8.0 RECOMMENDED IMPROVEMENTS

As discussed in the earlier sections of the SMP, stormwater infrastructure deficiencies were identified within each regional area of El Paso. A series of project alternatives were developed to address these inadequacies. During working meetings with the City and EPWU, the various alternatives were discussed and a preferred alternative was selected.

Some of the projects are very large and costly. Where possible, these projects were divided into phases. This approach identifies which elements of a specific project will provide the most immediate benefit and will allow for overall construction to occur in a phased approach. Projects and project costs and can be found summarized in Table 8-1. All costs presented in this section are conceptual in nature and were estimated using the methodology provided in Appendix E.

The selected alternative for each project is discussed below. Information on the other alternatives can be found in Appendix E.

8.1 Central Region

Flooding within the Central Region stems from many deficiencies associated with drainage infrastructure. The drainage infrastructure problems that contribute to flooding in the Central Region are undersized conduits, undersized culverts, under capacity reservoirs, and a lack of pump stations. To address these inadequacies in the current stormwater infrastructure, a series of projects was identified.

8.1.1 Government Hills System

8.1.1.1 Government Hills Channel Inlets (CE1)

The Government Hills Channel Inlets Project (CE1) calls for the improvement of four drainage inlets which convey stormwater runoff from the surrounding streets into Government Hills Channel. This project will provide sufficient drainage and prevent localized flooding. The inlets which will be expanded are located at the intersections of Government Hills Channel with Altura Avenue, Hastings Drive, Cambridge Avenue, and Cumberland Avenue. These intersections are circled on Figure 8-1.

8.1.1.2 Government Hills Channel Crossings (CE2)

The Government Hills Channel Crossings Project (CE2) includes the improvements to four road crossings, which will increase conveyance capacity to the 100-year storm. The culvert at Cambridge Avenue will be upgraded to a 2-barrel 8-foot by 4-foot CBC. Cumberland Avenue culverts will also be replaced by a 2-barrel 8-foot by 4-foot CBC. Trowbridge Drive culverts will be expanded to a 3-barrel 8-foot by 4-foot CBC. Finally,

Chester Avenue culverts will be replaced by a 72-foot wide free span bridge. The four crossing improvements mentioned are shown on Figure 8-2.

8.1.1.3 Government Hills 90-inch Discharge Conduit (CE3)

The Government Hills Discharge Conduit Project (CE3), shown on Figure 8-3, includes improvements to the 90-inch conduit and a proposed pond. Multiple tie-ins along the 90-inch conduit will be replaced with automated gates. An automatic gate at the outfall is also recommended to control discharge into the Rio Grande during storm events. A new pond (Saipan Reservoir) is proposed which will be located between IH-10 and Durazno Avenue, and between Radford Street and Saipan Place. The pond will have a footprint of 6.4 acres with a depth of 10 feet. The total storage capacity will be 65 acre-feet. This pond will provide detention for the adjacent Saipan Neighborhood. The drainage conduits will be replaced or redirected to reroute water previously entering the 90-inch discharge conduit into the Saipan Pond. A small 20 cfs pump station will also be included to drain the pond into the Lincoln Drain within 72 hours. Portions of this project were based on designs from the Government Hills Outfall Durazno Neighborhood, Storm 2006 Drainage Report (PSC, January 2007a), and Saipan-Ledo Pond Design, Preliminary Report (Quantum Engineering Consultants Incorporated, December 2007).

8.1.2 Cebada System

8.1.2.1 Cebada Reservoir and IH-10 Flooding (CE4)

The recommended improvements to the Cebada Reservoir and IH-10 Flooding Project have been divided into three separate phases as shown on Figure 8-4. In Phase 1, the Cebada Discharge Conduits will be cleared of all utility crossings and debris. The utility crossings will be relocated or the conduits will be modified to properly convey design flows. The 2-barrel 6-foot by 6.5-foot CBC will be cleared from Cebada Reservoir to the Cebada Pump Station. A 60-inch conduit that starts at Magnolia Street and Gateway Boulevard and runs to Missouri and Cebada will be severed from the Cebada System to reduce flow into the reservoir.

Expansion of Magnolia Reservoir is also recommended in Phase 1. The expansion primarily consists of sediment removal. Approximately 4 acre-feet of sediment will be removed from Magnolia Reservoir to return the total capacity back to the design capacity of 15 acre-feet.

A new pond, located on the east side of Copia Street and north of the railroad, is recommended as part of Phase 1 to add storage capabilities to the system. The pond will be fed by a 2-barrel 5-foot by 5-foot CBC 650 feet long that connects Copia Ditch to the proposed Copia Reservoir. The proposed reservoir will have a footprint area of 2.3 acres and a depth of 15 feet. The discharge conduit will be a 36-inch RCP 520 feet long that will tie into the 48-inch conduit at Cebada Road.

Phase 2 recommends the addition of conduits and a pump station as part of the Cebada Reservoir and IH-10 Project. A 5-foot by 4-foot CBC will be added to the Magnolia System. The conduit will start at Magnolia Street and Gateway Boulevard and travel to Piedras Street where it will turn south. From there, the conduit will continue beneath IH-10 and ultimately enter a 425 cfs pump station. The pump station will be located at Durazno Avenue and Piedras Street. The proposed pump station will discharge water into a 48-inch force main that will travel south and discharge into the Rio Grande.

Phase 3 consists of adding a detention pond in an existing railroad yard adjacent to Durazno Avenue and Piedras Street. The proposed pond has a footprint of 5.7 acres, depth of 20 feet, and a design capacity of 41.9 acre-feet. The pump proposed in Phase 2 will be reconfigured to drain the proposed Piedras Street Railroad Pond.

A concrete channel will also be added that connects the Cebada Reservoir with the proposed pond. The channel will travel from Cebada Reservoir on the north side of IH-10 and turn south at Raynor Street. The channel will continue under the IH-10 bridge, enter culverts under the road, and ultimately discharge into the Piedras Street Railroad Pond. The total length of the channel is 2,300 feet. The proposed channel is concrete-lined with a bottom width of 11 feet, depth of 4 feet, and 1H:1V side slopes.

8.1.3 Dallas System

8.1.3.1 Dallas Reservoir (CE5)

The Dallas Reservoir Project (CE5), shown on Figure 8-5, recommends the construction of a pump station in the Dallas Reservoir that will discharge water into a new 42-inch force main. Furthermore, the existing eastern discharge conduit will be severed from the western discharge conduit and extended to the Rio Grande as a separate gravity line. This improvement project is designed to provide protection from the 100-year storm and will be constructed in two phases.

Phase 1 recommends the construction of a 115 cfs pump station on the east side of Dallas Reservoir. The pump station will be connected to a proposed 42-inch force main which will discharge into the Rio Grande. This proposed force main will be constructed parallel to the existing eastern discharge conduit (a 7-foot by 5-foot CBC). The eastern discharge conduit will be cleared of obstructions and also be severed from the western discharge conduit (a 6-foot by 5-foot CBC). At the point where the eastern conduit currently ties into the western conduit, the tie-in line along Olive Avenue will be removed and the eastern conduit will be extended south toward the Rio Grande as shown on Figure 8-5. Any other tie-ins to the eastern discharge conduit that may exist will be severed, allowing the conduit to act as a pressurized gravity system. This phase will eliminate the connection between the Cebada and Dallas Systems and allow them to function independently of each other.

Two diversion lines which exist south of Paisano Drive were initially constructed to alleviate flow from the western discharge conduit, but the lines were never finished. The two diversion lines will be kept separate from the western discharge system by removing the tie-in lines and replacing the remaining sections with the new 42-inch force main and the extended portion of the eastern discharge conduit. If it is possible to utilize the existing diversion lines south of Paisano Drive instead of replacing them, it should be investigated in a separate study when more information about the current status of the partially constructed lines becomes available.

Phase 2 of this project calls for the upgrade of the Phase 1 pump station to a 370 cfs pump station. No other improvements will be made in this phase.

8.2 East Side Region

Flooding within the East Side Region is largely a result of impervious commercial, industrial, and residential areas where surface flow is conveyed in streets and not in storm drain systems. To address these inadequacies in the current stormwater infrastructure, a series of projects was identified.

8.2.1 Phelps Dodge System

8.2.1.1 Fort Bliss Spur Drain (EA1)

The proposed improvements at Fort Bliss Spur Drain consist of two phases, as shown on Figure 8-6.

Phase 1 consists of improvements to the existing channel crossings. The undersized crossing located at Edgemere Boulevard and Airway Boulevard, as described in Section 6.0, would be upsized to an approximately 2-barrel 8-foot by 4-foot CBC. The undersized crossing located at Edgemere Boulevard and Robert E. Lee Road, as described in Section 6.0, would be upsized to an approximately 2-barrel 8-foot by 4-foot CBC. The undersized crossing located at Robert E. Lee Road and International Drive, as described in Section 6.0, would be removed and replaced with concrete-lined channel to connect the channel.

Phase 2 consists of the installation of a storm drain system that would connect to the improved crossing from Phase 1, located at Edgemere Boulevard and Airway Boulevard. The proposed storm drain system would consist of approximately 3,650 linear feet of 48-inch to 60-inch RCP, and an 1,470 linear feet 8-foot by 4-foot CBC located underneath Cielo Vista Drive collecting surface flow from the residential areas to the east and northeast of Fort Bliss Spur Drain.

8.2.1.2 Sunmount Channel (EA2)

The proposed improvements at Sunmount Channel consist of constructing an approximately 20 acre-foot detention/desilting basin, as shown on Figure 8-7. The

proposed detention/desilting basin would reduce the flow going into the culvert crossing underneath Sunmount Drive and Viscount Boulevard and prevent water overtopping. The flow leaving the detention/desilting basin would be controlled to release stormwater volume amounts that the existing 54-inch RCP can handle.

8.2.1.3 Lorne Channel (EA3)

The proposed improvements at Lorne Channel consist of two phases, as shown on Figure 8-8.

Phase 1 consists of improvements to the existing channel. The existing channel, as described in Section 6.0, would be upsized to an approximately 10-foot wide by 3-foot deep rectangular channel. The existing channel crossing located at Lorne Road, as described in Section 6.0, would be upsized to an approximately 10-foot by 3-foot CBC.

Phase 2 would require the installation of storm drain systems consisting of approximately 3,870 linear feet of 30-inch to 48-inch RCP, and 680 linear feet of 8-foot by 3-foot CBC with two mainlines connecting to Lorne Channel. A mainline located underneath Shannon Place would collect the surface flow from the residential areas to the north and northeast of Lorne Channel. A second mainline located underneath Limerick Road would collect the surface flow from the residential areas to the south and southeast of Lorne Channel.

8.2.1.4 Zanzibar Storm Drain and Storage (EA4)

The improvements at Zanzibar would require installing storm drain systems and improving the storage of Eastwood/Album Park to approximately 85 acre-feet, as shown on Figure 8-9. The proposed storm drain systems consist of approximately 6,575 linear feet of 54-inch to 66-inch RCP with mainlines discharging into the proposed park pond. The mainlines would collect surface flows from the residential areas northeast, south, southwest, and west of Eastwood/Album Park.

8.2.2 Mesa Drain Upstream System

8.2.2.1 McRae and Wedgewood Storm Drain (EA5)

The proposed improvements at McRae consist of two phases, as shown on Figure 8-10.

Phase 1 would require the installation of storm drain systems beneath McRae Boulevard and improvements on the existing storm drain system beneath Wedgewood Drive. Improvements to the existing storm drain system on Wedgewood Drive consist of upsizing the infrastructure using approximately 4,505 linear feet of 48-inch to 60-inch RCP, 900 linear feet of 8-foot by 5-foot CBC, and 9-foot by 5-foot CBC. These improvements will collect the surface flow from the residential areas northwest and southeast of Wedgewood Drive. The installation of the storm drain system located

beneath McRae Boulevard would collect all the surface flow from the residential and commercial areas north of the intersection at McRae Boulevard and Wedgewood Drive.

Phase 2 would require the installation of storm drain systems consisting of approximately 4,375 linear feet of 30-inch to 60-inch RCP, with mainlines connecting to the improved storm drain system below Wedgewood Drive. The mainlines would collect the surface flow from the residential areas east and north of Wedgewood Drive.

8.2.3 Interstate Highway 10 Corridor

Culvert crossings along the IH-10 corridor between Robert E. Lee Road and the eastern City limits were analyzed to identify any potential problems along the IH-10 corridor. Sixty-six culvert crossings were identified and are listed in Table B-9b. The culvert crossings were identified by TxDOT station number at the centerline of the structure and the centerline of the roadway available from record drawing information. The culvert flows were estimated by prorating runoff from adjacent watersheds according to the number of culverts serving the affected watershed; for example, the total discharge for the watershed between STA 85+00 and STA 110+00 is 323.72 cfs. There are four culverts located along that segment, thus the estimated discharge at each culvert was 80.93 cfs. The culvert crossings were labeled as operating "Potentially Over Capacity" or operating "At or Below Capacity." This type of analysis was cursory in nature and further analysis on culvert crossings identified as "Potentially Over Capacity" is recommended.

One improvement in the IH-10 corridor is identified in Figure 8-10 as part of the proposed improvements in Section 8.2.2.1. An existing 3-barrel 36-inch RCP storm drain system runs underneath the IH-10 corridor into the Giles Basin Dam and is recommended to be upsized to a 9-foot by 5-foot CBC or its equivalent as part of the proposed improvements.

8.2.4 Lomaland Basin System

8.2.4.1 Pico Norte Improvements (EA6)

The proposed improvements at Pico Norte consist of five phases, as shown on Figure 8-11.

Phase 1 would require the installation of a storm drain system along Sam Snead Drive consisting of approximately 8,600 linear feet of 48-inch to 66-inch RCP, 330 linear feet of 7-foot by 4-foot CBC, 800 linear feet of 9-foot by 5-foot CBC, and 1,350 linear feet of 10-foot by 5-foot CBC. The mainline would collect the surface flow from the residential areas south and southeast of Pico Norte Park.

Phase 2 requires the installation of a storm drain system and improvements of the existing storm drain system along Yarbrough Drive and Ashwood Drive, consisting of approximately 1,870 linear feet of 66-inch RCP and 2,800 linear feet of 9-foot by 5-foot

CBC. The proposed storm drain system would collect the surface flow from the residential areas southwest of Pico Norte Park.

Phase 3 would require the installation of a storm drain system along Pebble Hills Boulevard and Eads Place consisting of approximately 1,350 linear feet of 60-inch RCP and 2,000 linear feet of 7-foot by 4-foot CBC. The proposed storm drain system would collect the surface flow from the residential areas north and northwest of Pico Norte Park.

Phase 4 would require the installation of a storm drain system along Gaston Drive and Ivanhoe Drive consisting of approximately 2,670 linear feet of 54-inch to 66-inch RCP and 2,000 linear feet of 7-foot by 4-foot CBC. The proposed storm drain system would collect the surface flow from the residential areas north and northeast of Pico Norte Park.

Phase 5 would require the installation of a storm drain system along Bywood Drive consisting of approximately 3,200 linear feet of 48-inch to 60-inch RCP. The proposed storm drain system would collect the surface flow from the residential areas east of Pico Norte Park.

8.2.4.2 Jesuit Basin Improvements (EA7)

The proposed improvements at Jesuit Basin consist of three phases, as shown on Figure 8-12.

Phase 1 would require improvements to the existing storm drain system consisting of upsizing the storm drains to include approximately 9,500 linear feet of 36-inch to 60-inch RCP and 1,500 linear feet of 10-foot by 4-foot CBC. Four mainlines are proposed in Phase 1. The first mainline would collect the surface flow from the commercial areas west of the intersection of Bessemer Drive and Lee Trevino Drive. The second mainline would collect the surface flow from the commercial areas east and northeast of the intersection at Lionel Drive and Bessemer Drive. The third mainline would collect the surface flow from the commercial areas north and south of Pellicano Drive. The fourth mainline would collect the surface flow from the commercial areas north of James Watt Drive.

Phase 2 would consist of expanding the existing storm drains to approximately 5,050 linear feet of 54-inch RCP and 1,000 linear feet of 8-foot by 5-foot CBC. Three mainlines are proposed in Phase 2. The first and second mainlines would run along Rojas Drive and would collect the surface flow from the commercial areas north of Rojas Drive. The third mainline would collect the surface flow from the commercial areas north of Gateway Boulevard West.

Phase 3 would require the installation of a storm drain system consisting of approximately 7,050 linear feet of 36-inch to 48-inch RCP with two proposed mainlines.

The first mainline would collect the surface flow from the residential areas east of Larry Wadkins Drive. The second mainline would collect the surface flow from the residential areas west of Larry Wadkins Drive.

8.2.5 Americas Basin System

8.2.5.1 Bluff Channel (EA8)

The proposed improvements at Bluff Channel consist of two phases, as shown on Figure 8-13.

Phase 1 consists of upsizing Bluff Channel from Rojas Drive to Esther Lama Drive to a trapezoidal concrete-lined channel with approximately 20-foot bottom, 1.5H:1V side slopes, and 4-foot normal depth. The existing channel crossing at Esther Lama Drive would be upsized to an approximately 3-barrel 10-foot by 5-foot CBC. Phase 1 would also require improvements to the existing storm drain system. The improvements to the storm drain system would consist of approximately 48-inch to 60-inch RCP in single and multi-barrels with three mainlines. The first and second mainlines would run along Rojas Drive and Zaragoza Road and collect the surface flow from the commercial areas west and northwest of the intersection at Zaragoza Road and Rojas Drive. The third mainline would collect the surface flow from the commercial areas north and northeast of the intersection at Pullman Drive and Rojas Drive.

Phase 2 consists of improvements to existing storm drain systems. The improvements to the existing storm drain systems would consist of upsizing the infrastructure to approximately 60-inch RCP. The proposed storm drain system would consist of approximately 36-inch to 60-inch RCP at three different locations. The first storm drain system would collect the surface flow from the commercial areas north and northwest of the intersection of Esther Lama Drive and George Dieter Drive. The second storm drain system would collect the surface flow from the commercial areas north of Rojas Drive at Peter Cooper Drive. The third storm drain system would collect the surface flow from the commercial areas east and northeast of Rojas Drive at Henry Brennan Drive.

8.2.6 Americas Ten Basin System

8.2.6.1 RV Channel (EA9)

The proposed improvements at RV Channel consist of two phases, as shown on Figure 8-14. Phase 1 consists of an 80 acre-feet desilting/detention basin. The desilting/detention basin would be located upstream of the RV Channel crossing at Paseo del Este Boulevard. Phase 2 consists of three concrete-lined channel sections. The first concrete-lined channel section would consist of a trapezoidal section with approximate dimensions consisting of a 20-foot bottom, 1H:1V side slopes and 4-foot normal depth. The second concrete-lined channel section would consist of a trapezoidal section with approximate dimensions consisting of a 30-foot bottom, 1H:1V side slopes and 4-foot normal depth. The third concrete-lined channel section would

consist of a trapezoidal section with approximate dimensions consisting of a 40-foot bottom, 1H:1V side slopes and 2-foot normal depth, located downstream of the junction point with the Mercantile Channel heading towards IH-10.

8.2.6.2 Mercantile Channel (EA10)

The proposed improvements at Mercantile Channel consist of two phases, as shown on Figure 8-15. Phase 1 consists of a 140 acre-feet desilting/detention basin. The desilting/detention basin would be located upstream of the Mercantile Channel crossing at Mercantile Avenue. Phase 2 consists of one new concrete-lined channel section. The concrete-lined channel section would consist of a trapezoidal section with approximate dimensions consisting of a 20-foot bottom, 1H:1V side slopes and 5-foot normal depth.

8.3 Mission Valley Region

Flooding within the Mission Valley Region is largely a result of undersized drains and the lack of utilized detention structures along the drains. Tailwater issues, stemming from the relatively flat terrain along the interceptor system, contribute to these capacity issues and magnify the flooding problems in the region. To address these inadequacies in the current stormwater infrastructure, a series of projects was identified.

8.3.1 Basin A System

8.3.1.1 Basin A Improvements (MV1)

According to the Basin A Draft Technical Memorandum prepared by CH2M HILL (January, 2007a), the pump station at Basin A is not sized for the 100-year storm. As a result, additional flow enters the Playa Drain and contributes to the capacity issues downstream. Project MV1, as suggested by CH2M HILL, involves replacing the pumps in the existing pump station with three new 175 cfs pumps, as shown on Figure 8-16. The condition of the existing pump station will need to be evaluated before any upgrades are made to it.

8.3.1.2 Basin B Pump Station (MV2)

Basin B currently acts as detention storage for the upper portion of the Playa Drain and the neighborhoods surrounding the basin. After leaving the basin, water flows through a conduit and enters the lower portion of the Playa Drain where it contributes to the capacity issues of the drain. Project MV2, shown on Figure 8-17, is comprised of two phases that involve utilizing Basin B for detention storage and installing a pump station to pump water from the basin to the Rio Grande.

Phase 1 involves installing a new 165 cfs pump station and conduits in the portion of Basin B west of Mimosa Avenue to pump water from Basin B to the Rio Grande. Basin B will also be excavated an additional 2 feet and re-graded so that water will flow to the

western portion of the basin, where the pump station will be located. The excavation will provide approximately 50 acre-feet of additional storage in the basin. It will also be necessary to replace the culvert under Mimosa Avenue with a 2-barrel 10-foot by 10-foot CBC that is sloping in the correct direction to allow flow to the western portion of the basin. In addition to alleviating problems along the Playa Drain, this project also provides the opportunity to convert the western portion of Basin B into a park pond.

Phase 2 includes upgrading the pump station at Basin B by adding a new pump and conduit for 165 cfs total added capacity.

8.3.2 Basin G System

8.3.2.1 Feather Lake II Improvements (MV3)

Flow from the Middle Drain currently enters the interceptor system in Mission Valley, contributing to capacity and tailwater issues in the system. Project MV3, shown on Figure 8-18, involves excavating the City owned Feather Lake II property so that it can be utilized as detention storage for the Middle Drain. All flow will be diverted to the basin via a 2-barrel 6-foot by 4-foot CBC and will enter the Mesa Drain Interceptor through two 36-inch automated gates in low flow situations. In large storm events, the gates will be closed and the basin will retain the flow until the peak of the storm has passed. Feather Lake II has already been excavated 5 feet, but this project requires excavating the 18.25 acre footprint an additional 13 feet deep. As a result, the base elevation of the basin will be lower than the channel bed elevation of the Mesa Drain Interceptor, thereby requiring the installation of a 25 cfs pump station to de-water the basin if desired. The design of the basin will provide approximately 195 acre-feet of storage. In addition to alleviating problems along the interceptor system, this project also provides the opportunity to convert Feather Lake II into a park pond similar to Feather Lake.

8.3.2.2 Middle Drain Interceptor Storage (MV4)

Flow from the Franklin Drain currently enters the interceptor system in Mission Valley, contributing to capacity and tailwater issues in the system. Project MV4, shown on Figure 8-19, involves creating a new detention basin along the Middle Drain Interceptor to be used as detention storage for the Franklin Drain. All flow will be diverted to the basin via a 4-barrel 6-foot by 4-foot CBC and will enter the Middle Drain Interceptor through two 36-inch automated gates in low flow situations. In large storm events, the gates will be closed and the basin will retain the flow until the peak of the storm has passed. The 8.7 acre footprint will be excavated 20 feet and will provide approximately 115 acre-feet of storage. As a result, the base elevation of the basin will be lower than the channel bed elevation of the Mesa Drain Interceptor, thereby requiring the installation of a 25 cfs pump station to de-water the basin if desired.

8.3.2.3 Basin G Improvements (MV5)

The current configuration and capacity of Basin G is causing tailwater to significantly restrict the capacity of the major drains and interceptor system in Mission Valley. Project MV5, shown on Figure 8-20, is comprised of two phases that involve increasing the capacity of Basin G, directing flow to the basin from the interceptor system and Playa Drain, and installing a pump station to pump water to the Rio Grande.

Phase 1 involves excavating the current footprint of Basin G to a base elevation of 3,645 feet. The portion of the Franklin Drain Interceptor from Carl Longuemare Road to Basin G will be re-graded to direct flow to the basin from both the Playa Drain and the interceptor system. As a result of directing flow to Basin G, the crossings at Carl Longuemare Road and Southside Drive will each need to be replaced with a 3-barrel 10-foot by 9-foot CBC. This concept design pond base elevation of 3,645 feet compares to a measured (February 2005) groundwater elevation of 3,644 feet. Final design will need to consider more detailed information concerning groundwater fluctuation in construction method selection, and evaluation of system operation.

Phase 2 involves installing an 820 cfs capacity pump station and new conduits from the pump station to the Rio Grande. Phase 2 will allow Basin G to pass the 100-year storm without overtopping and flooding the surrounding area.

8.3.2.4 Alameda Drive Storm Drain (MV6)

Currently there are many flooding issues on Alameda Drive (SH20) between Paisano Drive and El Paso Drive due to lack of drainage. Project MV6, shown on Figure 8-21, involves installing 8,750 feet of 2-barrel 6-foot by 5-foot CBC storm sewer along Alameda Drive to provide drainage for the road. The system will empty into the Playa Drain just north of the intersection with Delta Drive. This project will require major utility relocation, roadway reconstruction, and traffic detours.

8.3.2.5 Playa Drain Crossing (MV7)

The hydraulic analysis of the Playa Drain indicates the crossing immediately downstream of Yarbrough Drive is significantly undersized. Project MV7, shown on Figure 8-22, involves removing and replacing the undersized culvert with a 2-barrel 5-foot by 5-foot CBC. The proposed culvert is sized so that it will not interfere with the channel width or road surface elevation. It should also be noted that the culvert is only sized to the capacity of the channel upstream of the crossing.

8.3.2.6 Basin C Pump Station (MV8)

Basin C is currently serving as a detention area for water from surrounding neighborhoods. After leaving the basin, water enters the Playa Drain, where it contributes to the capacity problems of the drain. Project MV8, shown on Figure 8-23, involves excavating Basin C to a depth of 3 feet below the channel elevation in the

Playa Drain to prevent flow from entering the Playa Drain. In addition, flow from the Playa Drain will be diverted to the basin by a 2-barrel 6-foot by 4-foot CBC. A 160 cfs pump station and conduits will be installed to pump water from the basin to the Rio Grande. In addition to alleviating problems along the Playa Drain, this project also provides the opportunity to convert Basin C into a park pond.

8.3.3 Mesa Drain System

8.3.3.1 Mesa Drain Storage (MV9)

Analysis indicates that additional storage is necessary along the interceptor system in Mission Valley. Feather Lake is an existing detention structure along the Mesa Drain Interceptor, but is not being utilized to its full capacity due to channel bank elevations along portions of the Mesa Drain being lower than the top of dam elevation (3,669 feet). Project MV9, shown on Figure 8-24, involves constructing a parapet wall along the Mesa Drain from Le Barron Road to Feather Lake, bringing the channel bank elevation to 3,668 feet and providing approximately 80 acre-feet of additional storage. The project will require the construction of 7,173 feet of 2-foot high parapet wall and 855 feet of 5-foot high parapet wall. The final design will need to include flap gates to allow water from surrounding neighborhoods to enter the Mesa Drain when flows are below the level of the parapet wall.

8.3.3.2 Mesa Drain Improvements (MV10)

Analysis of the Mesa Drain indicates that the majority of the drain does not have sufficient capacity to convey any storm greater than the 10-year storm. This project, shown on Figure 8-25, involves increasing the capacity of the channel by expanding it to the south side by 20 feet wherever possible and lining 20 feet upstream of each existing crossing with concrete. Portions of the drain that cannot be expanded without removing homes or roads will retain their current geometry and be lined with concrete. The portions of the drain that can be expanded to the south are from North Loop Drive to Center Way (2,949 feet), from Center Way to Eastland Street (8,816 feet), and from Pendale Road to Burgundy Drive (10,604 feet). The portion of the drain that requires concrete lining is from Eastland Street to Pendale Road (3,416 feet). In addition to increasing the capacity of the Mesa Drain, this project also has potential to include linear parks along the drain.

8.4 Northeast Region

Seven of the channels studied within the Northeast Region have either crossing structures that are undersized or undersized channel segments, or both. Additionally, sedimentation and debris control is an issue in this area. To address these inadequacies in the current stormwater infrastructure, a series of projects was identified.

8.4.1 Fort Bliss Sump System

8.4.1.1 Railroad Drive Ditch - Upstream (NE1)

This project involves the removal and replacement of five undersized crossings located along Railroad Drive Ditch, upstream of its junction with Tobin Drain, as shown on Figure 8-26. These crossings are all currently between 12 and 18 inches in diameter. The recommended improvements at Falcon Avenue, Waycross Avenue and Wren Drive include removal of each crossing and replacement with a 5-barrel 4-foot by 2-foot CBC. The crossings located at Lexington Drive and the southern crossing of Falcon Avenue would be replaced with a 7-barrel 4-foot by 2-foot CBC. Based on the available geometric data, the proposed crossing dimensions would not interfere with the elevation of the existing roadway surface, nor would they extend beyond the outer channel banks.

8.4.1.2 Railroad Drive Ditch - Downstream (NE2)

Downstream of the junction with Tobin Drain (also known as Threadgill Drain), there is one additional undersized crossing located on Railroad Drive Ditch, as shown on Figure 8-27. This crossing is located in Fort Bliss property beneath a dirt road that is reportedly currently used as a tank crossing. Project NE2 calls for the removal and replacement of the 5-barrel 8-foot by 4-foot CBC crossing with a 6-barrel 7-foot by 6-foot CBC. The proposed dimensions would not interfere with the elevation of the existing roadway, nor would they extend beyond the outer channel banks.

8.4.1.3 Tobin Drain (NE3)

The Tobin Drain was identified as being extremely undersized (both the channel and the crossings) as discussed in Section 7.0. The Tobin Drain is located in an urban area and has a limited ROW. These issues are addressed by this project (NE3), as shown on Figure 8-28. The recommended improvements would require additional ROW or easement acquisition. Due to the magnitude of the recommended improvements, this project was separated into three phases.

Phase 1 includes the expansion of the furthest downstream reach with known capacity issues. The channel from Alps Drive to Hollings Street would be expanded to a 75-foot bottom width, 4.5 feet depth, with 2H:1V side slopes. Additionally, Phase 1 calls for the construction of a new portion of channel, diverting the channel from upstream of Hollings Street and re-joining the existing channel near Hondo Pass Drive. The proposed new section of channel would require a 75-foot bottom width, 4-foot depth and 2H:1V side slopes. Also as part of Phase 1, the crossings at Alps Drive, Hollings Street, and Hondo Pass Drive would be replaced with an 8-barrel 10-foot by 4-foot CBC, an 8-barrel 10-foot by 4-foot CBC and an 8-barrel 10-foot by 3-foot CBC, respectively.

Phase 2 would involve expanding Tobin Drain from Wren Avenue to Alps Drive to a 75-foot bottom width, 4.5 feet depth, with 2H:1V side slopes. Additionally, Tobin Drain between Sanders Avenue and Wren Drive would be lined and expanded to a 30-foot

bottom width, 4.5 feet deep, with 1H:1V side slopes. The crossing located at Wren Avenue would be replaced with a 7-barrel 10-foot by 4-foot CBC and the crossing at Raymond Telles Drive would be replaced with a 7-barrel 10-foot by 3-foot CBC.

Phase 3 of this project would involve expanding the most upstream portion of Tobin Drain bound by Threadgill Avenue on the upstream end, and Sanders Avenue on the downstream end. The existing channel would be widened to a 75-foot bottom width, 4.5 feet depth, with 2H:1V side slopes. Additionally, the crossing structure at Sanders Avenue would be replaced with a 4-barrel 10-foot by 4-foot CBC.

8.4.1.4 Range Dam Outlet Channel (NE4)

The recommended project at Range Dam Outlet Channel (NE4) involves removing and replacing the identified undersized crossing at Raymond Telles Drive with a 2-barrel 6-foot by 3-foot CBC, as shown on Figure 8-29. Additionally, the junction of the Range Dam Outlet Channel and Tobin Drain was identified by the EPWU as a potential issue, thus improvements to the junction were included in this project. Conceptual design was not performed for the junction improvements; however, an approximate cost was included in the cost estimate to address the potential future improvements to this junction.

8.4.1.5 Clearview Channel (NE5)

The Clearview Channel project (NE5) involves removing and replacing two undersized crossings along Clearview Channel, as well as constructing a sediment basin upstream of the channel, as shown on Figure 8-30. The crossing at Morningside Circle would be replaced with a 2-barrel 6-foot by 4-foot CBC and the crossing at Byron Street would be replaced with a 2-barrel 5-foot by 3-foot CBC. Upstream of the channel, a sediment basin would be constructed to control the sediment from the Franklin Mountains. The proposed basin would provide approximately 20 acre-feet of capacity and have a depth of 8 feet based on the initial conceptual design utilized for costing purposes.

8.4.1.6 Johnson Channel (NE6)

A preliminary site visit indicated the primary issue associated with Johnson Channel is the erosion of Lincoln Avenue at the downstream end of the channel. This project involves the construction of a retention basin at the downstream end of Johnson Channel providing approximately 13.5 acre-feet of storage with a depth of approximately 16 feet, as shown on Figure 8-31. This basin would be constructed on the undeveloped lots adjacent to Lincoln Avenue and would serve to retain the flows in Johnson Channel, preventing further undercutting of the Lincoln Avenue road base.

8.4.2 Northeast Ponding System

8.4.2.1 Northeast Channel No. 2 (NE7)

Northeast Channel No. 2, shown on Figure 8-32, was shown to be undersized in the hydraulic and hydrologic analysis performed for the SMP and improvements were recommended to address the capacity issues identified, as well as the sediment and erosion issues identified. This project involves expansion and lining of Northeast Channel No. 2, construction of a sediment basin, and the possible addition of detention to the sediment basin in a later phase. Recommended improvements, conceptual designs, and costs were obtained from the report titled *Northeast Channel 2 Improvements* prepared by MCi (January 2007). The recommended improvements below were noted to provide protection for the 10-year storm based on the MCi hydrology. Due to differences in precipitation and routing, the URS hydrology resulted in significantly lower hydrologic flows than the 2007 MCi study. Based on the URS hydrologic flows, it appears that the improvements recommended below would potentially provide flood protection between the 50- and 100-year storm. Due to this, the proposed improvements were separated into several phases during the project prioritization.

Phase 1 is a current City project that is in progress that includes the expansion and lining of the portion of Northeast Channel 2 from US 54 to Rushing Boulevard. Additionally seven undersized crossings will be removed and replaced. The proposed crossings and sizes include the following: an 8-foot by 4-foot CBC at Butterfield Trail Apartments, a 2-barrel 8-foot by 4-foot CBC at Sun Valley Drive, a 2-barrel 8-foot by 6-foot CBC at Bon Aire Drive, a 2-barrel 10-foot by 4-foot CBC at Kenworthy Street, a 3-barrel 9-foot by 8-foot CBC at Rushing Road, a 3-barrel 9-foot by 8-foot CBC at Mackinaw Street, and a 3-barrel 9-foot by 8-foot CBC at Alcan Street.

Phase 2 involves the expansion and concrete lining of the remainder of the Northeast Channel No. 2 to a rectangular channel with a bottom width ranging from 23 to 33 feet as described in the 2007 MCi report. In this phase, the undersized crossing at McCombs Street will be replaced with a 3-barrel 10-foot by 8-foot CBC.

Phase 3 involves the construction of a sediment basin approximately 10 feet deep located directly west of US 54. This basin is located in the Castner Range and requires coordination with the Army for any unexploded explosive ordnance (UXO) clearance and construction issues. Following Phase 3, further analysis would be required, along with monitoring of conditions to determine whether additional detention is required to address the flooding issues along NE Channel No. 2.

If additional detention is deemed necessary, then Phase 4 would be completed including the addition of flood detention to the Phase 3 sediment basin for a total storage volume of approximately 269 acre-feet. The MCi report requires the

construction of the detention basin to conform to a 100-year storm criteria and level of protection.

8.4.3 Range Dam System

8.4.3.1 Fairbanks Drive/Electric Ditch (NE8)

The Fairbanks Drive/Electric Ditch Diversion Channel area has several issues that are addressed by this project (NE8), as shown on Figure 8-33. Because of its magnitude, the project has been separated into two phases.

Phase 1 includes the construction of a debris basin directly west of US 54. The proposed debris basin would be approximately 9 feet deep with a 3-foot-high embankment providing a total storage volume of 225 acre-feet. This basin is located in the Castner Range and requires coordination with the Army for any UXO clearance and construction issues. This phase additionally would involve modifying the outlet of the culvert beneath US 54 to control the flow of water and prevent erosion to the roadway median.

Phase 2 of this project involves the construction of cross-sectional inlets in Fairbanks Drive at the upstream end of Electric Ditch Diversion Channel. These inlets would act to intercept the flow along Fairbanks Drive and direct it into the Electric Ditch Diversion Channel and ultimately to the Range Dam Impounding Area. This redirection of flow would potentially alleviate some of the flooding to the downstream properties adjacent to Fairbanks Drive.

8.4.3.2 Northgate Diversion Channel (NE9)

Project NE9 includes the construction of two 66-inch RCPs, as shown on Figure 8-34, to convey flow approximately 500 feet from the Northgate Diversion Channel to the Northgate Dam Impounding Area as described in the *Northgate Diversion Channel Drainage Study* prepared by Dorado Engineering, Inc. (2007). The purpose of these closed conduits will be to move the expected peak flows as estimated by Dorado Engineering, Inc. A comparison between the Dorado hydrology and the SMP hydrology resulted in similar 100-year storm flows. All costs included in the SMP for this project were obtained from the 2007 Dorado Engineering Report.

8.5 Northwest Region

The channels studied within the Northwest Region have several channel segments and crossing structures that are undersized. Additionally, sedimentation and debris control is an issue in some areas. To address the identified inadequacies in the current stormwater infrastructure, a series of projects was identified. The specific projects are discussed below.

8.5.1 Doniphan System

8.5.1.1 Doniphan Ditch Upstream (NW1)

The analysis indicates the crossing culverts and channel on Doniphan Ditch are undersized, as mentioned in Section 6.0. This project is intended to improve the channel and crossings from White Spur Drain to Doña Ana County Road, which is also the New Mexico border, as shown on Figure 8-35. The completion of Project NW2 is integral to the functionality of this project and it is recommended that NW2 be completed prior to NW1.

The project is intended to complement and extend the wetlands at Heritage Park by creating a "Heritage Park Loop Trail." The Loop Trail will extend along Doniphan Ditch, then along White Spur Drain, then along the south portion of Montoya Drain, and back to Doniphan Ditch along Doña Ana County Road. For the Doniphan Ditch portion of the trail, the wetlands part will be accomplished by making the channel wider than needed to pass the 100-year storm, and making the culverts slightly smaller than needed to pass the 100-year storm. The creation of permanent wetlands will need to be discussed with the stakeholders during design of the project. A biologist will need to be consulted in the design of the wetlands. The balance between the wider channel and smaller culverts will be the key element in the design of this project. Other alternatives to detaining a small amount of flow, such as small weirs upstream of each culvert, should be investigated. The trail will be along the top of the channel.

At the request of the Operations Department, and to ease the maintenance of the culverts, a section of the channel at each crossing is to be concrete-lined. The concrete-lined section shall be 100-feet upstream and 50-feet downstream of each culvert crossing.

As there is not an existing culvert under Sunset Drive, the portion of the channel north of Sunset Drive should be graded so it flows to White Spur Drain. The channel should be approximately 2.5 feet deep, with 2H:1V side slopes, and a bottom width of 9 feet. There are no culverts to be replaced for this section of the channel.

For the section of channel from Sunset Drive south to Bird Avenue, the channel should be approximately 3 feet deep, with 2H:1V side slopes, with a bottom width of 38 feet. At Bird Avenue, the 2-barrel 35-inch by 24-inch arch pipes should be replaced with a 2-barrel 4-foot by 2-foot CBC. From Bird Avenue to Frontera Road the channel should be approximately 5.5 feet deep, with 2H:1V side slopes, and a bottom width of 25 feet. The 2-barrel 35-inch by 24-inch arch pipes at Frontera Road should be replaced with 3-barrel 4-foot by 4-foot CBC. From Frontera Road to Doña Ana County Road the channel should be approximately 5.5 feet deep, with 2H:1V side slopes, and a bottom width of 24 feet. At Sunland Park Road, 2 additional barrels should be added to the existing 2 culverts to make it a 4-barrel 6-foot by 4-foot CBC.

The estimated cost for this project does not include design, construction, or landscaping of the trail.

8.5.1.2 Doniphan Ditch Downstream (NW2)

The analysis indicates the crossing culverts and channel on Doniphan Ditch are undersized, as mentioned in Section 6.0. This project is intended to improve the channel and crossings from Doña Ana County Road to the outlet into the Rio Grande as shown on Figure 8-35. The section of the project from Doña Ana County Road to the Power Station Road is in New Mexico; it will require coordination with the relevant stakeholders. The completion of Project NW1 is downstream of NW2 and integral to the functionality of this project. As with NW1, this project is also intended to complement and extend the wetlands at Heritage Park by creating a "Heritage Park Loop Trail." See discussion in NW1 for more information on the Heritage Park Loop Trail. The two main components of this project are channel improvements and construction of a debris basin. At the request of the Operations Department, and to ease the maintenance of the culverts, a section of the Doniphan Ditch is to be concrete-lined at each crossing. The concrete-lined section shall be 100-feet upstream and 50-feet downstream of each culvert crossing.

From Doña Ana County Road to the outlet into the Rio Grande, the channel should be approximately 8 feet deep, with 2H:1V side slopes, with a bottom width of 16 feet. For the two culvert crossings at Doña Ana County Road and the entrance road into the Power Plant, the two 36-inch CMPs at each should be replaced with a 4-barrel 6-foot by 5-foot CBC and a 4-barrel 7-foot by 7-foot CBC. The railroad bridge in front of the power plant, the railroad bridge near the outlet, and the pedestrian bridge at the confluence point are also undersized and should be replaced with bridges that match the width of the channel. The estimated cost does not include design, construction, or landscaping of the trail.

In addition to the channel improvements, the Operations Department requested that a sediment basin be placed on the undeveloped property west of the car lots. The basin should be designed to catch sediment-laden runoff from the area and keep if from clogging the inlets along Doniphan Drive, which leads to Pump Station 13. A geologist will need to be consulted to determine the volume of sediment to be retained by the basin. The estimated cost includes property acquisition.

8.5.1.3 Doniphan Pump Stations Outlet (NW3)

The two pump stations (PS13 and PS14) located along Doniphan Drive currently take flow from the roadway and discharge it into the Keystone Dam Outlet Conduit. This is not a preferred condition as it can adversely affect the functionality of the Keystone Dam Outlet Conduit and the pump stations. The proposed solution is to have the pump stations discharge directly into Doniphan Ditch via a 36-inch pipe for PS14 and a 42-inch pipe for PS13, as shown on Figure 8-36. As PS13 is within the State of New

Mexico, coordination with relevant stakeholders will be required. This project will only be possible after projects NW1 and NW2 are complete.

8.5.2 Flow Paths System

8.5.2.1 Flow Path No. 38 (NW4)

Three of the crossing culverts on Flow Path No. 38 were identified as being undersized, as mentioned in Section 6.0. The undersized crossings are at Playa del Sol, Corona del Sol, and Villa del Sol Streets, as shown on Figure 8-37. Proposed improvements will upgrade the crossings so they pass the 100-year storm. The proposed improvements consist of replacing the 24-inch RCP at Playa del Sol with a 5-foot by 5-foot CBC, replacing the 36-inch RCP at Corona del Sol with a 2-barrel 6-foot by 3-foot CBC, and adding an additional barrel to the 2-barrel 6-foot by 4-foot CBC at Villa del Sol to make it a 3-barrel 6-foot by 4-foot CBC.

8.5.2.2 Flow Path No. 39A (NW5)

The problems identified in Section 6.0 to be addressed by this project consist of the undersized culvert at Northwestern Drive and Flow Path No. 39A, the 90-degree bend in the channel at the berm along Flow Path No. 39A, and the split flow of Resler Channel, as shown on Figure 8-38.

To reinforce and prevent future blowouts of the berm, it is recommended that the 90-degree bend be lined with concrete for a distance of at least 20 feet upstream and downstream of the bend. To mitigate the other two issues, it is recommended that a detention basin be constructed at the location of the split flow. The basin should detain the peak flow such that the culvert at Northwestern will have capacity to pass the peak flow. The basin, and possibly an outlet channel, should be constructed so the discharge is directed to Flow Path No. 39A. It is recommended that these improvements be constructed when the area adjacent to the project is developed.

8.5.2.3 Flow Path No. 40 (NW6)

The hydraulic analysis, as discussed in Section 6.0, indicates that the downstream section of the channel and the culvert at Transmountain Highway (also known as Loop 375) are undersized, as shown on Figure 8-39. There are also identified plumes of sediment and debris in the upstream watershed.

The portion of the channel that is undersized is at the very downstream end of Flow Path No. 40, at the confluence with Unnamed Stream No. 23. It is a very short section of channel that is undersized in an undeveloped area. Unnamed Stream No. 23 quickly captures the flow that escapes the channel, and TxDOT is in the process of designing improvements to this area as part of the Spur 276 project. For these reasons, this portion of the channel has not been included in a project.

The undersized culverts are two separate box culvert installations, but due to the small drop in terrain between the two and the wide nature of the channel in this area, they act as one culvert installation. The proposed improvements consist of adding two additional barrels to the 4-barrel 6-foot by 6-foot CBC to make it a 6-barrel 6-foot by 6-foot CBC. The 3-barrel 7-foot by 4-foot CBC will not be altered. To enhance the functionality of these culverts, it is recommended that the existing channel and terrain between the two culverts be graded so there is no impediment to upstream flow entering either culvert. This section of the Transmountain Highway is part of the Spur 276 improvement project being designed by TxDOT. It is recommended that the culvert improvement be constructed during the highway improvement project. Therefore, no costs for this project have been included in this report.

To mitigate the sediment and debris plumes, it is recommended that a debris basin be constructed as close to the Franklin Mountain State Park boundary as practical. A geologist will need to be consulted to determine the volume of the debris and sediment plumes for sizing of the basin. It is recommended that the debris and sediment basin be constructed at the time the area is developed.

8.5.3 Keystone Dam System

8.5.3.1 Arroyo 4 (NW7)

The hydraulic analysis identified five undersized culverts, as shown on Figure 8-40. Proposed improvements consist of constructing a detention basin upstream of El Puente Street and upsizing the downstream culverts as needed. As the culverts at Westwind and Northwind Drives are upstream of the proposed detention basin, they will need to be replaced. The 30-inch and 36-inch RCPs at Westwind Drive are recommended to be replaced with a 6-foot by 5-foot CBC. The 54-inch RCP at Northwind Drive is recommended to be replaced by a 2-barrel 5-foot by 5-foot CBC. It is estimated that the maximum volume of water that can be detained by the proposed basin at El Puente is 24 acre-feet. The detention basin will reduce the downstream flow to approximately the 40-year storm. The reduced flows result in the culvert at El Puente Street will not need to be replaced, but will act as the primary outlet from the basin. Although the peak flow rate is reduced, the culverts at Resler Drive and Mesa Street will still need to be improved. At Resler Drive, a 48-inch RCP pipe is proposed to be added to the existing two 48-inch RCPs. At Mesa Street, three barrels are proposed to be added to the existing 2-barrel 4-foot by 4-foot CBC, making it a 5-barrel 4-foot by 4-foot CBC.

The estimated cost for this project does not include the acquisition of the property for the detention basin.

8.5.3.2 Arroyo 5 (NW8)

The hydraulic analysis identified one undersized culvert at Mesa Street, as shown on Figure 8-41. The proposed improvement consists of replacing the 6-foot by 4-foot CBC

with a 2-barrel 8-foot by 6-foot CBC. As the culvert is almost 500 feet long, the cost is rather high.

8.5.3.3 High Ridge Channel (NW9)

The hydraulic analysis identified two undersized culverts, as shown on Figure 8-42. For the culvert at Franklin Hills Street, the proposed improvement consists of replacing the 2-barrel 8-foot by 4-foot CBC with a 4-barrel 8-foot by 7-foot CBC. For the culvert at Franklin Crest Drive, the proposed improvement consists of replacing the 2-barrel 8-foot by 4-foot CBC with a 3-barrel 9-foot by 8-foot CBC.

8.5.3.4 Ridge View Channel (NW10)

The hydraulic analysis identified two undersized culverts, as shown on Figure 8-43. For the culvert at Desert Canyon Drive, the proposed improvement consists of replacing the 2-barrel 6-foot by 4-foot CBC with a 2-barrel 7-foot by 6-foot CBC. For the culvert at Shelby Drive, the proposed improvement consists of adding another barrel to the 2-barrel 8-foot by 6-foot CBC to make it a 3-barrel 8-foot by 6-foot CBC.

8.5.3.5 Ojo de Agua Channel (NW11)

The hydraulic analysis identified three undersized culverts, as discussed in Section 6.0. There is also an identified sediment plume upstream of Via Serena Channel, which is a tributary to Ojo de Agua, as shown on Figure 8-44. For Via Descanso Lane, the proposed improvement consists of adding one barrel to the existing 2-barrel 6-foot by 4-foot CBC. The proposed improvement for Loma de Cristo Drive consists of adding an additional barrel to the 9-foot by 9-foot CBC to make it a 2-barrel 9-foot by 9-foot CBC, and for Westwind Drive, the proposed improvement consists of adding two barrels to the 9-foot by 8-foot CBC to make it a 3-barrel 9-foot by 8-foot CBC.

To mitigate the sediment plume identified on Via Serena Channel, a sediment basin is proposed at the end of the development at Via Descanso Drive. A geologist will need to be consulted to determine the volume of sediment to be retained by the basin. It is recommended that the sediment basin be constructed when the area is developed.

8.5.4 Montoya Drain System

8.5.4.1 Doniphan Ditch (NW12)

This is the section of the Doniphan Ditch upstream of White Spur Drain to Country Club Road, which drains to the White Spur Drain, as shown on Figure 8-45. The hydraulic analysis indicates the channel is undersized, as discussed in Section 6.0. The existing flow path is a small channel formed along the toe of the berm for the railroad tracks. The proposed project consists of increasing the size of the channel to contain the 100-year storm, while detaining some of the flow and tying it into the Heritage Park

Loop Trail (see NW1 for a description of the Loop Trail). The proposed channel should be 4 feet deep, with 2H:1V side slopes, and a bottom width of 30 feet.

The estimated cost for this project does not include design, construction, or landscaping of the trail.

8.5.4.2 Montoya Drain - Upper Section (NW13)

The hydraulic analysis identified six undersized culverts and two culverts of unknown size that are suspected of being undersized, in the upper section of the Montoya Drain, as shown on Figure 8-46. The channel has capacity for the stormwater runoff. However, the analysis did not include the base flow in the drain. See Section 6.0 for further discussion. This project consists of replacing the undersized culverts. For the culvert at Montoya Drive, the proposed improvement consists of replacing the 18-inch CMP with a 2-barrel 10-foot by 7-foot CBC. For the culvert under the railroad tracks just north of Mulberry Avenue, the proposed improvement consists of replacing the 24-inch CMP with a 2-barrel 10-foot by 5-foot CBC. For the culvert at Mulberry Avenue, the proposed improvement consists of replacing the 36-inch CMP with a 2-barrel 10-foot by 5-foot CBC. For the culvert at Lindbergh Street, the proposed improvement consists of replacing the 36-inch CMP with a 2-barrel 10-foot by 5-foot CBC. During field reconnaissance, the culverts at Country Club Road and Country Club Place were buried in sediment and therefore the size is unknown. It is assumed these culverts are undersized and should be replaced with a 2-barrel 10-foot by 5-foot CBC. For the culvert at Lombardy Avenue, the proposed improvement consists of replacing the 48-inch RCP with a 2-barrel 12-foot by 6-foot CBC. For the culvert at Sunset Drive, the proposed improvement consists of replacing the 48-inch RCP with a 2-barrel 12-foot by 6-foot CBC. The completion of projects NW14 and NW15 are integral to the functionality of this project.

The estimated cost for this project does not include the acquisition of the Montoya Drain from the EPCWID No. 1.

There are seven additional crossings of the Montoya Drain within the golf course. It is recommended that these crossings be analyzed for their capacity and if found to be undersized replaced by the property owner. Undersized crossings would constrict the flow of water, severely restricting the functionality of the drain upstream of the constriction.

8.5.4.3 Montoya Drain - Middle Section (NW14)

The middle section of the Montoya Drain is from the confluence of the White Spur and Nemexas Drains with the Montoya Drain to the New Mexico border, which is approximately 1,000 feet south of Frontera Road, as shown Figure 8-47. The hydraulic analysis indicates the channel and three bridges are undersized, as discussed in Section 6.0. The proposed improvements consist of increasing the capacity of the channel and the crossings, while turning this section of the drain into a link in the

Heritage Park Loop Trail. For a description of the Heritage Park Loop Trail, see Project NW1. The completion of projects NW13 and NW15 are integral to the functionality of this project.

The existing channel is 6.5 feet deep, with side slopes of 1H:1V or steeper, and a bottom width of 36 feet. The proposed channel is 7 feet deep, with 2H:1V side slopes, and a bottom width of 45 feet. The bridges at Turnstone Drive, Frontera Road, and the pedestrian bridge at Perth Drive should all be replaced with structures that do not inhibit the flow in the channel, i.e. the channel does not narrow at the bridges and the low cord of the bridge does not drop below the elevation of the channel banks.

The estimated cost for this project does not include design, construction, or landscaping of the trail, nor does it include the cost of acquisition of the Montoya Drain from the EPCWID No. 1.

8.5.4.4 Montoya Drain - Lower Section (NW15)

The lower section of the Montoya Drain is from the New Mexico border, which is approximately 1,000 feet south of Frontera Road, to confluence of the Montoya Drain with the Rio Grande, as shown on Figure 8-47. The hydraulic analysis indicates the channel and three culverts are undersized, as discussed in Section 6.0. The proposed improvements consist of increasing the capacity of the channel and the culverts, while turning this section of the drain into a link in the Heritage Park Loop Trail. For a description of the Heritage Park Loop Trail, see Project NW1. The completion of projects NW13 and NW14 are integral to the functionality of the project.

The existing channel is 6.5 feet deep, with side slopes of 1H:1V or steeper, and a bottom width of 35 feet. The proposed channel is 7 feet deep, with 2H:1V side slopes, and a bottom width of 45 feet. For Sunland Park Drive, the 72-inch CMP should be replaced with a 3-barrel 16-foot by 6-foot CBC. For the northern crossing in the race track area, the 96-inch CMP should be replaced with a 4-barrel 12-foot by 6-foot CBC. For the outlet structure through the levee, the 3-barrel 5-foot by 5-foot CBC should be replaced with a 4-barrel 12-foot by 6-foot CBC. Automatic gate equipment should be installed on this structure so the gates will automatically open and close based on the elevation of the water in the Rio Grande.

The estimated cost for this project does not include design, construction, or landscaping of the trail. Nor does it include the cost of acquisition of the Montoya Drain from the EPCWID No. 1.

8.5.4.5 White Spur Drain (NW16)

The hydraulic analysis indicates the channel in the upper section of the White Spur Drain is undersized, as shown on Figure 8-48. The existing concrete-lined channel has a depth of 3 feet, with side slopes of 1.25H:1V, and a bottom width of 6 feet. The

proposed channel should be 4.5 feet deep, with side slopes of 1.25H:1V and a bottom width of 6 feet.

8.5.4.6 White Spur Drain (NW17)

The hydraulic analysis indicates the City of El Paso's effort to concrete line the entire channel in the lower section of the White Spur Drain will give it the capacity to pass the 100-year storm. However, the analysis also indicates there are two undersized crossings, as shown on Figure 8-48. The railroad bridge adjacent to Doniphan Drive is just slightly undersized as it passes approximately the 80-year storm. Replacement of the bridge with a wider span is recommended. However, the designer should perform a detailed analysis of the existing structure to determine if other options, such as constructing vertical buttresses, are feasible and will give the necessary capacity.

The other undersized structure is at River Bend Drive. It is recommended that the 3-barrel 48-inch RCP structure be replaced with a 2-barrel 8-foot by 6-foot CBC.

The area adjacent to the channel should be improved with a landscaping and a walking path to link the two parts of the Heritage Park Loop Trail along Doniphan Ditch and Montoya Drain. The project cost does not include design, construction, or landscaping of the trail.

8.5.5 Oxidation Dam System

8.5.5.1 Mesa Hills Channel (NW18)

The Operation Department staff stated there is a known sediment and debris problem in this portion of the Mesa Hills Channel. There is a privately owned debris basin that is in need of cleaning out. It is recommended that the existing debris basin be purchased from the private owner and expanded, as shown on Figure 8-49. A geologist will need to be consulted to determine the volume of sediment retention needed.

The estimated cost of this project includes acquisition of the needed property.

8.5.5.2 Silver Springs Channel (NW19)

As mentioned in Section 4.0, there is an identified plume of sediment in the upper watershed of Silver Springs Channel. This area is the target of a multi-phased improvement project implemented by the City of El Paso. Presently, the downstream channel and culvert crossings have been improved so they pass the 25-year storm. The next and last phase of the City project is to construct a small dam to control the upstream runoff and cut the peak runoff to no more than the 25-year storm. It is recommended that a combination sediment and detention basin be constructed to mitigate the identified sediment problem and lower the peak flow rate, as shown on Figure 8-50. The basin will need to have detention storage of approximately

142 acre-feet. A geologist will need to be consulted to determine the volume of sediment retention needed.

The estimated cost of this project includes acquisition of the needed property.

8.5.5.3 Spring Crest Channel (NW20)

There are identified plumes of sediment and debris in the upper watershed of Spring Crest Channel. This area is developed right up to the boundary of the Franklin Mountain State Park. During the development of this area, a debris basin was constructed just inside the park boundary. It is recommended that this existing debris basin be purchased or a maintenance permit or agreement be obtained. In addition, the existing basin should be expanded to retain the volume of sediment and debris identified in the upper watershed, as shown on Figure 8-51. A geologist will need to be consulted to determine this volume. The area around the basin is known to have shallow depths to bedrock, which could significantly increase the cost of expanding the basin.

The estimated cost to improve the existing debris basin does not include the cost of acquiring the basin or any fees associated with a maintenance permit or agreement.

8.5.6 Vinton System

8.5.6.1 Flow Path No. 45A Diversion (NW21)

The portion of Flow Path No. 45A upstream of IH-10 has been completely filled in by development, as mentioned in Section 6.0. The roadway does not have capacity for the runoff reaching it. To mitigate this problem, a channel is proposed upstream of the development to divert the flow from Flow Path No. 45A south to Flow Path No. 45, as shown on Figure 8-52. To mitigate the problems additional flow would cause and to alleviate some of the known problems on Flow Path No. 45, two combination sediment and detention basins are proposed upstream of the diversion outlet point along Flow Path No. 45 and Flow Path No. 45C. As mentioned in Section 4.0, there are identified sediment plumes in the upstream watersheds of Flow Path No. 45 and Flow Path No. 45C. This is why the sediment portion of the basins needs to be included. The detention portion of the basins needs to be approximately 388 acre-feet for the basin on Flow Path No. 45, and approximately 250 acre-feet for the basin on Flow Path No. 45C. A geologist will need to be consulted to determine the volume of sediment retention needed for each basin.

The estimated cost of this project does not include the cost of property acquisition, as the basins are to be located on EPWU property.

8.5.6.2 Flow Path No. 45A Improvements (NW22)

The hydraulic analysis indicates that for the portion of Flow Path No. 45A downstream of IH-10, there are six undersized culverts and a section of the channel is undersized, as mentioned in Section 6.0. After consultation with EPWU, it was determined the section of the undersized channel and undersized culverts contained within the junkyard will not be improved, as shown on Figure 8-53. This section is on private property and the inadequacies of the channel and culverts do not affect upstream or downstream residents. Therefore, it is recommended that only the undersized section of the channel and the culverts in the residential area be improved.

The section of channel to be improved is from approximately 230 feet upstream of Iron Drive to approximately 260 feet downstream of Kiely Road. The remainder of the downstream channel has capacity for the 100-year storm. The existing undersized channel is a V-ditch with a depth of approximately 2 feet and a top width of 40 feet. The proposed channel section is 5 feet deep, with 2H:1V side slopes, and a bottom width of 15 feet. For the culvert at Iron Drive, the 3-barrel 30-inch RCP structure should be replaced with a 6-barrel 6-foot by 6-foot CBC. For Kiely Road, the two-barrel 30-inch RCP structure should be replaced with a 5-barrel 7-foot by 4-foot CBC.

The estimated cost of this project includes a property acquisition costs.

8.5.6.3 Vinton Arroyo/Flow Path No. 45 Lower Section (NW23)

The hydraulic analysis indicates that for the portion of Flow Path No. 45 downstream of the confluence of Flow Path No. 45A, there are three undersized crossings, as mentioned in Section 6.0. The channel has capacity for the 100-year storm, as shown on Figure 8-54. For the 4-barrel 36-inch CMPs at AP Ramirez Street and the railroad bridge downstream of Doniphan Drive, it is recommended that the structures be replaced with bridges that do not impede the flow of water in the channel, i.e. the channel does not narrow at the bridge and the low cord of the bridge is above the channel bank elevation. For the culvert at Doniphan Drive, it is recommended that the 2-barrel 6-foot by 6-foot CBC be replaced with a bridge that does not impede the flow of water in the channel.

8.5.6.4 Vinton Arroyo/Flow Path No. 45 Middle Section (NW24)

The hydraulic analysis indicates that for the middle section of Flow Path No. 45, the channel is undersized from the southbound IH-10 on-ramp to the confluence of Flow Path No. 45A, as mentioned in Section 6.0. In addition, there are three undersized culverts, as shown on Figure 8-55. The channel crossing at Quejette Street is designed as a low water crossing. As the proposed channel section will make a low water crossing impractical, it is recommended that a bridge be constructed at this location.

The existing earthen channel is 4 feet deep, with 4H:1V side slopes, and a bottom width of 2 feet. The proposed channel is earthen, 9.5 feet deep, with 2H:1V side slopes, and

a bottom width of 20 feet. For the northbound IH-10 off-ramp, three additional barrels need to be added to the existing 13-barrel structure to make it a 16-barrel 9-foot by 5-foot CBC. For the southbound IH-10 on ramp, when the downstream channel is improved it will decrease the backwater effect on the culvert and the existing culvert will have sufficient capacity to pass the 100-year storm. The low water crossing at Quejette Street, the bridge at Vinton Road, and the 2-barrel 8-foot by 3-foot CBC at Kiely Road should be replaced with bridges that do not impede the flow of water in the channel, i.e. the channel does not narrow at the bridge and the low cord of the bridge is above the channel bank elevation.

8.5.6.5 Vinton Arroyo/Flow Path No. 45 Upper Section (NW25)

The hydraulic analysis indicates that for the upper portion of Flow Path No. 45, the channel is undersized from Tom Mays Drive to De Alva Drive, as mentioned in Section 6.0. The two roadway crossings in this section are at Tom Mays Drive and De Alva Drive and both are low water crossings, as shown on Figure 8-56. It is recommended that these remain low water crossings. The existing channel is a V-ditch that is 1.5-foot deep and has a top width of 45 feet. The proposed channel is 3 feet deep, has 2H:1V side slopes, and a bottom width of 30 feet.

If the two combination sediment and detention basins have not been constructed with Project NW21, they should be constructed with this project. See Project NW21 for descriptions of the basins.

The estimated cost of this project includes acquisition of property for the channel.

8.6 West Central Region

Three of the five channels studied within the West Central Region have crossing structures that are undersized and several segments of channel are undersized. Additionally, sedimentation and debris control is an issue in this area. To address these inadequacies in the current stormwater infrastructure, a series of projects was identified.

8.6.1 Canterbury Channel (WC1)

There is a debris plume in the upstream portion of the watershed, as discussed in Section 4.0. This project consists of constructing a debris retention basin, WC_DEB4, east of Stanton Street and at the end of Kenyon Joyce Lane, as shown on Figure 8-57. A geologist will need to be consulted to determine the volume of the debris plume for sizing of the debris basin. If runoff detention is added to the debris basin, it could have a minor positive effect on Project WC5. It is recommended that the debris basin be constructed at the time the adjacent area is developed.

8.6.2 Flow Path No. 20 (WC2)

As mentioned in Sections 4.0 and 6.0, there are identified debris plumes in the upstream watershed and two undersized crossing structures, the culvert at Zenith Drive and the storm drain along Castellano Drive that discharges to the arroyo just past Mesa Street, as shown on Figure 8-58. The proposed improvements consist of two combination debris and detention basins. The first basin, WC_DEB2, should be located at the upstream end of Flow Path No. 20 past the end of the existing residential subdivision, just north of Zenith Drive. The basin needs to be sized so it can retain the debris plume and detain enough runoff so the discharge passes through the downstream structures. Basin WC_DEB2 should have a volume of approximately 108 acre-feet. The second basin, WC_DEB3, should be located on a small tributary of Flow Path No. 20, just north of Excalibur Drive past the residential subdivision. The basin needs to be sized so it can retain the debris plume and detain enough runoff so the discharge passes through the downstream structures. Basin WC_DEB3 should have a volume of approximately 56 acre-feet. A geologist will need to be consulted to determine the volume of the debris plumes for sizing of the debris storage portion of the basins. This project could have a minor positive effect on Project WC3. It is recommended that these combination debris and detention basins be constructed at the time the adjacent areas are developed.

8.6.3 Flow Path No. 20 (WC3)

The hydraulic analysis, as discussed in Section 6.0, indicates that the downstream section of the channel and the culvert at Paisano Drive (also known as the Border Highway) are undersized, as shown on Figure 8-58. The existing earthen channel has a bottom width of 17 feet, depth of 6 feet, and side slopes of 3H:1V. The proposed improvements consist of deepening the channel to 9 feet, increasing the side slopes to 2H:1V and the bottom width to 24 feet. The existing bridge should be replaced with a bridge that restricts less flow. TxDOT has indicated that they are going to improve the highway in the next few years. It is recommended that improvements in this area be constructed during the reconstruction of the Border Highway. Coordination with TxDOT will be required. The improvements proposed with projects WC2 and WC8 could have a minor positive effect on this project.

8.6.4 Flow Path No. 21 (WC4)

This project consists of increasing the capacity of the Mesa Street Culvert on Flow Path No. 21, as shown on Figure 8-59. Presently, the culvert is a 2-barrel 4-foot by 4-foot CBC at a length of approximately 770 feet. The culvert needs to be upsized by adding a 6-barrel 4-foot by 4-foot CBC. Construction may also be hampered by the presence of buildings on top of the culvert. During the design effort for this project, the retention/detention capacity of the existing “ponding area” at the inlet of the culvert needs to be evaluated to determine if its expansion or enhancement is feasible and if it could mitigate the need to increase the size of the culverts. Preliminary investigation

determined it may not be feasible due to existing utility lines and structures, primarily sanitary sewer. The culvert at O'Keefe Drive is also undersized. However, it is designed as a low water crossing, so is not recommended for improvement. There have been no reports of problems at the location of either of these culverts, so this project should be considered a fairly low priority. If the ponding area upstream of Mesa Street is improved, it could have a minor positive effect on Project WC5.

8.6.5 Flow Path No. 21 (WC5)

The hydraulic analysis, as discussed in Section 6.0, indicates that the downstream section of the channel and the culvert at Paisano Drive (also known as the Border Highway) are undersized, as shown on Figure 8-59. The existing 13-foot-wide by 10-foot deep rectangular concrete channel should be replaced with a trapezoidal channel with a bottom width of 20 feet, a depth of 5 feet, and side slopes of 2H:1V. The existing bridge should be replaced with a bridge that restricts less flow. TxDOT has indicated that they are going to improve the highway in the next few years. It is recommended that improvements in this area be constructed during the reconstruction of the Border Highway. Coordination with TxDOT will be required. The improvements proposed with Project WC1 and WC4 could have a minor positive effect on this project.

8.6.6 Flow Path No. 23 (WC6)

Flow Path No. 23 has several issues which are addressed as part of this project (WC6). Due to the magnitude of the proposed improvements, the project has been divided into phases.

Phase 1 includes the construction of a sediment basin, WC_SED1, just downstream of the bend in Robinson Avenue, as shown on Figure 8-60. The undersized 30-inch culvert at Robinson Avenue is recommended to be left in place with the roadway reconstructed as a low water crossing.

The channel from Campbell Street to Mesa Street is undersized. This includes the culverts at Campbell, Kansas, and Stanton/Mesa Streets. Due to the limited space available and the historic nature of the area, Phase 2 recommends that the channel and culverts be left in place as-is and a 2-barrel 29-foot by 7-foot storm drain conduit be constructed from Campbell Street to Mesa Street so runoff can bypass the undersized channel and culverts. Construction of this storm drain conduit will be difficult due to the high level of development in the area. The 2-barrel 84-inch CMP at Oregon Street is undersized and should be replaced with a 4-barrel 9-foot by 9-foot CBC. The 142-inch by 91-inch arch pipe at University Avenue should be replaced with a 3-barrel 7-foot by 7-foot CBC.

If detention of runoff is added to the sediment basin, it could reduce the cost of the culvert improvements in Phase 2 and WC7. However, it would not completely mitigate the need for the storm drain or culvert replacements. Phase 2 of the project would

include the storm drain from Campbell Street to Mesa Street. The culvert improvements at Oregon Street and University Avenue could be included in Phase 2, or if needed, they could be constructed as Phase 3.

8.6.7 Flow Path No. 23 (WC7)

The hydraulic analysis, as discussed in Section 6.0, indicates that the three culverts at Paisano Drive (also known as the Border Highway), the culvert at Yandell Drive and the culvert upstream of Paisano Drive are undersized, as shown on Figure 8-60. The existing 6-barrel 8-foot by 3-foot CBC under northbound Paisano Drive should be replaced with a 10-barrel 12-foot by 4-foot CBC. For southbound Paisano Drive, an additional 7-foot by 7-foot CBC barrel should be added to the existing 4 barrels. The existing 4-barrel 6-foot by 4-foot CBC at Yandell Drive should be replaced with a 6-barrel 12-foot by 6-foot CBC. TxDOT has indicated that they are going to improve the highway in the next few years. It is recommended that improvements in this area be constructed during the reconstruction of the Border Highway. Coordination with TxDOT will be required. The improvements proposed with Project WC6 could have a minor positive effect on this project.

8.6.8 Paragon Channel (WC8)

There is a debris plume in the upstream portion of the watershed, as discussed in Section 4.0. This project consists of constructing a debris retention basin, WC_DEB1, east of Stanton Street, as shown on Figure 8-61. A geologist will need to be consulted to determine the volume of the debris plume for sizing of the debris basin. If runoff detention is added to the debris basin, it could have a minor positive affect on Project WC3. It is recommended that the debris basin be constructed at the time the adjacent area is developed.

8.7 Summary

The following table shows a summary of all the projects and their estimated costs. Detailed cost estimates are included in Appendix E.

Table 8-1. Project Cost Summary

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Central	Government Hills	CE1	Multiple street intersections along Government Hills Channel do not have sufficiently sized drainage inlets. Undersized inlets restrict water from entering the channel and contribute to localized flooding at the crossings.	Expand the street inlets at Altura, Hastings, Cambridge and Cumberland to allow street flow to enter the channel without flooding surrounding properties. Also, add Austin High Pond upstream from the channel to decrease the flow entering the street inlets.	$850,000
Central	Government Hills	CE2	Multiple culverts along Government Hills Channel are undersized and contribute to channel flooding in localized areas.	Enlarge culverts at Cambridge, Cumberland, Chester and Trowbridge to increase the overall capacity of the Government Hills Channel to convey the 100-year storm.	$2,060,000
Central	Government Hills	CE3	The Government Hills System consists of a 90-inch pressurized conduit that outfalls into the Rio Grande. The design capacity is 375 cfs but has been reduced to 50 cfs. The reduction in flow is a direct result of multiple tie-ins along the system which cause localized flooding along minor tie-ins.	The Government Hills System will be modified to reflect as built conditions. This will enable the system to remain pressurized from Boone Street Basin to the Rio Grande. The flow through the 90-inch conduit will increase from a current capacity of 50 cfs.	$6,672,000
Central	Cebada	CE4 Phase 1	Conveyance problems through Cebada Reservoir and Magnolia systems cause major flooding on IH-10 and on Cebada Road.	Clearing and relocating of existing utilities in Cebada Outfall Conduit (In Progress). Expansion of Magnolia Reservoir (In Progress). Construct Copia Street Pond.	$4,740,000
Central	Cebada	CE4 Phase 2	Conveyance problems through Cebada Reservoir and Magnolia systems cause major flooding on IH-10 and on Cebada Road.	Magnolia storm drains, Pump Station, and Force Main to Rio Grande.	$24,739,000
Central	Cebada	CE4 Phase 3	Conveyance problems through Cebada Reservoir and Magnolia systems cause major flooding on IH-10 and on Cebada Road.	Railroad Pond and concrete-lined channel from Cebada to RR Pond.	$7,407,000
Central	Dallas	CE5 Phase 1	The Dallas Reservoir does not properly discharge flow into the Rio Grande when river levels are high. This causes a back up and flooding occurs along the system at multiple locations.	Add a 115 cfs pump station which discharges into a new 42-inch force main running parallel to the existing eastern discharge conduit at Dallas Reservoir. Sever tie-ins of eastern discharge conduit to Line D and Cebada System and construct an extension of the line from the point where the tie-in to the Cebada system was severed. 50-year protection.	$19,290,000
Central	Dallas	CE5 Phase 2	The Dallas Reservoir does not properly discharge flow into the Rio Grande when river levels are high. This causes a back up and flooding occurs along the system at multiple locations.	Increase capacity of pump station from 115 cfs to 370 cfs.	$7,728,000
Central	Dallas	Dam 10 Upgrade	Dam No. 10, Memphis Avenue Dam - Upgrade to meet 2007 TCEQ Standards (dam not regulated per 2009 TCEQ rules).	Improve Dam No. 10 per Work Order 3, Task 4 Report by raising existing embankment, construct 4-foot wall on embankment and extend 36-inch outlet pipe.	$834,214
Central	Cebada	Dam 4 Upgrade	Dam No. 4, Memphis Avenue Dam - Upgrade to meet 2007 TCEQ Standards (dam not regulated per 2009 TCEQ rules).	Improve Dam No. 4 per Work Order 3, Task 4 Report by raising crest, and extending auxiliary spillway.	$1,049,249

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Central	Cebada	Dam 5 Upgrade	Dam No. 5, Memphis Avenue Dam - Upgrade to meet 2007 TCEQ Standards (dam not regulated per 2009 TCEQ rules).	Improve Dam No.5 per Work Order 3, Task 4 Report by raising west embankment, construct 3-foot wall on east side and reinforce embankment.	$837,768
Central	Dallas	Dam 9 Upgrade	Dam No. 9 has CMP pipe outlet that has higher risk of failure than RCP.	Replace CMP principal spillway on Dam No. 9.	$300,000
Central	Government Hills	Pershing Dam Upgrade	Pershing Dam - Upgrade to reduce frequency of flooding through auxiliary spillway.	Improve Pershing Dam per Work Order 3, Task 4 Report by extending and raising auxiliary spillway.	$696,306
Central	Dallas	Upgrade Dam 7	Dam crest is estimated to overtop at slightly greater that 100-year flood.	Increase dam crest or improve spillway (TBD).	$500,000
Central	Government Hills	Van Buren Dam	Van Buren Dam -.Upgrade to meet 2009 TCEQ Hydraulic Safety Standards.	Improve Van Buren Dam per Work Order 3, Task 4 Report by increasing flood pool and plugging one of two outlets.	$2,516,830
East	Phelps Dodge	EA1 Phase 1	Undersized culvert crossings, street flows travel too far over flat slopes causing flooding.	Culverts: Two 8-foot by 4-foot CBCs at Edgemere Blvd./Airway Avenue, two 8-foot by 4-foot CBCs at Edgemere Blvd./Robert E. Lee Crossing; remove french drain at Railroad Crossing and connect concrete channel.	$1,215,000
East	Phelps Dodge	EA1 Phase 2	Undersized culvert crossings, street flows travel too far over flat slopes causing flooding.	Add storm drain system including 48-inch RCP, 60-inch RCP, and 8-foot by 4-foot CBC.	$6,490,000
East	Americas Ten Basin	EA10 Phase 1	Undersized crossings, unfinished earthen channels, and sediment transfer clogging culverts.	Build sediment/detention basin upstream of Paseo del Este Drive.	$4,642,000
East	Americas Ten Basin	EA10 Phase 2	Undersized crossings, unfinished earthen channels, and sediment transfer clogging culverts.	Concrete line channels below proposed sediment/detention basin and concrete line earthen channels between concrete sections.	$1,424,000
East	Phelps Dodge	EA2	Undersized culvert crossing.	Construction of sediment basin west of US 54.	$653,000
East	Phelps Dodge	EA3 Phase 1	Undersized channel and flooding problems upstream of channel.	Increase channel capacity down to retention basin.	$792,000
East	Phelps Dodge	EA3 Phase 2	Undersized channel and flooding problems upstream of channel.	Add storm drain system within streets to reduce street flooding issues.	$4,043,000
East	Phelps Dodge	EA4	Street flows travel too far over flat slopes causing flooding, street closures and damage.	Storm drain system consisting of 54-inch RCP and 66-inch RCP.	$8,999,000
East	Phelps Dodge	EA5 Phase 1	Street flows flooding at Interstate crossing.	Add to existing storm drain system to increase capacity and reduce street and commercial flooding by getting flows to Giles Basin Dam more effectively.	$9,074,000
East	Phelps Dodge	EA5 Phase 2	Street flows flooding at Interstate crossing.	Add new storm drain system to reduce street by getting flows to Giles Basin Dam more effectively.	$3,158,000
East	Lomaland Basin	EA6 Phase 1	Street flows travel too far over flat slopes causing flooding, street closures, and damage.	Storm drain system consisting of 48-inch RCP to 66-inch RCP, 7-foot by 4-foot CBC, 9-foot by 5-foot CBC, and 10-foot by 5-foot CBC to handle flows from surrounding residential areas.	$15,590,000
East	Lomaland Basin	EA6 Phase 2	Street flows travel too far over flat slopes causing flooding, street closures, and damage.	Storm drain system consisting of 66-inch RCP and 9-foot by 5-foot CBC to handle flows from surrounding residential areas.	$10,353,000

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
East	Lomaland Basin	EA6 Phase 3	Street flows travel too far over flat slopes causing flooding, street closures, and damage.	Storm drain system consisting of 60-inch RCP and 7-foot by 4-foot CBC to handle flows from surrounding residential areas.	$5,177,000
East	Lomaland Basin	EA6 Phase 4	Street flows travel too far over flat slopes causing flooding, street closures, and damage.	Storm drain system consisting of 54-inch RCP, 66-inch RCP and 7-foot by 4-foot CBC to handle flows from surrounding residential areas.	$6,197,000
East	Lomaland Basin	EA6 Phase 5	Street flows travel too far over flat slopes causing flooding, street closures, and damage.	Storm drain system consisting of 48-inch RCP and 60-inch RCP to handle flows from surrounding residential areas.	$2,717,000
East	Lomaland Basin	EA7 Phase 1	Runoff flooding streets because it does not enter Jesuit Basin effectively.	Addition of 36-inch RCP, 48-inch RCP, 60-inch RCP and 10-foot by 4-foot CBC storm drain system to capture flows from residential and commercial areas before flooding at Lee Trevino and James Watt.	$11,244,000
East	Lomaland Basin	EA7 Phase 2	Runoff flooding streets because it does not enter Jesuit Basin effectively.	Addition of 54-inch RCP and 8-foot by 5-foot CBC storm drain system to capture flows from residential and commercial areas before flooding at Kaiser Dr and Gateway West.	$6,434,000
East	Lomaland Basin	EA7 Phase 3	Runoff flooding streets because it does not enter Jesuit Basin effectively.	Addition of 36-inch RCP, 42-inch RCP and 48-inch RCP storm drain system to capture flows from residential and commercial areas before flooding at Bessemer Dr and Lee Trevino.	$4,343,000
East	Americas Basin	EA8 Phase 1	Runoff from surrounding commercial areas flooding streets because of ineffective routing to Bluff Channel.	Increase size of Bluff Channel to a 20-foot bottom width from Rojas Dr to Esther Lama Dr and upgrade crossing at Esther Lama Dr to three 10-foot by 5-foot CBCs.	$5,926,000
East	Americas Basin	EA8 Phase 2	Runoff from surrounding commercial areas flooding streets because of ineffective routing to Bluff Channel.	Addition of 24-inch RCP to 60-inch RCP storm drain system added to surrounding commercial lots and streets to prevent flooding in Zaragosa Road and George Dieter Drive, and also IH-10 George Dieter intersection.	$8,422,000
East	Americas Ten Basin	EA9 Phase 1	Undersized crossings, unfinished earthen channels, and sediment transfer clogging culverts.	Build sediment/detention basin upstream of Paseo del Este Drive	$5,769,000
East	Americas Ten Basin	EA9 Phase 2	Undersized crossings, unfinished earthen channels, and sediment transfer clogging culverts.	Concrete line channels below proposed sediment/detention basin and concrete line earthen channels between concrete sections.	$2,026,000
Mission Valley	Basin A	MV1	The pump station at Basin A does not have capacity for the 100-year storm event. Additional flow is contributed back into the Playa Drain.	Upgrade the existing pump station at Basin A by installing new pumps (525 cfs total capacity). Project proposed by CH2M HILL.	$19,076,000
Mission Valley	Mesa Drain Upstream and Downstream	MV10	Mesa Drain is significantly undersized.	Expand Mesa Drain 20 feet in width on the south side of the channel where feasible. Also, line portions of channel with concrete that cannot be expanded and line 20 feet upstream of all crossings with concrete.	$6,262,000

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Mission Valley	Basin A	MV2 Phase 1	Basin B currently serves as detention storage for the upper portion of the Playa Drain and the neighborhoods surrounding the basin. After leaving the basin, water flows through a conduit and enters the lower portion of the Playa Drain where it contributes to the capacity problems of the drain.	Install a new pump station (165 cfs total capacity) and conduit in the portion of Basin B west of Mimosa Avenue to pump water to the Rio Grande River. Excavate and regrade the slope in Basin B so that water flows to the pump station. Install new culverts.	$10,413,000
Mission Valley	Basin A	MV2 Phase 2	Basin B currently serves as detention storage for the upper portion of the Playa Drain and the neighborhoods surrounding the basin. After leaving the basin, water flows through a conduit and enters the lower portion of the Playa Drain where it contributes to the capacity problems of the drain.	Expand pump station by installing an additional 165 cfs pump and conduit.	$6,023,000
Mission Valley	Basin G	MV3	The Middle Drain is contributing flow to the Mesa Drain Interceptor causing capacity and tailwater issues. There is need for additional storage along the Interceptor System in Mission Valley.	Excavate the City-owned Feather Lake II property and divert all flow from the Middle Drain to it via conduit. Install a small pump station at basin. Flow back into the Mesa Drain Interceptor from the basin will be controlled by automatic gates.	$10,724,000
Mission Valley	Basin G	MV4	The Franklin Drain is contributing flow to the Middle Drain Interceptor causing capacity and tailwater issues. There is a need for additional storage along the Interceptor System in Mission Valley.	Create a detention basin along the Middle Drain Interceptor and divert flow from the Franklin Drain to it via conduit. Install a small pump station at basin. Flow back into the Middle Drain Interceptor from the basin will be controlled by automatic gate	$16,203,000
Mission Valley	Basin G	MV5 Phase 1	The current configuration and capacity of Basin G is causing tailwater to significantly restrict the capacity of the major drains and Interceptor System in Mission Valley. There is a need for additional storage in Basin G.	Excavate existing Basin G area to a depth of 20 feet, replace the undersized crossings at Carl Longuemare and Southside, and re-grade the Franklin Drain Interceptor so that water will flow to the basin from both the Playa Drain and the Interceptor System.	$6,236,000
Mission Valley	Basin G	MV5 Phase 2	The current configuration and capacity of Basin G is causing tailwater to significantly restrict the capacity of the major drains and Interceptor System in Mission Valley. There is a need for additional storage in Basin G.	Upgrade the existing pump station at Basin G by installing new pumps (820 cfs capacity total) and installing new conduits to the Rio Grande River.	$27,038,000
Mission Valley	Basin A	MV6	There are flooding issues on Alameda Drive (SH20) between Paisano Drive and El Paso Drive	Install a storm drain system along the affected area of Alameda Drive that empties into Playa Drain just north of the intersection with Delta Drive.	$42,879,000
Mission Valley	Basin G	MV7	The following crossing on Playa Drain is undersized: Just Downstream of Yarbrough Drive (one 36-inch RCP).	Remove the undersized culvert and replace it with a culvert having the same capacity as the upstream cross section. The replaced culvert will not interfere with the channel width or road surface elevation.	$95,000

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Mission Valley	Basin G	MV8	Basin C is currently serving as a detention area for water from surrounding neighborhoods. After leaving the basin, water enters the Playa Drain where it contributes to the capacity problems of the drain.	Install a new pump station (160 cfs total capacity) and conduits at Basin C to pump water from the basin to the Rio Grande River. Excavate the basin so it is three feet below the channel elevation of Playa Drain. Install new culverts under Independence Drive.	$10,741,000
Mission Valley	Mesa Drain Downstream	MV9	The elevation of the channel banks along the lower portion of Mesa Drain is preventing the top portion of the Feather Lake capacity from being utilized.	Construct a parapet wall along both sides of Mesa Drain from Le Barron Road to Feather Lake to raise the channel bank elevation.	$4,777,000
Northeast	Fort Bliss Sump	Keltner Dam Upgrade	Keltner Dam - Upgrade to meet 2007 TCEQ Standards (dam not regulated per 2009 TCEQ Standards).	Improve Keltner Dam per Work Order 3, Task 4 Report.	$719,303
Northeast	Fort Bliss Sump	NE1	The following crossings on Railroad Channel are undersized: Falcon Avenue (one 18-inch RCP) Waycross Avenue (one 12-inch RCP) Wren Drive (one 18-inch RCP) Lexington Drive (one 18-inch RCP) Crossing S. of Falcon Avenue (one 12-inch RCP)	Replacement of five crossing structures.	$922,000
Northeast	Fort Bliss Sump	NE2	The following crossing on Railroad Channel Downstream is undersized: east of Julian Drive (five 8-foot by 4-foot CBCs).	Replacement of one crossing structure.	$402,000
Northeast	Fort Bliss Sump	NE3 Phase 1	1. Tobin Drain is significantly undersized with the exception of the far downstream end. 2. Crossing capacities are well below the 10-year flow.	Expansion of channel from Alps to Hollings. Construction of new portion of Tobin Drain parallel to Hollings from Hollings to Hondo Pass. Replacement of three crossing structures.	$7,595,000
Northeast	Fort Bliss Sump	NE3 Phase 2	1. Tobin Drain is significantly undersized with the exception of the far downstream end. 2. Crossing capacities are well below the 10-year flow.	Expansion of the portion of Tobin Drain from Wren to Alps. Expansion and lining of Tobin Drain from Sanders to Wren. Replacement of two crossing structures.	$10,210,000
Northeast	Fort Bliss Sump	NE3 Phase 3	1. Tobin Drain is significantly undersized with the exception of the far downstream end. 2. Crossing capacities are well below the 10-year flow.	Expansion of Tobin Drain from Threadgill to Sanders. Replacement of one crossing structure.	$6,412,000
Northeast	Fort Bliss Sump	NE4	1. The following crossing on Range Dam Outlet Channel is undersized (<10-year): Raymond Telles Drive (one 2-foot by 2-foot CBC). 2. Downstream junction of Range Dam Outlet Channel and Tobin Drain Channel identified by EPWU as issue and thus included in cost table.	Remove and replace undersized crossing and modify downstream junction.	$1,430,000

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Northeast	Fort Bliss Sump	NE5	1. The following crossings on Clearview Channel are undersized (<10-year): Morningside Circle (three 36-inch CMPs) and Byron Drive (three 36-inch CMPs). 2. There is a sediment problem in the upstream portion of Clearview Channel.	Replace two crossing structures and construct new sediment basin.	$1,686,000
Northeast	Fort Bliss Sump	NE6	1. Erosion along Lincoln Avenue due to flows in the downstream portion of Johnson Channel. 2. One undersized crossing was identified on Johnson Channel beneath a dead-end road in a vacant lot, but is not causing any serious problems.	Construct new retention basin.	$521,000
Northeast	Northeast Ponding	NE7 Phase 1	Northeast Channel No. 2 is significantly undersized (<10-year) with undersized crossings and serious erosion problems.	Expansion and lining of portion NE Channel 2 in progress.	$7,020,000
Northeast	Northeast Ponding	NE7 Phase 2	Northeast Channel No. 2 is significantly undersized (<10-year) with undersized crossings and serious erosion problems.	Expansion and lining of remaining channel.	$9,513,000
Northeast	Northeast Ponding	NE7 Phase 3	Northeast Channel No. 2 has high sediment loads due to large upstream deposits.	Construction of sediment basin west of US 54.	$7,933,000
Northeast	Northeast Ponding	NE7 Phase 4	Northeast Channel No. 2 is significantly undersized.	Construction of detention with Phase 2 sediment basin.	$15,416,000
Northeast	Range Dam	NE8 Phase 1	1. Flooding on Fairbanks Drive. 2. High sediment load from Castner Range.	Construction of sediment basin west of US 54. Improve US 54 culvert outlet.	$2,836,000
Northeast	Range Dam	NE8 Phase 2	Flow in Fairbanks Drive bypasses the entrance to Electric Ditch Channel resulting in downstream flooding.	Construction of cross sectional inlets.	$1,350,000
Northeast	Range Dam	NE9	Flooding and erosion issues at the intersection of Hondo Pass Avenue and Hondo Pass Drive due to flow from Northgate Diversion Channel.	Installation of pipes to convey flow to Northgate Dam.	$736,000
Northwest	West Central	Keystone Dam Upgrade	Keystone Dam - Upgrade to control existing seepage.	Stabilize downstream slope with toe-drain and berm.	$539,353
Northwest	Doniphan Ditch	NW1	This section of Doniphan Ditch is severely undersized with undersized crossings.	Increase the capacity of three culvert crossings. Increase the capacity of the channel to detain some volume making a linear "Heritage Park/Loop Trail." Grade the section north of Sunset Drive to drain to White Spur Drain.	$2,150,000
Northwest	Keystone Dam	NW10	Ridge View Channel has two undersized crossings.	Increase capacity of two box culverts.	$564,000
Northwest	Keystone Dam	NW11	Ojo De Agua Arroyo has three undersized crossings. Identified upstream sediment source.	Increase capacity of three box culverts. Construct sediment basin.	$1,947,000

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Northwest	Montoya Drain	NW12	Northern section of Doniphan Ditch is undersized.	Increase the capacity of the channel to detain some volume making a linear "Heritage Park/Loop Trail."	$151,000
Northwest	Montoya Drain	NW13	North section of Montoya Drain has eight undersized crossings.	Increase capacity of eight culverts.	$3,814,000
Northwest	Montoya Drain	NW14	Mid section of Montoya Drain has three undersized culverts and the channel is undersized.	Increase the capacity of three culvert crossings. Increase the capacity of the channel to detain some volume making a linear "Heritage Park/Loop Trail."	$3,595,000
Northwest	Montoya Drain	NW15	Lower section of Montoya Drain has three undersized culverts and the channel is undersized. This section of the drain is in New Mexico.	Increase the capacity of three culvert crossings. Increase the capacity of the channel to detain some volume making a linear "Heritage Park/Loop Trail." Install an automatic gate at confluence with river.	$4,590,000
Northwest	Montoya Drain	NW16	East extent of White Spur Drain is undersized.	Increase channel capacity. May need a storm drain system due to limited ROW.	$758,000
Northwest	Montoya Drain	NW17	White Spur Drain has two undersized crossings.	Increase capacity of crossings.	$391,000
Northwest	Oxidation Dam	NW18	Mesa Hills Channel has known sediment/debris issues.	Purchase and enhance existing debris/sediment basin.	$521,000
Northwest	Oxidation Dam	NW19	Silver Springs Channel has identified upstream sediment source.	Construct detention basin or dam.	$4,905,000
Northwest	Doniphan Ditch	NW2	This section of Doniphan Ditch has five undersized crossings and the channel is undersized. There is a known sediment issue.	Increase the capacity of three culvert crossings and two bridges. Increase the capacity of the channel to detain some volume making a linear "Heritage Park/Loop Trail." Construct a sediment basin.	$5,192,000
Northwest	Vinton	NW21	For the upper portion of Flow Path No. 45A, the roadway serves as the channel and does not contain the flow.	Construct a diversion channel to FP 45 and a sediment/detention basin on FP 45.	$21,812,000
Northwest	Vinton	NW22	The lower portion of Flow Path No. 45A has six undersized culverts and the channel is undersized.	Increase the capacity of the two culvert crossings and the channel in the residential area only.	$809,000
Northwest	Vinton	NW23	The lower portion of Flow Path No. 45 has three undersized crossings.	Increase the capacity of three crossings.	$3,288,000
Northwest	Vinton	NW24	The mid portion of Flow Path No. No. 45 has four undersized crossings and the channel is undersized.	Increase the capacity of the four crossings and the channel.	$3,217,000
Northwest	Vinton	NW25	For the upper portion of Flow Path No. 45, the channel is undersized and there is identified upstream sediment source.	The detention/sediment basin is to be constructed as part of NW21. Increase the capacity of the channel based on the outflow from the detention basin.	$120,000
Northwest	Oxidation Dam	NW20	Spring Crest Channel has identified upstream debris and sediment sources.	There is an existing debris/sediment basin. Would need maintenance permit or easement. Is in bedrock so could be expensive to expand.	$659,000
Northwest	Doniphan Ditch	NW3	Pump station outlet pipes discharges to Keystone Dam outlet conduit.	Install conduits that discharge to Doniphan Ditch.	$232,000

Table 8-1. Project Cost Summary (Continued)

Region	System	Project Number	Issue to be addressed	Description of Improvements	Total Cost
Northwest	Flow Paths	NW4	Flow Path No. 38 has three undersized crossings.	Increase the capacity of three culvert crossings	$458,000
Northwest	Flow Paths	NW5	Flow Path No. 39A has one undersized crossing and historical blow out of berm redirecting flow.	Create sediment/detention upstream to reduce peak flow at divergence point. Concrete line 90-degree bend in channel.	$10,850,000
Northwest	Flow Paths	NW6	Flow Path No. 40 has one undersized crossing and part of channel undersized. Identified upstream sediment and debris source.	Increase culvert size and construct a debris basin.	$3,525,000
Northwest	Keystone Dam	NW7	Arroyo 4 has four undersized crossings.	Construct detention basin at El Puente, increase capacity of four culvert crossings.	$3,027,000
Northwest	Keystone Dam	NW8	Arroyo 5 has one undersized crossing.	Increase capacity of one long culvert.	$1,900,000
Northwest	Keystone Dam	NW9	High Ridge Channel has two undersized crossings.	Increase capacity of two box culverts.	$1,409,000
West Central	West Central	WC1	Canterbury Channel has an identified upstream debris source.	Construct a debris basin.	$375,000
West Central	West Central	WC2	Flow Path No. 20 has identified upstream debris sources. There are two undersized culverts.	Construct two debris/detention basins.	$4,379,000
West Central	West Central	WC3	The lower portion of Flow Path No. 20 has an undersized culvert and channel.	Increase capacity of channel and crossing.	$2,923,000
West Central	West Central	WC4	Flow Path No. 21 has one undersized crossing.	Increase the capacity of the Mesa Street crossing. The other crossing is a low water crossing.	$7,246,000
West Central	West Central	WC5	The lower portion of Flow Path No. 21 has an undersized culvert and channel.	Increase crossing and channel capacity.	$2,907,000
West Central	West Central	WC6	For the upper portion of Flow Path No. 23, the channel and six culverts are undersized. There is an identified upstream sediment source.	Increase the capacity of two CBC culverts. Construct one low water crossing. Construct a storm drain system to bypass the undersized portion of the channel and three culverts.	$20,925,000
West Central	West Central	WC7	The lower portion of Flow Path No. 23 has three undersized culverts and discharges to Americas Canal.	Increase capacity of three crossings.	$1,825,000
West Central	West Central	WC8	Paragon Channel has an identified upstream debris source.	Construct a debris basin.	$687,000
		Flood Early Warning System	Some dams have elevated (but low) risk of piping failure, but high potential consequences.	Provide early warning.	$200,000