# 3. LAND USE PLANNING AND URBAN DESIGN

Moving forward with the rebuilding from Hurricane Katrina and preparing for inevitable flood hazards in the future require cities along the Gulf Coast to use a variety of flood risk mitigation methods addressing different site conditions, construction budgets and land use regulations. In combination, different mitigation methods have the potential to strengthen and unify neighborhoods that are currently beset with high rates of vacant and underutilized property. However, consideration must also be given to how mitigation methods used on one property relate to adjacent properties. Integrating new buildings into the existing urban fabric is especially important in older neighborhoods, where buildings have been constructed to meet an range of codes and regulations.

The previous chapter discussed the hazards and regulations associated with natural disasters common to the Gulf Coast. This chapter will discuss the benefits of dry floodproof construction with regard to urban design and accessibility of neighborhood commercial districts common to the Gulf Coast. The focus is on neighborhood commercial districts; dry floodproofing is limited by regulation to non-residential structures, and small businesses operating at the neighborhood level are most likely to benefit from this research. Among the communities and cities on the Gulf Coast striving to rebuild, dry floodproof construction has the potential to create viable neighborhood commercial districts when implemented in accordance with best practices in urban design.

This chapter will examine the regulatory framework that enables dry floodproofing as a flood risk mitigation strategy alone or in combination with other mitigation methods and discuss the implications of different site design techniques for dry floodproofed structures. The application of these ideas will be examined in a case study of neighborhood commercial corridors in East Biloxi, a Gulf Coast community in the midst of rebuilding from Hurricane Katrina.

## 3.1 Neighborhood Commercial Districts

The NFIP insures floodproof structures up to $500,000. Small business and property owners with structures valued below $500,000 are therefore more likely to take advantage of the NFIP than large business owners with higher-value properties. However, small business owners, who tend to operate at the neighborhood level, are also more likely to have difficulty meeting flood risk mitigation requirements due to lack of information and leverage. This research is intended to provide information on affordable and effective mitigation techniques and construction methods to augment current practices. In particular, this chapter discusses the ways in which neighborhood commercial districts can reap the greatest benefits from dry floodproof construction as a flood risk mitigation method.

Neighborhood-level commercial districts serve many important functions in sustaining nearby residents, small business owners and cities. Neighborhood businesses provide accessible goods and services to nearby residents, who may not have time or money to travel longer distances by car for daily shopping needs. They also build wealth within the community by promoting ownership and a local tax base. These benefits can be wrought

through careful consideration and implementation of flood risk mitigation methods that are appropriate for neighborhood commercial districts.

## 3.2 Benefits of Dry Floodproof Construction for Urban Design and Accessibility

### 3.2.1 Comparison of Flood Risk Mitigation Strategies

Developers and property owners intending to construct a building within the floodplain have several options for mitigating flood risk. The building can be elevated to bring the FFE to the required height, as determined by the local floodplain ordinance. Alternatively, the building can be constructed with a FFE below the BFE by using dry floodproof construction techniques, so long as the building is a non-residential structure. Finally, a building can be relocated outside of the floodplain and built with conventional construction techniques. These three mitigation strategies are diagrammed in Fig. 3.1. Of these three basic mitigation strategies (elevation, dry floodproofing and relocation), dry floodproofing is preferable from a land use and urban design perspective.

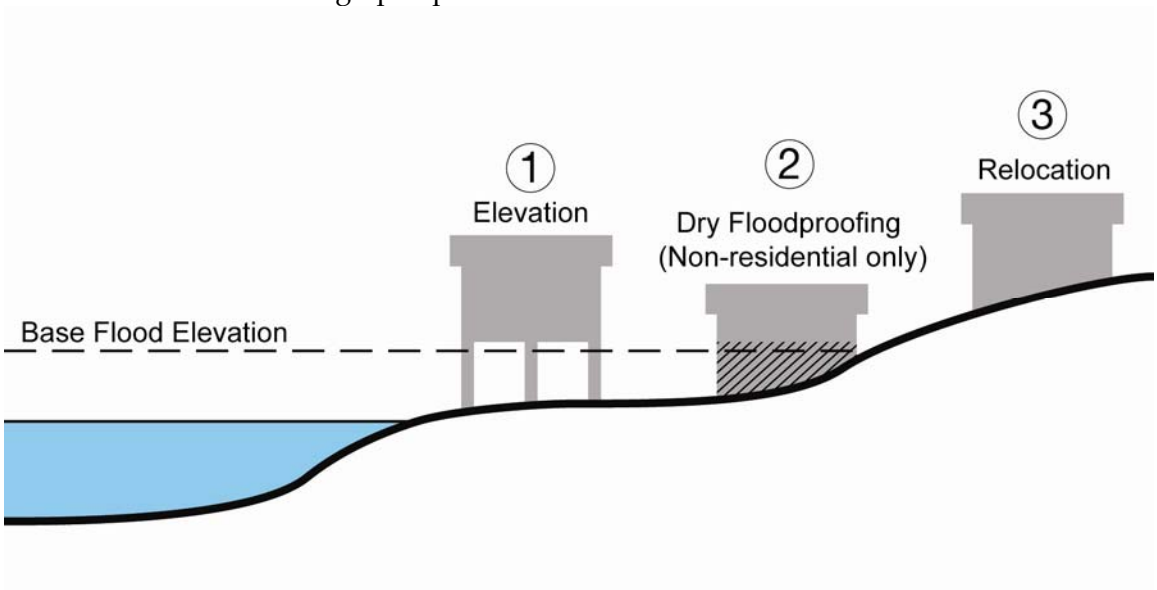


**Fig. 3.1. DIAGRAM: Basic flood mitigation strategies.**

Relocation poses the greatest threat to neighborhood commercial viability because it displaces neighborhood businesses and their associated benefits. Rather than providing relief to distressed neighborhood commercial areas with vacant and underutilized land, relocation shifts the benefits of small business to communities outside of the floodplain. This strategy may be more cost-effective for the business owner, but does not serve the greater purpose of rebuilding flood-prone communities.

Elevation involves raising the FFE of a building through the use of piers, piles, or structural fill. This mitigation strategy is problematic because it is less physically and visually accessible than at-grade construction, and tends to be out of context in existing commercial neighborhoods. Fig. 3.2 demonstrates poor physical access associated with a typically elevated commercial structure on the Gulf Coast.


**Fig. 3.2. PHOTO: Physical access problems associated with an elevated structure.**

Non-residential structures have ADA accessibility requirements, such as long ramps or costly elevators that make elevation less desirable. Elevated commercial buildings may have to develop costly and complex loading and unloading systems. Figure 3.3 illustrates the visual inaccessibility of elevated structures to pedestrians and street-level users.


**Fig. 3.3. PHOTO: Visual access problems associated with an elevated structure.**

In the example shown in Fig. 3.3, even the stairwell is hidden from view from the street. Elevated windows make it difficult for potential customers to see inside the building from street level. Finally, Fig. 3.4 shows how elevated structures appear out of context when sited next to existing structures that are at-grade. This is a particularly important consideration in older established neighborhood commercial corridors, where an elevated building would detract from the fabric of the historic streetscape.

**Fig. 3.4. PHOTO: Out-of-context elevated structure.**

In contrast to the design problems associated with elevation, dry floodproofing allows businesses to develop within an existing neighborhood commercial area while maintaining accessibility and the continuity of the streetscape, as shown in Figure 3.5 below. Dry floodproofing offers a potentially affordable alternative to relocating a commercial structure outside of existing neighborhood commercial corridors.


**Fig. 3.5. PHOTO: Dry floodproofed structure in East Biloxi.**

### 3.2.2 Combining Flood Risk Mitigation Strategies

Dry floodproof certification allows mitigation for up to three feet below the BFE. (*City of Biloxi 2011*) Many coastal commercial districts are located in areas where the BFE is greater than three feet above the existing ground plane. In these situations, combining dry floodproofing with other flood risk mitigation strategies reduces the total height to which a structure must be elevated.

Fig. 3.6 illustrates three flood risk scenarios categorized by required mitigation heights and recommended strategies: dry floodproofing, dry floodproofing in addition to elevating the FFE, and dry floodproofing in addition to elevating the FFE and elevating the exterior entryway. The diagram shows the relationship between the type of flood mitigation strategy, the BFE and user accessibility.

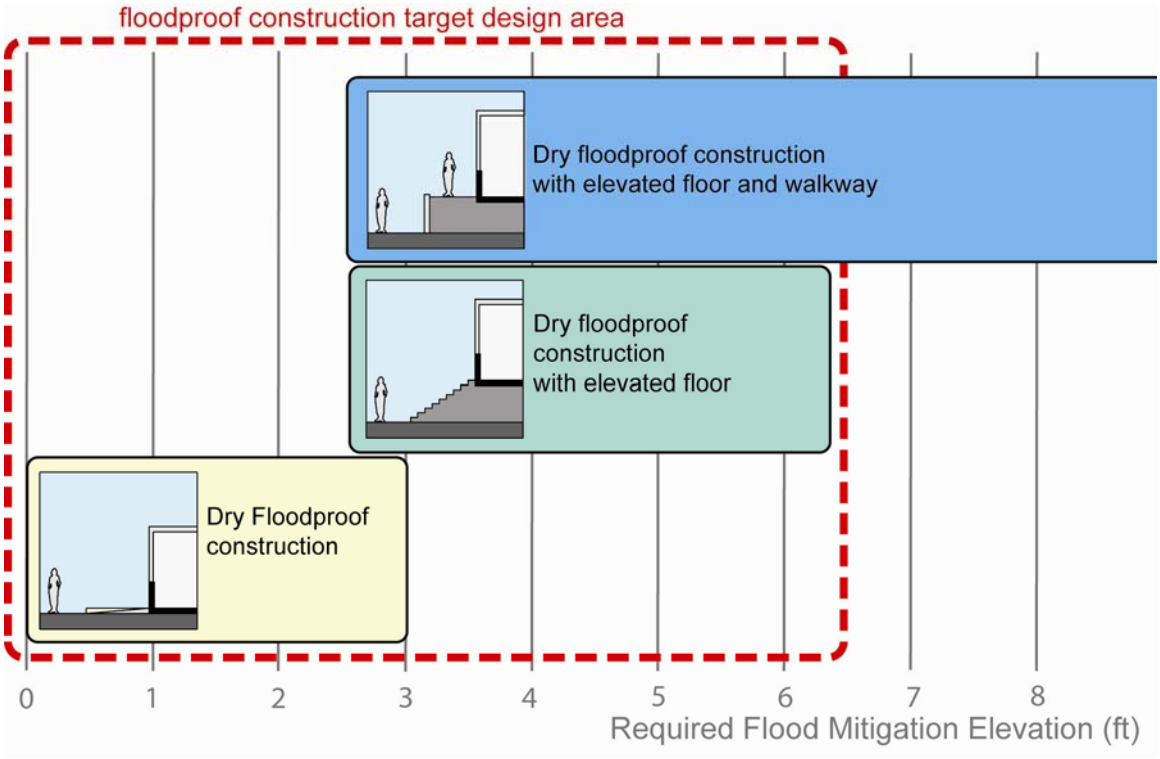


**Fig. 3.6. DIAGRAM: Flood risk mitigation and dry floodproofing suitability.**

### 3.2.2.1 Scenario 1: dry floodproofing

A site with a BFE of less than three feet above the existing grade can be wholly mitigated using dry floodproofing construction techniques, allowing the FFE of commercial buildings to remain with street level access. Physical accessibility, visual access, and street presence benefit from this situation. It is logical that all commercial properties with flood risk heights up to three feet should use dry floodproofing for mitigation, because regulatory dry floodproofing is limited to three feet below the BFE.

### 3.2.2.2 Scenario 2: dry floodproofing and elevation

For a site with between three and five feet of flood risk, dry floodproofing can be combined with elevation, usually by raising the finished floor over a plinth or chainwall supported with structural fill. For example, a flood risk of five feet above existing grade could be mitigated by elevating the finished floor two feet above grade and floodproofing the structure for the remaining three feet above the floor. The use of dry floodproofing reduces the height of elevation needed to meet mitigation requirements. The combination of

the two flood risk mitigation strategies increases the range of sites in a Special Flood Hazard Zone that can be mitigated through the use of dry floodproofing, while continuing to prioritize building characteristics such as accessibility and street presence.

To gauge the effects of these height differences, the following comparison is helpful. A commercial space with a finished floor two feet above grade requires three to four stairs to enter, versus eight or nine stairs required by a space elevated five feet above grade. Combining the two flood risk mitigation strategies reduces the number of stairs required to access the structure. Similarly, a ramp to provide access two feet above grade would need to be 24 feet in length, while a ramp to provide access to five feet above grade for the same site would require over sixty feet of length.

Dry floodproofing provides opportunities for accessible structures. Therefore, it is preferable to use dry floodproofing in combination with elevation to achieve flood risk mitigation in areas with three to five feet of flood risk, rather than using elevation as the sole mitigation strategy.

#### 3.2.2.3 Scenario 3: Dry floodproofing, elevation, and elevated walkways

In commercial areas with consistently high flood risk mitigation height requirements, larger or adjacent sites could also share elevated walkways to reduce the total number of trips pedestrians must take up and down stairs and ramps. Fig. 3.7 shows an example of a shared, elevated walkway in a neighborhood commercial district.

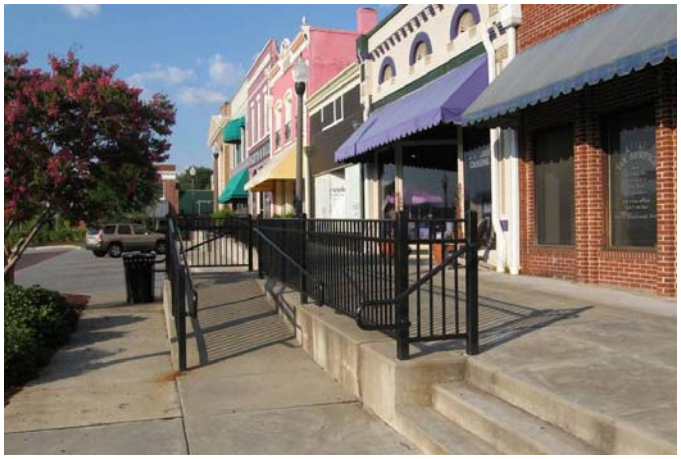

**Fig. 3.7. PHOTO: Shared, elevated walkway with ramp and stair access.**

This system allows pedestrians to move between commercial spaces without negotiating floor height changes. Pedestrians can access several shops or community spaces with a single trip up stairs or a ramp. The shared walkways help achieve a clear means of physical access, unobstructed sightlines between the sidewalk and the elevated space, and a contextual connection to the surrounding natural and built environment.

Shared, elevated walkways have the potential to reduce the cost burden of flood risk mitigation by enabling business owners to share in the cost of accessibility items like elevators and ramps.

The addition of dry floodproofing helps to bring elevated walkways as close to street level as possible, making them more visually and physically accessible from the street.

### 3.2.3 Diminishing Benefits of Dry Floodproof Construction

After a certain threshold of risk, dry floodproofing no longer makes sense, either functionally or financially. This threshold will depend on the specifics of the project and the cost of construction. For example, if a site has a flood risk of ten feet, and is elevated fully to meet the BFE requirements, a person may be able to comfortably stand under the building and the space beneath the building can take on alternative, yet limited uses, such as parking or outdoor space. Lowering the elevated floor to seven feet with the addition of three feet of floodproofing prohibits the ground plane as a usable space.

## 3.3 Regulatory Framework

Dry floodproofing has the potential to create accessible infill opportunities that corroborate with the existing street fabric along commercial corridors. However, the local regulatory framework that enables dry floodproofing as a flood risk mitigation strategy, alone or in combination with, other mitigation methods will influence the extent to which dry floodproof construction is successfully implemented.

### 3.3.1 Land Use Designations

Land use designations and requirements can encourage contextual integration of new buildings into the existing street fabric, making use of dry floodproofing strategies where applicable. If dry floodproofing is only permitted in non-residential zones, city planners should consider the zoning designations along the neighborhood commercial corridors that fall within the floodplain. For example, vacant residential parcels within a neighborhood commercial corridor could be re-zoned for commercial or mixed-use so that development is viable with dry floodproof construction techniques.

For this to occur, it is essential that residential and non-residential uses are clearly defined within the local zoning ordinance. Residential uses include houses, apartments and any spaces meant for human habitation. Non-residential uses include those that are zoned for commercial, industrial use, and mixed use. In order for dry floodproofing to be used as a mitigation strategy on a mixed-use site, the ground floor of the structure must be strictly used for commercial space. Any residential uses within a dry floodproofed mixed-use structure must be located at or above the BFE, as shown in Fig. 3.8. Municipalities can provide clarity within the zoning code so that developers and property owners better understand which non-residential uses are eligible for dry floodproof construction and which zones allow those uses.

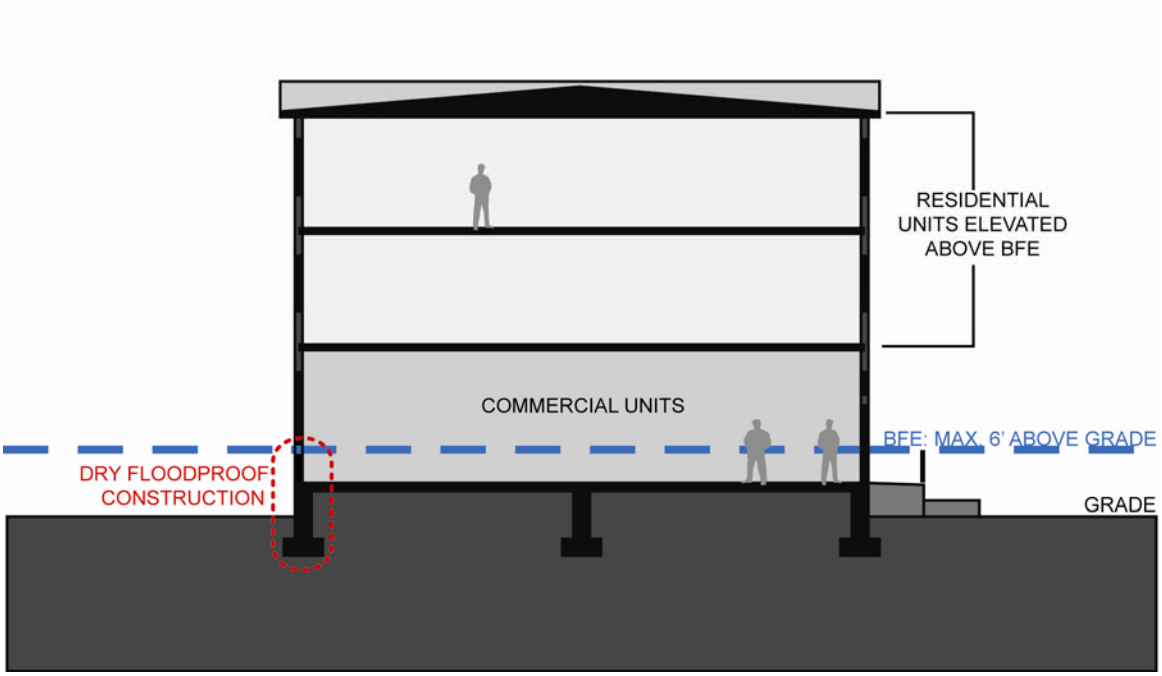


**Fig. 3.8. DIAGRAM: Mixed-use building with floodproof construction.**

Front and side building setback requirements are also important issues affecting the feasibility of dry floodproofing. Setbacks are requirements within the zoning code that dictate how far buildings must be situated from the property lines. In commercial districts with high elevation flood risks, dry floodproofing can be combined with elevated walkways for improved accessibility. However, in order for the elevated walkways to connect between buildings and work as a coherent system, buildings should have similar front setbacks. For optimum connectivity, these buildings should also have minimal side setbacks, or have zero-lot lines. Municipal zoning codes can encourage the implementation of these strategies by dictating setbacks on properties in neighborhood commercial corridors.

### 3.3.2 Design Guidelines

Design guidelines are a regulatory tool used by municipal planning commissions or design review boards to ensure that new developments or new buildings corroborate with existing neighborhoods. Dry floodproof construction should assist those working in historic districts, as it enables buildings to be constructed at-grade or at a lower elevation, which is generally more historically accurate. Design guidelines can help encourage best site practices and design techniques for structures that make use of dry floodproof construction in combination with other mitigation strategies.

For example, large development projects that are both dry floodproofed and elevated can be encouraged to use shared, elevated walkways through prescriptive design guidelines in neighborhood commercial corridors. Figure 3.9 illustrates recommended design guidelines for commercial structures built on small, medium, and large lots.

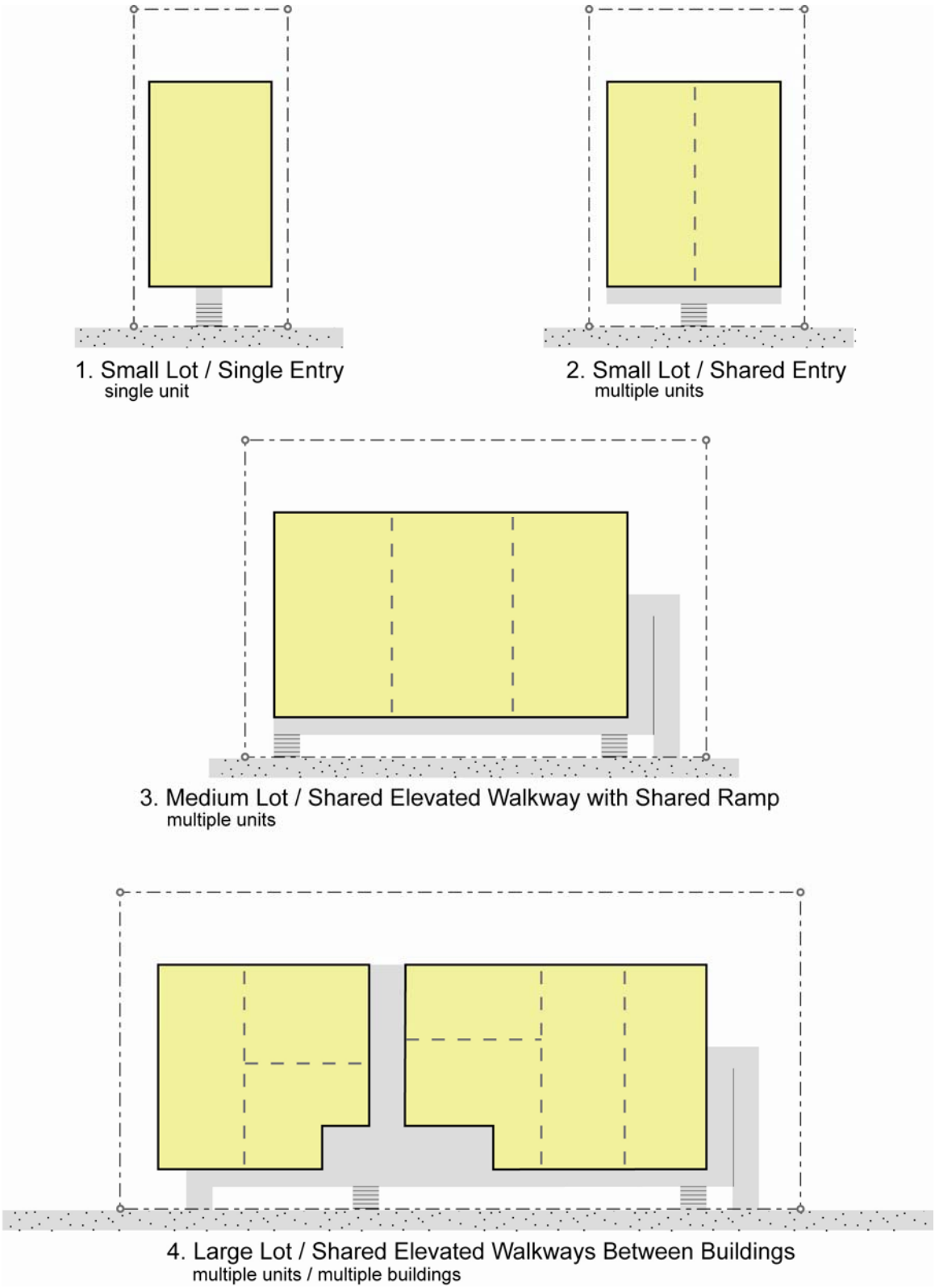


**Fig. 3.9. DIAGRAM: Guidelines for dry floodproof/elevated structures, by lot size.**

## 3.4 East Biloxi Case Study

The application of land use and planning issues related to dry floodproofing can be understood by looking at a case study from the Gulf Coast. East Biloxi, Mississippi is a Gulf Coast community with several neighborhood commercial corridors that sustained extensive damage during Hurricane Katrina. These neighborhoods are now plagued by a surplus of vacant and underutilized lots.

Fig. 3.10 shows how the floodplain in East Biloxi changed before and after Hurricane Katrina. Four main neighborhood commercial corridors are demarcated: Division Street, Oak Street, Howard Avenue, and Main Street.

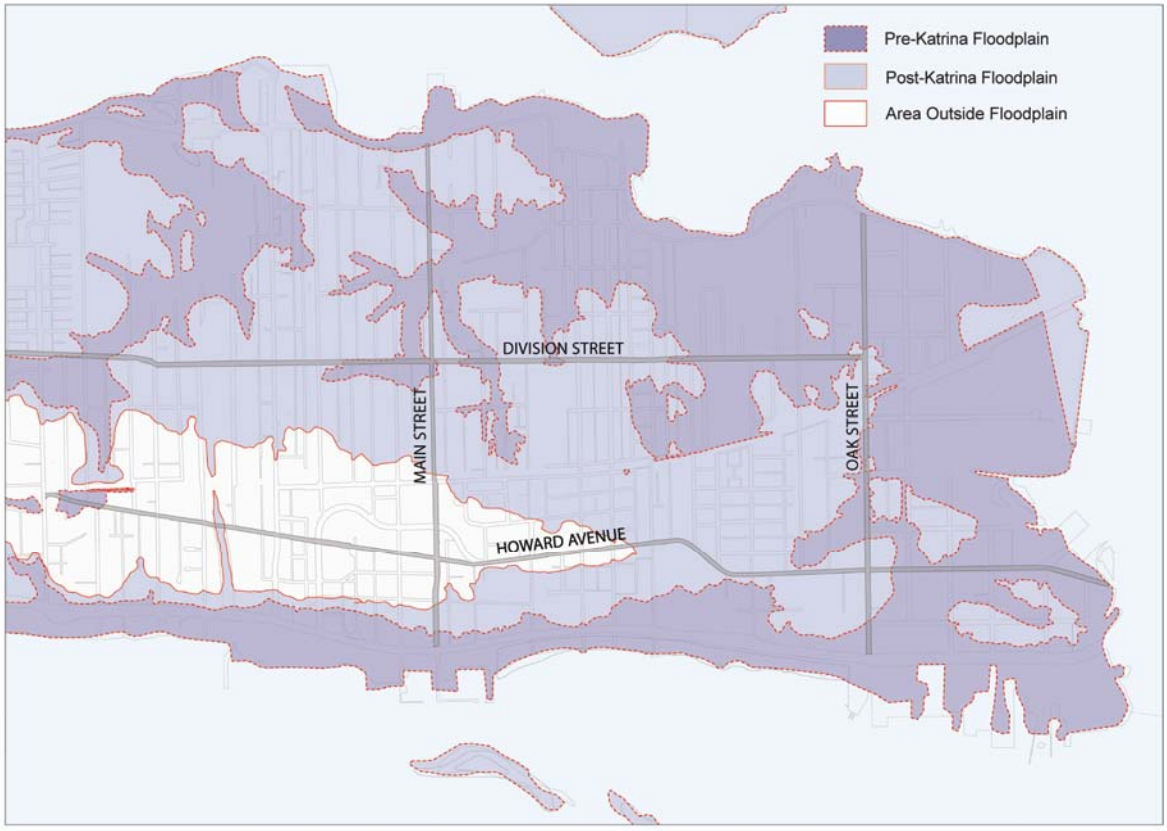


**Fig. 3.10. MAP: Floodplain change pre- and post-Katrina, East Biloxi.**

The dark shaded area marks the area within the floodplain prior to Hurricane Katrina. The lightly shaded areas are floodplain areas that were added in the revised floodplain after Hurricane Katrina. The small, white area on the map is the only remaining land outside of the floodplain in East Biloxi. This map demonstrates the large extent of the change post-Katrina, in flood risk mitigation requirements for this area. Properties that have been brought into the floodplain since Hurricane Katrina now must cope with stricter building standards and increased flood risk heights for new construction projects in order to meet

floodplain ordinances and insurance requirements. The challenges that property owners face have increased greatly, as shown in this map.

Dry floodproofing presents an opportunity to mitigate flood risk in a way that is sensitive to the existing communities on the Gulf Coast, like East Biloxi. The GCCDS created a series of maps to better understand how the different combinations of flood risk mitigation strategies could be distributed within the East Biloxi study area.

Figure 3.11 shows opportunities and suitability for floodproof construction for the entire study area. This map was created by overlaying a Digital Elevation Model (DEM) with Digital Flood Insurance Rate Map (DFIRM) data provided by FEMA. All Coastal A, V, and VE flood zones have been represented in gray, regardless of the flood elevation requirement, because these areas are not eligible for dry floodproof construction as a flood risk mitigation strategy. Figure 3.12 shows opportunities for floodproof construction along the neighborhood commercial corridors identified for the case study area in East Biloxi.

These maps illustrate the challenges of building back East Biloxi communities, as well as the opportunity for rebuilding with dry floodproof construction or a combination of dry floodproof construction and elevation. Each of the four neighborhood commercial corridors contains land within flood risk height ranges that allow for dry floodproof construction. Dry floodproofing is feasible to help these neighborhoods rebuild in an accessible and locally appropriate way.

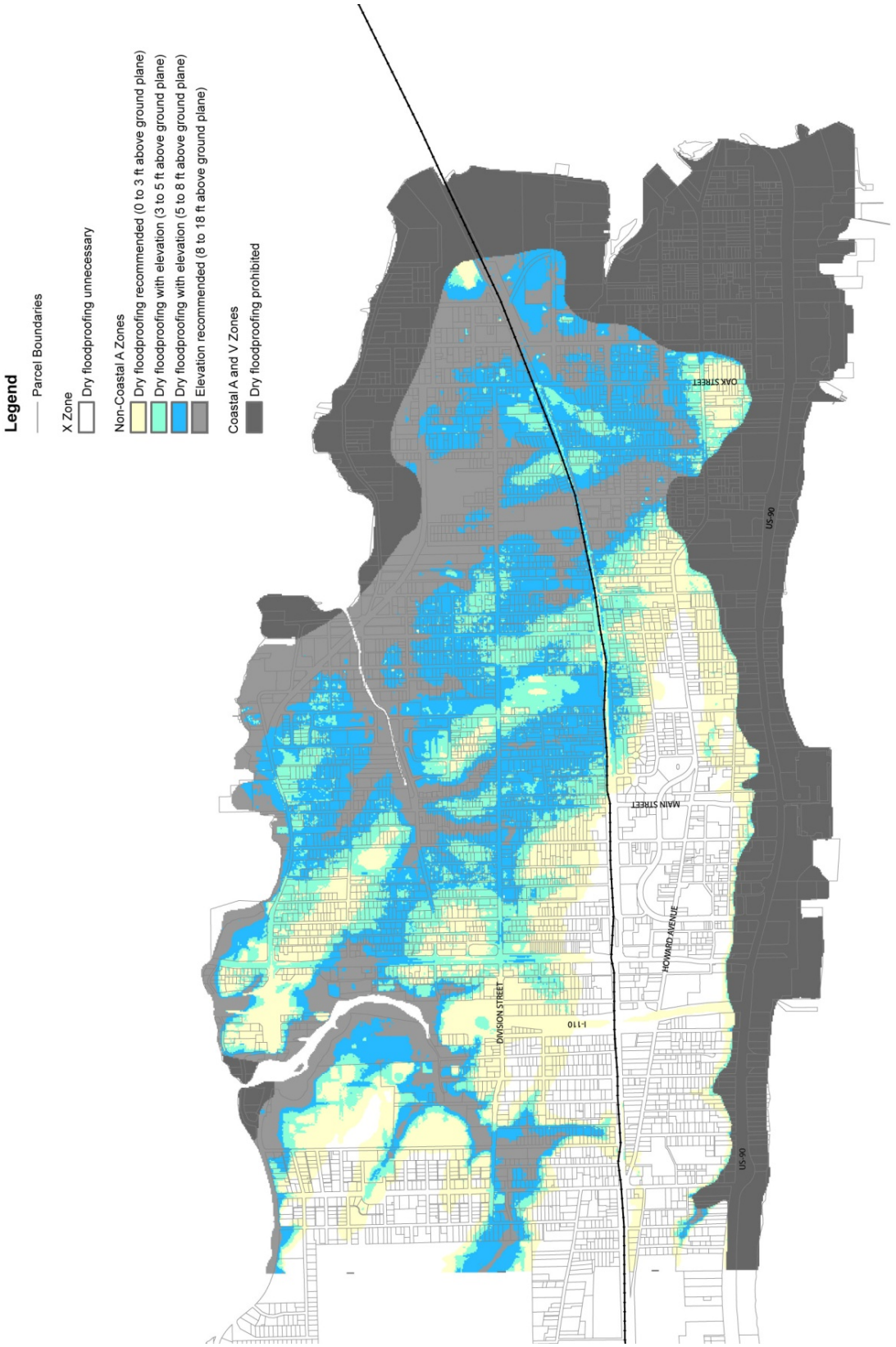


**Figure 3.11. MAP: Suitability of dry floodproofing in East Biloxi.**

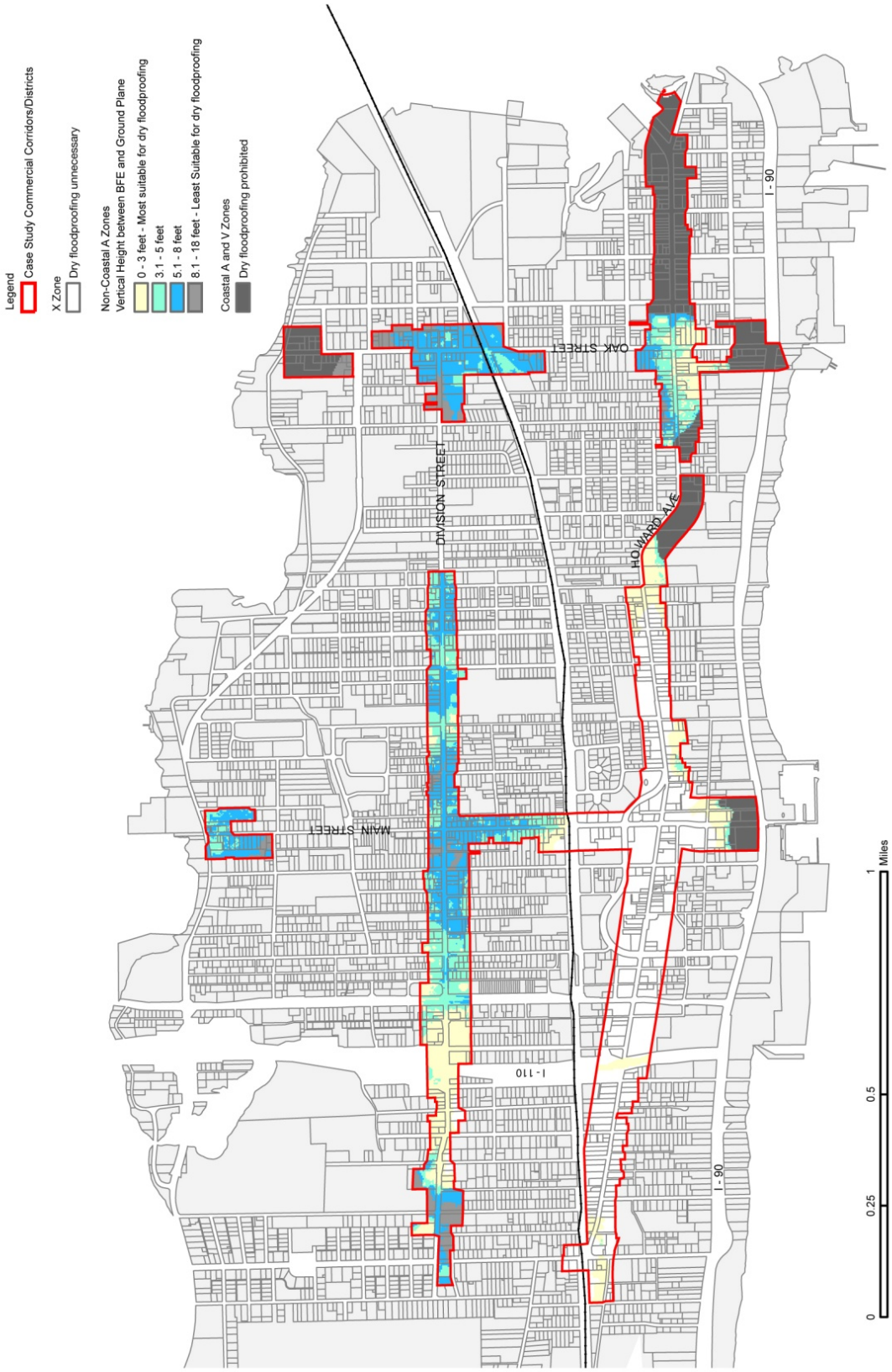


**Figure 3.12. MAP: Suitability of dry floodproofing in commercial corridors in, East Biloxi.**

A 2008 land use survey of Division Street in East Biloxi reveals a high number of vacant and underutilized properties, shown in Fig. 3.13.

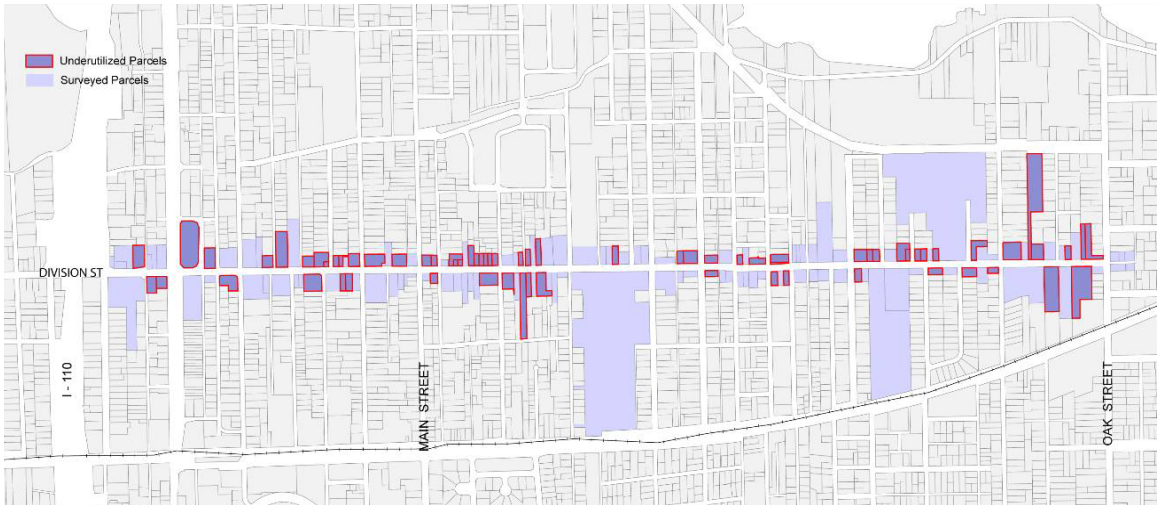


**Fig. 3.13. MAP: Underutilized properties, Division St., 2008.**

All of the vacant and underutilized properties shown above fall within the floodplain. However, overlaying flood risk mitigation heights with the 2008 land use survey in Fig. 3.14 shows that many of these underutilized parcels fall within the five-foot flood risk height range. Opportunities for these property owners to build on or use their properties could arise through the appropriate use of dry floodproofing mitigation strategies.


**Fig. 3.14. MAP: Dry floodproofing suitability on underutilized properties, Division St.**

These maps show over forty underutilized parcels on Division Street that could use of dry floodproof construction or a combination of dry floodproof construction and elevation techniques for development. Over twenty underutilized parcels could be developed with more accessible, visible and contextually appropriate structures through a combination of

mitigation strategies described earlier in this chapter. On adjacent, narrow parcels concentrated between Main Street and Elmer Street on Division Street, developers could make use of lot assembly and shared elevated walkways to create more viable development proposals that fit within the existing streetscape.

Though these maps cannot replace site specific design, they demonstrate more broadly the scope of opportunity for implementing dry floodproof mitigation strategies in East Biloxi. The maps translate complicated floodplain information into useful information for policymakers within the East Biloxi community, and can serve as an example for a suitability analysis in other communities and municipalities on the Coast.

## 3.5 Applicability to Other Communities

The neighborhood commercial corridors in the East Biloxi study area are representative of a common condition along the Mississippi Gulf Coast. After Katrina, neighborhood commercial corridors throughout the three coastal counties were reassigned to Special Flood Hazard Areas requiring additional flood risk mitigation. Similar to East Biloxi, business owners in other commercial corridors have had difficulty rebuilding and developing since Katrina, due to the new floodplain requirements and the uncertain risk surrounding them.

Streets in these types of neighborhoods fill important roles in the economic and social lives of communities and this research aims to facilitate the rebuilding process by demonstrating opportunities for a variety of flood risk areas and situations. The research in East Biloxi can serve as a case study to be modified and applied to other neighborhood commercial corridors along the Coast. (See Fig. 3.15)

The GCCDS focused this research on highly local conditions to produce information that would be most useful for the communities along the Mississippi Gulf Coast. The research was informed by familiarity with challenges facing Gulf Coast communities and applicable local floodplain management ordinances.

There are many types of flood risk that this research could be applied to elsewhere. However, flood risk characteristics of a particular place would need to be examined, including but not limited to: flood duration, water currents and ground saturation.

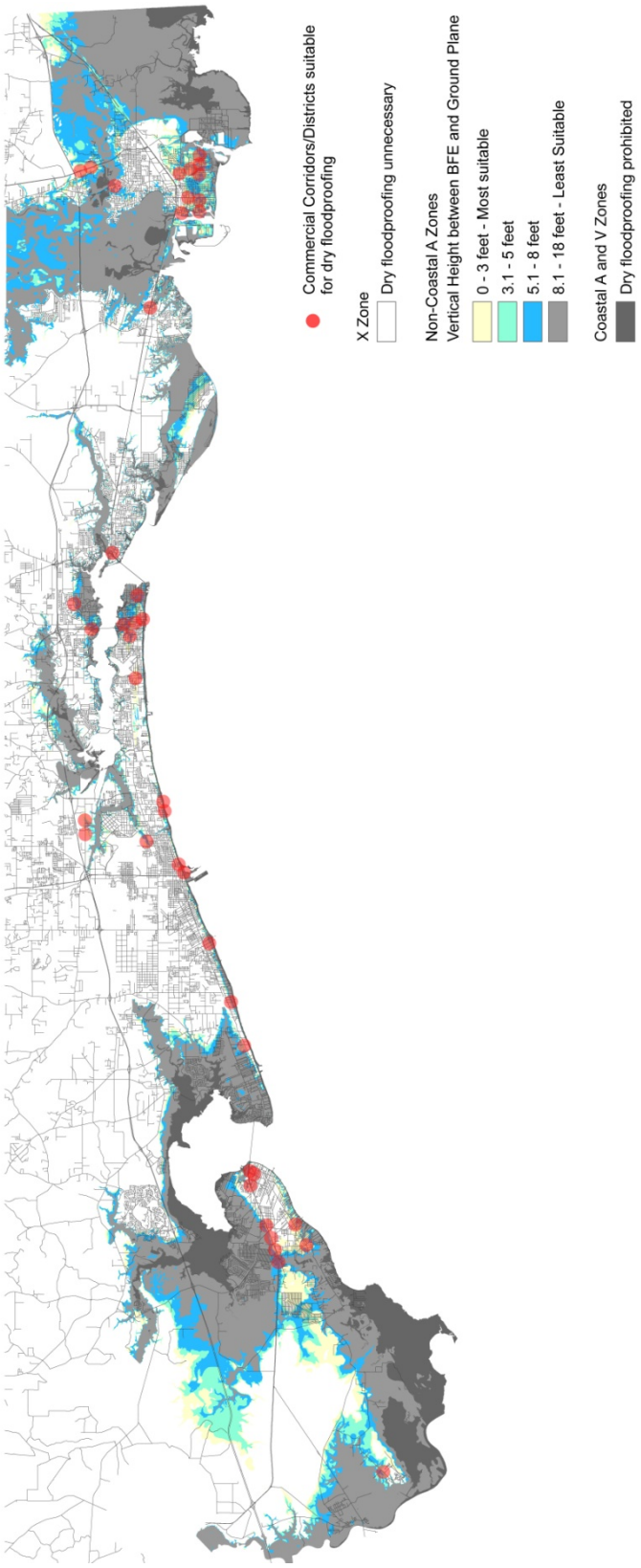


**Fig. 3.15. MAP: Commercial corridors and districts suitable for dry floodproofing.**