The property(s) by address entitled to use of the water source under this agreement.

4.2.3.4 Maintenance responsibilities to ensure the water source is available in accordance with minimum standards.

4.2.3.5 Inspection responsibilities for the water source.

4.2.3.6 Refill responsibility for the water source (if applicable).

4.2.3.7 Snow removal responsibility for fire department identification and accessibility.

4.2.3.8 Access rights for the fire authority and mutual-aid departments.

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4.2.3.9 Financial agreements / obligations if any for such services or execution of the agreement. *[This may be by fixed cost or percentage of annual costs incurred by water supplier.]*

4.2.3.10 Rights of the AHJ if the water source is not maintained. *[This could be to require the property owner to provide their own water source if the alternatively approved source is not being maintained as required.]*

4.2.4 The property owner shall be responsible for ensuring that a reliable water source is available and for enforcement of such agreements.

4.2.5 The AHJ shall be authorized to require the property owner to provide a reliable water source in accordance with this regulation when it has been determined that the alternative source is not being maintained or can no longer satisfy the required flow or quantity per this regulation.

4.2.5.1 Failure to ensure a reliable water source is maintained shall be grounds for revocation of a certificate of occupancy and order to vacate if a reliable water source cannot be provided.

4.2.5.2 The owner shall notify the fire department immediately upon identification that a water supply capable of the property demands can no longer be provided.

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5 INDIVIDUAL RESIDENTIAL PROPERTY REQUIREMENTS

5.1 GENERAL

5.1.1 An individual residential property that does not satisfy criteria for a municipal water supply shall have a cistern(s) or other accepted water source in accordance with Section 5. Parcel split provisions are provided in Section 5.6 where an individual property owner wishes to subdivide a property.

5.1.2 Connections to a reliable and accepted water source are to be located such that the distance that a fire truck must travel to reach the parking area that would be used to engage in a structural fire (house, barn, other structure) does not exceed a hose distance of 900'. A fire authority has the authority to reduce this distance based on their allowable hose lays. {See App. E} *[This distance is clarified from criteria of 1,000' to a "structure" by other codes / standards. This document requires 900' to an accepted parking area vs. the measurement to the structure. This is provided for clarity of intent of the actual truck path with loops to accommodate connection to the water source and at the truck, and where the truck will park vs a potential unrealistic path through landscaping to a structure. Jurisdictions that do not carry 900' of large diameter hose on their trucks will likely have a reduced allowable distance as identified in Appendix E.]*

5.1.3 Where a water source cannot be located within the criteria of 5.1.2, a Dedicated Private Fire Main served by a drafting cistern in accordance with Section 12 shall be provided. *[This approach supports sharing of water sources while extending hydrants to protect larger lots.]*

5.1.4 Water sources with the required levels of protection per Section 5.7 may be considered and accepted by the fire authority.

5.1.5 The distance from the accepted parking area to any part of the primary structure shall be between 40' - 60'. *[This is to keep the truck from being too close /far from hazard.]*

5.1.6 Unless otherwise established, under no circumstances shall the distance from a fire hydrant or water source exceed 1,000' to the primary structure / residence. *[Distances that exceed 1,000' violate ISO criteria for a creditable water source / hydrant and will require haul / shuttle evaluations taking into account multiple factors for PPC ratings.]*

5.1.7 Unless otherwise identified in submittal, for planning and design review purposes, an accepted parking area shall be assumed to be located 2/3rd to the back of the property from the street frontage for the purpose of measuring distances to a water connection / hydrant.

5.1.8 Installations shall comply with Sections 10 - 15, and other criteria referenced.

5.1.9 Sharing Water Sources Between Properties is encouraged and may be per the following criteria.

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5.1.9.1 Unless otherwise accepted by the AHJ, up to four residential properties may share a common water source under this section and the provisions indicated. *[Sharing water sources (cisterns) to reduce the number of cisterns while increasing the quantity of water within an individual cistern is encouraged. This approach reduces installation and maintenance costs for the owners while reducing the overall number of devices to track by the fire service. The reason this is limited to 4 properties is so that the AHJ can ensure that all properties are calculated, only the worst case 4 properties are used to establish reductions, and that the travel distance from source to each acceptable parking area has been addressed and accounted for. Upon these conditions being satisfied, additional properties could share a water source.]*

5.1.9.2 An easement shall be established to record the water source associated with the respective properties.

5.1.9.3 Each property shall have an encumbrance attached to the property deed. This document shall outline responsibility for maintenance of the water source and rights of the AHJ upon failure to maintain. See Section 1 for additional information.

5.1.9.4 See Section 4.2 for additional information as applicable related to sharing water supplies.

5.2 WATER SUPPLY RELIABILITY

5.2.1 An acceptable water supply must satisfy the minimum conditions of this Section.

5.2.2 Available 365 days out of the year and is not subject to freezing.

5.2.3 Contains the quantity of water as established by this document.

5.2.4 Will be accessible at all times of the year for fire truck access at 8’ of the point of connection of a fire truck suction inlet without blocking other vehicle traffic or emergency vehicles. This includes an accepted fire lane as defined in Section 1.

5.2.5 Access to a water supply must account for fire truck access, weight, width, positioning, parking, and exiting (turning around), as accepted by the fire authority.

5.3 WATER SUPPLY SOURCE

5.3.1 Cisterns shall be in accordance with Section 10.

5.3.2 Other sources of water are subject to review and acceptance of the fire authority and comply with Section 11 for dry hydrants.

5.3.3 Unless waived by the AHJ, area lighting shall be provided to illuminate the cistern tank parking and connection area with a minimum of 50 lux average along the truck side of the protective pipe barrier. Lighting shall not be directed at or illuminate adjacent properties or be a nuisance to other properties. Solar lighting may be accepted subject to the AHJ and accounting for reliability and established maintenance schedules. *[Subject to the AHJ, lighting options may include street lights or lighting incorporated into the protective pipe barrier to effectively illuminate the area between the protective pipe barrier and the fire truck.]*

5.3.4 Unless determined by the AHJ to be of benefit based on location, fuel loads, hazards, road conditions, or other factors, cisterns provided for individual residential protection will not incorporate drafting eductors within the cistern tank. *[See 10.2 for additional information on drafting eductors.]*

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5.3.5 Any and all conditions of acceptance shall be summarized on the review documents and maintained by the owner. This includes but is not limited to maintaining documentation, maintaining fire lanes, maintaining brush growth, maintaining water quantity, and condition / quality for fire authority use.

5.4 WATER QUANTITY

5.4.1 The quantity of water required for individual one and two-family dwellings shall be based on this section. *[The calculations in this section were established using the criteria in NFPA 1142, Ch4. In accordance with 4.1.3, other factors were also incorporated in addition to simplifying the calculation approach. Many quantities shown have been adjusted to coincide with common tank sizes.]*

5.4.2 Table 5.4 shall be used as the basis for calculating water supply requirements of Section 5 or as otherwise referenced in this document. *[Calculation forms and example calculations are provided in Appendix D for guidance in establishing the various credits and conditions intended. See Drawing Detail #8 for guidance in calculating areas.]*

5.4.3 The area in square feet used to establish the structure water supply requirements shall be the areas defined in Section 1.5 for "Area" and "Accessory Structure / Exposure".

5.4.4 Credits to Table 5.4 are identified based on various enhancements with required maintenance and legal documents attaching encumbrances (conditions of credits and conditions for failure to maintain) to the property deed.

5.4.5 This section is limited to residential use, associated sheds, shops, barns, hobby/crafts, and similar structures for personal use. Structures primarily used for business purposes such as vehicle repair, contractor material storage, industrial fabrication, etc. are to be protected with direction from the AHJ incorporating criteria of commercial provisions, increased water supply, and/or the International Fire Code.

5.4.6 The calculation methods used in this section allow for associated residential structures (exposures) to be located within 50' of the primary residence as long as the square footage calculations used account for the size of these structures. *[NFPA 1142, 4.3]*

5.4.6.1 Structures within the 50' spacing and not accounted for in the initial design will require new calculations to validate if the increased area will require an increase to the water quantity provided. *[See CWRC for other limitations.]*

5.4.6.2 Structures beyond the 50' spacing of primary residence would not require additional water as long as structures outside of the 50' spacing do not result in a larger combined area / hazard than was originally permitted and accepted, or the hazard changes.

5.4.7 Where possible, cisterns should be located at the highest elevation point practical and accessible.

5.4.8 Where elevation pressures will allow a positive pressure > 10 psi to be provided at hydrants from a water source, any private fire main shall be piped to have a positive gravity feed from the water source in accordance with criteria in Sections 10 and 12.

5.4.9 Head pressure loss / gain shall be calculated and accounted for in the design and layout of water source locations, fire main routing, hydrant locations, and accepted parking areas for fire apparatus.

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5.4.10 Friction loss and flows within the private fire main and fire hose shall be accounted for.

5.4.11 Additional water supply locations shall be provided as required to overcome friction loss and elevation pressures in accordance with Section 12.

5.4.12 Where separate properties share a single water source, or two residential buildings are on one property, the following criteria may be applied: *[Up to two Individual residential buildings on one property and separated by 50' may be treated as one with the worst-case condition establishing water quantity. Three or more are to be treated as separate properties for this section. Such as for business rental cabins,]*

5.4.12.1 The sum of the values for Structure Low Intensity column of Table 5.4 for two properties may be multiplied by a shared credit of 0.75 to establish the adjusted requirement. See minimum limitations in 5.4.13.

5.4.12.2 The sum of the values for Structure Low Intensity column of Table 5.4 for three properties may be multiplied by a shared credit of 0.65 to establish the adjusted requirement. See minimum limitations in 5.4.13.

5.4.12.3 The sum of the values for Structure Low Intensity column of Table 5.4 for four properties may be multiplied by a shared credit of 0.60 to establish the adjusted requirement. See minimum limitations in 5.4.13.

5.4.12.4 If the AHJ allows more than four properties to share a water source, the shared credit is limited to that of 5.4.12.3 for the four largest Combined Structure areas.

5.4.13 The required minimum volume of water established in 5.4.12 shall be the larger of the adjusted requirement for multiple buildings or the largest single property Structure volume (with sprinkler credit) multiplied by 1.25. *[Does not apply to a single structure.]*

[Examples: (35,000 gallons + 10,000 +10,000 + 10,000) x 0.60 = 39,000 gallons. However, per this requirement, the larger house must be evaluated against the 1.25 factor. The minimum required volume for these four structures would be 35,000 x 1.25 = 43,750 gallons.

If this larger house was sprinklered per 5.4.16, the calculation for this house could be 35,000 gallons x 0.5 (sprinklers) = 17,500 gallons {credit could be impacted by ratio of sprinklered area}. Applying the rule of 5.4.13 by multiplying 17,500 x 1.25 = 21,875 gallons.

If each house was sprinklered, the values for all at 50% would be (17,500 + 5,000 + 5,000 + 5,000) x 0.60 = 19,500 gallons which would then be less than the larger 1.25 factor of 21,875 gallons from 5.4.13 for the largest house.]

See next page for Table 5.4

See Appendix D for calculation worksheets and sample calculations related to this Section.

See Drawing Detail #8 in Appendix D for guidance on calculating square footage and common mitigation practices to achieve Low Intensity credits. Appendix C has additional resources for mitigation and defensible properties.

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TABLE 5.4

WATER QUANTITY REQUIRED FOR FIRE PROTECTION OF ONE- & TWO-FAMILY DWELLINGS [6]

	Minimum Gallons Required [1]				
	Structure (Low Intensity Acreage) [2]	Wooded Acreage Moderate - High Intensity Acreage [3] (See Footnotes for Low Intensity Acreage [4])			
Largest Area of Combined Structures not having 50' Separation [5] (ft2)	0 – 2.5 ac	0 - 1.1 ac	1.2 - 2.5 ac	2.6 - 10 ac	>10 Acres
0 - 1,500	10,000	10,000	20,000	30,000	45,000
1,501 – 3,100	10,000	15,000	25,000	35,000	50,000
3,101 -4,800	15,000	20,000	30,000	40,000	55,000
4,801 - 6,400	20,000	25,000	35,000	45,000	60,000
6,401 - 8,000	25,000	30,000	40,000	50,000	65,000
8,001 - 9,500	30,000	35,000	45,000	55,000	70,000
9,501 - 11,300	35,000	40,000	50,000	60,000	75,000
11,301 - 13,000	40,000	45,000	55,000	65,000	80,000
13,001 - 16,000	50,000	55,000	65,000	75,000	90,000
16,001 - 20,000	60,000	65,000	75,000	85,000	100,000
> 20,000	AHJ	AHJ	AHJ	AHJ	AHJ

[1] Gallons shown are rounded to match common nominal tank or combination of tank sizes. See Section 10.4.6 for limitations. *[A 20,000-gallon tank capacity will not have 20,000 gallons available for drafting.]*

[2] Low Intensity allows for tree crowns that are maintained at least 10' away from the house, minimum of 10' crown (drip line) spacing between trees, with no more than 10 trees per acre. Also see CWRC for guidance.

[3] This quantity is to be added to the Structure quantity of water. Moderate - High Intensity Acreage implies thick underbrush, tall grass, or "doghair strand of trees" creating a dense overcrowded thicket of fuels where fire can rapidly spread and get into the tree crowns. Also see definitions in Section 1.5 and CWRC.

[4] Where the wooded acreage is mitigated in accordance with recognized criteria and acceptable to the AHJ to limit the hazard in footnote #3, the volume of water may be reduced two columns to the left but shall not be reduced less than that required for Structure with Low Intensity Acreage, with sprinkler credit if applicable. To apply this credit, a legal document tied to the property must be recorded with the county/city. This document shall outline that the mitigation shall be maintained by the property owner, and the terms for failure to comply. The adoption of the CWRC that remains in effect with maintenance enforcement requirements could be used to satisfy this intent.

[5] The largest area of combined structures accounts for the total square footage under the roofline of the largest building and/or group of buildings (accessory buildings) that do not have a minimum 50' separation. Buildings separated by at least 50' and smaller than the largest group would not be included. *[NFPA 1140, 4.3]*

[6] The values in this table assume that the fire authority(s) intended to provide protection for the property can deliver a minimum of 1,000 gallons of water within an 8-minute response time, deliver a sustained minimum of 250 gpm within 5-minutes of arrival. Additional water tender shuttle service would allow an increase in gpm within 15-minutes which would be maintained for a 2-hour duration *[ISO]*. *[Depending on supply volume and how much the flow is increased, the time to establish tender shuttles may be more than 15-minutes.]* If these conditions cannot be provided under normal conditions, the AHJ shall be permitted to increase the available quantities based on site location, fire growth, and/or require other means of protection.

AHJ = To be determined by the fire authority based on factors including automatic suppression, other water sources, tender relay operations, etc.

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5.4.14 An increased volume for protection of Wooded Acreage > 2.5 acre parcel shall be provided. The difference between each Structure value and Wooded Acreage with credits, if applicable, shall not be reduced. *[See example below. Also see calculation forms and examples in Appendix D.]*

[Example: A 3,900 ft2 house and shed <50' spacing on 5 acres has a table Structure demand of 15,000 gallons and a Low Intensity Wooded Acreage value of 20,000 gallons (footnote 4) {5 acres for 3,900 ft2 would be 40,000 gallons, but is reduced two columns to left for 20,000 gallons being Low-Intensity}. In addition to the Structure water supply, this property requires 20,000 – 15,000 = 5,000 gallons for a Low Intensity wooded acreage fire. Even with sprinkler credits, the original 15,000 gallons is used to establish the Wooded Acreage demand. Each wooded property value would be added to the adjusted Structure volume. A sprinklered 3,900 ft2 house would have an adjusted Structure demand of 7,500 + 5,000 for acreage = 12,500 gallons. Recognizing each property may have different acreage or mitigation conditions.]

5.4.15 Sprinkler credits may be applied only to the respective Structure(s) that will be protected and not to the other structures that will not be protected with sprinklers.

5.4.15.1 Any structures or accumulation of structures without 50' separations shall be evaluated. If the area of these structures without sprinkler credits would result in a water demand higher than the sprinklered building, the higher water quantity shall be provided.

5.4.16 Where residential sprinklers are provided and maintained in accordance with NFPA 13, 13D or 13R, the respective Structure water supply volume identified in Table 5.4 may be reduced by a maximum of 50% using the formula below. Wooded Acreage volumes would still apply. *[Sprinkler credits are permitted in accordance with NFPA 1142, 4.4.1.]*

Res ÷ CS = Ratio

Ratio x 0.5 = SR

SR x SG = Credit

SG – Credit = Adjusted required volume

Res = Residential Structure with sprinklers (house) square footage

CS = Combined Structures area not having 50' separation

SR = The percent Sprinkler Reduction allowed for water volume

SG = Structure gallons required from Table 5.4 for the Largest Area of Combined Structures (residential and non-residential)

See example on next page

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[Example: Combined Structure (house and shed) 6,500 ft2, 2 acres

The Res (house) is 5,500 ft² divided by the CS (combined Structures) of 6,500 ft²= ratio of 0.85. Multiply the Ratio of 0.85 x 0.5 sprinkler credit = 0.42 Adjusted Sprinkler Reduction. Multiply the Sprinkler Reduction 0.42 x Structure Gallons of 25,000 = 10,500 gallon reduction for sprinklers. With the Table Structure Gallons of 25,000 – the sprinkler credit of 10,500 = 14,500 gallons required from the original 25,000 gallons. This adjusted credit accounts for the ratio of sprinklered hazard and the additional non-sprinklered hazard.]

5.4.17 All sprinkler systems will require plan review and inspection by the AHJ or designated representative in accordance with their permitting requirements.

5.4.18 Developers / owners are responsible to verify water supply and system requirements for NFPA 13 D / NFPA 13R including pressures and flow requirements prior to committing to taking credits and sizing water supplies. The AHJ shall not be held responsible for a well or other water source that does not satisfy required pressures and flows of the particular location.

5.4.19 Occupancies with sprinkler systems that are found to have been disabled or have not been maintained in operating condition, shall be subject to immediate revocation of certificate to occupy until such time as the system has been corrected and a re-inspection passed. *[IFC]*

5.4.19.1 Failure to have a system operational and re-tested within 14 days shall be subject to re-evaluation of water supply requirements.

5.4.19.2 Where it is determined that additional water is required, the property owner for the system(s) that were not operational / maintained shall be responsible to provide additional water as identified prior to re-occupancy of the structure(s).

5.4.19.3 The AHJ is authorized to evaluate the conditions for failure to comply and establish additional conditions to ensure proper protection is provided and maintained.

5.5 FIRE FLOW REQUIRED BASED ON QUANTITY OF WATER

5.5.1 Where required elsewhere (such as 12.4.2), calculations shall be based on the flow identified in Table 5.5 in accordance with Section 12.4.2, unless otherwise accepted by the AHJ. *[NFPA 1142, 4.6]*

5.5.2 Piping provided to draft from a cistern / water source and any underground main piping shall be capable of supporting a flow of 1,000 gpm at a velocity <12 fps, unless accepted otherwise by the AHJ. *[Minimum 6" unless otherwise accepted.]*

5.5.3 Quantities required shall account for structure and wooded acreage protection.

5.5.4 Structural water demand may be calculated through a single largest hose used by the fire authority (i.e. 4"). Demand for wooded acreage may be assumed shared through a second smaller hose (i.e. 3"). *[If water is needed for both structure and wooded acreage, it may be calculated as provided through multiple hoses as multiple trucks could be providing this level of protection.]*

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5.5.5 Flow demands of 1,000 gpm or higher may require additional considerations. See Section 10.7 for more information.

5.5.6 The AHJ shall be permitted to adjust the water delivery rate, giving consideration to local conditions and need. *[NFPA 1142, 4.6.2. This may include sprinkler credits.]*

Table 5.5: Water Delivery Rate Based on Quanty Required in Table 5.4	
Gallons Required by Table 5.4	Water Delivery Rate in gpm
<15,000	250
15,001 – 22,500	500
22,501 – 30,000	750
>30,000	1,000

5.6 PARCEL SPLIT PROVISIONS

5.6.1 The provisions of Section 5.6 are intended as a transition between Individual Properties within Section 5 and Subdivisions of Sections 6 and 7. Unless determined otherwise by the fire authority, Parcel Split provisions are limited to the following conditions:

5.6.1.1 The property is being divided by the property owner, representative of the family, or representative of a family trust owning the property.

5.6.1.2 Property being divided into smaller parcels intended for 5-10 properties. *[Parcels divided into four or fewer may be treated as Individual Properties of Section 5.]*

5.6.1.3 An initial area of 49.9 acres or less to be subdivided. *[50 Acres or more fall under the provisions of Section 6 or 7.]*

5.6.1.4 Divided parcels shall not be further subdivided for a period of 25 years from initial subdivision filing date which shall be recorded within deed restrictions.

5.6.1.5 The property may not be sold to another party for subdivision within the 25 years from initial subdivision filing date.

5.6.1.6 Where a parcel is to be further subdivided within the time period specified in 5.6.1.4 or 5.6.1.5, a minimum of 30,000 gallons additional water shall be provided for up to four parcels with connections within 900’ of each acceptable parking area. Five or more parcels shall be provided with water in accordance with Section 6 for Creditable Hydrants in effect at time of splitting.

5.6.2 Water quantity shall be provided in accordance with the larger of the following:

5.6.2.1 Based on the calculations of Section 5.4 for the worst case four properties.

5.6.2.2 A minimum of 30,000 gallons at a single location shall be provided to serve the properties.

5.6.2.3 Mitigation criteria of Table 5.4 shall be accounted for and recorded as agreed to for the basis of the calculations used.

5.6.3 Provisions of 5.7 for Alternative Water Sources shall not apply or be taken with Parcel Split properties of Section 5.6.

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5.6.3.1 A water connection (cistern or hydrant) shall be provided within 900' of the acceptable parking area as otherwise defined.

5.6.4 Unless otherwise determined by the fire authority, and with additional protection features provided to reduce fire risks, the Parcel Split Provisions are intended to at a minimum satisfy ISO criteria for Creditable Hydrant protection. *[The intended level of protection for ISO Creditable Hydrant protection is a nominal 30,000 gallons of water with a point of connection within 1,000' of each structure, and no more than one fire apparatus to provide such pressurized water at the required flow. Water quantities of less than 30,000 gallons or a distance exceeding 1,000' are outside the ISO creditable hydrant guidelines and require water supply haul evaluations, often resulting in limitations on insurance protection, increased risk, and likely higher PPC ratings.]*

5.6.5 Unless excluded, all other provisions of Section 5 and this regulation are applicable. *[In addition to the minimum criteria of Section 5, the Parcel Split provisions are to provide a minimum of 30,000 gallons within 1,000'. This is for properties that exceed the intended minimums of Individual Properties but are not yet into the intended scope of Subdivisions.]*

5.7 ALTERNATIVE WATER SOURCE – INDIVIDUAL PROPERTY

5.7.1 Upon review and acceptance, the fire authority may allow an individual property to increase the distance from the structure to a water source in accordance with all of the following:

5.7.1.1 All residential dwelling units shall be sprinklered in accordance with NFPA 13D, 13R, or 13.

5.7.1.2 Adjacent or connected non-sprinklered structures / exceeding 200 square feet shall be a minimum of 50' from any dwelling unit or of non-combustible or treated construction. Free-standing structures under 200 square feet shall be separated by a minimum of 15'. *[Free-standing structures under 200 ft2 such as shed, chicken coop, play swing, treehouse, etc. shall be at least 15' from primary structure. Outdoor kitchen patio / gazebo would be limited to 200 ft2 unless otherwise protected to limit combustible materials and acceptable to AHJ.]*

5.7.1.3 The sprinkler system shall be inspected and maintained in accordance with the applicable standard(s).

5.7.1.4 Properties shall be mitigated and all structures hardened to satisfy the minimum following requirements. *[Including sheds, barns, shops, etc.]*

5.7.1.4.1 All structures shall have minimum Class A roofs.

5.7.1.4.2 All structures shall have limited or non-combustible exterior walls (metal, brick, stucco, concrete fiber board, etc.).

5.7.1.4.3 All vents shall be screened to prevent embers from entering attic or other combustible spaces on all structures.

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5.7.1.4.4 Garages shall be separated in accordance with minimum 1/2" gypsum board on garage side walls and ceilings; 5/8" Type X gypsum board separating habitable rooms above the garage; Equal protection for attic access doors; Minimum 1/2" gypsum board wrap on structural columns within the garage supporting habitable spaces above; 1-3/8" Self-closing and self-latching solid wood or steel honeycomb-core doors with no windows separating garages from habitable spaces. *[From R302.6 of the 2021 International Residential Code.]*

5.7.1.4.5 Property shall be in accordance with and maintained to the criteria of the Colorado Wildfire Resiliency Code (CWRC) for Low-Intensity mitigation.

5.7.1.4.6 Minimum mitigation criteria of ERFWR Detail 8 mitigation criteria in Appendix D with regards to mulch, decks, fences, trees, bushes, distances, etc. The more restrictive criteria of the CWRC, local AHJ, or criteria of Detail 8 shall be provided to minimize hazards due to limited water supplies and delayed hauled water sources

5.7.1.5 A pressurized water source (such as a hydrant) shall not exceed 2-miles fire apparatus driving path from the structure. The AHJ shall be permitted to reduce this distance based on structure size, terrain, road width, available water from the source, etc. *[Written acceptance / agreement of the water source provider is to be obtained and maintained with property records.]*

5.7.1.6 The pressurized water source shall provide flows and durations as established in Section 5.4 and 5.5. Credits shall not be combined with other sprinkler credits for individual properties. *[Sprinkler credits are already allowing for an extended water source. Available water quantities, flows, and durations of the pressurized water source shall be based on non-sprinklered structure due to the extended haul times and potential for fire growth.]*

5.7.1.7 No more than one single pressurized water source shall be used as the basis of satisfying the minimum flow and duration requirements of Section 5.4 and 5.5. *[Trucks shall not be dependent on going to multiple locations to satisfy the requirements that should otherwise be provided within 1,000' of the property.]*

5.7.1.8 No commercial businesses other than private office space may be operated from the property. *[No construction materials, auto repair, factory, painting, or other increased hazards above residential use are permitted. However, it is recognized that any rental property could involve a higher fire risk than those occupied by the property owner.]*

5.7.1.9 The property shall not be used as a rental property for short-term rentals such as bread-and-breakfast, cabin rental, etc. *[This is not intended to include long-term rental / leasing such as 6-months or longer. Insurance coverage needs to account for rental properties.]*

5.7.2 Property owners are responsible to evaluate the availability of insurance coverage for properties that do not have a reliable water source within 1,000' of the property. *[Properties, especially in wildfire prone areas, may have fewer if any companies willing to provide coverage when adequate water sources are not provided within 1,000'.]*

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6 RESIDENTIAL SUBDIVISION – CREDITABLE HYDRANT PROTECTION

6.1 GENERAL

{Note that Sections 6 and 7 were flipped and renamed in June 2026 from previous versions.}

6.1.1 A residential subdivision that does not satisfy criteria for a municipal water supply as outlined in Section 3 shall have a cistern(s) or other accepted water source in accordance with Section 6, unless otherwise accepted.

6.1.2 The criteria of Section 6 for Creditable Hydrant Protection shall be provided for Subdivisions as defined in Section 1.5.22. *[The feature of Section 6 is to provide hydrants throughout the subdivision that will be pressurized by no more than one fire engine drafting from an established water source (cistern(s)). This one truck will pressurize the private fire main and hydrants to satisfy ISO criteria for Creditable Hydrant system.]*

6.1.3 Connections to a reliable and accepted water source, cistern, or private hydrant, are to be located such that the distance that a fire truck must travel to reach the parking area, as defined in Section 1, does not exceed a hose distance of 900'. The fire authority is authorized to reduce this distance based on their hose lays. {See App. E} *[This distance is clarified from criteria of 1,000' to a "structure" by other codes / standards. This document requires 900' to an accepted parking area vs. the measurement to the structure. This is provided for clarity of intent of the actual truck path with loops to accommodate connection to the water source and at the truck, and where the truck will park vs a potential unrealistic path through landscaping to a structure. This distance may be reduced by jurisdictions that carry less than 1,000' of large diameter hose. See Appendix E for local variations.]*

6.1.4 Where the size and/or quantity of lots does not allow a water source (cistern) connection to be located within the criteria of 6.1.3 for every lot, a Dedicated Private Fire Main in accordance with Section 12 shall be provided. *[This line may include a single hydrant or multiple to satisfy distance requirements to structure.]*

6.1.5 Fire hydrant spacing along roadways shall not exceed the distance of 900' for residential properties or as otherwise established by the fire authority.

6.1.6 For planning and design review purposes, an accepted parking area shall be assumed to be located 2/3rd to the back of the property from the street frontage for the purpose of measuring distances to a water connection / hydrant.

6.1.7 The distance to at least one part of the primary structure shall not exceed 60' from the accepted parking area and shall be a minimum of 40' from the structure.

6.1.8 Under no circumstances shall the distance from a fire hydrant or water source exceed 1,000' to the primary structure / residence. *[ISO requirement for creditable hydrant.]*

6.1.9 Installations shall also comply with Sections 10-15, and other referenced criteria.

6.2 WATER SUPPLY RELIABILITY

6.2.1 An acceptable water supply must satisfy the minimum conditions below.

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6.2.2 Available 365 days out of the year and is not subject to freezing.

6.2.3 Contains the minimum quantity of water as established by this document.

6.2.4 Will be accessible at all times of the year for fire truck access to within 8' of the point of connection of a fire truck suction inlet. This includes an accepted fire lane as defined in Sections 1 & 14. *[Hard suction may be in 8' or 10' segments, so this is a maximum and set distance with necessary work area between truck and fittings.]*

6.2.5 Where a community pond is provided that is intended to have water at least 9 months out of the year, a dry hydrant in accordance with Section 11 shall also be provided. This dry hydrant shall be provided to supplement firefighting needs in addition to the minimum gallons required for primary functions. *[This would include large ponds/lakes, irrigation ponds, etc. that could be utilized to support wildfires within the community.]*

6.2.6 Access to every water supply must account for fire truck access, weight, width, positioning, parking, and exiting (turning around), as accepted by the fire authority and in accordance with criteria in Chapter 1, 10, and 14.

6.3 WATER SUPPLY SOURCE

6.3.1 Cisterns shall be in accordance with Section 10.

6.3.2 Other sources of water are subject to review and acceptance of the fire authority and shall comply with Section 11 for dry hydrants.

6.3.3 Where the required water quantity exceeds 60,000 gallons, provisions for drafting shall include one unrestricted dry hydrant connection and one internal eductor equipped connection to facilitate two separate points and methods of drafting water. See Section 10.2 for eductor criteria. {See App. E} *[60,001 Gallons or more.]*

6.3.4 Where three or more tanks are provided at one location to achieve water quantity requirements, at least one cistern tank shall incorporate an internal drafting eductor in accordance with Section 10.2.

6.3.4.1 The AHJ shall be permitted to establish which and how many multi-tank drafting locations will incorporate internal eductors based on site conditions, apparatus, mutual aid response, or other factors. *[Depending on site conditions, it may be feasible to have one eductor equipped cistern in a subdivision, or multiple for a very large subdivision with multiple access points and more likely to have mutual aid response by departments not capable of drafting. This determination needs to be identified early in the site planning stages.]*

6.3.5 The AHJ shall be allowed to waive the requirement for an internal eductor based on site evaluation, construction and mitigation criteria, or other factors determined by the AHJ.

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6.3.6 Unless waived by the AHJ, area lighting shall be provided to illuminate the cistern tank parking and connection area with a minimum of 50 lux average along the truck side of the protective pipe barrier. Lighting shall not be directed at or illuminate adjacent properties or be a nuisance to other properties. This lighting may be included on the same circuit serving the electronic tank monitoring when in accordance with NFPA 70 / NEC. Solar lighting may be accepted subject to the AHJ and accounting for reliability and established maintenance schedules. *[Subject to the AHJ, lighting options may include street lights or lighting incorporated into the protective pipe barrier to effectively illuminate the area between the protective pipe barrier and the fire truck.]*

6.3.7 Any and all conditions of acceptance shall be summarized on the review documents and maintained by the property owner. This includes but is not limited to maintaining documentation, maintaining fire lanes, maintaining brush growth, maintaining water quantity, and condition / quality for fire authority use.

6.4 WATER QUANTITY

6.4.1 The quantity of water required for individual one and two-family dwellings in a subdivision shall be based on this section. *[The calculations in this section were established using the criteria in NFPA 1142, Ch4 and modeled after other established subdivision criteria which accounts for both structure and wildland acreage risks. Some quantities shown have been adjusted to coincide with common tank sizes.]*

6.4.2 Table 6.4 shall be used as the basis for calculating water supply requirements of Section 6.4 or as otherwise referenced in this document.

6.4.3 Credits to Table 6.4 are identified based on various criteria including structure size and sprinkler credits. Required maintenance and legal documents attaching encumbrances (conditions of credits and conditions for failure to maintain) should be incorporated with county records and/or the property deed.

6.4.4 The area in square feet used to establish the structure water supply requirements shall be the areas defined in Section 1.5 for “Area” and “Accessory Structure / Exposure”.

See next page for Table 6.4

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TABLE 6.4

SUBDIVISION - WATER QUANTITY REQUIRED FOR FIRE PROTECTION [6]

Structures and Accessory Buildings not having 50' Separation [5]	Minimum Gallons Required [1, 7]			
	Up to 50 Acres or up to 10 lots	51 to 100 Acres or 11 to 20 lots	101 to 200 acres or 21 to 40 lots	> 200 Acres or > 40 lots
Up to 5,000 ft2	45,000	80,000	100,000 [2]	115,000 [3]
Up to 5,000 ft2 with sprinklers	30,000 [7]	30,000	50,000	60,000 [4]
5,001 ft2 - 15,000 ft2	55,000	90,000	115,000 [2]	180,000 [3]
5,001 ft2 - 15,000 ft2 with sprinklers	30,000 [7]	45,000	60,000	90,000 [4]
> 15,000 ft2 or not-limited	60,000	100,000	120,000 [2]	180,000 [3]
>15,000 ft2 or not-limited, with sprinklers	40,000	55,000	65,000	90,000 [4]

[1] Minimum nominal gallons of water required for drafting operations for structural protection. See additional quantity requirements in 6.4.7 where a subdivision includes wooded areas. See 10.4.6 for tank sizing.

[2] Water supply (cisterns) shall be separated into two remote locations as accepted by the AHJ with the private fire main serving to both locations. Vehicle access is required from two directions. See other restrictions associated with friction loss and elevation of hydrants. *[This is to facilitate fire authority response from either direction while also keeping one location available if access to another becomes impaired.]*

[3] Subdivisions larger than 200 acres may require water supply (cisterns) separated into three or more separate locations based on distances and road access to be determined by the AHJ. Minimum 60,000 gallons at each location. See other restrictions associated with friction loss and elevation of hydrants. *[Depending on layout of subdivision, an additional cistern for each 150+ acres may be appropriate based on access points, distance between sources, friction loss, elevations, side roads, etc. Although such conditions could apply to smaller subdivisions it is more likely in larger subdivisions.]*

[4] With all residences sprinklered, water supply (cisterns) shall be separated into remote locations as accepted by the AHJ, with the private fire main interconnected serving all locations and additional quantity provided. Vehicle access is required from multiple directions. 2/3 Of the volume shown shall be provided in the most likely approach as determined by the AHJ. The other 1/3 quantity is to be located at another end of the subdivision. Based on other criteria of pipe length restrictions and elevation restrictions, each additional water supply volume shall not be less than 30,000 gallons.

[5] The largest area of combined structures accounts for the total square footage under the roofline of the largest building and/or group of buildings that do not have a minimum 50' separation. Includes each floor and basements. *[NFPA 1142]* Buildings separated by at least 50' and smaller than the largest group would not be included. If property deed does not limit structure(s) square footage, then >15,000 ft2 not-limited values shall apply. To take credit for sprinklers, all residential occupancies within the subdivision shall be sprinklered and maintained. Also see Area definition in 1.5.

[6] The values in this table assume that the fire authority(s) intended to provide protection for the property can deliver a minimum of 1,000 gallons of water within an 8-minute response time, deliver a sustained minimum of 250 gpm within 5-minutes of arrival. Additional water tender shuttle service would allow an increase in gpm within 15-minutes which would be maintained for a 2-hour duration. *[ISO, NFPA 1142] [Depending on supply volume and how much the flow is increased, the time to establish tender shuttles could be more than 15-minutes.]* If these conditions cannot be provided under normal conditions, the AHJ shall be permitted to increase the available quantities based on fire growth and/or require other means of protection.

[7] A value shown =< 30,000 gallons may be utilized in establishing a required flow per 6.5.5. The water provided shall not be less than 30,000 gallons for any subdivision. *[ISO criteria requires a minimum of 30,000 gallons. Allowing less requires haul analysis for remaining water requirement and would not satisfy creditable hydrant criteria.]*

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6.4.5 This section is limited to residential use, associated sheds, shops, barns, hobby/crafts, and similar structures for personal use. Structures primarily used for business purposes such as vehicle repair, contractor material storage, industrial fabrication, etc. are to be protected with direction from the AHJ incorporating criteria of commercial provisions, increased water supply, and/or the International Fire Code.

6.4.6 The calculation methods used in this section allow for associated residential structures (exposures) to be located within 50' of the primary residence as long as the square footage calculations used account for the size of these structures. *[NFPA 1142, 4.3]*

6.4.6.1 Structures within the 50' spacing and not accounted for in the initial design will require new calculations to validate if the increased area will require an increase to the water quantity provided. If the "not limited" criteria was applied than additional calculations are not required for residential and accessory use.

6.4.6.2 Structures beyond the 50' spacing of primary residence would not require additional water as long as structures outside of the 50' spacing do not result in a larger combined area than was originally permitted and accepted, or the hazard changes.

6.4.7 Where the subdivision incorporates wooded areas of Moderate or High Fire Intensity, as defined in Section 1.5, the following criteria shall apply in addition to the applicable quantities in Table 6.4. Developers are encouraged to mitigate the property prior to submitting for building permits to avoid impacts to water quantity requirements.

6.4.7.1 Prior to the submittal for building permits to construct any structure, the AHJ may perform or require that the property be re-evaluated.

6.4.7.2 For areas of Low Fire Intensity, no additional fire water shall be required. Developers and property owners shall maintain mitigation practices to ensure the fire intensity remains low. A failure to maintain the property during and following construction shall require additional water quantity and sources in accordance with criteria for Moderate or High Fire Intensity.

6.4.7.2.1 The AHJ shall have the authority to issue stop-work orders or restrict occupancy of buildings until mitigation or water supplies are resolved.

6.4.7.3 For each acre of Moderate or High Fire Intensity, an additional 2,000 gallons of fire water shall be provided and distributed among pre-identified cistern locations for the first 50 acres. An additional 750 gallons per acre shall be provided after the first 50 acres.

6.4.7.3.1 The AHJ is permitted to require the developer / owner to provide a third party to establish the acreage impacted and Intensity, with final acceptance by the AHJ.

6.4.7.4 Where a developer / property owner intends to leave property in a Moderate or High Fire Intensity condition, the additional water requirements shall be incorporated into the initial design and layout of the water supply system. *[Also see CWRC.]*

6.4.7.5 The AHJ shall be permitted to require an additional water supply be provided in a separate location from otherwise provided water sources, where access to the Moderate or High Fire Intensity area is more than 900' from a water connection. This may be during design stages, or during construction for failure to maintain a Low Fire Intensity condition.

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6.4.7.6 If the developer / property owner mitigates the property prior to the issuance of a building permit, the AHJ may at their discretion have the hazard re-evaluated.

6.4.7.7 The AHJ is authorized to require assessments to be performed by a third party at no cost to the jurisdiction. *[CWRC]*

6.4.8 Where sprinkler credits are to be taken in accordance with Table 6.4, all residential buildings within that subdivision shall be sprinklered to and maintained in compliance with NFPA 13, 13D or 13R. *[The difference in which code can depend on area, floor, or other credits by the applicable code, such as IRC/IBC.]*

6.4.9 All sprinkler systems shall require plan review and inspection by the AHJ or designated representative in accordance with their permitting requirements.

6.4.10 Developers / owners are responsible to verify water supply and system requirements for NFPA 13 D / NFPA 13R including pressures and flow requirements prior to committing to taking credits and sizing water supplies. The AHJ shall not be held responsible for a well or other water source that does not satisfy required pressures and flows of the particular location.

6.4.11 Where possible, cisterns shall be located at the highest elevation of that section of the subdivision.

6.4.12 Where elevation pressures will allow a positive pressure to be provided at hydrants from a water source, the private fire main shall be piped to have a positive gravity feed from the water source in accordance with criteria in Sections 10 and 12.

6.4.13 Head pressure loss / gain shall be calculated and accounted for in the design and layout of water source locations, fire main routing, hydrant locations, and accepted parking areas for fire apparatus.

6.4.14 Friction loss and flows within the private fire main shall be accounted for.

6.4.15 Additional water supply locations shall be provided as required to overcome friction loss and elevation pressures in accordance with Section 12.

6.5 FIRE FLOW REQUIRED BASED ON QUANTITY OF WATER

6.5.1 Hydraulic calculations shall be based on the flow identified in Table 6.5 in accordance with Section 12.4.2, unless otherwise accepted by the AHJ. *[NFPA 1142, 4.6]*

6.5.2 Piping provided to draft from a cistern / water source and any underground main piping shall be capable of supporting a flow of 1,000 gpm at a velocity <12 fps, unless accepted otherwise by the AHJ. *[Minimum 6”]*

6.5.3 Quantities required shall account for structure and wooded acreage protection.

6.5.4 Structural water demand may be calculated through a single largest hose used by the fire authority (i.e. 4”). Demand for wooded acreage may be assumed to share a second smaller hose (i.e. 3”).

6.5.5 Flow demands of 1,000 gpm or higher may require additional considerations. See Section 10.7 for more information.

See next page for Table 6.5

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6.5.6 The AHJ shall be permitted to adjust the water delivery rate, giving consideration to local conditions which may include sprinklers. *[NFPA 1142, 4.6.2]*

Table 6.5: Water Delivery Rate Based on Quanty Required in Table 6.4	
Gallons Required by Table 6.4	Water Delivery Rate in gpm
<15,000	250
15,001 – 22,500	500
22,501 – 30,000	750
>30,000	1,000

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7 RESIDENTIAL SUBDIVISION – OPTIONS WHEN ACCEPTABLE

7.1 GENERAL

{Note that Sections 6 and 7 were flipped and renamed in June 2026 from previous versions.}

7.1.1 Where permitted by the fire authority and in accordance with Section 4, the provisions of Section 7 may be utilized for reduced protection. *[The concepts within Section 7 utilizes cisterns located within a subdivision and without the use of private fire mains and hydrants. As such, the provisions do not satisfy ISO creditable hydrant requirements and would require a haul study and generally reduced PPC ratings. The lack of water within 1,000' of structures may also limit insurance options or coverage.]*

7.1.2 The fire authority has the discretion to adapt provisions of Section 7 as necessary based on conditions including but not limited to access, terrain, road conditions, distance from stations, available staffing, water shuttle capability, wildfire risk, structure size, construction type/materials, sprinkler protection, fuel loading, subdivision layout, and operational needs. *[The intent of this paragraph is not to create arbitrary requirements, but to ensure the fire authority has the authority to make site-specific decisions when the standard language does not adequately address the hazard and the level of protection varies from that of Section 6.]*

7.1.3 In order to utilize the reduced level of protection outlined in Section 7, the developer and the fire authority are required to ensure that the Public Protection Classification (PPC) rating for current protection or established goals of the fire authority are not reduced through any of the provisions identified.

7.1.4 Section 7 provides a reduced level of protection relying on tender/tanker shuttle / haul resources. *[Shuttle / haul procedures result in delays of water delivery and generally have a negative impact on ISO insurance ratings vs. a quicker and sustained water source incorporating hydrants and fewer truck resources. NFPA 1141, 15.2 requires an established water supply within 5 minutes of arrival utilizing available fire department resources. This can generally not be achieved with water shuttle operations.]*

7.1.5 By providing a water source in accordance with Section 7 in lieu of Section 6, the developer / builders understand and accept that the availability of delivering sustained water to fires involving structures, grass / wildland, or other hazards, will generally be delayed. This is due to the additional resources, personnel, and equipment necessary to set up and establish relay / tender haul operations for shuttling water.

7.1.6 A residential subdivision that does not satisfy criteria for a municipal water supply as outlined in Section 3 shall have a cistern(s) or other accepted water source in accordance with Section 6 or Section 7. These sections apply to any number of lots platted as a subdivision as defined in Section 1.5.22.

7.1.7 Unless otherwise accepted, connection to a reliable and accepted water source, cistern, or hydrant, are to be located such that the distance a fire truck must travel between the water source and the acceptable parking area (in front of the structure) shall not exceed 1/2 mile (2,640') as the shuttle tenders would travel. *[Cisterns / sources are to be located within the subdivision to maintain travel distances as identified. If a subdivision is large enough to exceed the outlined distance, then additional cistern locations would be provided.]*

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7.1.8 For planning and design review purposes, an accepted parking area shall be assumed to be located 2/3rd to the back of the property from the street frontage for the purpose of measuring distances to a water connection.

7.1.9 The water source(s) shall be located within and intended to serve the respective contiguous development. Water sources shall not be located to serve properties separated by a highway or separated by another subdivision or separate property. *[Common areas, schools, parks, etc. as part of the same subdivision and under control of the same Homeowners Association (HOA) may utilize the same water sources. Sections separated by a county or state highway, thoroughfare, or property managed by others shall have their own water sources available unless otherwise accepted by the AHJ. The intent is to ensure water and equipment is paid for and maintained by the intended users, and that emergency vehicles performing shuttle operations can remain within the intended subdivision. Note that schools and other commercial businesses will likely require their own water sources and potentially sprinkler supply with pumps.]*

7.1.10 Water sources shall be located in coordination with and as approved by the fire authority for access, direction of travel, turning around, shuttle operations, etc. *[It is essential that the layout allows shuttle trucks / tenders to be able to access connections for drafting, readily turning around to access or leave the water connections, ability to turn around after dropping water off at the attack truck drop tanks, and the continued shuttle operations.]*

7.1.11 Where specifically permitted by the fire authority in writing and with supporting documentation, the fire authority may allow longer water shuttle distances and/or use of water resources owned / maintained by others. Allowance of such conditions shall satisfy all of the following requirements: *[NFPA 1142, 7.1.8]*

7.1.11.1 Water supplies shall at a minimum maintain current Public Protection Classification (PPC) rating levels or long-term goals established by the fire authority. See Section 4.1.6 related to maintaining and achieving planning goals.

7.1.11.2 If a source owned / maintained by other parties is to be allowed by the fire authority, a legal agreement establishing access to, and use of the water source shall be recorded. Such document shall at a minimum clearly identify any right of use fees, responsibilities, maintenance costs, actions for failure of either / both parties to comply, corrections for non-compliance, liabilities for non-compliance, etc. See Section 4.2. *[NFPA 1142, 7.2]*

7.1.11.3 Due to the increased reliance on stationary water sources, the maintenance, inspection, and testing frequencies of the water source shall be reduced by one-half. *[Example: For stationary sources such as cisterns, inspections or testing that would normally be performed annually shall now be performed at 6-month intervals. This is essential due to the reliance and potential long distances of these resources. The failure of such a source and then the limitations and distances to find another source that has not been authorized for such use would likely result in unacceptable delays, use of resources, and risk to responders and occupants. This does not apply to pressurized hydrant systems provided by a municipal service provider.]*

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7.1.11.4 Insurance and liability concerns shall be identified and addressed for those who will rely on the water source, if it is not maintained, or does not provide the level of protection as intended for those relying on it. This could include multiple fires, wildland fires, or conditions where the water supply does not support the demand for all parties relying on it at the time or before it is refilled.

7.2 WATER SUPPLY RELIABILITY

7.2.1 An acceptable water supply must satisfy the minimum conditions below.

7.2.2 Available 365 days out of the year and is not subject to freezing.

7.2.3 Contains the minimum quantity of water as established by this document.

7.2.4 Will be accessible at all times of the year for fire truck access to within 8' of the point of connection of a fire truck suction inlet. This includes an accepted fire lane as defined in Sections 1 & 14. *[Hard suction may be in 8' or 10' segments, so this is a maximum and set distance with necessary work area between truck and fittings.]*

7.2.5 Access to every water supply must account for fire truck access, weight, width, positioning, parking, and exiting (turning around), as accepted by the fire authority and in accordance with criteria in Sections 1, 10, and 14.

7.2.6 Where shared water will be accepted, criteria of 4.2 shall be followed. *[Such as two subdivisions sharing a water source.]*

7.3 WATER SUPPLY SOURCE

7.3.1 Cisterns shall be in accordance with Section 10.

7.3.2 Other sources of water are subject to review and acceptance of the fire authority and shall comply with Section 0 for dry hydrants.

7.3.3 Unless waived by the AHJ, area lighting shall be provided to illuminate the cistern tank parking and connection area with a minimum of 50 lux average along the truck side of the protective pipe barrier. Lighting shall not be directed at or illuminate adjacent properties or be a nuisance to other properties. This lighting may be included on the same circuit serving the electronic tank monitoring when in accordance with NFPA 70 / NEC. Solar lighting may be accepted subject to the AHJ and accounting for reliability and established maintenance schedules. *[Subject to the AHJ, lighting options may include street lights or lighting incorporated into the protective pipe barrier to effectively illuminate the area between the protective pipe barrier and the fire truck.]*

7.3.4 Any and all conditions of acceptance shall be summarized on the review documents and maintained by the property owner. This includes but is not limited to maintaining documentation, maintaining fire lanes, maintaining brush growth, maintaining water quantity, and condition / quality for fire authority use.

7.4 WATER QUANTITY

7.4.1 The quantity of water required for individual one and two-family dwellings in a subdivision shall be based on this section. *[Quantities of water and number / size of cisterns may be lower when provided in accordance with Section 6 as the private fire mains allow for faster response and fewer resources necessary to provide a sustained water supply within the subdivision.]*

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7.4.2 Water quantity shall be based on the larger of the following conditions for contiguous properties, verified by the AHJ to be in compliance with Low Intensity fire classification per the Colorado Wildland Resiliency Code:

7.4.2.1 Calculated to provide 300 gallons for each acre within the subdivision plus 3,000 gallons per dwelling unit. *[Dwelling unit is not the same as lots. As such, it would be necessary to validate how many dwelling units may be on a lot.]*

7.4.2.2 Criteria in accordance with Section 5.4 excluding credits for shared properties of 5.4.12. *[Under the provisions of Section 7 as a subdivision, the calculated water of the four worst-case properties would be calculated. Use of the criteria in Section 5, just as using the criteria of NFPA 1142, requires the size of the structure and encroachment to calculate the required water supply. Where the size of the structure is not known or is not limited, 60,000 gallons per structure or 20,000 ft2 per Table 5.4 shall be used. The limitation of this section is to ensure that the water provided for subdivisions is not less than would be otherwise provided for four individual shared properties.]*

7.4.2.3 Water quantity for a subdivision shall be not less than 60,000 gallons for subdivisions up to 50 acres or 10 lots. *[These values are to coincide with minimum requirements of Table 6.4 for unlimited area structures. Even if structures are limited in size, these quantities are still applicable due to the extended water delivery shuttle delays of this Section.]*

7.4.2.4 Water quantity for a subdivision shall be not less than 100,000 gallons for subdivisions 51 - 100 acres or 11 - 20 lots.

7.4.2.5 Water quantity for a subdivision shall be not less than 120,000 gallons for subdivisions 101 - 200 acres or 21 - 40 lots.

7.4.2.6 Water quantity for a subdivision shall be not less than 180,000 gallons for subdivisions larger than 200 acres or more than 40 lots.

7.4.2.7 Not less than 30,000 gallons shall be provided at any single cistern location.

7.4.3 Subdivisions that are / will not be in compliance with the requirements for Low Intensity fire classification shall be provided with an additional 2,000 gallons of water per acre for the first 50 acres, and then 1,000 gallons per acre above 50. This water shall be added to the sources for the respective contiguous properties.

7.4.4 If all dwelling units are protected with sprinklers in accordance with NFPA 13D, 13R, or 13, the gallons per dwelling unit in 7.4.2.1 may be reduced to 2,000 gallons from 3,000 gallons. This only applies when all dwellings are required to be sprinklered.

7.4.5 If all dwelling units are protected with sprinklers in accordance with NFPA 13D, 13R, or 13, the quantity limits in 7.4.2.3 through 7.4.2.6 may be reduced by 30%. This only applies when all dwellings are required to be sprinklered. *[The credit is limited as much of this water is allocated for wildland fire, exposure protection, and other non-sprinklered buildings on the property.]*

7.4.6 Where the required water quantity exceeds 60,000 gallons, provisions for drafting shall include at least one unrestricted dry hydrant connection and one internal eductor equipped connection to facilitate two separate points and methods of drafting water. See Section 10.2 for eductor criteria. {See App. E} *[60,001 Gallons or more.]*

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8 RESERVED

9 COMMERCIAL PROPERTIES

9.1 GENERAL

9.1.1 Commercial properties shall be protected in accordance with this section or as otherwise established by the AHJ. *[This section is still under development and should be used as a guide taking into account the particular current and future hazards of a commercial occupancy – considering future changes in use and control / verification of the hazards through inspections and/or deed restrictions.]*

9.1.1.1 Commercial properties shall be calculated in accordance with NFPA 1142 Chapter 4 accounting for the Occupancy Hazard Classifications in Chapter 5 and the Classification of Construction values in Chapter 6.

9.1.1.2 An additional 2,000 gallons of water shall be provided for each Low Intensity commercial acre of land and added to the values of NFPA 1142 Chapter 4. *[This value is based on low intensity mitigation per sections below. Moderate and High Intensity will require additional water per acre.]*

9.1.1.3 Unless otherwise acceptable to the fire authority, no commercial business shall be provided with less than 30,000 gallons. *[ISO]*

9.1.1.4 Separate buildings that satisfy the property separation distance requirements of the International Building Code and have less than 50-foot separation shall be provided with at least the minimum quantity of the two worst-case structure water demands. *[Under this provision adjacent commercial properties may share a water source which satisfies the commercial hydrant spacing criteria as long as the two largest demands are accounted for. Example: Four buildings in a row that satisfy IBC spacing criteria shall have the NFPA 1142 water requirements for the larger of the two buildings higher demand buildings while meeting the hydrant and hose spacing requirements.]*

9.1.1.5 Separate buildings that have a minimum 50-foot separation may share a single water source with the water quantity based on a single structure with the highest water demand.

9.1.1.6 Where the Building(s) in 9.1.1.1 are fully sprinklered per NFPA 13, the water quantity may be reduced by 50% while maintaining a sprinkler demand and 100 gpm hose demand for 2-hours. A minimum of 30,000 gallons is required.

9.1.1.7 Wooded acreage, landscaping, hardening, distances, etc. for commercial structures shall be in accordance with other mitigation measures consistent with this regulation.

9.1.1.8 Commercial properties shall be maintained as Low Intensity fire risks.

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9.1.1.9 The criteria of Section 6.4.7 shall apply to commercial properties with regards to mitigation levels, additional water quantities per acre, failure to mitigate, reviews, etc.

9.1.2 A business that is constructed to be rented out for various uses / tenants shall be evaluated to ensure the water supply provided is adequate for all potential occupancies and uses anticipated. The property owner is responsible for establishing the water quantity and limitations of the particular structure. *[A building that may be initially rented as an office building and then wants to change to a mercantile occupancy will likely have different water requirements. It is the owner's responsibility to establish these limitations prior to establishing the water supply requirements. Water should be calculated based on the worst-case anticipated condition.]*

9.1.3 A business that undergoes a change of occupancy / use shall be evaluated to verify the water supply is adequate for the intended occupancy.

9.1.4 Limitations that are excluded from the provisions of this regulation and will require additional evaluation by the fire authority or a third-party consultant.

9.1.4.1 Rack storage and / or high-piled storage.

9.1.4.2 Idle pallet storage in or on a property.

9.1.4.3 Sale of flammable liquids or gases, or oxidizers.

9.1.4.4 Sale, rental, storage of components containing lithium batteries larger than cell phones or laptop computers. *[E-bikes, electric riding toys, electric cars, electric motorcycles, etc. are not permitted without detailed review and additional protection.]*

9.1.4.5 Other fire hazards as determined by the fire authority.

9.1.5 Fire hydrants / water source connection shall be within 100' of the structure and the Fire Department Connection (FDC).

9.1.6 The distance from a hydrant or water source connection to any part of the structure shall not exceed 400'.

9.1.7 Water supply systems shall be capable of supplying a minimum of 1,000 gpm drafting.

9.1.8 Systems under this section shall also comply with Sections 100 – 15.

9.1.9 Water sources shall be provided with an automatic fill provision, such as off a domestic water line, to ensure the tank(s) remains full.

9.1.10 Unless otherwise accepted by the fire authority, cisterns of water quantities over 60,000 gallons shall be provided with an internal eductor per Section 10.2.

9.1.11 Sprinkler system suctions from the same water source as the fire ground hose source shall be piped such that the sprinkler suction will stop at the calculated sprinkler demand and maintain the hose demand within the tank. *[If the designed sprinkler flow has not contained the fire, then it likely will not. The remaining water needs to be reserved for fireground operations and mop-up or manually pumped into the FDC if being effective.]*

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9.1.12 Unless waived by the AHJ, area lighting shall be provided to illuminate the cistern tank parking and connection area with a minimum of 50 lux average along the truck side of the protective pipe barrier. Lighting shall not be directed at or illuminate adjacent properties or be a nuisance to other properties. Solar lighting may be accepted subject to the AHJ and accounting for reliability and established maintenance schedules. *[Subject to the AHJ, lighting options may include street lights or lighting incorporated into the protective pipe barrier to effectively illuminate the area between the protective pipe barrier and the fire truck.]*

9.1.13 If not otherwise identified in this Section or by NFPA 1142, fire flow demands shall be in accordance with Appendix B of the IFC, or as established by the fire authority.

9.1.14 Fire pumps for commercial sprinkler systems shall be carefully evaluated and in accordance with NFPA 20. *[Reliability of fire pumps for sprinklers during power outages such as storms or wildfires should be considered. NFPA 20 requires reliable power for electric pumps. The determination of "reliable" is generally left up to the designer and AHJ. Maintenance of diesel pumps becomes a challenge and may become less reliable than the electrical source. Hardening of the exterior in wildfire environments is critical for structures and water credits that are otherwise reliant on functional sprinkler systems. Keeping the fire out of the structure during a wildfire event is likely the best approach.]*

9.1.15 Flow demands need to account for available water supplies. See 10.7 for additional considerations.

See next page for Section 10.

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10 CISTERN DESIGN AND SIZING REQUIREMENTS

10.1 GENERAL

10.1.1 Cisterns / sources shall be in accordance with NFPA 22 and accepted by the AHJ.

10.1.2 Unless accepted otherwise by the AHJ, cisterns shall satisfy the criteria of this section to establish standard procedures and expectations for firefighting operations. It is recognized that each project and location could have extenuating circumstances that could require consideration of other options.

10.1.3 Cisterns shall be buried to protect from freezing without relying on other equipment that would require regular maintenance or prone to failure during weather / fire events.

10.1.3.1 If there are locations where it is not feasible to bury a tank, above ground tanks can be considered taking into account insulation, heating, monitoring and reliability of power/heat. *[NFPA 22]*

10.1.4 Cisterns shall be installed in accordance with the manufacturer's recommendations for the use and location.

10.1.5 Coordinate and provide power for electronic monitoring and potable water for tank fill as outlined in this section.

10.1.6 Cisterns may be used to also support domestic drinking water and fire sprinkler systems when in compliance with the following conditions.

10.1.6.1 Piping for domestic usage shall be configured within the tank to ensure that the required fire water is maintained at all times. *[This can be achieved by limiting the depth of the domestic suction point.]*

10.1.6.2 The turnover rate (flow) within the tank is such to ensure the drinking water remains safe for consumption. *[This determination is the responsibility of the owner / developer and not the AHJ. Water filtration / treatment may be incorporated on the domestic usage. Chemicals shall not be added to the tank water that are not compatible and accepted for use in the fire sprinkler system or for use by the fire authority.]*

10.1.6.3 Piping for fire sprinklers shall be configured to maintain the required water volume for fire authority hose line use and domestic use as applicable.

10.1.6.4 Tank volumes shall be increased in size to account for domestic needs, fire sprinklers, and minimum required firefighting operations as applicable.

10.1.7 Cisterns may be configured to fill from rainwater collection systems as long as the water is filtered / screened from debris and in accordance with state or local laws / regulations for the collection and storage of rainwater. *[Colorado HB 23-1194; Colorado Statues 37-92-602(1)(g) & 37-90-105(1)(f).]*

10.1.8 See details in Appendix B for concept of location, spacing, piping, fittings, etc.

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10.2 CISTERNS INCORPORATING A DRAFTING EDUCTOR

10.2.1 The requirement for tanks with drafting eductor will be established within Sections 5, 6, 7, or 9 based on various conditions.

10.2.2 Where multiple cisterns are provided next to each other to achieve the required water supply demands, at least one cistern may be required to incorporate an internal drafting eductor satisfying the following criteria. See Detail #4 & #7 in Appendix B for concept drawings. *[A drafting eductor is used for multiple purposes to enhance drafting operations. For the purpose of this regulation, by incorporating the eductor into the cistern, fire apparatus that is not equipped with hard-suction, is experiencing a failure of a suction gasket, or has a hole in the suction line, can still achieve drafting capacities in excess of 1,000 gpm. This significantly enhances the availability to access the water supply by all fire apparatus and mutual aid departments not equipped for hard-suction drafting. Under standard drafting with a hard-suction line the eductor does not provide benefit and in fact restricts flow. The benefit is for use by equipment not equipped with hard-suction or failure of the hard-suction hose. Thus, it provides a critical backup to common issues with hard-suction drafting.]*

10.2.3 The AHJ shall be permitted to adjust the locations provided with the eductor(s) based on hazards, fuel loads, resources, apparatus, and other factors.

10.2.4 The eductor shall be capable of delivering 1,000 gpm with a lift not exceeding 12' while receiving a pressure not to exceed 180 psi. *[Tables on the mfg website of product detailed in Appendix B Detail #4 & #7 will show a lower flow as they are drafting from a further distance and higher lift and not specifically this condition. Other product tests have validated the flow should achieve 1,000 gpm under conditions outlined. The venturi principle of the eductor requires water and pressure from the fire truck to establish the initial flow and function of the eductor using soft hose. Once the flow is achieved, the truck utilizes the flow from the eductor to maintain flow and drafting. If utilizing hard-suction hose, no pressure is required to draft from the tank. However, due to the restriction of the venturi throat, pressurizing the venturi will significantly increase the flow, especially with a 6" hard-suction line. Videos of the product for general understanding are at TurboDraft.net or Youtube.]*

10.2.5 The tank(s) to be equipped with an eductor shall be specifically manufactured to accommodate the internal eductor. *[Tanks manufactured to accommodate the eductor can be installed to not take advantage of the extra fitting. However, a tank that is not manufactured to accommodate the eductor may not be field adapted. See tank and eductor details in Appendix B that are developed around one particular eductor and tank.]*

10.2.6 See details in Appendix B Detail #4 & #7 for design criteria for a particular product referenced as basis of design. Designer is responsible for final design with specific products used.

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10.3 TANK FILLING, LEVEL GAUGES, AND MONITORING

10.3.1 FILLING: Provisions for filling tanks shall be as indicated or otherwise accepted by the AHJ.

10.3.1.1 Owners, developers, and Home Owner Associations (HOA) shall establish an account with a bulk water supply company, and/or have reliable means to fill, refill, or top-off water storage tanks within 72-hours.

10.3.1.2 Subdivisions and commercial properties shall have a permanent means of automatic filling / topping off tanks.

10.3.1.2.1 The AHJ may allow other provisions to ensure tanks are maintained full if well water or other automatic potable water provisions are not feasible. *[Common area landscape sprinkler systems served by well water could be used to maintain tank levels. Alternative example may include monthly or quarterly inspection / topping off by an accepted service company. The frequency may be adjusted over time with evidence that the system is maintaining levels and not to exceed 6-month intervals.]*

10.3.1.3 At a minimum, cisterns serving individual properties or shared individual properties shall have an approved account / maintenance contract allowing tanks to be filled, inspected, and topped off by a bulk water delivery service within 72-hours.

10.3.1.4 Cisterns serving individual properties or shared individual properties, and do not supply gravity feed hydrants, shall be permitted to not have automatic fill connections. *[Automatic and/or manual fill provisions from a domestic water supply are strongly recommended for regular topping off. Systems without hydrants/piping are less likely to leak over time.]*

10.3.1.5 Where automatic or manual-piped fill provisions are provided, an accepted air gap or backflow preventer shall be provided to protect potable water from cross contamination with non-potable tank water. *[Local regulations may vary, but many recognize a minimum 1" air gap above overflow lines or a reduced pressure zone backflow preventer (such as for irrigation systems). Ensure all systems are protected from freezing.]*

10.3.1.6 Where electronic tank level monitoring is provided, it is recommended to incorporate tank fill functions (solenoid control) through the monitoring panel. *[Similar to FPT-50 Series by Waterline Controls as recommended by a tank manufacturer.]*

10.3.1.7 Automatic fill provisions shall be protected from freezing. This includes but is not limited to backflow preventers, valves, solenoids, water piping, etc. *[Although heat tracing can be used, it is generally not recommended due to limited life span, lack of maintenance, and history of ignition when not properly installed / maintained. The use of certain plastics that allow expansion can help to reduce the chances of failure. However, use of such plastic does not exclude proper design and installation to prevent freezing.]*

10.3.2 LEVEL INDICATORS: Provisions for verification of tank water level shall be as indicated or otherwise accepted by the AHJ.

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10.3.2.1 Tank water level gauges shall be provided that automatically identifies the quantity of water within the tank by percentage of volume or feet/inches of water. Where depth (feet/inches) of water indication is provided, signage shall be provided on protective pipe barrier to translate depth to percentage of volume at a minimum of 1/4 increments.

10.3.2.2 Mechanical gauges or electronic monitoring of water quantity may be provided when designed, intended, rated, and accepted for the conditions in which products will be used. *[Electronic monitoring of tank volume may be incorporated into high/low monitoring panels, or as a separate monitoring panel.]*

10.3.2.3 For all means of monitoring water levels, calibration shall be performed to validate the accuracy for the tank in which product is installed.

10.3.2.4 Visual indication of tank levels shall be installed so that they can be seen from where drafting operations are performed.

10.3.2.5 The head of a mechanical level shall be 36" – 48" above grade or higher to be above normal snow depth while still legible. {See Annex E}

10.3.3 MONITORING: Provisions for electronic monitoring of tank levels shall be as indicated or otherwise accepted by the AHJ.

10.3.3.1 Subdivisions and commercial building water sources (Sections 6, 7 & 9) shall be provided with electronic monitoring to include at minimum high and low water level, local audible, and visible red strobe of at least 15 candela. The audible alarm shall incorporate an acknowledge switch to temporarily silence the audible signal. *[Similar to FPT-50 Series by Waterline Controls as recommended by a tank manufacturer.]*

10.3.3.1.1 Although the monitoring system shall be provided with an audible alarm, this alarm may initially be disabled unless required to be enabled by the AHJ. *[This is to avoid audible alarms sounding at night and relying on the visual strobe to get attention of the residents for corrective actions within 48 hours. This is also beneficial to avoid constant audible alarms during an emergency event. Where it has been identified that corrective actions are not being addressed within this time frame by a strobe only, the AHJ shall be permitted to require activation of the audible alarm.]*

10.3.3.2 Monitoring panels shall be minimum NEMA 4X rated for the exterior conditions.

10.3.3.3 Monitoring equipment shall be designed and rated for temperatures between -20°F to 120°F or as otherwise anticipated for the location.

10.3.3.4 Provide local visual strobe alarm adjacent to panel and visible from at least 3 directions.

10.3.3.5 Provide signage with phone number to call for service when strobe is flashing.

10.3.3.6 Locate control panel on protective pipe barrier to be ~5' above grade and to the right side of connections so as not to interfere with connections.

10.3.3.7 Where above ground tanks are utilized, the monitoring panel shall incorporate temperature monitoring of tank water.

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10.3.3.8 A reliable source of power shall be provided for electronic monitoring equipment. Where site lighting is also required by this regulation, lighting circuits and monitoring equipment may be on the same circuit and in accordance with the National Electrical Code and approved by the manufacturer. *[The loss of power to site lighting can help to identify that there is a loss of power to the monitoring panel(s). Monitoring equipment should generally not share circuits with motorized equipment without mfg. acceptance. Solar power can be considered where it will provide notification of low battery conditions or battery failure, such as a visible constant power light when batteries are good and a flashing light when batteries are failing.]*

10.4 LOCATION

10.4.1 Where possible and gravity feed fire mains are to be incorporated, cisterns should be located at the highest feasible elevation for a site, while still being readily accessible from a main roadway.

10.4.2 Unless otherwise accepted, tanks shall be positioned perpendicular to vehicle traffic and vehicle loads.

10.4.3 The location cistern(s) will be located shall be evaluated for ground water accumulation by the designer. If the potential for water accumulation exists, then an engineer's report or design for anchoring shall be provided.

10.4.4 Which side of the street water supplies and connections are located must be determined based on evaluation of the normal or only direction fire apparatus may respond, provisions for turning around if coming from another direction, etc. Final locations are to be accepted by the fire authority. Drafting and other connections shall be configured for the driver's side of the truck for standard drafting operations, unless accepted otherwise. *[Depending on location and approach of responding trucks, this may need to be flipped. Consideration of the responding trucks approach, such as on a dead-end should be considered and adjusted accordingly. For means of turning around, a cul-de-sac or side street close to the water source may achieve these criteria.]*

10.4.5 Truck and tanker access must be carefully evaluated and include the following:

10.4.5.1 Cisterns shall be located to be readily accessible for drafting using a single 8-foot section of hard-suction and allowing working space at connections.

10.4.5.2 Fire apparatus parking shall allow for at least one additional truck to be parked adjacent to drafting truck to be filled or to be re-filling cistern during operations.

10.4.5.3 Parking for at least two 40-foot fire trucks shall not obstruct or restrict other emergency vehicles from safely passing along roadway. This shall include hoses that will be stretched out from trucks for filling or pressurizing the underground main.

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10.4.5.4 A designated parking area shall be provided for fire apparatus to park at the tank(s) and perform drafting operations out of main traffic flow. When on side of a public roadway that is minimum 20' wide, a minimum 12' pullout is required. 18' Is preferred to allow connections and passing traffic. If located along driveway to a property, a minimum of 12' clear width shall be provided for passing vehicles when a fire truck is connected to the drafting connection. *[Coordinate with fire authority to ensure adequate access will be provided. The fire authority may allow for a front draft connection along a private driveway depending on their apparatus configurations.]*

10.4.5.5 Unless otherwise directed, follow general guidelines of details in Appendix B.

10.4.6 Where additional cistern locations are required in accordance with Sections 5, 6, or 7, they shall be remotely spaced to allow emergency vehicle access from different directions and to limit the chances of two different water sources being compromised by fire, construction, road repairs, or other emergencies in the area. Elevation of tanks and if provided with gravity feed connections, ensure higher tanks do not drain / overflow into lower tanks. *[Lower tanks will generally not be provided with gravity connections. Isolation valves or check-valves may be required.]*

10.4.7 Where a pond, reservoir, or other water source is to be accessible for fire water, pullouts to access dry hydrants shall be provided and satisfy the same criteria for parking as cisterns.

10.4.8 See details in Appendix B for proposed parking, piping, tank orientation, and more.

10.5 SIZING

10.5.1 Cisterns shall not exceed a tank depth of 12'. This is to limit drafting lift / height specifically impacted by high altitude locations. *[With the tank buried so that the top of the tank is higher than the roadway, the drafting height is reduced. The depth of the tank also limits the impact of drafting at higher altitude.]*

10.5.2 Unless otherwise accepted by the AHJ, individual tank sizes shall not exceed 30,000 gallons. *[Due to delivery and transport costs, depth/diameter, and overall size of handling tanks, it is recommended that tank sizes be limited to a maximum of 30,000 gallons. Multiple smaller tanks are easier to handle and provide redundancy for service and repair. Diameter also reduces bury depth which impacts other design challenges of frost line, pipe bury, valve depth, etc. Deeper tanks create higher lift exceeding truck capacity at higher altitudes. Larger tanks need to satisfy other criteria including 10.4.1.]*

10.5.3 Cisterns shall be buried so that the top of the tank is at or above the street level. *[This is to reduce the impact of drafting lift due to altitude while also facilitating access to the various connections. The excavated dirt can often be used as cover over the tank. Landscaping features can help to blend in the tank mound to the locality.]*

10.5.4 The depth of bury over the top, sides, and ends of a cistern shall be at least equal to the frost line for the location for freeze protection.

10.5.4.1 The depth of cover over the tank can be reduced by 1-foot when a minimum of 2" rigid foundation rated foam board is provided over the top and any exposed sides.

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10.5.4.2 Other options for protection from freezing may be accepted when submitted by a registered engineer.

10.5.5 Semi-buried cisterns shall be provided with a protective pipe barrier between the tanks and designated fire truck parking area. *[This may be a retaining wall or other means to protect the pipes, allow for signage, protect from freezing, etc.]*

10.5.5.1 The protective pipe barrier shall be designed to support the soil mound under all weather conditions and loading. *[This must account for water saturation and weight against the wall. Weep holes to reduce hydrostatic pressure while preventing wash-out should be provided.]*

10.5.5.2 The protective pipe barrier shall incorporate all pipe fittings that will be utilized for fire truck connections.

10.5.6 Where a protective pipe barrier (such as a retaining wall) is not feasible, other options may be presented to the fire authority for consideration while ensuring the following conditions are satisfied:

10.5.6.1 Easy identification, parking, access, operations, vehicle protection, snow removal, and connection with a single 8' section of hard suction hose is provided.

10.5.6.2 All pipe connections (suction, fill, eductor) shall not be exposed for more than 12" to limit damage from sun, physical damage, children playing / climbing on, etc.

10.5.6.3 Pipe connections shall be oriented to satisfy standards for easy identification and access by the fire fighters. Distances, orientation, and standard criteria are critical.

10.5.6.4 Signage is provided to clearly indicate a property address / tank identification, water quantity, emergency contact, and other essential information for the fire authority.

10.5.6.5 Cistern location and equipment is easily identifiable to firefighters.

10.5.7 All piping, pipe barriers, retaining walls, etc. shall be protected by pipe bollards of minimum 6" diameter and buried a minimum of 3' in concrete. Bollards shall be painted yellow or as otherwise acceptable to the fire authority.

10.5.8 The quantities indicated in this document may represent nominal tank volumes as established by the tank manufacturer. *[A tank with a nominal size of 30,000 gallons may not hold exactly 30,000 gallons as the manufacturer rounds the number. In addition, the available water that can be drafted will be less than the total tank volume due to residual water left in the bottom of the tank at and just above the anti-vortex plate.]*

10.5.8.1 Usable water capable of being drafted from a tank/cistern/water source shall be at minimum 95% of the nominal tank volume.

10.5.8.2 Nominal tank volumes shall be indicated on tank signage.

10.6 CONNECTIONS

10.6.1 All pipes and connections shall be in accordance with the manufacturer's recommendations.

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10.6.2 Any plastic pipe that could be exposed to the sun shall be painted with at least two coats of protective paint to resist UV exposure. *[The color selection must account for fading and compatibility with the PVC pipe to not weaken the pipe. Paint must specifically include UV inhibitors and fade-resistant technology. Color selection should match reflective band zones when applicable, such as in subdivisions.]*

10.6.3 Connections shall be provided in accordance with this section and details in Appendix B for consistent fire ground operations and training.

10.6.4 Connections shall all slope back to the tank to prevent the accumulation of condensation or trapped water subject to freezing.

10.6.5 Unless otherwise directed by the fire authority, the following connections shall be provided. *[The AHJ needs to identify differences prior to or during plan reviews. This would include differences in sizes and thread pitch. Can be identified in Appendix E.]*

10.6.5.1 Dry hydrant suction line from tank and/or eductor discharge shall be 6" NH-Male with cap and chain. {See App. E}

10.6.5.2 Dry hydrant pipe / connections shall be painted a high-quality, UV resistant, Purple equal to Sherwin Williams SW9068 Berry Frappè, gloss finish. Connections used for other than drafting water shall not be painted the same color to avoid confusion of function. *[This uses Sherwin Williams 9068 which can be matched by others. Consider durability and quality of paint for longevity. Pipe and caps / fittings may be painted, ensuring the paint does not prevent removal of any caps or fittings. Other pipes may be painted white or as otherwise directed by the fire authority. See App. A for color sample.]*

10.6.5.3 Tanks equipped with internal drafting eductor shall be provided with the 6" NH-Male fitting for drafting hose in addition to the following adapters: {See App. E}

10.6.5.3.1 A 6" Female NH to 4.5" NH Male (same as fire hydrants) with cap and chain, and

10.6.5.3.2 Where required, a 4.5" long handle female NH with 30-degree elbow to 5" Storz fitting and cap. {See App. E}

10.6.5.4 A minimum 4" fill line from tank with a 2.5" NST-FS (Female Swivel) clappered Siamese FDC connection with caps and chains. *[Allowing to be filled with one or two hoses.]*

10.6.5.5 For tanks equipped with a drafting eductor, provide a 2.5" pipe from eductor to a single 2.5" single NST-FS (Female Swivel) FDC inlet with cap and chain. This will serve as the pressure line to eductor venturi.

10.6.5.6 Tank vent per tank mfg to accommodate drafting and fill flow rates. Vent must be piped above normal anticipated snow levels. A dome is recommended to shield vent screen from snow accumulation.

10.6.5.7 Level gauge per Section 10.3.2.

10.6.5.8 Fittings for electronic level and automatic fill controls identified in Section 10.3.

10.6.6 Provide a minimum 30" diameter manway secured to prevent unauthorized entry. Provide a 4" locking inspection hatch, or equivalent.

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10.6.7 If tank will be used for gravity feed to private hydrants, provide a bottom discharge. If the tank will incorporate a check valve to prevent the pressurized water from hydrant main re-entering the tank, this check valve shall be incorporated into the interior of the tank for future service. See details and coordinate final design with tank mfg. Otherwise, provide a PIV valve to isolate tanks from the pressurized inlet hydrant.

10.6.8 Where multiple tanks are provided at a location, the tanks shall be interconnected at the bottom with pipe large enough to facilitate flow between tanks at the required flow rate to allow equalization of all tanks. This connection shall be minimum 8", or larger per the tank manufacturer or engineer. *[If tanks are of different capacity / depth, the top of tanks shall be at the same elevation and all suction lines shall come from the larger tank to be at the lowest elevation. This is required to ensure the smaller tank does not overflow and the maximum capacity of the larger tank is available. Tanks of the same capacity / depth are recommended to overcome these challenges.]*

10.6.9 Provisions shall be provided to allow isolation of each tank individually for future interior inspections and service in accordance with recognized lock-out-tag-out isolation procedures. *[Account for bury depth of valves so that no valve is >7' below grade.]*

10.6.10 Provide drain for overfill as recommended by tank manufacturer.

10.6.11 Tanks suction / discharge connections shall be provided with anti-vortex plates in accordance with NFPA 22.

10.7 CONSIDERATIONS WITH FLOW DEMANDS

10.7.1 Where flow demands of 1,000 gpm or higher are required for residential, commercial, or other hazards, the following shall be considered and accounted for:

10.7.1.1 Ensuring the drafting ability of the location, pipe sizes, and pump capacity. Multiple drafting points and equipment may be required. *[This is one reason for incorporating the internal eductor into a cistern where multiple cisterns are required. This allows the same truck to tandem or twin-tube draft for increased flow and also additional trucks that may not be equipped for drafting can also increase flow.]*

10.7.1.2 Ensuring the ability to pump the volume into the underground private main. The size restrictions of a single inlet hydrant, hose, and the internal valve can significantly impact friction loss and available flow. Additional input hydrants may be required where higher flows are anticipated.

10.7.1.3 Limiting friction loss through private fire mains and hoses. Increasing fire main sizes may be necessary to limit the friction loss based on the required flow. Looping the main may also reduce friction loss.

10.7.1.4 The size of cisterns and / or water supplies shall take into account the required flow and durations. Residential occupancies will generally require a minimum of 2-hour supply. Commercial buildings may require two or more hours of available water supply. *{ISO criteria and that of NFPA 1142 can require 2-hours of supply. This document accounts for water haul calculations with tenders to offset this for smaller tanks. For commercial hazards or subdivisions the required water supply should typically be accounted for in the cisterns for that hazard.]*

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10.7.1.5 The interconnection pipe size between tanks may need to be increased for auto equalization during drafting of this volume. *[The interconnection piping should be at least one size larger than the required underground since the equalization is through head pressure and is not being pumped equal to the flow being drafted from source tank.]*

11 DRY HYDRANTS FOR WATER SOURCES OTHER THAN CISTERNS

11.1 GENERAL

11.1.1 For large developments that incorporate large water features such as ponds or lakes, a dry-hydrant connection shall be provided with an approved pullout for emergency operations. Bollards, distance to trucks, and connections shall be as indicated for cisterns unless otherwise accepted by the AHJ. Fire authorities that are equipped with drafting equipment capable of achieving a minimum 750 gpm fire flow through other means may waive the requirement for a dry-hydrant, with acceptable access / parking area provided. *[This could include parking close enough for hard-suction lines up to 20' maximum and/or portable eductors and a distance not to exceed 100' of large diameter hose.]*

11.1.2 Sources of ponds and lakes shall not be used to omit the requirements for an acceptable water source available year-round if the area is subject to freezing or fluctuating water levels below what would otherwise be required. *[In a location where the water source is not subject to freezing or seasonal fluctuations, the AHJ may consider such sources to offset other requirements.]*

11.1.3 Dry hydrants to be accepted as alternative water sources shall be provided as established by the AHJ and following guidelines of this document for access to cisterns in addition to criteria of NFPA 1142.

11.1.4 Dry hydrant connections shall be sized, protected, located, identified, and painted in accordance with Section 10, 10.6, 13, and Appendix E unless otherwise directed by the fire authority.

11.1.5 Unless waived by the AHJ, area lighting shall be provided to illuminate dry hydrant connection area with a minimum of 50 lux average along the truck side of the protective pipe barrier. Lighting shall not be directed at or illuminate adjacent properties or be a nuisance to other properties. Solar lighting may be accepted subject to the AHJ and accounting for reliability and established maintenance schedules.

11.1.6 Dry-Hydrant connections at non-potable sources such as ponds shall be identified by a high-quality, UV resistant, Purple equal to Sherwin Williams SW9068 Berry Frappè, gloss finish. Connections used for other than drafting water shall not be painted the same color to avoid confusion of function. *[This uses Sherwin Williams 9068 which can be matched by others. Consider durability and quality of paint for longevity. Pipe and caps / fittings may be painted, ensuring the paint does not prevent removal of any caps or fittings. Other pipes may be painted white or as otherwise directed by the fire authority.]*

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12 DEDICATED PRIVATE FIRE MAINS

12.1 GENERAL

12.1.1 Where municipal type water systems are provided, fire mains, hydrants, etc. that will be maintained by that system shall be provided in accordance with Section 3. Colors, labeling, etc. shall be coordinated between the fire authority and municipal provider.

12.1.2 Private fire mains served by a municipal type or private water system shall be permitted in accordance with NFPA 24. Where such condition is provided the hydrant colors and labeling shall be coordinated with the fire authority and water supplier to distinguish from municipal serviced hydrants and non-potable systems. *[This would be a condition where a municipal type water supplier stops service at a demarcation line, often with backflow prevention. The remainder of the water system in the subdivision would be privately maintained. This could also be a private water distribution system provided and maintained by the subdivision / HOA / private entity just for this system.]*

12.1.3 Where accepted sources of water cannot be located within the prescribed distances to an accepted parking area for a respective structure or hazard, fire hydrants on a wet pipe manual (truck supplied) main shall be provided. *[Under this provision, a wet hydrant system is provided with the intent of serving firefighting operations.]*

12.1.3.1 The AHJ may permit a dry-standpipe approach where appropriate and items such as the following are addressed.

12.1.3.1.1 Provisions and procedures for venting air quickly and prior to entering a fire pump.

12.1.3.1.2 Provisions for draining after use to prevent freezing.

12.1.3.1.3 Consideration of pipe size to achieve required flow while also increasing the air volume to be vented from entire system.

12.1.4 Fire hydrants and their associated mains shall be provided so that a single fire truck can draft from an acceptable water source and pump into and pressurize the underground main.

12.1.5 Where required by the AHJ, an acceptable fire pump in accordance with NFPA 20 shall be provided to deliver automatic fire water supply without the need of a fire truck. *[This approach may be used for commercial buildings or unique hazards that require immediate water flow upon detection of a fire, such as for sprinkler systems.]*

12.1.6 Private fire mains shall be installed in accordance with NFPA 24, latest edition and criteria of this document. *[IFC 507.2.1]*

12.1.7 Private fire mains shall be located within utility easements or otherwise identified in recorded documents to ensure that no structure or other feature is located over or immediately adjacent to the mains that would prevent access for repair or service.

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12.1.8 Where a distribution system may now or in the future be utilized for both domestic water and fire water, materials used and installation shall be in compliance with American Water Works Association standards for distribution of potable water. *[This is not perceived to add cost to the system when properly designed. However, it may facilitate the potential connection and use by a municipal water service in the future following proper disinfection and inspection. It is recognized that once a system serves non-potable use it may not be possible to use for potable water. This determination is beyond the scope of this document, but the concept has been identified for consideration.]*

12.1.9 See concept drawings in Appendix B.

12.2 PIPING AND MATERIALS

12.2.1 Pipe size shall be based on hydraulic calculations to deliver the required flow over the distance and elevation for each hydrant location provided. *[Some demands will be driven by distance, while others may be driven by elevation. All conditions must be evaluated.]*

12.2.2 Distribution pipe size shall be minimum 6" unless otherwise validated through calculations and accepted by the AHJ.

12.2.3 Fire hydrants in areas subject to freezing shall be of the dry-barrel type.

12.2.4 Fire hydrants shall have a minimum 48" clearance on all sides, with minimum10' unobstructed clearance in front of steamer connection (larger fitting).

12.2.5 Hydrants shall be installed such that the steamer connections face the street / access.

12.2.6 Hydrant connections shall be elevated such that the center of a hose connection is a minimum of 18" and a maximum of 36" above grade.

12.2.6.1 Where angled adapters are provided, such as inlet fire hydrants, the hydrant shall be elevated so that when the angled adapter is installed the bottom of the adapter is 18"-36" above grade.

12.2.7 A designated **"Input" hydrant** shall be provided adjacent to drafting operations and comply with the following. This hydrant shall be used to pump water into the underground water main from the drafting truck.

12.2.7.1 Unless otherwise directed by the fire authority, the hydrant shall have connections to accommodate all of the following*: [The AHJ needs to identify differences prior to or during plan reviews. This would include differences in sizes and thread pitch. Such criteria can also be incorporated into Appendix E for the local jurisdiction.]*

12.2.7.2 One 4.5" female swivel incorporated into the hydrant barrel (as part of the hydrant), with an adapter to accommodate a 4.5" male to 5" Storz with cap secured by a cable. *[This is to allow a fire truck discharge to connect a threaded large diameter hose with threaded fittings, or a truck using 5" Storz hose from pumper discharge.]* {See App. E}

12.2.7.3 The two 2.5" connections shall be fitted with female swivel 2.5" NH-FS inlets and threaded plugs on chains. *[This is to allow departments or trucks that do not have large diameter pump discharge connections to utilize two 3" hoses with 2.5" fittings from pumper discharge outlets into hydrant swivel fittings, similar to an FDC.]*

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12.2.7.4 The fire hydrant shall be located within 40’ of hose reach from the fire trucks passenger discharge outlet, or as otherwise established by the fire authority. This distance is with the fire truck connected by a 8 or 10-foot section of hard-suction to the cistern dry hydrant fitting. This is to allow connection of a large diameter discharge hose or two 3” hoses.

12.2.7.5 The fire hydrant shall be towards the front drivers side of the truck, unless otherwise established by the fire authority. See details including Detail #2 in Appendix B.

12.2.7.6 Coordinate hydrant placement with the PIV (if gravity feed) and operational instruction signage.

12.2.7.7 Which side of the street water supplies and connections are located must be determined based on evaluation of the normal or only direction fire apparatus may respond, provisions for turning around if coming from another direction, etc. See Section 10 for cistern locations.

12.2.7.8 See drawing details in Appendix B for orientation of various components.

12.2.8 Pipes shall be buried a minimum of 1-foot below frost lines for the area, or as otherwise required by local regulations for water pipes, whichever is deeper. *[Because water is not flowing through these pipes, they are more likely to freeze than domestic mains with water flow. Also see NFPA 24.]*

12.2.9 Buried pipes that run along a protective pipe barrier or slopped area shall be located horizontally at least equal to the required bury depth from the exposed surface. *[This includes piping next to semi-buried cisterns. Pipes that are exposed to freezing temperatures both above and to a side are subject to freezing quicker than just buried pipe.]*

12.2.10 Where water sources (cisterns) are at an elevation higher than hydrants, and such condition will provide a positive pressure of 10 psi or greater at 2’ above grade *[pump inlet],* the water supply shall be provided with a gravity feed discharge to maintain pressure within the private main. *[It is recognized that not all hydrants may be at a lower elevation or have a static head pressure. Such conditions should be evaluated and discussed with the AHJ as to the number of hydrants that can benefit from this pressure. This pressure will allow hydrants to be used, in some cases with very limited flows, until a drafting truck arrives to pressurize the fire main. Use caution for hydrants that are at higher elevations than the cistern / inlet hydrant resulting in water flowing backwards and filling underground pipe with air.]*

12.2.10.1 A Post Indicator Valve (PIV) for isolating the cistern(s) from the private fire main shall be located within 5’ – 7’ of the Inlet hydrant. This PIV shall be painted and labeled as to function. *[This valve is to prevent / control supply truck pressured water going back into the cistern(s).]*

12.2.10.2 Post Indicator Valves shall be painted BLACK and labeled as indicated in this document or directed by the AHJ. See Detail #2 & #3 in Appendix B.

12.2.10.3 Post indicator valves shall have a minimum of 3’ of clear space on all sides.

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12.2.10.4 Post indicator valves shall be provided with a breakaway lock or other tamper evident device acceptable to the AHJ. *[The fire authority will need to be familiar with breakaway locks and have a suitable hammer, wrench readily available to operate the PIV during drafting operations. The fire authority needs to establish who will maintain the key or if key box is to be provided at cistern location.]*

12.2.11 Check valves shall be permitted to be placed within a cistern on the gravity discharge pipe to prevent water pumped into the inlet hydrant from returning to the cistern tank. *[In general, the pumped / pressurized water should be directed down the main and not back into the tank. However, providing a PIV allows for such isolation and also allows the drafting operator to provide some flow circulation back to the tank for pump cooling during times that attack water is not flowing. Providing check-valves where multiple tanks need to self-adjust water levels during drafting will prevent this water balance between tanks. In such case separate connections between the bottoms of each tank would be required for self-leveling. The reason for incorporating the check valve inside the tank is for future service vs. buried in the ground. Operation tactics must be established by the fire authority to establish best approach. See drawing details in Appendix B for concepts.]*

12.2.12 Each cistern shall be provided with a street valve box for isolation of each respective tank during maintenance. This valve shall be provided for each tank, even when there is only one tank having a gravity feed connection.

12.2.13 All valve locations around cisterns shall take into account the bury depth (mound) around the cistern and depth to reach the valves from grade.

12.2.14 No street valve shall be deeper than 84” below grade. *[Depth is limited due to lengths and use of “T” wrenches to operate the valves.]*

12.2.15 Isolation valves shall be provided to allow repair/maintenance of branch lines from main distribution lines.

12.2.15.1 Where a main distribution is served from two or more directions (remote cisterns), valves shall be provided to allow isolation of the distribution main such that at least 40% of hydrants can remain in service for a single repair.

12.2.16 All fire hydrants, including the inlet hydrant, shall be provided with an isolation valve in a street valve box within 3’ of the hydrant.

12.2.17 All street valve boxes used on the dedicated private fire main shall have a lid stamped with the words “FIRE” or “FIRE VALVE”.

12.2.18 Mechanical pipe restraint and/or thrust blocks shall be provided in accordance with NFPA 24 and at all changes in direction.

12.2.19 Where plastic fire mains are used, accepted tracer wire / ribbon shall be installed in accordance with the manufacture and at a depth that will facilitate pipe locating.

12.2.19.1 Tracer wire shall be accessible at every fire hydrant and protected by PVC minimum Schedule 80 1/2" conduit to prevent damage from weed trimmers / mowers.

12.2.20 Where cathodic protection is required due to soil conditions and pipe materials, including hydrant valves and barrels, pipe and fittings shall be coated/wrapped/protected in accordance with NFPA 24.

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12.2.21 Photographs of all pipe and hydrant installations prior to bury shall be obtained and provided to the AHJ during / after formal inspections, or prior to inspections when requested.

12.2.22 Where private fire mains are not connected by gravity feed, the mains shall be filled with water and excess air bled out during testing, commissioning, and as part of regular testing.

12.3 IDENTIFICATION OF FIRE HYDRANTS

12.3.1 Private fire hydrants including the dry-barrel hydrants and dry-hydrants for drafting are to be colored, marked, and identified per this Section 12.3.6 or as otherwise directed by the AHJ.

12.3.2 Municipal type hydrants shall be marked and color coded per the water provider. Snow markers shall be provided by either the water provider or the developer in accordance with section and Appendix "E".

12.3.3 COLOR OF HYDRANT REFLECTOR ASSOCIATED WITH CISTERN:

12.3.3.1 Hydrants that are part of a subdivision private system to be pressurized by a fire truck, a fixed private fire pump, or municipal hydrants where required by the AHJ, shall be marked per this section.

12.3.3.2 The color of the reflective band and snow pole are to be coordinated so that the Inlet hydrant is color coded with the discharge hydrants served by the same private main. As such, reflective bands will vary. *[Generally acceptable colors for cistern sourced zones include blue, green, orange, and yellow. Orange and yellow should not be used on adjacent zones due to color similarities.]*

12.3.3.3 Colors of red and white shall not be used without acceptance of the AHJ on hydrants that require pressurization by a fire truck. *[Red and white are generally reserved for hydrants or sources that are provided with a positive pressure such as a municipal type water supply or an automatic private fire pump that does not require fire department interactions to achieve a water supply.]*

12.3.3.4 Colors of adjacent systems shall be different to identify they are served by different systems. *[One system may be green, with an adjacent zone or subdivision having red, and another having blue reflectors. A subdivision further away from the first green (~1 mile) can re-use green or other colors. The intent is so that the fire authority can readily identify that hydrants with green reflectors are only served by the black inlet hydrant also having green reflectors for that zone. Designer needs to verify the selected color is available in matching components. Attack engine first grabbing hydrant to fire can advise other units / dispatch "Catching hydrant on GREEN zone". Arriving drafting engine confirms and reports to GREEN zone cisterns and input hydrant.]*

12.3.3.5 Colors may be re-used as long as adjacent systems utilize different colors.

12.3.4 INLET FIRE HYDRANT USED TO PRESSURIZE THE MAIN:

12.3.4.1 Unless otherwise identified by the fire authority, this hydrant shall be painted and identified as follows:

12.3.4.1.1 A high-quality, UV resistant **BLACK** gloss enamel finish of hydrant.

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12.3.4.1.2 Provided with a minimum 1.5", High Intensity, reflective color band (**To Be Determined**), located just below the bonnet, and wrapping fully around the hydrant.

12.3.4.1.3 Snow marking per Section 12.3.6 and Appendix "E".

12.3.4.1.4 Round hydrant ring matching color of reflective band and pole bands with 10.5" outside diameter and 4.75" inside diameter hole to fit over steamer connection.

12.3.4.1.4.1 Text on ring to be the following or as established by designer and fire authority.

12.3.4.1.4.1.1 "PUMP INTO SYSTEM AT 150 PSI" "INLET HYDRANT". Other pressures to be established by designer and coordinated with the AHJ.

12.3.4.1.4.1.2 "MAXIMUM 200 PSI", "NON-POTABLE – FIRE DEPT. USE ONLY".

12.3.4.1.5 Color of reflective identification (bands and poles) of the same system shall match.

12.3.4.1.6 See marking drawings Details #3, #5, #6 in Appendix B.

12.3.5 PRIVATE FIRE HYDRANTS SERVED BY CISTERNS / WATER SUPPLY:

12.3.5.1 Unless otherwise identified by the fire authority, these hydrants providing a water supply served by a cistern or other non-potable water source shall be painted and identified as follows:

12.3.5.1.1 A high-quality, UV resistant, Purple equal to Sherwin Williams SW9068 Berry Frappè, gloss finish. *[This uses Sherwin Williams 9068 which can be matched by others. Consider durability and quality of paint for longevity. Pipe and caps / fittings may be painted, ensuring the paint does not prevent removal of any caps or fittings. See App. A for color sample.]*

12.3.5.1.2 Provided with a minimum 1.5", High Intensity, reflective color band **(To Be Determined),** located just below the bonnet, and wrapping fully around the hydrant. *[The colored reflective band helps to associate the hydrant with the cisterns on the same system / zone.]*

12.3.5.1.3 Snow marking per Section 12.3.6 and Appendix "E".

12.3.5.1.4 Round hydrant ring matching color of reflective band and pole bands with ~10.5" outside diameter and 4.75" inside diameter hole to fit over steamer connection.

12.3.5.1.4.1 Text on ring to be as follows or otherwise directed by fire authority. *[Gravity pressures may be established after installation and based on cistern ½ full.]*

12.3.5.1.4.1.1 "FIRE DEPT. PRESSURIZED HYDRANT"

12.3.5.1.4.1.2 "NON-POTABLE - FIRE DEPT. USE ONLY" & "GRAVITY PRESSURE __ PSI".

12.3.5.1.5 Color of reflective identification (band and pole) of the same system shall match.

12.3.5.1.6 See marking drawings Details #3, #5, #6 in Appendix B.

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12.3.6 HYDRANTS SUBJECT TO CONCEALMENT BY SNOW

12.3.6.1 Where hydrants are subject to being concealed in snow, or where required by the AHJ, identification of hydrants shall be provided as directed by the AHJ in accordance with Appendix "E" and this section. The following terms and criteria shall apply unless directed otherwise. *[See Appendix "A" for example photos.]*

12.3.6.2 Port Mount 2.5" Outlet Pole (PMP-2.5).

12.3.6.2.1 5' Minimum length.

12.3.6.2.2 Steel or Fiberglass as directed by AHJ.

12.3.6.2.3 Minimum four reflective bands, alternating white and color. Color shall match supply zone where applicable or as otherwise identified by AHJ.

12.3.6.2.4 Rigid or Spring mount as directed by AHJ. *[Spring allows hydrant to be opened without having to loosen cap and also minimizes damage by kids/individuals who may permanently bend rigid rods.]*

12.3.6.2.5 Maximum 1/2" thickness at hydrant cap. Hydrant cap shall create a tight seal when under pressure against gasket/washer and also prevent pole from spinning when tight. *[Caps often fit differently and over time with washer shrinkage. Cap must ensure pole stays upright under normal conditions and also seals when hydrant is opened with all caps on.]*

12.3.6.2.6 Contractor to submit pole concept for AHJ acceptance. *[Subject to AHJ criteria, generally acceptable products include: Port, spring, and bolt mounts with color options www.rodoncorp.com.]*

12.3.6.3 Bolt Mount Pole (BMP)

12.3.6.3.1 5' Minimum length.

12.3.6.3.2 Stainless Steel, aluminum, or Fiberglass as directed by AHJ.

12.3.6.3.3 Minimum four reflective bands, alternating white and color. Color shall match supply zone where applicable or as otherwise identified by AHJ.

12.3.6.3.4 Rigid with lift and lay-over design or Spring mount as directed by AHJ. *[Spring allows hydrant to be opened without having to loosen cap and also minimizes damage by kids/individuals who may permanently bend rigid rods. Spring type can slap user in face if not held down.]*

12.3.6.3.5 May be secured to the back of Bonnet flange bolt or at back of ground flange bolt per AHJ. Spring style shall be mounted to underside if bonnet bolt is used to keep spring as low as feasible for operation. *[Securing to a ground flange bolt is easier to lay over when operating the hydrant tap valve. If spring type is mounted to bonnet flange it must be mounted to underside of bonnet and to not obstruct operation or laying over.]*

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12.3.6.3.6 Contractor to submit pole concept for AHJ acceptance. *[Subject to AHJ criteria, generally acceptable products include: fiberglass spring style with color reflectors equal to Hydra-Finder by trafficsafetyproducts.net; Fiberglass or aluminum fold-over and spring type from www.e-zguideproducts.com (verify color requirements vs options); color and fiberglass pole options www.rodoncorp.com.]*

12.3.6.4 Stand Alone Signage (SAS)

12.3.6.4.1 Sign post shall be minimum 24" from and to the rear of hydrant to allow operation of hydrant without obstructing connections.

12.3.6.4.2 Bottom of sign at minimum 5' above grade.

12.3.6.4.3 Pole shall extend into ground minimum 24-inches. User shall verify utilities prior to placement. Above ground post anchors may be used when secured to concrete. *[Verify post length as it may require separate segment in the ground, such as an anchor base, bolted to top segment to facilitate easy replacement when damaged.]*

12.3.6.4.4 Pole shall be standard highway grade traffic sign material of one of the following.

12.3.6.4.4.1 2" Galvanized square steel tube.

12.3.6.4.4.2 Heavy-Duty baked enamel or galvanized U-channel with minimum 1-3/8" channel depth.

12.3.6.4.5 Sign shall be reflective red and white on minimum .080-inch aluminum backing.

12.3.6.4.6 Contractor to submit sign and post concept for AHJ acceptance.

12.3.6.4.7 Preferred standardized size and appearance is 8" wide by 18" tall. *[Similar to R-001 by www.dornbossign.com]*

12.3.6.5 Dry-Hydrant connections such as at cisterns or ponds shall be identified by purple equal to Sherwin Williams SW9068.

12.3.6.6 Automatic and positive pressure hydrants, such as municipal hydrants. Where a color on reflective poles is not required to match a supply cistern/source the colored bands shall be reflective red and white. *[Red and white are generally reserved for hydrants or sources that are provided with a positive pressure such as a municipal type water supply or an automatic private fire pump that does not require fire department interactions to achieve a water supply.]*

12.4 HYDRAULICS AND CALCULATIONS

12.4.1 Private fire mains shall be evaluated by a qualified professional engineer to evaluate the following conditions at a minimum:

12.4.1.1 Elevation pressure loss / gain taking into account water supply, hydrants, and protected properties.

12.4.1.2 Friction loss through pipes. *[Piping with a C-factor of 150 is recommended.]*

12.4.1.3 Friction loss through fire hose lays from the hydrant to accepted parking area serving the attack fire truck(s). See Appendix A for fire hose friction loss values.

12.4.1.4 Altitude and impact on drafting operations. *[Altitude plays a significant factor in drafting and available lift.]*

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12.4.1.5 Resources of local fire authority(s) who will be providing primary and secondary response. *[Available water on truck to be used during connections, number of trucks, response times, pump flow / pressure ratings at altitude.]*

12.4.1.6 Isolation valves and locations to provide isolation during fire emergencies and maintenance operations. The type of valves (street valve / Post Indicator Valves) must be evaluated, located, and identified.

12.4.2 Unless accepted by the AHJ, the following limitations apply.

12.4.2.1 Private fire mains shall be not less than 6". See Section 10.7 for additional considerations requiring larger main size.

12.4.2.2 Private fire main hydrants shall not exceed 4,000' from a cistern or drafting water supply source. Equivalent pipe length with fittings (elbows, 45's, valves, T's, etc.) shall not exceed 4,300'. *[It is preferred that distances of a cistern to a hydrant not exceed 2,640' or ½ mile. However, factors such as elevations may support up to 4,000'. Friction loss through 900' of 4" fire hose is 180 psi at 1,000 gpm. As such, it is important to limit losses in the underground main to ensure fire trucks have required flow and pressures. Establishing what size hose the local fire authority will use between the hydrants and accepted parking area is critical.]*

12.4.2.3 Fire main shall be calculated to deliver the minimum flow identified in Section 5.5 or 6.5 as applicable with a residual pressure of 20 psi at the attack fire truck in an accepted parking area for the worst-case conditions. At a minimum, conditions shall account for drafting lift, altitude (absolute pressure), friction loss (pipe & hose), and elevations. *[Failure to deliver the appropriate pressures from a single engine at the cistern, through a hydrant and hose to the attack truck would require a third engine to relay between the hydrant and the hose to attack truck. This would defeat the objectives of this regulation in resources.]*

12.4.2.4 Hydraulic calculations shall account for hose friction loss based on the values identified in the "Theoretical Friction Loss in Fire Hose" table in Appendix A using worst case hose lay lengths utilized by the respective jurisdiction. {See App. E}

12.4.3 Wet fire mains shall be kept full of water to limit algae growth. Filling of the water mains needs to be accounted for when filling cisterns.

12.4.4 Drawings and hydraulic calculations shall be submitted to the AHJ or their representative for review and acceptance following permit procedures of the AHJ.

12.5 ACCOUNTING FOR ENTRAPED AIR IN FIRE MAIN

12.5.1 Fire mains and fire hydrant locations shall take into consideration the potential for entrapped air at high-points. *[Common domestic flows and regular flushing by utility companies reduces this potential on municipal systems. However, due to the limited use of the dedicated systems in this regulation they are more prone to entrapped air. Regular flushing / testing / training with these systems incorporating high-points is important.]*

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12.5.2 Where fire mains will be installed with various elevations, including high-points, fire hydrant spacing shall be adjusted to ensure a hydrant is provided as close to high-points as feasible to facilitate bleeding off excess air. *[As an example, a water main humped in the center, with the cistern location and the end of the system at lower elevations than a center point, will have air trapped at the high point. This trapped air will occur during initial installation and over time as air (gas) is released from the water and accumulates at this high-point following each system use / flush. Provisions must be provided to release this air and replenish the volume with water at regular inspection periods in accordance with Section 15 to avoid damage to fire pumps and equipment. Although full system flushing should remove much of this air, it will generally not remove all air or air released over time. It is recognized that the highest point may occur at an intersection of a roadway. In such cases, the hydrant may be located at the adjacent shoulder to provide the most effective venting. Pipe bury depth may be used to shift the location of a high-point.]*

12.5.3 If the inlet fire hydrant is a high-point, label as such. If cisterns are connected for gravity feed and are at the high-point, then air may vent through cistern tanks. Designer to evaluate.

12.5.4 High point hydrants shall be identified in accordance with Section 13 on the hydrant and on drawings.

13 SIGNS, IDENTIFICATION & TRACKING OF WATER SOURCES

13.1 GENERAL

13.1.1 House / Property address identification.

13.1.1.1 New and existing buildings shall be provided with accepted address identification. The address identification shall be legible and placed in a position that is visible from the street or road fronting the property. Address identification characters shall contrast with their background. Address numbers shall be Arabic numbers or alphabetical letters. Numbers shall not be spelled out. Each character shall be not less than 4 inches high with a minimum stroke width of $^1/_2$ inch. *[IFC 505]*

13.1.1.2 Where required by the AHJ, address identification shall be provided in additional approved locations to facilitate emergency response. Where access is by means of a private road and the building cannot be viewed from the public way, a monument, pole or other sign or means shall be used to identify the structure.

13.1.1.3 Address identification shall be maintained.

13.1.2 Equipment signage shall be provided and at minimum include the following:

13.1.2.1 Identification of the cistern per the fire authority's tracking system.

13.1.2.2 Nominal capacity of tanks/cisterns per the manufacturer.

13.1.2.3 Operating instructions, as coordinated by the fire authority.

13.1.2.4 Identification / Function of all connections.

13.1.2.5 Identification / Function of all valves.

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13.1.2.6 Emergency contact phone number.

13.1.2.7 Address(s) cistern is intended to serve for individual properties (under Section 5).

13.1.2.8 Other signage as identified by the AHJ during plan review and based on the particular configuration of each project. Information can be combined, such as individual property information. *[AHJ may have standard sign formatting with local sign shop.]*

13.1.3 Identification of Fire Hydrants

13.1.3.1 Hydrant color coding and marking shall also be in accordance with 12.3.

13.1.3.2 Indicating "Non-Potable - Fire Department Use Only"

13.1.3.3 Indicating static pressure or drafting use only

13.1.3.4 Hydrant number for tracking and service

13.1.3.5 Color coding as otherwise established by the AHJ

13.1.3.6 Identification of High-Point hydrants with "HIGH POINT VENT" stenciled or as otherwise accepted on barrel of hydrant. See Section 12.5 for locating these hydrants.

13.1.4 Street Valve Boxes

13.1.4.1 Valve boxes shall include base, stem, box top, and lid.

13.1.4.2 Lids to street valve box shall be cast iron.

13.1.4.3 Valve lids shall be labeled to clearly indicate Fire function.

13.1.4.4 Valve box top shall be flush with the surface on which it is installed. Adjustment risers shall be provided as necessary to ensure flush and smooth fit.

13.1.5 Signage at drafting location (cisterns / water sources).

13.1.5.1 All signage shall have reflective text on an aluminum DOT traffic grade base.

13.1.5.2 Text size shall be as identified in Appendix B details.

13.1.5.3 Signs shall be attached using bolt / screw anchors which allow removal and replacement.

13.1.5.4 Where provided, the signs are to be anchored to the protective pipe barrier, above / adjacent to respective fittings, or as otherwise accepted by the fire authority.

13.1.5.5 Signage and pavement marking shall be provided at all cistern locations with the following.

13.1.5.5.1 Traffic signs 12" x 18", red on reflective white, indicating "NO PARKING ANY TIME FIRE LANE – TOW AWAY ZONE", shall be provided at maximum 20' spacing on protective pipe barriers. Signs shall be no more than 10' from each end of designated fire truck parking.

13.1.5.5.2 Red road stripes indicating designated fire truck parking and marked with "FIRE LANE NO PARKING".

13.1.6 See Appendix B for signage details.

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13.2 REVIEW AND ACCEPTANCE

13.2.1 Contractor shall submit sign details with proposed printing, colors, sizing, etc. for review and acceptance by the fire authority prior to ordering.

13.2.2 All signage shall be installed prior to scheduling final commission inspection and testing.

13.2.2.1 When accepted by the fire authority, signage with pressures may be installed after testing to verify / confirm values to be used on signage.

14 FIRE LANES AND LOADING

14.1 GENERAL

14.1.1 Roadways through subdivisions shall have a minimum clear width of 20’ or as otherwise established by traffic authority reviews.

14.1.2 Roadways and driveways shall have a clear and unobstructed minimum height of 13’-6”.

14.1.3 Planting of trees shall account for this and ensure the clearance is maintained without requiring annual pruning.

14.1.4 Driveways shall be provided from a street to an accepted parking area in front of the residence or structures to be protected. This parking area is limited to 900’ from a point of water connection.

14.1.4.1 In accordance with IFC 503, a clear unobstructed width of 20’ shall be provided.

14.1.4.1.1 For residential driveway purposes, and unless otherwise determined by the fire authority, the following criteria may be used.

14.1.4.1.2 The road surface (gravel/asphalt/concrete) that a fire truck will travel may be reduced to 14’ in width for straight drives under the following conditions:

14.1.4.1.2.1 The additional 3’ on each side (20’ total) is compacted to support the weight of the truck without sinking.

14.1.4.1.2.2 The 20’ width remains clear of bushes, trees, boulders, poles, or other obstructions.

14.1.4.1.2.3 A single 12’ wide gate is permitted as long as it is at least 40’ back from where a truck would be parked in the accepted parking location.

14.1.4.2 At minimum, turns shall be provided with an inside turning radius of 28’ and an outside radius of 50’.

14.1.4.3 Dead end roads shall be limited to 150’ unless an accepted turnaround is provided.

14.1.4.4 For areas with snow, the drive shall account for being hidden in the snow. Means, such as slightly sloped sides, shall be provided to help distinguish the intended drive path throughout. Slope or feature shall be capable of driving on and not become a tripping hazard for operations around the truck.

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14.1.5 Alternatives to this section may be accepted by the AHJ after detailed review of road surface construction, loading, width, slope, grade, turns, distances to turn-around, dead-ends, slope on each side of roadways, traffic flow along roadway, and other similar factors that can impact emergency operations.

14.2 LOAD CRITERIA

14.2.1 Driveways shall be designed to accommodate a fire truck of minimum 50,000 lbs during all-weather conditions. {See App. E}

14.2.2 Compacted gravel should be incorporated on the sides and in curves to avoid a truck getting stuck in snow or mud conditions.

14.2.3 Subdivision roads and pull-outs for drafting operations shall be constructed to county / state road standards or as otherwise established by county traffic review.

14.2.4 The AHJ may require heavier loading criteria based on the hazard and equipment anticipated on the respective roadway surface.

14.3 GRADE / SLOPE

14.3.1 Unless otherwise accepted by the AHJ, grade and slope shall be in accordance with this section. {See App. E}

14.3.2 The maximum longitudinal slope for any apparatus access primary roadway shall not exceed 10%. *[Not more than a 10' elevation change over 100' distance, or 5' elevation change over 50'.]*

14.3.3 The maximum longitudinal slope for any fire apparatus access driveway shall not exceed 10%. *[Not more than a 10' elevation change over 100' distance, or 5' elevation change over 50'.]*

14.3.4 To accommodate proper angles of approach and departure, the gradient should not change more than 5% along any 10' section.

14.3.5 The transverse (cross)slope shall not exceed 4%.

14.3.6 Where a grade greater than those indicated are evaluated and permitted by the AHJ, primary structures, any structure within 25' of the primary structure, and any structure used for sleeping or provided with sleeping quarters (such as a guest house) shall be protected by fire sprinklers in accordance with NFPA 13, 13D, or 13R.

14.3.7 All cut and fill slopes shall be stable for the soil involved.

15 MAINTENANCE OF WATER SOURCES AND DELIVERY SYSTEMS

15.1 GENERAL

15.1.1 Unless identified within this section or Appendix E, mitigation, equipment, water levels, etc. shall be inspected, tested, and maintained in accordance with the IFC, CWRC, NFPA 25, NFPA 13D, manufacturer recommendations, and other applicable criteria.

15.1.2 Inspections, Testing, and Maintenance is hereby abbreviated and referenced as ITM. Definitions and intents are as follows *[NFPA]*:

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15.1.2.1 **ITM service** is a service provided by qualified personnel through which specific system components are inspected and tested at required frequencies and are maintained as necessary.

15.1.2.2 **Inspections** consist of a visual examination of a system or portion thereof to verify that it appears to be in operating condition and is free of physical damage. This can usually be performed by an owner or member of an HOA assigned to such duties. This includes but is not limited to visual inspection for damage, ensuring that caps are present on fittings, ensuring monitoring equipment has power, site lighting is operational, equipment is not obstructed, etc.

15.1.2.3 **Maintenance** consists of work performed to keep equipment operational. This includes but is not limited to fully operating valves (when safe to operate), lubricating valves, cleaning sensors, flushing lines, verification of sensors and alarms, checking gaskets, checking for wasp nests & ant mounds, clearing brush and weeds beyond regular landscape grooming, etc.

15.1.2.4 **Testing** is a procedure used to determine the operational status of a component or system by conducting periodic physical tasks. This includes but is not limited to flushing systems while verifying intended flows are achieved at the intended pressures, ensuring automatic fill systems are operating as intended, verification that level gauges are operating with water level fluctuations, removing trapped air from high-point hydrants, refilling all systems after testing, testing high and low level alarms, etc. Testing activities shall also include Inspection items by an independent party.

15.1.3 ITM shall be performed on all systems following implementation of this regulation.

15.1.4 Where required by other sections of this regulation, ITM frequencies may be reduced due to risk or as otherwise determined by the fire authority. *[See Section 6.]*

15.1.5 **RETROACTIVE:** Section 15 of the regulation is retroactive for all existing fire water systems that were installed prior to the adoption of this regulation. Effective immediately with the adoption of this regulation owners of fire protection water supplies shall implement steps / procedures to perform the required ITM as identified. ITM services shall be performed and submitted to the authority within 60 days of notification. *[Such systems were required to have ITM services in accordance with the International Fire Code as adopted and national standards. This process may not have been enforced to provide verification of such services. With the adoption of this regulation, existing systems shall be identified, tracked, and evaluated in accordance with this regulation to ensure they are functional.]*

15.1.6 ITM shall be performed by a qualified individual or company that possesses and has been trained over the applicable standards, including this regulation and performance requirements. Personnel shall be competent and capable individuals having met the requirements and training for a given field acceptable to the AHJ.

15.1.7 All ITM shall be documented indicating the following as a minimum:

15.1.7.1 Date

15.1.7.2 Who performed the inspection, testing, or service

15.1.7.3 Contact information

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15.1.7.4 What services were provided (checklist of all items evaluated)

15.1.7.5 Findings

15.1.7.6 Corrective actions shall be clearly identified and reported to the fire authority and system owner.

15.1.8 ITM records shall be maintained for a minimum of 5 years.

15.1.9 ITM records shall be provided to the AHJ upon request, and within 72-hours of such request.

15.1.10 Any items identified as needing repair or attention shall be corrected within 72-hours. The fire authority shall be immediately notified of the situation. The fire authority shall be consulted of any additional delays in the system being placed back in service.

15.1.11 Upon damage and repair of any equipment, full testing of the respective and associated equipment shall be performed to verify system compliance.

15.1.12 Any inspection or work involving entry into a cistern or other tank shall be in accordance with confined space entry criteria of the Occupational Safety and Health Administration by qualified personnel.

15.1.13 The fire authority may inspect and / or test systems for operational readiness. Unless informed otherwise such function does not take the place of owner required inspection and testing requirements. Liability of ITM is the responsibility of the system owner.

15.2 SNOW REMOVAL

15.2.1 Access to cistern parking areas, fittings, valves, level gauges, etc. shall be maintained year-round.

15.2.2 Snow shall be cleared within 24-hours (or as safe to do so) to ensure that emergency vehicles can see and access all equipment. This will require removal of snow between parking area and fittings behind bollards. *[Recognizing that the risk for house fires is higher in colder weather due to heaters, heat lamps, warming devices, fire places, etc.]*

15.2.3 The owner / Home Owners Association is responsible to maintain access to all equipment.

15.3 FREQUENCY

15.3.1 At a minimum, the following functions shall be performed:

15.3.1.1 Inspections shall be as identified on the "System Routine Inspections" checklist in Appendix D. Unless indicated otherwise, inspections shall be performed on a monthly basis. *[Some items such as internal tank inspections will be longer such as 10-year intervals.]*

15.3.1.2 Maintenance shall be as identified in the "System Maintenance" checklist in Appendix D. Unless indicated otherwise, maintenance shall be performed on a yearly basis. *[Some items may require quarterly or semi-annual maintenance.]*

15.3.1.3 Testing shall be as identified in the "Yearly Testing" checklist in Appendix D. Unless indicated otherwise, testing shall be performed on a yearly basis.

15.4 TESTING VOLUME AND PRESSURES

15.4.1 Systems shall be operated / flushed with adequate flow and pressure to remove trapped

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air and verify minimum system performance. Flows shall be verified with an accepted fire flow pitot with annually calibrated gauge. *[An acceptable pitot is one designed and intended for testing fire flows such as hydrants or fire pumps with no damage that would impact results.]*

15.4.1.1 For individual properties or individual shared properties (without a private fire main) systems shall be tested for drafting at a minimum flow as established by Section 5.5 to verify performance. Water may be returned to the tank in a means that can validate required flow.

15.4.1.2 For individual tanks serving commercial properties (without a private fire main) systems shall be tested for drafting at a minimum flow as established by Section 9 to verify performance. Water may be returned to the tank in a means that can validate required flow.

15.4.1.3 For private fire main systems served by a cistern or water source (systems with hydrants):

15.4.1.3.1 Yearly, the minimum flow shall be 250 gpm for each hydrant tested and long enough to verify system operation. Systems shall be pressure tested to a minimum of 150 psi and maintained for a period of 10 minutes.

15.4.1.3.2 At least every five years, systems shall be flushed at a flow equal to the design criteria per Sections 7.5, or 9. Systems shall be pressure tested to a minimum of 180 psi and maintained for a period of 10 minutes.

15.4.2 This includes the following components at minimum:

15.4.3 Drafting from cistern suction lines.

15.4.4 Flow through internal eductors (where provided).

15.4.5 Flow through private fire mains including furthest hydrant, dead-end main hydrants, and all high-point hydrants to vent air.

15.4.6 If a pump is left running while remote flushing is occurring, the operator shall ensure there is water circulation to avoid overheating the pump.

15.4.7 Tank level gauges shall be checked and verified operational during testing and changes in water levels.

15.4.8 Following flow testing, all cisterns shall be re-filled to full status as soon as possible, and not to exceed 72 hours.

15.4.9 The fire authority shall be notified prior to starting testing and estimated time that all tanks will be re-filled.

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15.5 NEW INSTALLATIONS AND COMMISSION TESTING

15.5.1 System shall be fully inspected and tested to ensure the system performs as designed and intended. This shall include flows and pressures.

15.5.2 The system designer shall prepare and provide a written test plan to the AHJ 15 days prior to scheduled testing. *[Templates may be provided in Appendix D or E as starting points.]*

15.5.3 The system designer shall ensure that the system has been functionally pre-tested and evaluated prior to scheduling the fire authority for final commission testing.

15.5.4 The system designer and the fire authority shall be present for final commission testing.

15.5.5 All test results shall be recorded including and pressures and flows at various test points and locations. All results shall be provided to the fire authority and the owner as part of complete as-built record documents. All documents shall clearly identify the design intent for future benchmark testing.

15.5.6 Consult with the fire authority and the design engineer for specific procedures.

15.5.7 Any items that do not satisfy the design intents shall be reviewed and corrective actions taken. Based on the circumstances of the deficiencies, full re-testing may be required by the AHJ.

15.5.8 Following flow testing, all cisterns shall be re-filled to full status as soon as possible, and prior to final acceptance.

15.6 SUMMARY OF INSPECTION, TESING, AND MAINTENANCE

15.6.1 Table 15.6 summarizes criteria of this Section.

15.6.2 Items not identified within Table 15.6 shall be as otherwise identified in Section 15, as established by the applicable NFPA Standard, or otherwise determined by the AHJ.

15.6.3 Table 15.6 deviates from NFPA 25 and is intended to provide the intended level of reliability while reducing costs.

15.6.4 Where it is identified that the frequencies provided are not adequate, more frequent inspection, testing, or maintenance shall be provided.

15.6.5 Where water is found to be dirty or contaminated such that it can impact or obstruct firefighting equipment, pumps, or nozzles, the fire authority shall be consulted for appropriate measures.

15.6.6 This section is still under development and review and is subject to modification by the fire authority. *[Many older systems have not been inspected. Based on evaluation of these older systems and from lessons learned, frequencies may be adjusted.]*

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Table 15.6: Inspection and Testing Frequency			
	Item	Frequency	Notes
	Access to system	Weekly	Ensuring nothing is blocking fire department access to the tank, connections, and function.
	Signage	Weekly	Ensuring signage is present, not obstructed, and legible.
	Illumination	Monthly	Night illumination is functioning.
	Caps and Fittings	Monthly Annually	In place; No damage visible. Removed for inspection
	Tank vents	Monthly Annually	No visible damage or obstructions Inspection for no obstruction or restriction when drafting from tank.
	Level gauge	Monthly Every 2-years	Verify tank level is full Verify gauge is operational during drafting operations.
	Cistern tank(s)	Monthly Annually	Covered; No visible damage Open and inspect access hatch; Visual inspection of water level;
	Pipes	Monthly Annually	Visual inspection for damage; Protected from sun Close inspection of dirt cover and/or wall penetrations for any exposed or damaged piping
	Water quality inspection	Annually	Sample from bottom for inspection of slime, algae, insects, silt. Ensuring water contaminants will not obstruct pump or hose nozzles.
	Internal tank inspection	Fiberglass / Poly = Every 10-years. Steel coated = Every 5-years. Concrete/Other = Every 5-years.	Remote camera to inspect fittings, anti-vortex plate, pipe supports, rust, silt, water quality,
	Water tank drafting test to verify operation	Every 2-years	Draft and return water into tank at minimum of design flow, or 500-gpm, whichever is lower.
	Operation of hydrants with minimum flow (5-gpm)	Annually	Each hydrant must be operated (fully open and closed) at a minimum flow of 5-gpm to prevent air from entering system. This is to ensure each hydrant is operational. A valve or hydrant cap with valve may be used with pressure applied to the system and any air bled off. (Failure to fully open/close a dry barrel hydrant can result in the drain valve at bottom of hydrant failing to seal and leaking.) Apply a minimum of 50-psi to system during testing and a flow of at least 5-gpm.
	Hydrant lubrication	Annually	Each hydrant must be lubricated and operated annually.

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	Private fire main flow test	Every 2-years at remote hydrant; May alternate other hydrants ensuring each hydrant (other than the most remote) is flushed at maximum of 4-year intervals. (Each hydrant still requires lubrication and operation yearly with minimum flow.)	Draft and flow design flow (see 5.5 or 7.7) for minimum of 30-seconds at each tested private hydrants to verify operation and measured flow capacity out of hydrants. If water is clean, it can be captured to return to tank. If water is not clean, see notes. Hydrants must be flowed at alternating 2-year intervals to not exceed 4-year maximum of flowing each hydrant. Most remote hydrant must be verified every 2-years. Start with hydrants closest to water source and work towards furthest for best flushing of entire system. Overall system must be flowed / flushed a minimum of 30-seconds for each hydrant on system.

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APPENDIX A – SUPPORTIVE INFORMATION

This section provides additional information and rationale to clarify the intent of enforcement provisions and calculations.

Examples of hydrant snow poles, hydrant rings, colors, etc. are provided under Section 12.

Also includes friction loss values for common fire hose sizes per 100’ length.

Users are encouraged to submit additional information for this and other sections to provide clarity.

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NOTES RELATED TO SECTION 1 OF REGULATION:

- **Objectives:** Objectives of this standard are to comply with NFPA 1140, 15.2, and ISO criteria for a sustainable water supply of 250 gpm within 5 minutes of the first truck arriving. Then increasing the flow based on size and construction, while being able to sustain at least 2-hours of flow (depending on hazard). Tender and hauling may be used in some conditions to substitute the duration requirements. During wildfire events, tender operations are not practical as every piece of equipment will be performing suppression operations. The focus of this regulation is not limited to a single structure fire, as most codes and standards are developed around. This regulation accounts for the reality of water requirements for fires beyond a single structure and/or to protect multiple structures such as in a subdivision.
- **Cross Jurisdiction Standards:** This document is developed to standardize criteria across multiple jurisdictions for training and mutual aid response. Each jurisdiction may provide some local amendments / variations based on their staffing, equipment, or other factors (Appendix E).
- **Individual Property Sizing:** Objectives of cistern sizing for an individual smaller home, is that the initial engine lays a line from next to the cistern to the house/fire and starts attack. The second engine will draft the cistern and pressurize the line to the attack engine. Thus, the first truck will have 750+ gpm to start attack. The second engine has 750+ gallons in addition to the cistern water. With the smaller sized cisterns having available water of ~9,300 gallons (assuming a 10,000 gallon tank size) there is an initial 10,800 available (within first 5 minutes of first truck arrival). This amounts to 43 minutes at 250 gpm for 10,750 gallons. Then the remaining 19,250 gallons at 250 gpm during the remaining 77 minutes (for 2 hour total), mutual aid departments would be providing tender water delivery to the cistern location and refilling the cistern. It should be noted that some fire engines only carry 500 – 750 gallons of water. Some rural engines may be more likely to carry 750+ gallons.
- **Subdivision Quantity:** Objectives of cistern sizing for subdivisions, with a private hydrant distribution system, is that the initial engine grabs the closest hydrant/source and lays to the house and starts attack. The second engine will grab the cistern(s) and pressurize the private fire main and hydrants (with hose lay to first engine). Thus, the first truck may have 750+ gpm to start attack. The second engine has 750+ gallons in addition to the cistern water. With subdivision supplies starting at 30,000 gallons and generally higher, there is adequate water to satisfy the minimum ISO requirements of 250 gpm for 2-hours. Additional water for subdivisions is intended due to large house sizes, protection of multiple exposures during wildland fire conditions, and to ensure water for other structures during refilling of the tanks after one fire. Properties with Medium to High Intensity fuel loads are provided with additional water to support suppression activities.
- **Subdivision Private Mains:** Subdivisions will utilize minimum 6” private fire mains with hydrants spaced to achieve 900’ to the accepted parking area in front of the

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structure. Cisterns will be located based on friction loss and elevation considerations. See drawing "Detail #1 Site Plan Private Hydrant Concept" in Appendix B for how this concept is laid out. Multiple groups of cisterns may be provided in larger subdivisions and based on elevations and distances.

- **300' Hose Lay:** Limitations for the 300' hose lays around a structure are based on pre-connected hose that is readily available on a truck. This may involve direct 1-3/4" hose or extending a 2.5" hose branching off to two 1-3/4" hoses. This length varies by department and by truck depending on typical needs of each department and truck.
- **Sprinkler Credits:** It is important to recognize that sprinkler systems are not designed nor intended to extinguish a fire. Their intent is two-fold:
    - Provide time for occupants, especially those sleeping, to escape an incipient stage fire while reducing the chance of a dangerous flashover.
    - Control the fire until the fire department can arrive to fully extinguish the fire.

  Although most fires are controlled with the automatic activation of 1-3 sprinklers in the fire compartment, and a timely response of a firefighting personnel, this is not always the case. Residential sprinklers do not provide protection in combustible concealed spaces such as attics, walls, crawl spaces, etc. They are generally limited to occupied spaces to give occupants time to escape. In addition residential sprinklers frequently do not protect garages unless required by the AHJ or specific circumstances. Therefore, a fire that starts or gets into an attic, wall cavity, or garage can grow rapidly without quick manual firefighting intervention. Sprinkler credits are provided due to their history of success. However, it is essential to still ensure water is available for those cases or events that occur outside the protection area of sprinklers. This includes necessary water for exterior fires to protect exposures.
- **Mitigation:** Assessments for risk mitigation, fuel intensity, etc. may be initially established by GIS/WUI maps, on-site third-party assessments, or the AHJ. Criteria of assessments per the Colorado Wildfire Resiliency Code should be utilized. For this regulation, the AHJ has the authority to establish the final determination based on information available to them.

NOTES RELATED TO SECTION 2 OF REGULATION:

- **Permitting & Plan Review:** The jurisdiction will need to establish if fire protection systems under this regulation are reviewed and inspected under existing permitting systems and procedures, or new procedures will need to be established. Contractors should be responsible for all preliminary testing. This includes pressure testing of underground fire mains in accordance with NFPA 24. NFPA 22 and NFPA 25 should be used for tank testing.
- **Performance Commissioning:** should be a two-step process.
    - The installation contractor should be held responsible to initially test the system using portable pumps to verify drafting and pressurizing of any hydrant system.
    - Once contractor verifications have been performed and verified to not have trash in the piping or tanks, leaks (air and water), level gauges calibrated, alarms verified, all

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threads verified for size and thread type, etc., then the fire authority can provide an engine to check and establish final flows.

- **Learning Curve:** Note that there will be a learning curve for the first several systems within each jurisdiction. Systems shall be tested to establish exactly what flow can be achieved with what pressures, and other such conditions for the altitude and various conditions. Therefore, it is critical to ensure that the proper designers are present to evaluate system performance. System needs to be tested at multiple flows to evaluate discharge and suction pressures. All data shall be evaluated and compared to original expectations prior to confirmation on system pass / fail or necessary modifications. Sending test results to the author of this standard will help to evaluate and improve criteria.
- **Checklists**: Checklists should be created and provided for plan reviews and inspection items to be recorded. Some such checklists and standardized forms are included within Appendix D.

NOTES RELATED TO SECTION 3 OF REGULATION:

- **Municipal Type Supply:** The criteria identified for municipal systems of 1,000 gpm at 20 psi is intended for residential occupancies and will need to be evaluated based on factors of elevation and hazards. Municipal systems should be capable of providing 1,000 gpm at pressures over 20 psi to be most effective for fire operations and only a single truck. Pressures below this will likely require a second truck to catch the hydrant and boost pressures to the attack truck. This will vary based on where the fire is and distance from hydrant to the attack truck. Friction loss of the hose lay and the fire authority hose size must be evaluated. Hydrants need to be marked to identify anticipated pressures and flows to clearly identify if the first engine can get the water needed, or a second relay truck is required. The consideration needs to account for the available water from the municipal system vs. installing and maintaining cisterns and underground systems.
- **Documentation:** A standardized Municipal Fire Water Evaluation form to document the feasibility of a municipal type system for fire suppression is provided in Appendix D.

NOTES RELATED TO SECTION 4 OF REGULATION:

- Section 4 is very short to trigger requirements of other sections when a municipal type water supply is not available. This section may be expanded at a later time.

NOTES RELATED TO SECITON 5 OF REGULATION:

- **Sharing of Cisterns:** This section promotes multiple individual owners sharing cisterns(s). This criterion requires the hose lay distance of 900’ from water source to accepted parking area in front of a house. There is then a distance limitation of 40’-60’ from the parking area to reach at least a part of the house. There is also a 300’ limit to reach around the house or structures with handlines. This distance is based around the anticipated 10,000 ft2 houses for some lots. If houses are multiple stories, then this footprint would likely be smaller. If private homes want to share cisterns and the distance from the cistern is >900’ then they would also have to provide a private hydrant system similar to subdivisions to ensure the 900’ distance to a water source is achieved. This distance is based

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on limits of hose on a truck and to satisfy ISO maximum distances of 1,000' from a water source to a structure.

- **Sample Calculations:** Various scenarios are included in Appendix D to include low density and moderate density conditions, sprinklers, sharing of cisterns, and more to be developed. Calculation forms are provided in Appendix D and should be completed and submitted with design documents.
- **Enforcing Maintenance:** The maintenance for sharing cisterns, and underground piping if applicable, needs to be clearly established to be legally enforceable. Such criteria should be recorded with property deeds.
- **Future Additions / Renovations:** Additions and renovations to properties need to be evaluated to the original design and sizing criteria to verify if water volumes need to be increased. It is the owner's responsibility to perform and provide such evaluations.

NOTES RELATED TO SECTION 6 and 7 OF REGULATION:

The enhanced regulations were originally established with Section 7 intended to provide fire mains and hydrants in subdivisions, like urban and suburban subdivisions. Per Section 7 the hydrant system is pressurized by one fire truck with a single driver drafting from a cistern(s) and pressurizing the fire main. By using this one truck all the hydrants along that main are supplied with water, supporting structure and wildfire activities over a large area. Section 7 therefore provides the intended level of protection for life safety, property protection, and improved insurance options and a potential for lower rates due to available water. In addition, NFPA 1140, 15.2 has a requirement for a water supply to be established and maintained within 5 minutes. This generally cannot be achieved with shuttles. The goal of reducing ISO / PPC insurance ratings cannot be achieved without adequate water supply in a timely manner. Thus, it is essential that new developments satisfy such requirements for class 8b or less based on the goals of the jurisdiction.

Home builders / developers expressed concerns over the increased cost for the hydrant infrastructure per Section 7. There was also concern that this added cost would not be accounted for by appraisers in properties loanable value. As such, the jurisdictions were encouraged to provide an alternative level of protection for life safety and property protection if Section 7 could not be justified. Section 6 was created based on older criteria that required additional resources and personnel hauling water. Section 6 now provides for the water within a subdivision but requires tender/tanker trucks to shuttle the water to the fire. If a fire is close enough to the water source, it may be possible to lay hose lines to reach between the drafting truck and the attack truck. However, these hose lengths are limited by friction loss and available hose. There was also additional concern and request for longer hauls of water up to 2 miles away. This will generally require a third party to pay for and maintain a water source for other people to freely use. Fairness of who is paying to provide and maintain this water is of great concern. In addition, the legal liability for this third party to ensure the system is always operational and full for multiple back to back fires or wildfire events is unconceivable. You would have legal agreements (as required for such a process and as required by NFPA 1142) for all these properties depending on a few water sources. During a large event there would not be enough water for the demands. The third party then becomes liable. To address this, specific requirements had to be incorporated into Section 6 for such conditions.

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Fires involving hauled water will typically require an attack truck at a residence (up the driveway from the street for larger lots), a relay truck at the street where a tender/tanker can dump water into a portable drafting tank to be drafted by the relay truck to pressurize a supply hose up to the attack truck. Typically, multiple tenders refilling and shuttling water from a remote water source, as established by the water supplies in accordance with Section 6, are then used to resupply the relay truck. Tender trucks typically only carry 1,000 – 2,000 gallons of water at a time which can be used by the attack truck(s) within 1-10 minutes. Establishing tender shuttle operations can often take 30-45 minutes to get established, depending on where the other resources are coming from (often adjacent fire departments). With rural fire departments, staffing is limited and every person is one more that could be helping to perform rescue / fire ground suppression activities. During wildfire events these other departments / tenders are often committed to other suppression activities, and shuttle trucks may be limited if even available. To ensure that the provisions of Section 6 would not compromise a jurisdiction who is trying to improve their ISO / PPC insurance ratings, the use of Section 6 requires the developer to pay for a water supply evaluation. With the concerns and restrictions of the concepts in Section 6, the criteria of Section 7 shall be utilized unless otherwise documented by the developer and acceptable to the AHJ. Insurance companies may establish that compliance with this regulation including Section 7 provides an enhanced level of protection allowing more choices and/or reduced rates over those protected per Section 6, or with no formalized water sources. The criteria of Section 3 utilizing municipal type water supplies with hydrants are the preferred approach over Sections 6 & 7.

NOTES RELATED TO SECTION 7 OF REGULATION:

- **Private Fire Mains / Hydrants:** In this section, subdivisions utilize minimum 6" private fire mains with hydrants to distribute a sustained water supply utilizing one driver and one drafting fire truck. This driver can then supply water to all the hydrants along that section of the subdivision, including an attack truck served by a hydrant up to structure fires. This also greatly enhances resources trying to distribute multiple hose lines for wildfire protection within a subdivision. Cisterns with the inlet hydrant will be located based on friction loss, elevation, and maximum separation distances. See Notes related to Section 6 above for additional reasoning for utilizing Section 7. See drawing "Detail #1 Site Plan Private Hydrant Concept" in Appendix B for how this concept is laid out.
- **Establishing 900' Distance:** This distance may vary by jurisdiction based on the amount of large diameter hose that jurisdiction caries on their trucks. Friction loss and elevation must be factored into each location with the required pressure to deliver the necessary water. For preliminary design and plan review purposes the 900' travel distance to an accepted parking area should be conservative. The criteria for the back 2/3rd part of a property is to give the unknown future owner flexibility in the house placement. When there are restrictions such as drainage or easements that would prevent a structure to the rear of the property this should be identified on the plat. In addition, there could be drainage or easement restrictions in the center of a property that could push a building further back on a property. Failure of the designer to be conservative can place design restrictions on the future owner. The AHJ shall not be held responsible for the developer not providing the proper distance from a water source to a proposed building lot. If in doubt the designer should add an additional

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hydrant to reduce spacing limitations. Maximum spacing of 1,000' from a water supply to a structure is critical to satisfy ISO insurance guidelines. 900' Is used in this regulation to be realistic with truck hose limitations and actual hose lays and bending radius at connections.

- **Cistern Spacing:** The distance between cisterns / groups of cisterns in large subdivisions needs to be carefully evaluated. Section 7 has a restriction of not more than 4,000' from a cistern to the furthest hydrant. Friction loss and elevation can significantly impact the performance of a system. It is feasible that one cistern or group of cisterns would be placed at the highest point in a subdivision with a gravity feed to the main. Then, at a further remote location a second group of cisterns be provided. If the second group is at a lower elevation, then these tanks should not be provided with gravity feeds or be isolated from the main served by the higher tanks. Failure to plan around this could result in the higher tanks overflowing the lower tanks due to elevation. The difference in pressures needs to be carefully evaluated to the effectiveness of trucks being able to pump from elevations that are too low and in addition to drafting limitations.
- **Mitigation:** The mitigation assessment needs to be performed and clearly established before initial development plans are submitted. This is so that the proper water quantities and design are prepared up front. It is recognized that mitigation may not occur until after initial development plans are accepted and final funding obtained by the developer to start construction. Mitigation must be completed prior to the issuance of building construction permits for any structure, residential or commercial, within that respective subdivision plat / filing. The criterion of this regulation allows the AHJ to stop work if mitigation is not completed or maintained prior to or during building construction activities. The start of construction is considered the issuance of a building permit for a residence or commercial building. No work shall start without mitigation completed, or a new water assessment and additional water provided, as identified. If a developer has started construction without mitigation, then the credits for Low Intensity shall be voided and additional water for Moderate – High Intensity shall be provided prior to resuming construction activities. This includes after roads, sidewalks, and other infrastructure that has been installed. The costs of such changes are the developer's responsibility for failure to comply with initial commitments.

NOTES RELATED TO SECTION 9 OF REGULATION:

- Commercial structures need to be carefully evaluated based on occupancy (now and potentially in the future). A change of occupancy requires a full new code assessment and may require additional water supply, cisterns, or other requirements. However, the function and occupant load could change without triggering a change of occupancy/use upgrade. Therefore, it is critical that the current intended occupancy take into account any potential use under that occupancy classification and for the type of construction. The potential spread of fire between adjacent commercial businesses may be higher than houses on separate lots of multiple acres. Thus, additional water quantities for exposure protection should be evaluated. NFPA 13 sprinkler systems should be utilized for larger structures / hazards in rural areas with reduced resources.

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NOTES RELATED TO SECTION 10 OF REGULATION:

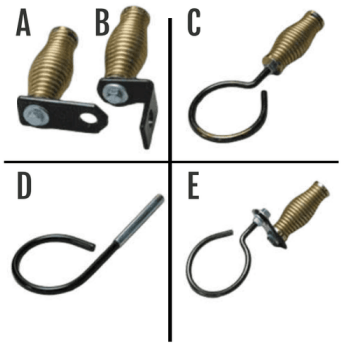
- **Drafting Eductor:** Drafting eductors have been extensively used and proven for fighting fires where rivers, ponds, lakes, etc. are the available water source. They can be used without the use of hard-suction hose by apparatus that does not carry hard-suction, or when gaskets or failures occur and a prime cannot be achieved due to air within suction line. As outlined within this regulation, they provide a redundant means to access valuable water in the event of hard-suction challenges. This regulation triggers eductors when larger volumes of water are identified as necessary and multiple cistern tanks / sources are provided. A primary responding truck capable of hard-suction drafting can utilize a direct piped hard-suction dry-hydrant line. If additional water is required to supply a fire scene or to separately refill tenders, the initial truck (twin-tube drafting) or a second truck can take advantage of the additional eductor equipped connection. While the initial truck is already committed in position with a hard-suction, the use of flexible hose and the eductor provides for increased suction capacity and reduced stress on the pump. A cistern tank as shown in Detail #4B can be fabricated with fittings to allow an eductor (at minimal extra cost). By plugging the inlet pressure fitting and inserting a straight internal suction pipe, it can easily be used without an eductor. As such, multiple tanks could be ordered the same (with provisions) and then field configured based on placement. Hard-suction drafting from an eductor equipped fitting without pressurizing the venturi will reduce available flow due to venturi throat restrictions. However, using hard-suction hose with venturi pressure can increase available flow vs using soft hose or standard dry-pipe drafting.
- Internal Cistern Check Valve: Where a cistern or other tank is at an elevation that can provide gravity pressures to a private fire main (hydrants), a check valve can prevent pressurized supply water (from drafting truck) from returning back into the tank. This could be especially beneficial where a single cistern / tank is provided. If multiple cisterns are connected together with the same pipe to serve automatic equalization of tank levels, and supply downstream hydrants, then the check valve impacts automatic equalization. The check valve will prevent water levels from equalizing between the tanks. To get around this, a separate pipe connecting all the tanks could be provided for automatic equalizing of tank levels. Thus, all tanks connected with an equalizing line, and all tanks connected to a gravity feed line. Although a single tank could supply a gravity feed line, connecting each tank is recommended with isolation valves provided to allow individual tank isolation during future required inspections / maintenance.
  Detail #2 “Cistern Tank Placement with Associated Piping” utilizes a black Post Indicator Valve (PIV). This valve is utilized to limit water from the drafting truck that is pressurizing the underground main, returning back to the tanks once the drafting truck starts to pressurize the underground. Cracking this valve slightly open allows for limited return water to help with pump cooling during times that fire operations are not utilizing water.
- Tank Valves and Bury Depth: Multiple tanks should be provided with piping to equalize water levels. Valves should be provided to allow for individual tank isolation as inspections and maintenance will be required. The depth of bury for isolation valves must be accounted for, considering the tank depth and the frost line bury depth. Valves buried deeper than 7’ below grade may be impractical to isolate with a PIV or valve key. The concept of burying the tanks above street grade (Detail #4B), and the locating the isolation valves out in front of the protective pipe barrier at street grade (Detail #2) provides for an acceptable depth to tank isolation valves.

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NOTES RELATED TO SECTION 12 OF REGULATION:

Examples of Hydrant Marking and Signs: Products are not limited to the products mentioned here and we cannot endorse specific products. Some examples are manufactured by RoDon Corporation www.rodoncorp.com and are available through various distributors. We have provided these brands as they offer several products and offer custom configurations. Other products such as custom signs are available through Dornbos Sign www.dornbossign.com or a local supplier.

Reflective Poles



Port or Bolted Mount Pole Holders



Hydrant Number Tags



Custom Hydrant Rings with Custom Printing and Colors



Non-Potable Color SW9068



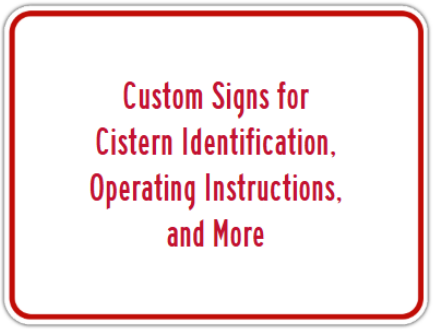
Reflective Collars



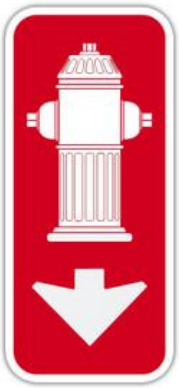
Trumbull mfg. Port Mount



Custom Address



Cistern Identification, Pipe Identification, Etc.



Hydrant Sign for Pole Mount

NOTES RELATED TO OTHER SECTIONS MAY BE PROVIDED IN FUTURE.

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Provided as a reference to evaluate common friction loss in fire hose. May vary by Manufacturer.

National Fire Equipment Ltd.
Interior Fire Protection - January 2003

Theoretical Friction Loss in Fire Hose

Pressure Loss per 100 feet (psi)												
	Hose Diameter											
gpm flow	3/4"	1"	1 ½"	1 ¾"	2"	2 ½"	3"	3 ½"	4"	4 ½"	5"	6"
12	16	2	0									
20	44	6	1	1	0							
23	58	8	1	1	0							
30	99	14	2	1	1	0						
45	223	30	5	3	2	0						
60	396	54	9	6	3	1	0					
95		135	22	14	7	2	1	0				
125		234	38	24	13	3	1	1	0			
150		338	54	35	18	5	2	1	0			
200			96	62	32	8	3	1	1	0	0	
250			150	97	50	13	5	2	1	1	1	0
300			216	140	72	18	7	3	2	1	1	0
350			294	190	98	25	10	4	2	1	1	1
375				218	113	28	11	5	3	1	1	1
400				248	128	32	13	5	3	2	1	1
450				314	162	41	16	7	4	2	2	1
500					200	50	20	9	5	3	2	1
550					242	61	24	10	6	3	2	2
600					288	72	29	12	7	4	3	2
650					338	85	34	14	8	4	3	2
700						98	39	17	10	5	4	2
750						113	45	19	11	6	5	3
800						128	51	22	13	6	5	3
850						145	58	25	14	7	6	4
900						162	65	28	16	8	6	4
950						181	72	31	18	9	7	5
1000						200	80	34	20	10	8	5
1250						313	125	53	31	16	13	8

References: National Fire Protection Association (NFPA) Fire Protection Handbook - 17th Edition
International Fire Service Training Association (IFSTA) Fire Protection Publications - Fire Stream Practices - 7th Edition
These figures may vary depending on manufacturer and age of hose.

Formula for Friction Loss: $FL = CQ^2 L$

FL = Friction Loss in psi — **Q = Flow rate in hundreds of GPM**
C = Friction Loss coefficient — **L = Hose length in hundreds of feet**

Hose Diameter and Type (Inches)	Coefficient	Hose Diameter and Type (Inches)	Coefficient
¾" booster	1,100	3" with 2 ½ couplings	0.8
1" booster	150	3 ½"	0.34
1½" rubber lined	24	4"	0.2
1 ¾" with 1 ½" couplings	15.5	4 ½"	0.1
2" rubber lined with 1 ½" couplings	8	5"	0.08
2 ½ "rubber lined	2	6"	0.05

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APPENDIX B – CONCEPT DRAWINGS & IMAGES

This section provides concept details to reinforce objectives of this regulation.

Project designers are responsible for establishing final details and drawings specific to each project.

Details Include:

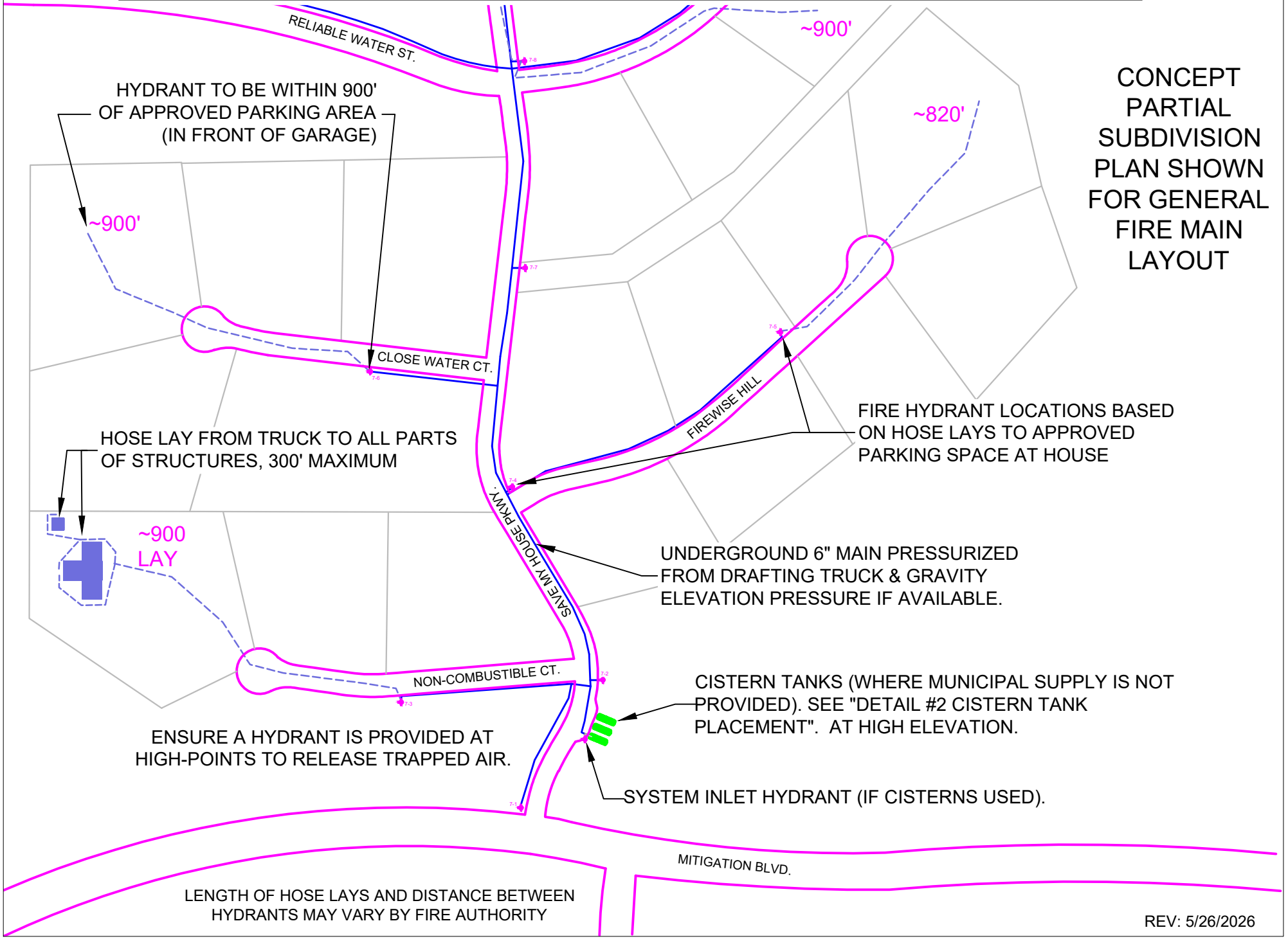
- Detail #1: Site Plan Private Hydrant Concept
- Detail #2: Cistern Tank Placement With Associated Piping
- Detail #3: Cistern Signage and Connection Placement
- Detail 4A: Basic Cistern Configuration (Individual / Shared Property)
- Detail #4B: Cistern with Integrated Eductor for Universal Operation
- Detail #5: Inlet Fire Hydrant for Fire Truck to Pressurize
- Detail #6: Private Fire Hydrant – Served by System
- Detail #7: Drafting Eductor Mounting Inside Cistern Tank
- See Appendix D for Detail #8: Calculations and Mitigation Concepts
- Detail #9: End View of Barrier Wall – Individual Property

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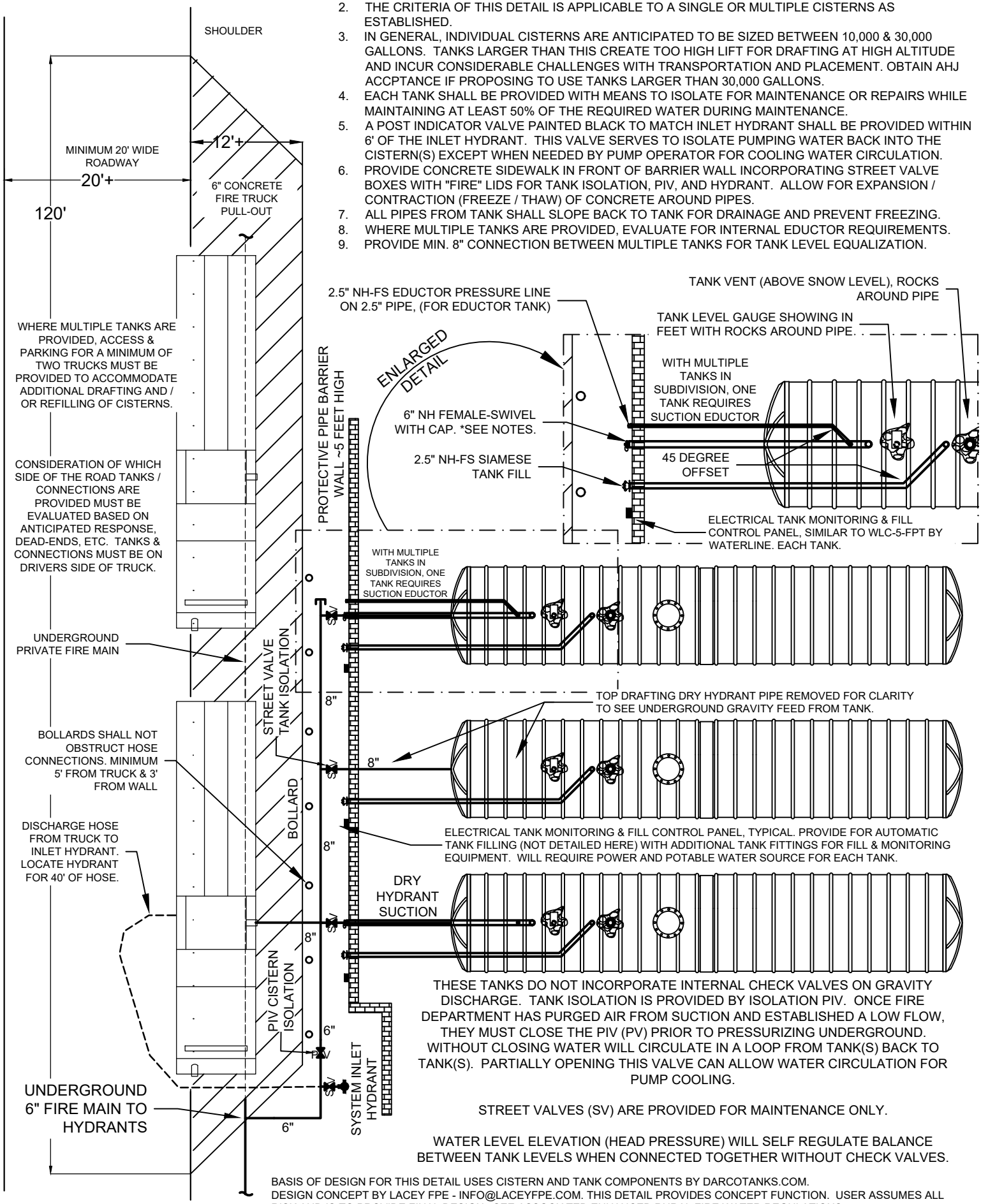
ERFWR DETAIL #1 SITE PLAN PRIVATE HYDRANT CONCEPT



ERFWR - DETAIL #2 CISTERN TANK PLACEMENT WITH ASSOCIATED PIPING

GENERAL NOTES:

1. THIS DETAIL OUTLINES GENERAL EXPECTATIONS FOR CISTERN PLACEMENT, FITTINGS, PULLOUT, VALVES, BOLLARDS, DIMENSIONS AND FUNCTION.
2. THE CRITERIA OF THIS DETAIL IS APPLICABLE TO A SINGLE OR MULTIPLE CISTERNS AS ESTABLISHED.
3. IN GENERAL, INDIVIDUAL CISTERNS ARE ANTICIPATED TO BE SIZED BETWEEN 10,000 & 30,000 GALLONS. TANKS LARGER THAN THIS CREATE TOO HIGH LIFT FOR DRAFTING AT HIGH ALTITUDE AND INCUR CONSIDERABLE CHALLENGES WITH TRANSPORTATION AND PLACEMENT. OBTAIN AHJ ACCPTANCE IF PROPOSING TO USE TANKS LARGER THAN 30,000 GALLONS.
4. EACH TANK SHALL BE PROVIDED WITH MEANS TO ISOLATE FOR MAINTENANCE OR REPAIRS WHILE MAINTAINING AT LEAST 50% OF THE REQUIRED WATER DURING MAINTENANCE.
5. A POST INDICATOR VALVE PAINTED BLACK TO MATCH INLET HYDRANT SHALL BE PROVIDED WITHIN 6' OF THE INLET HYDRANT. THIS VALVE SERVES TO ISOLATE PUMPING WATER BACK INTO THE CISTERN(S) EXCEPT WHEN NEEDED BY PUMP OPERATOR FOR COOLING WATER CIRCULATION.
6. PROVIDE CONCRETE SIDEWALK IN FRONT OF BARRIER WALL INCORPORATING STREET VALVE BOXES WITH "FIRE" LIDS FOR TANK ISOLATION, PIV, AND HYDRANT. ALLOW FOR EXPANSION / CONTRACTION (FREEZE / THAW) OF CONCRETE AROUND PIPES.
7. ALL PIPES FROM TANK SHALL SLOPE BACK TO TANK FOR DRAINAGE AND PREVENT FREEZING.
8. WHERE MULTIPLE TANKS ARE PROVIDED, EVALUATE FOR INTERNAL EDUCTOR REQUIREMENTS.
9. PROVIDE MIN. 8" CONNECTION BETWEEN MULTIPLE TANKS FOR TANK LEVEL EQUALIZATION.



THESE TANKS DO NOT INCORPORATE INTERNAL CHECK VALVES ON GRAVITY DISCHARGE. TANK ISOLATION IS PROVIDED BY ISOLATION PIV. ONCE FIRE DEPARTMENT HAS PURGED AIR FROM SUCTION AND ESTABLISHED A LOW FLOW, THEY MUST CLOSE THE PIV (PV) PRIOR TO PRESSURIZING UNDERGROUND. WITHOUT CLOSING WATER WILL CIRCULATE IN A LOOP FROM TANK(S) BACK TO TANK(S). PARTIALLY OPENING THIS VALVE CAN ALLOW WATER CIRCULATION FOR PUMP COOLING.

STREET VALVES (SV) ARE PROVIDED FOR MAINTENANCE ONLY.

WATER LEVEL ELEVATION (HEAD PRESSURE) WILL SELF REGULATE BALANCE BETWEEN TANK LEVELS WHEN CONNECTED TOGETHER WITHOUT CHECK VALVES.

BASIS OF DESIGN FOR THIS DETAIL USES CISTERN AND TANK COMPONENTS BY DARCOTANKS.COM.
DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN. SEE ASSOCIATED ENHANCED RURAL FIRE WATER REGULATIONS. REV: 5/26/2026

ERFWR - DETAIL #3 CISTERN SIGNAGE AND CONNECTION PLACEMENT

SIGNAGE AND CONNECTION NOTES:

1. SIGNS SHOWN ARE UNIVERSAL FOR MULTIPLE APPLICATIONS. IF TANKS WILL HAVE INTERNAL TURBODRAFT EDUCTOR THAN APPLICABLE SIGNAGE SHALL BE PROVIDED. IF A PARTICULAR TANK WILL NOT HAVE INTERNAL EDUCTOR THEN SELECT APPROPRIATE SIGNAGE.
2. ALL SIGNAGE TO BE TRAFFIC GRADE ALUMINUM, MINIMUM 1.5" HIGH TEXT FOR INSTRUCTIONAL SIGNS AND MINIMUM 2" HIGH TEXT FOR IDENTIFICATION SIGNS, REFLECTIVE RED BORDER, REFLECTIVE RED TEXT, REFLECTIVE WHITE BACKGROUND. UV RESISTANT TO FADING.
3. CISTERN ZONE IDENTIFICATION SIGN SHALL HAVE MINIMUM 4" TEXT AND MINIMUM 3" TEXT FOR GALLONS. ZONE IDENTIFICATION TO BE DETERMINED AND PROVIDED BY THE AHJ.
4. CISTERN ZONE WILL GENERALLY APPLY TO THAT CISTERN OR GROUP OF CISTERNS AT SAME LOCATION. PROVIDE SIGN WITH GALLONS AND TANK # FOR EACH TANK.
5. TEXT SHOWN ON SIGNS IS NOT TO SCALE. COORDINATE FINAL TEXT AND SIGN SIZING WITH SUPPLIER.
6. CONNECTIONS ARE TO BE LOCATED AS INDICATED.
   - 6.1. SUCTION LINE TO BE LOWEST TO KEEP AIR MOVING UPWARDS TOWARDS PUMP.
   - 6.2. WHEN EQUIPPED, EDUCTOR INLET TO BE ON LEFT OF SUCTION (SUPPLIED FROM REAR OF TRUCK DISCHARGE LINE).
   - 6.3. TANK FILL SIAMESE TO BE ON RIGHT OF SUCTION LINE AND HIGHER TO ENSURE LINES CAN BE ROUTED TO AVOID PUMP OPERATOR MOVEMENT. WITH MULTIPLE CISTERNS, REFILLING TENDERS CAN UTILIZE SIAMESE ON OTHER TANKS (BEHIND DRAFTING TRUCK).
   - 6.4. ELECTRONIC TANK MONITORING PANEL TO BE RIGHT OF SIAMESE FOR ACCESS BY PUMP OPERATOR. FOR SUBDIVISIONS, ELECTRONIC MONITORING IS TO BE PROVIDED IN ADDITION TO MECHANICAL TANK LEVEL GAUGE.
   - 6.5. PROVIDE VISUAL STROBE FOR TANK ALARM(S).
7. PROVIDE FOR AUTOMATIC TANK FILL LINE. WHEN ELECTRONIC MONITORING IS PROVIDED IT IS TO BE INTEGRATED TO OPERATE A TANK FILL SOLENOID.

FIRE TRUCK MUST DRAFT AND PUMP INTO BLACK FIRE HYDRANT TO PRESSURIZE UNDERGROUND MAIN TO DELIVER WATER TO OTHER HYDRANTS IN SAME ZONE. ENSURE ATTACK TRUCKS ARE USING HYDRANTS ON SAME ZONE.

THIS CISTERN HAS AN INTERNAL EDUCTOR. IF USING WITHOUT HARD SUCTION, USER MUST PRESSURIZE EDUCTOR "INLET" WITH 150-180 PSI USING TANK WATER TO START DRAFTING FLOW THROUGH LARGE DIAMETER HOSE FROM SUCTION LINE TO PUMP INLET. BLEED OFF AIR. REFILL TRUCK TANK.

PRESSURIZING INLET, & DRAFTING WITH HARD SUCTION WILL INCREASE FLOW. USER MUST MAINTAIN DISCHARGE PRESSURE ~150 PSI TO MAINTAIN FLOW FROM CISTERN USING SOFT SUCTION.

ONCE LOW FLOW IS ESTABLISHED, CLOSE BLACK POST INDICATOR VALVE NEXT TO BLACK HYDRANT. OTHERWISE YOU ARE PUMPING WATER BACK INTO TANKS AND NOT HYDRANTS. VALVE CAN BE CRACKED OPEN TO MAINTAIN CIRCULATION / COOLING. CLOSING STOPS ALL GRAVITY FEED TO HYDRANTS.

[SIGN ABOVE FOR SYSTEMS INCORPORATING TURBODRAFT EDUCTOR.]

FIRE LANE SIGNS ON BARRIER WALL AND ROAD STRIPPING PER SECTION 13 OF REGULATION



DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN PER AHJ. SEE ASSOCIATED ENHANCED RURAL FIRE WATER REGULATIONS. REV: 7/17/2026

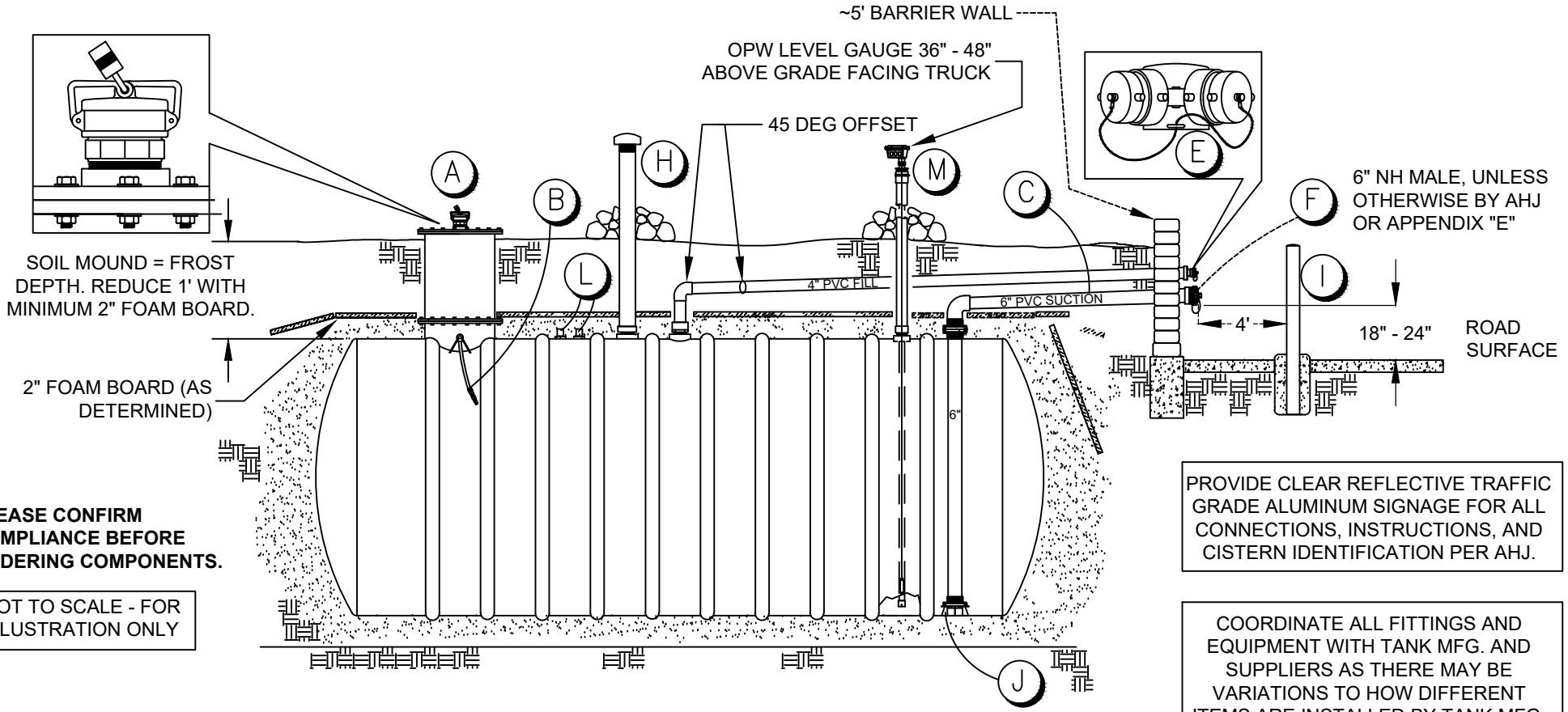
ERFWR - DETAIL #4A BASIC CISTERN CONFIGURATION (INDIVIDUAL / SHARED PROPERTY)

APPURTENANCES:

A. 30" DIAMETER MANWAY, BOLTED COVER, 4" LOCKING INSPECTION HATCH.
B. HIGH LEVEL WEEP OVERFLOW TO ALLOW EXCESS DRAIN OFF.
C. HORIZONTAL 6" SCH 80 PVC DRAW PIPE ASSEMBLY. SUCTION FITTING TO BE 18" - 24" ABOVE ROAD SURFACE AND LOWER THAN TRUCK INLET.
D. NA
E. 2.5" NST-FS CLAPPERED SIAMESE REFILL WITH THREADED CAPS.
F. 6" NH MALE THREAD DRY HYDRANT SUCTION WITH CAP & CHAIN.
G. NA
H. TANK VENT WITH VENT HEAD ABOVE MAXIMUM ANTICIPATED SNOW LEVEL.
I. MINIMUM 6" CONCRETE FILLED PIPE BOLLARDS IN CONCRETE, ~4' FROM PIPE FITTINGS.
J. NFPA ANTI-VORTEX PLATE WITH 8-HOLE FLANGED FITTING.
K. NA
L. ELECTRONIC MONITORING FOR LEVEL AND AUTO TANK FILL SOLENOID. PANEL TO RIGHT OF TANK FILL SIAMESE. (WHEN REQUIRED BY CRITERIA)
M. AT MINIMUM, MANUAL TANK LEVEL GAUGE IS REQUIRED PER CRITERIA.

NOTES:

1. THIS DESIGN HAS TANK HIGHER THAN ROAD ELEVATION TO REDUCE REQUIRED LIFT. BARRIER WALL HOLDS BACK SOIL AND CONTAINS SIGNS & FITTINGS. ALLOW TRUCK CONNECTION WITH SINGLE 8' HARD SUCTION.
2. BARRIER WALL AND TANK MUST BE SEPARATED GREATER THAN FROST DEPTH FOR THE REGION TO LIMIT FREEZE HAZARD.
3. ALL PIPES MUST SLOPE BACK TO TANK TO DRAIN CONDENSATE AND FORCE SUCTION AIR TOWARDS TRUCK INLET / VENT.
4. INSULATE ABOVE TANK AND BARRIER WALL WITH MINIMUM 2" RIGID FOUNDATION GRADE FOAM BOARD IN EXTREME COLD AS NEEDED.
5. ANCHORING TO BE DETERMINED BY DESIGNER FOR GROUND WATER.
6. LOCATE CISTERNS PERPENDICULAR TO THE ROAD WHEN POSSIBLE.
7. PVC TO BE SCHEDULE 80. PAINT EXPOSED PVC FOR UV PROTECTION.
8. 6" SUCTION LINE SHOULD RUN TO BARRIER WALL WITH MINIMAL BENDS.
9. 4" SIAMESE REFILL LINE TO INCORPORATE 45 DEGREE FITTINGS AND MOUNT IN WALL TO RIGHT OF SUCTION MINIMUM OF 36".



PLEASE CONFIRM COMPLIANCE BEFORE ORDERING COMPONENTS.

NOT TO SCALE - FOR ILLUSTRATION ONLY

PROVIDE CLEAR REFLECTIVE TRAFFIC GRADE ALUMINUM SIGNAGE FOR ALL CONNECTIONS, INSTRUCTIONS, AND CISTERN IDENTIFICATION PER AHJ.

COORDINATE ALL FITTINGS AND EQUIPMENT WITH TANK MFG. AND SUPPLIERS AS THERE MAY BE VARIATIONS TO HOW DIFFERENT ITEMS ARE INSTALLED BY TANK MFG.

BASIS OF DESIGN FOR THIS DETAIL USES CISTERN AND TANK COMPONENTS BY DARCOTANKS.COM. DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN. SEE ASSOCIATED ENHANCED RURAL FIRE WATER REGULATIONS. REV: 7/17/2026

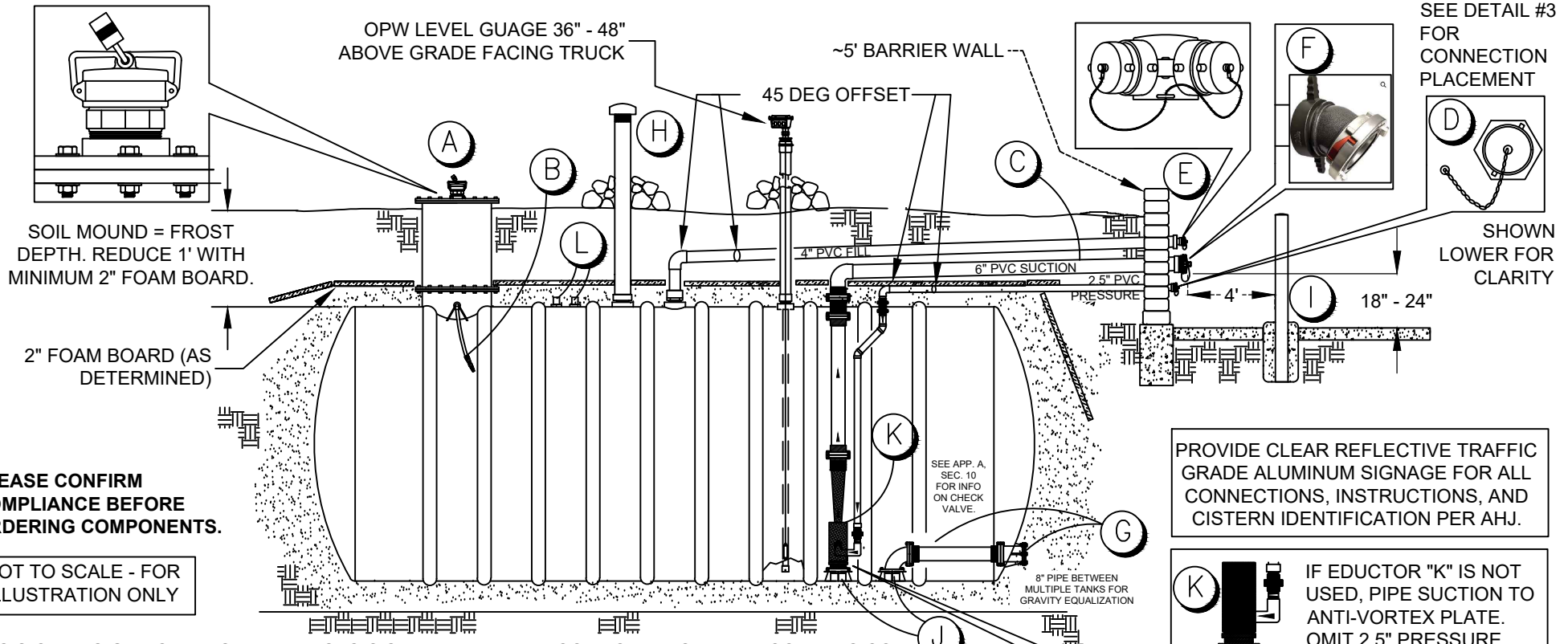
ERFWR - DETAIL #4B CISTERN WITH INTEGRATED EDUCTOR FOR UNIVERSAL OPERATIONS

APPURTENANCES:

A. 30" DIAMETER MANWAY, BOLTED COVER, 4" LOCKING INSPECTION HATCH.
B. HIGH LEVEL WEEP OVERFLOW TO ALLOW EXCESS DRAIN OFF.
C. HORIZONTAL 6" SCH 80 PVC DRAW PIPE ASSEMBLY. SUCTION FITTING TO BE 18" - 24" ABOVE ROAD SURFACE AND LOWER THAN TRUCK INLET.
D. 2.5" SINGLE NST-FS FDC INLET WITH CAP FOR EDUCTOR PRESSURE LINE (WHEN PROVIDED).
E. 2.5" NST-FS CLAPPERED SIAMESE REFILL WITH THREADED CAPS.
F. 6" NH MALE THREAD DRY HYDRANT & CAP. ON EDUCTOR SYSTEMS INCLUDE 6" NH FEMALE X 4.5" NH MALE REDUCER, AND ALSO A LONG HANDLE 4.5" FEMALE NH WITH 30 DEG. ELBOW & 5" STORZ WITH CAP.
G. 8" GRAVITY DISCHARGE TO HYDRANTS (WHEN PROVIDED AND SUPPORTED BY ELEVATION ABOVE HYDRANTS). [OPTION OF CHECK VALVE SHOWN].
H. TANK VENT WITH VENT HEAD ABOVE MAXIMUM ANTICIPATED SNOW LEVEL.
I. MINIMUM 6" CONCRETE FILLED PIPE BOLLARDS IN CONCRETE.
J. NFPA ANTI-VORTEX PLATE WITH 8-HOLE FLANGED FITTING.
K. TURBODRAFT CS DRAFTING EDUCTOR. SEE OTHER DETAIL SHEET.
L. ELECTRONIC MONITORING FOR LEVEL AND CONTROL AUTO TANK FILL.

NOTES:

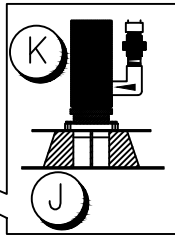
1. THIS DESIGN HAS TANK HIGHER THAN ROAD ELEVATION TO REDUCE REQUIRED LIFT. BARRIER WALL HOLDS BACK SOIL AND CONTAINS SIGNS & FITTINGS. ALLOW TRUCK CONNECTION WITH SINGLE 8' HARD SUCTION.
2. BARRIER WALL AND TANK MUST BE SEPARATED GREATER THAN FROST DEPTH FOR THE REGION TO LIMIT FREEZE HAZARD.
3. ALL PIPES MUST SLOPE BACK TO TANK TO DRAIN CONDENSATE AND FORCE SUCTION AIR TOWARDS TRUCK INLET / VENT.
4. INSULATE ABOVE TANK AND BARRIER WALL WITH MINIMUM 2" RIGID FOUNDATION GRADE FOAM BOARD IN EXTREME COLD AS NEEDED.
5. ANCHORING TO BE DETERMINED BY DESIGNER FOR GROUND WATER.
6. LOCATE CISTERNS PERPENDICULAR TO THE ROAD WHEN POSSIBLE.
7. PVC TO BE SCHEDULE 80. PAINT EXPOSED PVC FOR UV PROTECTION.
8. 6" SUCTION LINE SHOULD RUN TO BARRIER WALL WITH MINIMAL BENDS.
9. 4" SIAMESE REFILL LINE TO INCORPORATE 45 DEGREE FITTINGS AND MOUNT IN WALL TO RIGHT OF SUCTION MINIMUM OF 36".
10. 2.5" EDUCTOR PRESSURE LINE TO INCORPORATE 45 DEGREE FITTINGS AND MOUNT IN WALL ~20" TO LEFT OF SUCTION AND HIGHER.



PLEASE CONFIRM COMPLIANCE BEFORE ORDERING COMPONENTS.

NOT TO SCALE - FOR ILLUSTRATION ONLY

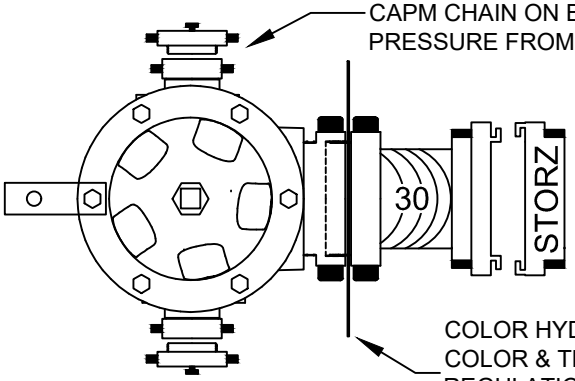
PROVIDE CLEAR REFLECTIVE TRAFFIC GRADE ALUMINUM SIGNAGE FOR ALL CONNECTIONS, INSTRUCTIONS, AND CISTERN IDENTIFICATION PER AHJ.



IF EDUCTOR "K" IS NOT USED, PIPE SUCTION TO ANTI-VORTEX PLATE. OMIT 2.5" PRESSURE LINE, & STORZ ADAPTER. PROVIDE 6" NH SUCTION CAP.

BASIS OF DESIGN FOR THIS DETAIL USES CISTERN AND TANK COMPONENTS BY DARCOTANKS.COM, DRAFT EDUCTOR BY TURBODRAFT.NET. DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN. SEE ASSOCIATED ENHANCED RURAL FIRE WATER STANDARDS. REV: 7/17/2026

ERFWR - DETAIL #5 INLET FIRE HYDRANT FOR FIRE TRUCK TO PRESSURIZE



2.5" NH FEMALE SWIVEL WITH GASKET, CAPM CHAIN ON BOTH SIDES FOR 3" PRESSURE FROM PUMPER INTO SYSTEM.

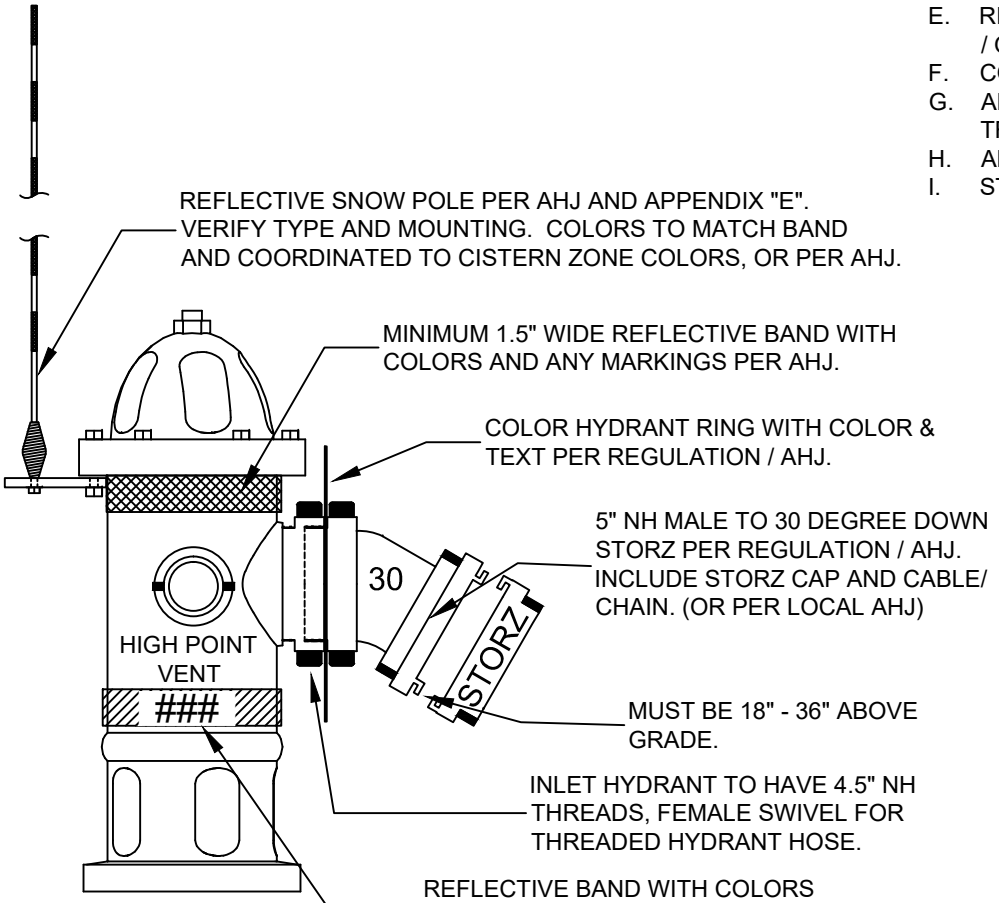
BLACK INLET HYDRANT

COLOR HYDRANT RING WITH COLOR & TEXT PER REGULATION / AHJ. BETWEEN STORZ AND NH-F SWIVEL.

TOP VIEW OF HYDRANT

NOTES:

A. THIS DETAIL IS FOR DRY-BARREL INLET FIRE HYDRANT ONLY. THIS IS THE HYDRANT THAT DRAFTING FIRE ENGINE WILL PRESSURIZE FROM CISTERN OR ACCEPTED WATER SOURCE.
B. THIS INLET HYDRANT IS TO BE **FACTORY BLACK GLOSS**, UNLESS DIRECTED OTHERWISE FROM FIRE DEPARTMENT.
C. COLORS OF REFLECTIVE BANDS ON BARREL AND SNOW POLE ARE TO MATCH BETWEEN INLET HYDRANT AND PRIVATE MAIN FIRE HYDRANTS ON THE SAME CISTERN ZONE. DOWN-STREAM HYDRANTS USED FOR FIRE ATTACK MUST HAVE SAME COLOR BANDS AS THE INLET HYDRANT AT CISTERN SO THAT TRUCKS ARE ENSURED THEY ARE ON THE SAME ZONE. ADJACENT ZONES ARE TO HAVE DIFFERENT COLORS (ALTERNATE COLORS BETWEEN ZONES).
D. THIS FIRE HYDRANT WILL BE CONFIGURED WITH FITTINGS FOR PUMPING INTO, SIMILAR TO PUMPING INTO A FIRE DEPARTMENT CONNECTION. FIRE HYDRANT IS USED TO PROVIDE AUTOMATIC DRAIN WHEN CLOSED TO PREVENT FREEZE DAMAGE.
E. RING LABELING AS SHOWN UNLESS DETERMINED OTHERWISE BY DESIGNER AND / OR BY AHJ.
F. CONFIRM ALL CRITERIA WITH REGULATION AND AMENDMENTS OF THE AHJ.
G. ADAPTERS SHOWN PROVIDE FLEXIBILITY FOR ADJACENT DEPARTMENTS AND TRUCKS TO UTILIZE SYSTEM.
H. ALL FITTINGS TO HAVE GASKETS & CHAINS / CABLES ON CAPS.
I. STORZ SIZE TO BE 4" UNLESS OTHERWISE INDICATED BY AHJ.



REFLECTIVE SNOW POLE PER AHJ AND APPENDIX "E". VERIFY TYPE AND MOUNTING. COLORS TO MATCH BAND AND COORDINATED TO CISTERN ZONE COLORS, OR PER AHJ.

MINIMUM 1.5" WIDE REFLECTIVE BAND WITH COLORS AND ANY MARKINGS PER AHJ.

COLOR HYDRANT RING WITH COLOR & TEXT PER REGULATION / AHJ.

5" NH MALE TO 30 DEGREE DOWN STORZ PER REGULATION / AHJ. INCLUDE STORZ CAP AND CABLE/ CHAIN. (OR PER LOCAL AHJ)

MUST BE 18" - 36" ABOVE GRADE.

INLET HYDRANT TO HAVE 4.5" NH THREADS, FEMALE SWIVEL FOR THREADED HYDRANT HOSE.

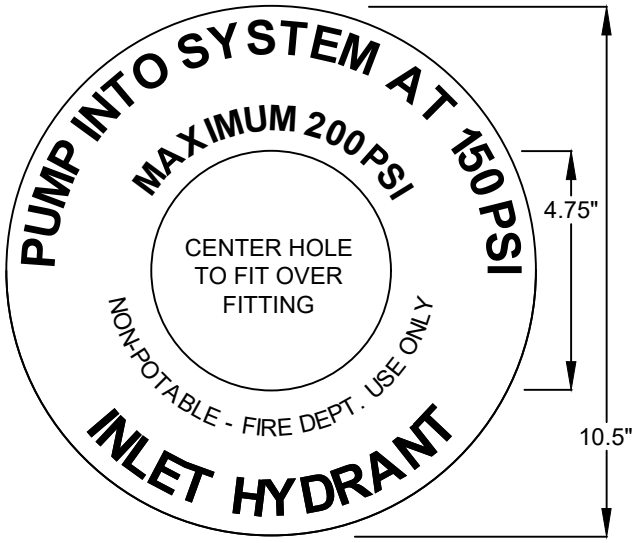
REFLECTIVE BAND WITH COLORS AND ANY MARKINGS PER AHJ. SUCH AS CISTERN ZONE & HYDRANT NUMBER WITHIN THAT ZONE.

SIDE VIEW OF HYDRANT

STEAMER / LARGE CONNECTION TO FACE STREET.

TEXT SIZE TO FIT PROPORTIONAL AS SHOWN

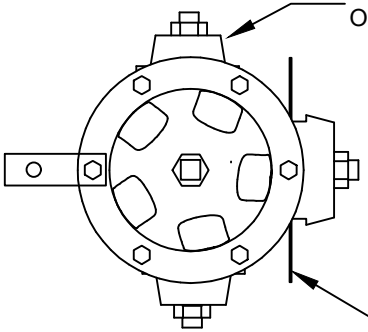
IF THE INLET HYDRANT IS A HIGH-POINT VENT, LABEL PER REGULATIONS.



FIRE HYDRANT RING SIGNAGE

DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN PER AHJ. SEE ASSOCIATED ENHANCED RURAL FIRE WATER REGULATIONS. REV: 7/17/2026

ERFWR - DETAIL #6 PRIVATE FIRE HYDRANT - SERVED BY SYSTEM

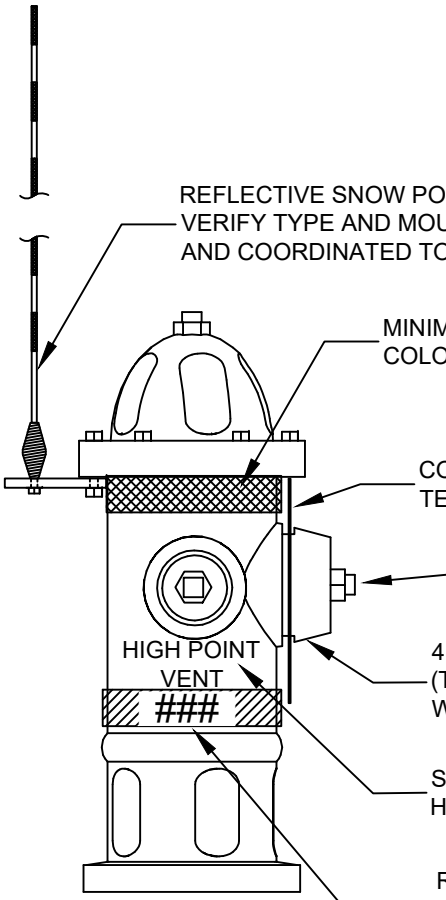


2.5" NH MALE WITH GASKET, CAP, CHAIN ON BOTH SIDES.

PURPLE PRIVATE HYDRANT

COLOR HYDRANT RING WITH COLOR & TEXT PER REGULATION / AHJ. UNDER CAP.

TOP VIEW OF HYDRANT



REFLECTIVE SNOW POLE PER AHJ AND APPENDIX "E". VERIFY TYPE AND MOUNTING. COLORS TO MATCH BAND AND COORDINATED TO CISTERN ZONE COLORS, OR PER AHJ.

MINIMUM 1.5" WIDE REFLECTIVE BAND WITH COLORS AND ANY MARKINGS PER AHJ.

COLOR HYDRANT RING WITH COLOR & TEXT PER REGULATION / AHJ.

CENTER MUST BE 18" - 36" ABOVE GRADE.

HIGH POINT VENT

4.5 NH MALE WITH CAP AND CHAIN (TYPICAL HYDRANT CONFIGURATION WITH THREADED OUTLET)

STENCIL HIGH-POINT AIR VENT HYDRANTS PER REGULATION.

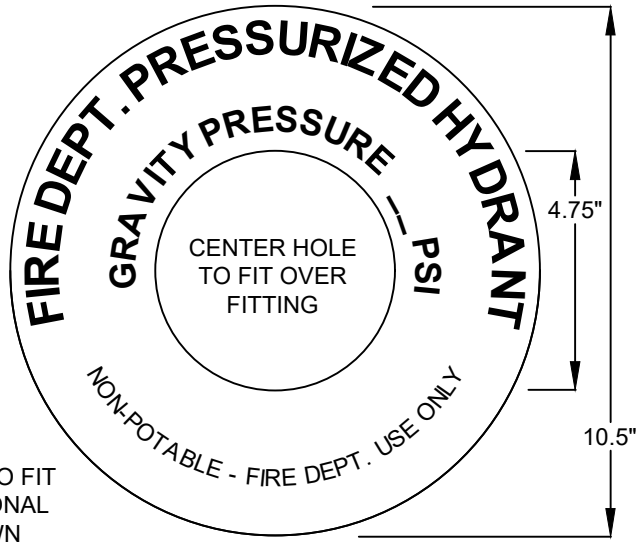
REFLECTIVE BAND WITH COLORS AND ANY MARKINGS PER AHJ. SUCH AS CISTERN ZONE & HYDRANT NUMBER WITHIN THAT ZONE.

SIDE VIEW OF HYDRANT

NOTES:

A. THIS DETAIL IS FOR DRY-BARREL PRIVATE FIRE HYDRANT ONLY. THIS HYDRANT WILL BE PRESSURIZED FROM A FIRE TRUCK DRAFTING FROM CISTERN OR ACCEPTED WATER SOURCE.
B. NON-POTABLE PRIVATE HYDRANT TO BE FACTORY PAINTED **PURPLE PANTONE 522** UNLESS DIRECTED OTHERWISE FROM AHJ.
C. COLORS OF REFLECTIVE BANDS ON BARREL AND SNOW POLE ARE TO MATCH BETWEEN INLET HYDRANT AND PRIVATE MAIN FIRE HYDRANTS ON THE SAME CISTERN ZONE. DOWN-STREAM HYDRANTS USED FOR FIRE ATTACK MUST HAVE SAME COLOR BANDS AS THE INLET HYDRANT AT CISTERN SO THAT TRUCKS ARE ENSURED THEY ARE ON THE SAME ZONE. ADJACENT ZONES ARE TO HAVE DIFFERENT COLORS (ALTERNATE COLORS BETWEEN ZONES).
D. STATIC PRESSURE TO BE ESTABLISHED DURING DESIGN FOR 1/2 CISTERN ELEVATION AND BY HYDRANT LOCATION. VALUE MAY BE PROVIDED AFTER INSTALLATION AND VERIFICATION.
E. THIS FIRE HYDRANT WILL BE CONFIGURED WITH STANDARD 4.5" MALE STEAMER OUTLET AND TWO 2.5" MALE HOSE OUTLETS WITH CAPS AND CHAINS.
F. RING LABELING AS SHOWN UNLESS DETERMINED OTHERWISE BY DESIGNER AND / OR BY AHJ.
G. CONFIRM ALL CRITERIA WITH REGULATION AND AMENDMENTS OF THE AHJ.
H. STORZ FITTINGS WILL NOT BE PROVIDED ON THESE PRIVATE HYDRANTS UNLESS OTHERWISE INDICATED BY THE AHJ.

STEAMER / LARGE CONNECTION TO FACE STREET.

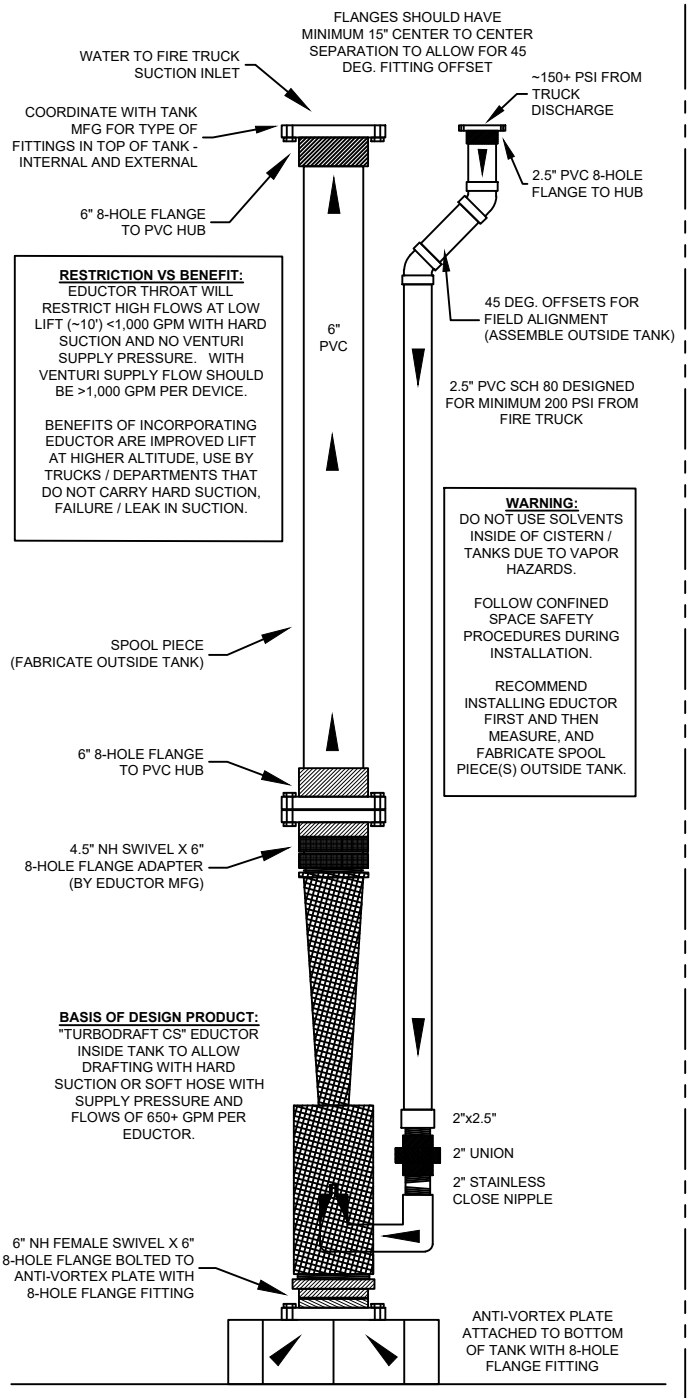


TEXT SIZE TO FIT PROPORTIONAL AS SHOWN

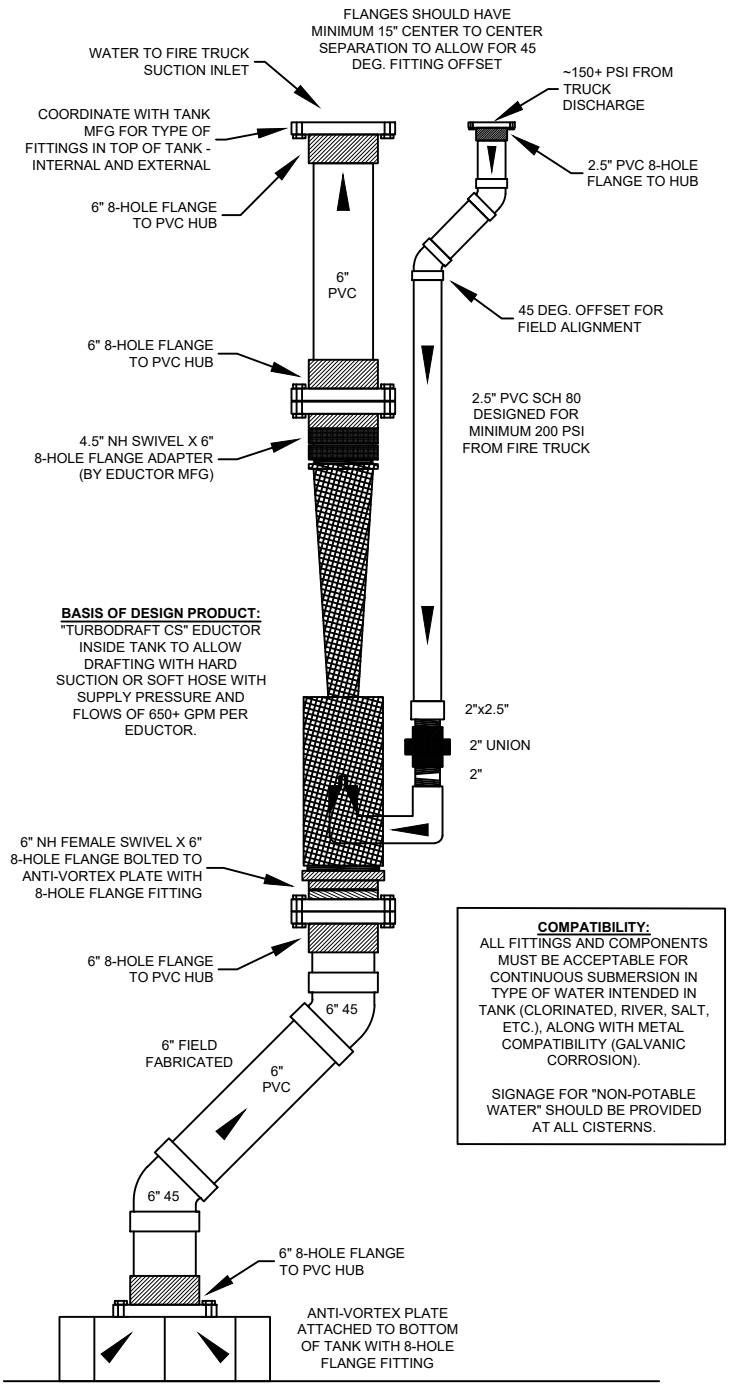
FIRE HYDRANT RING SIGNAGE

DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN PER AHJ. SEE ASSOCIATED ENHANCED RURAL FIRE WATER REGULATIONS. REV: 7/17/2026

ERFWR - DETAIL #7 DRAFTING EDUCTOR MOUNTING INSIDE CISTERN TANK



1 STRAIGHT SUCTION AND DISCHARGE (PREFERRED)
NOT TO SCALE



2 OFFSET SUCTION AND DISCHARGE (FIELD FLEXIBILITY)
NOT TO SCALE

GENERAL DETAIL NOTES:

DESIGN CONCEPT ALLOWS FOR DRAFTING FROM BELOW GRADE CISTERN BY FIRE APPARATUS EQUIPPED WITH HARD SUCTION AND THOSE WITHOUT HARD SUCTION UTILIZING A VENTURI CONCEPT. THIS CONCEPT PROVIDES VERSITILITY FOR MULTI-AGENCY SUPPORT AND IS INTENDED FOR MULTI-STRUCTURE PROTECTION SUCH AS IN SUBDIVISIONS, COMMERCIAL APPLICATIONS, AND AS DETERMINED BY THE AUTHORITY HAVING JURISDICTION FOR RURAL FIRE APPLICATIONS.

THIS DETAIL HAS BEEN PROVIDED FOR CONCEPT AROUND PRODUCT INDICATED. THE FIRE PROTECTION DESIGNER AND EQUIPMENT SUPPLIERS ARE RESPONSIBLE FOR FINAL DETAIL, DIMENSIONS, AND PRODUCT SELECTION BASED ON PERFORMANCE REQUIREMENTS.

ADDITIONAL INFORMATION REGARDING THE USE AND FUNCTION OF THIS DRAFTING EDUCTOR CAN BE FOUND AT TURBODRAFT.NET.

TWO CONCEPTS ARE SHOWN. DETAIL #1 (PREFERRED) PROVIDES FOR A STRAIGHT ALIGNMENT OF SUCTION ANTI-VORTEX PLATE TO DISCHARGE FLANGES OUT OF TANK. DETAIL #2 ALLOWS FOR FIELD ADJUSTMENTS IF THE ANTI-VORTEX PLATE WILL NOT BE PERFECTLY LINED UP WITH TOP OF TANK DISCHARGE FITTINGS. USER AND TANK MFG TO CONFIRM FINAL FABRICATION WHILE SATISFYING AHJ PERFORMANCE REQUIREMENTS.

TYPICAL APPLICATION COULD INCLUDE MULTIPLE CISTERN TANKS (ACCOUNTING FOR SIZE AND SHIPPING FEES). SOME TANK(S) WITH EDUCTOR CONFIGURATION, OTHER TANK(S) WITHOUT EDUCTOR FOR HARD SUCTION ONLY. ALLOWING FOR MULTIPLE DRAFTING POINTS TO IMPROVE GPM (TWIN-TUBE DRAFTING) OR MULTIPLE TRUCKS. MULTIPLE TANKS ALLOWS FOR SERVICE OF ONE TANK WITHOUT IMPACTING OTHERS WHEN PROPERLY ISOLATED / CONNECTED. ONE LARGE TANK MAY INCORPORATE MULTIPLE DRAFTING POINTS WITH AND WITHOUT AN EDUCTOR. DESIGN MUST ACCOUNT FOR FLOWS, ELEVATIONS, ALTITUDE, DRAFTING LIFTS, JURISDICTION FITTING TYPES, HOSE & FITTING SIZES, FRICTION LOSS, ETC.

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ERFWR - DETAIL #9 END VIEW AND BARRIER WALL OF INDIVIDUAL PROPERTY CISTERN

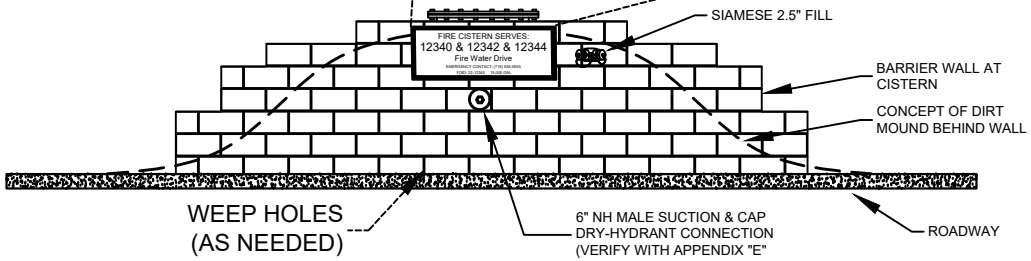
NOTES:

1. THIS DETAIL SHOWS A GENERAL CONCEPT OF AN INDIVIDUAL PROPERTY OR SHARED PROPERTY CISTERN TANK WITH A BLOCK BARRIER WALL. THE BARRIER WALL (SIMILAR TO A RESIDENTIAL LANDSCAPE WALL) HOLDS BACK THE DIRT MOUNDED OVER THE CISTERN TANK AND PROVIDES PROTECTION FOR FIRE DEPARTMENT CONNECTIONS. THE WALL ALSO PROVIDES A SURFACE FOR MOUNTING INFORMATION SIGNAGE.
2. THERE ARE MANY WAYS AND TYPES OF BARRIER WALLS THAT COULD BE USED TO BLEND IN WITH THE LOCATION AND STILL PROVIDE INTENDED FUNCTION. DESIGNER TO ESTABLISH FINAL DESIGN FOR SPECIFIC CONDITION.
3. KEY OBJECTIVES ARE:
   - 3.1. REDUCE THE DEPTH FOR BOTTOM OF TANK DUE TO CHALLENGES OF DRAFTING LIFT AT HIGH ELEVATIONS. THIS IS WHY THE TANK DEPTH INCORPORATES THE MOUND.
   - 3.2. PROVIDE A MEANS OF SECURING AND PROTECTING FITTINGS.
   - 3.3. PROVIDE ADDRESS AND TANK IDENTIFICATION SIGNAGE.
   - 3.4. STANDARDIZE FITTING ORIENTATION.
   - 3.5. PROTECT PIPE FROM SUN AND MECHANICAL DAMAGE.
   - 3.6. PROVIDE PROTECTION FOR TANK VENT AND LEVEL GAUGE THAT WILL COME OUT OF TOP OF TANK (NOT SHOWN IN DETAIL).
   - 3.7. TANK GAUGE MUST BE VISIBLE FROM FIRE TRUCK. MAINTAIN ACCESS TO LID FOR INSPECTIONS.
   - 3.8. PROVIDE DESIGNATED PARKING FOR TRUCK WITH 8' SECTION OF HARD SUCTION FROM POINT OF SUCTION CONNECTION.
   - 3.9. ANTICIPATE CHILDREN CLIMBING AND PLAYING ON WALL AND TANK MOUND DEPENDING ON CONFIGURATION. DESIGNER TO IDENTIFY IF A RAILING WILL BE REQUIRED.

INDIVIDUAL PROPERTY(S) SIGN CONCEPT:

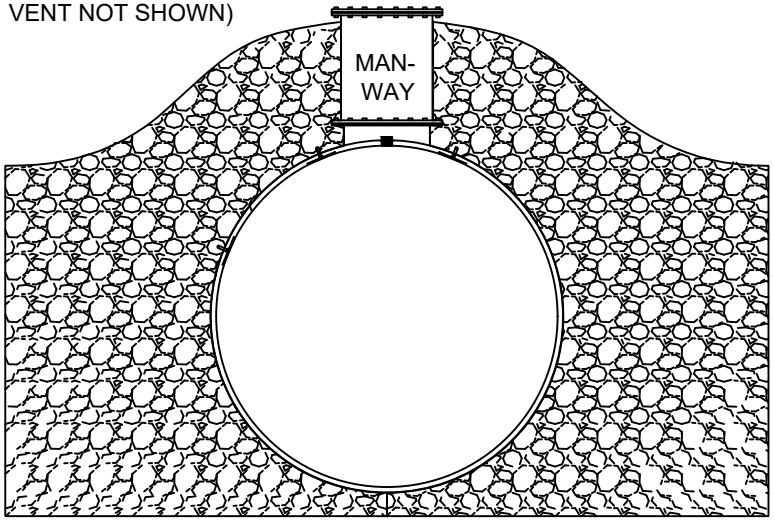
TEXT TO BE REFLECTIVE RED ON REFLECTIVE WHITE BACKGROUND.
REFLECTIVE RED 3/4" BORDER.
SIGN MADE OF TRAFFIC GRADE ALUMINUM.
TOP LINE AND STREET NAME ARE 2" HIGH.
ADDRESS NUMBERS ARE 3" HIGH.
CONTACT, FIRE AUTHORITY TANK ID, AND TANK SIZE ARE 1" HIGH.





CONCEPT OF MOUND BEHIND PROTECTIVE PIPE BARRIER

(TANK LEVEL GAUGE AND VENT NOT SHOWN)



END VIEW OF BURIED / MOUNDED CISTERN

DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN PER AHJ. SEE ASSOCIATED ENHANCED RURAL FIRE WATER REGULATIONS. REV: 7/17/2026

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APPENDIX C – FIRE MITIGATION

Some Resources Include:

Colorado Wildfire Resiliency Code (Required enforcement in 2026)
https://dfpc.colorado.gov/WRCB

Fire Wise
https://www.nfpa.org/education-and-research/wildfire/firewise-usa

Wildfire Mitigation | National Interagency Fire Center
https://www.nifc.gov/fire-information/fire-prevention-education-mitigation/wildfire-mitigation

Fire Adapted Colorado (FACO)
Colorado's Network for Wildfire Resilience
https://fireadaptedco.org/

Rocky Mountain PBS – Partners in Prevention
Connects Coloradans with information and resources about how emergency responders, businesses and community partners work together to address wildfire prevention and preparedness.
https://www.rmpbs.org/community-resources/wildfire

Boulder Colorado "Wildfire Partners" Homeowner Resources
https://wildfirepartners.org/for-homeowners/homeowner-resources/

Also See Detail #8 calculation and mitigation drawing in Appendix D for concepts.

Fire-resistance-rated wall panels such as some Hardie®Plank sidings can provide 1-hour rated walls when installed per the manufacturer. See other similar products.

Builders, property owners and homeowners' associations are the first and best ones to provide defense and protection of property and structures.

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APPENDIX D – CALCULATION FORMS & CHECKLISTS

This section incorporates:

- Individual Property Calculation Worksheets
- Detail #8: Calculation and Mitigation Concepts (for use with calculations)
- Example Calculation Worksheet (sample calculations)
- Municipal Fire Water Evaluation form
- Reduced Level of Protection Acknowledgement
- Rural Water Design Checklist – Individual Residence
- Rural Water Design Checklist – Subdivision
- Rural Water Inspection Checklist
- Rural Water Testing Checklist
- Rural Water Maintenance Checklist
- Rural Water Commissioning Checklist

calculation forms, example calculations, an example drawing to help with calculations and common mitigation techniques, checklists to help with design, plan review / inspections, and other forms as applicable.

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Enhanced Rural Fire Water Regulations

Calculation of Water Supply Requirements (Section 5)

Submit these calculations as part of fire authority design submittals

Property 1 Calculations:

1. Property Name / Address: _____
2. Roofline area of Structures with <50' Separation: _____ ft2 Acreage: _____
3. Is property all Low Intensity or Moderate/High Intensity Acreage: _____
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? _____
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: _____ gallons
6. Are any of the primary structures sprinklered: _____ Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered _____ ft2 ÷ _____ ft2 roof line area in Line #2 = _____ ratio
8. Multiply the ratio from #5 _____ x 0.5 sprinkler credit = _____ Adjusted Sprinkler Credit
9. Adjusted value from #8 _____ x _____ gallons from Line #3 = _____ Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. _____ Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: _____ gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12_____ - Structure Table Value #5_____ = _____ Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 _____ + _____ result of Line #13 = _____gallons
15. Value of Line #11 or Line #14 _____ gallons. This is water required for Property 1.

Property 2 Calculations:

1. Property Name / Address: _____
2. Roofline area of Structures with <50' Separation: _____ ft2 Acreage: _____
3. Is property all Low Intensity or Moderate/High Intensity Acreage: _____
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? _____
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: _____ gallons
6. Are any of the primary structures sprinklered: _____ Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered _____ ft2 ÷ _____ ft2 roof line area in Line #2 = _____ ratio
8. Multiply the ratio from #5 _____ x 0.5 sprinkler credit = _____ Adjusted Sprinkler Credit
9. Adjusted value from #8 _____ x _____ gallons from Line #3 = _____ Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. _____ Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: _____ gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12_____ - Structure Table Value #5_____ = _____ Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 _____ + _____ result of Line #13 = _____gallons
15. Value of Line #11 or Line #14 _____ gallons. This is water required for Property 2.

Enhanced Rural Fire Water Regulations

Calculation of Water Supply Requirements (Section 5)

Submit these calculations as part of fire authority design submittals

Property 3 Calculations:

1. Property Name / Address: _____
2. Roofline area of Structures with <50' Separation: _____ ft2 Acreage: _____
3. Is property all Low Intensity or Moderate/High Intensity Acreage: _____
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? _____
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: _____ gallons
6. Are any of the primary structures sprinklered: _____ Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered _____ ft2 ÷ _____ ft2 roof line area in Line #2 = _____ ratio
8. Multiply the ratio from #5 _____ x 0.5 sprinkler credit = _____ Adjusted Sprinkler Credit
9. Adjusted value from #8 _____ x _____ gallons from Line #3 = _____ Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. _____ Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: _____ gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12_____ - Structure Table Value #5_____ = _____ Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 _____ + _____ result of Line #13 = _____gallons
15. Value of Line #11 or Line #14 _____ gallons. This is water required for Property 3.

Property 4 Calculations:

1. Property Name / Address: _____
2. Roofline area of Structures with <50' Separation: _____ ft2 Acreage: _____
3. Is property all Low Intensity or Moderate/High Intensity Acreage: _____
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? _____
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: _____ gallons
6. Are any of the primary structures sprinklered: _____ Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered _____ ft2 ÷ _____ ft2 roof line area in Line #2 = _____ ratio
8. Multiply the ratio from #5 _____ x 0.5 sprinkler credit = _____ Adjusted Sprinkler Credit
9. Adjusted value from #8 _____ x _____ gallons from Line #3 = _____ Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. _____ Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: _____ gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12_____ - Structure Table Value #5_____ = _____ Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 _____ + _____ result of Line #13 = _____gallons
15. Value of Line #11 or Line #14 _____ gallons. This is water required for Property 4.

Enhanced Rural Fire Water Regulations

Calculation of Water Supply Requirements (Section 5)

Submit these calculations as part of fire authority design submittals

MULTI-PROPERTY CREDIT SHEET

CALCULATIONS FOR PROPERTIES SHARING A WATER SOURCE PER SECTION 5.4.11.

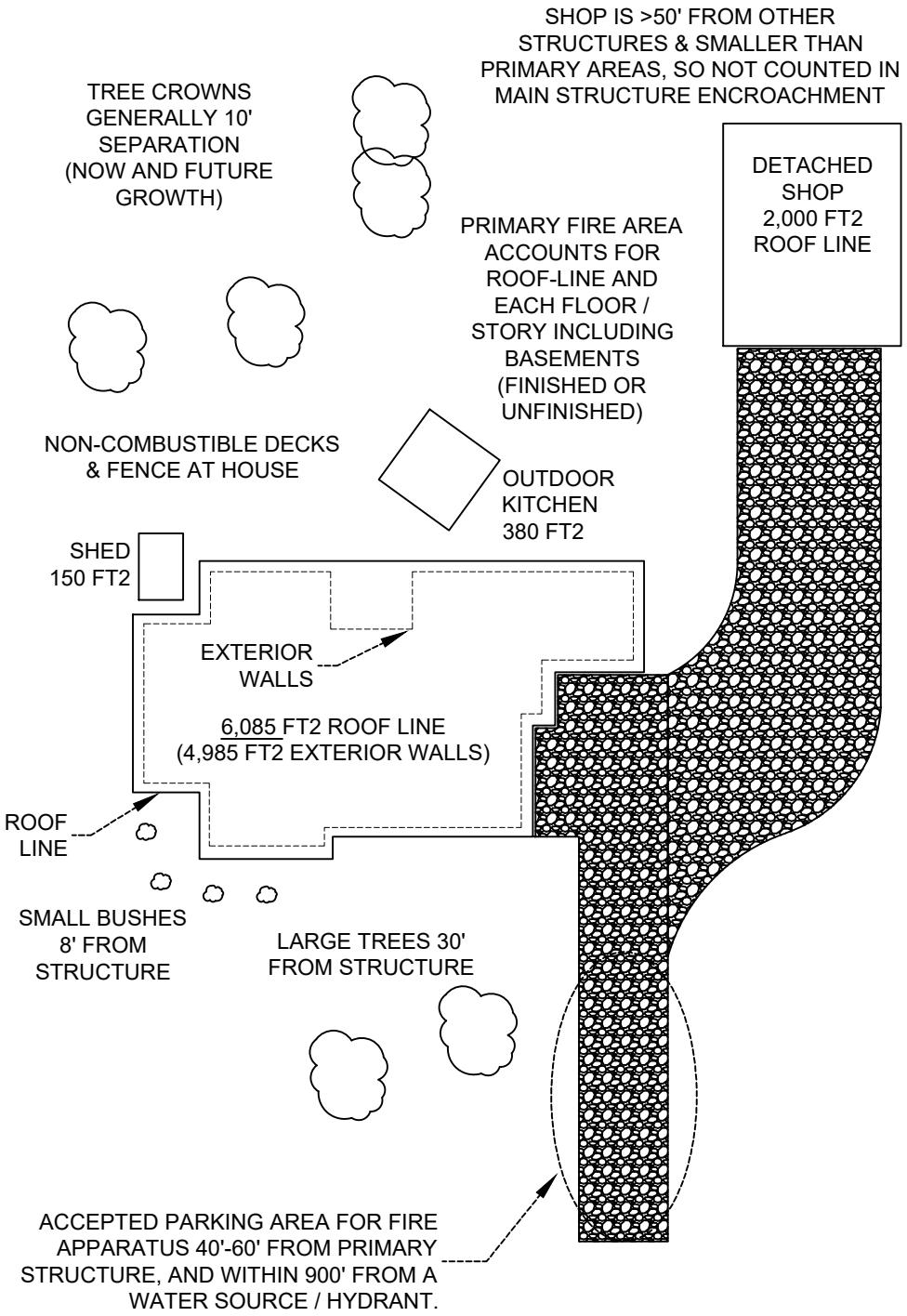
Use this Form if taking credit for multiple properties / Buildings served by a single cistern / water source. Do not use this calculation for a single structure / property or for subdivisions per Section 7.

1. Adjusted water quantity for Property 1, Line #15: _____ gallons
2. Adjusted water quantity for Property 2, Line #15: _____ gallons
3. Adjusted water quantity for Property 3, Line #15: _____ gallons
4. Adjusted water quantity for Property 4, Line #15: _____ gallons
5. Add the sum of properties above: _____ gallons

   If more than 4 properties are allowed by the AHJ, the 4 largest / highest water demand are to be used in calculating water supply quantities. Each property must be calculated with individual property calculations on previous pages to establish the 4 largest demands.

6. Number of properties to be calculated (2-4): _____
7. Sharing factor to be applied based on number of properties (2=0.75; 3=0.65; 4=0.60): _____
8. Value from Line #5 _____ x Factor of Line #7 _____ = _____ gallons
9. Largest value from Lines 1 – 4 _____ gallons x 1.25 = _____ gallons
10. Enter the larger of Line #8 or Line #9 _____ gallons. This is required quantity for a shared cistern.

ERFWR - DETAIL #8 SITE PLAN FOR AREA CALCULATIONS & MITIGATION



NOTES:

1. THIS DETAIL SUMMARIZES A NUMBER OF CONCEPTS FOR CLARITY. THIS INCLUDES:
   - 1.1. CALCULATIONS OF SQUARE FOOTAGES FOR STRUCTURES AND ENCROACHING STRUCTURES WITHIN 50' TO ESTABLISH WATER QUANTITIES PER SECTION 5.
   - 1.2. COMMON MITIGATION STRATEGIES WITH A FOCUS ON LOW-INTENSITY OBJECTIVES.
2. SQUARE FOOTAGE OF BUILDINGS MUST ACCOUNT FOR THE ROOF LINE (LARGEST AREA) AND NOT ADVERTISED PROPERTY SQUARE FOOTAGE SUCH AS CONDITIONED SPACE.
3. CALCULATING AREAS TO ESTABLISH WATER QUANTITY FOR THIS EXAMPLE INCLUDES:
   - 3.1. PRIMARY RESIDENCE ROOF LINE (AND STORIES): 6,085 FT2
   - 3.2. OUTDOOR KITCHEN ROOF LINE: 380 FT2
   - 3.3. SHED ROOF LINE: 150 FT2
   - 3.4. TOTAL AREA: 6,615 FT2
4. MITIGATION STRATEGIES CAN VARY BASED ON THE DOCUMENT / CRITERIA BEING USED. AS SUCH, SOME OF THE DISTANCES MAY VARY. THE OBJECTIVES ARE TO ENSURE A DEFENSIBLE SPACE AROUND ALL STRUCTURES AND LIMIT THE FIRE SPREAD, RADIANT HEAT, AND EMBER PRODUCTION / SPREAD. COMMON FACTORS INCLUDE:
   - 4.1. KEEP COMBUSTIBLE MATERIALS (BUSHES, MULCH, FENCE, DECKS, ETC.) 8' AWAY FROM ANY STRUCTURE.
   - 4.2. LARGER TREES (ACCOUNTING FOR FUTURE GROWTH) - RECOMMEND 30' AWAY FROM STRUCTURE. (ALSO LIMITS COMBUSTIBLE LEAVES COLLECTING IN GUTTERS.)
   - 4.3. LIMITING TREE CLUSTERS TO MAINTAIN 10' SPACING BETWEEN CROWNS (DRIP LINE) NOW AND FUTURE.
   - 4.4. KEEPING LOWER TREE BRANCHES TRIMMED UP TO LIMIT FIRE SPREAD FROM GROUND INTO THE TREES (6'-10' OR 1/3 HEIGHT).
   - 4.5. LIMITING THE NUMBER OF TREES WITHIN 50' OF STRUCTURES.
   - 4.6. DECKS AND FENCES NEAR STRUCTURES NEED TO BE NON-COMBUSTIBLE AND WITHOUT ACCUMULATION OF COMBUSTIBLES (LEAVES / TRASH) UNDER DECKS.
   - 4.7. COVER ALL VENTS TO ATTIC SPACE WITH SMALL WIRE SCREEN TO KEEP EMBERS FROM ENTERING (ROOF AND SOFFITS).
   - 4.8. NON-COMBUSTIBLE EXTERIOR WALLS AND SOFFITS.
   - 4.9. NO MULCH OR GRASS AROUND STRUCTURES (ROCK INSTEAD).
   - 4.10. NON-COMBUSTIBLE / CLASS "A" RATED ROOFS.
   - 4.11. KEEPING ALL TREES ON PROPERTY TRIMMED UP & ELIMINATING DEAD-WOOD / OVERGROWTH OF GRASS AND BRUSH.
   - 4.12. PROPERTY OWNERS MUST PLAN FOR THEIR OWN PROTECTION.

DESIGN CONCEPT BY LACEY FPE - INFO@LACEYFPE.COM. THIS DETAIL PROVIDES CONCEPT FUNCTION. USER ASSUMES ALL RISK AND IS TO PROVIDE FINAL DESIGN PER AHJ. SEE ASSOCIATED ENHANCED RURAL FIRE WATER STANDARDS. REV: 2/7/2026

Calculation of water supply requirements for Chapter 5

Property 1 Calculations:

1. Property Name / Address: Sample Calculation 1 - with sprinklers
2. Roofline area of Structures with <50' Separation: 6,500 ft2 Acreage: 5
3. Is property all Low Intensity or Moderate/High Intensity Acreage: Low Intensity
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? yes
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: 30,000 gallons
6. Are any of the primary structures sprinklered: x Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered 5,500 ft2 ÷ 6,500 ft2 roof line area in Line #2 = 0.85 ratio
8. Multiply the ratio from #5 0.85 x 0.5 sprinkler credit = 0.42 Adjusted Sprinkler Credit
9. Adjusted value from #8 0.42 x 30,000 gallons from Line #3 = 12,600 Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. 12,600 Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: 30,000 gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12 30,000 - Structure Table Value #5 25,000 = 5,000 Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 12,600 + 5,000 result of Line #13 = 17,600 gallons
15. Value of Line #11 or Line #14 17,600 gallons. This is water required for Property 1.

Property 2 Calculations:

1. Property Name / Address: Sample Calculation 2 - no sprinklers
2. Roofline area of Structures with <50' Separation: 6,500 ft2 Acreage: 5
3. Is property all Low Intensity or Moderate/High Intensity Acreage: Low Intensity
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? yes
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: 30,000 gallons
6. Are any of the primary structures sprinklered: _____ Yes ; x No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered _____ ft2 ÷ _____ ft2 roof line area in Line #2 = _____ ratio
8. Multiply the ratio from #5 _____ x 0.5 sprinkler credit = _____ Adjusted Sprinkler Credit
9. Adjusted value from #8 _____ x _____ gallons from Line #3 = _____ Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. 30,000 Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: _____ gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12_____ - Structure Table Value #5_____ = _____ Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 _____ + _____ result of Line #13 = _____ gallons
15. Value of Line #11 or Line #14 30,000 gallons. This is water required for Property 2.

Calculation of water supply requirements for Chapter 5

Property 3 Calculations:

1. Property Name / Address: Sample Calculations 3 - with sprinkler medium intensity
2. Roofline area of Structures with <50' Separation: 7,000 ft2 Acreage: 5
3. Is property all Low Intensity or Moderate/High Intensity Acreage: Medium Intensity
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? No
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: 25,000 gallons
6. Are any of the primary structures sprinklered: x Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered 7,000 ft2 ÷ 7,000 ft2 roof line area in Line #2 = 1 ratio
8. Multiply the ratio from #5 1 x 0.5 sprinkler credit = 0.5 Adjusted Sprinkler Credit
9. Adjusted value from #8 0.5 x 25,000 gallons from Line #3 = 12,500 Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. 12,500 Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: 50,000 gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12 50,000 - Structure Table Value #5 25,000 = 25,000 Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 12,500 + 25,000 result of Line #13 = 37,500 gallons
15. Value of Line #11 or Line #14 37,500 gallons. This is water required for Property 3.

Property 4 Calculations:

1. Property Name / Address: Sample Calculations 4 - small
2. Roofline area of Structures with <50' Separation: 1,500 ft2 Acreage: 1
3. Is property all Low Intensity or Moderate/High Intensity Acreage: Low
4. Will Credit for Low Intensity (footnote #4 of Table 5.4) be applied? No
5. Value from Table 5.4 for Structure Low Intensity 0 – 2.5 Acres: 10,000 gallons
6. Are any of the primary structures sprinklered: x Yes ; _____ No. If no, skip to Line #10.
7. If sprinklered,
   roof line of area sprinklered 1,300 ft2 ÷ 1,500 ft2 roof line area in Line #2 = 0.87 ratio
8. Multiply the ratio from #5 0.87 x 0.5 sprinkler credit = 0.44 Adjusted Sprinkler Credit
9. Adjusted value from #8 0.44 x 10,000 gallons from Line #3 = 4,400 Structure gallons
10. If sprinklered, value from Line #9. If not, value from line #5. 4,400 Structure gallons
11. If Acreage is 0 – 2.5 and Low Intensity, skip lines 12 – 14 and enter value of Line #10 at Line #15.
12. Value from Table 5.4 for Moderate to High Intensity Wooded Acreage: _____ gallons
    If Low Intensity, take value from two columns to left per footnote #4.
13. Calculating extra acreage water.
    Acreage #12_____ - Structure Table Value #5_____ = _____ Acreage gallons
    This is additional water required for wildland firefighting if applicable.
14. Structure gallons from Line #10 _____ + _____ result of Line #13 = _____ gallons
15. Value of Line #11 or Line #14 4,400 gallons. This is water required for Property 4.

Calculation of water supply requirements for Chapter 5

CALCULATIONS FOR INDIVIDUAL PROPERTIES SHARING A WATER SOURCE PER SECTION 5.4.11.

Use this Form if taking credit for multiple properties / Buildings served by a single cistern / water source. Do not use this calculation for a single structure / property or for subdivisions per Section 7.

1. Adjusted water quantity for Property 1, Line #15: 17,600 gallons
2. Adjusted water quantity for Property 2, Line #15: 30,000 gallons
3. Adjusted water quantity for Property 3, Line #15: 37,500 gallons
4. Adjusted water quantity for Property 4, Line #15: 4,400 gallons
5. Add the sum of properties above: 89,500 gallons

   If more than 4 properties are allowed by the AHJ, the 4 largest / highest water demand are to be used in calculating water supply quantities. Each property must be calculated with previous property calculation to establish the 4 largest demands.

6. Number of properties to be calculated (2-4): 4
7. Sharing factor to be applied based on number of properties (2=0.75; 3=0.65; 4=0.60): 0.60
8. Value from Line #5 89,500 x Factor of Line #7 0.60 = 53,700 gallons
9. Largest value from Lines 1 – 4 37,500 gallons x 1.25 = 46,875 gallons
10. Enter the larger of Line #8 or Line #9 53,700 gallons. This is required quantity for a shared cistern.

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MUNICIPAL FIRE WATER EVALUATION

Project Name: _____ Date: _____

Project Address / Location: _____

Owner / Developer: _____

Contact Name: _____ Title:_____ Phone: _____

Contact Email: _____

Description of Project: _____

_____

In accordance with regulations of the _____ fire authority, a new development or building construction is required to have a water supply acceptable to the Authority Having Jurisdiction (AHJ) which is capable of supporting minimum fire ground operations. Where a municipal type water supply is available and feasible it is required to be utilized. Where a municipal type water supply is not available or is not feasible, approved alternate sources of water, such as cisterns, shall be provided.

In order to effectively evaluate the water needs of a development / project, the water authority may require design / development plans with enough information to evaluate water needs. At a minimum, the following information is to be provided to assist the water utility company, the fire authority, and other planning and development reviewers in establishing the appropriate provisions for the development related to water supplies. Each review discipline may require additional information to ensure a thorough evaluation and determination.

____Commercial ____Residential; Number of serviced buildings: _____; Number of acres: _____

Anticipated total daily domestic water needs (sinks, showers, toilets): _____ gpm at _____ psi

Anticipated monthly landscape / pool / other water usage: _____ gpm; Months of use: _____

Anticipated maximum flow for a single site: _____ gpm; Average max. use remaining sites: _____ gpm

How will sewer / discharge be provided (municipal/spray/leach field/pond): _____

Will buildings be protected with fire sprinklers to reduce fire flow demands (13,13D, 13R): _____

Minimum fire flow required by fire authority: _____ gpm at _____ psi. Duration factored in next line.

Water quantity required by Sections 5/7/9 considering structures/mitigation/credits: _____ gallons

I hereby certify the information included on and with this form is true and correct at the time of initiating this evaluation. Changes that could impact the decision of the water provider will require re-evaluation.

Signature: _____ Title: _____ Date: _____

This field to be completed by the municipal or other water supply company:

Water Company: _____ Date Issued: _____

Contact Person: _____ Title:_____

Contact Phone: _____ Contact Email: _____

In accordance with Section 3 of the *Enhanced Rural Fire Water Regulations*:

____ It appears feasible that a municipal type water supply can be provided to this development.

____ It does not appear feasible to provide a municipal type water supply to this development.

_____ Supportive letters or documentation regarding the indicated feasibility above is attached.

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Reduced Level of Protection Acknowledgement

I _____ (individual name) of _____ (company) hereby acknowledge that the fire authority has strongly recommended the project known as _____ be in full compliance with the minimum criteria as outlined in the Enhanced Rural Fire Water Regulations Section ____, dated _____. Due to the following items as indicated, I/we am/are requesting an allowance for protection below the established minimum requirements / recommendations.

☐ The project is already in construction and the criteria of the referenced regulation was not available at the time of design / development.

☐ The project is in late stages of final review / approval and the criteria of the referenced regulation was not available at the time of design / development.

☐ Other as identified in the attached supporting document(s).

I hereby acknowledge the requirements in effect, including the International Fire Code (IFC), The El Paso County Land Development Code (LDC), and by reference NFPA 1142 and NFPA 24, incorporate minimum requirements. These minimum requirements included, but may not be limited to:

- IFC 507.1/NFPA 1142 – An approved water supply providing the required fire flow
- IFC 507.2/NFPA 1142 – Type of water supply capable of providing the required fire flow
- IFC 507.2.1 – Private fire service mains shall have been installed in accordance with NFPA 24.
- IFC 507.5 – Fire hydrant systems are required with spacing of not more than 400' from a hydrant to a portion of the building.
- NFPA 1142 / LDC – Establishes the water quantity and required fire flow if not identified elsewhere.

The "Enhanced Rural Fire Water Regulations", provide clarification on means and criteria acceptable to the fire authority in achieving water supplies in the above listed adopted documents. The fire authority recognizes that a project previously in development may not have anticipated or planned for any added costs associated with the clarification of criteria within the regulation. On occasion there may be extenuating situations for new projects that warrant alternative considerations. Although the fire authority believes that additional protection is generally justified and appropriate, the authority recognizes that there could be a financial hardship placed on a developer due to unique or unforeseen circumstances. As such, the developer is requesting to implement provisions less than those otherwise required for new projects / developments. Based on the box checked above, the fire authority is willing to evaluate a lower level of protection than the fullest level otherwise required of new projects. The level of protection shall not be less than

otherwise required by the referenced documents and otherwise agreed to by the fire authority.

The developer recognizes that not only for safety of the occupants, firefighters, and community, the criteria of the regulation is intended to reduce the risks for insurance and finance companies. This objective is for competitive coverage and risk-based rates. By not enhancing the readiness and availability of reliable water sources in accordance with the regulations, the developer understands that insurance coverage / rates may be impacted and passed on to the property owners. Additional liabilities for not providing minimum levels of protection may be incurred by the requesting party.

The level of protection proposed is summarized ☐ Below, ☐ On a separate attached document(s).

_____

_____

_____

_____

_____

_____

_____

_____

_____

Submitted by:

Signature: _____ Print: _____

Title: _____ Date: _____

Company: _____

Fire Authority use only: ☐ Accepted ☐ Denied

By: _____ Title: _____

Date: _____

RURAL WATER DESIGN CHECKLIST
INDIVIDUAL RESIDENCE – SECTION 5

This form can be filled out by hand or is available in a MS Word fillable format.

Enhanced Rural Fire Water Regulations (ERFWR)

This form shall be used by the submitter to assist with compliance of the current Enhanced Rural Fire Water Regulations as adopted by the jurisdiction. Complete form and include with each submittal. Include drawings / calcs / data that detail and support all dimensions, areas, distances, etc.

Date:	Project Name:	
Location of Project:		
County of Project:		Date of ERFWR used:

Designer Information:	Company:	
Contact:	Email:	Phone:

Developer / Owner:		
Contact:	Email:	Phone:

Fire District:	☐ First Time Submittal | ☐ Resubmittal
Fire Dept. Permit # if Established:	County Permit/Proj. # if established:
Notes for Reviewer:	

General Information (This form is for Individual Properties Section 5 and not Subdivisions):

☐ New Project: | Addendum or Revision to Existing Project: ☐ Previously Approved or ☐ Pending
☐ Municipal Fire Water is Provided ☐ Municipal Fire Water is Not Available – Water Storage is Required
☐ Municipal Fire Water Evaluation has been completed and a copy of decision must be provided.
Domestic water to property will be provided by ☐ Municipal utility, ☐ Well water, ☐ Truck/Tank
☐ Multiple Properties are Sharing Water Source ☐ Individual Water Source for Single Property
☐ Underground Cistern(s) ☐ Above Ground Tank ☐ Other Source:
Are ☐ some, ☐ all, ☐ none of the properties protected by fire sprinklers: Type:
If properties are protected with sprinklers, what flow gpm is required at a pressure of psi.
Is / Will property be properly mitigated for Low Intensity hazard: ☐ No, ☐ Yes – Apply credits

☐ Project has been evaluated and is in compliance with requirements of Section 5. (Not for subdivisions)
☐ Primary structures have approved parking area located 40'-60' from structure and within 900' hose lay from approvable water source / connection. Approximate truck distance to water source: ft.
☐ All parts of all structures can be reached within 300' hose lay from a fire truck on an approved fire lane.
☐ Calculation of Water Supply Requirements (Appendix D) has been completed for each property and where sharing water source, Multi-Property Credit Sheet is completed. Include sheets with submittal.
Are there any structures with roof-line area larger than primary structures within 50' of each other: ☐ N, ☐ Y
Building roof-line area for all buildings within 50' of each other, as used in Table 5.4: ft^2

RURAL WATER DESIGN CHECKLIST
INDIVIDUAL RESIDENCE – SECTION 5

Continued from previous page for Individual Residence:

Water quantity required in accordance with Sections 5: Gallons
Maximum flow required based on gallons / hazard per Section 5.5: gpm
Will water mains/hydrants be used to achieve 900' distance from source to approved parking area: ☐ N, ☐ Y This would apply if the source is located greater than 900' from each protected parking area.
☐ Property deeds, covenants, restrictions, etc. will clearly identify property restrictions to ensure and maintain compliance with all conditions and credits for which the owner has indicated per these regulations.
☐ Primary roads are at least 20' wide. ☐ There are no trees / overhangs below 13'-6" over any roadway.
☐ Driveway / Fire Lane to house is at least 14' wide with compacted load (50,000 lb+) and clear width of 20'.
☐ Grade <=10%. ☐ For angle of approach, no grade change exceeds 5% (1') along any 10' section.
☐ The transverse (cross) slope does not exceed 4%. ☐ All turns have a min. 28' inside & 50' outside radius.

Cistern Criteria: This section ☐ Is Applicable, or ☐ Is NOT Applicable (Municipal Type Supply)
Will cistern be located / accessible ☐ at the public street, or ☐ further back on property. Cisterns shall be located to allow fire truck with 10' hard suction to make connection while allowing other fire apparatus to get around to reach structures / other properties.
What size cistern(s) will be provided: gallons How many tanks will be provided: (Make sure to take into account transport restrictions, cranes, excavations, etc.)
Will cistern(s) incorporate provisions for automatic filling: ☐ Yes (required), ☐ No (only if accepted by AHJ)
Is electronic tank level monitoring / fill provided: ☐ Yes (required), ☐ No (only if accepted by AHJ)
☐ Where multiple cisterns are at one location, they are all connected to ensure maximum water availability from lowest level without the potential to overflow smaller tanks with lower top elevation. ☐ NA
What is the minimum depth of bury over cistern: ft. Depth from side of tank to retaining wall: ft.
☐ 6" Male-NH dry-hydrant connection with cap and chain will be provided 18"-24" above grade.
☐ 4" Fill line with 2.5" NST-FS 2-way clappered Siamese connection, threaded caps, and chains are provided.
☐ Tank vent is provided and configured above normal snowfall, with shield to protect screen.
☐ 30" Manway with locking 4" inspection hatch is provided.
Will tank require anchoring to prevent floating if ground water is present: ☐ No, ☐ Yes
☐ Traffic grade signage will be provided to identify fittings, tank #, tank size, address(s), emergency contact #.
☐ Drawings, product data/cut sheets, and other supporting documentation is included for review.

☐ **Developer /** ☐ **Owner Certification:**

I hereby certify that the information provided in this document is true and correct. I understand that I am responsible for ensuring compliance with all regulations and rulings of the fire authority. I understand that I am responsible for maintaining all conditions for which this design and submittal is established around. This includes but may not be limited to the sizes of structures, any credit for sprinkler systems, any credits for mitigation and hardening of the property, maintenance of cisterns, water supplies, and access roads. If any of the conditions change for which my water supply was established around, I understand that I am responsible to perform an evaluation and to identify any impacts along with making the necessary corrections.

Signature: Print: Date:

RURAL WATER DESIGN CHECKLIST
INDIVIDUAL RESIDENCE – SECTION 5

FOR USE BY REVIEWERS ONLY

Date logged in / received:	Logged in / received by:	
Reviewer Name:	Title:	Review Date:
Reviewer Email:	Reviewer Phone:	

☐ Submittal is rejected due to inadequate information to start review. See limited notes.

☐ Submittal is not prepared / sealed by an acceptable registered engineer (when required or determined).

☐ Submittal is returned. Review was stopped and not completed due to too many errors identified.

☐ Submittal is returned for corrections based on notes provided. ☐ See separate document for comments.

☐ Submittal is accepted* as noted. Proceeding implies the submitter will fully comply with conditions noted.

☐ Submittal is accepted* as a partial submittal with additional information required ☐ now, ☐ Differed

☐ This submittal is accepted*. See "*" regarding terms of acceptance.

Review Notes:

*Acceptance does not exclude future or separate submittals that may be required by this or other departments / jurisdictions. Many projects require multiple submittals at different stages. These can include concepts, detailed design, shop drawings for particular components, deferred submittals, mitigation reports, fire risk reports, special inspections, progress test reports, record of completion, commissioning reports, etc. The owners / designers / contractors are responsible to identify and ensure all such submittals and milestones are completed. Any revisions to an accepted submittal will require a re-submittal before proceeding with work. Acceptance is based on cursory review / inspection only to identify potential issues. The owners / designers / contractors are fully responsible for 100% compliance with all applicable codes, standards, regulations, and engineering documents. The jurisdiction shall not be held liable or responsible for any delays or required corrections to achieve compliance. The submitter understands and accepts these terms by proceeding with construction.

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RURAL WATER DESIGN CHECKLIST
SUBDIVISIONS – SECTION 6

This form can be filled out by hand or is available in a MS Word fillable format.

Enhanced Rural Fire Water Regulations (ERFWR)

This form shall be used by the submitter to assist with compliance of the current Enhanced Rural Fire Water Regulations as adopted by the jurisdiction. Complete form and include with each submittal. Include drawings / calcs / data that detail and support all dimensions, areas, distances, etc.

Date:	Project Name:	
Location of Project:		
County of Project:		Date of ERFWR used:

Designer Information:	Company:	
Contact:	Email:	Phone:

Developer / Owner:		
Contact:	Email:	Phone:

Fire District:	☐ First Time Submittal | ☐ Resubmittal
Fire Dept. Permit # if Established:	County Permit/Proj. # if established:
Notes for Reviewer:	

General Information (This form is intended for subdivisions per Section 6 only):

☐ New Project: | Addendum or Revision to Existing Project: ☐ Previously Approved or ☐ Pending
Some subdivisions may incorporate commercial buildings / hazards in addition to residential occupancies. This form is focused on residential aspects. See separate form for commercial buildings.
☐ Municipal Fire Water is Provided ☐ Municipal Fire Water is Not Available – Water Storage is Required
☐ Municipal Fire Water Evaluation has been completed and a copy of decision must be provided.
If other than municipal: ☐ Underground Cistern(s), ☐ Above Ground Tank, ☐ Other Source:
Domestic water to properties will be provided by ☐ Municipal utility, ☐ Well water, ☐ Private system
Will landscaping, such as common areas, be served by ☐ Well water, ☐ Municipal supplier, ☐ Private syst.
Size of subdivision: acres with lots. Identify typical lot sizes:
Summarize common use areas (pool, trails, park, clubhouse):
Are ☐ some, ☐ all, ☐ none of the residences protected by fire sprinklers: Type:
If residences are protected with sprinklers, what flow gpm is required at a pressure of psi. This is to verify that the intended water supply will provide the necessary flow/pressure early in design.
Is / Will subdivision be properly mitigated for Low Intensity hazard: ☐ No, ☐ Yes – Apply credits
Is there wooded acreage: ☐ No, ☐ Yes. If yes, approximate percentage:
Will there be large ponds / lakes: ☐ No, ☐ Yes. If yes, approximate average size:
Is the subdivision under this submittal divided by a major thoroughfare: ☐ No, ☐ Yes
Other notes to help reviewer:

RURAL WATER DESIGN CHECKLIST
SUBDIVISIONS – SECTION 6

☐ Project has been evaluated and is in compliance with requirements of Section 6, and others as applicable.
☐ Property deeds, covenants, restrictions, etc. clearly identify property restrictions to ensure and maintain compliance with all conditions and credits for which the developer has indicated per these regulations.
☐ Roads through subdivision, fire lanes to houses, pullout for cisterns (when applicable), turning radius, loads, overhangs / trees, etc. are in compliance with applicable requirements and Section 14.
☐ Primary structures will have approved parking area located 40'-60' from structure and within ____' hose lay from approvable water source / connection. Maximum truck distance to water source: ft.
☐ All parts of all structures can be reached within ____' hose lay from a fire truck on an approved fire lane.
Will there be any deed restrictions on the sizes of residential structures (Table 6.4): ☐ Yes, ☐ No
Water quantity required in accordance with 6.4: Gallons. This is ☐ with, ☐ without sprinkler credits.
Is additional fire water required for Moderate or High Intensity per 6.4.67: ☐ No, ☐ Yes - Gallons
Maximum flow required based on gallons / hazard per Section 6.5: gpm
☐ Property deeds, covenants, restrictions, etc. will clearly identify property restrictions to ensure and maintain compliance with all conditions and credits for which the developer has indicated per these regulations.
☐ Primary roads are at least 20' wide. ☐ There are no trees / overhangs below 13'-6" over any roadway.
☐ Driveway / Fire Lane to house is at least 14' wide with compacted load (50,000 lb+) and clear width of 20'.
☐ Grade <=10%. ☐ For angle of approach, no grade change exceeds 5% (1') along any 10' section.
☐ The transverse (cross) slope does not exceed 4%. ☐ All turns have a min. 28' inside & 50' outside radius.

Cistern and Privat Main Criteria: ☐ Is Applicable, or ☐ Is NOT Applicable (Municipal Type Supply)
☐ Cisterns will be located in similar condition as Detail #2 with pullout and perpendicular to roadway. ☐ Cisterns are proposed to be situated differently than Detail #2 and are detailed in this submittal for review.
What size cistern(s) will be provided: gallons How many tanks will be provided: (Make sure to take into account transport restrictions, cranes, excavations, etc.)
How many cistern locations (groups of tanks) are proposed: Provide drawings including elevations.
☐ Cisterns incorporate automatic filling through a solenoid valve using electronic tank level monitoring.
☐ All equipment, pipe, valves, solenoid, etc. are / will be protected from freezing.
☐ Where multiple cisterns are at one location, they are all connected to ensure maximum water availability from lowest level without the potential to overflow smaller tanks with lower top elevation. ☐ NA
What is the minimum depth of bury over cistern: ft. Depth from side of tank to retaining wall: ft.
Based on criteria of 6.3, are internal eductors to be provided: ☐ No, ☐ Yes – How many:
☐ If eductors are provided, each location is provided with the indicated adapters, pressure line & fitting, etc.
☐ If eductors are provided, specific tank requirements have been coordinate with manufacture, and coordination of required fittings and pipe between each supplier and field installers.
☐ 6" Male-NH dry-hydrant connection, cap, and chain will be provided 18"-24" above grade (non-eductor).
☐ 4" Fill line with 2.5" NST-FS 2-way clappered Siamese connection, threaded caps, and chains are provided.
☐ Tank vent is provided and configured above normal snowfall, with shield to protect screen.
☐ 30" Manway with locking 4" inspection hatch is provided.
Will tank require anchoring to prevent floating if ground water is present: ☐ No, ☐ Yes

RURAL WATER DESIGN CHECKLIST
SUBDIVISIONS – SECTION 6

☐ Traffic grade signage provided to identify fittings, tank #, tank size, instructions, emergency contact #, etc.
☐ Private 6" fire mains are provided to ensure hydrants are within _____' of acceptable parking areas.
☐ Isolation valves are provided to allow isolation of branches/main for repairs/maintenance limiting impact.
☐ All street valves and/or PIV's are installed so that no valve is deeper than 7' below the grade level.
☐ Cistern piping, fittings, connections, valves, input hydrant, PIV, signage, etc. are in accordance with details of this document for standardized use and training.
☐ Inlet hydrants are provide with proper fittings (opposite of normal hydrants) to facilitate pumping into.
☐ Hydrants are color coded for function, and reflective bands / snow poles are color coded to cistern zone.
☐ Hydrants are labeled and numbered to coincide with cistern zone, and hydrant rings will be provided.
☐ Color coding of cistern zones and reflective bands are coordinated to be different from adjacent zones.
☐ Street valve covers will be cast with "FIRE" in lid.
☐ All pipe that may be exposed will be properly protected / painted from UV exposure.
☐ Pipe bollards and other means of protection from physical damage have been provided. This includes vents, level gauges, and other items that can be damaged by mowers, weed trimmers, or other hazards.
☐ Electrical power has been provided for electronic monitoring panel and trouble / fault strobe.
☐ Area street lighting of minimum ____ lux average has been provided at cistern parking area (6.3.6).
☐ Drawings, product data/cut sheets, and other supporting documentation is included for review.
☐ Hydraulic calculations have been performed to evaluate flow, elevations, friction loss (distance and fittings), drafting lift, fire hose used by the respective department, and other relevant conditions.
☐ Where road and fire main elevations have high and low points, hydrants have been located to facilitate bleeding off trapped air. (Can be a problem since system is not normally pressurized with steady flow. 12.5)
☐ Have provisions (dry-hydrants) been provided at other sources of water (ponds, lakes, pools, etc.). ☐ NA
Other Notes for reviewers:

☐ **Developer /** ☐ **Owner Certification:**

I hereby certify that the information provided in this document is true and correct. I understand that I am responsible for ensuring compliance with all regulations and rulings of the fire authority. I understand that I am responsible for maintaining all conditions for which this design and submittal is established around. This includes but may not be limited to the sizes of structures, any credit for sprinkler systems, any credits for mitigation and hardening of the property, maintenance of cisterns, water supplies, and access roads. If any of the conditions change for which my water supply was established around, I understand that I am responsible to perform an evaluation and to identify any impacts along with making the necessary corrections.

Signature: Print: Date:

FOR USE BY REVIEWERS ONLY

Date logged in / received:	Logged in / received by:	
Reviewer Name:	Title:	Review Date:
Reviewer Email:	Reviewer Phone:	

☐ Submittal is rejected due to inadequate information to start review. See limited notes.

☐ Submittal is not prepared / sealed by an acceptable registered engineer (when required or determined).

☐ Submittal is returned. Review was stopped and not completed due to too many errors identified.

☐ Submittal is returned for corrections based on notes provided. ☐ See separate document for comments.

☐ Submittal is accepted* as noted. Proceeding implies the submitter will fully comply with conditions noted.

☐ Submittal is accepted* as a partial submittal with additional information required ☐ now, ☐ Differed

☐ This submittal is accepted*. See "*" regarding terms of acceptance.

Review Notes:

*Acceptance does not exclude future or separate submittals that may be required by this or other departments / jurisdictions. Many projects require multiple submittals at different stages. These can include concepts, detailed design, shop drawings for particular components, deferred submittals, mitigation reports, fire risk reports, special inspections, progress test reports, record of completion, commissioning reports, etc. The owners / designers / contractors are responsible to identify and ensure all such submittals and milestones are completed. Any revisions to an accepted submittal will require a re-submittal before proceeding with work. Acceptance is based on cursory review / inspection only to identify potential issues. The owners / designers / contractors are fully responsible for 100% compliance with all applicable codes, standards, regulations, and engineering documents. The jurisdiction shall not be held liable or responsible for any delays or required corrections to achieve compliance. The submitter understands and accepts these terms by proceeding with construction.

RURAL WATER INSPECTION CHECKLIST

To be provided at a later date. Ask AHJ if form is ready.

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RURAL WATER TESTING CHECKLIST

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RURAL WATER MAINTENANCE CHECKLIST

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RURAL WATER COMMISSIONING CHECKLIST

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APPENDIX E – LOCAL FIRE AUTHORITY AMENDMENTS / DEVIATIONS

When provided, the following pages will identify specific criteria of the respective jurisdiction(s) as indicated. The jurisdiction will be identified on the documents, and local amendments or criteria will be provided. The jurisdiction may also attach amendments or changes to the original pdf document or as a separate document. This could include photographs of good / bad installations as examples, specific forms to be submitted, or similar items. If the regulation is used by multiple jurisdictions in a county or adjacent to each other then it may be feasible to compile these differences into a table format within this appendix.

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This table provides clarification for certain dimensions, fittings, etc. by fire authority. Items not indicated in table below shall be per the respective sections within the regulation. See body of regulation for general requirements and limitations. See Footnotes next page.

See Footnotes	Fire Authority				
Description	**Black Forest**	TBD	TBD	TBD	TBD
Distance from Source to Parking Area	900’				
Max Distance between Hydrants	900’				
Max Distance of Handline Around House	300’				
Dry Hydrant Fittings	6” M NH				
Cistern Fill Fitting	1-2.5” FS				
Inlet Hydrant Fittings					
Internal Eductor Inlet	1-2.5” FS				
Dry Hydrant for Tank with Internal Eductor Outlet	6” M NH w/ 6” F to 4.5” M NH				
Eductor 30-Deg. Storz Adapter (size or NR)	NR				
Maximum Draft Lift	12’				
Minimum Design Snow Level	48”				
Illumination Levels at Drafting Sources	50-100 Lux (100 preferred)				
Gate Access	Knox or Appr.				
Access Road Width	20’ Min.				
Access Driveway Width	20’ Min.				
Driveway Load Main Road Load	50,000+ lb 70,000+ lb				
Snow Pole, Sign or NR	Pole				
Snow Pole Bolt Mount Pole (BMP), or Port Mount Pole (PMP)	Port Mount on 2.5in				
Snow Pole Material	NS				
Snow Pole Spring	Required				
Inlet Hydrant Color (non-potable at cistern)	Black Gloss				
Outlet Hydrant (non-potable from cisterns)	Purple Gloss SW9068				

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Dry-Hydrant Cistern & Pond Connections	Purple Gloss SW9068				

M = Male; F = Female; FS = Female Swivel;
NA = Not Applicable; NR = Not Required; NS = Not Specified (designer / contractor selectable)
w/ = "With" indicated adapter so that either may be used (Example: 6" Male with adapter to 5" Storz)
NH = National Hose: NST = National Standard Thread (these are the same and are non-tapered threads)
All fittings are required to have chains, threaded caps, and gaskets for female fittings / Storz.

The following hydrant colors have been identified by utility companies. These are not set in stone but are provided to assist with identification. Verify with each utility company for their colors. Refer to NFPA 291 for additional considerations in marking of hydrants and fire flow testing procedures.

Common Utility Company Hydrants	
Yellow hydrants	Potable water distribution hydrants
Bonnets and Cap colors varied	Often used to identify flow / pressures
Purple hydrants	Reclaimed water hydrants (non-potable)

Cherokee Water (El Paso County, CO)	
White hydrant with blue bonnets / caps	Potable water distribution hydrants
White hydrant with green bonnet / caps	Raw water (non-potable) prior to treatment
Purple hydrants	Reclaimed water hydrants (non-potable)

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