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HAZARD MITIGATION METHODOLOGY (HMM)

Technology Transfer Tool

Session 3.05

NIST WUI DAYS 2023 – Session 3.05

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National Institute of Standards and Technology

www.NIST.gov/EL/HMM

Hazard Mitigation Methodology

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- NIST TN 2205 (March 2022) from NIST WUI case studies
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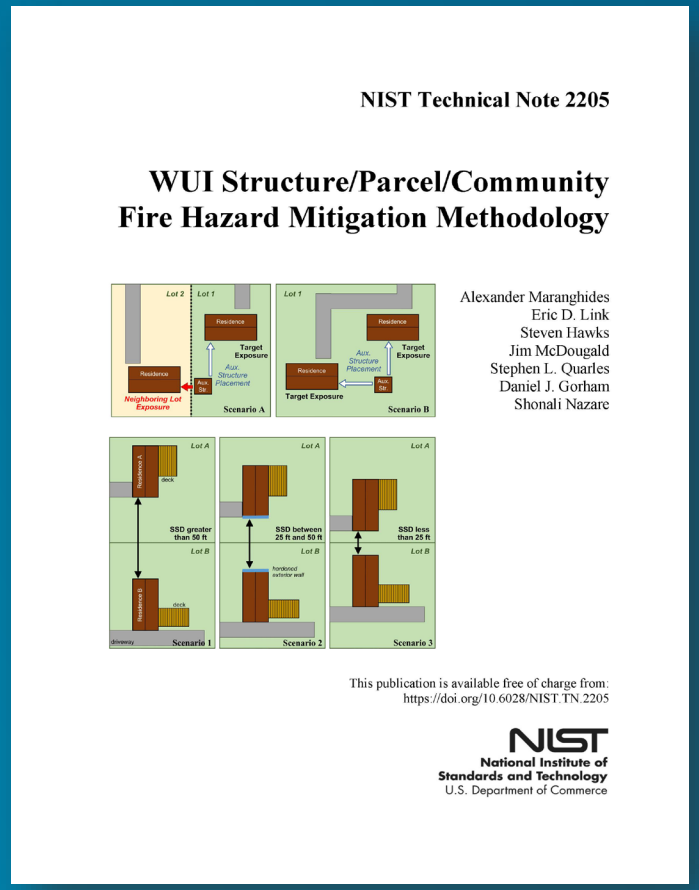

NIST Technical Note 2205

WUI Structure/Parcel/Community Fire Hazard Mitigation Methodology

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HAZARD MITIGATION METHODOLOGY (HMM)

WHAT IS HMM?

HMM is a performance-based approach to WUI fire hazard mitigation for structures, parcels, and communities. The proposed methodology was developed to reduce structural losses in WUI fires by hardening structures and parcels across a community. HMM prioritizes mitigation efforts to reduce overall mitigation costs. Click here to go the HMM project site.

WHY WAS HAZARD MITIGATION METHODOLOGY (HMM) CREATED?

In the last 20 years, WUI fires have become more severe and destructive. Structural losses occur due to exposures from both embers (firebrands) and fire. HMM was created to harden structures to fire and ember exposures from WUI fires. Traditional hazard mitigation strategies focus on individual structures or parcels; however, comprehensive WUI fire mitigation requires a community-wide hazard assessment and mitigation method to address this complex community problem. The HMM goes beyond the traditional approach of protecting individual homes and addresses the unified problem of protecting the entire WUI community.

LINKS TO:

NIST Technical Note 2205

NIST HMM presentation

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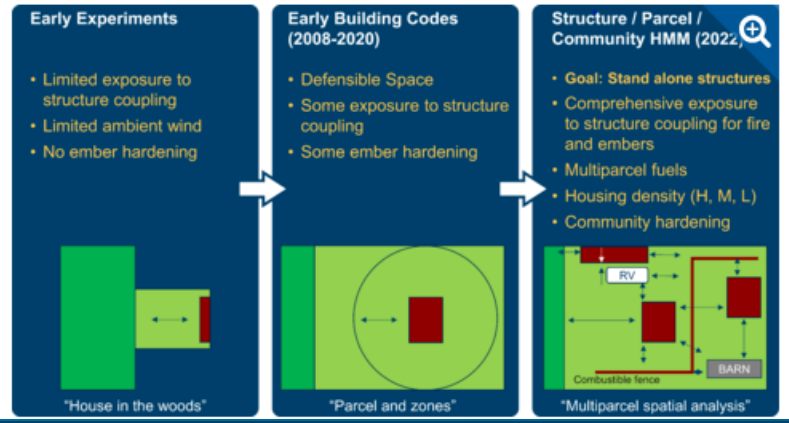
THE EVOLUTION OF STRUCTURE PROTECTION



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NIST HMM presentation materials

NIST WUI website

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HOW IS HMM DIFFERENT FROM TRADITIONAL CODES AND STANDARDS?

HMM is a spatial approach, not a parcel-centric approach. Current building codes and standards specify minimum hardening requirements, that add value in reducing losses in certain conditions. For example, the fire-hardened structure on the left, compliant with an existing WUI building code, survived the exposure from the burning shed. The non-hardened structure on the right ignited within minutes of exposure.

Photos from NIST experiments show the effects of a burning shed located 15 ft from the primary structure.

Best practices are typically voluntary and therefore may not be uniformly adopted or implemented across the community. Furthermore, current approaches often do not address all vulnerabilities that have been identified from past WUI fires. This leads to partial protection of individual structures and the community as a whole.

Comparisons of HMM to some current building codes are provided in a table, found here: HMM Table 6 "HMM items completely included in selected existing WUI building codes"

WHO CAN USE HMM?

- ✓ Existing communities, via retrofitting
- ✓ New construction

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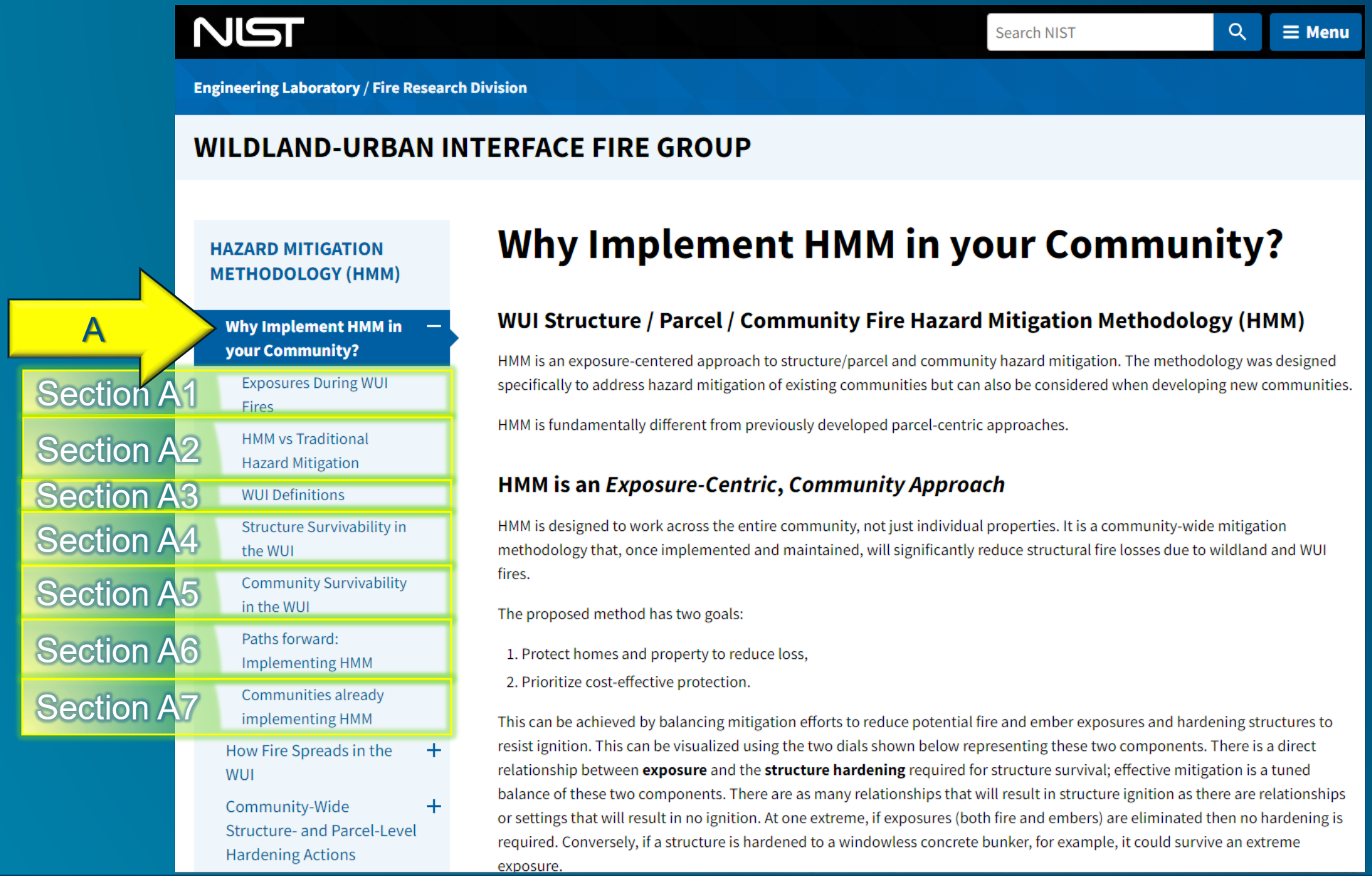

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A

WUI Structure / Parcel / Community Fire Hazard Mitigation Methodology (HMM)

HMM is an exposure-centered approach to structure/parcel and community hazard mitigation. The methodology was designed specifically to address hazard mitigation of existing communities but can also be considered when developing new communities.

HMM is fundamentally different from previously developed parcel-centric approaches.

HMM is an *Exposure-Centric, Community Approach*

HMM is designed to work across the entire community, not just individual properties. It is a community-wide mitigation methodology that, once implemented and maintained, will significantly reduce structural fire losses due to wildland and WUI fires.

The proposed method has two goals:

1. Protect homes and property to reduce loss,
2. Prioritize cost-effective protection.

This can be achieved by balancing mitigation efforts to reduce potential fire and ember exposures and hardening structures to resist ignition. This can be visualized using the two dials shown below representing these two components. There is a direct relationship between **exposure** and the **structure hardening** required for structure survival; effective mitigation is a tuned balance of these two components. There are as many relationships that will result in structure ignition as there are relationships or settings that will result in no ignition. At one extreme, if exposures (both fire and embers) are eliminated then no hardening is required. Conversely, if a structure is hardened to a windowless concrete bunker, for example, it could survive an extreme exposure.

WUI FIRE HAZARD MITIGATION IS A BALANCE BETWEEN TWO INPUT DIALS: REDUCING EXPOSURE AND INCREASING STRUCTURE HARDENING.

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  - How do Structures Survive WUI Fires?
  - Fire Spread Pathways
  - Why Exposure Matters, not Parcel Boundary
  - Hazard from Fuel Agglomeration
  - Community-scale WUI Fire Hazards
- Community-Wide Structure- and Parcel-Level Hardening Actions +
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How Fire Spreads in the WUI

PREVENTING OR ISOLATING FIRE THROUGHOUT A COMMUNITY *CAN* SAVE HOMES.

Large destructive fires transition from wildlands into urban/urban-interface conflagrations via radiation, direct flame contact, and ember exposures.

- **Radiant** exposures occur when large flames from either wildfire or structural fires are close to exposed structural elements. The intensity of thermal radiation reduces with increasing distance.
- **Direct flame contact** occurs when flames from nearby fires, such as burning wood piles, vegetation, or structures come in direct contact with structural components.
- **Embers** are responsible for the majority of structure losses in WUI fires. Embers present high fire hazards as they can:
  1. directly ignite exterior structural components by radiant heating.
  2. accumulate and the pile of smoldering embers can ignite the fuel which may transition to flaming.
  3. penetrate the structure via openings and ignite flammable components within the structure.
  4. ignite vegetative fuels and other combustibles.
  5. spread fire hours after the "fire front" has passed.

Structure ignitions can be characterized into four categories, described below:

Category A (uninterrupted vegetative fire or ember ignition): defined as potential structure ignition due to the uninterrupted spread of fire through vegetation to the structure. By definition, all structures at the perimeter of the WUI community belong to this category. (Not all perimeter structures necessarily ignite by this method; however, determining the ignition pathway after the fire has occurred is often not possible.)

Hazard Mitigation Methodology

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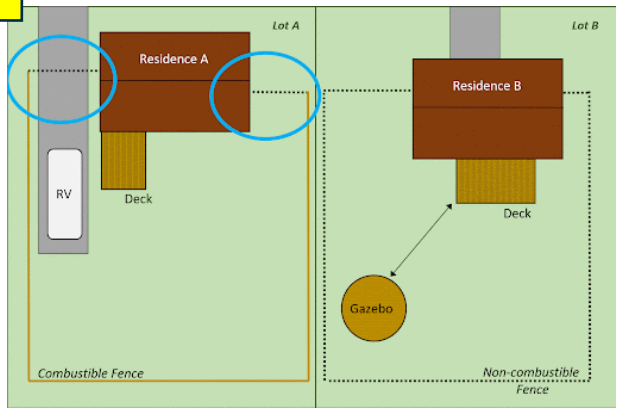
Section B2

Fire Spread Pathways

There are dozens of pathways for fire to spread through communities. Even just one vulnerability can ignite a structure, potentially leading to the ignition of numerous additional structures and the loss of an entire community. Pathways often differ depending on the type of exposure, therefore, a home must be protected from both embers and fire.

The animation below shows an example fire spread pathway between neighboring parcels. Note that while Residence B is protected by a safe Structure Separation Distance, SSD, [illegible] the structure and gazebo, and installation of a non-combustible fence, the fire can still spread to the neighboring structure.

1. Embers ignite gazebo located away from Residence B
2. Fire spreads from the gazebo and ignites wood fence
3. Fire spreads along a wood fence and ignites an RV parked on the property
4. RV fire ignites wood deck
5. Wood deck fire ignites home



Parcel-level combustible components (primary or neighboring parcels)

Detached combustibles	Attached combustibles	Vehicles	Secondary Structures
• Fences • Firewood piles • Railroad ties • Mulch • Ornamental vegetation	• Decks • Pergolas • Awnings	• Cars • RV's • Boats	• Sheds • Barns • Car ports • Auxiliary dwelling units (ADUs) ("In-Law Suite")

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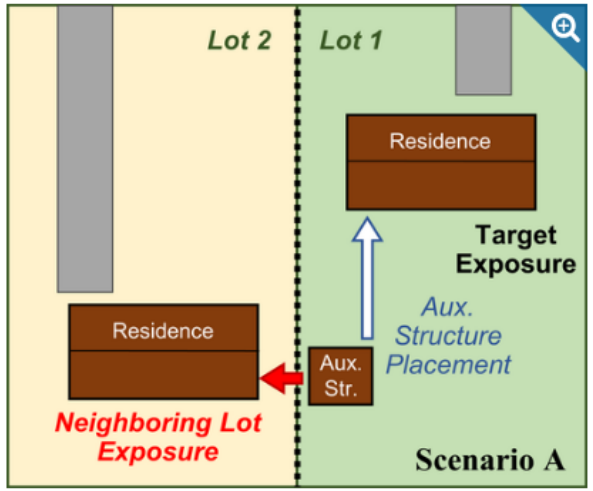
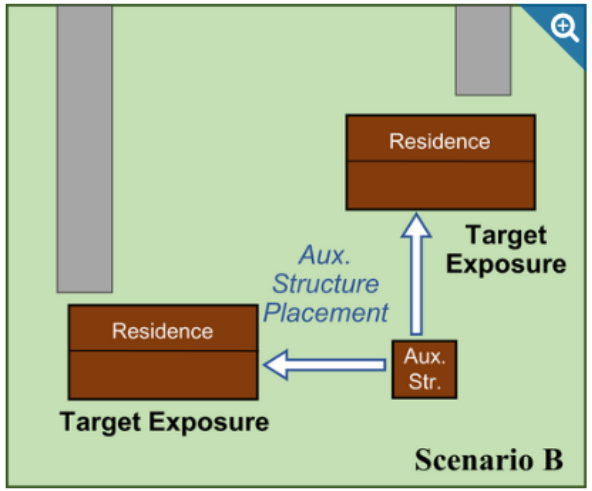
Section B3

Why Exposure Matters, not Parcel Boundary

PROPERTY BOUNDARIES ARE NOT BARRIERS TO FIRE SPREAD.
EXISTING PARCEL-CENTRIC CODES OFFER LIMITED OR NO PROTECTION TO THE NEIGHBORING PARCEL.

- Historically, codes have been parcel-centric and address exposures in the context of protecting a residence from the exposures originating on the same parcel.
- Focusing only on structures and exposures within a property boundary may threaten a neighbor's home.
- The distance between secondary structures, like a storage shed, to all surrounding structures is important, including structures on a neighboring property.





Scenario A:

Shed is located far away from the house on Lot 1 but is too close to the neighboring house across the property boundary on Lot 2. Limiting code application within property lines leaves the hazard imposed from the shed to the neighboring house unmitigated.

Scenario B:

When the property boundary is ignored and the potential exposure is considered, the shed is located far away from both residences.

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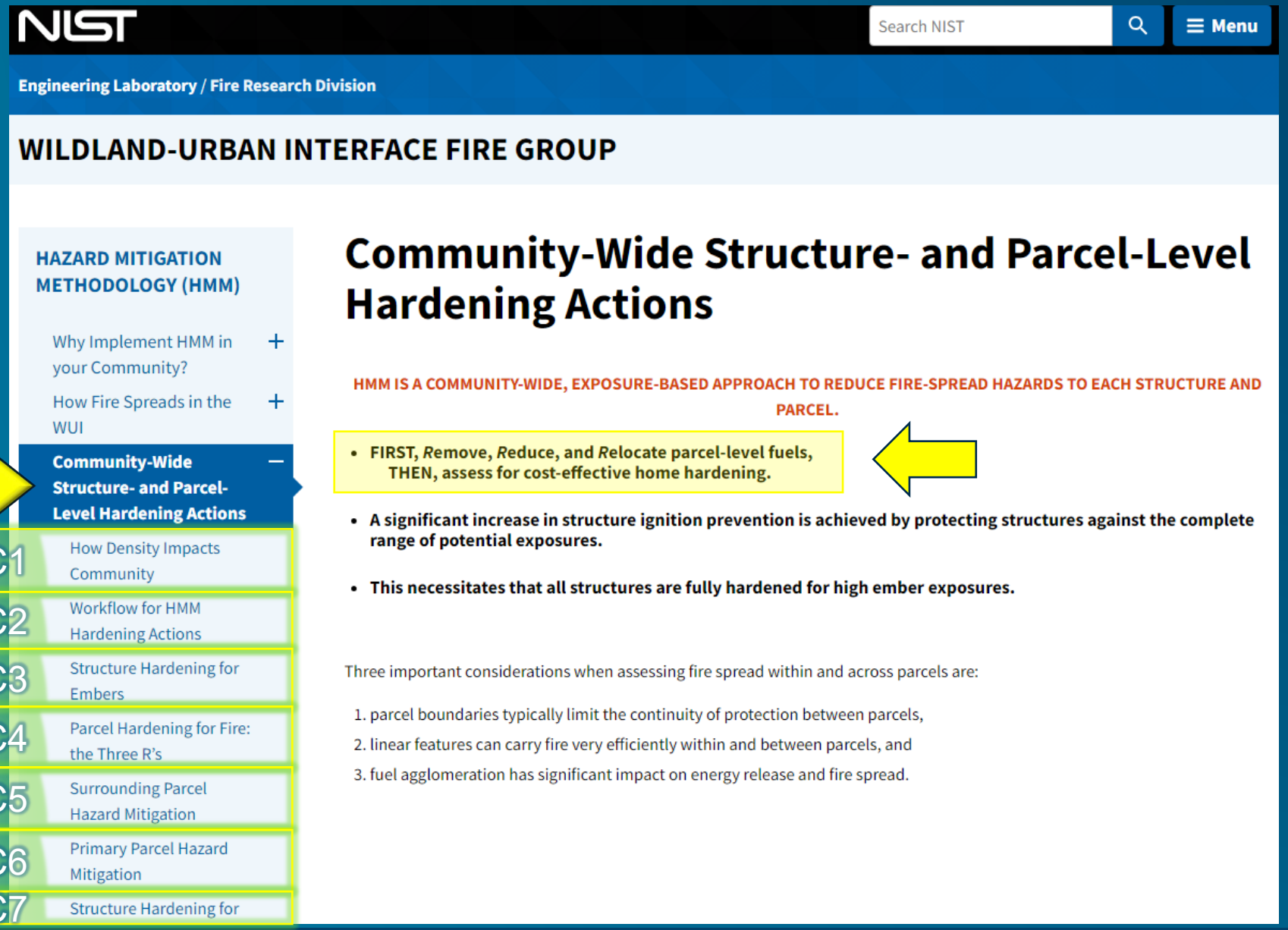

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Section C2

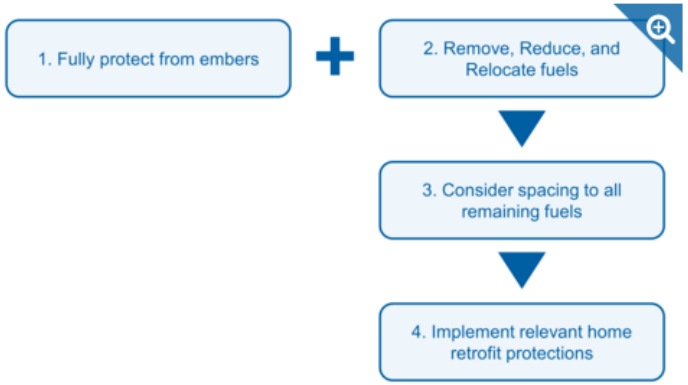
Workflow for HMM Hardening Actions

The basic approach to implement HMM is to:

1. Fully protect each structure from embers (Table A).
2. Remove fuel where possible, reduce fuel that can not be removed, and relocate fuel away from structures and fences, etc.
3. Consider the spacing between fuels on the property being mitigated (Table C) and neighboring properties (Table B).
4. Consult Table D for mitigating actions if spacing is not adequate to reduce exposure.

VULNERABILITIES TO EMBERS AND FIRE MUST BE ADDRESSED INDEPENDENTLY.

The expanded workflow cycle is illustrated in the flowchart below, highlighting independent mitigation of embers and fire exposure vulnerabilities.



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Section C3

ALL STRUCTURES MUST BE HARDENED FOR EMBER EXPOSURES.

Research and experience from past WUI fires shows that a majority of structures are ignited by embers. The widespread and unpredictable nature of ember showers means that all structures need to be protected against ember ignitions.

- Ember exposures cannot be eliminated or reliably reduced.
- Embers can arrive miles ahead of the wildfire front and cause ignition to homes and property.
- A single vulnerability can result in destroyed structures.
- To reduce ember ignitions of homes, ADUs, and other structures of interest, vulnerabilities on these structures need to be *fully* mitigated.

HMM recommends addressing all vulnerabilities unique to each structure. Forty vulnerabilities to ember ignition, and their mitigating actions, have been identified in Table A. Steps should be taken to further mitigate any additional vulnerabilities that may be identified on individual structures.

Link/expand to Table A

Table A. Structure and attached combustible hardening against ignition from embers.

Item #	Structure Component, Assembly, or Attached Combustible	Hardening Action	Performance Goal	Applicable Condition(s)	Notes	Expected Cost Range ($, $$, $$$)	Matched in Existing Code
Roof							
1	Skylights	Replace plastic skylight with multipaned glass with tempered glass outer pane. If skylight opens, install metal screen on the inside. If screen is non-metal replace with metal.	Minimize embers with enough energy to cause ignitions	Plastic skylight pane, nonmetal screen, no screen	Screen is needed only on openable skylights	$	Chapter 7A NFPA 1140 ICC IWUIC
2	Roof to skylight flashing	Check for standard metal flashing and that no exposed wood is present, repair as necessary.	Prevent ignition of combustible skylight framing	Lack of metal flashing around skylight	n/a	$	None
3	Roof assembly details (i.e., dormer and other roof-to-wall intersections)	Metal flashing at roof-to-wall	Prevent ignition of roof from burning debris accumulation	Combustible siding at roof-to-wall intersection	Alternative option: Add the 6 inch "tall" flashing over the existing siding or remove the siding and put flashing on.	$	None
		Replace with noncombustible siding in that area only (e.g., dormer or split-level residence)			Preferred option: remove combustible siding and replace with noncombustible siding	$$	None
4	Solar panels	Minimize debris accumulation under and next to solar panels	Prevent ignition of debris, solar panels, and roof	Solar panels on roof	No additional baffles or screening should be installed as they may impact PV cooling	$	None
5	Roof covering – old wood shake	Replace with Class A (with noncombustible birdstopping, if needed)	Prevent ignition of roof material	Non-fire retardant treated wood shake roof	n/a	$$$	Chapter 7A NFPA 1140 ICC IWUIC
6	Roof covering – Class B Roof covering – Class C	Replace with Class A when needed	Prevent ignition of roof material	Degraded or end of life Class B roof and needs replacement Degraded or end of life Class C roof and needs replacement	n/a	$$$	Chapter 7A
7	Roof covering with openings between roof covering and edge or ridge	Close/plug with noncombustible material	Prevent accumulation of debris between roof covering and roof deck	Style of roof (tile or metal) that creates openings	n/a	$-$$	Chapter 7A NFPA 1140 ICC IWUIC
8	Gutters	Noncombustible gutter cover [a]	Limit accumulation of ignitable debris in gutters	Combustible gutter cover or no gutter cover	If metal cover cannot be installed on plastic gutter, then replace gutter with metal gutter and noncombustible cover	$-$$	ICC IWUIC NFPA 1140
		Metal drip edge	Prevent ignition from embers, protect facia and sheathing from flames		Certain gutters already have drip edge as part of the gutter	$	None
		No-gutter	Prevent ignition from embers		Very expensive solution, less expensive options are available	$$$	None
9	No gutter	Add metal flashing if fascia does not cover roof sheathing	Prevent accumulation of embers at fascia-sheathing intersection	Exposed sheathing (i.e., not covered by fascia)	May require subsurface-surface drainage such as ICC 11.01.6	$	None
Cladding (Siding)							
10	Height of wall assembly from the ground	Replace exterior wall covering with noncombustible material for the bottom 2 ft (from ground); add metal flashing to protect bottom edge of sheathing	Prevent windblown debris and local fuels from igniting the wall	All siding within 2 ft of ground	Metal flashing is required for all claddings, including noncombustible	$$	None
Vents[b]							
11	Ridge vent	Add metal baffle	Minimize embers with enough energy to cause ignitions	Plastic ridge vent AND installable metal baffle	Metal flashing	$	None
		Replace ridge vent w/ metal ridge vent		Plastic ridge vent AND non-installable metal baffle	n/a	$$	None

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Section C4

Parcel Hardening for Fire: the Three R's

PREVENT STRUCTURE AND PROPERTY IGNITIONS WITH THE 3 R'S: *R*EMOVE, *R*EDUCE, AND *R*ELOCATE FUEL.

The preferred mitigation action is to reduce exposures as much as possible. This approach is

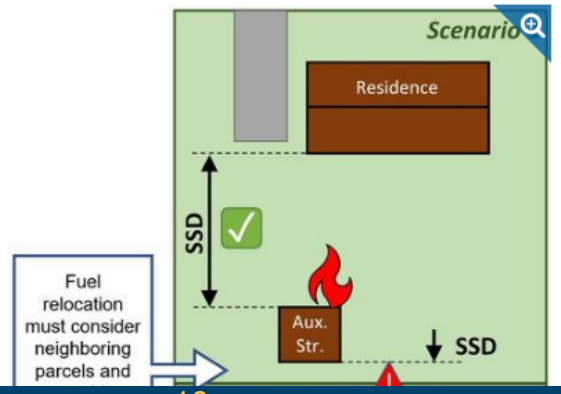
- technically effective (less exposure is less hazard), and
- more cost effective than exterior structure hardening for flame exposures.

Residents have significant control over the fuels located within their parcel. Exposure reduction can be done through three approaches.

The 3 R's:

- ***Remove*** fuels completely from the property (most effective) (e.g., no firewood on property)
- ***Reduce*** fuel by decreasing the amount, or replacing items with non-combustible alternatives (e.g., less firewood, smaller storage shed)
- ***Relocate*** fuel further away from homes and structures (e.g., move firewood or storage shed)

If these approaches are not possible, hardening the structure for fire will likely be necessary. Hardening increases the likelihood of structure survivability but may not be as effective as hazard removal and is the least desirable option. Also, hardening is typically the most expensive option.



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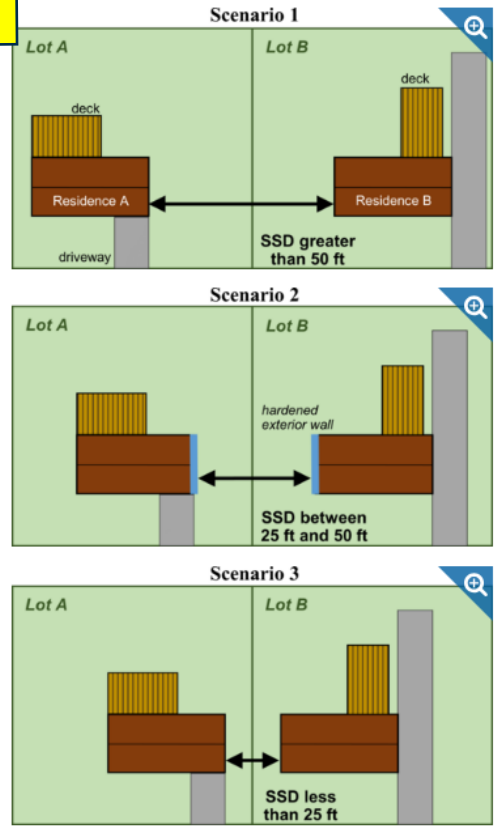
Section C5

Surrounding Parcel Hazard Mitigation

THE POTENTIAL EXPOSURE FROM NEIGHBORING STRUCTURES SHOULD BE ASSESSED AND MITIGATED IF APPROPRIATE.

Depending on the spacing of existing structures on neighboring parcels, mitigating actions may provide resistance to structure-to-structure fire spread. This concept is illustrated in the figure below with three scenarios.

If the minimum SSD is too close and fuels cannot be removed or relocated (e.g. homes and primary structures), then targeted home protection actions can help in certain cases.



Scenario 1 - Homes have space across property boundary. No hardening for flames is needed, as SSD is large enough (< 50 ft) and the structure will not experience significant fire (radiant and convective) exposure from the neighboring structure.

Scenario 2 - Neighboring homes are close enough where one may ignite the other if they catch fire. Targeted, directional structure hardening (indicated by the blue walls) can increase ignition resistance from the expected level of flame exposures

Scenario 3 - Structures are close together and structure hardening is not likely going to increase structure survivability. Exposures will be too high and ignition is likely even if efforts have been taken to harden the exteriors. Both homes must be prevented from ignition because ignition of one will lead to ignition of both. Hardening for embers can enhance ignition resistance of each. Fuel removal and reduction is essential. In a high fuel density scenario as such, a structure could be a residential structure or an auxiliary structure for e.g., storage shed or auxiliary dwelling unit.

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Section C6

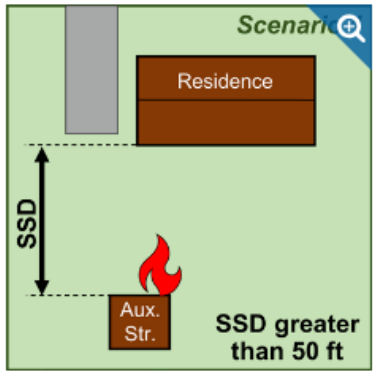
Primary Parcel Hazard Mitigation

FUEL REMOVAL AND DISPLACEMENT (WHEN POSSIBLE) IS ALWAYS PREFERABLE TO EXTERIOR HARDENING.

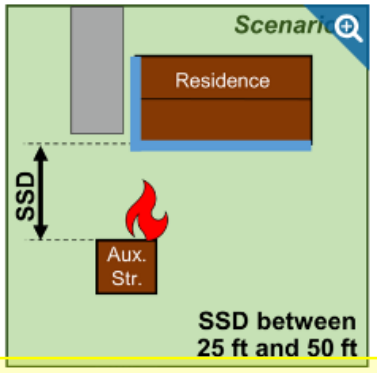
Assess property features that can contribute to fire pathways on or across a property to protect the home (Table C):

- Firewood piles ($)
- Vegetation ($ to $$)
- Sheds ($ to $$$)
- RVs ($)
- Fences ($)

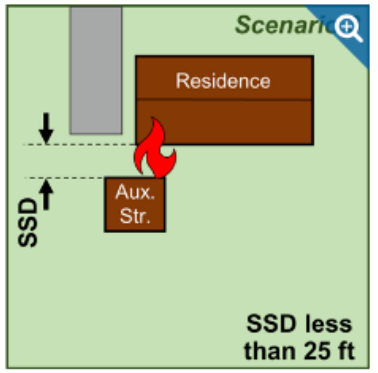
Additional mitigating actions and targeted hardening of the residential structure and nearby fuels may be necessary when a sufficient separation distance is not possible.



Scenario 1 - Exterior hardening of the primary residence is not necessary because the distance between the home and shed is sufficient to prevent ignition by flames. Ember protection is still needed, however.



Scenario 2 - For intermediate separation distances, directional hardening of the home facing the shed (indicated in blue) can help increase the ignition resistance of the residence.



Scenario 3 - The spacing between the home and shed is too close. The fire exposure to the home will likely be too intense for exterior hardening to be cost-effective. Removing the shed is best.

Hazard Mitigation Methodology

NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
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Section C7

Structure Hardening for Fire

TARGETED STRUCTURE HARDENING IS PERFORMED IF FLAME EXPOSURES CANNOT BE AVOIDED AND HARDENING CAN BE EFFECTIVE.

Apply home protective actions against fire when surrounding properties and primary property protective actions are not possible (Table D).

Table B and Table C determine the need and effectiveness of potential structure hardening.

Remember - Always fully protect structures and property against embers!

Table D. Structure hazard mitigation – hardening structure and attached combustibles against ignition from fire (radiation, convection).

Item #	Structure Component – Exposure Distance (ED) or Structure Separation Distance (SSD)	Hardening Action	Performance Goal	Applicable Condition(s)	Notes	Expected Cost Range ($, $$, $$$)	Match Existing Code
1	Roof covering and roof design (assembly) including dormer and bump out roofs	Replace non-Class A roofs by assembly or by covering alone	Prevent ignition of roof from flames	Non-Class A roof	n/a	$$$	None
2	Dormer side	Replace all combustible siding with noncombustible options	Prevent ignition of dormer from flames	Combustible dormer siding	n/a	$$	None
3	Dormer under eave	Replace all under eave construction with noncombustible options or cover with noncombustible material	Prevent ignition of dormer from flames	Combustible dormer eave	n/a	$$	NFPA 1140
4	Dormer window	Replace with dual pane window with both being tempered	Prevent complete window failure[2]	Single pane or dual pane non-tempered	n/a	$$	NFPA 1140 ICC IWUIC
5	Exterior wall(s) including bump out(s)	Add on top (of existing cladding) or replace with noncombustible cladding. Trim must be noncombustible	Prevent siding ignition	Combustible cladding facing exposures in Table B and/or Table C	1. Add on top option is available only for residences with cladding that have a flat profile. 2. Add moisture barrier under new cladding.	$$$	None
6	Bump out bottom (underside)	If exposed framing, enclose with noncombustible material. If enclosed with combustible material, replace or cover with noncombustible material. Trim must be noncombustible and extend (vertically) to account for added material	prevent ignition under bump out(s)	Combustible bump out(s) underside material or exposed framing	n/a	$$	None
7	Glazing in doors and glass sliding doors	Double pane windows (both panes tempered)	Prevent complete window failure[2]	Single pane non-tempered, non-tempered double pane, or double pane with one tempered facing exposures in Table B and/or Table C	Vinyl frames must have reinforcement to prevent panes from being dislodged because of frame deformation (due to heating)	$$$	NFPA 1140 ICC IWUIC
8	Under eave(s) - overhanging eave and overhanging rake (gable end)	Create a soffited eave (horizontal) or enclose eave (angled) using noncombustible material	Prevent ignition in under eave area and entry of fire in residence	Under eave(s) combustible construction facing exposures in Table B and/or Table C	n/a	$$	NFPA 1140 ICC IWUIC
9	Screens	Screen over entire window(s) (even if window does not open) and other glazed surfaces. Framing for screens must be of noncombustible material	Reduce radiative exposures to glass and possibly to parts of frame	All glazed surfaces facing exposures in Table B and/or Table C	n/a	$$	None
10	Windows	Replace with dual pane window with both being tempered	Prevent complete window failure[2]	Single pane non-tempered, non-tempered double pane, or double pane with one tempered facing exposures in Table B and/or Table C	Vinyl frames must have reinforcement to prevent panes from being dislodged because of frame deformation (due to heating)	$$$	NFPA 1140 ICC IWUIC

Note: All sides of a structure must be hardened for fire and radiation unless a field inspection identifies more localized exposures that demonstrate directional hazard (with no fire exposure to other side(s)).

[2] Complete glazing failure will open up residence and allow embers and fire to enter.

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WILDLAND-URBAN INTERFACE FIRE GROUP

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- Community-Wide Structure- and Parcel-Level Hardening Actions +
- **Hardening Actions: Construction Guidance**
- Contacts

D

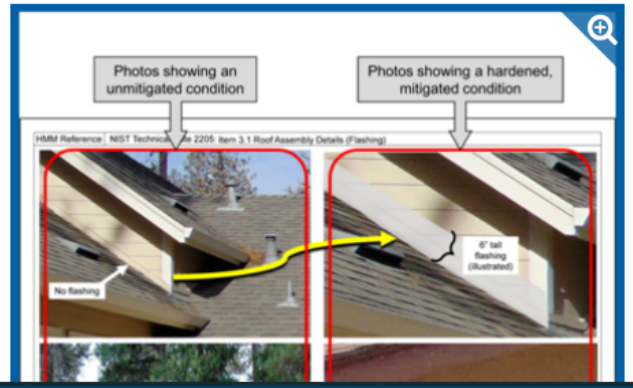
Hardening Actions: Construction Guidance

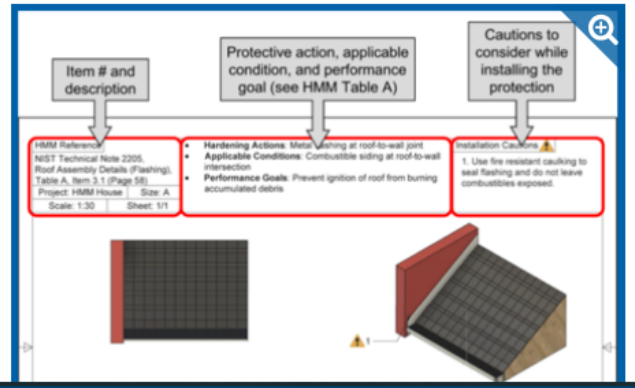
All structures and property should be fully protected from embers. Forty vulnerabilities and hardening actions have been identified for embers and are listed in Table A.

Diagrams and photographs of each vulnerability and hardening action are provided in the accompanying PDF files.

The following photographs and Computer-Aided Design (CAD) drawings are provided as illustrations of the described hardening actions. Implementation of each item should be done by a qualified individual following the appropriate codes, standards, and industry practices.

Guides for each info sheet: Each information sheet is arranged as follows:





Hazard Mitigation Methodology

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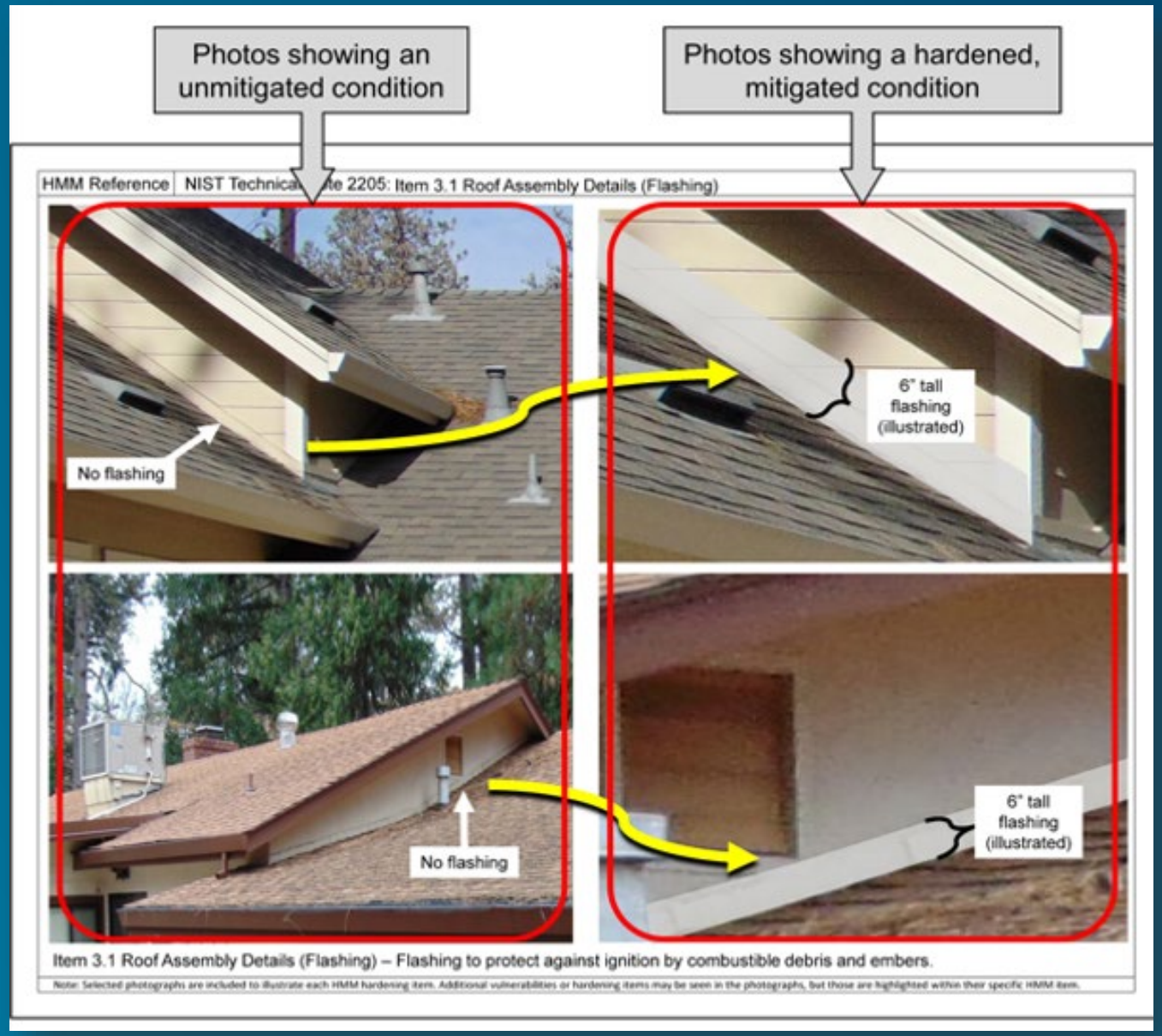

Guidance for PHOTOS

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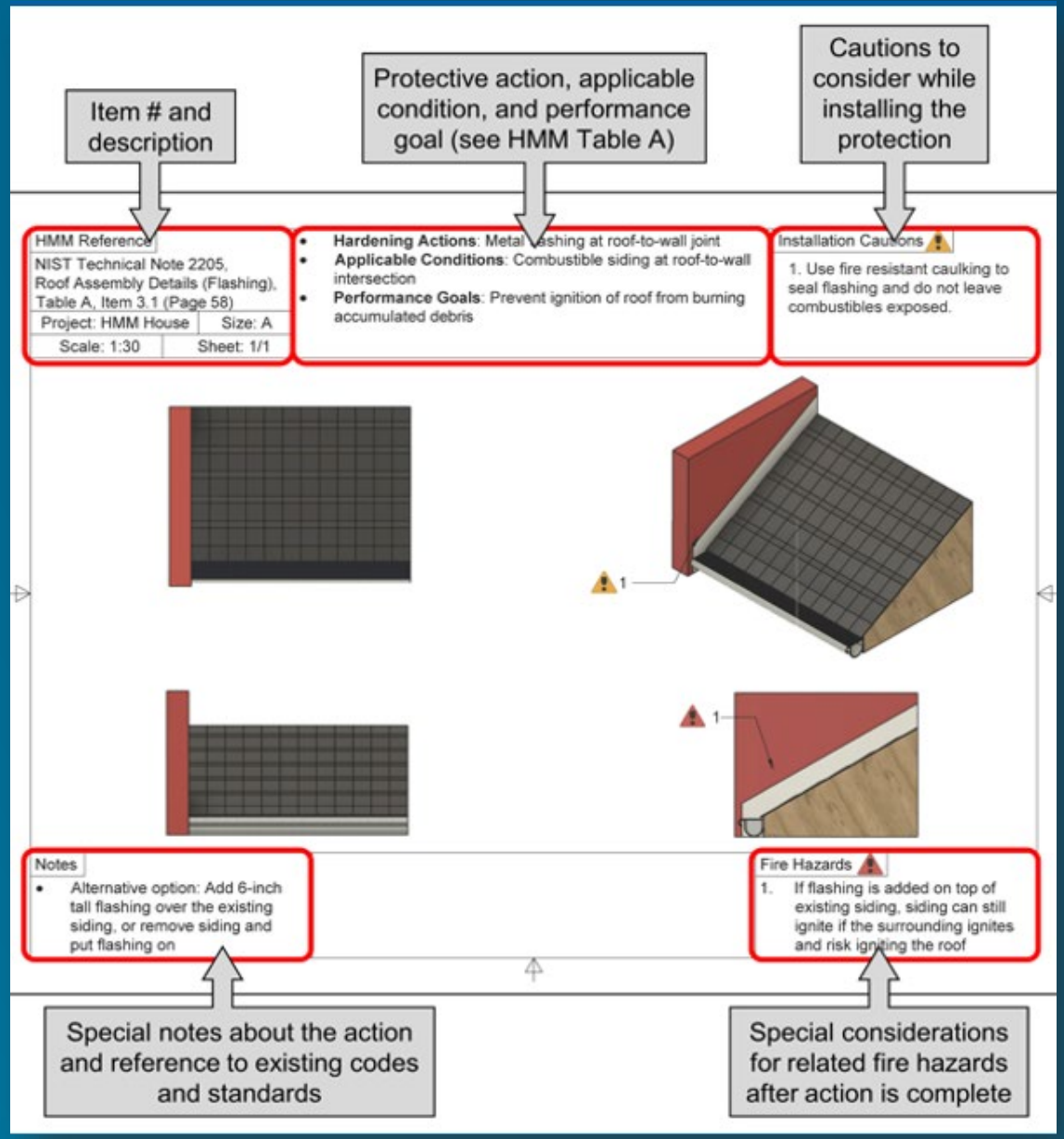

Guidance for CAD DRAWINGS

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ROOF

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- ROOF ASSEMBLY DETAILS (FLASHING)
- ASSEMBLY DETAILS (DORMER)
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- ROOF COVERING (CLASSES B AND C)
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- METAL DRIP EDGE
- NO GUTTERS

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- WINDOW (SINGLE PANEL)
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- DRYER VENTS
- MAKEUP AIR INTAKE
- OTHER ATTACHMENTS TO MOBILE HOME

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- EXTERIOR DOOR (SLIDING)
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HMM Reference | NIST Technical Note 2205 | Item 10 Height of Wall Assembly

Item 10 Height of Wall Assembly – Hardening exterior walls and deck supports 2 ft above ground will prevent windblown debris and embers from igniting the wall.

Note: Selected photographs are included to illustrate each HMM hardening item. Additional vulnerabilities or hardening items may be seen in the photographs, but those are highlighted within their specific HMM item.

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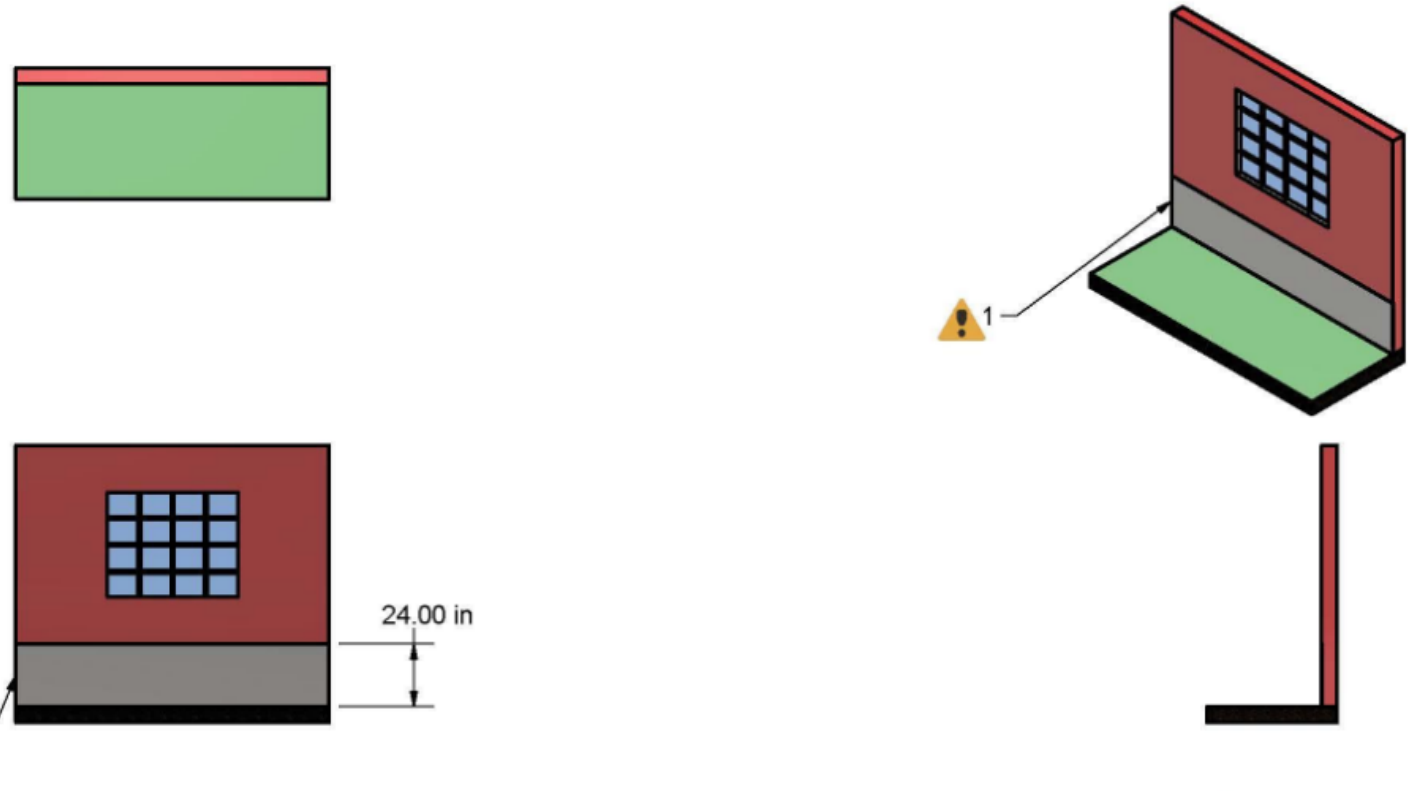
HMM Reference		• **Hardening Action**: Replace exterior wall covering with noncombustible material for first two ft (from ground) and add metal flashing to protect bottom edge sheathing • **Applicable Conditions**: All sheathing within two feet of the ground • **Performance Goals**: Prevent windblown debris and embers from igniting the wall	Installation Cautions ⚠
NIST Technical Note 2205 Height of Wall Assembly, Table A, Item 10 (Page 58)			1. Seal noncombustible wall covering to house exterior.
Project: HMM House	Size: A		
Scale: 1:60	Sheet: 1/1		



Notes		Fire Hazards ⚠
• Metal flashing is required for all claddings, including ignition resistant materials		1. If superheated by close proximity to flame, metal flashing risks igniting siding

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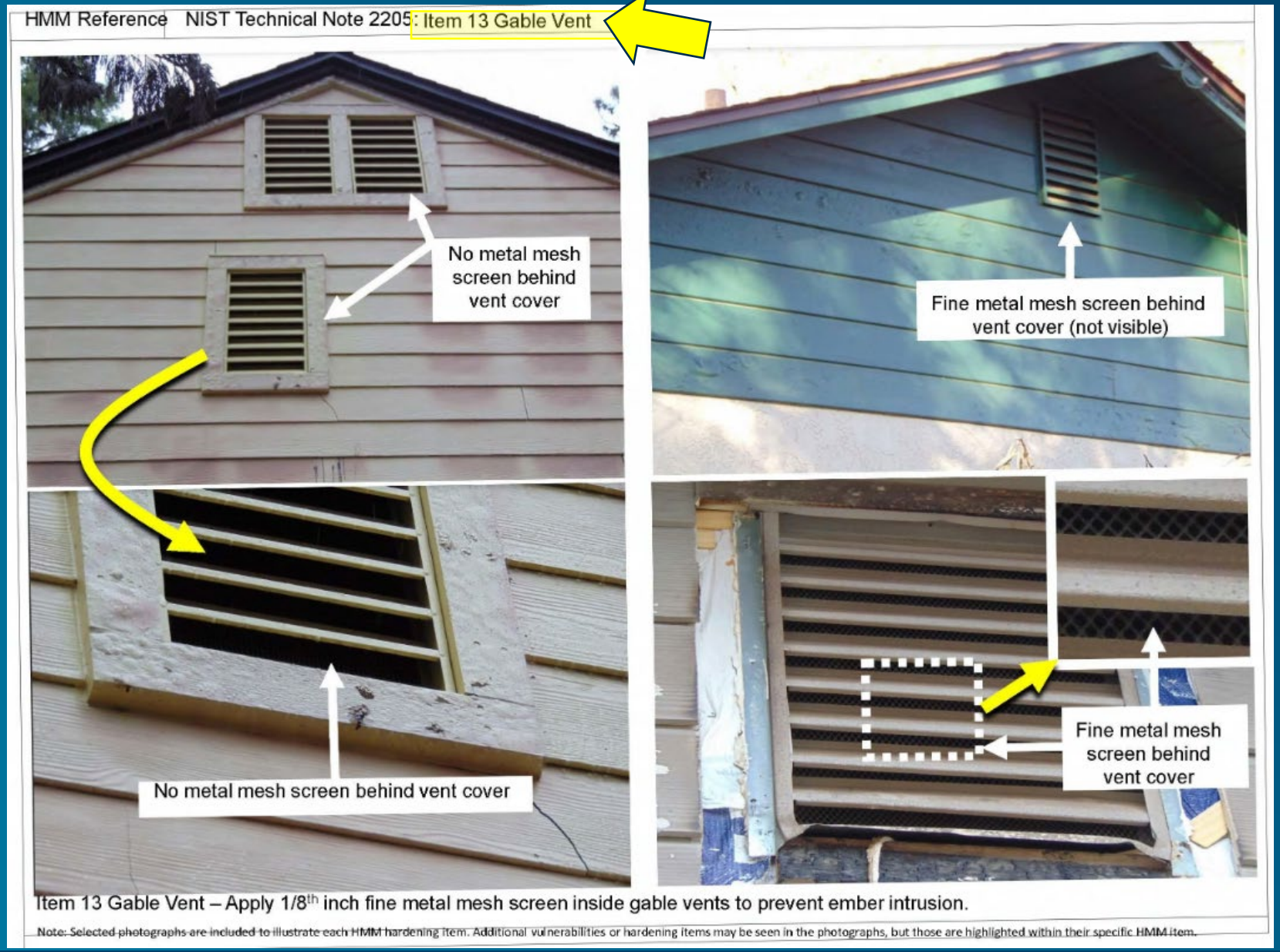

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HMM Reference | NIST Technical Note 2205: Item 14.1 Under Eave Vent (Vertical)

Item 14.1 Under Eave Vent (Vertical) – Keep vents clean, cover with a 1/8th inch fine metal mesh screen, and seal vent with fire-resistant caulking.

Note: Selected photographs are included to illustrate each HMM hardening item. Additional vulnerabilities or hardening items may be seen in the photographs, but those are highlighted within their specific HMM item.

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HMM Reference | NIST Technical Note 2205: Item 37 Mobile Home Skirting

Item 37 Mobile Home Skirting – Noncombustible skirting can prevent mobile home underside from igniting and accumulating flammable (windblown) debris.

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HMM Reference | NIST Technical Note 2205: Item 30 Combustible Decks & Nearby Fuels

Item 30 Combustible Decks & Nearby Fuels – Remove combustibles around the house and away from the deck.

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Hazard Mitigation Methodology

NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY U.S. DEPARTMENT OF COMMERCE

HAZARD MITIGATION METHODOLOGY (HMM)

- Why Implement HMM in your Community? +
- How Fire Spreads in the WUI +
- Community-Wide Structure- and Parcel-Level Hardening Actions +
- **Hardening Actions: Construction Guidance** ← D
- Contacts

[Download the Adobe Acrobat document](#) **(pdf) of all these items listed as follows:**

ROOF

- SKYLIGHTS
- ROOF-TO-SKYLIGHT FLASHING
- ROOF ASSEMBLY DETAILS (FLASHING)
- ASSEMBLY DETAILS (DORMER)
- SOLAR PANEL RAISED UP
- ROOF COVERING (OLD WOOD SHAKE)
- ROOF COVERING (CLASSES B AND C)
- ROOF COVERING WITH OPENINGS
- GUTTER MESH COVERING
- METAL DRIP EDGE
- NO GUTTERS

CLADDING (SIDING)

- HEIGHT OF WALL ASSEMBLY

WINDOWS

- WINDOW SCREEN
- WINDOW (SINGLE PANEL)
- WINDOW (DOUBLE PANE)

VENTS

- RIDGE VENT
- OFF-RIDGE VENTS
- GABLE VENT
- UNDER EAVE VENT, VERTICAL
- UNDER EAVE VENT, HORIZONTAL
- CRAWL SPACE VENT
- CRAWL SPACE VENT, NONE
- DRYER VENTS
- MAKEUP AIR INTAKE
- OTHER ATTACHMENTS TO MOBILE HOME

SKIRTING

- SKIRTING, MOBILE HOME
- SPACE ACCESS HINGED DOOR, MOBILE HOME
- CRAWL SPACE VENTS, MOBILE HOME

DOORS

- EXTERIOR DOOR (NON-SLIDING)
- EXTERIOR DOOR (SLIDING)
- WOOD-FRAME SCREEN DOOR
- PLASTIC SCREEN DOOR
- GARAGE DOOR

ATTACHMENTS

- DECK ATTACHED TO RESIDENCE
- DECKS ATTACHED TO RESIDENCE
- DECK-TO-WALL INTERSECTION
- BETWEEN DECK BOARDS
- COMBUSTIBLE DECKS & NEARBY FUELS
- FENCE ATTACHED TO RESIDENCE
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HMM Reference | NIST Technical Note 2205: Item 31 Fence Attached to Residence

Item 31 Fence Attached to Residence – Keep combustible fence away from house, use noncombustible fence within 8 ft of house.

Note: Selected photographs are included to illustrate each HMM hardening item. Additional vulnerabilities or hardening items may be seen in the photographs, but those are highlighted within their specific HMM item.

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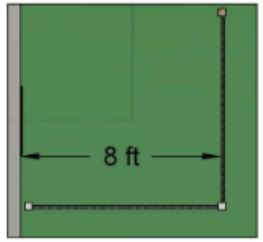
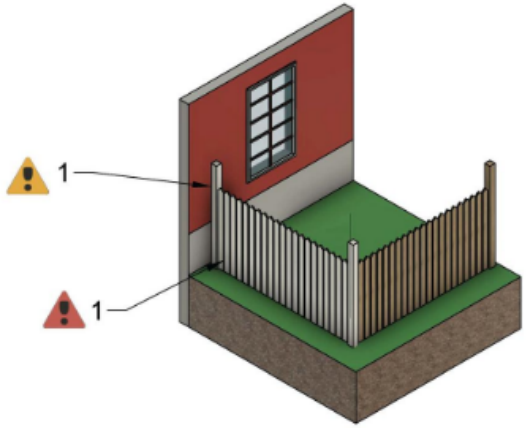
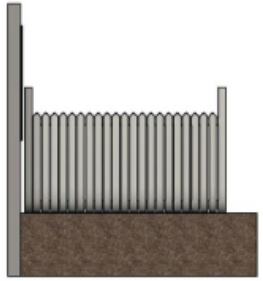
HMM Reference		Installation Cautions
NIST Technical Note 2205, Fence Attached to Residence, Table A, Item 31 (Page 60) Project: HMM House Size: Scale: 1:75 Sheet: 1/1	• **Hardening Action**: Replace with flame-retardant option (metal or other option), minimum 8 ft • **Applicable Conditions**: Combustible fence • **Performance Goals**: Prevent ignition of combustible fence from spreading to house	1. Do not use combustible materials to attach noncombustible fence to the house.







Notes	Color Key:		Fire Hazards
• Only applies to single fences - Table B, Item 10 is double fences • Fences must be a minimum 8 ft from any residence	• Brown: Wood fence • Light gray: Metal fence • Mottled brown: Soil	• Red: Exterior wall siding • Gray: Metal flashing • Green: Lawn	

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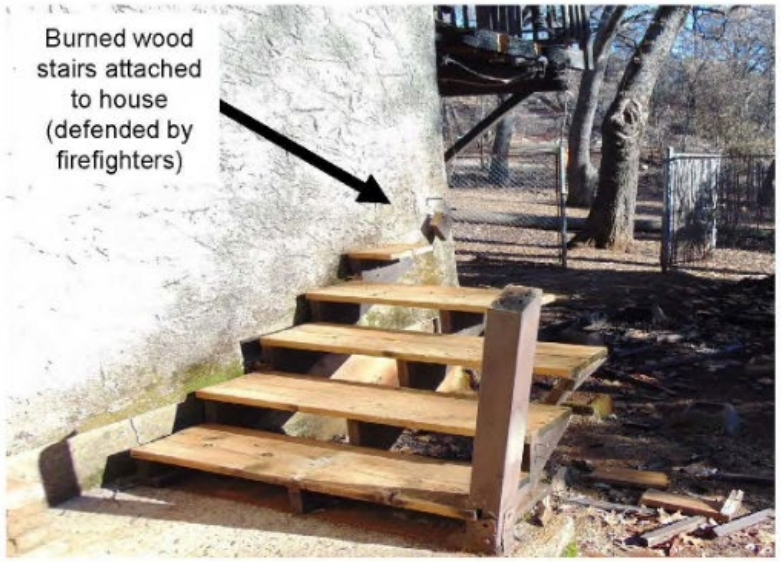
HMM Reference | NIST Technical Note 2205 | Item 32 Stairs Connected to Residence



Item 32 Stairs Connected to Residence – Use a noncombustible material for exterior stairs attached to noncombustible barrier/section between steps and house and between handrails and house (min 1') or replace with noncombustible handrail.

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HMM Reference | NIST Technical Note 2205: Item 34 Attached Retaining Walls

Item 34 Attached Retaining Walls – Replace retaining wall length equal to two times retaining wall height with noncombustible components.

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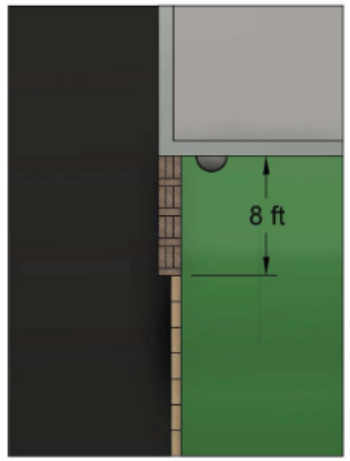
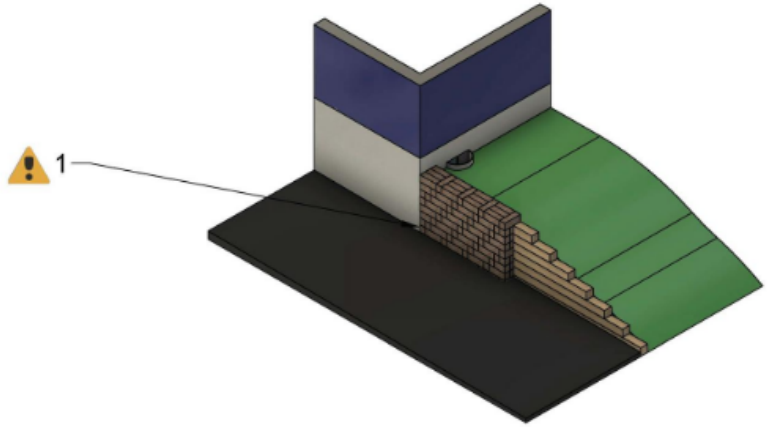
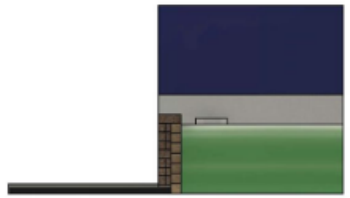
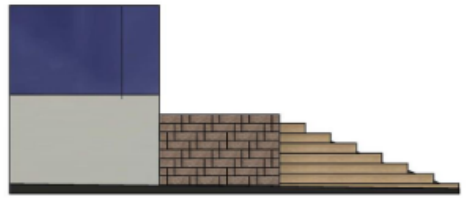
D

HMM Reference		• **Hardening Actions**: Replace retaining wall length equal to two times retaining wall height with ignition resistant components • **Applicable Conditions**: Combustible retaining wall withing two times the retaining wall height from the residence • **Performance Goals**: Prevent flames from retaining wall from igniting residence.	Installation Cautions ⚠
NIST Technical Note 2205, Attached Retaining Walls, Table A, Item 34 (Page 61)			1. Seal retaining wall and house joint with ignition resistant material.
Project: HMM House	Size: A		
Scale: 1:125	Sheet: 1/1		









Notes		Fire Hazards ⚠
• Structural components of retaining wall must be maintained (must meet code). • Ignition resistant material to 8 ft		

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It's a beautiful day in the neighborhood,

and with ***HMM-N***eighborhood

we can keep it that way!

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Thank You

www.nist.gov/el/hmm