Residential Fire Sprinkler Cost Benefit Analysis

For

City of Las Vegas (NV) Fire and Rescue

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Authors:

Sanford D. Mangold
(Adjunct Professor, Crisis & Emergency Mgt)
Chad Hofius
(Cost Analyst)

Residential Fire Sprinkler Study - 2017

Executive Summary:

This is a study commissioned by the Las Vegas Fire and Rescue Department, which provides a dispassionate and objective cost benefit analysis of residential fire suppression (sprinkler) systems, which could be mandated in all new home construction up to 5,000 square feet of livable space*. This study is in direct response of Nevada Revised Statue (NRS) 278.586, which specifies that any governing body considering such a mandate must perform a cost benefit analysis and hold a public hearing on the results of that analysis prior to enacting legislation requiring residential fire suppression systems in all new home construction.

UNLV performed a detailed study over the course of 3 months and determined that there is a definite cost benefit to both homeowners and home builders by installing fire suppression systems in all new residential homes up to 5,000 square feet of livable space.

The following pages detail the UNLV study, which also compares and contrasts the study results with those provided by Applied Analysis (a local Las Vegas analytical company), which was contracted to perform a similar study by the Southern Nevada Homebuilders Association in March 2015.

The UNLV study clearly shows that survival is the primary reason for mandating installation of residential fire sprinkler systems, as well as detailing the source of all cost savings back to homeowners and homebuilders, if such a mandate were enacted.

***The scope of this report addresses new homes which are less than 5,000 square feet in total livable area to match the scope of the requirements of Section 278.586, added to Nevada Revised Statue as a result of the passage by of SB477. This statute requires that a cost cost-benefit analysis be performed whenever a residential sprinkler ordinance will be considered for residential dwelling structures which are less than 5000 sq. feet in livable area. Please see Attachment 1 of this report for the complete NRS 278.586.**

Residential Fire Sprinkler Study - 2017

Purpose:

The purpose of this study is to present an independent, objective analysis regarding the possible installation of residential fire suppression systems (sprinkler systems) in all new single-family home construction within the city limits of Las Vegas, Nevada. As a starting point, the University of Nevada Las Vegas (UNLV) was asked to study, analyze, and document the different perspectives presented in two studies prepared by reputable organizations:

- The National Institute of Standards and Technology (NIST): Benefit-Cost Analysis of Residential Fire Sprinkler Systems (NISTIR-7451), September 2007.
- Applied Analysis: Benefit-Cost Analysis of Residential Fire Suppression Systems – A Review and Analysis in Unincorporated Clark County, March 2015.

Background:

The City of Las Vegas, through the Las Vegas Fire and Rescue, commissioned a cost-benefit analysis to determine the affordability of residential fire sprinklers in single family dwellings with usable living space equaling 5,000 square feet or less. This analysis is to determine the costs associated with a local mandate, as well as the benefits the homeowner and the community gain from residential fire sprinklers. This cost-benefit analysis is also required to satisfy Nevada Revised Statute 278 enacted during the 2015 Nevada legislative session through Senate Bill 477 (attachment 1). Embedded in the Senate language is a mandate requiring that a cost-benefit analysis be performed to demonstrate that the installation of a residential fire suppression system in a new home would be:

> to the benefit of the owners of the residential dwelling units to which the requirement would be applicable and that such benefit exceeds the costs related to the installation of automatic fire sprinkler systems in such residential dwelling units. (Reference: Nevada Senate Bill 477)

Further, the City may elect to issue a mandate requiring fire suppression systems in new residential homes with livable area of 5,000 square feet or less, if:

> the unique characteristics or the location of the residential dwelling unit, when compared to residential dwelling units of comparable size or location within the jurisdiction of the governing body, would cause an unreasonable delay in firefighter response time. (Reference: Nevada Senate Bill 477)

The Senate bill also specifies that the City may mandate residential fire suppression systems in new homes with livable area greater than 5,000 square feet without requiring either of the two criteria mentioned above.

Following the City of Las Vegas' decision to consider adopting this fire suppression system mandate, the Southern Nevada Home Builders Association commissioned a local analytical company, Applied Analysis, to perform a cost-benefit analysis in order to determine the financial feasibility of such a mandate.

Applied Analysis used the 2007 NIST Study (referenced above) as a baseline document. Then, using only local Clark County (Nevada) data in the NIST-developed algorithms, Applied Analysis performed a study to determine if there was, indeed, a cost benefit to the homeowner derived from having a residential fire suppression system installed. Applied Analysis concluded:

> The National Study found that sprinkler systems are economical (i.e., the benefits outweigh the costs) based on national data; however, the utilization of local datasets leads to a different conclusion. Based on the cost-benefit analysis conducted and described herein, results indicate that in unincorporated Clark County, home fire sprinkler systems are not economical (i.e., the costs outweigh the benefits of installation) based on local fire probabilities and system installation costs. (Reference: Applied Analysis Study, page 3)

Observations:

It is important to note that the Applied Analysis study did not dispute the factual content of the NIST Study. Further, Applied Analysis did not suggest that the data used by NIST was flawed; the cost-benefit algorithms developed by NIST were incomplete; nor the conclusions reached by NIST were faulty. Rather, Applied Analysis simply stated that when local Clark County (Nevada) data is plugged into the NIST-developed algorithms, then the installation costs of a residential fire suppression system appear more expensive than any potential financial benefit for a homeowner.

Additionally, the Applied Analysis Study did not consider the potential economic benefits to the homebuilders nor the community, if residential fire suppression systems were mandated in all new residential home construction of 5,000 square feet or less. Without this information, any attempt to provide the City of Las Vegas with a comprehensive cost-benefit analysis is short-sighted and incomplete.

Following the action of the 2015 Legislative Session, the City of Las Vegas asked the University of Nevada Las Vegas (UNLV) to conduct an independent study in an attempt to, if possible, reconcile the differences between the two studies (NIST and Applied Analysis) and to determine if there was additional information, which could shed more light on the wisdom of adopting the legislation mandating the installation of fire suppression systems in all new residential home construction.

Armed with both studies, the UNLV researchers commenced their independent study.

Approach:

UNLV met with the Las Vegas Fire Rescue (LVFR) Fire Marshals with whom they conducted extensive interviews, took detailed notes, and obtained a wealth of background studies on residential fire suppression systems performed over the past 15 years. Further, UNLV met with several fire suppression installation contractors to determine the types of fire sprinkler systems available to home builders and the costs of installation based on current and projected residential home building trends with the Las Vegas city limits.

The researchers also contacted fire marshals, insurance companies, and analytical companies from across the nation. Specifically, they contacted Verisk Analytics:

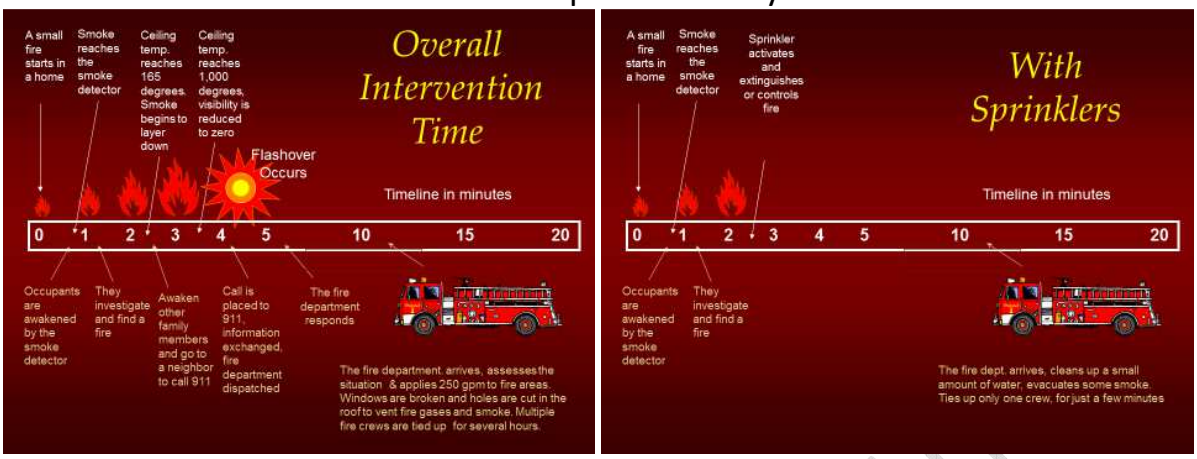
> Verisk Analytics, Inc. is an American data analytics and risk assessment firm based in Jersey City, New Jersey, United States, serving customers worldwide in insurance, natural resources, financial services, government, and risk management.

Each of the organizations and individuals provided the UNLV researchers with supplementary information. The information indicated that additional data (beyond simply just the cost of installation) needed to be factored into any thorough study on fire suppression systems. This new data coupled with realistic fire suppression system installation costs would provide Las Vegas City Council with comprehensive information upon which to make a final decision as to how to proceed with residential fire suppression system legislation.

Findings:

- **Cost:** UNLV performed an in-depth cost analysis, which refutes the cost figures generated by Applied Analysis and its subsequent conclusions (Attachment 2). As shown Attachment 3, UNLV discovered that a residential fire suppression system actually pays for itself in a matter of months after the new residential home is complete (For more detailed information, see Attachment 4). Further, the positive cost benefits to the homebuilder and community-in-general were studied and detailed in the following pages.

- **Smoke Alarms – A Case of Too Little, Too Late:** Smoke alarms without residential fire suppression systems do not appear to be enough to save lives and/or avert major home damage.
    - Smoke alarms do not provide sufficient warning to save all lives. In a typical residential house fire, they activate at about the 45 second point after a fire has started. Smoke becomes a visibility problem at 2 ½ minute point. Temperatures reach in excess of 1,000 degrees in about 4 minutes. Delays in notification (occupants waking up; assessing & identifying the problem; insuring humans and pets are alerted; then calling 911) means the Fire Department commences response at approximately the 5-minute point. It takes (on average) 10 minutes (total elapsed time) for the fire department to arrive. (Source: Power Point Presentation "Why Sprinklers?") By that time, the residence is fully involved in the fire.



Fire Suppression in Homes with and without Sprinkler Systems
(Source: "Residential 1-2 WHY SPRINKLERS" Presentation by Roy Marshall)

- **<u>Damage to Home:</u>** Beyond fire and smoke damage, there is a significant amount of water and structural damage to a house that has experienced a fire.

    - Residential sprinkler systems are set to activate at 150 degrees F.
        - The average residential sprinkler system outputs water at an average of 13 gallons per minute (GPM).
        - Given average fire department response times, a residential sprinkler head may output less than 200 gallons of water before being shut off by a fire fighter.
    - Unprotected residential dwellings will require between 1,500 and 100,000 gallons of water to extinguish the blaze. (This figure does not include damage to doors, windows, and the roof as the fire department works to gain entry into the home.)

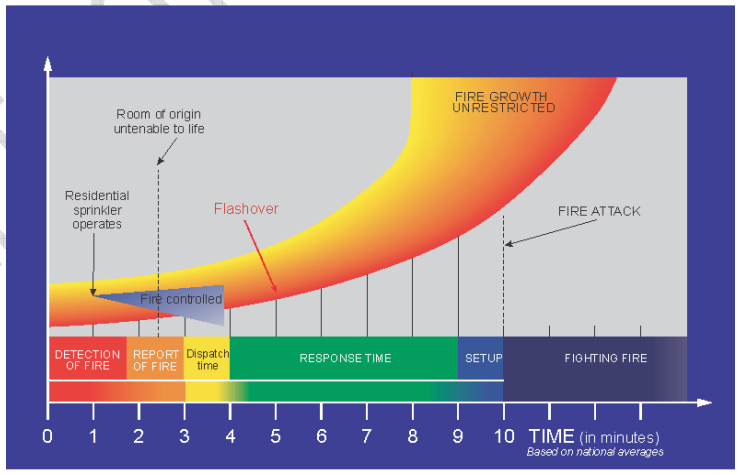


Figure 3: Positive Effects of Residential Sprinklers
(Source: "Why Sprinklers" Power Point Presentation by Pat Coughlin)

- **The Danger in Synthetics:**
  When a house is on fire, many times It is not the structural fire that causes fire deaths, it is the synthetic composition of the residential contents. (Synthetics burn twice as hot and twice as fast.) **(Source: Power Point Presentation "Why Sprinklers?")** Additionally, synthetic materials will typically outgas extremely hazardous and toxic smoke clouds.

  - During a fire, temperatures in a house (without fire suppression systems) can reach 1200 degrees F in less than 5 minutes.
  - "Thermal burns and smoke inhalation were the primary symptoms leading to death, accounting for 90 percent of all fatalities in residential fires." **[Source: Topical Fire Report Series, Volume 16, Issue 2 / July 2015, *"Civilian Fire Fatalities in Residential Buildings (2011-2013)*]**

- **Fatalities:**
  Residential Fire Suppression Systems save lives. According to an extensive study performed by the Medford (Oregon) Fire Department:

  - Home fire sprinklers are designed to ensure a tenable atmosphere for escape.
  - Fire sprinklers with smoke detectors increases chance of surviving a fire by over 97%.
  - Smoke detectors aren't enough.
    (Source: Power Point Presentation "The Case for Residential Sprinklers in Medford, Oregon.)

- **Modern Home Building Trends:**
  New trends in home building and modern furnishing are compressing the timelines between a fire starting, toxic smoke release, and flashover occurring. The Federal Emergency Management Agency (FEMA) and the US Fire Administration hosted a two-day workshop at the Maryland Fire & Rescue Institute (College Park, MD) on 11-12 Dec 2012. This workshop was attended by leading experts from the fire service and home fire research specialists, who gave compelling presentations on how the latest trends in homebuilding and residential furnishing are cause for concern. What they revealed is that there is not only increased concern for the residents, but substantially increased risks for the firefighters as they combat fires in newer residential homes. Their observations are summarized as follows:

  - Changes in the Design of New Homes
    - Larger home footprints.
    - Open concept floor plans.
    - More unventilated attics.
    - Increasingly airtight construction.
    - Increased concealed space.
    - Variety in plans and construction types.
    - Increased housing density.
    - Building at the wildland interface.

- **Modern Home Building Trends (continued):**

  - Changes in Home Construction Materials and Techniques
    - Engineered wood assemblies.
    - Combustible exterior finishes.
    - Green building features.

  - Changes in Home Furnishings
    - New information on effectiveness and hazards of fire retardant chemicals in upholstered furnishings.
    - Overall increased plastic contents.
    - Energy-saving technologies.
    - Photovoltaics.
    - Electric vehicles.
    - Energy storage and distributed power solutions.

  - Changing Fire Service-related Risks
    - Shorter time available for size up due to reduced times to flashover.
    - Fire flow/Wind-driven fires phenomena.
    - Current fire ground procedures and firefighter training inadequate to address those new risks.
    - Less experience in fighting fires due to fewer fires.
    - Staffing reductions in selected jurisdictions independent of increased risks.
    - New firefighter gear/tools with varying performance levels.
    - Firefighter gear improvements increasing other personnel risks.
    - Exposure to carcinogens from contents and construction materials.

    (Source: "Changing Severity of Home Fires Workshop Report," US Fire Administration/National Fire Data Center, December 2012)

- **IRC 2012:** Las Vegas adheres to 2012 International Residential Code (IRC), which mandates fire sprinkler systems. However, during the adoption process, the City placed a qualifier on when residential fire sprinklers will be required. Las Vegas City Ordinance 6351 stipulates:

  The commencement date for residential sprinkler installation shall be the July 1st that follows the first calendar year, if any, during which the combined number of building permits issued by the Southern Nevada jurisdictions for single family dwellings reaches or exceeds 10,000.
  (Note: Southern Nevada jurisdictions include all of Clark County to include the cities of Las Vegas, North Las Vegas, and Henderson.)

  Although, special provisions are provided when fire sprinkler systems are installed (0-hour versus 1-hour fire resistance walls and decreased separation distances between homes), the lack of a mandate means that many new homes are built with the inherent issues identified in the bullet statement above.

It is important to note that Residential occupancies are required by the IRC and International Energy Conservation Code (IECC) to limit air leakage to prevent conditioned air escaping the dwelling. This approach to energy savings has created a condition to limit the escape of smoke and fire gases in the case of a fire condition within the dwelling. The combination of fire gases from synthetic materials with limited ability to vent causes fires to reach flashover potential within three minutes of ignition.

- **<u>Incentives or Trade-ups for Homebuilders and Developers.</u>**

  - **Garages:**
    The base IRC, 2012 Edition, Section 302.6 and Table 302.6 requires fire rated separation from habitable rooms and garages when the habitable rooms are located above the garage. The City of Las Vegas may consider the installation of fire sprinklers in the garage space as an equivalent alternative to 5/8" Type X gypsum board. This may be proposed as a local code amendment.
    - As a result, homes and garages with sprinklers can use less expensive and fewer gypsum panels in the construction of garage walls and ceilings. Assuming a 22' by 22' garage with 8' ceilings, two walls adjacent to living space, and living space above, the estimated cost savings per house from this incentive was estimated to be $226.
    - Without sprinklers in the house and garage, the design is assumed to include two layers of 5/8'' Type X gypsum board on the ceiling and have two garage walls with 5/8" Type X panels on both the inside and outside of the wall. These specifications are based on 1-hour rated assemblies found in the Gypsum Association's "Fire Resistance Design Manual." With sprinklers used in the garage and the home, there would be only one layer of ½'' drywall on the ceiling and ½" gypsum panels on the walls dividing the garage from the home.
    - Approximate prices for the 5/8'' Type X and ½'' standard gypsum panels were based on a review of the cost of a 4' by 12' panel from several national retailers who supply the products. The cost for 5/8'' Type X panel was roughly $15.23 per panel while the standard ½'' panel was about $11.98. (These prices are only estimates.)

  - **Exterior Wall Elements:**
    - The IRC requires separation between homes to reduce the likelihood of fire spreading from one home to the next. If they are placed closer than outlined in Section R302.1 (Table R302.1(1)) then a 1-hour minimum fire resistance rating, as tested by approved standards, is required.

- **Exterior Wall Elements (continued):**
  - Table R302.1(2) allows dwellings to be spaced two feet closer when fire sprinklers are installed versus Table R302.1(1) which is used for dwellings without fire sprinklers.
  - This provision allows a home builder to install fire sprinklers to decrease separation distance between houses without exterior walls being rated. The house can grow one foot wider on each side.

- **Increased Fire Hydrant Spacing:**

  The City of Las Vegas allows fire hydrants serving homes built under the IRC to be spaced every 500 feet, and if all homes served by the hydrant have fire sprinklers, then the spacing can be every 600 feet (CLV Fire Code - Section 507). The City of Las Vegas may consider larger spacing of fire hydrants, up to 900 foot intervals with master planned communities where all homes have fire sprinklers. This can be done as a code amendment, or as part of development agreement with a master developer. In considering the information gathered from jurisdictions for this incentive, it was determined that a 400 foot increase in hydrant spacing feet was representative, resulting in an "incentivized spacing" of roughly 900 feet. The more distance there is between hydrants, the lower the hydrant cost per building lot because one hydrant covers more lots. The value of the incentive is therefore presented as a reduced cost per building lot.
  - The value of this incentive was estimated to be $49 per building lot. In calculating this figure, the cost of a fire hydrant is estimated to be $4,000. This figure was obtained from a price sheet of a residential fire hydrant manufacturer (Kennedy). Also, it was necessary to assume that a standard sized lot would have 50 feet of frontage for tract home developments. This figure was sourced from a Tualatin Valley Fire and Rescue report on fire sprinkler incentives, and is a representative lot width in many residential developments nationwide. In considering both sides of the street, 20 building lots can be covered by a hydrant under standard spacing requirements. This results in a per-building lot hydrant cost of $110.
  - There can be 36 lots covered by a single hydrant under the incentivized spacing, reducing the per-building lot hydrant cost to about $122. This translates into an incentive value of $98 per building lot.
  - It is worth noting that the incentive's per-lot value may not hold under certain development scenarios. For example, a sub-division's layout might not allow for each hydrant to cover the maximum amount of building lots. Most hydrants may cover the full 36 lots, but others may cover fewer based on the layout of roads and buildable lots. (This would serve to increase the sub-division's hydrant cost per lot, and reduce the overall value of the incentive.)

- **Increased Fire Hydrant Spacing (continued):**

  - One additional benefit is reducing the need for water district easements for each hydrant location and, if applicable, additional space for on street parking.
    ("Study of Cost Implications Associated with a Voluntary Residential Sprinkler System for New Construction," hydrants. This report provides a comparison between the cost of a sprinkler system and the total value of a number on and off-site tradeoffs, or incentives.)

- **Reduction of Road Width:**
  The City of Las Vegas currently does not allow a reduction of road through a code amendment, but can as a condition of a development agreement. The City of Las Vegas has a fire apparatus access road minimum width requirement of 24 feet. Of the jurisdictions that offer this type of incentive, several different road width reductions are noted.

  - In light of this, a 4' reduction provides a reasonable estimate. In order to present this incentive on a per-lot basis, the reduction in width is divided by two to account for lots being present on each side of the street. The frontage length of a building lot (50') is multiplied by ½ of the road width reduction (2') to determine the area of road, per building lot, which no longer needs to be paved. This area, 100 square feet (SF), is then multiplied by an estimated road development cost ($3.50/SF) to determine the savings from avoided excavation and paving costs ($350/lot). The estimated road development cost per SF of $3.50 was calculated by obtaining the paving cost per single-family lot from Public Works Sources. This cost was divided by one-half the total area of road in front of a building lot, assuming road frontage of 50' and road width of 24', to obtain the cost per SF.

  - The value of the raw land that is able to remain unpaved as a result of this incentive also serves as a component of the value determination, because this land becomes available to the developer for some other use. It is assumed that the developer is able to make some sort of productive use of the non-paved land, such as additional building lots, open spaces, etc. In calculating an estimate for the value of raw land, a raw lot cost of $48,769 was obtained from the NAHB's 2004 Construction Cost Survey while a median lot size of 9,114 for new single-family detached homes was obtained from the U.S. Census Bureau's Characteristics of New Housing for 2009. Relevant data was combined to arrive at a raw land cost of $5.35 per SF, which was in turn multiplied by 100 SF (per lot) to arrive at value of $535/lot for the value of the additional available land.

  - Combining these two components of the reduced road width incentive, the estimated value of the 4' width reduction is roughly $1,172 per building lot.

- **Reduced Fire Flows:**

  Code required fire flow for one- and two-family dwelling currently is a minimum requirement of 1500 gallons per minute (GPM). The fire code as adopted will allow for a 50 percent reduction in fire flow as long as the 1500 gallons per minute is maintained. A reduced minimum fire flow requirement of 750 gallons per minute (GPM), down from a standard flow rate of 1,500 GPM could be implemented for dwellings less than 3000 square feet. The Las Vegas Valley Water District will maintain a minimum flow rate and pressure for residential tract areas, but a reduction in fire flow could reasonably result in the water main size being reduced from 8" to 6" in diameter.

  - The value of this incentive was found to be $50 per lot. For this calculation, it was assumed that the 2" reduction in water main diameter would result in a cost savings of $2 per linear foot of pipe.
  - To obtain the per-lot metric, a lot frontage of 50 feet was used. The water main was assumed to serve both sides of a street; therefore, lots across the street from each other "shared" the value of this incentive, essentially dividing the value by 2. Both the 50' lot frontage and the $2 cost savings/lineal foot pipe figures were obtained from the Tualatin Valley Fire and Rescue report referenced above.

- **Reduced Cul-De-Sac Width:**

  Based on information gathered from jurisdictions offering this incentive, the most common reduction of a cul-de-sac radius was found to be 2 feet. For instance, to allow developers to decrease the radius of a cul-de-sac 2 feet in exchange for including sprinkler systems in the project's homes.

  - Unlike some of the previous incentives which have been valued on a per-lot basis, this incentive is valued for a single cul-de-sac. With the three-foot reduction noted above, the estimated value was found to be $5,433 per cul-de-sac. This figure is based on the area of cul-de-sac which would not have to be paved in moving from a 52' radius to 50' radius, allowing for the fact that part of this area would still be paved where the road enters the cul-de-sac. Road paving cost per square foot was obtained using the same method as was applied in estimating the value of a reduced road width. (This will also require a code amendment if the City of Las Vegas and the homebuilding industry find value in using this approach.)
  - In addition to reduced excavation and paving costs, this figure is also based on the estimated value of raw land of $5.35 per SF that no longer needs to be paved and becomes available to the developer for some other use. Again, this component of the valuation assumes the developer can make some sort of productive use of the preserved land. The value for raw land was determined using the NAHB and U.S. Census Bureau sources noted above in the discussion on reduced road widths.

- **Increased Dead-End Street Length:**
  The typical amount of extended dead-end street length found in the study was 125 feet.
  - Similar to the incentive for reduced radii of cul-de-sacs, this incentive is not valued on per-lot basis. Instead, the benefit of the incentive is stated in terms of how many lots can be added as a result of the increased street length. Under a scenario where 125 feet of street length can be added to a dead-end, an additional four lots can be included.
  - **T**his determination assumes that a standard size lot includes 50 feet of street frontage, and that lots are situated on both sides of the extended dead-end. It should be noted that the value of these additional lots would be partially offset by added land development costs, and that the application of this incentive could be limited by some development layouts.

- **Secondary Access Point:**
  The International Fire Code as adopted and amended though Section 503.1.2 requires a secondary access point for emergency services when a planned community has more than 100 dwelling units. The code allows this secondary access point to be eliminated until a planned community reaches 200 dwelling units with equipped throughout with residential fire sprinklers. This secondary access point may represent a buildable lot for an additional dwelling unit. The return on investment for the homebuilder and master developer will vary based on the street and lot configuration of the community.

Conclusions:

- **Cost is the wrong metric:**
  The cost of installation is not a core issue. In our opinion, the issue of cost appears to be a "red herring" issue. Certainly, while important, cost cannot be used as the sole criterion for accepting or rejecting the provisions contained in Senate Bill 477, NRS 278.576.
  - First, it does not matter whether fire suppression systems increase value of a Las Vegas home by $3,500 - $5,049 (NIST Study) or provide negative value by as much as $2,230 (Applied Analysis Study). (See Attachments 2 & 3) The real issues are: "Do fire suppression systems work and do they save lives and property?" The answer to both questions is: "Yes."
  - Second, the UNLV Cost Analysis (Attachment 4) demonstrates that having a fire suppression system installed in a new home (during construction, not retrofitting) amortizes to zero within the first 12-18 months of home ownership. What is important about this analysis, is that it used current Las Vegas area costing data.

  - Third, on page 4 of the Applied Analysis study, the following statement is made:
    "It is also noteworthy that to retrofit older, existing houses in unincorporated Clark County with a fire sprinkler system, assuming similar pricing, it would cost nearly $ 1 billion."

Nowhere in Senate Bill 477, NRS 278.576, or any Las Vegas Fire Department proposal put in front of the City Council mention anything about retrofitting older homes. We view this statement as completely unnecessary and a distraction, which may be interpreted as an attempt to strengthen a very weak case against residential sprinkler systems.

- Finally, community developers and homebuilders can realize significant overall cost savings and increased profit margins by allowing residential fire suppression systems to be an integral part of new residential homes built in Las Vegas. These cost savings come in the form of reduced street widths; reduced cul-de-sac widths; less costly building materials in certain areas of the home; and more.

In the opinion of the UNLV researchers, cost is an ancillary issue. This study has essentially put the perception of increased cost of new home construction due to installation of fire suppression systems to rest. Fire suppression systems pay for themselves. So, if cost is not the main issue, what is? The core issue is Safety.

- **Survival is the Paramount Issue:** Abraham Maslow, noted American psychologist, developed a concept called the Hierarchy of Needs. The most fundamental human need is: Survival. While fire alarms provide some level of warning, they do not provide sufficient notification to the occupants of a burning home to allow the occupants to get to safety in a reliable manner. Residential sprinkler systems are designed to put water on the ignition source of a home fire, while allowing the resident to escape safely. Thus, residential fire sprinkler systems in new homes speaks to the most fundamental human need – Survival.

- **Mandated Residential Sprinklers do not "disincentize" home buyers:** The UNLV researchers took the extra step of reviewing new home permits for the Las Vegas area. What was discovered that the City of Henderson, NV (which mandates residential fire suppression systems in all new residential home construction) has surpassed the City of Las Vegas in new home permits. It would appear that mandating residential fire sprinkler systems will not adversely affect new home building in Las Vegas. (Attachment 5)

Recommendation:

In the opinion of the researchers from the University of Nevada Las Vegas, the Las Vegas City Council should immediately pass the ordinance mandating fire suppression systems for all new single family residential home construction.

Attachment 1

Adopted language as a result of Senate Bill 477

NRS 278.586 Adoption of building code or other action by local government requiring installation of automatic fire sprinkler system in new residential dwelling units and other structures.

1. A governing body may adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of 5,000 square feet or more.

2. Except as otherwise provided in subsection 3, a governing body may, on or after July 1, 2015, adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet only if, before adopting the building code or taking the action, the governing body:

(a) Conducts an independent cost-benefit analysis of the adoption of a building code or the taking of any other action by the governing body that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet; and

(b) Makes a finding at a public hearing that, based on the independent cost-benefit analysis conducted pursuant to paragraph (a), adoption of the building code or the taking of any other action by the governing body that requires the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet is to the benefit of the owners of the residential dwelling units to which the requirement would be applicable and that such benefit exceeds the costs related to the installation of automatic fire sprinkler systems in such residential dwelling units.

3. A governing body may require the installation of an automatic fire sprinkler system in a new residential dwelling unit that has an area of livable space of less than 5,000 square feet without conducting the analysis or making the findings required by subsection 2 if the governing body makes a determination at a public hearing that the unique characteristics or the location of the residential dwelling unit, when compared to residential dwelling units of comparable size or location within the jurisdiction of the governing body, would cause an unreasonable delay in firefighter response time. In making such a determination, the governing body may consider:

(a) The availability of water for use by firefighters in the area in which the residential dwelling unit is located;

(b) The availability to firefighters of access to the residential dwelling unit;

(c) The topography of the area in which the residential dwelling unit is located; and

(d) The availability of firefighting resources in the area in which the residential dwelling unit is located.

4. A governing body shall not adopt a building code or take any other action that requires the installation of an automatic fire sprinkler system in a structure other than a residential dwelling unit or any portion of such a structure, whether located on public or private property:

(a) That is covered but not completely enclosed;

(b) That is used primarily for agricultural, livestock or equestrian activities;

(c) That has spectator seating situated around the perimeter of the structure or portion thereof; and

(d) Which is otherwise in compliance with all relevant building codes concerning exits and fire alarm systems.

5. The provisions of this section do not prohibit:

(a) A local government from enforcing an agreement for the development of land which requires the installation of an automatic fire sprinkler system in any residential dwelling unit; or

(b) A person from installing an automatic fire sprinkler system in a structure described in subsection 4 or any residential dwelling unit.

6. As used in this section:

(a) "Automatic fire sprinkler system" has the meaning ascribed to it in NRS 202.580.

(b) "Residential dwelling unit" does not include a condominium unit, an apartment unit or a townhouse unit that shares a common wall with more than one other such unit.

(Added to NRS by 2015, 1989)

Residential Fire Sprinkler Study - 2017

Attachment 2

Summary of Benefit-Cost Analysis per Housing Unit: National Study vs. Unincorporated Clark County

(Source: Applied Analysis Study: March 2015)

	National Study (2005 dollars)	National Study (2014 dollars)	Unincorporated Clark County (2014 dollars)
Benefits			
Fatalities Averted	$3,725.57	$4,516.01	$1,019.61
Injuries Averted	$224.74	$272.74	$145.18
Direct Uninsured Property Losses Averted	$79.64	$96.54	$36.95
Indirect Costs Averted	$15.93	$19.31	$7.39
Insurance Credit	$948.41	$1,149.63	$1,341.15
Benefits Subtotal	$4,994.29	$6,054.23	$2,550.29
Cost	$829-$2,075	$1,005-$2,515	$4,780.00

Residential Fire Sprinkler Study - 2017

Attachment 3

Cost Benefit Comparison Analysis

	Cost of Sprinkler Installation		
Newly Constructed Tract Home	AA Study (2014 Dollars)	National Study (2014 Dollars)	UNLV Study (2016 Dollars)
Per Square Foot	$2.00	$1.02	$0.95
2,000 Square foot Home	($4,000)	($2,040)	($1,900)

	Benefit		
Newly Constructed Tract Home	AA Study (2014 Dollars)	National Study (2014 Dollars)	UNLV Study (2016 Dollars)
Insurance Premium Credit	12%	8%	15%
Annual Insurance savings	$71	$48	$89
Appreciation in First Year	2.80%	6.80%	2.80%
2,000 Square foot Home	$6,384	$15,504	$6,384
Total Benefit in first year	$6,455	$15,552	$6,473

Attachment 4

The provided Cost Benefit Analysis (CBA) will compare the cost of the installation with a residential fire suppression system versus the monetary benefits. For the ease of a mathematical baseline, the square footage of 2,000 was used to represent a single family new construction tract home in Las Vegas, NV. Please note that number for any square footage of a home does not affect the formula used in the Cost Benefit Analysis.

The following dataset inputs were used in the CBA:

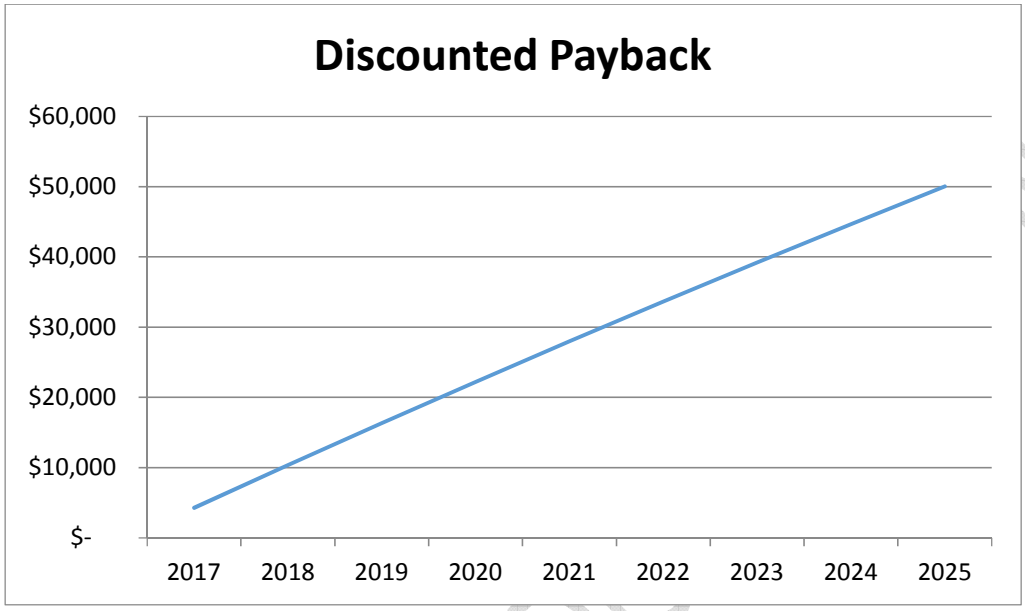
1. The estimate proposal of $.95 per ft² for the cost of installation in a new tract home.[1]
2. The average cost of $114 per ft² to build was used for the square footage of a new constructed tract home. [2]
3. The average home appreciation of 2.8% was applied for a ten-year projection. [3]
4. The discount rate used was the same 4.6% discount rate found in the Applied Analysis study.
5. The average insurance premium discount of 15% for a credit of $89 annually. [4]

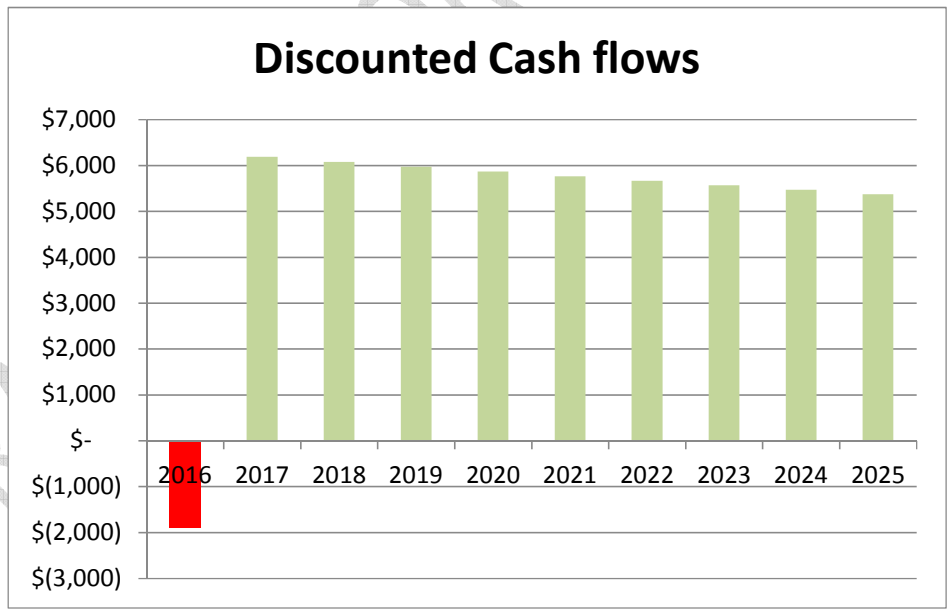
The cost of a new 2,000 ft² tract home is $228,000 in today's dollars net a projected 10-year benefit of $64,032 bringing the potential value of the home to $292,032 in 2025. The investment cost of a $1,900 residential fire suppression system has a payback period in the first year of home ownership. See table 1 below.

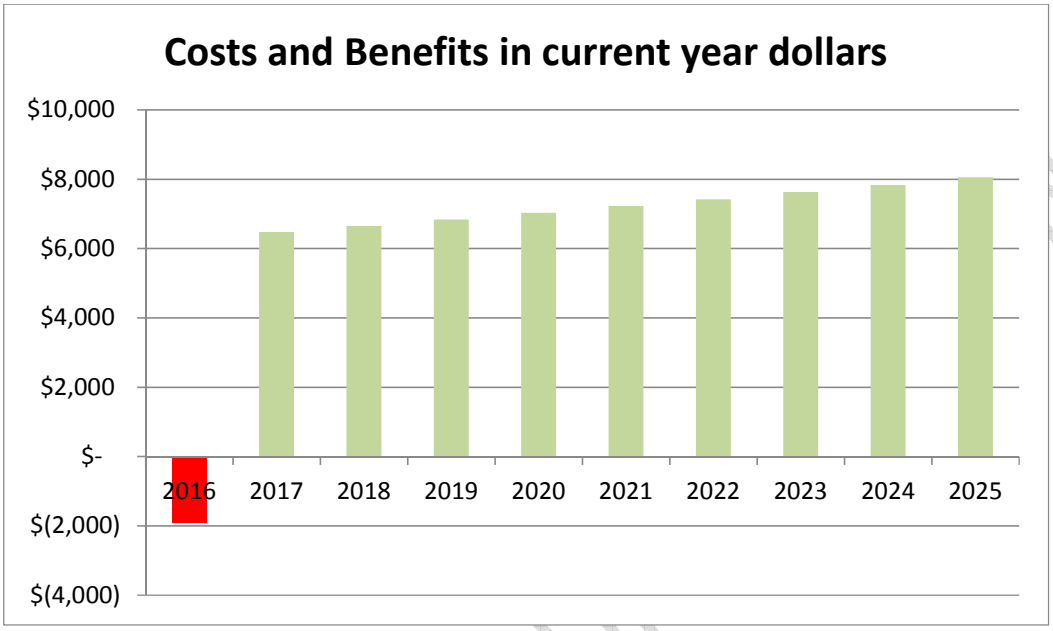
Table 1

2000 SF Single Family Home	**$228,000**									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fire Sprinkler Cost	$(1,900)									
Home Appreciation		$6,384	$6,563	$6,747	$6,935	$7,130	$7,329	$7,534	$7,745	$7,962
Insurance Premium Credit		$89	$89	$89	$89	$89	$89	$89	$89	$89
Total Benefits Per Year/FCF	$(1,900)	$6,473	$6,652	$6,836	$7,024	$7,219	$7,418	$7,623	$7,834	$8,051
Cumulative Benefits	$64,032									
Discount Factors										
Discount Rate	4.6%									
Base Year	2016									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9560	0.9140	0.8738	0.8354	0.7986	0.7635	0.7299	0.6978	0.6671
Discounted FCF	$(1,900)	$6,188	$6,080	$5,973	$5,868	$5,765	$5,664	$5,565	$5,467	$5,371
Cumulative FCF	$(1,900)	$4,288	$10,368	$16,341	$22,209	$27,974	$33,637	$39,202	$44,669	$50,040
NPV	$50,048									
IRR	343%									

[1] The cost of the residential fire sprinkler system was based on an estimate from a local reputable installer.
[2] According to the Las Vegas Review-Journal, the average sale price of home in 2015 is $114 per square foot.
[3] Since 1990 the average appreciation rate for homes in Las Vegas is 2.8% (neighborhoodscout.com).
[4] The average insurance rate premium credit for an automatic sprinkler system to a home in Las Vegas is 15% annually (USAA underwriting, property and casualty).


Discounted Payback
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$-
2017
2018
2019
2020
2021
2022
2023
2024
2025


Discounted Cash flows
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$-
$(1,000)
$(2,000)
$(3,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

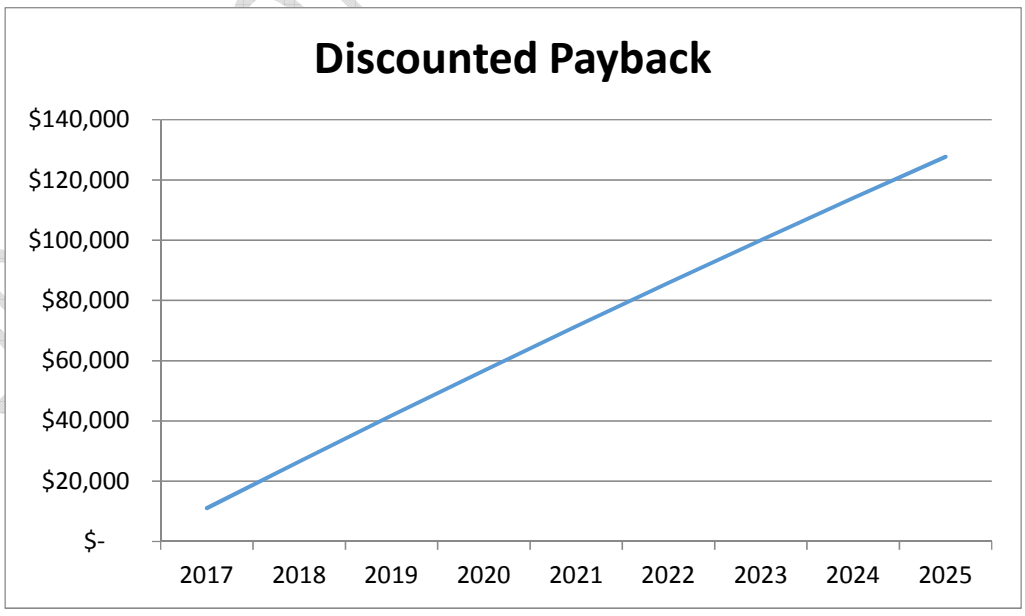


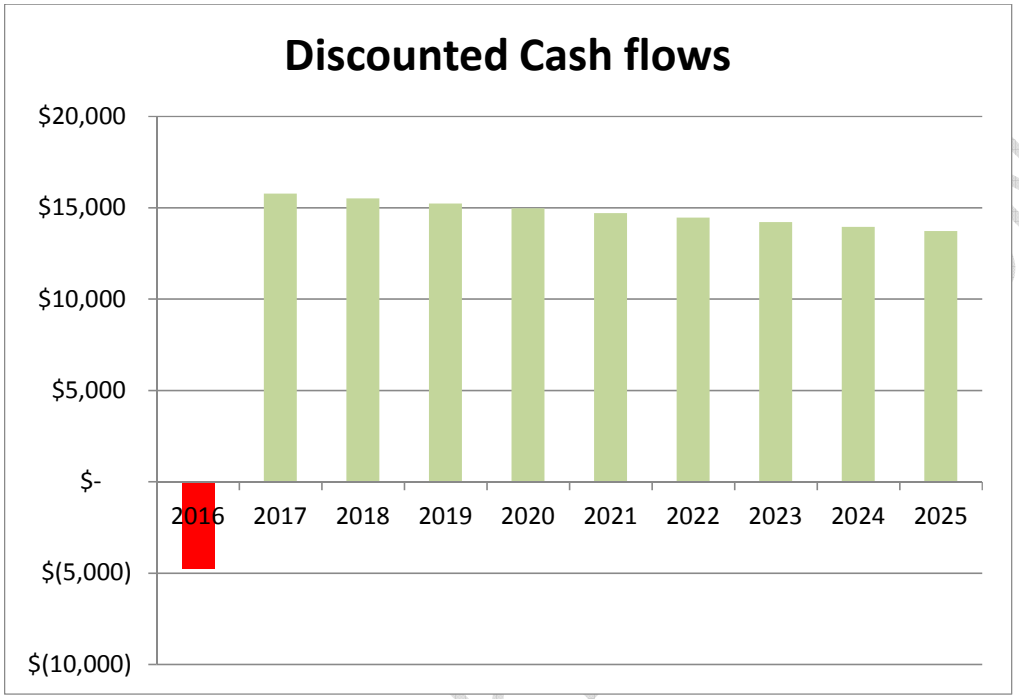
5,000 Square Foot Example:

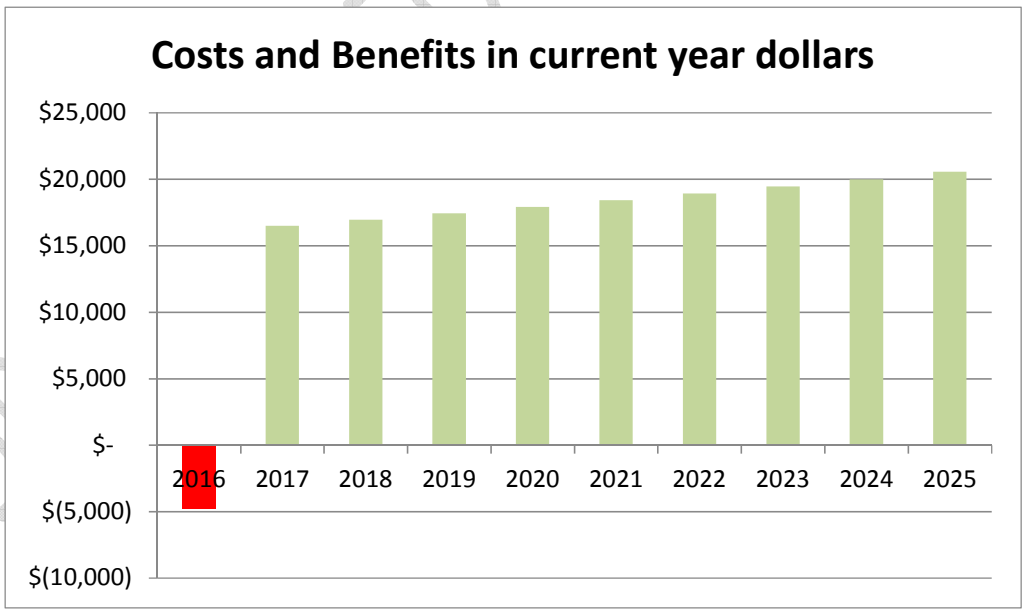
The cost of a new 5,000 ft² tract home is $570,000 in today's dollars net a projected 10 year benefit of $162,180 bringing the potential value of the home to $732,180 in 2025. The investment cost of a $4,750 residential fire suppression system has a payback period in the first year of home ownership. See table 2 below.

Table 2

5000 SF Single Family Home	$570,000									
Year	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Fire Sprinkler Cost	$(4,750)									
Home Appreciation		$16,407	$16,866	$17,339	$17,824	$18,323	$18,836	$19,364	$19,906	$20,263
Insurance Premium Credit		$89	$89	$89	$89	$89	$89	$89	$89	$89
Total Benefits Per Year/FCF	$(4,750)	$16,496	$16,955	$17,238	$17,913	$18,412	$18,925	$19,453	$19,955	$20,552
Cumulative Benefits	$162,180									
Discount Factors										
Discount Rate	4.6%									
Base Year	2016									
Year Index	0	1	2	3	4	5	6	7	8	9
Discount Factor	1.0000	0.9560	0.9140	0.8738	0.8354	0.7986	0.7635	0.7299	0.6978	0.6671
Discounted FCF	$(4,750)	$15,771	$15,497	$15,228	$14,964	$14,704	$14,449	$14,199	$13,953	$13,711
Cumulative FCF	$(4,750)	$11,021	$26,517	$41,745	$56,709	$71,413	$85,863	$100,062	$114,015	$127,726
NPV	$127,734									
IRR	350%									




Discounted Cash flows
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025


Costs and Benefits in current year dollars
$25,000
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
2016
2017
2018
2019
2020
2021
2022
2023
2024
2025

Attachment 5

New Home Permits
Las Vegas Area
2001-2016

New Home Permits	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001
Boulder City	3	22	15	10	9	3	11	7	9	19	13	26	45	52	46	69
Clark County	4085	3593	3410	3567	2966	1604	2137	1931	2470	5859	9765	13535	14367	11132	10644	10329
Henderson	2223	1689	1222	1274	1117	799	707	505	1097	2387	4249	4923	4595	4267	3980	4109
Las Vegas	1454	1662	1438	1517	1233	808	926	744	1085	2356	2998	4268	6200	6861	4451	4281
Mesquite	246	202	196	202	169	134	201	106	379	487	303	599	429	387	289	404
North Las Vegas	794	630	471	497	618	510	648	498	834	2365	4262	7007	6105	4599	2735	2665
Totals	8805	7798	6752	7067	6112	3858	4630	3791	5874	13473	21590	30358	31741	27298	22145	21857

http://socds.huduser.gov/permits/

We, the undersigned, have read the Residential Fire Sprinkler Study – Final Copy (July 2017). We monitored the research throughout the study. We have reviewed and agree with the finding, and find that analysis to be sound and thoughtful in its approach. Therefore, we endorse the conclusions reached. Please let us know if you have any questions or need any additional clarifications.

Date: 7/27/17

Christopher Stream, Ph.D.
Director
School of Public Policy and Leadership
Greenspun College of Urban Affairs
University of Nevada, Las Vegas (UNLV)