and livability experience of the metro area greatly enhanced while flood risk is reduced.

In terms of flood risk, it is unfortunate that floodplain areas are so attractive to commercial, residential, and industrial developers. The consequences associated with locating damageable property and people within such areas can be extreme to not only property owners and floodplain occupants but to taxpayers at all levels who have, over the decades, largely evolved to "foot the bill" for flood response, recovery, and rebuild when a flood source decides to reoccupy its traditional floodplain.. Within the context of this study, an objective is to identify strategies and measures that can be used in tandem to both discourage development in high risk areas and to encourage development in areas of low and no risk. Some strategies and measures may be more appropriate for Federal action while others will be more attuned to local regulatory action and administration. In either case, these measures must be effective, socially acceptable, environmentally suitable, and mindful of the existing neighborhood and community social and economic systems within which they would be implemented. It is the intent of this appendix to identify such nonstructural measures.

1.3 Floodplain and Flood Risk Characteristics

Fargo and Moorhead are both exposed to flood risk from the Red River of the North. While other flood sources are located in the area as mentioned above, the Red River of the North remains as the primary flood source of concern. While some permanent levees have been constructed along the Red River and some upstream flood storage exists in the Red River Basin upstream from the metro area, flood water surface elevations from the 100-year and larger floods in the metro area are excessive. As stated earlier, the floodplains in both Fargo and Moorhead are relatively flat. An examination of a flooded area map for the metro area shows the floodplain for the 500-year flood to cover almost all of Fargo. As stated earlier, the topography of Moorhead, while relatively flat, does provide greater elevation relative to the Red River than does Fargo. For this reason, a much larger percentage of Moorhead than Fargo is located above the 500-year flood. Depths of flooding for 100-year and 500-year floods can vary from several feet to zero depending on location.

The source of the most major historic floods from the Red River is spring snowmelt, with summer rainfall events also causing flood problems. Because of the characteristics of the Red River Basin, flood warning is generally quite ample to enable human intervention to reduce flood damages. Because of the basin characteristics and the characteristics of the Red River within the metro area, actual flood duration can last from days up to weeks.

The floodplain within Fargo and Moorhead consists of basically the entire spectrum of development—residential, commercial, industrial, and governmental. Basements are prevalent. Almost all residential structures have basements, with many being a form of "walk out". Basements also exist in some of the other building types. Age of development is also across the entire spectrum from new to old.

The floodplain for purposes of this appendix is considered to be the entire floodplain from the Red River. This is not just the 100-year floodplain that the National Flood

Insurance Program specifically relates to but rather the entire floodplain that is subject to flooding from any flood, regardless of how infrequent that flood is. With that definition of floodplain, no part of the present Fargo Metro Area is located out of this floodplain. Looking at the Moorhead Metro Area, the same is probably true with the caveat that there does exist locations within Moorhead that are on higher ground, but probably still located within the above definition of floodplain. What this paragraph discussion is really saying is from the perspective of reducing flood risk in the Fargo-Moorhead Metro Area in its totality, further floodplain development within this total Metro Area would appear now to make most sense to be in the eastern portion of Moorhead rather than within Fargo.

1.4 Executive Order 11988

This executive order [EO] was issued by President Jimmy Carter on 24 May 1977 and is entitled "Floodplain Management". In issuing the EO the President stated "in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative, it is hereby ordered that each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities…". The nonstructural analysis was done in complete compliance with the EO meaning that any nonstructural measures that are incorporated into alternatives recommended for implementation support the vision of the EO.

1.5 Critical Facilities

Structures/facilities exist in the metro area which should never be flooded. These are called critical facilities in terms of Executive Order 11988 [EO]. They are essential during a flood to provide human safety, health, and welfare. Facilities that could, if flooded, add to the severity of the disaster such as petroleum terminals, waste water treatment plants, toxic material storage sites, are considered critical. Critical facilities are also generally those services required during the flood such as police and fire protection, emergency operations, people evacuation sites, and medical care. Facilities that house elderly people that require extensive evacuation time would also be considered critical. Each critical facility within the guidelines of the EO should be located at a flood free site. If this is not possible or practicable, the facility should be located external to the 500-year floodplain. If this is not possible or practicable, the facility must be, at a minimum, protected to the extent that it can function as intended during all floods up to and equal to a 500-year event.

Within the nonstructural analysis, all such facilities meeting the critical facility criteria discussed above were treated with nonstructural measures to meet the above objectives for critical facilities. If they were located in the 500-year floodplain, they were considered for relocation if the 500-year flood depth was greater than 9 feet. For flood depths less than 9 feet, other nonstructural measures were considered with the assumption that the facility could continue to function as intended during the flood with implementation of those nonstructural measures.