Developing Proposed Hazard Mitigation Initiatives from the Vulnerability Assessment of Facilities and Systems

Developed for City of Houston by:

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INTRODUCTION AND PURPOSE

This manual is included in the Hazard Mitigation Committee planning support program for City of Houston to facilitate the identification of proposals for initiatives to be included in the local mitigation plan being developed. There are three likely sources for the identification of mitigation initiatives, based on the current mitigation planning process being used in City of Houston. These can be summarized as follows:

1. **Experience with past disasters** and emergencies that have demonstrated to local officials and private sector representatives the need for mitigation initiatives to address already recognized vulnerabilities to disasters impacts,

2. The findings of the hazard identification and vulnerability assessment processes that has been undertaken by the planning participants using the Hazard Mitigation Committee computer support program, and

3. The results of a “policy and code” analysis of existing plans, policies, and regulations promulgated by local governments

This manual should assist the City of Houston Hazard Mitigation Committee participants in developing ideas of proposed mitigation initiatives based on the second listed source: the hazard identification and vulnerability assessment process. Its purpose is to provide an approach for participants to use the vulnerability assessment process incorporated into the Hazard Mitigation Committee program to identify mitigation initiatives that could be proposed for incorporation into the City of Houston Mitigation Strategy. It could be assumed that completion of the vulnerability assessment process will prompt most participants to recognize structural and non-structural mitigation initiatives that should be proposed to address the identified vulnerabilities. However, this manual may provide participants with additional ideas and suggestions for initiatives that could be considered.

In offering the suggestions contained in this manual, there is no expressed or implied guarantee in the Hazard Mitigation Committee program or by erp&m, inc. that the initiatives suggested herein are either complete or will necessarily be effective or economical in all cases for the vulnerabilities being addressed or the situations in which they may occur. Further, no direct or indirect implication is intended that the suggested initiatives are certain to be eligible for mitigation-related funding by local, state or federal agencies. Selection of mitigation initiatives for incorporation into the strategy and their implementation is at the sole discretion and responsibility of the sponsor.

HOW TO USE THIS MANUAL

The manual is designed to be used directly with the vulnerability assessment form for facilities and systems given in the Hazard Mitigation Committee planning support program. The form enables knowledgeable individuals, using their own judgment, to assess and document the vulnerability of selected facilities and systems to the impacts of future disasters. It also allows individuals to define the operational criticality of the facility or system to the overall welfare of the community. The form is used to rank the vulnerabilities of specific facilities and systems to types of hazard events, as well as specific vulnerable characteristics of the facilities or systems, on a scale of 0 to 3, with 0 being the least vulnerable and 3 the most vulnerable. Similarly, the importance or operational criticality of the facility or system, where applicable, can be ranked from 0 to 3. Using this form in the Hazard Mitigation Committee program allows the operator to print a report indicating, for each facility, what hazard types or facility characteristics
have been ranked as “3,” or the most vulnerable. This section describes how to use this report to develop ideas for proposed mitigation initiatives from this report.

**Complete the vulnerability assessment process**

Use of this manual begins with the completion of the vulnerability assessment form incorporated into the Hazard Mitigation Committee program for identifying the vulnerable features of facilities and systems important to the welfare of the community.

The form for assessing facilities and systems has the following categories of vulnerability to hazard types and vulnerable characteristics of the facility or system:

- Subject to high winds
- Vulnerability to flooding
- Vulnerability to surge or tsunami
- Subject to drought
- Vulnerable to hail storms
- Vulnerable to infestation/disease outbreak
- Vulnerable to earthquake
- Vulnerability to landslide/mudslide/avalanche
- Vulnerable to subsidence/expansive soils
- Subject to volcanic activity
- Subject to winter storm
- Vulnerable to lightning
- Vulnerable to a major fire
- History of damage
- Vulnerable to power outage
- Subject to access and egress roadway blockage
- Dependent on water supply
- Vulnerable to sewer system outage
- Vulnerable to civil disorder
- Vulnerable to terrorist attack
- Vulnerable to hazardous materials incident
- Vulnerable to radiological materials accident
- Dependent on communications
- Vulnerable to an employment crisis
- Disruption causes health and safety hazard
- Disruption would cause psychological hardship
- Disruption would cause economic impact
- Disruption impacts community services
- Environmental problems would occur with disruption
- Facility has historic value
- Facility impact agriculture

The vulnerability assessment form for facilities and systems, and the specific instructions for its use in evaluating the vulnerability of a facility or system, can be accessed through the main menu of the Hazard Mitigation Committee planning support program.

**Identify possible mitigation initiatives**

Once the vulnerability assessment form has been completed, the participants can use this manual to assist in the process of identifying proposed structural and/or nonstructural mitigation initiatives that should be included in the City of Houston local hazard mitigation plan. This is done through a seven-step process, as follows:

**Step One:** Print out the proposed initiative assessment form
There is a form to be used to initially evaluate the value of any proposed mitigation initiative. It will be easier to use this manual if the form is printed out in the beginning. The form is provided in the attachment to this manual. Each page of the form would allow for initial assessment of two facilities or system components. Print as many pages of the form as likely to be needed.

**Step Two: Examine the facilities and systems vulnerability report to identify facilities of greatest concern**

Participants should then print out the completed facility or system vulnerability assessment detail report which will list all facilities with vulnerabilities scores of “3,” or the most vulnerable. There is also a report also shows the total vulnerability score for the particular facility or system component. Using these reports, participants can then select those facilities and/or systems of greatest concern to them, their organization or their jurisdiction, for addressing in the next edition of the local mitigation plan. This selection of the facilities or systems of greatest concern could be made in a number of ways, for example, by selecting facilities or systems that:

- Have the highest total vulnerability scores,
- Have more than five or six hazard or characteristics factors scored as 3,
- Are of most concern of the participants,
- Are consistent with the goals and objectives set for the next planning period,
- Are of particular importance to the sponsoring organization or jurisdiction, or
- Are significant for some other qualitative or quantitative consideration.

If there are a relatively few facilities or system components that have vulnerability scores of 3, then the participants could decide to examine all the facilities listed on this report.

Keep in mind that the objective of this step is to focus the planning process for the current planning period on the most vulnerable and/or most important of the facilities or systems of greatest concern. During subsequent updates of the City of Houston local mitigation plan, facilities and systems of lesser or differing priority can be addressed.

The facilities and systems selected in this step should now be listed in first column of the initial assessment form printed out in Step One. This report is given as an attachment to this document.

**Step Three: Select the specific vulnerabilities or importance factors scoring 3, or most vulnerable**

Examining the form prepared for the facilities or systems identified in Step Two, the participants should identify the specific vulnerabilities or importance factors by selecting individual assessment categories with the scores of 3 (i.e. the most vulnerable). There is space for listing of up to three such vulnerability or importance factors for each facility. However, there may be more than three such categories for a facility or system component. If so, the participants may wish to select those that are of most concern or are the most feasible to address via mitigation initiatives to be proposed for the next edition of the City of Houston local mitigation plan.

**Step Four: List the vulnerabilities or importance factors to be addressed**
The selected vulnerability factors selected in Step Three should then be listed in the second column of the initial assessment form, with up to three factors for each facility or system.

**Step Five: Locate the appropriate section of this manual**

The manual contains a separate “menu” of ideas and suggestions for structural and non-structural initiatives for each of the highest scoring vulnerability or importance factor selected in Step Four. Using each of the selected vulnerabilities recorded on the initial assessment form, the participants can then turn to that page of the manual to review the ideas and suggestions for mitigation initiatives that could be proposed.

**Step Six: Select the most appropriate suggestions for a mitigation initiative**

Under each section, the participants can select one of the suggested structural or non-structural mitigation initiatives given in each “menu,” or perhaps participants will have their own idea for a mitigation initiative to address the vulnerability. These ideas can be recorded in column three of the initial assessment form. There is space on the form for recording up to two ideas for each vulnerability category.

**Step Seven: Briefly consider the feasibility of the selected suggested initiative**

The suggestions provided in the “menus” are, of course, general structural and non-structural approaches to mitigating vulnerabilities. As such, they may or may not actually be feasible or effective when applied to the particular vulnerability, facility, or system being considered by the participants. Therefore, prior to investing additional time in the evaluation of the initiative, the participants should use the “feasibility criteria” listed on the initial assessment form to very quickly consider if the suggestion selected from the menu is worth further consideration and evaluation. The participants should use their best judgment and reasonable assumptions to reach such a conclusion, and record “yes” or “no” as appropriate. Unless there are extenuating circumstances or a clear need for further analysis, an answer of “no” for any of the feasibility criteria would rule out further development of the proposed initiative because it could probably never be implemented.

At the conclusion of these seven steps, the participants will have identified structural and non-structural mitigation initiatives that would appear to be feasible and effective to implement, and warrant additional consideration for characterization, prioritization and incorporation into the local mitigation plan.

**Complete the forms for the characterization and prioritization of initiatives**

The suggested mitigation initiatives that have a “yes” answer to each of the feasibility criteria on the initial assessment form need to be evaluated further before they can be incorporated into the City of Houston local mitigation plan. The next steps in the Hazard Mitigation Committee planning process for each initiative are:

- Identify an agency or organization to sponsor the initiative and to undertake further assessment,
The sponsor prepares the Hazard Mitigation Committee characterization and prioritization form for each initiative to be proposed for incorporation into the plan, and
The Steering Committee approves the proposed initiative for incorporation into the local mitigation plan.

**Ideas for Proposed Mitigation Initiatives**

The remainder of this manual has a “menu” of possible mitigation initiatives listed for each of the hazard types or vulnerable characteristic of the facility or system being evaluated. Of course, no such standardized, general list of possible mitigation initiatives can be complete or uniquely tailored to effectively address the needs of specific facilities or system components. Participants in City of Houston Mitigation Committee are encouraged to develop their own ideas for mitigation initiatives for the facilities of concern. There is a space given in each menu for the participants to do just that!

**Subject to high winds:**

The effects of high winds are typically through direct damage to a structure itself, damage to external features, such as decks and awnings, and the impact of wind blown debris hitting the structure or its external features. (Utility outages to buildings or systems caused by high winds are addressed under the corresponding vulnerability factor below.) Complete destruction of a building frequently begins with the failure of the roof, doors, or windows, while damage to a system component may result from the force of the wind itself or the impact of wind blown debris.

Ideas for structural initiatives --

- Structure demolition and replacement or relocation
- Roof retrofitting
  - Redesign/reconstruction for less wind resistance
  - Stronger roof covering
  - Strengthen sheathing
  - Install hurricane clips/straps
  - Reduce length of unsupported roof spans
  - Other roof strengthening techniques
- Wall opening retrofitting
  - Redesign/reconstruct smaller wall openings
  - Install permanent storm shutters on windows and doors
  - Make temporary storm shutters and install placement fixtures
  - Install laminated glass in windows/doors
  - Install bracing for larger doors, e.g., garage doors
“Hardening” of utility services to facility or system component
- Replace/bury above-grade utility services, e.g., power, telephone
- Strengthen utility poles/conductor fixtures
- Install “safe rooms” in facilities
- Purchase and install a severe weather/high wind notification system
- Install or provide high wind warning equipment (e.g., weather radios)

Control of structure’s external features
- Removal of unnecessary/unused outbuildings, sheds, decks, etc.
- Install tie-downs for portable outbuildings, sheds, etc.
- Strengthen/brace/anchor external features, e.g., decks, etc.
- Install removable external features, e.g., awnings, decks, etc.
- Remove/trim trees/limbs in proximity to structure

Other structural initiative: ________________________________
Other structural initiative: ________________________________

Ideas for non-structural initiatives –
- Conduct an engineering study on wind vulnerability of the facility and/or component
- Develop an alternate operational site (e.g., alternate “cold” or “hot” site)
- Develop plan to facilitate relocation to the alternate site
- Develop plan/procedure for pre-hurricane preparation of facility or system
  - Removal/storage/tie-down of exterior features
  - Installing shutters on wall openings
  - Bracing large doors
- Develop plan/procedure for pre-hurricane/storm relocation of operations
- Develop procedure for pre-hurricane/storm removal of valuable contents
- Train employees in pre-hurricane/storm plans/procedures for facility protection
- Develop/implement program to promote employees’ home retrofitting for wind impact
- Develop/apply criteria to future building, siting, landscaping, etc. for wind protection
- Other: __________________________________________
- Other: __________________________________________

**Vulnerability to flooding** –

Facilities and systems located within the flood plain and/or flood prone areas can be easily impacted through the inundation of vulnerable materials or the physical force of the water. Flooding can also result in facility chemical/bacterial contamination, and despoliation by mud and debris carried by the floodwaters. For facilities, floodwaters can damage both the structure itself and its contents, while for systems, damage to system components can be costly and/or interfere with or fully stop operations.

Additional suggestions for structural initiatives –
- Protect the structure or component
  - Remove and relocate the facility or system component to a flood safe area
  - Improve drainage in proximity to the facility or system component
  - Construct flood walls, dikes, etc. to prevent contact with water/floating debris
- Elevate the structure or system component above predicted flood water height
- Elevate vulnerable components (e.g., electronics) above predicted flood height

☐ Prevent the entry of flood water or damage from water immersion
- Provide water proof doors and seals for wall openings and/or seal components
- Replace vulnerable components with water proof components
- Install back-flow prevention valves in sewers and drains
- Purchase and install seals for drains
- Improve seals on all wall penetrations below flood water levels
- Relocate vulnerable interior contents, furniture, etc. to higher levels in structure

☐ Prevent floatation and/or movement of the structure or component
- Strengthen fastening of structure sill to foundation
- Strengthen/reinforce foundation against movement
- Anchor facility components against physical force of flood water

☐ Address flood damage to exterior features
- Remove or anchor all outbuildings, decks, etc.
- Elevate/secure all exterior features, e.g., propane tanks, electronics, etc.

☐ Other: ______________________________________

☐ Other: ______________________________________

Ideas for non-structural initiatives –

☐ Insure the structure and/or its contents under the National Flood Insurance Program
☐ Enhance the standing of the jurisdiction in the NFIP Community Rating System to lower flood insurance premiums
☐ Determine/confirm the elevation of the structure, component, and/or flood height
☐ Conduct an engineering of structure or component vulnerability to flooding
☐ Develop a plan/procedure for flood damage control
- Temporary protection of the facility or component (sand bagging, etc.)
- Temporary relocation and storage of equipment, contents and furniture
- Procedure for temporary relocation of furniture, contents, etc. to higher levels
☐ Inform employees of flood risk for facility or component
☐ Train employees in flood plans/procedures for facility component protection
☐ Promote employee actions for flood protection of their homes and property
☐ Develop a post-flood clean-up, decontamination, and recovery plan/procedure
☐ Educate community on structure/component vulnerability and actions taken
☐ Prepare, train in, and practice employee/visitor evacuation plan
☐ Other: ______________________________________
☐ Other: ______________________________________
**Vulnerability to storm surge**

If the facility or system assessed is located in a designated area vulnerable to surge or tsunamis, the physical impact of inundation and/or wave action can be enormously destructive and easily threaten the lives of individuals who may be present in the facility.

While there are differences between the causes and impacts of hurricane surge and tsunamis, the strong similarities in the structural damage by water inundation and threat to public safety, and therefore potential mitigation initiatives for consideration, enable the Hazard Mitigation Committee program to consolidate them as a single vulnerability category. However, most of the suggested structural and non-structural mitigation initiatives for flooding are applicable to mitigation for storm surge and tsunamis, and therefore should be reviewed for this hazard as well. The ideas provided below are additional considerations and focus specifically on surge or tsunami.

Additional ideas for structural initiatives:

- Construct new and/or enhance existing dunes near the facility or system component
- Build new sea walls, revetments or groins near the facility or system component
- Re-nourish beaches and maintain beach size near the facility or system component
- Relocate system components out of the areas vulnerable to surf and beach erosion
- Remove/reduce structure’s surface areas subject to wave action
- Strengthen or enlarge existing sea walls, revetments, etc.
- Set back, while elevating, existing structures or system components
- Strengthen anchoring of structures or system components
- Replace shoreline facility features with removable components, e.g., decking, etc.
- Provide for “wet” flood proofing of the facility or system component
- Elevate vulnerable electronics or other features of a system component
- (For marinas) Strengthen features; construct facilities for prompt boat relocation
- Build offshore artificial reefs to dampen onshore waves impacting the facility
- Other: ______________________________________

Additional ideas for non-structural initiatives –

- Conduct an engineering study of structure/component vulnerability to surge/tsunami
- Conduct a study of environmental features impacting the strength of surge/waves
- Adopt policy to prohibit reconstruction of facility or component in surge/tsunami area
- Adopt policy to require reconstruction only with appropriate mitigation considerations
- Adopt plan to setback structure to coastal control line, elevation, etc. if damaged
- Conduct a study to define options for nearby beach/dune/reef enhancement
- Adopt plan/code for protection of nearby natural features, e.g., dune protection
- Adopt prohibitions for storage of fuels or contaminants at facility
- Install a surge/tsunami warning system at facility for employee protection
- Develop evacuation plans for facility personnel from surge/tsunamis
- Develop a procedure for effective and rapid shutdown of vulnerable processes
- Develop plan for relocation of facility equipment or contents upon warning
Provide a education program for facility personnel for surge/tsunami
(For marinas) Develop plan for prompt boat removal out of surge/tsunami zone
Other: _________________________________
Other: _________________________________

**Vulnerable to drought** --

Drought can threaten a facility’s operations through two closely associated hazards: failure of the facilities water supply and the increased threat of wildfire. Therefore, many of the structural and non-structural mitigation initiatives applicable to these hazards will also pertain to drought. Mitigation initiatives that could be proposed for a facility or system due to its vulnerability to drought include the following:

Additional ideas for structural initiatives:

- Construct additional water supply storage facilities/Install emergency water supply storage facilities to serve the facility
- Replace the facility’s well(s) with a more drought-resistant community water system
- Deepen the facility’s well(s)
- Install equipment or modify processes to reduce the water-dependency of facility operations
- Install equipment to make temporary interconnections with other systems more feasible
- Repair leaking water system components serving the facility
- Install water saving devices
- Conduct landscaping/vegetation control program to reduce wildfire risk
- Other: _________________________________
- Other: _________________________________

Additional suggestions for non-structural initiatives:

- Conduct engineering/hydrologic studies to determine the extent of drought vulnerability of the facility
- Educate facility employees on drought mitigation techniques, including wildfire risk reduction techniques for the facility property
- Implement a program of routine vegetation control to reduce wildfire risk in and around the facility
- Develop a “reduced water usage” plan for continuing facility operations during a drought
- Purchase business interruption insurance applicable to drought-caused reduction or termination of operations.
- Other: _________________________________
- Other: _________________________________
**Vulnerable to hail storms** --

Large hailstones can be very damaging to structures and equipment. For facilities in areas subject to this hazard, it may be necessary to propose structural and non-structural mitigation initiatives to minimize property damage or disruptions to operations. Such mitigation initiatives could include the following:

Additional suggestions for structural initiatives:

- Remove or retrofit vulnerable external attachments (e.g., awnings, antennae, etc.)
- Replace vulnerable exterior building surfaces (e.g., shingle and siding, etc.) with hail resistant surfaces
- Protect or relocate essential utility and communications equipment serving the facility to protect from hailstone damage
- Other: _________________________________________
- Other: _________________________________________

Additional suggestions for non-structural initiatives:

- Develop operating procedures for pre-storm facility preparation to remove or protect key external features of the facility
- Obtain insurance to minimize property loss from hail damage
- Other: _________________________________________
- Other: _________________________________________

**Vulnerable to infection/disease outbreak** --

The purposes or operations of the facility, its location in the jurisdiction, or the adequacy of its utility services, could be the reason it is considered vulnerability to infection or disease outbreaks. Facilities closely tied to agricultural activities could also be more directly threatened by agriculturally-related disease outbreaks and their spread as well. Structural and non-structural mitigation initiatives that could be considered for the facility or system component are as follows:

Additional suggestions for structural mitigation initiatives:

- Provide and/or replace the water and sewer services to the facility to ensure their adequacy; Replace or rehabilitate the sanitary facilities available within the facility for use by employees
- Install equipment or facilities to avoid or minimize the potential for pathogenic contamination of employees, products or the areas adjacent to the facility
- Construct improved drainage systems and other projects to modify the environmental conditions on the facility property conducive to disease outbreak and/or spread
- Provide for effective and adequate disposal of biological materials that are a waste product of facility operations
- Replace outdated equipment that may malfunction and contribute to disease spread
Provide redundant equipment and standby power to waste treatment or other process control devices to prevent temporary malfunctions due to equipment failure or community power loss

Other: __________________________________________

Other: __________________________________________

Additional suggestions for non-structural initiatives:

Provide educational programs for facility employees regarding control of disease outbreak and promulgation

Develop, adopt and enforce policies and procedures applicable to operations that could foster disease outbreak and promulgation

Develop plans or procedures for modification or control of plant processes upon indication or warning that an infection or disease outbreak could occur.

Other: __________________________________________

Other: __________________________________________

**Subject to landslide or erosion**

If City of Houston has topographic characteristics conducive to slides, avalanches, or erosion, facilities and system components could be damaged in a major event. Damage can occur for the physical impacts of the moving material striking and burying the facility or component, or from the loss of its foundation resulting in its dislocation. With this type of event, the damage can be catastrophic, and there can be both structural loss and threats to the safety of occupants of the facility. Therefore, if the facility or system component is vulnerable to slides, avalanche or erosion, structural and non-structural initiatives that could be considered for incorporation into the local mitigation plan include:

Additional ideas for structural initiatives:

Demolish and replace or relocate the structure or system component from risk area

Decrease the angle of the slope above or below the facility or component

Cover slopes with protective physical or vegetative materials

Install structural measures for control of slope movement

Install structural measures for facility and system protection from slope movement

Install system to monitor meteorological and soil conditions

Install slide/avalanche warning systems

Install drainage systems to divert water from slope or eroding soils

Provide armoring of eroding or sliding soils, e.g., revetment, vegetation, etc.

Replace and armor eroding or sliding soils

Provide equipment/supplies for temporary erosion control measures during storms

Setback/relocate structure or component from erosion site

Relocate that portion of structure or system component vulnerable to erosion or slide

Redesign/reconstruct the foundation of structure or anchoring of component

Remove or mitigate cause of erosion, e.g., re-channel stream, place in culvert, etc.

Construct alternate access and egress routes to facility or component
Retrofit or relocate utilities serving facility or component from slide or erosion areas
Other: ________________________________________
Other: ________________________________________

Additional ideas for non-structural initiatives:

- Conduct an engineering/geologic study of probability for slide/avalanche/erosion
- Conduct an engineering/geologic study to confirm facility or component risk
- Conduct an engineering study of structural retrofits or slope control potential
- Establish an mitigation and safety education program for facility personnel
- Develop a plan for reconstruction/relocation in the event of future slide damage
- Develop a safety/evacuation plan for facility personnel in the event of a slide
- Develop/implement plan for monitoring of erosion and threat to facility/component
- Plan/schedule relocation/retrofitting of facility/component prior to damage
- Prepare plan/procedure for temporary erosion control measures during storms
- Develop plans for resumption of operations at alternate location
- Other: __________________________________________
- Other: __________________________________________

Vulnerable to subsidence or expansive soils --

Earth movement caused by subsidence and/or expansive soils can cause extensive damage to a facility structure or the components of a system. In the case of the former, the physical pressures on foundations and infrastructure components can be gradual, while in the case of the latter, may be sudden and precipitous. In either case, in terms of such impacts, there are strong similarities to those caused by earthquake and landslide/erosion, and it is recommended that the suggested mitigation ideas for these hazards be reviewed as well. Mitigation ideas that could be considered are:

Additional ideas for structural initiatives:

- Remove or relocate the facility or specific structures out of areas of known risk
- Install soil moisture control systems to protect facility foundations and infrastructure components
- Retrofit/rebuild structure foundations to resist movement of expansive soils without damage to foundations
- Develop alternative access/egress routes and infrastructure components to serve the
- Install physical mechanisms to inhibit structural damage to foundations or infrastructure components from soils movement
- Remove and replace expansive soils from near the foundation of the facility, its subsurface utilities or other threatened features
- Other: __________________________________________
- Other: __________________________________________

Additional ideas for non-structural initiatives:
- Conduct engineering/geologic studies to identify areas of risk and feasible mitigation techniques to facility protection
- Map areas of the facility property at risk from subsidence or expansive soils
- Assess facility equipment, structures and operations to identify components most likely to create secondary impacts, e.g., release of hazardous materials, if damaged
- Plan programs for replacement, relocation or removal of facility components or structures subject to subsidence or expansive soils damage.

Other: ______________________________________

Other: ______________________________________

**Subject to winter storm disruption**

Winter storms, whether in the form of blizzards or ice storms, can cause widespread physical damage, particularly to above-ground electric power distribution systems, prevent movement over roadways, and isolate individuals from assistance. For facility or system component being evaluated, these impacts could result in structural damage, disruption of operations, or isolation of facility personnel, depending on the severity and duration of the storm or its effects. There are structural and non-structural mitigation initiatives that could be considered for this type of vulnerability.

Additional ideas for structural initiatives:

- Retrofit/reconstruct facility roof and other components for heavier snow/ice loading
- Install standby electric power for facility or component needs
- Improve physical access to facility or system component under storm conditions
- Purchase snow removal equipment for quicker access and egress
- Install below grade electric power and other utility services to facility
- Protect computers and telecommunications capabilities for power loss
- Provide redundant utility and facility services systems

Other: ______________________________________

Other: ______________________________________

Additional ideas for non-structural initiatives:

- Conduct engineering studies of snow/ice load capabilities of the facility
- Develop procedures for pre-season preparations (e.g., install snow fence)
- Develop procedures for safe facility closure prior to storm’s arrival
- Develop procedures for relocation of operations to another facility
- Develop plan for transporting personnel to/from facility

Other: ______________________________________

Other: ______________________________________
**Vulnerability to lightning:**

Lightning can endanger lives, cause structural damage, start fires, and ruin electrical equipment. If the facility or system component is located in a lightning prone area, it may be helpful to propose structural or non-structural mitigation initiatives to include in the City of Houston local mitigation plan.

Ideas for structural initiatives –

- Purchase and install a severe weather warning system
- Install an appropriate arrestor system on structures and components
- Replace metallic building components with ceramic or plastic
- Install surge protection device(s) on the structure’s or component’s electric system
- Ground all electrically-operated equipment
- Electrically isolate sensitive equipment
- Remove taller trees from around the structure or component
- Relocate and/or electrically isolate tall towers, metal tanks, etc. from structure
- Other: ______________________________________

Ideas for non-structural initiatives –

- Develop a plan/procedure for suspension of operations during a lightning episode
- Conduct an engineering study of lighting vulnerability and safe corrective actions
- Plan for damage assessment and operation restoration after a lightning strike
- Develop a plan for equipment/facility isolation/protection during lightning episodes
- Plan for alternative locations for operations in the event of a lightning strike
- Adopt a policy of routine testing of all lightning protection equipment/systems
- Other: ______________________________________

**Subject to major fire:**

If the facility or system component has been found to be highly vulnerable to wildland, urban interface or structural fires, the following list of ideas for mitigation initiatives could be considered.

Ideas for structural initiatives --

- Conduct programs for removal of vegetative fuels on adjacent undeveloped land
- Conduct programs to create vegetative fuels buffer zones for existing structures
- Purchase wildland fire fighting apparatus for applicable jurisdiction’s fire department
- Develop alternative water supplies at or near the facility for wildfire suppression
- Replace facility’s existing landscaping with fire-safe landscaping
- Purchase and install fire/smoke alarm and/or sprinkler systems
- Provide for remotely-alarmed fire/smoke detectors un-staffed system components
- Design and construct alternative evacuation/fire fighting access routes to facility
- Retrofit structures in urban or urban interface zones for improved fire resistance
Ideas for non-structural initiatives --

- Conduct a detailed assessment of fire risk for the facility or system component
- Prepare and implement fire safety educational programs for facility personnel
- Alter existing operational procedures to reduce fire risk
- Initiate and maintain a routine fire inspection and prevention program
- Develop plan for periodic vegetative fuels reduction on nearby undeveloped lands
- Ensure adequate/enhanced fire code enforcement at facility

Other: ______________________________________
Other: ______________________________________

History of damage –

One of the most telling signs of a vulnerability to future disasters is if a facility or system component has been damaged in past disasters. If the damage was not repaired with appropriate mitigation measures incorporated, it is very likely to remain vulnerable to the same type of damage in future events. In addition, however, some further structural or non-structural initiatives can be considered specifically for previously damaged and reconstructed facilities and system components.

Ideas for structural initiatives –

- Reconstruct previously damaged features using appropriate mitigation techniques
- Alter/remove the previously damaged structure or component to avoid future damage

Other: ______________________________________

Ideas for non-structural initiatives –

- Conduct engineering study of damage to identify continuing or added vulnerabilities
- Adopt plan/policy to prohibit reconstruction in similar manner after next event
- Apply prior damage experience to other similar structures or system components
- Use prior damage experience in jurisdiction to prohibit similar construction
- Use damage experience to design and implement educational/awareness program

Other: ______________________________________

**Vulnerable to power outage:**

One of the most common impacts of major disasters can be the prolonged loss of electrical power, whether from localized damage to distribution systems or from remote impacts to generation and transmission facilities. Depending on the characteristics and use of the facility or component in question, protracted loss of power could significantly disrupt normal operations, endanger health and safety, or result in the loss of product or
inventory in some cases. There are a number of possible structural or non-structural initiatives that can be used to counteract vulnerabilities to protracted power outages.

Ideas for structural initiatives –

- Install and wire facility or component with permanent generator with fuel storage
- Wire facility or component to accept a temporary generator
- Equip specific facility operations with standby power capabilities
- Purchase and install batteries, UPS or alternate energy source for critical operations
- Relocate critical operations to another facility equipped with generator
- Secure redundant power service from another substation/distribution system
- Install capabilities to utilize alternative energy sources for critical processes
- Provide separate, uninterruptable monitoring and alarms for hazardous processes
- Other: ______________________________________
- Other: ______________________________________

Ideas for non-structural initiatives –

- Conduct a engineering study of electric power needs
- Negotiate contracts for rental of portable generators
- Negotiate with applicable utility for higher priority power restoration
- Plan for safe shut down of hazardous operations without electric power
- Prepare plan/procedure for relocation/restart of operations after power loss
- Other: ______________________________________
- Other: ______________________________________

**Roadway access and egress reliability:**

A facility or system component may not itself be vulnerable to the impacts of a disaster, yet access to it or egress from it could be blocked. The inability to enter or leave the facility could significantly impact its operational capabilities, create a public safety hazard or prevent its adequate maintenance. There may be several different causes that a facility or system component is vulnerable to access blockage, such as flooding, erosion, wildfire, etc. Additional ideas for mitigation initiatives to address access blockage caused by these hazards may be listed under the corresponding section for the specific vulnerability. Other structural and non-structural initiatives are suggested below to also address this vulnerability.

Ideas for structural initiatives –

- Relocate facility or component to a more accessible location
- Reconstruct system component to avoid or minimize need for access
- Construct an alternate/redundant access route to facility or system component
- Resurface/reconstruct existing access for “all weather” use
- Take action on the most likely causes of access blockage:
  - Elevate roadway or improve drainage for flooding
• Reconstruct/protect roadway for erosion vulnerability
• Remove vegetation for mitigation of wildfire and/or wind damage to trees
• Strengthen bridges and/or overpasses for flood and/or erosion vulnerability

☐ Reconstruct system component for remote operations/monitoring via telemetry
☐ Other: ____________________________
☐ Other: ____________________________

Ideas for non-structural initiatives –

☐ Develop plan to suspend operations while minimizing impact of that action
☐ Develop plan for operations at alternate location until access restored
☐ Develop plan or contract for services to expedite roadway clearance
☐ Other: ____________________________
☐ Other: ____________________________

*Dependent on water supply:*

Loss of water services is also a fairly common result of the impacts of a major disaster. The lack of water can require facilities to suspend operations, create an extra fire hazard, or endanger public health by disrupting sanitary services. Often the simultaneous loss of water and sewer service occurs as the result of the same event and/or to the loss of electrical power. Therefore, it may be advisable to consider suggestions for initiative for such an event, and participants may wish to also review the ideas provided below for sewer system outage as well. Some of the structural and non-structural mitigation initiatives that could be considered for loss of water service are listed below.

Ideas for structural initiatives –

☐ Permanently relocate operations to a more secure water supply system
☐ Redesign/reconstruct operations that require water for safety purposes
☐ Construct and connect an auxiliary water storage and supply system
☐ Redesign operations to eliminate or minimize the need for water service
☐ Install a standby water well and/or equip well with generator
☐ Provide a dry chemical fire suppression system
☐ Install separate potable and non-potable water systems
☐ Other: ____________________________
☐ Other: ____________________________

Ideas for non-structural initiatives –

☐ Develop a plan/procedure for a temporary relocation of operations
☐ Negotiate contract with water supplier for emergency services
☐ Develop plan for “minimum or no” water operations
☐ Other: ____________________________
☐ Other: ____________________________
**Vulnerable to sewer outage:**

This vulnerability is closely interrelated to a vulnerability to disruption in water supply, especially for urban facilities interconnected to a community-based water system. Here, very often when the water supply system fails the sewer system cannot be used and vice versa. For rural facilities dependent on septic systems, there may be less direct interdependence. However, several of the suggested mitigation initiatives to minimize the impact of water system outage will be beneficial to avoiding disruption due to failure of the sewer system. Loss of a sewer system can require the suspension of operations, create a public health hazard, and cause environmental contamination. Some mitigation initiatives that can be considered are listed here.

Ideas for structural initiatives –

- Permanently relocate to facility less vulnerable to sewage system outage
- Install or make provisions for installing dry/chemical toilets
- Install equipment to make “tele-commuting” a feasible, temporary operational basis
- Construct systems to separate sewage from other water waste streams
- Install emergency sewage holding tanks and connect to facility plumbing
- Other: ______________________________________
- Other: ______________________________________

Ideas for non-structural initiatives –

- Negotiate contact for emergency delivery of portable toilets
- Develop plan/procedure for minimization of staff use or relocation to other facilities
- Develop plan/procedure for limited operation by personnel away from site
- Other: ______________________________________
- Other: ______________________________________

**Vulnerable to civil disorder:**

Vulnerability to civil disorder is most likely to be a concern for facilities or system components located in urban neighborhoods or suburban neighborhoods containing facilities (e.g., convention centers, university campuses, sports arenas, etc.) that could become the location for a civil disorder event. The impacts of such events, in some cases, match those of other categories of hazards, e.g., urban fires, and the mitigation initiatives suggested for that hazard may be helpful to consider for the vulnerability to civil disorder. In other cases, civil disorder can have impacts that are often unique to this type of event, e.g., looting, vandalism, assault, etc. Some mitigation initiatives that could be considered for incorporation into the plan include:

Additional suggestions for structural initiatives:

- Installation of improved lighting, fencing, remote monitoring and other facility security features
- Removal or relocation of facilities or operations from the neighborhood that may be the site of a civil disorder event
Vulnerable to terrorist attack:
A facility or system component could be considered as higher profile targets for a terrorist attack and the impacts from such events could be severe in terms of fatalities and injuries and property damage. The physical consequences of a variety of terrorist-type actions can resemble those from other hazards, such as fire, spread of an infectious disease, release of a hazardous material, etc. However, the intentional and criminal characteristics of such an event is important to identifying potential mitigation initiatives, which could include the following:

Additional suggestions for structural initiatives:
- Design and install suitable security devices, e.g., fences, gates, security monitors, etc.
- Purchase equipment needed for emergency response to such an event
- Purchase and/or install specialized equipment, e.g., HVAC system filters, on facility components potentially vulnerable to terrorist attack

Additional suggestions for non-structural initiatives:
- Establish a program to routinely consult with local law enforcement agencies regarding potential terrorist events involving the facility
- Develop and utilize procedures to minimize exposure of facility equipment and personnel to a terrorist attack
- Educate facility employees regarding terrorism preventative measures and appropriate response actions
- Develop a plan for emergency response to the consequences of a terrorist event

Hazardous materials are involved:
Hazardous materials can be involved in the impacts of a disaster in two ways. First, a facility or system may accidentally release a hazardous material, causing an emergency or disaster in its own right. Second, during another type of disaster event, such as a hurricane or flood, hazardous materials could be released due to the physical or operational impacts of the event. In both cases, such a release could endanger public health and safety, property, and/or environmental resources.

In order to address the mitigation issues involved in the potential release of hazardous materials, it is important for participants to review the suggested mitigation initiatives for the other vulnerability categories that are relevant to the facility or system being reviewed. In addition, however, the suggestions listed here specifically for mitigation of hazardous materials released can be considered by participants.

Additional suggestions for structural initiatives --

- "Harden" the containers or processes in which the materials are normally contained
- Relocate vulnerable storage vessels or processes out of hazard impact zones
- Redesign/reconstruct processes to eliminate or reduce the need for the material
- Install effective, "hardened" equipment to mitigate disaster-caused release
- Design/purchase/install release monitoring systems
- Design/purchase/install release alarm systems
- Design/purchase/install "hardened" alert and notification systems for public warning
- Purchase appropriate containment and clean-up equipment and supplies
- Purchase appropriate personal protection equipment for response personnel
- Purchase appropriate equipment for health care facilities to treat/decon victims
- Other: ____________________________
- Other: ____________________________

Additional suggestions for non-structural initiatives --

- Conduct a detailed study of storage/process vulnerabilities to disaster impacts
- Conduct a detailed study of likely impacts of a release/disaster situation
- Conduct a detailed study of hazardous materials transport near the facility
- Develop an emergency response plan/procedure to use in event of a release
- Develop a plan for post-impact containment, clean-up and decontamination
- Develop and provide containment and clean-up training to appropriate personnel
- Plan for protective actions (evacuation - sheltering) in threatened neighborhoods
- Provide a public information program in the appropriate response to a release
- Provide educational materials to health care institutions for victim treatment
- Train the staff of institutions/facilities in the impact area in appropriate response
- Other: ____________________________
- Other: ____________________________

Subject to accidents involving radiological materials --
It may be that the facility or system being evaluated is vulnerable to a radiological accident during transportation of nuclear materials or at a nuclear power plant in the vicinity. Such an accident could involve both a health and safety hazard for the occupants of the facility, or could contaminate the facility or system component rendering it unusable until decontamination is completed. If the facility or system component has been identified as vulnerable to a radiological materials incident, the following ideas for mitigation initiatives could be considered:

Ideas for structural initiatives --

- Construct additional shielding for all or key portions of the facility
- Install barriers or covers on system components to protect from contamination
- Provide facility ventilation control to isolate indoor atmosphere
- Install radiological monitoring equipment and warning devices
- Purchase portable equipment for decontamination operations
- Provide direct “hotline” communications between facility and nuclear power plant
- Other: ______________________________________
- Other: ______________________________________

Ideas for non-structural initiatives --

- Conduct a detailed study of radiological materials transport near the facility
- Prepare a plan for sheltering/evacuation of facility personnel
- Prepare a decontamination plan
- Other: ______________________________________
- Other: ______________________________________

**Dependent on communications:**

The loss of communications capabilities at many facilities and system components can be create a major disruption to normal operations or may even require suspension of operations until communications are restored. Communications here also is considered to include consideration of those facilities and systems needed to communicate with the general public before, during or after a disaster. Initiatives that could be considered to counteract this vulnerability are listed below.

Ideas for structural initiatives –

- “Harden” the communications system to withstand the impacts of expected events
- Purchase an alternate system (e.g., cell phones for hardwire phones, radios)
- Relocate communication-vulnerable operations to another facility or system
- Design and install a permanent, “hardened” public alert and warning system
- Provide for redundant capabilities in critical systems (e.g., public warning systems)
- Other: ______________________________________
- Other: ______________________________________

Ideas for non-structural initiatives –
☐ Conduct detailed engineering studies of communications system vulnerability
☐ Negotiate with communications providers for higher priority restoration of service
☐ Develop a plan to establish a temporary communications center or capability
☐ Develop a plan for temporary relocation of communication sensitive operations
☐ Develop a plan for alternate means for employees to receive information
☐ Develop a plan for replacement or alternate public alert and warning
☐ Develop a plan to maintain the flow of public information under disaster conditions
☐ Other: ______________________________________
☐ Other: ______________________________________

**Employment crisis:**

An employment crisis could take many forms. It could include a strike or work stoppage at the facility, in the community, or at a critical supplier, a lack of employees to perform critical tasks, or, importantly, closure of the facility could cause an employment crisis in the community. Regardless of its form, an employment crisis could disrupt facility operations, require the facility to close, or have significant economic effects in the community. Mitigation initiatives to consider for facilities subject to an employment crisis:

Additional suggestions for structural initiatives:

☐ For critical community employers, implement structural, disaster-resistant improvements in the infrastructure, utilities and community services needed to sustain or improve operations at the facility
☐ Construct or install standby storage facilities to all continued operation during strikes or work stoppages at critical suppliers or transportation companies
☐ Install or construct equipment or facilities to ensure a safe and healthful working environment for employees
☐ Install or construct facilities or amenities to create a more pleasant working environment for employees
☐ Other: ______________________________________
☐ Other: ______________________________________

Additional suggestions for non-structural initiatives:

☐ Develop and implement contracts and agreements with backup suppliers for emergency delivery of critical materials and supplies
☐ Develop and implement suitable types of employee assistance and support plans to improve employee performance and attitude
☐ Other: ______________________________________
☐ Other: ______________________________________

**Disruption creates health and safety hazard:**
The vulnerable facility or system component may have such features or characteristics that, disruption to its continued operation or structural integrity could create a health or safety hazard. In this way, its continued operation or protection from damage as the result of a disaster is very important to the well being of the community. Many of the structural initiatives suggested in this manual for mitigation against other types of hazards would be effective for avoiding disruption or damage to the facility or component, and thereby avoid the health and safety impact of concern. Users of this manual will wish to look under the other vulnerability categories for general ideas on protecting a facility or system component that could impact health and safety. The ideas listed below are additional approaches to limiting the health and safety impacts of disruption or damage.

Idea for structural initiatives –

- Reconstruct facility to isolate health/safety functions in a “hardened” location
- Redesign the facility or component to minimize the health and safety impact
- Relocate critical facilities or system components to a less vulnerable area
- Construct/install redundant or alternate systems to fulfill health and safety role
- Install appropriate monitoring and warning systems to allow protective action
- Permanently transfer health and safety responsibility to a less vulnerable facility
- Other: __________________________________________

Ideas for non-structural initiatives –

- Conduct engineering studies of facilities contributing to added risk during disasters
- Develop plan/procedure for employee/community education on potential impacts
- Develop plan/procedure for education on appropriate protective action
- Develop procedure for temporary transfer health and safety role to another facility
- Develop policies for new facilities to avoid/minimize future health and safety impacts
- Other: __________________________________________

*Disruption causes psychological hardship:*

One of the most difficult community issues to effectively manage in the aftermath of a disaster are the adverse effect on the quality of life that disruption or damage to certain facilities or systems can cause. The damage or disruption to these facilities is important for its impact on the community’s psychology, rather than for the loss of the facility or service itself. For example, the loss of power and utility services for an extended period can begin to exert psychological as well as physical hardship throughout the impacted area. Or, the loss of special facilities, such as schools, community centers, churches, etc., can cause a significant psychological hardship beyond the economic cost of the damage itself. First, initiatives capable of avoiding or mitigating the damage or disruption of this type of facility or system can be proposed for incorporating into the City of Houston local mitigation plan. Planners should review the suggestions provided in the other vulnerability categories to protect these facilities or systems from damage or disruption. Some additional initiatives that could be considered to mitigate psychological impact are listed below.
Additional suggestions for structural initiatives –

- Relocate/retrofit structure or system component to withstand disasters’ impacts
- Construct or prepare alternate structures to provide substitute services
- Other: ________________________________

Additional suggestions for non-structural initiatives –

- Conduct a special study of the potential psychological impact of facility loss
- Develop a plan for alternate/substitute services upon damage to facility
- Develop a plan to provide post-impact community counseling/support services
- Adopt codes/policies regarding future location of such facilities in hazard zones
- Other: ________________________________

**Disruption has economic impact:**

One of the most devastating impacts that a disaster can have on the community is the damage and disruption caused to its businesses and industries, or to public sector organizations that have responsibilities for the economic well being of the community. Such an impact can occur for many reasons, including

- Physical damage to businesses and industries,
- Loss of utilities requiring suspension of operations,
- Community impacts that interfere with access by customers, or
- The disaster’s impact on a businesses employees’ homes and family

With regard to the physical damage to structures and system components, a participant can review the suggested mitigation initiatives in the other vulnerability categories in this manual to explore the most appropriate options. The ideas offered below address mitigation needs extending beyond protection of a business's physical property. Because of these facilities’ importance to the community economically, the focus is on promoting the capabilities of these operations to withstand the impacts of the disaster and return to normalcy as rapidly as possible after an event.

Additional suggestions for structural initiatives:

- Purchase redundant equipment needed to maintain business operations
- Designate and equip standby facilities to sustain essential business operations
- Other: ________________________________
- Other: ________________________________

Additional suggestions for non-structural initiatives:

- Develop a community wide plan to assist businesses to recovery after an event
- Prepare a “We’re open for business again!!” plan for post-event economic recovery
- Implement an emergency response and business resumption educational program
- Establish a plan for activating a “business recovery center” after an event
- Promote flood and business interruption insurance to businesses
Develop an incentive program/revolving loan fund to finance mitigation of businesses
Involve businesses in community emergency planning
Develop a business alliance to promote improved business emergency planning
Other: ______________________________________
Other: ______________________________________

Disruption impacts community services:

Many structures and systems within the community are vitally important to providing essential community services in support of health and safety, public assistance, education and childcare, etc. Damages to these facilities or systems can make the impact of a disaster even worse for a community by also disrupting the services it needs to return to normalcy. For suggestions on mitigation of physical or operational impacts to the facilities or system components being evaluated, the participants should review discussions in the other vulnerability categories in this manual. For ideas that are unique to the issue of disruption to community services, the initiatives listed here could be considered.

Additional suggestions for structural initiatives:

- Design/construct redundant facilities or system components for impacted service(s)
- Equip alternate facilities or systems to provide similar or equivalent services
- Purchase and equip mobile facilities and services to replace damaged service
- Other: ________________________________

Additional suggestions for non-structural initiatives:

- Develop a plan to restore the impacted service(s) to operation as quickly as possible
- Study and define all critical services most needed by the community after an event
- Develop “Community Emergency Response Teams” to provide immediate services
- Negotiate “mutual aid agreements” to obtain personnel/equipment for maintaining:
  - Public safety services
  - Educational and child care programs
  - Welfare and public assistance programs
  - Purchasing, permitting and other governmental operations
  - Mass transit and taxi operations
  - Grocery and pharmacy operations
  - Banking and financial services
  - Retail store, hotel, and restaurant operations
  - Gasoline sales and auto repair
  - Other critical services needed by the public
- Other: ________________________________

Environmental problems could occur:

The outcome of damage to facilities and systems can be an associated impact on valuable environmental resources important to the community. Harm to such resources could result in the endangerment of public health and safety, such as contamination of a
water supply or despoliation of valuable natural resources, such as an oil spill into a wetland or onto a beach. It is possible that addressing the physical and/or operational vulnerabilities of the facility or system in question can mitigate this type of impact, and suggestions for such mitigation initiatives have been listed under the appropriate vulnerability category. Additional steps could be taken, however, that may be considered unique to addressing this type of problem, and ideas for this type of initiative are listed here.

Additional suggestions for structural initiatives –

- Relocate the facility or system component away from the valuable resource
- Provide a physical barrier between the facility/system and the resource:
  - Impermeable barriers
  - Walls or dikes
  - Buffer zones
  - Water sprays
- Purchase/stockpile equipment/supplies specific to the threat for use after a disaster
  - Booms and absorbents
  - Neutralizing chemicals
  - Vacuum trucks
  - Other spill cleanup devices/supplies specific to the threat
- “Harden” the specific component vulnerable to causing environmental damage
- Relocate the vulnerable resource feature (e.g., water intake) away from the threat
- Provide for permanent or temporary alternatives to the threatened resource
- Other: ______________________________________
- Other: ______________________________________

Additional suggestions for non-structural initiatives –

- Analyze the disaster vulnerabilities of the environmental resources in the community
- Develop a plan for immediate post-disaster resource protection
- Develop a clean-up or resource restoration plan responsive to the expected impacts
- Adopt policies/codes based on restricting/mitigating threats to resources
- Negotiate contracts with specialists to ensure post-disaster contractor availability
- Educate and train personnel in resource protection or restoration
- Other: ______________________________________
- Other: ______________________________________
**Facility has historic value:**

Many communities have structures, districts or locations within them that have historic value that expands beyond the simple economic value of the property itself. These valuable resources are as vulnerable to the impacts of disasters as any other facilities or systems. In this sense, protecting historic resources from the physical or operational impacts of disasters is similar to any other facility, and participants should review the suggested mitigation initiatives given in this manual under the various vulnerability categories to select appropriate actions for consideration. However, with historically valuable resources, some additional mitigation initiatives can also be evaluated, as suggested here. In considering these suggestions, it is very important to note that physical actions taken to mitigate impacts to the resource must be very carefully planned, designed and implemented. This is to avoid any damage to the structure, its contents, or to artifacts in the vicinity. It is also necessary to avoid contravening any relevant local, state or federal law or regulation regarding protection of such properties.

Additional suggestions for structural initiatives –

- Replace vulnerable structural features with disaster-resistance features
- Relocate the structure out of the area likely to be impacted
- Construct devices (e.g., flood walls, buffers, etc.) to protect the structure
- Other: ____________________________
- Other: ____________________________

Additional suggestions for non-structural initiatives –

- Conduct a detailed engineering/historic study of the resource to define vulnerabilities
- Develop plans to provide temporary, pre-event protection for the structure/contents
- Develop plans for prompt, careful restoration of disaster-caused damages
- Adopt policies/plans for disaster-related operations in the vicinity of the resource
- Negotiate contracts with specialists needed for post-impact restoration activities
- Other: ____________________________
- Other: ____________________________

**Facility impacts agriculture:**

In some communities, specific facilities or systems have important inter-relationship with the agricultural sector of the economy, which can experience unique impacts from disasters. In many ways, if a community is significantly dependent on agriculture, including fisheries-related businesses, participants should consider the suggested initiatives listed under the “Disruption has economic impacts” and “Environmental problems could occur,” which are discussed above. Other additional specific initiatives that could be considered for mitigating agricultural impacts are listed below.

Ideas for structural initiatives --

- Relocate facility or system to avoid disaster-caused impact on agriculture
- Provide barriers between facility/system and agricultural area of concern
- Modify processes used to eliminate or minimize agent that threatens agriculture
☐ Develop alternate capability for temporary holding, processing and storage of crops
☐ Develop alternate capability for prompt, post-impact harvesting of crops
☐ Other: ______________________________________
☐ Other: ______________________________________

Additional suggestions for non-structural initiatives --

☐ Establish plan/policy to promptly address resultant agricultural impacts
☐ Negotiate mutual aid agreements/contracts for substitute services to agriculture
☐ Develop plans for prompt post-impact harvesting of salvageable crops
☐ Identify alternative markets for use or salvage of damaged crops
☐ Plan for the rapid condemnation of contaminated food and animal feed products
☐ Develop approaches to rapid financial compensation of impacted farmers/fishermen
☐ Provide education/training for agricultural enterprises in impact minimization
☐ Other: ______________________________________
☐ Other: ______________________________________
City of Houston
Mitigation 20/20™ Task Force

Developing Proposed Hazard Mitigation Initiatives from the Vulnerability Assessment of Facilities and Systems

ATTACHMENT

Form for Documenting Selected Mitigation Initiatives for Further Consideration
<table>
<thead>
<tr>
<th>Facility/System Component Location</th>
<th>Vulnerability Category being Addressed</th>
<th>Describe Proposed Initiative being Considered</th>
<th>Is Proposed Initiative Likely to be (Y or N)?:</th>
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