

## V. DRAINAGE IMPROVEMENTS

### 5.1 Formulation of Drainage Improvements

As indicated in Chapter 4, following the completion of the hydrologic analysis associated with future land use conditions, drainage improvements were identified and evaluated to mitigate the flooding problems identified within each drainage basin. The results of this initial planning effort generated improvements that exceed a total construction cost of \$22 million. Given the magnitude of the cost estimate along with the potential increase associated with the construction of the improvements on the existing stormwater fees, it was determined that the formulation of drainage improvements would assume the construction of on-site detention ponds associated with future development within each basin. The on-site detention ponds assumed 100-year future condition flows were detained and released at the 10-year existing condition discharge rate (i.e., over-detention requirements). The exceptions to this detention criteria are: (a) the Ptarmigan Basin where release rates have been previously determined based on the capacity of the existing structures; and (b) the Jacoby Basin where the area upstream of the Greeley No. 2 Canal and west of WCR 15 is limited to 0.2 cfs/acre during the 100-year storm event.

With the direction provided in meetings with the Town staff, drainage improvements were generated to mitigate the potential flooding assuming future land use conditions and over-detention in each drainage basin. The potential flooding problems were previously described in Chapter 4 for this hydrologic condition. This chapter presents the drainage improvements developed to mitigate these flooding problems.

In general, several improvements were initially identified as potential solutions for the drainage problems discussed in Chapter 4. These improvements were also intended to meet master planning objectives associated with the undeveloped portions within each drainage basin. The following items were considered during the formulation of a comprehensive drainage plan.

- Construction of detention ponds.
- Installation, removal or replacement of structures at specific problem areas.
- Improvement or enlargement of major drainage channels.
- Acquisition of property/structures within specific flooding areas and relocation of homeowners and/or businesses.
- Floodproof structures in specific flooding areas, where appropriate.

- Construction of berms and spill structures to contain additional stormwater captured by the irrigation canals/ditches and control the release of excess stormwater.

As previously indicated, over 90 percent of the watershed that contributes stormwater to the Town of Windsor is presently undeveloped and largely consists of land associated with agricultural, ranching, open space and floodplains. Within the Growth Management Boundary, flooding problems are predominantly associated with road crossings and limited channel capacity along the major drainageways, and limited on-site detention in developed areas. Due to the nature and location of the flooding problems, this master planning effort focused on providing alternatives that would significantly reduce the peak discharge in the major drainageways within each drainage basin.

Flooding problems are created at several of the road crossings within the Growth Management Boundary that do not adequately convey the 100-year flood event without overtopping the roadway. Currently, the responsibility for improving some of the structures may rest with either the county or state highway officials. Given that these structures are located within the Growth Management Boundary, however, this master planning effort assumed replacement of the structures as development occurs within the basin. Furthermore, replacement of these structures assumes the stormwater runoff is conveyed to these locations as indicated by the existing topographic mapping. Where drainage channels do not presently exist, channel improvements may ultimately be necessary to ensure that these stormwater flows are conveyed to the location of the crossing structures.

Several detention areas that presently exist behind roadway and railroad embankments do not meet existing drainage criteria. Nevertheless, these ponds may play an important role in reducing the 100-year peak discharge in the subbasins in which they are located. In addition, several irrigation reservoirs provide detention and/or retention benefits that reduce the stormwater runoff during major storm events. This master planning effort assumed that those ponds and reservoir, that provide effective detention during major storm events, will remain intact or will be replaced/incorporated into detention requirements associated with future development within each basin.

The general approach taken to provide solutions to the existing drainage problems consisted of the major improvements indicated below.

- Where appropriate, crossing structures with limited capacity should be improved and enlarged to meet existing drainage criteria or criteria identified in the master plan. These improvements will reduce backwater elevations and roadway overtopping.
- Open channels should be improved and enlarged to reduce channel overbank flooding and mitigate potential channel erosion.

- Regional detention ponds should be constructed where appropriate to reduce the peak discharges within a drainageway.
- On-site detention ponds should be constructed within the basins to limit the peak discharges in the drainageways, as well as the runoff from each subbasin, during the 100-year storm to the magnitude of the existing condition, 10-year storm event.
- Maintain or replace the existing roadway and railroad detention ponds where these facilities provide significant benefit during the major storm events. The releases from these structures should be limited to maximize the existing storage present at these locations.
- Construct spill structures and enlarge the canal section, where appropriate, along the irrigation canals/ditches to prevent flooding of adjacent properties. Divert the stormwater captured by the irrigation facilities to major outfall conveyance facilities or major drainageways.

## **5.2 Description of Drainage Improvements**

The improvements discussed in the previous section were initially evaluated and screened for applicability. A preferred list of improvements was identified and a comprehensive plan was developed that would address flooding problems along the major drainageway in each drainage basin within the Growth Management Boundary. In the paragraphs that follow, the preferred improvements are discussed. Unless otherwise stated, these improvements assume that on-site detention is provided to limit the releases for future developments to the 10-year existing condition levels.

To facilitate the screening and evaluation of proposed improvements as well as the formulation of an implementation plan, each basin was evaluated on an individual basis, and if necessary, the major drainageway was divided into reaches as described below.

### ***Law Basin-Main Channel***

Reach L1: Cache la Poudre River to downstream of Eastman Park Drive

Reach L2: Downstream of Eastman Park Drive to State Highway 392

Reach L3: State Highway 392 to WCR 70

### ***Law Basin-West Tributary***

Reach L4: Colorado and Southern Railroad to State Highway 392

Reach L5: Kern Reservoir, WCR 19 to Greeley No. 2 Canal

Reach L6: WCR 19 to State Highway 257

### ***Windsor Basin***

Reach W1: Lower Basin-State Highway 392 to Eastman Park Drive

Reach W2: Lower Basin-State Highway 392 to Eastman Park Drive

Reach L5: Upper Basin, Kern Reservoir to Greeley No. 2 Canal

### ***High School Basin***

Reach H: State Highway 392 to Cache la Poudre River

### ***Jacoby Basin***

Reach J: Greeley No. 2 Canal to Cache la Poudre River

### ***Timnath Reservoir Basin***

Reach T: Cache la Poudre River to 1,400 feet Upstream of LCR 32 ½

### ***Ptarmigan Basin***

Reach P: 500 feet south of LCR 30 to State Highway 392

### ***Oklahoma Basin***

Reach O1: Cache la Poudre River to Great Western Railroad

Reach O2: WCR 17 and WCR 60

### ***South State Highway 257 Basin***

Reach S: Cache la Poudre River to State Highway 34

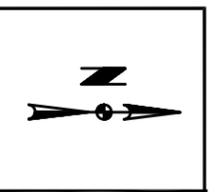
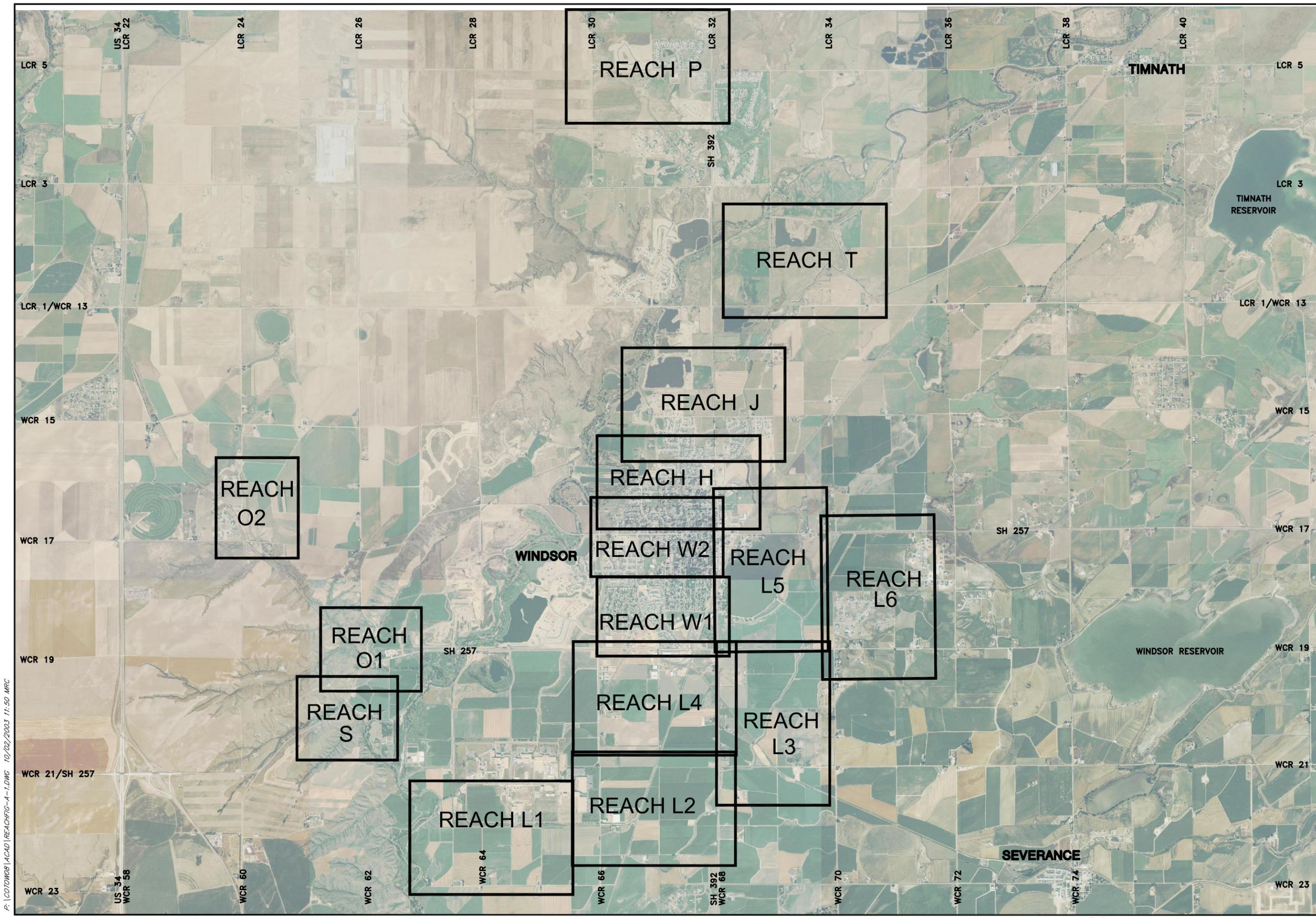
No drainage improvements have been identified within the River Ridge and Bluff Basins; consequently no reach delineations were necessary for these basins.

The drainage improvement plans for each reach are referenced in Figure 5.1. Figures 5.2 to 5.16 present the conceptual plans associated with the improvements within each drainage basin.

#### ***5.2.1 Law Basin-Reach L1***

The proposed improvements to Reach L1 are presented below and in Figure 5.2.

Stormwater Channel (Sta. 0+00 to 72+00). Construct approximately 7,200 feet of channel improvements from the confluence of the Cache la Poudre River to approximately 1,200 south of Eastman Park Drive. The channel configuration includes a low flow channel along with an overbank area to convey flood flows. In addition, the



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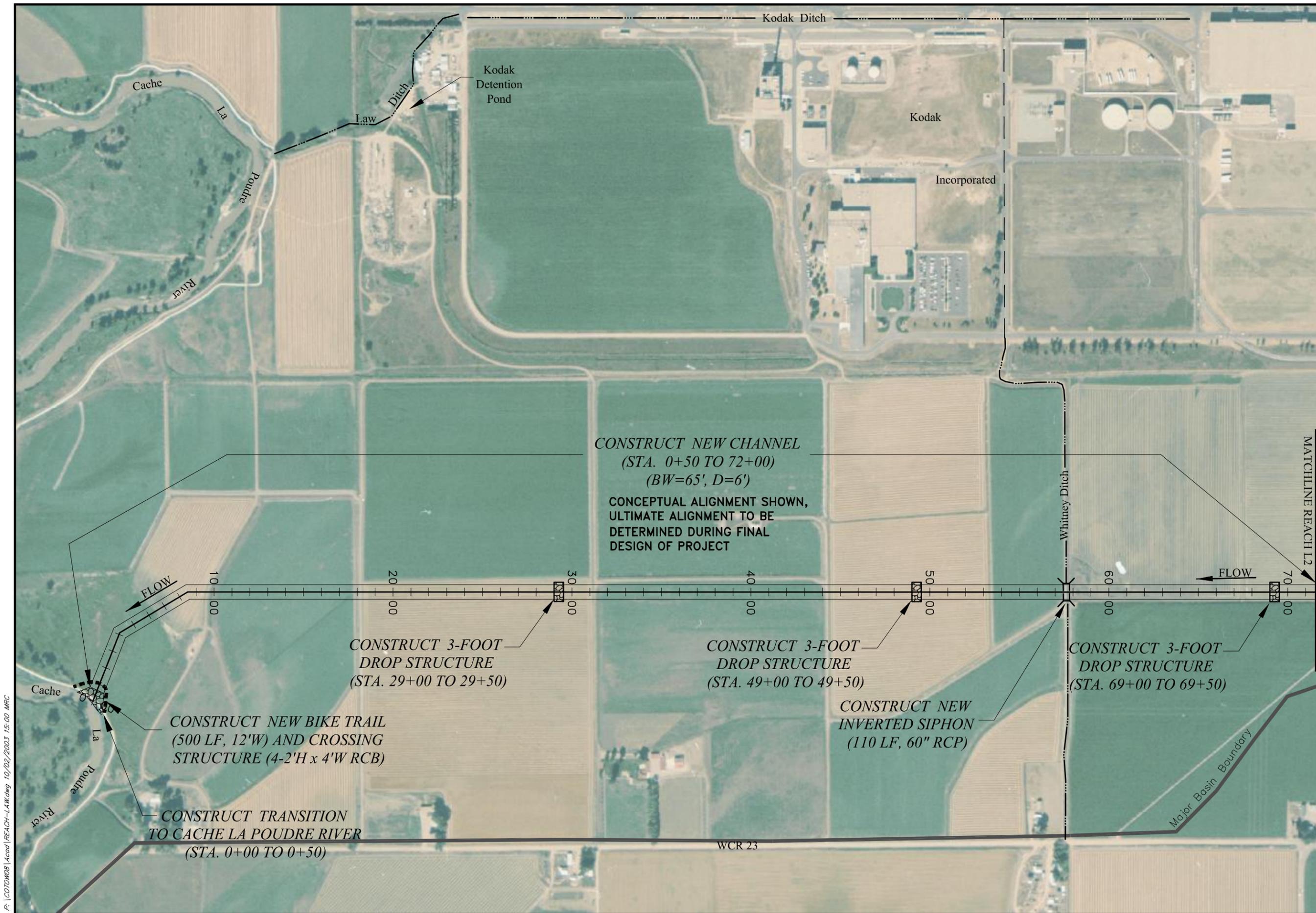
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**FIGURE  
5.1**

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**TOWN OF WINDSOR  
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LAW BASIN  
REACH L1**

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**FIGURE  
5.2**

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channel incorporates a grass lining, total bottom width of 65 feet including a bottom width of 20 feet for the low flow channel, maximum top width varying from 110 to 125 feet, sideslopes of 4H:1V, channel slope of 0.003 ft/ft, and design depth of approximately 5 feet. In conjunction with construction of the channel, a rock-lined transition structure into the Cache la Poudre River is required. To maintain a non-erosive channel slope, construction of three 3-foot grouted rock drop structures will be required.

Whitney Ditch Crossing. Construction of a 60-inch inverted siphon is required to convey irrigation diversions in the Whitney Ditch under the new stormwater channel. The siphon is approximately 110 feet in length and includes concrete headwalls at both the inlet and outlet to the siphon.

Bike Trail Crossing. Construction of the stormwater channel will required installation of a crossing for the existing bike trail along the Cache la Poudre River. The structure will convey the peak discharge associated with the future conditions 2-year storm event under the crossing. Events greater than the 2-year storm will be conveyed over the bike trail crossing. The structure consists of four 2'H x 4'W reinforced box culverts. Erosion protection will be provided along the embankments of the crossing to protect the trail during overtopping events between the 2-year and 100-year events.

### ***5.2.2 Law Basin-Reach L2***

The proposed improvements to Reach L2 focus on the new stormwater channel and crossing structures at Eastman Park Drive and the Colorado & Southern Railroad. Figure 5.3 presents the improvements in Reach L2.

Stormwater Channel (Sta. 72+00 to 136+00). Construct approximately 6,400 feet of channel improvements from approximately 1,200 south of Eastman Park Drive to a point along the north side of the Colorado & Southern Railroad. The channel improvements include a low flow channel along with an overbank area to convey flood flows. In addition, the channel incorporates a grass lining, bottom width ranging from 20 to 65 feet (high flow channel), maximum top width ranging from 90 to 120 feet, channel slope varying from 0.0013 ft/ft to 0.003 ft/ft, sideslopes of 4H:1V, and a design depth of varying from 6 to 8 feet.

Eastman Park Drive Crossing. Construct a new crossing consisting of a 6'H x 16'W reinforced concrete box culvert. Transitions from the existing channel to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing.



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**FIGURE  
5.3**

Colorado & Southern Railroad Crossing. Construct a new crossing consisting of three 72-inch diameter RCPs. Transitions from the existing channel to the culvert crossing are required along with placement of stabilization measures to control the potential erosion near the crossing. Construction costs associated with the crossing assume the RCPs will be bored under the tracks to facilitate railroad operations during construction.

Stormwater Channel (Sta. 136+00 to 163+00). Construct approximately 2,700 feet of channel improvements from the Colorado & Southern Railroad to State Highway 392. The channel should incorporate a grass lining, a bottom width of 17 feet, maximum top width of 90 feet, channel slope ranging from 0.0024 ft/ft to 0.003 ft/ft, sideslopes of 4H:1V, and design depth of approximately 9 feet. A 2-foot drop structure and a 3-foot drop structure will be required along the new channel to maintain the non-erosive slope.

State Highway 392 Crossing. Construct a new crossing consisting of two 4'H x 8'W reinforced concrete box culverts. The crossing will be approximately 250 feet in length and will convey stormwater flows from the Main Channel of the Law Basin under the Greeley No. 2 Canal and State Highway 392. Transitions from the new channels to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing.

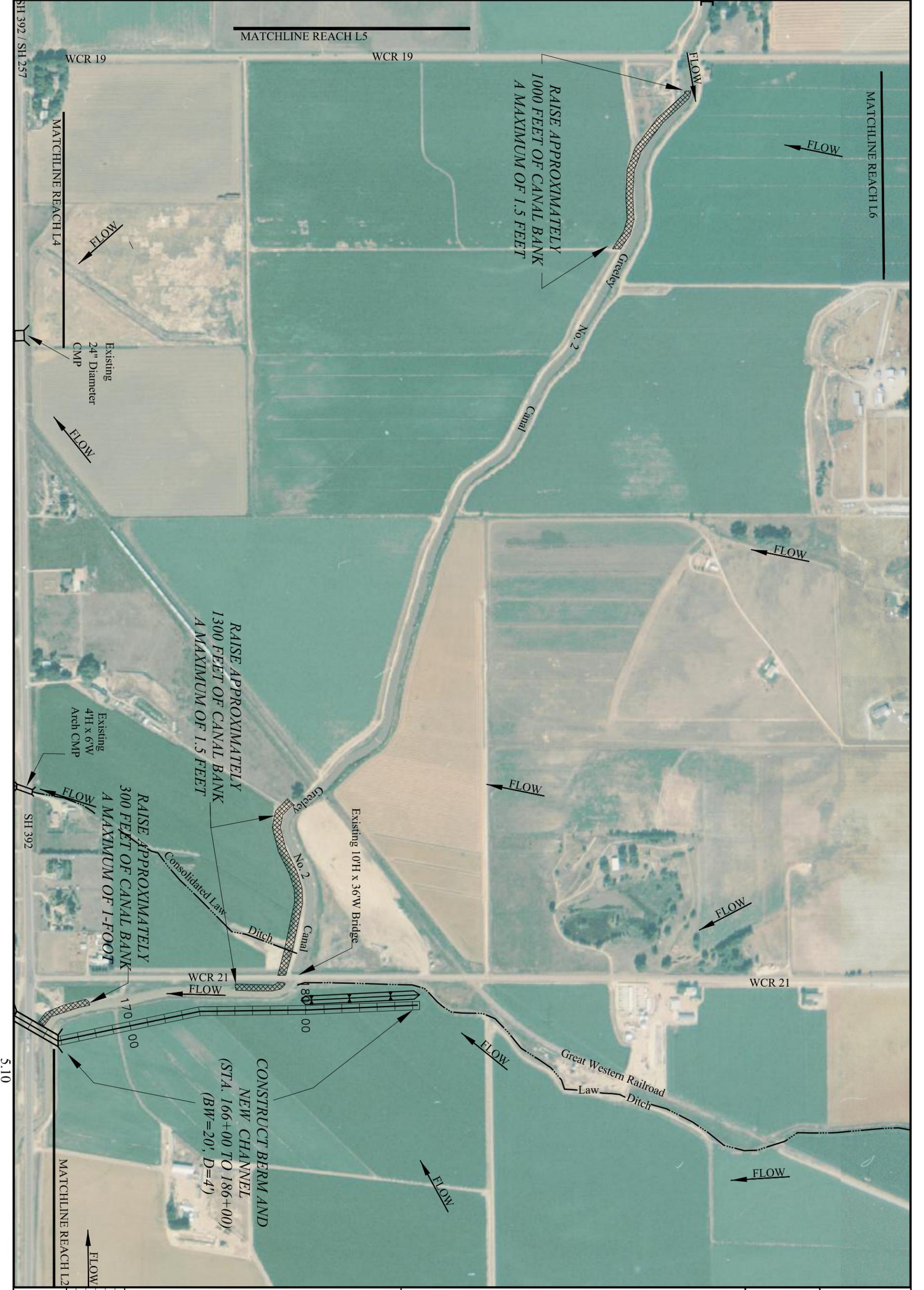
Stormwater Channel (Sta. 0+00 to 8+50). Construct approximately 850 feet of stormwater channel along the south side of State Highway 392 from the outlet of the proposed State Highway 392 crossing structure to the Greeley No. 2 Canal. The channel incorporates a grass lining, a bottom width of 8 feet, maximum top width of 60 feet, channel slope of 0.004 ft/ft, sideslopes of 4H:1V, and design depth of approximately 6 feet. A 3-foot drop structure and a 4-foot drop structure, respectively, will be required at the inlet and outlet to the channel.

Improvements to Greeley No. 2 Canal. Modifications to the existing check structure on the Greeley No. 2 Canal and construction of a new side-channel weir downstream of State Highway 392 will be required to divert as much as 210 cfs of stormwater flow conveyed by the canal due to upstream improvements. The side-channel weir incorporates a bottom width of 30 feet and a depth of 2 feet.

### **5.2.3 Law Basin-Reach L3**

Improvements in Reach L3 focused on the alleviation of flooding problems at the intersection of WCR 21 and State Highway 392. The specific improvements to Reach L3 are presented below and in Figure 5.4.

Channel Improvements Sta. 166+00 to 186+00. Approximately 2,000 feet of channel improvements upstream of S.H. 392 will be required to capture and convey stormwater runoff captured by the main drainage channel in the Law Basin. The channel improvements should incorporate a grass lining, bottom width of 20 feet, maximum top



5.10

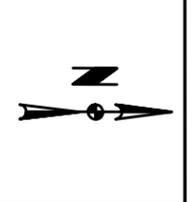
<b>FIGURE 5.4</b>	Project No. COTOW08
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width of 50 feet, channel slope of 0.003 ft/ft, sideslopes of 4H:1V, and design depth of 4 feet. At the upstream end of the channel improvements, approximately 600 feet of berming is required to capture the stormwater runoff and direct the flows into the proposed improvements.

Greeley No. 2 Canal Improvements. Approximately 2,600 lineal feet of the south and west bank of the Greeley No. 2 Canal between WCR 19 and State Highway 392 will be elevated. A maximum of 1.5 feet of fill will be required to provide approximately 1 foot of freeboard to convey the design discharge of 800 cfs (600 cfs of irrigation flows plus 200 cfs of stormwater during the 100-year event).

#### **5.2.4 Law Basin-Reach L4**

The proposed improvements to Reach L4 focus on the construction of new stormwater channels and the improvement of two existing crossing structures. Figure 5.5 presents the improvements for Reach L4.

Channel Improvements (Sta. 0+00 to 50+00). Construct approximately 5,000 feet of the West Tributary Channel from the Colorado & Southern Railroad confluence with the Main Channel to State Highway 392. The channel should incorporate a grass lining, a bottom width of 10 feet, maximum top width of 55 feet, channel slope of 0.0016 ft/ft, sideslopes of 4H:1V, and design depth of approximately 5 feet.

Consolidated Law Ditch Crossing. Construct a 36-inch diameter RCP, inverted siphon to convey Consolidated Law Ditch flows under the West Tributary stormwater channel improvements. The siphon will be approximately 100 feet in length.

Great Western Railroad Crossing. The existing 48-inch diameter CMP will be replaced with a crossing structure consisting of five 36-inch diameter RCPs. Transitions from the proposed channel to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing. The construction cost estimate assumes that the pipes will be bored under the tracks to facilitate railroad operations during construction. If construction will permit an open cut of the railroad tracks, a reinforced box culvert with an open area of approximately 40 square feet will be required.

State Highway 392 Crossing. The existing 24-inch diameter CMP will be replaced with a crossing structure consisting of two 3'H x 6'W reinforced concrete box culverts. Transitions from the existing channel upstream and the proposed channel downstream to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing.

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**FIGURE  
5.5**

### 5.2.5 Law Basin-Reach L5

The proposed improvements to Reach L5 focus on the diversion of stormwater runoff into Kern Reservoir and the utilization of Kern Reservoir as a regional stormwater detention facility. The stormwater generated in both the Upper Windsor Basin and the West Tributary of the Law Basin will be captured and conveyed into Kern Reservoir. Modifications to the Greeley No. 2 Canal facilities are required to divert the stormwater into Kern Reservoir and convey the releases from the reservoir to the outfall channel improvements near State Highway 392. The proposed improvements encompass the West Tributary of the Law Basin as well as upper portion of the Windsor Basin. Figure 5.6 presents the improvements associated with Reach L5.

Kern Reservoir Enlargement. The sediment accumulated in Kern Reservoir will be excavated to create additional storage for irrigation water. This will allow the reservoir to be operated at a lower elevation (operating levels: current = 4,795 msl, NAVD 1988; proposed = 4,793.0 ft, msl, NAVD 1988) thereby creating additional storage for stormwater runoff. The required flood storage is 718 acre-feet.

Plug Existing Principal Spillway. The existing principal spillway presently controls the water surface in the reservoir at elevation 4,795.0 ft, msl, NAVD 1988 and releases as much as 60 cfs into the Lower Windsor Basin during the 100-year storm event. To prevent the stormwater releases into the Lower Windsor Basin during the 100-year event, it is recommended that the existing principal spillway be plugged. A new principal spillway can be incorporated into the new radial gate structure on the Greeley No. 2 Canal upstream of WCR 19.

Emergency Spillway Improvements. As a result of the proposed improvements to the Kern Reservoir, requirements for dam safety as promulgated by the Office of the State Engineer will need to be reviewed. It is anticipated that the results of this investigation will require modifications to the existing emergency spillway.

Greeley No. 2 Canal Improvements at Osterhaut Lake. The Greeley No. 2 Canal between the Colorado & Southern Railroad bridge and State Highway 257 (approximately 3,500 feet in length) will be enlarged to capture and convey stormwater emanating from the Upper Windsor Basin. The captured flows will be conveyed under State Highway 257 using the existing bridge and into Kern Reservoir using the existing inlet structure approximately 500 feet east of State Highway 257. The east bank of the canal will be elevated as much 5 feet and the canal cross section will need to be enlarged. Channels necessary to convey stormwater runoff from the Upper Windsor Basin and transition into the Greeley No. 2 Canal will be required and are assumed to be provided during development of the property in the upper basin.



Water Line Relocation. Currently, two raw water lines for the City of Greeley cross over the Greeley No. 2 Canal immediately downstream of the existing radial gates on the Kern Reservoir. As canal improvements are made to accommodate the capture and conveyance of stormwater in the basin, relocation of the raw water lines is anticipated.

Extend Pedestrian Bridge. Currently, a pedestrian bridge spans the Kern Reservoir outlet immediately upstream of the existing radial gates. When canal improvements are made to accommodate stormwater releases from the reservoir; it is anticipated that the pedestrian bridge will be extended.

Greeley No. 2 Canal/Kern Reservoir Outlet Improvements. To promote the capture and diversion of stormwater runoff from the West Tributary of the Law Basin into the Kern Reservoir, several improvements are necessary to the Greeley No. 2 Canal and the Kern Reservoir outlet canal. The banks of both canals will be raised a maximum of 5 feet. The banks should be elevated to contain and control the runoff from the future conditions 100-year storm event with out exceeding the elevation of the emergency spillway (4,797.0 ft, msl, NAVD 1988). The existing radial gates at the outlet will be relocated to Greeley No. 2 Canal in the vicinity of WCR 19. The existing measurement structure will also be relocated near WCR 19. Diversion of additional stormwater runoff from the Law Basin into Kern Reservoir will require coordination with the Office of the State Engineer to ensure all dam safety requirements are satisfied.

#### **5.2.6 Law Basin-Reach L6**

The proposed improvements to Reach L6 involve the diversion of stormwater runoff from the West Tributary of the Law Basin into Kern Reservoir, channel improvements to the Springer Ditch and installation of a crossing structure in State Highway 257. Figure 5.7 presents the improvements associated with Reach L6.

Channel Improvements. Construct approximately 2,400 feet of stormwater channel along the south side of WCR 70 west of WCR 19 to the confluence with the Springer Ditch. The channel will capture stormwater runoff from the Law Basin, specifically the Windsor Ranch Subdivision and the watershed tributary to the subdivision, and convey the runoff to the Springer Ditch. The channel incorporates a grass lining, a bottom width of 14 feet, maximum top width of 45 feet, channel slope ranging from 0.002 to 0.005 ft/ft, sideslopes of 4H:1V, and design depth of approximately 4 feet.

Springer Ditch Improvements (Sta. 15+00 to 46+00). Construct approximately 3,100 feet of improvements to the Springer Ditch from the confluence with the Greeley No. 2 Canal to State Highway 257. The improved channel should incorporate a grass lining, a bottom width of 15 feet, maximum top width of 65 feet, channel slope of 0.002 ft/ft, sideslopes of 4H:1V, and design depth of approximately 10 feet. Consideration should be given to a low-flow channel capable of conveying the normal irrigation flows in the Springer Ditch.



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**FIGURE  
5.7**

State Highway 257 Crossing. Construct a crossing structure consisting of a 3'H x 10'W reinforced concrete box culvert. The culvert is anticipated to be 40 feet in length and will convey stormwater flows generated west of State Highway 257 under the highway and into the Springer Ditch. Transitions from the new channels to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing. Minor berming may be required west of State Highway 257 to direct shallow sheet flooding to the crossing.

### **5.2.7 Windsor Basin-Reach W1**

The improvements recommended in eastern portion of the Lower Windsor Basin are intended to minimize localized street flooding through the optimization of existing and proposed detention facilities and installation of storm sewer and channel improvements. Where appropriate, floodproofing measures have been recommended to minimize the damages from local street flooding. These improvements are presented in Figure 5.8.

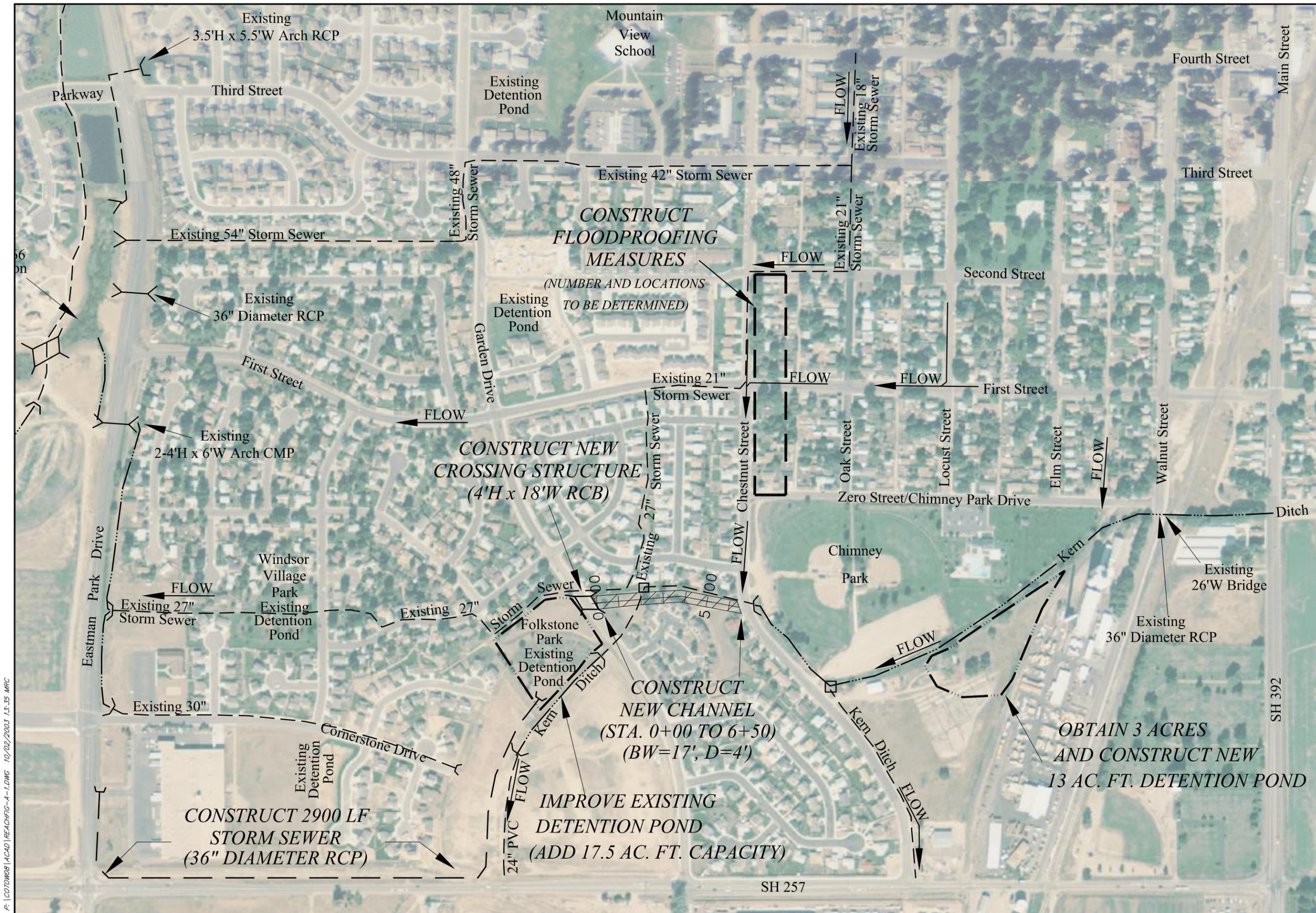
Chimney Park Regional Detention Pond. To reduce peak flows in the lower Windsor Basin, a regional detention pond is proposed in the area east of Chimney Park. The proposed pond will incorporate a storage volume of 13 acre-feet and will require acquisition of 3 acres of land.

Folkstone Park Regional Detention Pond. To further reduce peak flows in the lower Windsor Basin, improvements are required to the existing detention facility at Folkstone Park. The existing pond will be enlarged to provide an additional 17.5 acre-feet of capacity. The park is currently owned by the Town of Windsor and therefore no property acquisition is required.

Chestnut Street Floodproofing Measures. Floodproofing measures are recommended for structures located along Chestnut Street. The exact number, location, and type of improvements should be determined following a detailed hydraulic study in this area.

Channel Improvements (Sta. 0+00 to 6+50). Construct approximately 650 feet of stormwater channel between Chestnut Street and Garden Drive. The channel will capture stormwater runoff on Chestnut Street and the drainage basin to the north and convey the runoff into the Folkstone Park Detention Pond. Due to space limitations, the proposed channel should incorporate vertical sideslopes, a channel slope of 0.0028 ft/ft, bottom width of 17 feet, and a design depth of approximately 4.5 feet.

Garden Drive Crossing. Construct a crossing structure consisting of a 4'H x 18'W reinforced concrete box culvert. The culvert is estimated to be 60 feet in length and will convey stormwater flows from north of Garden Drive under the road and into the Folkstone Park Detention Facility. Transitions from the new channel to the culvert crossing and from the culvert to the detention pond are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing.



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REACH W1**

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**FIGURE  
5.8**

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Folkstone Park Detention Pond Outfall. Install 2,900 feet of 36-inch diameter RCP storm sewer. The storm sewer will serve as an outfall facility for the Folkstone Park Detention Pond. The outfall pipe will convey stormwater to the roadside ditch located north of Eastman Park Drive.

### **5.2.8 Windsor Basin-Reach W2**

The improvements recommended in the western portion of the Lower Windsor Basin are intended to minimize the damages associated with localized street flooding through the installation of floodproofing measures. These improvements are presented in Figure 5.9.

Oak Street Floodproofing Measures. Floodproofing measures are recommended for structures adjacent Oak Street between Third Street and Fourth Street. The exact number, location, and type of floodproofing measure should be determined following completion of a detailed hydraulic analysis.

Locust Street Floodproofing Measures. Floodproofing measures are recommended for structures located between Locust Street and Oak Street directly east of Seventh Street. The exact number, location, and type of improvements should be determined following completion of a detailed hydraulic analysis.

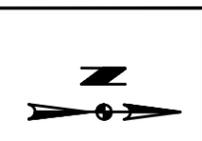
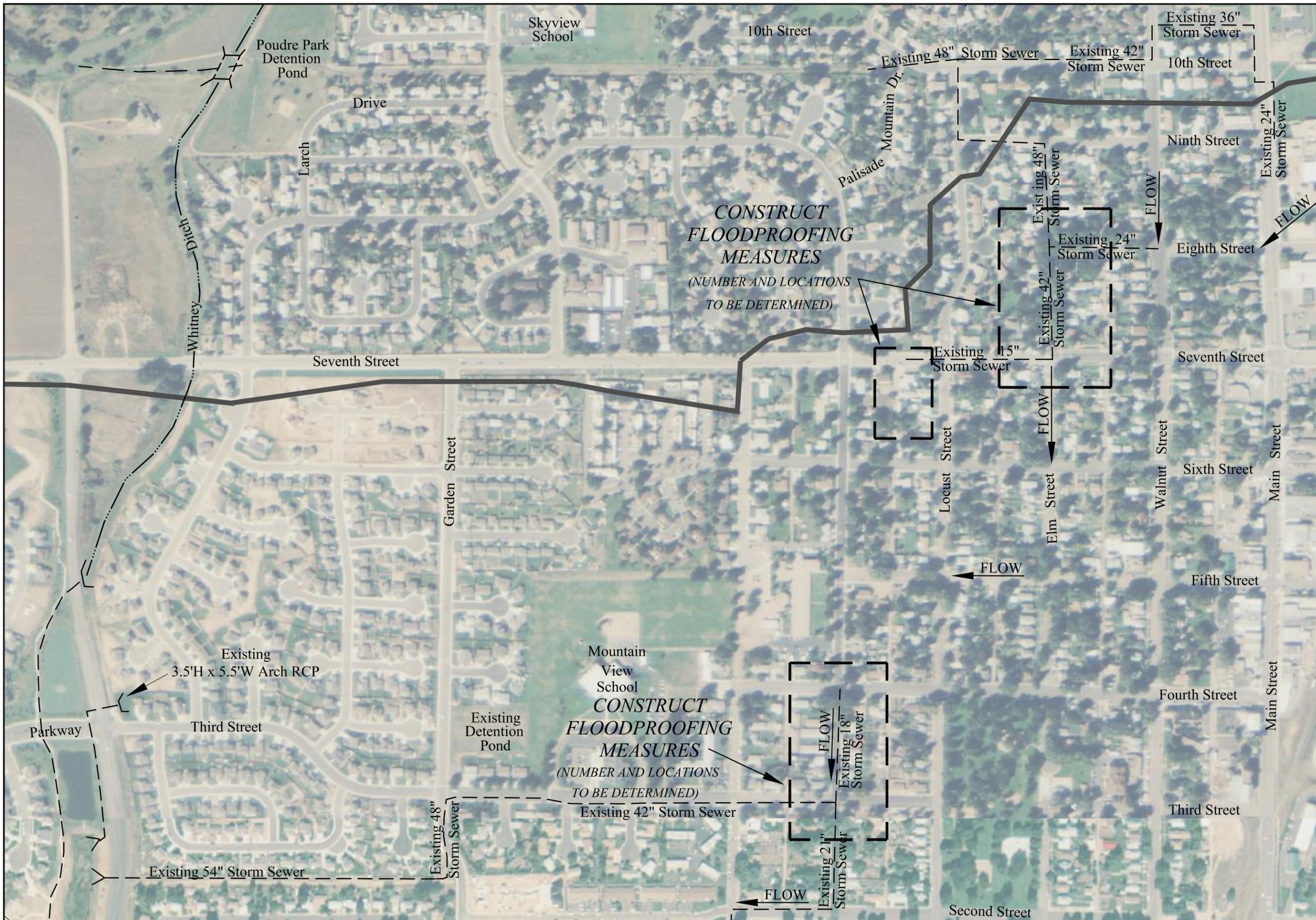
Elm Street Floodproofing Measures. Floodproofing measures are recommended for structures along Elm Street between Seventh Street and Eighth Street. The exact number, location, and type of improvements should be determined following completion of a detailed hydraulic analysis.

### **5.2.9 High School Basin**

Improvements in the High School Basin are intended to alleviate the potential flooding problems in the vicinity of Stone Mountain Drive. The specific improvements to the High School Basin are presented below and also on Figure 5.10.

10<sup>th</sup> Street Channel Outfall. Construct an outfall channel from the Poudre Park Detention Pond to the Cache la Poudre River. The outfall channel is approximately 600 feet in length and incorporates a bottom width of 40 feet, depth of 5 feet, channel slope of 0.001 ft/ft, grass-lined sideslopes of 3H:1V, and a stabilized transition into the Cache la Poudre River.

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SCALE  
1" = 400'

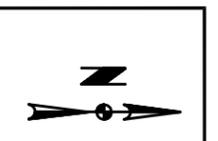
**TOWN OF WINDSOR  
MASTER DRAINAGE PLAN  
WINDSOR BASIN  
REACH W2**

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**FIGURE  
5.9**



SCALE  
1" = 500'

**TOWN OF WINDSOR  
MASTER DRAINAGE PLAN  
HIGH SCHOOL BASIN  
REACH H**

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**FIGURE  
5.10**

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Whitney Ditch Siphon. A siphon will be installed under the outfall channel to convey irrigation diversions associated with the Whitney Ditch. The siphon will be approximately 60 feet in length and will consist of a 60-inch RCP with inlet and outlet transition structures.

10<sup>th</sup> Street Channel - Downstream of Stone Mountain Drive. Improve approximately 700 lineal feet of channel between the Poudre Park Detention Pond and Stone Mountain Drive. The channel improvements include a grass lining, bottom width of 10 feet, maximum top width of 35 feet, channel slope of 0.005 ft/ft, sideslopes of 3H:1V, and a design depth of approximately 4.0 feet.

Stone Mountain Drive Crossing Improvements. Replace the existing triple-30" CMP crossing of Stone Mountain Drive with two 4'H x 9'W reinforced box culverts. Transitions from the existing channel to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing.

10<sup>th</sup> Street Conveyance Improvements. During large storm events, runoff is collected and conveyed in 10<sup>th</sup> Street and ultimately the 10<sup>th</sup> Street Stormwater Channel. To promote the safe conveyance of stormwater into the 10<sup>th</sup> Street Channel, improvements are required at two locations. Improvements at the intersection of Palisade Mountain Drive and 10<sup>th</sup> Street are recommended to divert stormwater flows on the east side of the street into the 10<sup>th</sup> Street Channel. The improvement may include installation of a cross pan, localized lowering of the curbs/gutters and sidewalks, and construction of a swale from Palisade Mountain Drive to the outlet of the existing 48-inch diameter storm sewer. In addition, improvements are recommended at the end of the cul-de-sac where 10<sup>th</sup> Street turns to the west (see Figure 5.10). A drainage easement should be preserved at this location to allow stormwater runoff which collects in the cul-de-sac to be conveyed to the 10<sup>th</sup> Street Channel. The drainage improvements from the cul-de-sac may include construction of drainage swales, and lowering of street curbs/sidewalks.

### ***5.2.10 Jacoby Basin***

Improvements in Jacoby Basin focused on the alleviation of flooding problems at WCR 68 ½, the Greeley No. 2 Canal, and at State Highway 392. The specific improvements to Jacoby Basin are presented below and also on Figure 5.11.

WCR 15 Storm Sewer. Construct approximately 1,300 feet of 60-inch diameter, RCP storm sewer along the west side of WCR 15. The storm sewer will transition into the existing 60-inch RCP storm sewer at State Highway 392 and terminate on the north side of the Greeley No. 2 Canal. A 60-inch RCP siphon will be required near the Greeley No. 2 Canal to convey stormwater runoff beneath the canal facilities.



SCALE  
1" = 500'

**TOWN OF WINDSOR  
MASTER DRAINAGE PLAN  
JACOBY BASIN  
REACH J**

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**FIGURE  
5.11**

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Limiting Stormwater Releases from Subbasins J11 and J12. It is recommended that future development (those parcels platted and approved for construction after June 1, 2000) north of the Greeley No. 2 Canal and west of WCR 15 limit the release of stormwater to approximately 0.2 cfs/acre. This recommended improvement will ensure that the capacity of the existing 72-inch diameter storm sewer is not exceeded.

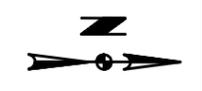
### ***5.2.11 Timnath Reservoir Basin***

Improvements in the Timnath Reservoir Basin are intended to mitigate the potential flooding problems at LCR 32½ and the Greeley No. 2 Canal through the construction of a regional drainage channel, improved crossing structure and siphon/wasteway structure on the Greeley No. 2 Canal. The specific improvements in this basin are presented below and on Figure 5.12.

Channel Improvements. Construct approximately 6,000 feet of channel improvements from the Cache la Poudre River to the Timnath Reservoir Outlet Ditch located north of the Greeley No. 2 Canal. The channel configuration includes a compound channel, i.e., a low flow channel along with an overbank area to convey flood flows. In addition, the channel incorporates a grass lining, bottom width ranging from 35 to 40 feet, channel slope of approximately 0.003 ft/ft, sideslopes of 4H:1V, and a design depth ranging from 5 to 6.5 feet. At the downstream end of the channel improvements, a transition into the Cache la Poudre River is required to convey flows safely and in a non-erosive manner to the river. In a similar manner, a transition structure will be required near the Timnath Reservoir Outlet Ditch to convey stormwater into the channel improvements.

LCR 32½ Crossing Structure. Replace the existing 30-inch diameter CMP crossing of LCR 32½ with two 6'H x 10'W reinforced concrete box culverts. Transitions from the new channel to the culvert crossing are required along with placement of stabilization measures to control the potential erosion in the vicinity of the crossing.

Greeley Number 2 Improvements. In order to safely convey stormwater from the Timnath Reservoir Basin through the facilities associated with the Greeley No. 2 Canal, the following improvements are required: (a) an inverted siphon to convey irrigation flows underneath the new stormwater channel, (b) a wasteway structure upstream of the inverted siphon, and (c) a headgate/diversion structure at the upstream end of the channel improvements. The inverted siphon will consist of two 6'H x 10'W reinforced concrete box culverts. The wasteway structure will spill stormwater flows captured by the canal, which cannot pass through the new siphon. The headgate/diversion structure is required to allow conveyance of irrigation flows in the Timnath Reservoir Outlet Ditch into the Greeley No. 2 Canal while diverting stormwater flows into the channel improvements.



SCALE  
1" = 500'

**TOWN OF WINDSOR  
MASTER DRAINAGE PLAN  
TIMMATH RESERVOIR BASIN  
REACH T**

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**FIGURE  
5.12**

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LCR 1 / WCR 13

LCR 1/WCR 13

### ***5.2.12 Ptarmigan Basin***

The improvements in the Ptarmigan Basin are intended to alleviate the potential flooding identified at two crossings (Subbasin P14 and Subbasin P09) of State Highway 392. The specific improvements to Ptarmigan Basin are presented below and in Figure 5.13.

LCR 5 Crossing Structure. Improve the existing 21-inch diameter steel pipe crossing LCR 5 north of State Highway 392. The improvements consist of: (a) enlarging the existing drainage channel located north of State Highway 392 to the inlet of the 21-inch steel pipe, (b) installation of improved inlet and outlet structures (headwalls/flared end sections/trash rack), and (c) removal of all sediment within, and adjacent to the existing crossing structure.

State Highway 392 Crossing Structure. Improve the existing 24-inch diameter HDPE pipe crossing immediately east of LCR 5. The improvements consist of: (a) enlarging the existing drainage channel immediately south of the crossing, (b) constructing improvements to the existing drop inlet structures into the existing 18-inch diameter HDPE outfall pipe; (c) installing improved inlet and outlet structures (headwalls, flared end sections, trash rack, etc), and (d) removal of all sediment within, and adjacent to, the existing crossing structure.

LCR 30 Detention Pond. To reduce the peak flows at the State Highway 392 crossing in Subbasin P14, a regional detention pond is proposed south of LCR 30 and east of I-25. The pond is located upstream of the existing Loudon Ditch. The pond requires 8.6 acre-feet of storage, which will necessitate the acquisition of approximately 4 acres of land along with the construction of an outlet structure under the Loudon Ditch. The outfall channel from the detention pond to State Highway 392 is assumed to be included in the construction associated with development of the property between LCR 30 and State Highway 392.

### ***5.2.13 River Ridge Basin***

No flooding improvements in the River Ridge Basin are recommended assuming the enforcement of on-site over-detention within the basin. Special attention should be focused on potential channel stability problems within the main drainage channel as development occurs in the basin.



SCALE  
1" = 500'

**TOWN OF WINDSOR  
MASTER DRAINAGE PLAN  
PTARMIGAN BASIN  
REACH P**

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**FIGURE  
5.13**

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#### **5.2.14 Bluff Basin**

No flooding improvements in the Bluff Basin are recommended assuming the enforcement of on-site over-detention within the basin. Similar to the River Ridge Basin, special attention should be focused on erosional issues as develop occurs in the basin.

#### **5.2.15 Oklahoma Basin-Reach O1**

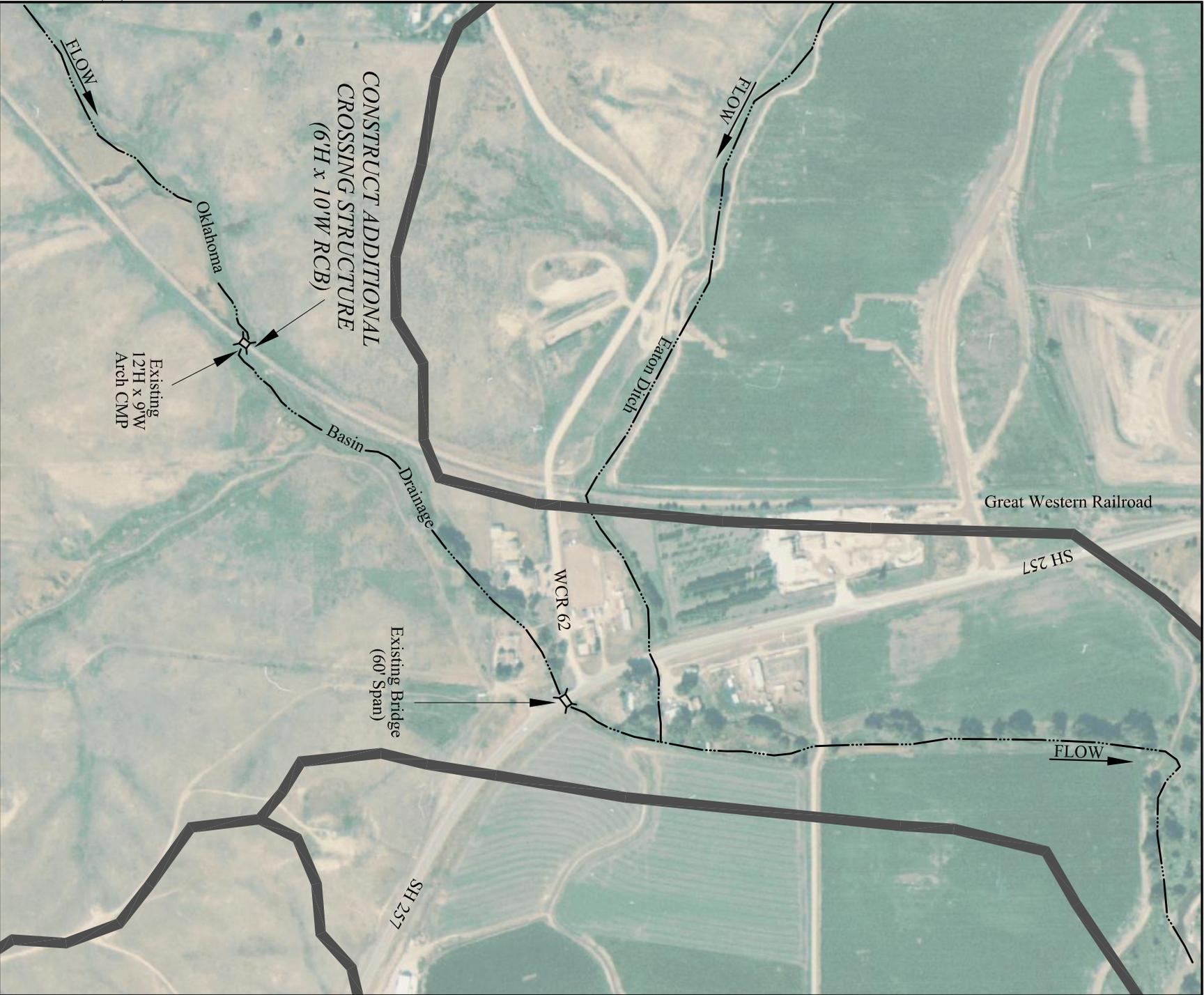
The improvements in Reach O1 involve the construction of an additional crossing structure at the Great Western Railroad. In addition to the existing 12'H x 9'W arch CMP, a 6'H x 10'W reinforced concrete box culvert is recommended. Erosion protection is also recommended for both structures. Localized channel work will be required to provide transitions from the existing channel to the improved culverts. These improvements are presented on Figure 5.14.

#### **5.2.16 Oklahoma Basin-Reach O2**

During the master planning effort, the longevity of the existing crossing structure at WCR was estimated to be less than 10 years due to the deterioration of the concrete box culvert. Furthermore, the inadvertent detention provided behind the road embankment provides significant reduction in the peak discharges during the major storm events. Consequently, the improvements in Reach O2 focused on: (a) replacement of the existing culvert at WCR 17; and (b) preservation of the existing detention area upstream of WCR 17. The specific improvements to Reach O2 are presented below and in Figure 5.15.

WCR 17 Crossing. This improvement involves the replacement of existing 8.5'H x 5.5'W reinforced box culvert which is in poor condition. The replacement structure recommended for this crossing should provide similar hydraulic characteristics as the existing culvert. Similar operational characteristics are required because this structure acts as the outlet control to the existing inadvertent/regional detention pond located on the upstream side of WCR 17. For the purposes of this master planning effort, an 8.5'H x 5.5'W RCB is recommended for this crossing.

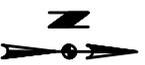
Regional Detention Pond. To insure continued reduction of peak flows within the major drainageway of the Oklahoma Basin, the inadvertent storage/regional detention pond upstream of WCR 17 should be purchased and preserved. At this location, approximately 235 acre-feet of storage are available which will necessitate the acquisition of approximately 18 acres of land.



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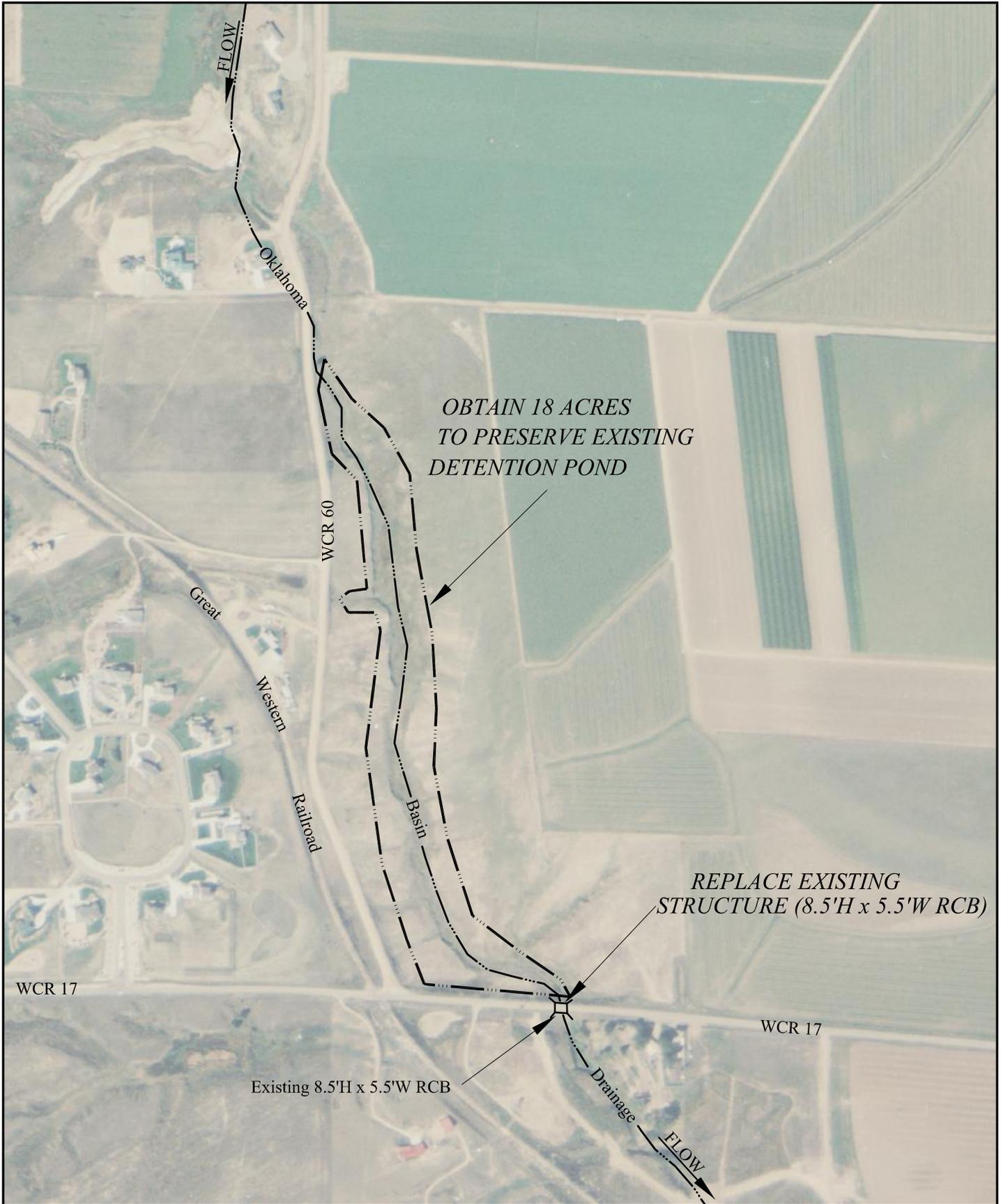
**TOWN OF WINDSOR  
 MASTER DRAINAGE PLAN  
 OKLAHOMA BASIN  
 REACH 01**

SCALE  
 1" = 500'



Project No.	COTOW08
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ACADFILE:	REACH-A-DMG

**FIGURE 5.14**



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**TOWN OF WINDSOR  
 MASTER DRAINAGE PLAN  
 OKLAHOMA BASIN  
 REACH 02**

SCALE  
 1" = 500'

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ACADFILE:	REACH-A-LDWG

**FIGURE 5.15**

### ***5.2.17 South State Highway 257 Basin***

The improvements identified for this basin are intended to reduce the potential overtopping of State Highway 257 during the 100-year flow event. The existing crossing structure consists of two 6'H x 10'W reinforced concrete box culverts with a capacity of 1,075 cfs prior to overtopping the roadway. Channel improvements along the west bank upstream of the crossing structure will increase the capacity of the existing structure to approximately 1,500 cfs prior to overtopping the roadway. The 100-year peak flow at this location is estimated to be 1,565 cfs. The recommended improvements consist of placing compacted fill along the west bank in the vicinity of the existing driveway access. The elevation of the compacted fill should not be less than 4,791 ft, msl. This improvement is presented on Figure 5.16.

### ***5.2.18 Additional Considerations***

As indicated previously, road crossings of several tributaries to the major drainageways also exist. Several of these crossings lack the capacity to convey the peak discharge from the major storm events for existing conditions. In addition, several of the crossings were noted to be experiencing potential sediment and debris problems that would tend to reduce the conveyance capacity. As land development occurs within the basin, these crossing structures will require improvements to meet the existing drainage criteria. Improvements to these structures should consider the peak discharges conveyed through or over these crossings during the major storm event. In addition, the capacity and stability of downstream conveyance facilities should be considered.

As stated previously, the drainage improvements described in this chapter pertain to the major drainageways within each drainage basin. As future development occurs in each basin, it is assumed that on-site drainage facilities will be provided to convey stormwater runoff to the improvements identified in the master plan.

## **5.3 Drainage Criteria**

It is assumed that land development within the growth management boundary will be governed by the guidelines and recommendations provided in this master planning document. The following information is presented to guide development within this area as well as areas contributing stormwater to the Town of Windsor.



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**TOWN OF WINDSOR  
 MASTER DRAINAGE PLAN  
 SOUTH SH 257 BASIN  
 REACH S**

SCALE  
 1" = 500'



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Design:	CLP/BMA
Drawn:	MRC
Revisions:	11/12/2002
ACADFILE:	REACH-A-01MG

**FIGURE 6.16**



- Land development in the drainage basins will be required to limit the stormwater runoff from the 100-year storm event to the magnitude of the existing condition 10-year storm event.
- Land development in the Ptarmigan Basin will be required to limit the stormwater runoff from the 100-year storm event for the area located south of State Highway 392 to the available capacity of existing facilities under State Highway 392.
- Land development in the Jacoby Basin, upstream of the Greeley No. 2 Canal and west of WCR 15, will be required to limit stormwater runoff from the 100-year storm event to 0.2 cfs/acre.
- Stormwater generated from the development of land in each subbasin will be conveyed in a safe and stable manner to the major drainageway. This statement implies that stormwater runoff will be conveyed in an appropriate outfall facility such as a channel, storm sewer, etc.
- All existing detention and retention areas that are effective in reducing the runoff generated during the major storm events, must remain intact or be replaced.

#### **5.4 Cost Estimates**

Estimates of the costs were developed for the proposed improvements and provided the basis for the opinion of costs generated for the comprehensive plans for each basin. Data used to develop unit costs were obtained from bid tabulations, quotations from various suppliers and manufacturers, and information supplied by local contractors and the Town of Windsor Engineering Department. The unit pricing data compiled and used to generate the cost estimates is provided in the project notebook. The cost estimates for the comprehensive plans included the following categories: (a) general drainage infrastructure; and (b) engineering, permitting, legal, fiscal and administrative costs.

General drainage infrastructure costs are defined as the costs associated with the labor and materials for the construction of drainage improvements. This item also includes acquisition of the drainage ROW/easements or land necessary for the construction and maintenance of the drainage improvements. A contingency of 35% was included in the estimate of construction costs to include those real and intangible items not directly accounted for in the unit pricing data and the costs associated with mobilization, utility relocation, etc.

The final cost category was estimated to be approximately 20 percent of total construction costs. This category is intended to include professional engineering and construction services, labor required to obtain the necessary permits, and legal requirements.

Administrative costs relate to the implementation of the construction plan by the various governmental agencies.

The cost estimates for the comprehensive plans are presented in Tables 5.1 and 5.2. Table 5.1 presents the cost estimates generated for each improvement in each drainage basin. Table 5.2 provides a summary, by basin, of the total costs to construct the improvements.

## **5.5 Hydrologic Analysis**

Following the formulation and evaluation of the drainage improvements, the future condition hydrologic model (with over-detention) was modified to reflect the improvements identified for the comprehensive plans. Hydrologically, the plans reflect the reduction in peak discharges provided by the improved facilities. Discharge data assuming implementation of the comprehensive plans are presented in tabular form in Table 5.3. For illustrative purposes, Figure 5.17 presents the 100-year peak discharge data at several locations within the watershed based on the hydrologic model of future conditions with over-detention along with construction of the proposed improvements..

**Table 5.1 Cost Estimates for Drainage Improvements with Over-Detention.**

Reach-Item	Description	Proposed Improvements/ General Drainage Infrastructure	Property Acquisition	Engineering, Permitting, Legal & Admin.	Total Cost
<b>LAW BASIN</b>					
L1-1	New Channel (Sta. 0+00 to 72+00)	\$1,253,000	\$209,000	\$250,000	\$1,712,000
L1-2	Bike Trail Crossing Structure	\$67,000	\$0	\$13,000	\$80,000
L1-3	Whitney Ditch Siphon	\$38,000	\$0	\$7,000	\$45,000
<b>Reach L1 Subtotal</b>					<b>\$1,837,000</b>
L2-1	New Channel (72+00 to 136+00)	\$810,000	\$152,000	\$162,000	\$1,124,000
L2-2	Eastman Park Crossing Structure	\$125,000	\$0	\$25,000	\$150,000
L2-3	C&S Railroad Crossing Structure	\$130,000	\$5,000 <sup>(1)</sup>	\$26,000	\$161,000
L2-4	New Channel (Sta. 136+00 to 163+00)	\$342,000	\$59,000	\$68,000	\$469,000
L2-5	State Highway 392/Greeley No. 2 Crossing	\$477,000	\$2,000	\$95,000	\$574,000
L2-6	New Channel (Sta. 0+00 to 8+50)	\$90,000	\$14,000	\$18,000	\$122,000
L2-7	Check Structure and Wasteway	\$28,000	\$2,000	\$5,000	\$35,000
<b>Reach L2 Subtotal</b>					<b>\$2,635,000</b>
L3-1	New Channel (Sta. 166+00 to 186+00)	\$89,000	\$28,000	\$18,000	\$135,000
L3-2	Greeley No. 2 Bank Improvements WCR19/State Highway 392	\$8,300	\$0	\$1,700	\$10,000
<b>Reach L3 Subtotal</b>					<b>\$145,000</b>
L4-1	New Channel (Sta. 0+00 to 50+00)	\$237,000	\$74,000	\$47,000	\$358,000
L4-2	Consolidated Law Ditch Siphon	\$22,000	\$0	\$4,000	\$26,000
L4-3	G.W. Railroad Crossing Structure	\$177,000	\$5,000 <sup>(1)</sup>	\$35,000	\$217,000
L4-4	State Highway 392 Crossing Structure	\$126,000	\$0	\$25,000	\$151,000
<b>Reach L4 Subtotal</b>					<b>\$752,000</b>
L5-1	Kern Reservoir Excavation	\$3,027,000	\$0	\$606,000	\$3,633,000
L5-2	Plug Existing Principal Spillway	\$7,000	\$0	\$2,000	\$9,000
L5-3	Emergency Spillway Improvements	\$135,000	\$0	\$27,000	\$162,000
L5-4	Greeley No. 2 Bank Improvements at Osterhaut Lake	\$148,000	\$40,000	\$29,000	\$217,000
L5-5	Lower Water Lines	\$61,000	\$0	\$12,000	\$73,000
L5-6	Extend Pedestrian Bridge	\$41,000	\$5,000	\$8,000	\$54,000
L5-7	Greeley No. 2 Channel/Kern Reservoir Outlet Improvements	\$332,000	\$22,000	\$66,000	\$420,000
<b>Reach L5 Subtotal</b>					<b>\$4,568,000</b>
L6-1	Windsor Ranch Channel	\$68,000	\$30,000	\$13,000	\$111,000
L6-2	Springer Ditch Improvements	\$89,000	\$46,000	\$18,000	\$153,000
L6-3	State Highway 257 Crossing Structure (Law Basin)	\$65,000	\$10,000	\$13,000	\$88,000
<b>Reach L6 Subtotal</b>					<b>\$352,000</b>
<b>Law Basin Total Cost</b>					<b>\$10,289,000</b>

**Table 5.1 Cost Estimates for Drainage Improvements with Over-Detention (continued).**

Reach-Item	Description	Proposed Improvements/ General Drainage Infrastructure	Property Acquisition	Engineering, Permitting, Legal & Admin.	Total Cost
<b>WINDSOR BASIN</b>					
W1-1	36" Storm Sewer	\$367,000	\$0	\$73,000	\$440,000
W1-2	Folkstone Detention Pond Improvements	\$124,000	\$0	\$25,000	\$149,000
W1-3	Garden Street Crossing Structure	\$138,000	\$0	\$28,000	\$166,000
W1-4	New Channel (Sta. 0+00 to 6+50)	\$430,000	\$13,000	\$86,000	\$529,000
W1-5	Chimney Park Detention Pond	\$175,000	\$150,000	\$35,000	\$360,000
W1-6	1 <sup>st</sup> St. & Chestnut St. Floodproofing	\$81,000	\$0	\$16,000	\$97,000
<b>Reach W1 Subtotal</b>					<b>\$1,741,000</b>
W2-1	7 <sup>th</sup> & Elm St. Floodproofing	\$202,000	\$0	\$41,000	\$243,000
W2-2	3 <sup>rd</sup> St. & Oak St. Floodproofing	\$203,000	\$0	\$40,000	\$243,000
<b>Reach W2 Subtotal</b>					<b>\$486,000</b>
<b>Windsor Basin Total Cost</b>					<b>\$2,227,000</b>
<b>HIGH SCHOOL BASIN</b>					
H-1	10 <sup>th</sup> Street Outfall Channel	\$61,000	\$11,000	\$12,000	\$84,000
H-2	Whitney Ditch Siphon	\$31,000	\$0	\$6,000	\$37,000
H-3	10 <sup>th</sup> Street Channel Improvements	\$30,000	\$0	\$6,000	\$36,000
H-4	Stone Mountain Crossing Structure	\$148,000	\$0	\$30,000	\$178,000
H-5	10 <sup>th</sup> Street Improvements	\$31,000	\$0	\$6,000	\$37,000
<b>High School Basin Total Cost</b>					<b>\$372,000</b>
<b>JACOBY BASIN</b>					
J-1	WCR 15 Storm Sewer	\$385,000	\$0	\$77,000	\$462,000
J-2	Over-Detention in Subbasins J11&J12	\$0	\$0	\$0	\$0
<b>Jacoby Basin Total Cost</b>					<b>\$462,000</b>
<b>TIMNATH RESERVOIR BASIN</b>					
T-1	Cache la Poudre Transition	\$108,000	\$3,000	\$22,000	\$133,000
T-2	New Channel (Sta. 1+00 to 15+70)	\$228,000	\$43,000	\$46,000	\$317,000
T-3	LCR 32 ½ Crossing Structure	\$102,000	\$0	\$20,000	\$122,000
T-4	New Channel (Sta. 16+00 to 59+50)	\$322,000	\$85,000	\$64,000	\$471,000
T-5	Greeley No. 2 Siphon, Wasteway, and Turnout	\$319,000	\$0	\$64,000	\$383,000
<b>Timnath Reservoir Basin Total Cost</b>					<b>\$1,426,000</b>

**Table 5.1 Cost Estimates for Drainage Improvements with Over-Detention (continued).**

Reach-Item	Description	Proposed Improvements/ General Drainage Infrastructure	Property Acquisition	Engineering, Permitting, Legal & Admin.	Total Cost
<b><i>PTARMIGAN BASIN</i></b>					
P-1	LCR 5 Culvert and Swale	\$11,000	\$0	\$2,000	\$13,000
P-2	State Highway 392 Culvert and Swale	\$13,000	\$0	\$3,000	\$16,000
P-3	LCR 30 Detention Pond	\$88,000	\$40,000	\$17,000	\$145,000
<b>Ptarmigan Basin Total Cost</b>					<b>\$174,000</b>
<b><i>RIVER RIDGE BASIN</i></b>					
<b>No Master Plan Improvements recommended for this basin.</b>					
<b><i>BLUFF BASIN</i></b>					
<b>No Master Plan Improvements recommended for this basin.</b>					
<b><i>OKLAHOMA BASIN</i></b>					
O1-1	Enlargement of G.W. Railroad Crossing	\$136,000	\$0	\$27,000	\$163,000
<b>Reach O1 Subtotal</b>					<b>\$163,000</b>
O2-1	Replacement of WCR 17 Crossing <sup>(2)</sup>	\$244,000	\$0	\$49,000	\$293,000
O2-2	WCR 17 Detention Pond	\$0	\$54,000	\$5,000	\$59,000
<b>Reach O2 Subtotal</b>					<b>\$352,000</b>
<b>Oklahoma Basin Total Cost</b>					<b>\$515,000</b>
<b><i>SOUTH STATE HIGHWAY 257 BASIN</i></b>					
S-1	Channel Improvements at State Highway 257 Crossing	\$10,000	\$0	\$2,000	\$12,000
<b>South State Highway 257 Basin Total Cost</b>					<b>\$12,000</b>

<sup>(1)</sup>In railroad right-of-way, cost to obtain permits from railroad.

<sup>(2)</sup>Possibly funded by Weld County during WCR17 improvements.

**Table 5.2 Summary of Basin Costs.**

<b>Basin</b>	<b>Total Cost of Improvements With Over-Detention</b>
Law Basin	\$10,289,000
Windsor Basin	\$2,227,000
High School Basin	\$372,000
Jacoby Basin	\$462,000
Timnath Reservoir Basin	\$1,426,000
Ptarmigan Basin	\$174,000
River Ridge Basin	\$0
Bluff Basin	\$0
Oklahoma Basin	\$515,000
South State Highway 257 Basin	\$12,000
<b>Total Cost Drainage Improvements</b>	<b>\$15,477,000</b>

**Table 5.3 Major Drainageway Peak Discharges for Future Conditions with Improvements.**

Location	EPA SWMM Element	Drainage Area (acres)	Peak Discharge (cfs)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
<b>LAW BASIN (MAIN CHANNEL)</b>								
Cache la Poudre River	L701	18,671	880	1,282	1,541	2,062	2,458	2,938
Eastman Park Dr.	L206	16,331	94	140	178	343	592	1,012
C&S Railroad.	L208	16,135	82	122	154	309	550	972
State Highway 392	L225	11,012	42	61	75	185	371	697
Greeley No. 2 Canal/WCR 21	L226	10,778	35	52	63	166	344	667
WCR 70	L227	10,236	25	37	44	125	288	604
WCR 70 ½	L229	9,425	15	23	27	74	240	509
Law Reservoir Outflow	L340	8,084	0	0	0	36	169	362
Law Reservoir Inflow	L240	8,084	53	79	95	248	468	762
Loop Lake Outflow	L341	5,713	0	0	0	0	0	346
Loop Lake Inflow	L241	5,713	78	116	141	403	811	1,349
State Highway 14/WCR 82	L442	2,986	32	46	55	207	407	665
<b>LAW BASIN - WEST TRIBUTARY</b>								
State Highway 392	L910	4,676	51	72	88	133	181	238
Great Western Railroad**	L210	4,676	651	672	688	733	781	838
Greeley No. 2 Canal at WCR 19**	W141	3,929	641	659	671	709	748	793
Basin L11 Concentration Point	L711	3,929	211	311	375	643	926	1,289
Greeley No. 2 Canal	L715	3,577	195	287	346	599	868	1,215
Basin L12 Inflow Downstream of State Highway 257*	L712	2,522	298	368	413	595	776	1,007
Ventana Way*	L118	1,707	254	303	334	465	595	762
WCR 72*	L219	1,460	230	268	291	396	498	629
WCR 74*	L220	793	195	217	230	289	349	428
Basin L20 Inflow	L820	793	45	67	80	139	199	278
State Highway 257 (WCR 17)	L812	815	46	67	81	133	183	247
<b>WINDSOR BASIN – LOWER</b>								
Cache la Poudre River	W700	4,208	554	789	945	1,323	1,596	1,921
Water Valley Parkway	W204	3,784	59	89	108	220	329	470
Eastman Park Drive East of 1 <sup>st</sup> St.	W220	3,553	26	36	42	61	84	118
Folkstone Park Pond	W323	3,454	9	14	16	24	30	37
Garden Drive	W723	3,454	76	113	138	202	260	335
Chestnut Street	W223	3,392	59	86	104	148	197	247
Chimney Park	W128	3,158	6	9	11	16	21	26
Walnut Street	W229	3,116	30	46	55	77	93	113
C&S Railroad	W240	3,089	9	13	15	23	30	39
<b>WINDSOR BASIN – UPPER</b>								
Kern Reservoir Outflow**	W341	3,043	642	659	672	710	749	795
Kern Reservoir Inflow**	W241	3,043	1,170	1,455	1,647	2,039	2,289	2,748
State Highway 257**	W742	2,883	753	829	878	1,079	1,269	1,505
Upstream of Greeley No. 2 Canal/State Highway 257	W142	2,713	145	217	263	455	639	867
WCR 15	W243	2,322	134	198	240	420	592	809
Basin W44 Outlet Point	W144	913	58	86	103	184	258	350
Lake Canal	W244	913	59	87	104	187	262	356
State Highway 68/WCR 74	W245	609	45	65	78	143	201	275

\* Discharge values include assumed irrigation base flow of 150 cfs.

\*\* Discharge values include assumed irrigation base flow of 600 cfs.

\*\*\* Includes Kern Reservoir releases carried in Greeley No. 2 Canal to be spilled into Law Ditch Main Channel.

**Table 5.3 Major Drainageway Peak Discharges for Future Conditions with Improvements  
(continued).**

Location	EPA SWMM Element	Drainage Area (acres)	Peak Discharge (cfs)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
<b>WINDSOR BASIN – UPPER (continued)</b>								
Greeley No. 2 Canal at C&S Railroad**	GRNO2B	173	613	619	623	641	659	681
High School Basin at Greeley No. 2 Canal	H410	35	2	3	3	5	6	8
Jacoby Basin at Greeley No. 2 Canal	J208	138	11	16	20	37	53	73
<b>WINDSOR BASIN – LOWER MISCELLANEOUS</b>								
Eastman Park Dr. at 1 <sup>st</sup> St.	W715	262	16	25	34	71	111	162
1 <sup>st</sup> St. Flows	W124	234	12	19	27	57	92	136
Chestnut St. Flows	W924	234	58	85	103	142	190	238
1 <sup>st</sup> St. at Chestnut St.	W224	234	82	124	153	222	290	381
Oak St. Flows	W130	197	62	91	116	178	248	328
Elm St. at 7 <sup>th</sup> St.	W131	77	33	51	62	85	114	123
Eastman Park Dr. at 54-inch Storm Sewer	W710	162	22	32	38	78	115	161
Eastman Park Dr. at 3 <sup>rd</sup> St.	W210	109	72	112	137	194	238	295
<b>HIGH SCHOOL BASIN</b>								
Cache la Poudre River	H700	558	191	288	353	548	720	942
Whitney Ditch – East	H205	302	116	172	206	307	405	527
Stone Mountain Dr. – East	H206	229	121	178	214	309	392	494
State Highway 392 at High School	H209	103	4	6	7	10	13	16
Greeley No. 2 Canal	H410	n/a	Flows captured by canal and conveyed to Kern Reservoir.					
Whitney Ditch – West	H212	150	106	150	180	251	310	381
Stone Mountain Dr. – West	H214	129	86	122	146	202	248	302
State Highway 392 at 12 <sup>th</sup> Street	H315	11	2	2	3	6	8	11
<b>JACOBY BASIN</b>								
Cache la Poudre River	J700	1,016	101	145	175	247	297	356
Whitney Ditch	J205	871	16	23	31	61	83	112
Walnut Street	J206	777	6	8	10	14	17	20
State Highway 392	J707	692	32	47	57	97	131	176
State Highway 392 East Path	J207	195	8	12	14	30	44	60
Greeley No. 2 Canal East Path	J208	n/a	Flows captured by canal and conveyed to Kern Reservoir.					
State Highway 392 West Path	J210	496	24	36	43	69	92	121
Greeley No. 2 Canal West Path	J211	457	19	28	34	53	69	89
72-inch Storm Sewer	J500	692	32	47	57	97	131	176
<b>TIMNATH RESERVOIR BASIN</b>								
Cache la Poudre River	T201	14,989	415	536	611	760	880	1,024
State Highway 392	T204	14,466	292	359	403	563	713	904
LCR 32E	T205	14,286	292	360	404	564	713	897
Greeley No. 2 Canal	T206	14,044	286	350	392	534	665	823
C&S Railroad & LCR 36	T207	12,988	240	283	311	405	490	593
LCR 38	T208	12,451	205	232	250	313	372	443
Timnath Reservoir Outlet	T320	11,300	160	167	174	199	225	250
Inflow to Timnath Reservoir	T720	11,300	753	1,083	1,285	1,926	2,495	3,331

\* Discharge values include assumed irrigation base flow of 150 cfs.

\*\* Discharge values include assumed irrigation base flow of 600 cfs.

\*\*\* Includes Kern Reservoir releases carried in Greeley No. 2 Canal to be spilled into Law Ditch Main Channel.

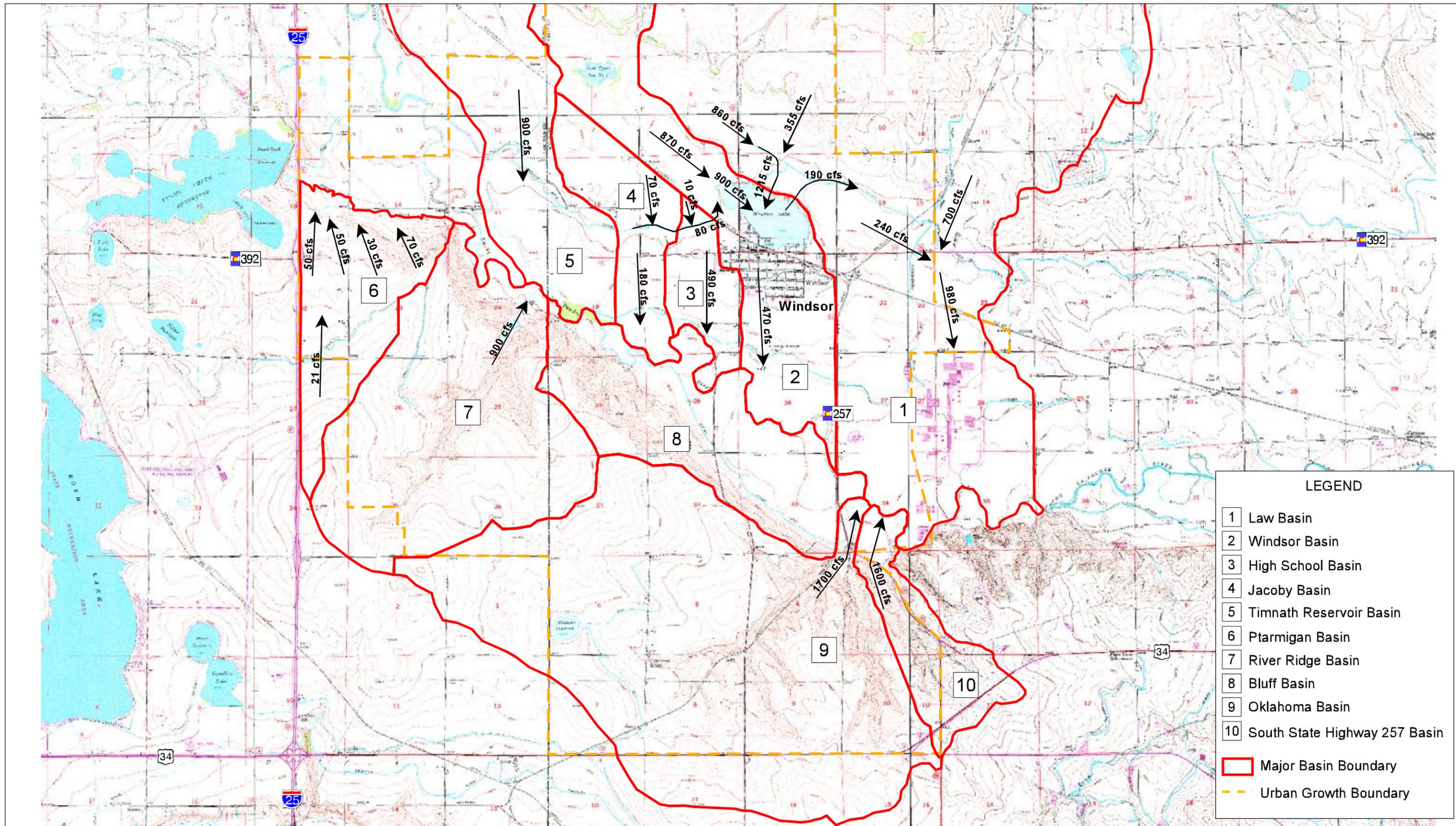
**Table 5.3 Major Drainageway Peak Discharges for Future Conditions with Improvements  
(continued).**

Location	EPA SWMM Element	Drainage Area (acres)	Peak Discharge (cfs)					
			2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
<b><i>PTARMIGAN BASIN</i></b>								
Fossil Creek	P701	1,245	91	129	154	224	280	348
Basin P02 Outlet	P202	182	124	176	211	301	376	466
State Highway 392	P303	71	23	27	30	41	53	68
Basin P04 Outlet	P204	380	89	126	150	215	270	337
State Highway 392 at REA Parkway	P205	299	6	8	10	17	22	28
Basin P07 Outlet	P207	865	41	60	73	114	145	184
Downstream of State Highway 392 & LCR 5	P711	311	9	14	18	30	40	52
State Highway 392 at LCR 5	P209	52	8	12	15	24	31	40
State Highway 392 at Country Meadows	P211	259	2	3	4	10	16	22
Shutts	P212	175	1	2	3	9	13	19
State Highway 392 at I-25	P214	339	14	20	24	34	41	50
Inflow to Westgate	P215	298	6	9	11	20	27	35
LCR 30 at I-25 Frontage Road	P516	212	1	1	3	9	14	21
<b><i>RIVER RIDGE BASIN</i></b>								
Cache la Poudre River	R700	3,751	212	300	359	547	745	991
River West Drive	R104	3,417	145	214	265	494	678	906
Basin R04 Concentration Point	R704	3,417	147	216	266	495	680	910
Basin R06 Inflow	R706	2,859	102	149	185	352	482	642
Basin R07 Concentration Point	R207	2,000	70	103	126	242	333	447
Basin R08 Inflow	R408	1,127	42	61	74	137	191	258
<b><i>BLUFF BASIN</i></b>								
<b>No major drainageway for this subbasin. See subbasin peak runoff table (Appendix B.3) for results.</b>								
<b><i>OKLAHOMA BASIN</i></b>								
Cache la Poudre River	O701	7,264	260	377	456	940	1,298	1,699
State Highway 257	O201	7,189	259	377	455	942	1,302	1,699
Great Western Railroad	O703	6,017	249	362	436	865	1,153	1,469
Basin O04 Concentration Point	O704	5,785	246	357	430	851	1,125	1,427
Basin O05 Concentration Point	O705	5,022	218	316	380	770	1,010	1,273
Basin O07 Concentration Point	O707	3,774	163	237	284	607	779	981
WCR 17 Pond Outflow	O308	3,040	151	219	263	552	688	849
WCR 17 Pond Inflow	O109	3,040	165	243	291	633	929	1,308
Basin O08 Inflow Concentration Point	O208	3,040	166	243	292	635	933	1,313
Basin O09 Inflow	O809	1,637	111	163	197	411	603	851
<b><i>SOUTH STATE HIGHWAY 257 BASIN</i></b>								
<b>No improvements that will alter peak discharges in this basin; major drainageway peak discharges same as in future conditions.</b>								

\* Discharge values include assumed irrigation base flow of 150 cfs.

\*\* Discharge values include assumed irrigation base flow of 600 cfs.

\*\*\* Includes Kern Reservoir releases carried in Greeley No. 2 Canal to be spilled into Law Ditch Main Channel.



**LEGEND**

- 1 Law Basin
- 2 Windsor Basin
- 3 High School Basin
- 4 Jacoby Basin
- 5 Timnath Reservoir Basin
- 6 Ptarmigan Basin
- 7 River Ridge Basin
- 8 Bluff Basin
- 9 Oklahoma Basin
- 10 South State Highway 257 Basin

Major Basin Boundary  
 Urban Growth Boundary

REVISIONS:

Contour Interval 10 feet  
 2500 0 2500 5000 7500 10000  
 Feet

PROJECT NUMBER: COTOWD8	DRAWN BY: RJN
FILENAME: Windsor-masterplan.apr Future Condition - Over Detention with Improvements 11x17	DESIGNED BY: CJP
DATE: 10/02/2003	CHECKED BY: BAA



**TOWN OF WINDSOR  
Master Drainage Plan**

**FUTURE CONDITION  
OVER-DETENTION (100-10)  
WITH IMPROVEMENTS  
100-YEAR PEAK DISCHARGES**

FIGURE 5.17