

A.R.S. Section 9-461.05. E. 8 – Safety Element

A safety element for the protection of the community from natural and man-made hazards including features necessary for such protection as evacuation routes, peak load water supply requirements, minimum road widths according to function, clearances around structures and geologic hazard mapping in areas of known geologic hazards.

9 – SAFETY ELEMENT

The Safety Element has the ability to strengthen and direct development through identifying and promoting essential emergency services like law enforcement and other emergency services that reduce the potential impact of natural or man made disasters within the City.

A disaster is a sudden and dramatic emergency. When a disaster strikes, the demands are obvious and compelling, however, planning prior to a disaster to minimize harm to the community is very different from emergency preparedness and response. The purpose of this Safety Element is to develop a long-term plan for physical development of the City that addresses protection of the community from unreasonable risks associated with the effects of natural and man-made disasters.

This Safety Element is divided into four sections which are: Background and Existing Management Strategies, Hazard Evaluation and Analysis, Goals, Objectives, and Policies and the Action Plan. The Background and Existing Management Strategies section provides a brief overview of the roles of local agencies in the aftermath of a disaster and describes past mitigation efforts and current City management strategies. The Hazard Evaluation and Analysis section identifies the natural and man-made hazards potentially affecting the City. The focus of this section is on flooding and earthquakes, since the risks for disastrous flooding damage and seismic activity from earthquakes are known as substantial threats to the area. The Goals, Objectives, and Policies section outlines the City's aim of protecting residents and businesses from threats of natural and man-made hazards. The Element concludes with an Action Plan designed to reduce risks and the potential for future losses.

BACKGROUND AND EXISTING MANAGEMENT STRATEGIES

ROLES OF LOCAL AGENCIES IN THE AFTERMATH OF A DISASTER

POLICE AND FIRE DEPARTMENTS

Primary among police functions at the onset of an emergency is the evacuation of a disaster-stricken area when that is necessary. Both during evacuation and after the disaster, police will also play a crucial role in coordinating the flow of traffic. Fire departments provide fire suppression, emergency rescue, emergency medical services (EMS), and hazardous materials exposure containment.

EMERGENCY MANAGEMENT

The purpose of emergency management is to reduce the City's vulnerability to major emergencies and to prepare for the aftermath of natural or manmade disasters. The emphasis of local emergency management is organizing the immediate response to disaster, including the provision of emergency shelter, maintenance of vital services, access

to essential provisions like food and drinking water, and the coordination of outside help. Emergency management focuses on planning for potential events that require coordination of resources from various agencies to prevent further loss of life or property.

LAND USE PLANNING AND REDEVELOPMENT

Community Development Planners work to build consensus, prior to an event, around a vision of the post-disaster community that will guide rebuilding a more disaster-resistant community. Also, Planners focus on such disaster-related land use issues to prevent inappropriate development in hazard-prone areas. Redevelopment planning is the process of rebuilding by arranging parcels of land for project development utilizing financial incentives and assistance to advance disaster-resistant reconstruction. The City's Planning and Zoning Commission has the ability to "prepare (through the Department of Community Development) and recommend emergency plans and policies for the replanning, reconstruction or redevelopment of any area or district which may be destroyed in whole or part or seriously damaged by fire, earthquake, flood or other disaster" (City Code §154-550).

BUILDING SAFETY

The Building Safety staff is responsible for inspecting and determining the habitability of damaged structures and the potential reinforcing measures for private and public structures. The Building Safety staff may also assist with providing setup of long-term shelters, water and other life necessities.

PUBLIC WORKS

Water and sewage treatment facilities and transportation corridors may be vulnerable in a major disaster. Contingency plans are required in the event of structural damage or disablement. Disasters like earthquakes, floods and hurricanes can cause damage to streets, inflict city-wide power outages affecting traffic signals, and knock down or disable structures like streetlights. The Public Works and Utilities Departments maintain the essential roles of restoring normal service to any public infrastructure under each of their control. Major highway connections through the City include Highway 95 and Interstate 8 (I-8). These highway corridors are essential for transportation to and from the City and provide for the trucking freight routes for food, clothing and other necessary commodities.

HEALTH

The Yuma County Health Department has staff trained in mitigating and preventing communicable diseases, especially when large displaced or homeless populations are crowded together in temporary shelters. In addition, the Yuma County Health Department can oversee the provision of emergency essentials.

CITY ADMINISTRATION

The Mayor and the City Administrator's offices serve as the lead communicator to the public. The city administration not only maintains

communication internally with emergency management, departments, and the emergency operations center, but also with state and federal governments and relief agencies like the American Red Cross.

PAST MITIGATION EFFORTS AND PROJECT IMPACT

Millions of dollars have been spent in the Yuma area on flood control and seismic strengthening.

FLOODING

The Colorado and Gila Rivers have had extensive work along the banks and have been dredged to help reduce the potential for flooding. The City has coordinated its storm drain construction activities with the Yuma County Flood Control District master plans. To further reduce flooding potential, retention and/or detention basins have been built throughout the City.



City of Yuma Fire Fighters remove downed electrical wires following a seasonal wind storm.

HURRICANES AND WIND STORMS

Hurricanes have affected the Yuma County area numerous times with high wind speeds and rainfall which has led to flooding and structural damage.

Monsoon season present storms during the summer months due to high atmospheric temperatures and an accumulation of moisture causing mass flooding and damage to homes, structures and public facilities.

EARTHQUAKE

Some critical municipal buildings, have been constructed or seismically upgraded to withstand earthquakes within a Seismic Zone 4. A seismic evaluation of essential facilities in the City and County was conducted under a National Earthquake Technical Assistance contract. The Arizona Earthquake Information Center also conducted an Earthquake Hazard Evaluation. These activities are a continuation of studies for the Arizona Division of Emergency Management's Earthquake Program.

MANMADE HAZARDS

The City of Yuma was selected by the Federal Emergency Management Agency (FEMA) to participate in a new initiative regarding natural disasters. *Project Impact* seeks to reduce the personal and economic costs of disasters by bringing together community leaders, citizens, and business to prepare for and protect themselves against disasters. *Making Yuma Disaster Resistant* was initiated in 1999 with a variety of community partners. Projects funded through Project Impact include:

- Automated storm water lift station in Hacienda Estates;
- Water heater strapping kits with City/County permits and inspections;
- Installation of glass safety film on public school cafeteria windows; and,
- Safety surveys for businesses.

Highlights of actions by community partners related to or supportive of Project Impact include:

- 2001 - Arizona Public Service completed a total of 2,144 line miles towards its commitment to strengthen our community's electrical distribution system.
- 1999-2003 - Arizona Department of Transportation completed work on seismic retrofitting two overpasses along Interstate 8.
- 2001 - Yuma County Water Users' Association and Yuma County Flood Control District completed the construction of a power line distribution system to provide power to fifteen groundwater recovery wells to mitigate high ground water in the Yuma Valley.
- 2000 - Yuma County Flood Control District completed Phase V of the East Mesa Storm Sewer Outfall Project. The construction of this of line provides a vital link to future improvements that will relieve historical flooding in the area.
- 2001 - Yuma County Housing Department and the Housing Authority for the City of Yuma installed over 500 water heater straps to make public housing units resistant to earthquakes.
- 1999- 2001 - The United States Bureau of Reclamation dredged two million cubic yards of sediment from the Colorado River to comply with flow and groundwater specifications outlined in treaties with Mexico. Sediment removal also lowers the area's groundwater table and makes the river better able to handle large flood prevention releases from upstream dams.

The results of Project Impact are essential upgrades to the City's existing infrastructure in the form of electrical distribution, additional flood control measures and residential earthquake mitigation. Since 2002 the City of Yuma has not experienced excessive flooding, but the City has experienced earthquakes up to 7.2 that left minimal damage, and tested measures implemented from Project Impact.

EMERGENCY OPERATIONS PLANNING

The City of Yuma has established and provided for emergency management in accordance with State emergency plans and programs (A.R.S. 26-308). The City Emergency Management Program is organized as a division under the City of Yuma Fire Department. The City Administrator has appointed the Fire Chief as the Emergency Management Director who is responsible for the organization, administration, and operation of the program subject to the direction and control of the City Administrator. The Fire Chief has assigned full time emergency management functions to a member of the Fire Department senior staff who is the Emergency Management Coordinator. The Emergency Management Coordinator administers the comprehensive Emergency Management Program. The Program is combined and expenditures are shared between the City and County of Yuma based on an intergovernmental agreement dating back



Emergency Operations Center exercise.

to 1978. The Program is designed to protect the community from both man-made and natural catastrophes. It is based on a comprehensive approach and includes all four phases of emergency management: mitigation, preparedness, response, and recovery.



City of Yuma Fire and Police personnel operate from mobile command center.

The City *Emergency Operations Plan* (EOP) was adopted by resolution of the City Council in 2004. The EOP is a directive to City departments to plan for and, upon order, execute emergency tasks to ensure safety and survival of residents and protection of property in the event of a disaster. Its purpose is to provide an organized and coordinated response effort by City personnel and resources to minimize the impact of any disaster. The provisions of the EOP are applicable to all disasters of such magnitude as to require a response above that which is part of the normal role of the City. The plan also includes an implementation strategy that describes the tasks to be accomplished during pre-emergency, emergency, and recovery stages.

The City of Yuma EOP identifies the possibility of evacuation from any part of the city that may be in danger from natural or man made disaster. The second tier of evacuation is to provide temporary lodging, feeding and general welfare of persons forced to leave their homes due to emergency. Movement and transportation of evacuees is stated in the City of Yuma EOP as follows:

The American Red Cross has the responsibility to provide mass shelter and care in the event of either a natural or man-made disaster. The EOP includes a directory of emergency public shelters, primarily schools and churches, located in neighborhoods throughout the City. An assessment of capacity and facilities at each shelter is provided.

YUMA COUNTY HAZARDOUS MATERIALS EMERGENCY PLANNING

Hazardous materials are used in commercial, industrial, institutional, and agricultural operations throughout the Planning Area. They are also transported along area highways, railroads, and pipelines. Hazardous materials released by accident or catastrophic event may result in dangerous conditions to citizens and property within a radius of several miles around the release site. An incident involving hazardous substances may require a response under the *Yuma County Hazardous Materials Emergency Plan*.

The emergency plan is published in support of the Local Emergency Planning Committee (LEPC). The plan is intended to support the City's EOP and does not change any provisions of that plan. The LEPC consists of elected officials, fire and law enforcement officers, emergency responders, emergency managers, media, community members, industry, transportation and medical representatives. The mission of LEPC is:

To coordinate the public and private responses that may be required/requested to minimize the impact of hazardous materials

accidents/incidents on health, safety, property, and the environment; and to minimize the exposure of the populace to the effects of an accidental release of hazardous materials through the establishment of effective warning, evacuation, sheltering, decontamination, and recovery procedures.

A “vulnerability analysis” identifies schools, hospitals, and other similar facilities, and a resident population subjected to exposure due to their proximity to hazardous materials facilities. Transportation routes of hazardous substances identified in the *Hazardous Materials Emergency Plan* within the Planning Area include: Interstate 8, US 95 (16th Street and Avenue B), and Avenue 3E. Hazardous materials are also transported along the mainline Union Pacific Railroad that bisects the Planning Area.

OTHER GENERAL PLAN ELEMENTS

Land Use Element. The Land Use Element of the General Plan, specifically addresses the need to plan for land uses that are compatible with military air operations in the vicinity of the Marine Corps Air Station – Yuma (MCAS) and the Yuma International Airport. Also, floodplains and seismicity are taken into account in an examination of development constraints. A “seismic assessment” recommends several measures be taken:

- Continuation and expansion of public information and awareness program;
- Site-specific investigations and seismic evaluations prior to developments and to guide retrofitting;
- Land use planning guidelines in areas of seismic risk; and,
- Development and/or application of building codes that address design and construction for seismic loads.

Transportation Element. The street system is critical to disaster response, recovery, and evacuation. The 2005 Major Roadways Plan (incorporated into the Transportation Element, Chapter 3 of this General Plan) is specifically intended to provide for the safe and efficient movement of traffic. The Major Roadways Plan establishes an orderly classification and spacing of arterial and collector roadways and sets minimum roadway widths according to function. The location of existing and proposed streets is correlated with the Land Use Element (refer to Map 3-1, *Transportation Element*, for the location of major roadways).

Public Services and Facilities. The plans for provision of public facilities are provided in the Public Services Element (Chapter 8 of this General Plan; refer to Maps 8-1 through 8-7 for the locations of selected public and lifeline facilities). One of the objectives of the Integrated Master Plan is to identify improvements needed to maintain or increase water pressures and supply capacity. The City of Yuma 2007 Fire Services and Facilities Plan seeks to maintain a high standard of fire prevention and protection. It is the City’s policy to insure that new developments have the necessary water supplies to meet projected fire flows.

CITY CODES

Fire Prevention. City code requires installation of automatic fire sprinkler systems in multi-family residential buildings, commercial and industrial buildings and in homes on cul-de-sacs longer than 600 feet. Automatic fire sprinkler requirements also apply to buildings with use changes.



City of Yuma Fire Fighters participating in hazardous material exercise.

Hazardous Materials. Anyone storing or using hazardous materials in excess of specified quantities must provide an inventory and other process information when applying for a building permit or when applying for a business license. Owners and operators of existing facilities utilizing and storing hazardous materials must provide the same information prior to incorporating those materials in their operations.

Building. The City currently uses the International Building Code (IBC), 2003 Edition, including certain appendices and amendments, for commercial construction projects. Buildings must be constructed to conform to Seismic Design Category "D" earthquake criteria. The City uses the International Existing Building Code, 2003 Edition, including certain appendices and amendments, for projects involving existing buildings. The City uses the International Residential Code for One- and Two-Family Dwellings (IRC), 2003 Edition, including certain appendices and amendments, for residential construction projects of detached single family homes, duplexes and townhouses.

Floodplain Management. The City has participated in FEMA's National Flood Insurance Program (NFIP) since 1983. The City Council has adopted ordinances addressing floodplain management and drainage policy. The ordinances establish standards for construction in areas of special flood hazard, storage of materials and equipment, utilities, subdivisions, and manufactured homes.

Storm Water Runoff in New Development. The City adopted a code for storage and disposal of storm water runoff in the late 1970's. This code was later modified and reinforced when the City joined the Federal Emergency Management Agency (FEMA) Flood Insurance Program (FIP) in 1983. It was further upgraded in the City's Stormwater Management Program in 2003, as mandated through the Federal Clean Water Act of 1972, as amended. The developer of each parcel of land within the City must provide storage of sufficient volume to hold the total runoff from the design storm falling on that parcel of land. Implementation of this code has alleviated flash flooding in newly developed areas of the City.

Zoning. The City Zoning Ordinance is designed to "lessen congestion in streets; secure safety from fire, panic and other dangers; promote health, safety, or general welfare; provide adequate light and air; prevent overcrowding of land; avoid undue concentration of population; facilitate adequate provision of transportation, water, sewerage, schools, parks and other requirements."

The basic philosophy behind land use zoning is to separate incompatible land uses into districts and then establish a set of permitted land uses and regulations for each district. For example, any land use that requires a state or federal agency permit, license or other type of certification for the use or handling of “dangerous materials” is only allowed by “conditional use permit” in the Light and Heavy Industrial zoning districts if approved by the Planning and Zoning Commission at a public hearing.

The Airport Overlay District is established to promote the public health, safety and general, welfare in the vicinity of the Marine Corps Air Station – Yuma (MCAS) and the Yuma International Airport by minimizing exposure to high noise levels generated by aircraft. The Airport District also promotes public health and safety by minimizing potential aircraft failure hazards in the approach and take off sections of the runways. Each of these measures encourages future development that is compatible with the continued operation of the airport.

The City zoning code defines safety strategies that promote “Crime Prevention through Environmental Design” (CPTED), site development that provides for:

- 1) Building forms - environments where provisions are designed to allow a belief that occupants are not vulnerable or isolated;
- 2) Compatible building placement - environments where provisions are designed to provide placement of compatible building types together to enhance the safety of occupants;
- 3) Lighting - environments where provisions are designed for natural, night, and security lighting and the avoidance of unlighted areas;
- 4) Natural surveillance - environments where provisions are designed to allow adequate public and police surveillance by such items as window placement, elimination of “blind” spots, and appropriate landscaping and positioning of entrance doors to maintain sight lines;
- 5) Territoriality - environments where provisions are designed to allow a “marking” of place to provide a boundary or perceived access control, including appropriate landscaping, fencing, and screening.

In the aftermath of the 1995 Murrah Federal Building bombing in Oklahoma City and the September 11, 2001, terrorist attacks on the World Trade Center and the Pentagon, these strategies should play an increasingly important role in physical security plans for new construction.

HAZARD EVALUATION AND ANALYSIS

SITUATION

All areas within the City of Yuma are vulnerable to disasters that result in loss of life, social disruption, and property damage. The following is a summary of possible hazards derived from the City’s and the County’s emergency operations plans, that have the potential to disrupt and cause damage, and casualties in the area:

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- Flood/flash flood: The Yuma area is subject to localized flash flooding from excessive rains. Riverine flooding is possible in the event of massive releases of waters from the upstream dams on either the Colorado or the Gila Rivers or from dam failure.
 - Major fire: Uncontrolled structural and wild land fires may reach such proportions as to become a disaster. If not promptly controlled, even small fires can threaten lives and cause significant destruction of property and the environment. Specifically wildlands along the Colorado River are prone to fires.
 - Aircraft crash: The skies above Yuma experience a heavy volume of traffic from military, commercial carrier, and general aviation aircraft. An aircraft crash as a result of lack of fuel, collision, equipment failure, or pilot error could occur in Yuma at any time.
 - Windstorm: High winds can cause damage depending on location, intensity of the winds, and the speed and direction of their movement.
 - Hazardous material: The manufacturing, transport, storage, use and disposal of hazardous materials create a considerable risk to lives, property, and environment. Incidents involving these materials have occurred at fixed facilities and along transportation routes as a result of highway accidents or train derailments.
 - Earthquake: The seismic hazard for the Yuma region is considered the greatest in the State of Arizona. Yuma is subject to ground shaking from earthquakes originating in southern California and northern Mexico. The seismic hazard is high because of regional seismicity and increase in the amount of development in areas having a potential for liquefaction.
 - Terrorism: Terrorist incidents in the United States involving explosives, bacterial pathogens, nerve gas, and toxins, have shown that the United States is also vulnerable to biological and chemical threats.

The Yuma area has a history that involves a range of hazard incidents. However, the focus of this evaluation and analysis is on flooding and earthquakes, since the risks for disastrous flooding damage and from earthquakes are known as substantial threats to the area.

FLOODING

Assessment. Probably the most significant disaster exposure is that of river flooding as a result of flood releases from storms upstream. Prior to dams being built on the Gila and Colorado Rivers, large and damaging floods were common in the Yuma area. Completion of the Hoover Dam in 1935 eliminated the extreme floods reaching Yuma from the upper Colorado River. Parker and Davis Dams on the Colorado River added to the control of the River. Dams on the Gila River system added substantial control. Yuma is now protected from Colorado and Gila River floodwaters by a series of levees. The levees have been improved to prevent overtopping during the 100-year flood, reducing flood hazards in areas protected by the levees.

Significant flooding is still a potential hazard in the Yuma area. In 1983, large amounts of runoff from record snowfalls and late rains required the upper Colorado River reservoirs to release unprecedented volumes of water into the lower Colorado River. The releases caused the Colorado River to flood low-lying areas, erode riverbanks, and raise adjacent ground water levels. Groundwater seepage caused surface ponding. Recreational facilities were damaged, along with septic tank systems and water treatment systems. This disaster resulted in \$13 million in damages to the City and County of Yuma.

In 1993, heavy rain fell in Arizona resulting in significant flooding along most major watercourses. In Yuma County, raging floodwaters, sediment deposition, and extensive bank erosion caused severe damage to public infrastructure and structural damage to private property, agricultural crops and land, economic loss and environmental damage. Water released from dams north and east of Phoenix into the Gila River below Painted Rock Dam caused in excess of \$100 million in public infrastructure, agricultural, private property, economic, and environmental damages in the Yuma area. The 1993 flood brought an additional five-feet of sediment to the Colorado River adjacent to Yuma. Lack of channel maintenance to remove this sediment both upstream and downstream of Morales Dam has increased the potential for both flooding and high ground water conditions in the Yuma Valley. The U.S. Bureau of Reclamation remedies this situation by dredging of the East Main Canal.

AREAS OF SPECIAL FLOOD HAZARD

Zones of anticipated flooding have been mapped by FEMA. Map 9-2 shows areas that would be inundated by the 100-year flood up to the 500-year flood. Delineated 100-year floodplains have been determined in the planning area along the Colorado River and Gila Rivers. Development within these 100-year flood areas is sparse with most areas used for recreational or agricultural purposes. An approximate ¼-mile wide 100-year floodplain is delineated along the East and West Main Canals in the City. A broad area subject to 100-year flooding occurs in the north end of the City between the Main Canal and land near Carver Park. These areas are occupied by residential and commercial developments. The remainder of the Yuma and Gila Valleys is shown within areas between limits of the 100-year flood and 500-year flood. This includes certain areas subject to 100-year flooding because of the high water table. The Yuma Mesa is outside the area of major flooding; however, areas on the mesa, like areas in the valleys beyond the 100-year flood, may be subject to extraordinary floods and are locally subject to storm flooding.

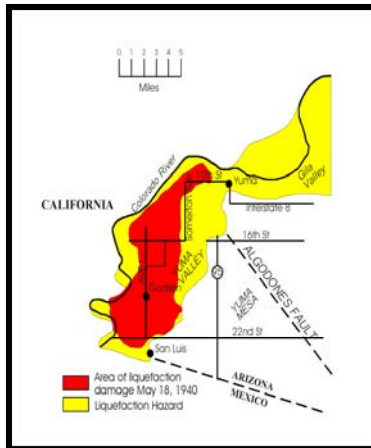
EARTHQUAKES

Assessment

The U.S. Geological Survey monitors seismic activity in the Yuma area through a cooperative effort with the Southern California Seismic Network.

Historical accounts describe severe earthquakes in the Yuma area in 1852, 1915, and 1934. Earthquakes originating in the Imperial Valley

region of southern California have resulted in damage to the Yuma region in 1940 (magnitude 7.1), 1979 (magnitude 6.5) and in 2010 (magnitude 7.2). Liquefaction damage occurred throughout much of the Yuma Valley region in 1940.



Source: Arizona Earthquake Information Center, 1996.

Sources of earthquakes in the Yuma region include: San Andreas and San Jacinto fault zones, located within 65 miles of Yuma, Cerro Prieto fault within 45 miles, and Imperial fault within about 28 miles. The Algodones fault, which appears to be a continuation of the San Andreas Fault, bisects the Yuma mesa and valley. The segment of the San Andreas Fault nearest Yuma has not ruptured in a major earthquake in more than 300 years, and is considered a likely segment to rupture in a magnitude 8 or greater earthquake.

One or more of the following hazards can cause damage from an earthquake:

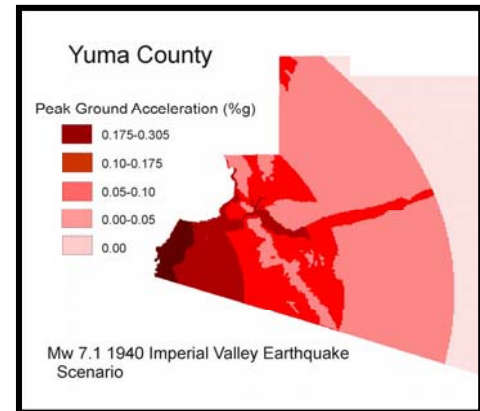
- Ground motion (vibrations) during an earthquake is considered the greatest source of damage to structures. The degree of damage will depend on the intensity and duration of the shaking, type of structure, and subsurface soil conditions. The most often used measure of the strength of ground motion is “peak ground acceleration,” measured in “g,” the percent of the acceleration due to gravity.
- Liquefaction is a process by which water-saturated earth materials lose strength and may fail during strong ground shaking. Four kinds of ground failure commonly result from liquefaction:
 - Lateral spread
 - Flow failure
 - Ground oscillation
 - Loss of bearing strength
- Steep slopes within the City are located primarily along the margin of the Yuma mesa. This area may destabilize in an earthquake resulting in landslides or lateral spreading. Liquefaction within the Yuma and Gila valleys adjacent to the mesa slopes may remove resisting forces at the base of the slopes resulting in slope failures. These areas require site-specific geotechnical studies to determine risk and mitigation measures. Development has encroached on the mesa margins, and the views available from these locations are considered valuable.
- Ground surface rupture due to active faulting is not considered likely due to the absence of any known active faults underlying the area. Lurching or cracking of the ground surface within the City as a result of nearby or distant seismic events is a possibility but is considered unlikely.

In a report sponsored by the Arizona Council on Earthquake Safety, two scenario earthquakes were chosen for FEMA’s nationally standardized

loss estimate model known as HAZUS™.

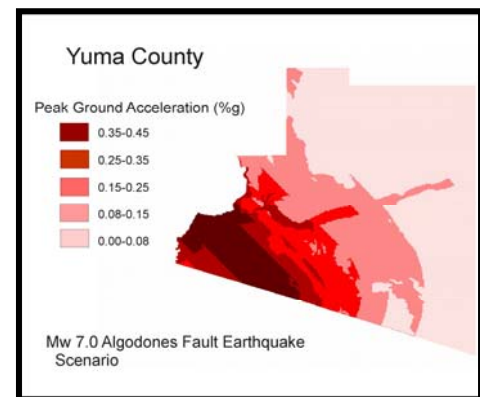
The Maximum Probable Earthquake (MPE) represents the earthquake that has a “probable” chance of occurring within a specific time period. The earthquake chosen was a repeat of the 1940 magnitude 7.1 Imperial Valley earthquake that resulted in liquefaction damage to the then sparsely populated Yuma Valley. The Maximum Credible Earthquake (MCE) event represents the largest earthquake expected with very little emphasis given to the recurrence interval of such an event. This earthquake scenario provides useful information for emergency response training and for design of critical facilities. The earthquake chosen for this scenario is a magnitude 7.0 rupture of the Algodones fault.

Maximum Probable Earthquake (MPE). The 1940 magnitude 7.1 Imperial Valley Earthquake was chosen as the MPE because it has a finite chance of occurring within the lifetime of structures in the County of Yuma. Based on historic seismicity and the current knowledge of the tectonic framework of the area, the probability of the City experiencing shaking levels similar to the MPE is about 50 percent in the next 50 years.



Source: Arizona Earthquake Information Center, 1999.

- The HAZUS™ computer model generates loss estimates for a repeat of the 1940 magnitude 7.1 Imperial Valley earthquake indicate that the County may suffer total direct economic losses to building stock of about \$75 million.
- Less than one-half of the pre-1973 building stock will escape undamaged. While most of the post-1973 building stock will escape undamaged except through liquefaction.
- The building type projected to suffer the greatest losses is mobile homes. Only 34% of pre-1973 mobile homes are expected to survive undamaged, while about 68% of post-1973 mobile homes are projected to survive undamaged.
- No modern wood-frame structures are expected to suffer extensive or complete damage, and most are expected to be undamaged except through liquefaction.
- Of the county’s 333 hospital beds, 264 (80%) are estimated to be available 24 hours after the earthquake.
- Functionality of the County’s emergency response facilities is projected to be 79% at one-day after the earthquake.
- Casualty estimates range from 27 to 52 persons with fewer than 6 requiring hospitalization, and no fatalities. The greatest casualty estimates are nighttime occurrence, rather than a daytime or commute-time event.
- HAZUS™ estimates that 74 households will be displaced with 66 of the households requiring short-term shelter.
- No major fire ignitions in the County are projected, while an estimated 71,000 tons of debris is estimated to be generated.



Source: Arizona Earthquake Information Center, 1999.

Maximum Credible Earthquake. Estimated losses associated with a magnitude 7.0 Algodones Fault Earthquake was chosen as the MCE because it has a finite chance of occurring within the current tectonic framework of Yuma County. Such an event should be considered when designing and siting essential facilities, as well as for emergency planning and exercises. It is an event that likely occurs only once every several thousand years, but should it occur tomorrow, this loss estimation approximates the casualties and damage for the County of Yuma.

- The HAZUS™ loss estimation for the MCE indicates that the County of Yuma may suffer total economic damages approaching \$1 billion.
- Functionality of the County's fire and police stations is estimated at about 17% at one-day after the earthquake.
- About 15% of the county's capital stock (buildings and inventory) may be lost.
- HAZUS™ estimates that only about one in four buildings will escape undamaged by the MCE, with high rates of damage for mobile homes and pre-1973 construction.
- As many as 30,000 buildings may require inspection after the earthquake, with more than 10,000 "red-tagged" and 12,000 "yellow-tagged."
- Casualty estimates range from 15 to 495 persons with 110 to 158 requiring hospitalization, with 10 to 12 fatalities projected.
- HAZUS™ estimates that 2,432 of the County's households will be displaced with 2,103 requiring short-term shelter.
- Less than 17% of the area's schools are expected to be operational following the MCE.
- Seven major fire ignitions in the County resulting in \$16 million in damages are projected.
- An estimated one million tons of debris will be generated in the County as a result of the MCE.

Liquefaction Hazard Evaluation. A detailed study of the liquefaction hazard was conducted by Southland Geotechnical, Inc. for the City of



Example of liquefaction in the Yuma Valley as a result of the 1940 Imperial Valley Earthquake

Yuma, Department of Community Development in 1997, to provide criteria for evaluating the hazard and ground failure potential. A hazard map of the area outlines a "Liquefaction Hazard Zone" (Map 9-3). The hazard map is recommended as a planning guide to require site-specific liquefaction investigations for development proposed within the Hazard Zone. The stability of a structure is only as good as its foundation. Extensive damage can occur to structures from soil liquefaction beneath. Development may be safeguarded from liquefaction hazard using deep foundation systems, ground improvements to prevent its occurrence, or structurally designed foundations to withstand expected deformation of the ground. Liquefaction should be mitigated for development proposed within the Liquefaction Hazard Zone.

COMBINED EFFECTS

In the unlikely event that flooding and the design earthquake occur at the same time, the anticipated effects could be magnified. Liquefaction from even a moderate earthquake could impact a larger area than expected if the region is affected by shallow groundwater due to flooding. Flood saturated levees or other water control structures could be subject to ground shaking from a regional earthquake if both occur simultaneously. The *Hazardous Materials Emergency Plan* notes that some hazardous materials facilities are located in the floodplain making them subject to flooding. This could result in contamination of the Colorado and Gila Rivers and their tributaries. These facilities include Shaw Industries located and numerous Arizona Public Service substations located within the Yuma Valley. Also, because the County is in a high earthquake risk area, any locally occurring earthquake of sufficient magnitude to cause structural damage could affect all fixed-site hazardous materials facilities resulting in multiple releases.

PLANNING FOR POST-DISASTER RECOVERY AND RECONSTRUCTION

The City/County Emergency Operations Plans (EOP's) do not spell out recovery actions beyond rapid damage assessment and the actions necessary to satisfy the immediate life support needs of disaster victims. Some short-term recovery actions are natural extensions of response and are covered in the EOP's, e.g. restoration of infrastructure "lifelines" and debris removal to facilitate response. Beyond that lies long-term recovery, which is not strictly time-sensitive. As stated in the County's EOP, "the urgency to rebuild as soon as possible must be weighed against the longer-term goal of reducing future risk and lessening possible impacts should another disaster occur."

GOAL, OBJECTIVES, AND POLICIES

Goal 1.0: Protect City residents and businesses from threats of natural and man-made hazards.

Objective 1.1: Ensure that necessary preparations to minimize impacts to the City from natural and man-made hazards are maintained and, as necessary, improved.

Policy 1.1.1: The City shall review and update emergency evacuation plans periodically to ensure the safe departure of residents, employees, and visitors in times of natural or man-made disaster.

Policy 1.1.2: The City shall upgrade water system capacity where necessary to meet peak load water supply requirements for fire fighting.

Policy 1.1.3: The City shall continue to collaborate with qualified consultants and agencies to study and map geologic hazards.

Objective 1.2: Minimize the economic impact of strong ground motion, liquefaction, and fault rupture on public and private property.

Policy 1.2.1: The City shall continue its program of retrofitting and strengthening essential and critical facilities.

Policy 1.2.2: The City shall continue to monitor and enforce seismic codes.

Policy 1.2.3: The City shall continue to educate the public regarding risks from seismic and geologic hazards.

Objective 1.3: Minimize public and private losses due to flood conditions in areas of special flood hazard.

Policy 1.3.1: The City shall restrict or prohibit land uses which may cause detrimental impacts to health, safety, and property due to increase in water or erosion hazards, or which result in increases in erosion or in flood water depths or velocities.

Policy 1.3.2: The City shall require that uses vulnerable to floods, including facilities that serve such uses, be protected against flood damage at the time of initial construction.

Policy 1.3.3: The City shall control the alteration of natural floodplains, stream channels, and natural protective barriers that help accommodate or channel floodwaters.

Policy 1.3.4: The City shall control filling, grading, dredging, and other activities, which may increase flood damage.

Policy 1.3.5: The City shall prevent or regulate the construction of flood barriers which unnaturally divert floodwaters or which may increase flood hazards in other areas.

Policy 1.3.6: The City shall support the United States Bureau of Reclamation and the International Boundary and Water Commission in their efforts to fulfill their Federal responsibilities to provide Colorado River channel

maintenance sufficient to pass flood flows and relieve high ground water conditions.

Objective 1.4: Promote and facilitate sustainable redevelopment during the post-disaster recovery and reconstruction process by identifying opportunities for building a disaster-resistant community.

Policy 1.4.1: The City shall ensure that development in identified natural hazard zones shall be designed to safe, appropriate engineering and construction standards.

Policy 1.4.2: The City shall develop and establish procedures for expeditious and orderly post-disaster recovery and rebuilding that incorporate hazard mitigation measures.





ACTION PLAN

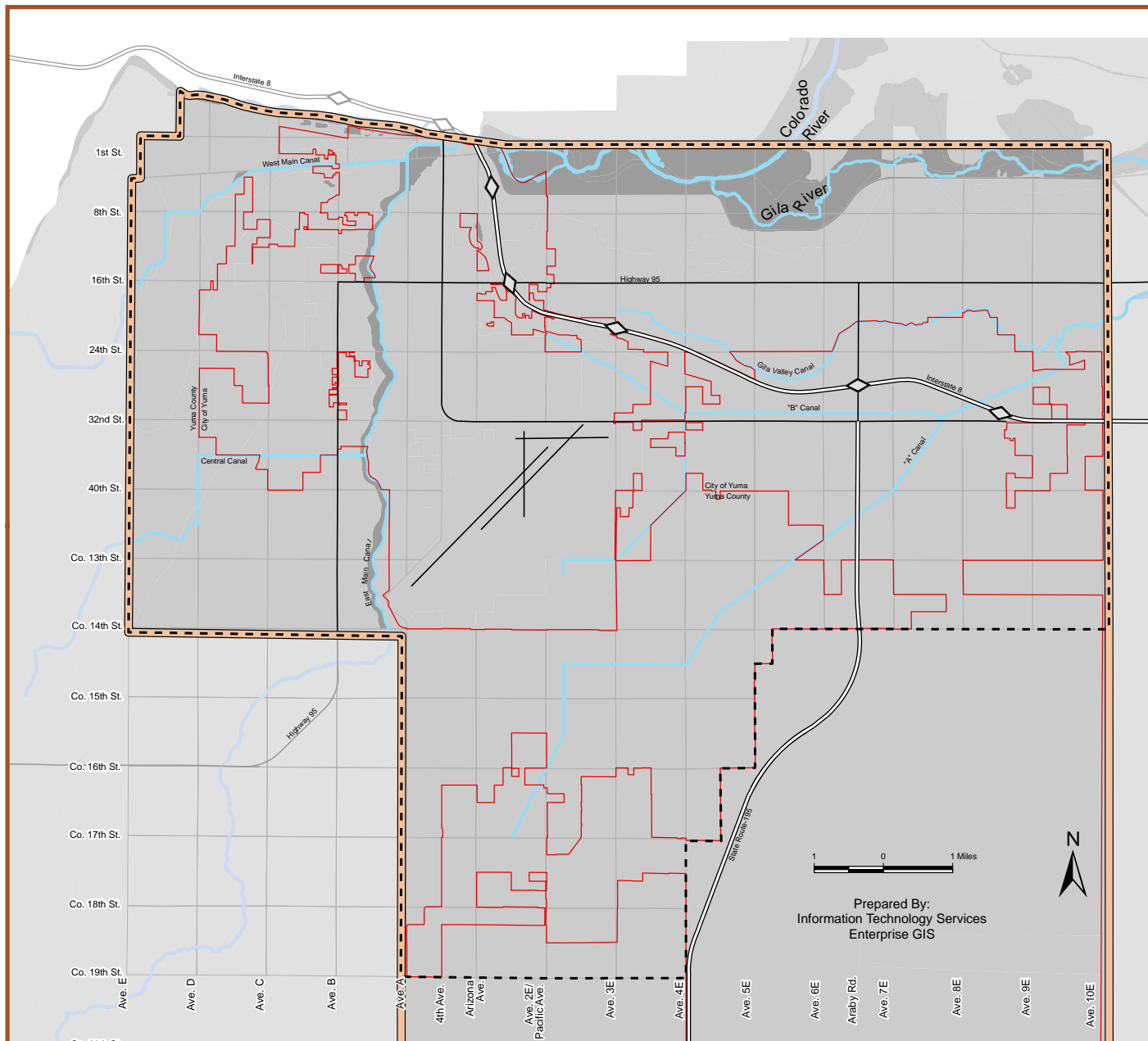
Phase	Project	Responsible Agency/ Department	Funding Source
1 – 5 years	Evaluate and update emergency evacuation routes	Emergency Management, Public Works, and Community Development	General
	Identify North/South or East/West roadway clear of overhead power lines.	Emergency Management, Public Works, and Community Development	General
	Identify floodplain issues along the East Main Canal	Emergency Management, Public Works, and Community Development	General
	Assess benefits and costs of participating in NFIP's Community Rating System	Community Development	General
	Prepare plan for managing post-disaster recovery and reconstruction	Community Development	General
	Plan for post-disaster recovery and reconstruction should be developed. Such a plan would be composed of policies, actions, and designated responsibilities related to expeditious and orderly recovery and rebuilding with an emphasis on mitigation.	Community Development	General
6+ years	Develop liquefaction hazard overlay zoning district based on delineations in <i>Liquefaction Hazard Evaluation</i> report	Community Development	General
	Research and develop special setbacks for residential uses near hazardous materials facilities and transportation routes – including rail, truck, and pipeline – in Zoning Code	Community Development	General

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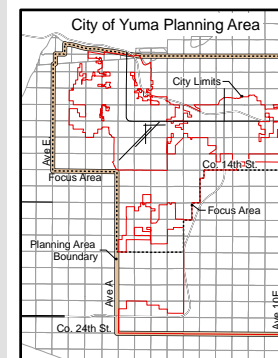


Areas of Special Flood Hazard

- 100 Year Flood 
- 500 Year Flood 
- Focus Area 
- Planning Area Boundary 



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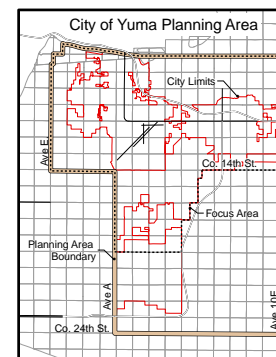
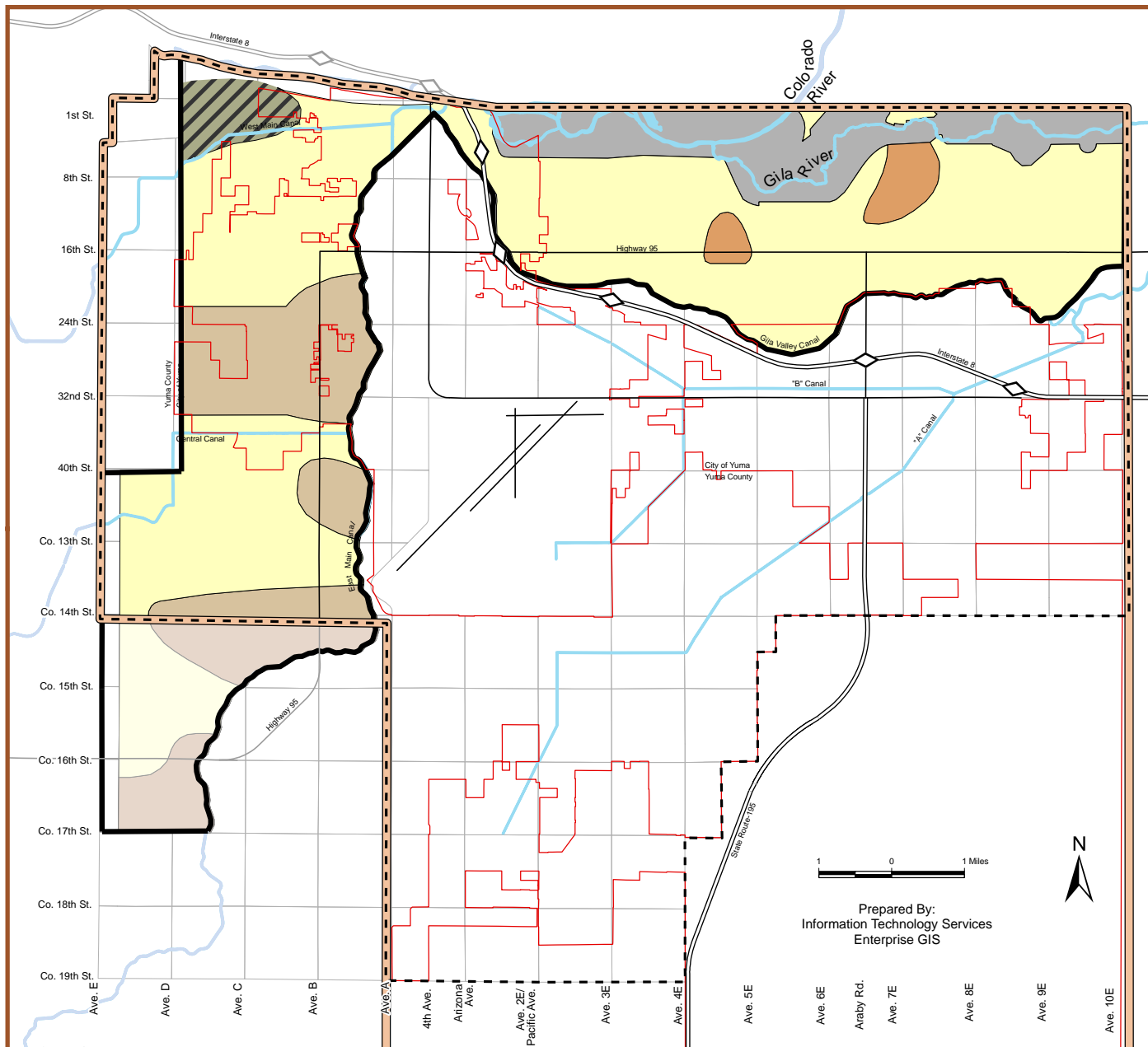


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Liquefaction Hazard Map

- Liquefaction Boundary
- Historic (1940) Liquefaction Zone
- Current Floodplain
- Groundwater less than 6' deep
- Groundwater 6' to 12' deep
- Groundwater Over 12' deep
- Focus Area
- Planning Area Boundary



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Enterprise GIS