III. INVENTORY OF EXISTING FACILITIES

Within the Growth Management Boundary, the existing storm drainage facilities are largely associated with development that has historically occurred in the ten drainage basins. In general, small local detention ponds, storm sewers, and conveyance channels comprise the network of drainage facilities that provide flood control during the minor storm events within these developments. Drainage structures also occur at crossings of both natural and storm drainage outfall channels. These crossings are typically associated with the local, county and state roadways as well as railroads and the existing canals within the watershed.

During this master planning effort, an inventory of the existing storm drainage facilities within the Growth Management Boundary was conducted. The inventory and assessment of each structure involved: (a) field reconnaissance to document location, condition and additional data requirements; (b) review of available design and construction drawings; (c) collection of site-specific survey data; and (d) evaluation of the hydraulic capacity. Table 3.1 summarizes the results of the inventory and evaluation of the existing storm drainage facilities. Sheets 1A and 1B present the location and description of those storm drainage structures that were identified and inventoried. Specific information related to these facilities is provided in the following paragraphs. Detailed data and photographic documentation pertinent to each structure are provided in the project notebook submitted in conjunction with this report.

3.1 Detention Facilities

Within each subbasin, few detention facilities exist that substantially reduce the stormwater runoff during major storm events. Detention areas at two locations provide the storage necessary to significantly attenuate the peak runoff. In one location, storage is available at an existing irrigation reservoir and at the second location, inadvertent storage exists immediately upstream of a roadway crossing. Both detention facilities are described in the following sections.

Several detention facilities that presently exist within the Growth Management Boundary effectively reduce the peak runoff during minor storm events but offer limited benefits during the major storms. These detention facilities were identified but were not specifically inventoried or evaluated during the master planning effort.

Several major detention and retention facilities exist outside the Growth Management Boundary and therefore were not included in the detailed inventory of existing structures. These

Table 3.1 Inventory of Existing Drainage Facilities.

Name	Type	Location	Condition	EPA-SWMM ID	Maximum Storage Volume (acre-ft)	Maximum Discharge Capacity[1] (cfs)
LAW BASIN (MAIN CHANNEL)						
Eastman Park Drive	Arch CMP	0.75 mile East of State Highway 257	fair	L206	0	59
Colorado & Southern Railroad	RCB	C&S R.R. ¾ mile Southeast of State Highway 257	fair	L208	0	370
State Highway 392	Arch CMP	0.75 mile East of State Highway 257	good	L710	0	45[2]
Greeley No. 2 Confluence	CMP	WCR 21 Greeley No. 2 Crossing	fair	L226	0	56
LAW BASIN - WEST TRIBUTARY						
G.W. Railroad	CMP	300′ South of State Highway 392	good	L210	0	123
State Highway 392	CMP	1,500′ East of State Highway 257	good	L210	0	20
WCR 19	None	1,000′ North of State Highway 392	N/A	L211	N/A	0
Greeley No. 2 Canal	None	1,400′ West of WCR 19	N/A	L711	N/A	0
WCR 17 / State Highway 257	None	WCR 70	N/A	L812	N/A	0
WCR 72	Arch CMP	400′ East of State Highway 257	good	L219	0	606
WCR 74	Bridge	2,000′ East of State Highway 257	good	L220	0	580
WINDSOR BASIN						
Water Valley Parkway	RCB	WCR 64 ½	good	W204	0	1,814
Eastman Park Drive - A Crossing	Ellip.RCP	3rd Street to 500' East of 3rd Street	good	W210	0	230
Eastman Park Drive - B Crossing	RCP	Storm Sewer Outlet 500’ West of 1st Street	good	W113	0	N/A
Eastman Park Drive - C Crossing	RCP	230′ West of 1st Street	good	W215	0	87
Eastman Park Drive - D Crossing	2-Arch CMP	300′ East of 1st Street	good	W220	0	173
Folkstone Park Pond	Pipe Spillway	Garden Drive	fair	W323	13.5[3] 19.0[4]	6[3] 80[4]
Walnut Street	RCP	Kern Ditch Crossing of Walnut Street	good	W229	0	95
C&S Railroad	Bridge	Kern Ditch just upstream of Walnut Street	fair	W240	0	~700
State Highway 392	Pipe	Kern Reservoir Outlet Pipe to Kern Ditch	good	W240	0	60

Table 3.1 Inventory of Existing Drainage Facilities (Continued).

Name	Type	Location	Condition	EPA-SWMM ID	Maximum Storage Volume (acre-ft)	Maximum Discharge Capacity[1] (cfs)
WINDSOR BASIN (continued)						
Kern Reservoir	Pipe Spillway	Principal Spillway Kern Reservoir Emergency Spillway	good	W341	440[3] 1,030[4]	60[3] 834[4]
WCR 17 or State Highway 257	CMP	Outlet Osterhaut Lake	good	W142	66	31
WCR 15	None	WCR 70 ½	n/a	W243	0	0
HIGH SCHOOL BASIN						
Whitney Ditch	2-CMPs	1,100′ South/Downstream of Stone Mountain Dr.	fair	H205	0	211
Stone Mountain Drive	3-CMPs	1,200′ West of Seventh Street	good	H206	0	94
10th Street	Channel	Palisade Mountain Dr. to Whitney Ditch	good	H806	0	350
State Highway 392	None		n/a	H209	0	0
JACOBY BASIN						
State Highway 392	RCP	West Side Storm Sewer, From State Highway 392 to Cache la Poudre River	good	J207	0	200
WCR 68 ½	None	East of WCR15	n/a	J12	0	0
TIMNATH BASIN						
State Highway 392	RCP	1,100′ West of WCR 13	poor	T204	0	0
LCR 32 ½ (WCR 68 ½)	CMP	2,600′ West of WCR 13	fair	T205	0	10
LCR 36 (WCR 72)	Bridge	1,500′ West of WCR 13	good	T207	0	2,700/1,050[2]
C & S Railroad	Bridge	1,500′ West of WCR 13	good	T207	0	2,700/1,050[2]
PTARMIGAN BASIN						
Basin P03 Outlet	CMP/RCP	Under State Highway 392	good	P303	unknown	422
Basin P05 Outlet	RCP	Under State Highway 392	good	P205	0	47
Basin P09 Outlet	RCP	Under State Highway 392	poor	P209	0	0
Basin P11 Outlet	HDPE	Under State Highway 392	good	P711	0	30
Basin P14 East, at Royal Vista Dr.	CMP	Under State Highway 392	good	P214	0	25
Basin P14 West, North of Arbys	Arch CMP	Under State Highway 392	good	P214	0	24

Table 3.1 Inventory of Existing Drainage Facilities (Continued).

Name	Type	Location	Condition	EPA-SWMM ID	Maximum Storage Volume (acre-ft)	Maximum Discharge Capacity[1] (cfs)
RIVER RIDGE BASIN						
River Edge Rd.	5-RCPs	0.5 mile South of State Highway 392, 0.5 mile West of LCR1/WCR13	good	R704	0	2,535
River West Dr.	5-RCPs	0.5 mile South of State Highway 392, 0.5 mile West of LCR1/WCR13	good	R704	0	2,340
OKLAHOMA BASIN						
State Highway 257	Bridge	0.75 mile South Cache la Poudre River	good	O201	0	5,000/2,900[2]
G.W. Railroad	Arch CMP	1,300′ South of WCR 62	good	O103	0	770
WCR 17	RCB	1 mile North of US Hwy 34	poor	O308	235	1,240
SOUTH STATE HIGHWAY 257 BASIN						
State Highway 257	2-RCBs	1 mile South of Cache la Poudre River	good	S802B	0	1,075
BLUFF BASIN						
No structures inventoried in this basin.						
GREELEY NO. 2 CANAL						
State Highway 392	Bridge	900′ East of WCR 21	good	n/a	0	>1,500
WCR 21	Bridge	1,500′ North of State Highway 392	fair	n/a	0	>1,500
G.W. Railroad	Bridge	1,200′ Upstream of WCR 21	fair	n/a	0	>1,500
WCR 19	Bridge	3,800′ North of State Highway 392	fair	n/a	0	>1,500
Greeley No. 2 Canal	Bridge	WCR 17/State Highway 257	good	W142	0	3,500/330[2]
Greeley No. 2 Canal	Bridge	At C & S Railroad	good	n/a	0	2,630/2,000[2]
Greeley No.2 Canal	Bridge	At WCR 15	fair	J211	0	2600/630[2]
Greeley No. 2 Canal	None	1,500′ West of WCR 13	n/a	T206	0	0

[1] Maximum discharge capacity prior to overtopping, assuming no obstructions.
[2] Prior to overtopping the stream bank upstream of the structure.
[3] At the elevation of the emergency spillway crest.
[4] At the elevation of the dam crest

reservoirs or storage areas were determined to have sufficient capacity to fully retain the runoff from the major storm events. In general, these facilities were associated with irrigation reservoirs and were included in the hydrologic analysis to define the stormwater runoff during existing conditions as discussed in Chapter 4.

As stated previously, detention facilities located inside the Growth Management Boundary that are effective in reducing the peak discharge from the major storm events do not exist within the majority of the basins. These basins include the Law Basin, Jacoby Basin, Timnath Reservoir Basin, Ptarmigan Basin, River Ridge Basin, Bluff Basin and South State Highway 257 Basin. Kern Reservoir in the Windsor Basin and inadvertent storage in the Oklahoma Basin were determined to significantly reduce the stormwater runoff and are described in the paragraphs below.

3.1.1 Windsor Basin

Windsor Lake (Kern Reservoir) is an irrigation reservoir located in the middle of the Windsor Basin immediately north of State Highway 392. Windsor Lake represents the divide for the upper and lower portions of the Windsor Basin. The reservoir was originally created to provide irrigation water to the farmland immediately surrounding the Town of Windsor. The dam embankment starts in the southeast corner of the reservoir and extends approximately 2,500 feet to the west. The spillway facilities are located in the southeast corner of the reservoir and include: (a) a principle spillway consisting of a 42-inch standpipe and outlet; and (b) an emergency spillway. The principle spillway controls the operating level of the reservoir and also provides a mechanism for the diversion of water in to the Kern Ditch. The emergency spillway consists of a concrete spill structure (100 feet in width and 2 feet in depth) and riprap stabilization measures. Storage available in the reservoir is also utilized as equalization storage for the New Cache la Poudre Irrigating Company and the irrigation diversions conveyed in the Greeley No. 2 Canal. Irrigation water conveyed in the Greeley No. 2 Canal is diverted into the reservoir in the northwest corner near State Highway 257 through a controlled inlet structure. The irrigation flows are released from the reservoir and into the Greeley No. 2 Canal through two 10'H x 12'W radial gates located near the northeast corner of the reservoir.

Kern Reservoir (in background) and Outlet to Greeley Canal No. 2

Based on information in "Project Manual for Kern Reservoir Windsor Lake Dike Upgrade" [TST, Inc., 1984], the reservoir was reported to have 1,030 acre-feet of storage available for irrigation diversions between the Kern Ditch Outlet (4785.3 ft, 1929 NGVD) and the principle spillway (4792.0 ft, 1929 Datum). Prior to overtopping the existing dam embankment, the principle outlet and emergency spillway have a maximum discharge capacity of 834 cfs. During the Master Drainage Plan's 100-year storm event (existing condition land use), approximately 1980 cfs is conveyed into the reservoir. During the 100-year storm event, the principle spillway releases 58 cfs, while the reservoir stores approximately 290 acre-feet of floodwater. The reservoir's emergency spillway does not operate during the Master Plan's existing condition 100-year storm event.

Although it is not effective in attenuating the peak flow during the 100-year storm event, Osterhaut Lake is hydraulically connected to Windsor Lake and captures much of the stormwater runoff generated within the basin. Osterhaut Lake is located immediately west of Kern Reservoir with the inadvertent detention for small events created by the road embankment associated with State Highway 257. The lake is surrounded by the Greeley Number 2 Canal on the north and west sides and by a small subdivision on the south side. A 24-inch CMP under State Highway 257 provides the hydraulic connection to the Windsor Lake and is considered the principle outlet for Osterhaut Lake. The roadway embankment associated with State Highway 257 is elevated approximately 5 feet above the invert of the existing 24-inch CMP. The flood storage volume provided in Osterhaut Lake before overtopping is approximately 66 acre-feet with a maximum release rate of 31 cfs from the existing outlet pipe. The 100-year existing condition discharge that is captured and conveyed through Osterhaut Lake is estimated to be 1,860 cfs and corresponds to an overtopping depth of approximately 0.7 feet on State Highway 257. Although a hydraulic connection exists between Osterhaut Lake and Windsor Lake, the 24-inch CMP was assumed to be blocked.

3.1.2 Oklahoma Basin

In the Oklahoma Basin, an inadvertent detention pond is located approximately one mile north of U.S. Highway 34 on the west side of WCR 17. At this location, WCR 17 crosses the major drainageway of the basin. The roadway embankment associated with WCR 17 was constructed across a deeply incised portion of the major drainageway and is elevated approximately 32 feet above the channel invert. A crossing structure, consisting of an 8.5'H x 5.5'W RCB, releases runoff from the detention area. The volume provided behind the roadway embankment prior to overtopping is approximately 235 acre-feet with a corresponding release through the existing box culvert of approximately 1,240 cfs. The 100-year peak inflow (existing condition land use) to this detention

area is estimated to be 1,100 cfs, which corresponds to a storage volume of approximately 156 acre-feet with no overtopping of WCR 17.

3.2 Major Crossing Structures

As mentioned previously, the majority of the drainage structures that were inventoried and evaluated during this planning effort involved the crossings of both natural and storm drainage outfall channels. Crossing structures were identified, inventoried and evaluated in every basin with the exception of the Bluff Basin where no crossings presently exist. The existing crossings are generally associated with the local, county and state roadways as well as railroads and the existing canals within the watershed. The capacity of each crossing was calculated using the U.S. Army Corps of Engineer's HEC-2/HEC-RAS Water Surface Profile program and/or the Federal Highway Administration's HY-8 Culvert Analysis program. Table 3.1 summarizes the location, condition, and hydraulic capacity of each crossing structure. A brief description of the crossing structures that were inventoried within each basin is provided in the following paragraphs.

Within the Growth Management Boundary, several additional road crossings of minor tributaries to the major drainageways within each basin also exist. Depending on the location and the contributing drainage area, these tributaries convey significant storm flows that may require crossing structures or improvements to existing structures to prevent overtopping during relatively minor storm events. This master planning effort did not specifically identify or inventory these crossings. In general, these crossing structures lack the capacity to convey runoff generated during relatively minor storm events and several structures were presently experiencing sedimentation problems that further reduce their capacity. As development within each basin occurs, these structures should be identified, inventoried and evaluated.

3.2.1 Law Basin

Seven major road crossings, two railroad crossings, and two canal crossings were identified and evaluated on the major drainageways within the Law Basin. Those crossings where structures presently exist consisted of one bridge, one reinforced concrete box culverts (RCB), three arched corrugated metal pipes (CMP), and three circular CMPs. At three locations, no structures exist and storm water simply overtops the existing road or canal.

<u>Eastman Park Drive Culvert.</u> The crossing at Eastman Park Drive consists of a 3'H x 5'W arch corrugated metal pipe culvert. At this location, roadway overtopping occurs at a depth of

approximately 4 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 59 cfs. The 100-year existing condition discharge in the Law Basin at Eastman Park Drive is approximately 4,840 cfs.

Colorado & Southern Railroad Culvert. The crossing at Colorado & Southern Railroad consists of a 4'H x 8'W reinforced concrete box culvert. At this location, the railroad overtops at a depth of approximately 7.5 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 370 cfs. The 100-year existing condition discharge in the Law Basin at Colorado & Southern Railroad is approximately 5,080 cfs.

State Highway 392 Culvert. The crossing of the major drainageway and State Highway 392 consists of a 4'H x 6'W arch corrugated metal pipe culvert. At this location, culvert capacity is limited by the approximately 4-foot height of the right bank upstream of the culvert. The capacity of the culvert prior to overtopping the right bank is 45 cfs. Overtopping of State Highway 392 will occur on the right bank approximately 1,750 feet west of the culvert. The 100-year existing condition discharge in the main channel of the Law Basin upstream of State Highway 392 is 1,890 cfs.

Upstream Side of State Highway 392 Culvert on the Law Basin Main Channel

Greeley No. 2 Canal Culvert. Stormwater runoff conveyed within the major drainageway (also known as the Law Ditch at this location) is intercepted by the Greeley No. 2 Canal on the east side of WCR 21. Normal Law Ditch irrigation flows and minor storm water flows enter the Greeley No. 2 Canal through a 3-foot diameter corrugated metal pipe culvert. High flows enter the canal over the left bank immediately east of WCR 21. At this location, the culvert will overtop at a depth of flow approximately 4 feet above the invert of the culvert. The capacity of the culvert prior to overtopping is 56 cfs. The 100-year existing condition discharge in the Main Channel of the Law Basin at the Greeley No. 2 Canal is approximately 1,880 cfs.

Great Western Railroad Culvert. At this location, a western tributary to the major drainageway is conveyed under the Great Western Railroad in a 4-foot diameter corrugated metal pipe culvert. The culvert will overtop at a depth of flow approximately 7.6 feet from the invert of the culvert.

Greeley No. 2 Canal at Confluence with the Law Ditch

The capacity of the culvert before overtopping is 123 cfs. The 100-year existing condition discharge conveyed in the western tributary channel of the Law Basin at the Great Western Railroad is 3,180 cfs.

State Highway 392 Culvert-West Tributary. The crossing at State Highway 392 and the western tributary channel is a 2-foot diameter corrugated metal pipe culvert. At this location, roadway overtopping occurs at a depth of approximately 4.5 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 20 cfs. The 100-year existing condition discharge in the western tributary channel of the Law Basin at State Highway 392 is 3,180 cfs.

WCR 19-West Tributary. A crossing structure does not exist where the West Tributary of the Law Basin crosses WCR 19 approximately 1,000 feet north of State Highway 392. Overtopping of WCR 19 will occur for any significant event, especially events which may overtop the Greeley No. 2 Canal upstream of WCR 19. The 100-year existing condition discharge in the western tributary channel of the Law Basin at Weld County Road 19 is 2,970 cfs.

Greeley No. 2-West Tributary. The western tributary channel confluences with the Greeley No. 2 Canal approximately 1,400 feet west of WCR 19. Stormwater captured by the Springer Ditch is conveyed to the canal at this location. Large flow events will exceed the capacity of the canal thereby overtopping the right bank and spilling the stormwater to the southeast toward WCR 19. The 100-year existing condition discharge in the Western Tributary channel of the Law Basin at the Greeley No. 2 Canal is 2,850 cfs.

State Highway 257 (WCR 17). A crossing does not exist for State Highway 257 (WCR 17) near its intersection with WCR 70. At this location, stormwater generated in the western portion of the basin will spill over the road. The road embankment will overtop during any significant flood event. The 100-year existing condition discharge in Law Basin at State Highway 257 is 670 cfs.

WCR 72 Culvert-West Tributary. At this location, stormwater conveyed by the western tributary channel is essentially stormwater captured by the Springer Ditch (also known as the Windsor Reservoir Outlet). The crossing at WCR 72 consists of a 7'H x 11.5'W arched corrugated metal pipe culvert. The road embankment overtops at a depth of approximately 9.0 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 600 cfs. The 100-year existing condition discharge in the western tributary channel (Springer Ditch) at WCR 72 is 1,280 cfs.

WCR 74 Bridge-West Tributary. Stormwater at this location is captured and conveyed by the Springer Ditch through a steel bridge that incorporates an opening approximately 10 feet in width and 8 feet in height. The capacity of the bridge prior to overtopping the roadway embankment is 580 cfs. The 100-year existing condition discharge in the western tributary channel (Springer Ditch) at WCR 74 is 760 cfs.

3.2.2 Windsor Basin

There are ten locations where existing structures convey stormwater across the major drainageway in the Windsor Basin. These crossings consist of two steel/timber bridges, two reinforced concrete box culverts (RCB), four reinforced concrete pipes (RCPs), and two corrugated metal pipes (CMPs). At one location, no structure exists and storm water simply overtops the existing county road.

Water Valley Parkway Culvert. The crossing at Water Valley Parkway is a 12'H x 12'W reinforced concrete box culvert. At this location, roadway overtopping occurs at a depth of approximately 10.3 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 1,810 cfs. The 100-year existing condition discharge in the Windsor Basin's major drainageway at Water Valley Parkway is 620 cfs.

Eastman Park Drive-Crossing A. This structure is the western-most crossing of Eastman Park Drive and consists of a 5.5'H x 3.5'W elliptical reinforced concrete pipe culvert. At this location, roadway overtopping occurs at a depth of approximately 5 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 230 cfs. The 100-year existing condition discharge in the major drainageway at this location is estimated to be 295 cfs.

Eastman Park Drive-Crossing B. The structure represents a crossing directly east of Crossing A on Eastman Park Drive. Crossing B consists of a 54-inch reinforced concrete pipe storm sewer outlet. The storm sewer drains an area north of Eastman Park Drive in the older residential portion of the Town of Windsor. The storm sewer receives flow from area inlets on Oak Street at the intersections of Second Street, Third Street, and Fourth Street. Additional flow enters the storm sewer from two detention ponds north of Garden Drive; the Mountain View School Pond and the Condos Pond. Limited data exists for the storm sewer; however, it appears to have capacity in excess of 130 cfs. The 100-year existing condition discharge in Windsor Basin at Eastman Park Drive–Crossing B was estimated to be 50 cfs.

Eastman Park Drive-Crossing C. This structure is located east of Crossing B on Eastman Park Drive and consists of a 36-inch diameter reinforced concrete pipe culvert. At this location, roadway overtopping occurs at a depth of approximately 7.5 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 87 cfs. The 100-year existing condition discharge in the major drainage path at this location on Eastman Park Drive is 85 cfs.

Eastman Park Drive-Crossing D. This crossing represents the eastern-most crossing of Eastman Park Drive and consists of two 4'H x 6'W arch corrugated metal pipe culverts. At this location, roadway overtopping occurs at a depth of approximately 3.8 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 173 cfs. The 100-year existing condition discharge in the major drainage path at this location on Eastman Park Drive is 350 cfs.

Walnut Street Culvert. The crossing at Walnut Street is a 3-foot diameter corrugated metal pipe culvert. At this location, roadway overtopping occurs at a depth of approximately 6.7 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 95 cfs. The 100-year existing condition discharge at this location on Walnut Street is estimated to be 150 cfs.

Colorado & Southern Railroad Bridge. The crossing at the Colorado and Southern Railroad consists of a timber bridge with an opening that is approximately 26 feet wide. The depth of flow at which the railroad overtops is approximately 9 feet. The capacity of the bridge before overtopping the railroad was estimated to be approximately 700 cfs. The 100-year existing condition discharge in the major drainage path at the Colorado & Southern Railroad is estimated to be 76 cfs.

State Highway 392 Culvert. The reinforced concrete box culvert at this location has been abandoned and is not capable of passing any storm water. The 3.5-foot diameter outlet pipe from Kern Reservoir uses the culvert to cross under State Highway 392 prior to discharging into Kern Ditch. Stormwater generated from the small watershed tributary to this location will pass over State Highway 392 prior to combining with the releases from the Kern Reservoir south of the highway. The 100-year existing condition discharge in the Windsor Basin at this location along the major drainage path is 76 cfs, including the uncontrolled releases from Kern Reservoir.

State Highway 257 Culvert. This crossing of State Highway 257 (WCR 17) is located in the upper portion of Windsor Basin and consists of a 2-foot diameter corrugated metal pipe, which is the outlet for Osterhaut Lake. The depth of flow at which roadway overtopping occurs is approximately 5.0 feet. The capacity of the culvert prior to overtopping the roadway embankment was calculated to be 31 cfs. The 100-year existing condition discharge in the Windsor Basin at State Highway 257 is 1,860 cfs.

State Highway 257 Culvert in the Windsor Basin

Greeley No. 2 Canal. Stormwater runoff generated in the upper portion of the Windsor Basin will be captured by the Greeley No. 2 Canal immediately west of Osterhaut Lake. Stormwater will be conveyed in the canal, under State Highway 257 in a bridge, and finally to Kern Reservoir. Due to capacity limitations of the canal west of the State Highway 257 bridge, large runoff events will overtop the right bank of the canal and flow into Osterhaut Lake. The crossing at State Highway 257 is a 38-foot wide steel bridge with a capacity of approximately 3,500 cfs prior to overtopping the highway. However, the capacity of the canal west of State Highway 257 is limited to approximately 330 cfs. The 100-year existing condition discharge in Windsor Basin at this location is 1,860 cfs.

WCR 15. A crossing structure does not exist where the Windsor Basin Drainageway crosses WCR 15 approximately 1,000 feet north of the Colorado & Southern Railroad. Overtopping of WCR 15 will occur for any storm event that generates significant runoff. The 100-year existing condition discharge in the Windsor Basin at Weld County Road 15 is estimated to be 1,980 cfs.

3.2.3 High School Basin

There are two major crossings of the major drainageway in the High School Basin. Both crossings consist of installations of multiple corrugated metal pipes (CMPs). A single major crossing at State Highway 392 does not exist. The drainage basin upstream of State Highway 392 is relatively small and bisected by the Greeley No. 2 Canal. At this location, it should be noted that the Greeley No. 2 Canal has the capacity to capture and convey a portion of the basin runoff through a timber bridge under the C&S Railroad and into the Windsor Basin.

Whitney Ditch. The crossing at the Whitney Ditch consists of two, 3-foot diameter, corrugated metal pipes. At this location, ditch bank overtopping occurs at a depth of approximately 9 feet from the invert of the culvert. The capacity of the culverts prior to overtopping is 210 cfs. The 100-year existing condition discharge at this location along the major drainage path is estimated to be 530 cfs.

Stone Mountain Drive. The crossing at the Stone Mountain Drive consists of three, 2.5-foot diameter, corrugated metal pipes. At this location, roadway overtopping occurs at a depth of approximately 4.5 feet from the invert of the culvert. The capacity of the culvert prior to overtopping the roadway embankment is 95 cfs. The 100-year existing condition discharge at Stone Mountain Drive is 495 cfs.

Stone Mountain Drive Crossing in the High School Basin

3.2.4 Jacoby Basin

Only one major crossing presently exists within the Jacoby Basin. The crossing at State Highway 392 (immediately west of the 15th Street intersection) consists of a 5-foot diameter reinforced concrete storm sewer pipe. The 5-foot diameter storm sewer connects to a 6-foot diameter storm sewer prior to discharging into the Cache La Poudre River. The capacity of the storm sewer

prior to surcharging onto State Highway 392 is approximately 170 cfs. The 100-year existing condition discharge in the major drainage path at State Highway 392 is 450 cfs.

3.2.5 Timnath Reservoir Basin

There are four locations where existing structures convey stormwater across the major drainageway in the Timnath Reservoir Basin. These crossings consist of one steel bridge, one concrete bridge, one reinforced concrete pipe (RCP) culvert, and one corrugated metal pipe (CMP) culvert. It should be noted that no crossing structure of the Greeley No. 2 Canal exists along the major drainageway in the Timnath Reservoir Basin. Stormwater conveyed to the Greeley No. 2 Canal will either be captured or spilled at this location. Given the limited capacity of the canal compared to the magnitude of the storm runoff, it is assumed that the majority of the stormwater runoff will spill over the banks of the canal.

State Highway 392 Culvert. The crossing at State Highway 392 is a 3-foot diameter reinforced concrete pipe. The capacity of the culvert is very limited due to sediment deposition and debris blockage. Overtopping of State Highway 392 is likely during storm events that generate significant runoff. The 100-year existing condition discharge in the major drainage path at State Highway 392 is 2,210 cfs.

LCR 32½ Culvert. The crossing at LCR 32½ consists of a 2.5-foot corrugated metal pipe. At this location, roadway overtopping occurs at a depth of approximately 4 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 10 cfs. The 100-year existing condition discharge in the major drainageway at LCR 32 ½ is 2,199 cfs.

Looking Upstream at LCR 36 Bridge in Timnath Basin

LCR 36 Bridge. This concrete bridge incorporates an opening that is approximately 15 feet wide. The depth of flow at which the left bank of the drainageway overtops is approximately 8 feet. The capacity of the bridge before overtopping the left bank was determined to be approximately 1,050 cfs. Overtopping of the road would occur at approximately 2,700 cfs. The 100-year existing condition discharge along the major drainage path at LCR 36 is 1,570 cfs.

Colorado & Southern Railroad Bridge. This crossing consists of a timber bridge that incorporates an opening of approximately 13.5 feet in width. This structure is closely located to the LCR 36 bridge and reflects similar hydraulic characteristics. At this location, the depth of flow at

which the left bank of the drainageway overtops is approximately 8 feet. The capacity of the bridge before overtopping the left bank was calculated to be approximately 1,050 cfs. Overtopping of the railroad would occur at approximately 2,700 cfs. The 100-year existing condition discharge at this location along the major drainage path is 1,570 cfs.

3.2.6 Ptarmigan Basin

The crossings inventoried in the Ptarmigan Basin were limited to those crossings of State Highway 392. Presently, six crossing structures of State Highway 392 exist in the Ptarmigan Basin. The crossings are generally in good condition with the exception of the crossing immediately east of LCR 5, which appears to be plugged with sediment. Development upstream of the crossings has been required to over-detain storm water releases to meet the capacity constraints of the existing crossings of State Highway 392. Table 3.2 displays the crossing structures, capacity information and the 100-year existing condition discharge at each crossing.

Table 3.2 Ptarmigan Basin Existing Crossing Structures Summary.

Name	Type	Location	Maximum Discharge Capacity (cfs)	Existing Peak 100-Year Discharge (cfs)
PTARMIGAN BASIN				
Basin P03 Outlet	CMP/RCP	Under State Highway 392	422	68
Basin P05 Outlet	RCP	Under State Highway 392	47	92
Basin P09 Outlet	RCP	Under State Highway 392	0	160
Basin P11 Outlet	HDPE	Under State Highway 392	30	266
Basin P14 East, at Royal Vista Dr.	CMP	Under State Highway 392	25	195
Basin P14 West, North of Arbys	Arch CMP	Under State Highway 392	24	195

3.2.7 River Ridge Basin

There are two major crossings of the major drainageway in the River Ridge Basin. The crossings at River Edge Road and River West Drive are very similar. Both crossings consist of five, 7-foot diameter reinforced concrete pipes. The depth of flow upstream of the culverts is estimated to be approximately 11 feet prior to overtopping the road. The maximum capacity at River Edge Road and River West Drive prior to overtopping the road is 2,535 cfs and 2,340 cfs respectively. The 100-year existing condition discharge in the major drainageway at the two road crossings is 3,440 cfs.

River West Drive Crossing in the River Ridge Basin

3.2.8 Oklahoma Basin

There are three locations where existing structures convey stormwater across the major drainageway in the Oklahoma Basin. These crossing structures consist of one concrete bridge, one arch corrugated metal pipe (CMP) and one reinforced concrete box culvert (RCB).

State Highway 257 Bridge. The crossing at State Highway 257 consists of a 60-foot span concrete bridge. At this location, roadway overtopping occurs at a depth of approximately 19 feet from the invert of the bridge. However, left bank overtopping will occur at a depth of approximately 14 feet from the invert of the channel. The capacity of the bridge prior to overtopping the road and left bank is 5,000 cfs and 2,900 cfs respectively. The 100-year existing condition discharge at this location along the major drainageway is 5,010 cfs.

State Highway 257 Bridge in the Oklahoma Basin

Great Western Railroad Culvert. The Great Western Railroad crossing is single 12'H x 9'W arched CMP. Railroad overtopping occurs at a depth of approximately 12 feet above the invert of the culvert. The maximum capacity of the culvert before overtopping the railroad is 770 cfs. The

100-year existing condition discharge in the major drainage path at the Great Western Railroad is 3,700 cfs.

WCR 17 Culvert. This crossing of WCR 17 is a 8.5'H x 5.5'W reinforced concrete box culvert. The depth of flow at which roadway overtopping occurs is approximately 33 feet. The roadway embankment impounds stormwater associated with the existing WCR 17 detention area. The capacity of the culvert prior to overtopping the roadway was calculated to be 1,240 cfs. The 100-year existing condition discharge at this location is 1,100 cfs.

3.2.9 South State Highway 257 Basin

There is one crossing of the major drainageway in the South State Highway 257 Basin. A crossing structure presently exists at State Highway 257. This structure consists of two 6'H x 10'W reinforced concrete box culverts. At this location, roadway overtopping occurs at a depth of approximately 7.3 feet from the invert of the culvert. The capacity of the culvert prior to overtopping is 1,075 cfs. The 100-year existing condition discharge in the major drainageway at State Highway 257 is estimated to be 1,560 cfs.

3.3 Open Channels

Open channels that were identified and inventoried during this planning effort were limited to existing stormwater channels and irrigation ditches/canals that serve as a major drainageway within a basin. In general, channels with a primary purpose of conveying stormwater through the basin are noticeably absent and runoff is typically conveyed in existing swales. Few of the basins have natural channels that collect and convey the stormwater runoff. Where the natural channels exist, they are located in basins south of the Cache la Poudre River (River Ridge Basin, Oklahoma Basin, South State Highway 257 Basin) that area characterized by an increase in topographic relief with channels naturally incised into the bluffs in the upper portions of the watershed.

The majority of the open channels discussed in the following paragraphs are related to the conveyance channels associated with the releases from irrigation reservoirs. The remaining conveyance channels were constructed as stormwater facilities during development of the property within each basin.

3.3.1 Law Basin

The major drainage channel in the Law Basin is the Law Ditch upstream of the Greeley No. 2 Canal and the Consolidated Law Ditch downstream of the Greeley No. 2 Canal. Both ditches convey irrigation releases from irrigation reservoirs located in the upper portion of the basin and offer approximately 50-100 cfs of conveyance capacity. The Law Ditch conveys both irrigation releases and stormwater runoff into the Greeley No. 2 Canal immediately east of WCR 21. At this location, the magnitude of the stormwater runoff (1,890 cfs) from the major storm events (100-year) greatly exceeds the capacity of both the Law Ditch and the Greeley No. 2 Canal. Large stormwater flows will overtop the canal banks and continue south to State Highway 392. The Consolidated Law Ditch begins at the Greeley No. 2 Canal, immediately west of WCR 21, and continues in a southerly direction to property owned by Kodak Incorporated south of Eastman Park Drive. South of Eastman Park Drive, both irrigation diversions and stormwater captured by the Consolidated Law Ditch flow through a small irrigation pond, along the west side of the Kodak property, through a water quality pond and ultimately into Cache la Poudre River. Existing condition 100-year stormwater discharges along the Consolidated Law Ditch are approximately 5,000 cfs.

Great Western Railroad Culvert on the West Tributary of the Law Basin

The major flow path draining the western portion of the Law Basin, northwest of the intersection of State Highway 392 and the Great Western Railroad, will be referred to in this master drainage plan as the West Tributary of the Law Basin. A defined channel does not exist for the West Tributary between State Highway 392 and the Greeley No. 2 Canal. Upstream of the Greeley No. 2 Canal, the West Tributary is known as the Springer Ditch (also known as the Windsor Reservoir Outlet) and serves as the only major defined drainage channel for the area. In addition to irrigation releases from Windsor Reservoir, the Springer Ditch captures stormwater in the ditch facilities and ultimately conveys all flows into the Greeley No. 2 Canal.

Between the Windsor Reservoir and the Greeley No. 2 Canal the West Tributary/Springer Ditch has a capacity of 500 to 1,000 cfs and estimated 100-year stormwater flows range from 800 to 2,500 cfs. According to representatives of the New Cache la Poudre Irrigation Company, during the irrigation season the Springer Ditch could be conveying a maximum of 150 cfs of irrigation flows. For the purpose of this master planning effort, the maximum irrigation flows of 150 cfs are assumed to be conveyed by the Springer Ditch between WCR 74 and the Greeley No. 2 Canal.

A hydraulic capacity evaluation of the Greeley No. 2 Canal was performed between the Kern Reservoir and the State Highway 392 crossing to determine the canal's ability to capture and direct stormwater flows. The capacity of the Greeley No. 2 Canal between the Kern Reservoir radial gates and the confluence with the Springer Ditch was determined to be approximately 500 cfs. However, between the Springer Ditch confluence and State Highway 392, the Greeley No. 2 Canal minimum capacity was approximately 700 cfs. According to representatives of the New Cache la Poudre Irrigation Company, during the irrigation season the Greeley No. 2 Canal could be conveying a maximum of 600 cfs of irrigation flows. Therefore, the Greeley No. 2 has the capability to capture and divert approximately 100 cfs (700 cfs capacity – 600 cfs of irrigation flows) of stormwater flows downstream/east of the Springer Ditch confluence in the existing condition. When the Greeley No. 2 Canal's minimum capacity of 500 cfs is reached between the Kern Reservoir and the Springer Ditch confluence, flows will overtop the right bank of the canal. A defined West Tributary channel does not existing downstream of the Greeley No. 2 Canal, therefore, a wide shallow flooding zone will convey stormwater across WCR 19, the Great Western Railroad, and State Highway 392. The existing condition 100-year discharges along the West Tributary between the Greeley No. 2 Canal and State Highway 392 are approximately 3,000 cfs. Downstream of State Highway 392 the West Tributary flows will confluence with the Law Ditch Main Channel flows.

3.3.2 High School Basin

The primary drainage channel in the High School Basin is the 10th Street Channel. The channel is located between Palisade Mountain Drive and the Whitney Ditch. The channel has a 2-foot bottom width and is approximately 5 feet deep. Between Palisade Mountain Drive and Stone Mountain Drive, the channel bottom is lined partially with concrete to a height of 1.5 feet. The channel has a maximum conveyance capacity, prior to overtopping into adjacent properties, of 350 cfs. The 100-year existing condition discharge along the 10th Street Channel is approximately 500 cfs.

10th Street Channel between Palisade Mountain Drive and Stone Mountain Drive

3.3.3 Timnath Reservoir Basin

The Timnath Reservoir Outlet Ditch serves as the major drainageway for the Timnath Reservoir Basin. Both irrigation releases from Timnath Reservoir as well as stormwater runoff intercepted by the ditch facilities are conveyed to the Greeley No. 2 Canal. At this location, runoff in excess of the capacity of the Greeley No. 2 Canal is spilled to the south into the floodplain of the Cache la Poudre River. The Timnath Reservoir Outlet Ditch ranges from 10 to 15 feet in width and is characterized by relatively steep side slopes (1H:1V to 2H:1V). The ditch is deeply incised (typically 8 to 10 feet) and is lined with vegetation as well as concrete rubble/riprap to stabilize locations of historic erosion. The maximum discharge capacity of the ditch is estimated to range from 800 and 1,200 cfs. The 100-year existing condition discharge along the Timnath Reservoir Outlet Ditch varies from approximately 1,000 to 2,200 cfs.