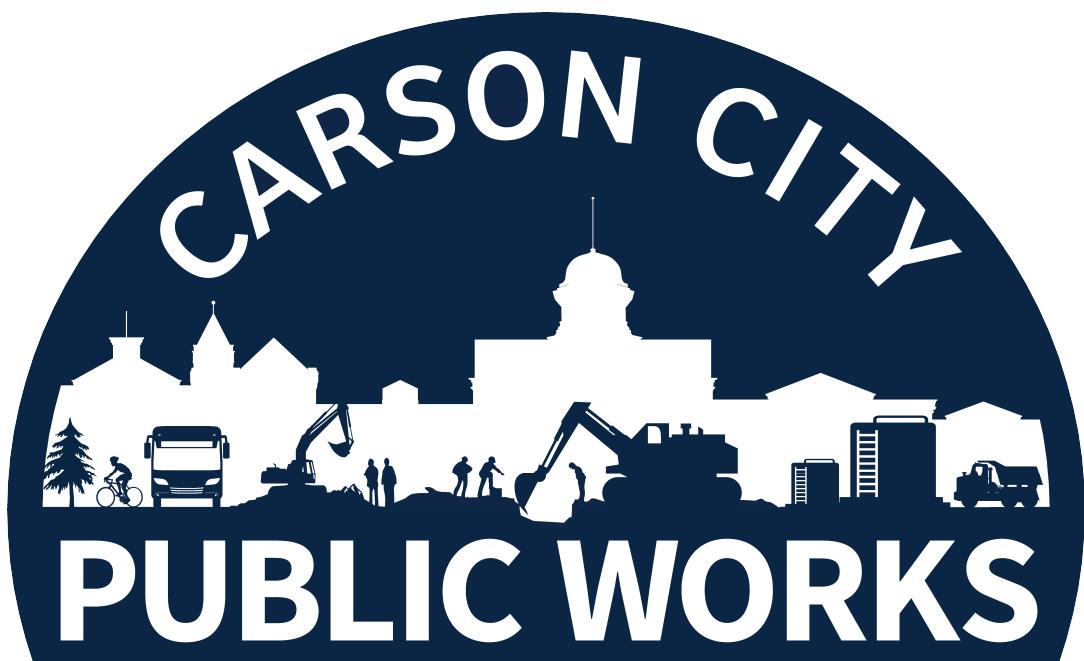


**CARSON CITY
STORM DRAINAGE FACILITIES
OPERATION AND MAINTENANCE
MANUAL**



November 2022

TABLE OF CONTENTS

Chapter 1 Introduction

| | | |
|------|--|---|
| 1.01 | Location & Description of Northwest Drainage Facilities | 3 |
| 1.02 | Location & Description of Vicee Retention Facilities | 6 |
| 1.03 | Location & Description of Golf Course Detention Basin | 6 |
| 1.04 | Location & Description of Lompa Ranch Conveyance Facilities..... | 7 |
| 1.05 | Location & Description of Graves Lane Detention Basin | 7 |
| 1.06 | Location & Description of Little Lane Village Detention Basin..... | 8 |
| 1.07 | Responsibilities for Drainage Maintenance..... | 8 |
| 1.08 | Use of This Manual..... | 9 |

Chapter 2 Inspection & Maintenance Requirements for Public Drainage Facilities

| | | |
|------|---|----|
| 2.01 | Inspection Frequency..... | 9 |
| 2.02 | Inspection Criteria..... | 10 |
| 2.03 | Prioritization of Maintenance & Repair..... | 10 |
| 2.04 | Inspection Check List..... | 13 |

Chapter 3 Inspection & Maintenance Requirements for Private Drainage Facilities

| | | |
|------|--|----|
| 3.01 | Private Storm Drainage Facilities..... | 13 |
| 3.02 | Ponds, Open Detention & Retention Facilities..... | 14 |
| 3.03 | Closed Detention & Infiltration Facilities..... | 14 |
| 3.04 | Control Structures & Flow Restrictors..... | 15 |
| 3.05 | Drainage Inlets, Manholes & Junction Structures..... | 16 |
| 3.06 | Energy Dissipators and Erosion Control Devices..... | 17 |
| 3.07 | Pipes, Culverts & Storm Drainage Conveyance Systems..... | 17 |
| 3.08 | Trash Racks & Debris Barriers..... | 18 |
| 3.09 | Grounds, Fences & Gates..... | 19 |
| 3.10 | Access Roads..... | 20 |

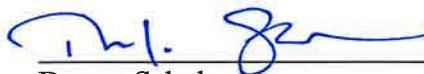
This edition of the "Carson City Storm Drainage Facilities Operation and Maintenance Manual" supersedes the July 2020 edition and is hereby adopted by the Carson City Public Works Department on this 30 day of November 2022.



Robert D. Fellows, P.E.,
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The facilities listed below are design to impound and/or convey flows from the 100-year 24-hour storm event and are dedicated for flood control purposes:

Northwest Drainage Facilities:

Shenandoah Detention Basin and Conveyance Facilities
Eagle Creek Detention Basins, Levee and Conveyance Facilities
Timberline/Combs Canyon Sediment, Levee and Conveyance Facilities
Silver Oak Detention Basins, Levee and Conveyance Facilities
Silver Oak Drive (Broadleaf Lane) & Arrowhead Drive Culvert Crossings and Conveyance Facilities

Carson City Freeway Drainage and Conveyance Facilities - Phase 1A & 1B (NDOT)
Vicee Retention Facilities
Eagle Valley Golf Course Detention Basin
Lompa Ranch Conveyance Facilities
Little Lane Village Detention Basin

The facilities listed below are design to impound and/or convey flows from the 10-year 24-hour storm event:

Graves Lane Detention Basin

1 INTRODUCTION

This manual was originally developed by Carson City to be used by City forces for the Operation and Maintenance of storm drainage facilities built by the City in conjunction with the Carson City Freeway Project (the Northwest Drainage Facilities). But, because there was a need to include other important public storm drainage facilities and to establish guidelines for private storm drainage facilities, the manual was expanded to include guidelines for the inspection, operation and maintenance of all public and private storm drainage facilities within the City. The datum for all elevation is NGVD 29 unless otherwise stated.

1.01 Location and Description of Northwest Drainage Facilities

The Interlocal Cooperative Agreement between the Nevada Department of Transportation (NDOT) and Carson City, for the Carson City Freeway, identified storm drainage facilities to be constructed and maintained by the City. These storm drainage facilities, known as the Northwest Drainage Facilities, are as follows:

- a. Shenandoah Detention Basin and Conveyance Facilities;
- b. Eagle Canyon Creek Detention Basins and Conveyance Facilities;
- c. Timberline/Combs Canyon Sediment Basins and Conveyance Facilities;
- d. Silver Oak Detention Basins and Conveyance Facilities;
- e. Silver Oak Drive & Arrowhead Drive Culvert Crossings and Conveyance Facilities.

The **Shenandoah Detention Basin and Conveyance Facilities** are located in northwest Carson City within Section 31, T16N, R20E on the east side of US 395 and just south of Bonanza Drive. The reservoir is owned and operated by Carson City Public Works Department. Drainage originates from the south side of the Virginia Range and is conveyed to the detention basin through a box culvert under Bonanza Drive. This box culvert will direct the flow from upstream watersheds into the upper detention basin. The detention facility itself has two interconnected retention/detention basins in series. The detention basins are constructed of zoned earth-fill embankments with an impervious clay core. The upper detention basin has an approximate volume of 6 acre-feet and will function as the primary detention basin in the 5-year event and as a sediment basin in the 100-year event. The low-level outlet is a vertical 48" RCP at an elevation of 4754.5 feet and an 18" RCP at an elevation of 4750.0 feet that discharges to the lower detention basin. The spillway is sized to pass the 100-year event at a depth of approximately 1.8 feet. The 5 Year event is impounded to an elevation of 4758.41 feet, which will provide for approximately 2.23 acre-feet of sediment storage and will overflow the spillway by 0.41 feet. The 100-year event will pass through the basin spillway with little effect besides sediment storage.

The lower detention basin has an approximate storage volume of 23 acre-feet and will function as the primary detention basin in the 100-year event. The low-level outlet is a 48" RCP that is connected to the existing storm drain system. An orifice plate with an area of 33" in diameter is used between the 48" RCP and the 5' x 5' riser. The spillway is sized to pass more than double the 100-year event flow. The 100-year event is impounded to an elevation of 4751.93 feet, which will provide for approximately 0.5 feet of freeboard. The flow coming out of the outlet pipe

enters the existing storm drain inlet in the south east corner of the detention facility. This 60-inch diameter storm drain runs south along the west side of Garnet Way to the southwest corner of Arrowhead Drive and Gamet Way. The system then continues west along the south side of Arrowhead Drive to the rear properties of Dean Court, turning south the 60-inch diameter pipe changes to two 48-inch diameter pipe and continues in between Mina and Midas Way connecting to the NDOT 395 storm drainage system.

The Eagle Creek Detention Basins, Levee, and Conveyance Facilities are located in the northwest area of Carson City near Medical Parkway (Section 6, Township 15 North, and Range 20 East). It consists of three detention basins with a total of 74.5 acre-feet of storage and appurtenances (Basin 1: 10.6 ac-ft; Basin 2: 32.8 ac-ft; Basin 3: 31.1 ac-ft). Of this, 70.5 acre-feet is for water storage, and 4.0 acre-feet is for sediment storage. The levee is approximately 600 feet and goes southeast through the healthcare facility. The levee has an embankment slope that ranges from 3:1 to 4:1 (horizontal to vertical) and the elevation of the berm crest ranges from 4789 feet to 4802 feet above sea level. The 100-year event is estimated to produce a discharge of 498 cubic feet per second (cfs) and the metered outlet is designed to discharge a maximum of 77 cfs, draining the facility within 48 hours of the peak of the 100-year storm event. The 100-year flood event elevation along the levee varies from 4784.35 feet to 4798.85 feet. A concrete inlet weir into the upper basin is located at the northwest corner of the basin. The middle basin and lower basins both have rip-rap armored emergency outlet spillways along the south corners of the facilities. Controlled flows are routed via a 48-inch diameter reinforced concrete pipe south to Medical Parkway, and then east along Medical Parkway, crossing under North Carson Street, to Arrowhead Drive (this is known as Arrowhead Crossing) and connecting to the NDOT 395 storm drainage system. In August of 2009, Black Eagle Consulting performed a Geotechnical Stability Evaluation of the levee for two sections, EC1 and EC2. Black Eagle found that for the EC1 section, the minimum factor of safety for static loading was 2.2, seismic loading was 1.2, steady seepage was 1.5, and sudden draw down was 4.2. For the EC2 section, the minimum factor of safety for static loading was 2.2, seismic loading was 1.2, steady seepage was 1.4, and sudden draw down was 2.8.

The Timberline/Combs Canyon Sediment and Conveyance Facilities are located in the northwest part of the City, consist of sediment storage, watershed stabilization, and stormwater routing improvements. These improvements begin upstream of Murphy Drive, and extend through the northwest portion of the Western Nevada College (WNC) Campus to Combs Canyon Creek, and then through other public and private lands to the Driving Range and Fairway 9 on the Silver Oak Golf Course. Sediment Basin 1 is located within the WNC Campus to the east of Murphy Drive (V&T right-of-way). It is designed to receive flows from Timberline watershed, to retain the sediment load from a single 100-year 24-hour storm event, and to pass the stormwater without detention. Sediment basin 1 is sized to hold approximately 1.5 acre-feet of sediment. The 100-year storm flow through this facility is estimated to be 190 cfs. Flows from this basin are routed under Combs Canyon Road into Combs Canyon Creek (normally a dry bed) and then east to Sediment Basin 2. The route leading into Sediment Basin 2 is protected by a levy located on the south side of the Combs Canyon Creek bed. Sediment Basin 2 is located on city property, formerly the open space parcel for University Heights, PUD, Phase 2, and is sized to hold approximately 2 acre-feet of sediment (the 100-year combined Timberline and Combs Canyon storm flows are estimated at 725 cfs). This basin is equipped

with a slow drain outlet and an outlet weir that directs flows into an existing swale on the Silver Oak Golf Course. This swale conveys the flow through the golf course to the driving range detention basin located on the Silver Oaks Golf Course Property.

The **Silver Oak Detention Basins, Levee, and Conveyance Facilities** are located in the northern part of the City on the Silver Oak Golf Course (Section 31, Township 16 North, Range 20 East) and consists of two detention basins. Detention is provided within the Driving Range and within Fairway 9. A levee is located in between these two detention basins with the elevation of the top of the levee ranging from 4754-4758 feet above sea level. The levee is between 8-16 feet tall, has a fill thickness between 6 and 10 feet, and has a rounded crest of approximately 4-6 feet wide. The levee is covered in grass with a line of pine trees around 12 feet high along the center part of the crest. The 100-year flood event is expected to be at 4735.2 feet, and it is expected that the floodwater from this event will be in contact with the embankments of the levee for approximately 16 hours. The Driving Range Detention Basin holds approximately 72 acre-feet and is designed to meter the 100-year storm flow of 725 cfs to 140 cfs via a 42" diameter RCP low flow outlet pipe. The Fairway 9 Detention Basin provides 20 acre-feet of storm storage and is designed to meter the 100-year storm flow of 376 cfs to 67 cfs via a 30" diameter RCP low flow outlet pipe. Controlled flows from both of these detention basins are routed via a 60" diameter RCP to Silver Oak Drive, connecting to 7 feet x 5 feet reinforced concrete box culvert (RCBC). This flow is then routed within the RCBC East along Silver Oak Drive to an open ditch on the westerly side of North Carson Street where it crosses under North Carson Street to the extension of Silver Oak Drive (aka Broadleaf Lane, this is known as the Broadleaf Crossing). In August of 2009, Black Eagle Consulting performed a Geotechnical Stability Evaluation on the levee for two sections: SO1 and SO2. For section SO1, the minimum factor of safety for static loading was 2.2, seismic loading was 1.1, steady seepage was 1.5, and sudden draw down was 3.0. The other section (SO2) was found to have a minimum factor of safety of 2.7 for static loading, 1.2 for seismic loading, 1.7 for steady seepage, and 2.7 for sudden draw down.

The **Silver Oak Drive (Broadleaf Lane) & Arrowhead Drive Culvert Crossings and Conveyance Facilities** are located in the northwest part of the City, consist of two cross-drains and downstream conveyance systems between North Carson Street and the Carson City Freeway. One of these cross-drains is located at North Carson Street and Arrowhead Drive, and the other is located at North Carson Street and Silver Oak Drive (Broadleaf Lane). These facilities convey the flows from the Eagle Canyon Creek and Silver Oak Detention Basins across North Carson Street to Arrowhead Drive and to Silver Oak Drive respectively. The 48-inch diameter RCP cross-drain at North Carson Street and Arrowhead Drive (Arrowhead Crossing) is designed to convey approximately 109 cfs to the Freeway storm drain system via Arrowhead Drive. The 6' x 4' RCBC cross-drain at North Carson Street and Silver Oak Drive (Broadleaf Crossing) is designed to convey approximately 218 cfs to the Freeway storm drain system by means of Silver Oak Drive.

1.02 Location and Description of Vicee Retention Facilities

The **Vicee Retention Facilities** are located in Section 12, Township 15, North, Range 19 East at the end of Foothill Drive. The facilities are south of Western Nevada College (WNC) Campus and are on city property. The facilities consist of nine small sedimentation/infiltration basins and one large retention/infiltration/sediment basin. The small sedimentation/infiltration basins support a dual function by capturing sediment and allowing ground water recharge. The small basins are an important part of the city's municipal water system. Every March through June approximately 100-acre feet of surface water is released from lakes in the upper watershed to infiltrate in the system whereby the city receives water credit. The city then extracts this water credit from wells near the Carson River to supply water to the city. The nine small basins combined hold about 30 acre-feet. The large basin has a bottom elevation of 4800 and 4812 with the outlet weir at 4842. The large basin retains 165-acre feet to elevation 4842 and a maximum capacity of 212-acre feet of storage at an elevation of 4845. If storm water reaches the outlet, the outlet weir would release about 43 cfs at 1 foot height, 150 cfs at 2 feet and 310 cfs at 3 feet. Any flow out of the basin is directed down Foothill Drive to Winnie Lane, then west to Ash Canyon Road. The 100-year flow into the large basin peaks at 475 cfs for a 24-hour event. For this single storm event, no water will leave the basin.

1.03 Location and Description of Eagle Valley Golf Course Detention Basin

The **Eagle Valley Golf Course Detention Basin** is located in northeast Carson City in portions of Township 16 North, Range 20, East, Section 34 and Township 15 North, Range 20 East, Section 4. It is located on the west course of the Eagle Valley Golf Course, north of Arrowhead Drive. The basin is owned and maintained by Carson City. The crest elevation of the basin is at 4,771 feet and the top crest width of the basin is approximately 15 feet. The detention basin is bound by the earth embankment to the south and by the existing ground slope to the north. The southern bank of the basin has a 3:1 side slope and is covered by riprap with some brush and grasses that have grown through the rocks. The northern bank has slopes that vary from 10% to 20% and are covered with moderate brush, grasses, and small trees. The bottom elevation of the detention basin is at 4,743 feet. There is an outlet structure and 30" corrugated metal pipe at the bottom of the detention basin. The outlet structure has a trash rack to help reduce debris from entering the basin. The detention basin has an emergency spillway at the west of the basin to bypass emergency flows around the basin to the south. The spillway is approximately 15 feet wide and 500 feet long with side slopes that vary from 4:1 to 2:1. The spillway is riprap lined. The elevation of the spillway varies from 4,765 feet at the upstream start to 4,740 feet at the downstream end. Assuming no water is being released via the outlet structure and pipe, the volume of stormwater detained by the basin is 34 acre-feet to the emergency spillway elevation of 4,765 feet. If the outlet structure and emergency spillway are both inactive, the basin can detain 53 acre-feet of stormwater to the crest elevation of 4,771 feet. Storm water from the Eagle Valley Golf Course Basin will flow in a southerly direction toward the Carson River. The storm water leaving the basin will travel through a well-defined channel through the golf course and then travels to the southeast to Arrowhead Drive.

1.04 Location and Description of Lompa Ranch Conveyance Facilities

The **Lompa Ranch Conveyance Facilities** are located within the portions of the central $\frac{1}{4}$ of Section 16, Township 15 North, and Range 20 East M.D.M., lying within Carson City, State of Nevada. Further defined, the location is in Carson City, Nevada and is bound by US-395 to the east, Saliman Road to the west, US-50 to the north, and 5th Street to the south. The public stormwater facilities within the project generally consist of four on-site channels comprised of the Vicee Channel, the Ash Canyon Channel, the Kings Canyon Channel and the Saliman Road Channel. Goni Canyon Creek originates north of Carson City, flows south, and ends along the east side of I-580 at the northern border of the project site. Ash Canyon Creek (ACC) originates in the western mountain ranges and flows east through the project site. Kings Canyon Creek (KCC) also originates in the western mountain range, just south of ACC, and flows east through the project site, then through an existing bridge at I-580. Vicee Canyon Creek (VCC) flows from west to east and enters the northern portion of the site through the high school property. Finally, the Southwest Carson City watersheds, including Voltaire Canyon and Tributaries "H" and "I", flow from south to north and enter the project area just west of I-580. All four of these watersheds meet and flow under I-580, joined to be called Kings Canyon Creek (KCC). VCC will be channelized across the northern portion of the site from the end of the existing channel on the high school property to the large channel parallel to US-395/I-580. It is planned as an open, trapezoidal channel with a depth of 4-feet and side slopes of 3:1. The proposed Spine Road will cross the VCC channel with a 4' X 14' CONTECH Bebo bottomless arch culverts. The ACC channel begins on the east side of the property at the intersection of Robinson Road and Saliman Road. The channel will direct flow to the east, along the south side of Robinson Road, to the large open channel adjacent to US-395/I-580. The conceptual cross section for ACC is an earthen, open, 4-foot-deep trapezoidal channel, with 3:1 side slopes with three boxes (5.5' X 22') CONTECH Bebo bottomless arch culvert crossings. The KCC channel will travel adjacent to East 5th Street, follow the property boundary of the Lompa homestead, and continue to join VCC, ACC, and the Voltaire Canyon/Tributaries H & I watersheds before flowing under the bridge at US-395/I-580. The proposed channel is 6-feet deep, with 3:1 side slopes, and includes a bench at 3-feet for a 12-foot-wide maintenance road. Downstream of where VCC, ACC, and KCC join is referred to as Lower KCC channel. The KCC Channel will have CONTECH Bebo bottomless arch culverts that consist of two 6.5' X 20' at each of the three proposed crossings.

1.05 Location and Description of Graves Lane Detention Basin

The **Graves Lane Detention Basin** is located in the Northeastern part of Carson City, Township 15 North, Range 20, East, Section 10. The detention basin is directly west of the intersection between Highway 50 and Sherman Lane. There is currently no road named Graves Lane in Carson City because the road name was changed to College Parkway. The detention basin was built when Grave Lane existed. Graves Lane Detention Basin is owned and managed by Carson City, and was approved for construction in February 1999. The elevation of the crest of the basin is 4629.5 feet (NGVD 1929), and the banks enclosing the bottom of the basin are dirt slopes with a maximum slope of 3:1. Existing on these sloped banks are different assortments or grass, bushes, and shrubs surrounding the entire basin. The bottom of the basin also contains several trees. There are two inlets to the basin, one on the Northwest corner and one on the Southwest corner; both of which are lined with rock riprap. The Northwest inlet is a

34" x 53" reinforced concrete pipe with an elliptical shape and has a flared end section. The inverted elevation of this Northwest inlet pipe is 4625.73 feet. The Southwest inlet pipe is a 36" reinforced concrete pipe with a flared end section and an inverted elevation of 4625.62 feet. The elevation of the bottom of the basin at the outlet is 4621.97 feet and the outlet is composed of three 36" reinforced concrete pipes. The two outside pipes have been plated shut, and in front of the middle pipe, a two-stage orifice outlet box has been added in order to slow the outlet flow. On top of this box is a metal grate to prevent floating debris from flowing into the pipe during the second stage and creating an obstruction. The basin has a capacity of approximately 9.23 acre-feet. The basin was designed needing a volume of about 5 acre-feet to be able to detain the storm water of the 10-year storm event. The distance from the Northwest inlet to the outlet structure is approximately 315 feet and has a 1.17% slope. From the detention basin, the stormwater flows south east under Highway 50 and continues south. The water then turns west and eventually flows into the Carson River.

1.06 Location and Description of Little Lane Village Detention Basin

The **Little Lane Village Detention Basin** is located within the southeast $\frac{1}{4}$ of the southeast $\frac{1}{4}$ of Section 17, Township 15 North, and Range 20 East M.D. M., lying within Carson City, Nevada. The detention basin is northwest of the intersection of Little Lane and South Saliman Road. The Little Lane Detention Basin with the public storm drain infrastructure will be managed by Carson City and was approved for construction in August 2020. Within the detention basin on a higher elevation will be a neighborhood park owned and maintained by the Little Lane Village Homeowners Association (HOA). The HOA will also be responsible for maintaining the landscaping surrounding and within the detention basin which consists of trees, shrubs, and grass. The basin has a maximum slope of 3:1 along the sides and has the neighborhood park and access road to the north, an access road to east, Little Lane to the south, and Spartan Avenue to the west. There are two inlets with riprap aprons to the basin along the west side. Both pipes are 24-inch reinforced concrete with a headwall. The northern most inlet has an invert elevation of 4638.14 feet and the southernmost inlet has an invert elevation of 4637.60 feet. The outlet pipe in the southeast corner is an 18-inch reinforced concrete with a headwall and trash rack. The invert elevation is 4636.97 feet. A beehive catch basin near the headwall serves as a secondary outlet with a rim elevation of 4640.55 feet and is connected to the 18-inch pipe and outlets as a 30-inch pipe. The basin was designed with a volume of 4.5 acre-feet with 1 foot of freeboard and meant to handle the increase of runoff due to the development and the existing flood water volume. The elevation of the crest of the basin is 4642.7 feet at the southeast corner. The approximate size of the basin is 460 feet long by 160 feet wide by 5 feet deep with the slope on the bottom on the basin of 0.5 percent. From the detention basin, the stormwater flows south along South Saliman Road to Cardinal Way and exits east to a linear ditch eventually flowing towards Carson River.

1.07 Responsibilities for Drainage Maintenance

Responsibility for the City's stormwater facilities falls under the Public Works Department, including directing the overall maintenance activities of Stormwater Operations Staff. Stormwater Operations staff are responsible for tracking inspections for City storm

drainage facilities, and for prioritizing and scheduling maintenance, and repair work to be performed by the City's drainage maintenance crews. The Public Works Department currently has an Operations Manager, who is in charge of the City's drainage system maintenance.

Individual site inspections will be conducted in response to citizen complaints and/or drainage service requests. These requests are generally received by Public Works either by email, Carson Connect, hotline, office visit, or general call. When an inspection identifies the need to maintain, repair or clean the City storm drainage facilities, a work order shall be generated, and the work shall be scheduled and performed according to the priority assigned to the work. When an inspection identifies the need to maintain, repair or clean privately owned, on-site drainage facilities the property owner shall be notified by the City Engineer and requested to take corrective action. If the property owner(s) fail to adequately maintain said facilities, Carson City shall be given the right to enter said property, upon proper notice, for the purposes of maintenance. All such maintenance costs shall be assessed against the owner(s), [C.C.M.C Title 12.18.100 Maintenance Requirements].

1.08 Use of This Manual

This manual is designed to outline the inspection, operation and maintenance requirements for all public and private storm drainage facilities in Carson City. Where possible, the information contained in the manual should be used in conjunction with the record drawings for each facility. Record drawings for most public storm drainage facilities and many private facilities are on file in the Engineering Division Office, located at 108 E Proctor Street, Carson City, NV 89701. The drainage hotline telephone number for the Engineering Office is (775) 887-2305.

2 INSPECTION & MAINTENANCE REQUIREMENTS FOR PUBLIC DRAINAGE FACILITIES

2.01 Inspection Frequency

A good preventative maintenance program begins with inspection. Twenty percent of all drainage channels, creeks, streams, and storm drainage facilities maintained by the City are to be inspected at least once a year.

The Northwest Drainage Facilities and all urban drainage facilities within FEMA designated Special Flood Hazard Areas (SFHA) are deemed to be '*critical drainage facilities*' and are to be inspected at least once a year, using the inspection check list included in section 2.04 of this manual. These inspections shall be done in late spring or in the fall.

Additionally, all City storm drainage facilities are to be inspected after a major storm that could adversely impact the drainage system (5yr/24hr, or greater storm event).

2.02 Inspection Criteria

The inspection of public storm drainage facilities will consist of a detailed evaluation of the existing condition of each of the components of the system. The following inspection items, while not all inclusive, are typical of most facilities.

- a. note the condition of the side slopes and bottom with emphasis on the amount of erosion or sediment present;
- b. note the condition of earthen berms and levies;
- c. note the condition of inlet and outlet structures, grade control structures, & rock rip-rap;
- d. note the condition of landscaping, vegetation, and erosion protection measures;
- e. note the condition of fences (if present), and signs of unnatural erosion or vandalism;
- f. note the presence of sediment or debris that could obstruction the free flow of water through the conveyance system; and
- g. note the presence of trash, shopping carts, lawn clippings, and other rubbish that could obstruction the free flow of water through the conveyance system.

Inspections shall be scheduled and tracked by Public Works operations staff using the Department's maintenance management program. The information collected from these inspections shall be entered into the program and used to generate appropriate work orders.

All City maintained storm drainage facilities shall also be inspected after a major storm that could adversely impact the drainage system (greater than 5-year, 24-hour).

Operational problems or possible design flaws discovered during the inspection of City storm drainage facilities will be directed to the Chief Stormwater Engineer for analysis and recommendation.

2.03 Prioritization of Maintenance & Repair

All storm drainage maintenance and repair work will be prioritized. Major watersheds drainage system will have top priority, especially ones that affect greater portions of the city. Work orders for maintenance and repair work generated by inspections will be carried out by drainage maintenance personnel, or private contractors hired by the City, as early as practical. Given the fact that there is frequently a backlog of work to be accomplished, the drainage maintenance crews will perform the highest priority assignments first, and then make their way down the list according to the priorities and completion dates assigned to the remaining work.

Emergency work will be given the highest priority (where life/safety issues are involved). This work should be initiated as soon as the manpower and equipment are available to perform the needed tasks.

The next highest priority, priority "A", will be given to removing obstructions to flow and correcting the underlying cause of these obstructions; and to addressing immediate threats to property damage. The goal for completing this work is one (1) to two (2) weeks from the completion of the inspection, depending on the complexity of the work involved. All problem

site areas are considered priority “A” and get extra attention before and after a storm event.

Routine preventative maintenance activities will be given a lower priority, priority “B” or “C”, but will be carried out as early as practical by drainage maintenance personnel. The goal for completing routine work Priority “B” is within six months or before the winter season from the creation of the work order. Priority “C” activities would be added to other capital improvement projects. Routine work may include, but is not limited to, removal of sediment and debris; spraying, trimming or removing vegetation; and minor repairs to earthen slopes, berms and levies, or surrounding fences.

Typical procedures for the maintenance and repair of City storm drainage facilities are, as follows:

Removal of Sediment & Debris:

- Removal of sediment and debris will consist of excavation and transport of excavated material to an approved off-site land fill, stockpile, or disposal site.
- Monuments or markers may be installed within basins and channels to assist operators in locating the bottom limits of the excavation. Potentially submerged structures may be marked with a staff gauge to prevent damage by heavy equipment.
- Excavation and removal of sediment material from the basin or channel bottom will be to the original lines and grades indicated on the as-built drawings for these facilities, or to the depth indicated by the monuments or markers.
- Operators must use caution to avoid undercutting existing rip-rap or concrete slope protection when excavating near or around the toe of protected slopes.

Repair of Erosion:

- Remove loose material, repair and stabilize eroded surfaces, using mechanical compaction.
- Remove slide material and rebuild failed slopes with suitable fill material, keying compacted material into the slope.
- Replace any soil removed by burrowing rodents, using mechanical compaction. Consider removing burrowing animals from sensitive areas.
- Re-establish vegetation.

Repair of Rock Rip-Rap Slope Protection:

- Remove rock from undermined and/or eroded areas; pull back geotextile filter fabric (where present); fill scoured areas; re-compact material supporting the rock rip-rap;

replace geotextile fabric and rip-rap.

Cleaning & Maintenance of Pipes, Drainage Inlets & Manholes:

- Remove and dispose of sand, silt, trash and debris to approved disposal locations.
- Clean and flush storm drain inlets and pipe lines by use of water hose and heavy-duty vacuum or by rodding the lines. All material removed from the storm drainage system shall be hauled to an approved disposal area.
- Check for any signs of leakage at pipe joints, or damage to pipes or structures.
- All public storm drains are to be cleaned and maintained in accordance with the best management practices (BMPs) adopted as a part of the City's Storm Water Management Plan (SWMP), including the frequency of cleaning and measurable goals established for this activity.

Cleaning & Maintenance of Streams, Open Channels & Ditches:

- Sand, silt, trash and debris, and any other restrictions to the flow of water will be removed, including excess vegetation.
- Vegetation will be removed by trimming or cutting, and *not* by excavating. Pruning, trimming or removal of mature vegetation will be at the direction of a trained arborist. Mowing of native grasses and weeds will be by use of mechanical devices, such as lawn mowers and brush mowers.
- All material removed will be hauled away from the site to an approved land fill or stock pile area, including all grass clippings and cuttings from trees and shrubs.
- All streams, channels, and ditches in the urbanized portion of the City are to be cleaned and maintained in accordance with the best management practices (BMPs) adopted as a part of the City's Storm Water Management Plan (SWMP), including the frequency of cleaning and measurable goals established for this activity.
- Natural channels and drainages are evaluated on a case-by-case basis. Permits and coordination with other agencies may be necessary as well as engineering plans before maintenance work can begin.

Repair or Replacement of Damaged Elements of the Facilities:

- Storage vessels, valves, plates or other facilities that are bent out of shape or deformed more than 10% of their design shape will be repaired to design or replaced.

- Rusted, bent, cracked, or chipped pipe will be repaired to design or replaced.
- Damaged or missing manhole covers, or grates will be repaired to design or replaced.
- Cracks in the walls, top slab or bottom of catch basins, manholes or other concrete structures will be repaired to design or the structures replaced.
- Any storm drainage facilities that are deteriorated due to age and/or use will be repaired to design or replaced.
- An inspection may reveal that important elements of the storm drainage system are damaged or missing, and/or that design flaws or operational problems may be the root cause of the damage that needs to be repaired. In either event, the Chief Storm Water Engineer may be requested to perform a detailed evaluation of the site prior to implementing a solution. The replacement or type of repairs of these elements will depend upon the results of the engineering evaluation and the recommended course of action.

2.04 Inspection Check List

The regular inspection of public storm drainage facilities will consist of observation and notations of the condition of each of the components of the system. A *Check List* was developed to aid in the inspection process, located at the end of the manual.

3 INSPECTION & MAINTENANCE REQUIREMENTS FOR PRIVATE DRAINAGE FACILITIES

3.01 Private Storm Drainage Facilities are defined as storm drainage improvements constructed on private property solely for the benefit of the property owner(s) or as a mitigation to the impacts of developing the subject property. The property owner, developer, homeowners' association, or property manager designated by the owner(s) shall be responsible for the inspection and maintenance of all private storm drainage facilities including, but not limited to, manholes, inlets, control structures, pipes, channels, and detention basins, unless otherwise provided for in a binding agreement with the City.

All private storm drainage facilities must be inspected at least once a year and maintained so that they continue to function properly. The components of these private facilities must be kept free from major defects and maintained according to the criteria listed below. Should the owner(s) fail to adequately maintain said facilities, City representatives may enter said property, upon proper notice, for the purposes of performing needed maintenance. All such maintenance costs shall be assessed against the owner(s). For requirements and procedures related to private maintenance see Carson City Municipal Code Title 12.18.100, Maintenance Requirements.

3.02 Ponds, Open Detention & Retention Facilities

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|---------------------------|-------------------------------|---|--|
| Side Slopes | erosion | erosional features over 2" deep | slopes stabilized and shielded from erosion |
| Storage Volume | sediment | accumulations exceeding 10% of the design volume | sediment cleaned out |
| | trash/debris | accumulations exceeding 1 cu. ft. per 1000 sq. ft. within a landscaped area | trash/debris removed |
| Overflow/Spillway | missing rock | any exposure of native soil | rock restored to original lines & grades |
| Dikes & Levies | settlement | lowering of height (of any part of the facility) by 4" or more | facility restored to design elevation |
| | rodent holes | any evidence of rodent holes or water piping through embankment | slopes repaired and rodents removed |
| Vegetation Control | tree growth | trees interfering with access, silt removal, mowing or vacating | trees pruned, trimmed and repaired/removed |
| | plant growth | height of ground cover, grass, or plants interferes with the function of the facility | grass mowed to 2" in height, plants thinned and/or trimmed |
| | noxious/ poisonous vegetation | Russian knapweed, yellow star thistle, tall white-top and other poisonous and/or noxious plants | all undesirable vegetation removed or controlled |

3.03 Closed Detention & Infiltration Facilities

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|------------------------|-------------------|--|--|
| Storage Vessels | sediment | accumulations exceeding 10% of the design volume | sediment cleaned out |
| | plugged air vents | one-half of the cross-section of a vent is blocked with sediment or debris | obstructions removed vents free of sediment and debris |

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|------------------------------------|---|--|--|
| Storage Vessels | joints, cracks & openings | any openings allowing material to be transported into the facility | joints properly connected & sealed |
| | bending or deformation | any part of storage vessel or pipes bent out of shape, or deformed more than 10% of its design shape | pipe and/or storage vessel repaired or replaced to design |
| Manholes & Catch Basins | damaged or lost cover/grate | cover or grate missing, or only partially in place; frame & grate or manhole cover bent/damaged | cover, grate and/or frame repaired and reinstalled to design |
| | cover/grate difficult to remove | one person cannot remove after applying 80 pounds of lift and/or cover, grate or frame visibly bent | frame & cover/grate cleaned & repaired or replaced to design |
| | cover/lid not working properly | bolt down cover or self-locking lid cannot be opened by one person with proper tools | all covers & lids repaired or replaced to design |
| | structural damage, cracking, & spalling | cracks in walls, bottom, and/or top slab wider than $\frac{1}{2}$ inch, and longer than 1 foot; visible deformation; or misalignment | manhole or catch basin repaired or replaced to design |
| | joints, cracks or openings | any openings allowing material to be transported into the facility | openings properly connected & sealed |

3.04 Control Structures & Flow Restrictors

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|------------------------------------|---------------------------------|---|--|
| Manholes & Catch Basins | damaged or lost parts | cover or grate missing, or only partially in place; frame & grate or manhole cover bent/damaged | cover, grate and/or frame repaired and reinstalled to design |
| | cover/grate difficult to remove | one person cannot remove after applying 80 pounds of lift and/or cover, grate or frame visibly bent | frame & cover/grate cleaned & repaired or replaced to design |
| | cover/lid not working properly | bolt down cover or self-locking lid cannot be opened by one person with proper tools | all covers & lids repaired or replaced to design |

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|------------------------------------|------------------------------|--|---|
| Manholes & Catch Basins | joints, cracks or openings | any openings allowing material to be transported into the facility | all openings are properly sealed |
| Cleanout Gate | damaged or missing parts | gate not watertight, and/or parts are damaged or missing | gate repaired or replaced to design |
| | gate rusted and/or stuck | cleanout gate cannot be operated by one person or is rusted over 50 % of its surface area | gate repaired or replaced to design |
| Orifice Plate | damaged or missing | control structure is not working properly due to missing, bent, or out of place orifice plate | plate repaired or replaced to design |
| Overflow System | obstructions | any sediment, trash, or debris blocking or having the potential to block the overflow system | overflow system is free of obstructions & works as designed |
| General | structural damage & cracking | cracks in walls, bottom, and/or top slab wider than $\frac{1}{2}$ inch, and longer than 1 foot, or visible deformation | manhole or catch basin repaired or replaced to design |
| | sediment, and debris | accumulations exceed 10% of the volume of the control structure | sediment, trash and debris removed |

3.05 Drainage Inlets, Manholes & Junction Structures

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|-------------------------------------|---------------------------------|---|--|
| Manholes, & Catch Basins | damaged or lost covers | cover or grate missing, or only partially in place; frame & grate or manhole cover bent/damaged | cover, grate and/or frame repaired and reinstalled to design |
| | cover/grate difficult to remove | one person cannot remove after applying 80 pounds of lift and/or cover, grate or frame visibly bent | frame & cover/grate cleaned & repaired or replaced to design |
| | cover/lid not working properly | bolt down cover or self-locking lid cannot be opened by one person with proper tools | all covers & lids repaired or replaced to work properly |
| | joints, cracks or openings | any openings allowing material to be transported into the facility | openings properly connected & sealed |

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|------------------------------------|-------------------------------|--|--|
| Manholes & Catch Basins | settlement or misalignment | concrete basin or vault has settled more than 1 inch or rotated more than 2 inches out of alignment | basin repaired or replaced to design |
| | structural damage, & cracking | cracks in walls, bottom, and/or top slab wider than $\frac{1}{2}$ inch, and longer than 1 foot, or visible deformation | concrete structures repaired or replaced to design |
| | sediment, and debris | accumulations exceed 10% of the design volume | sediment, trash and debris removed |
| Vegetation Control | weeds | vegetation growing across and blocking more than 10% of basin opening; or growing inside basin or pipe inlet | weeds removed |

3.06 Energy Dissipators & Erosion Protection Devices

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|--------------------------|----------------------------------|--|--|
| Rock Rip-Rap | rock missing or displaced | only one layer of rock exists above native soil in area 5 square feet or larger; or any exposed soil | rock restored to original lines & grades |
| Concrete Chamber | baffles worn or damaged | any concentrated worn spot exceeding one square foot | repair or replace to design |
| | sides of chamber worn or damaged | any concentrated worn spot exceeding one square foot or visible damage | repair or replace to design |
| Dispersion Trench | sediment | accumulated sediment that exceeds 10% of design depth | system cleaned and flushed |

3.07 Pipes, Culverts & Storm Drainage Conveyance Systems

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|-----------------------------|------------------|--|---------------------------|
| Pipes & Culverts | damage or rust | protective coating is damaged; rust is causing more than 50% deterioration to any part of pipe | pipe repaired or replaced |

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|-----------------------------|------------------------------|---|---|
| Pipes & Culverts | dents | any dent that decreases the cross sectional area of the pipe by more than 10% | pipe repaired or replaced |
| | chips or cracks | cracked or chipped concrete pipe should be sealed to insure the protection of the reinforcing steel | pipe sealed & repaired or replaced |
| | settlement or deflection | settlement or deflection resulting in misalignment or sags where pipe is bent out of shape, or deformed more than 10% of its design shape | pipe or culvert replaced |
| | erosion | erosional features over 2 inches deep on side slopes | slopes stabilized and shielded from erosion |
| Open Ditches | missing or out of place rock | rock on sides or bottom of ditch is disturbed or removed, exposing the underlying soil to erosion | replace rock lining to design standard |
| | sediment, trash and debris | accumulated sediment, trash and/or debris exceeding 10% of the volume of the conveyance system | sediment, trash and debris removed |
| General | vegetation | any vegetation that reduces the free flow of water through the conveyance system | vegetation removed |

3.08 Trash Racks & Debris Barriers

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|--------------------------------|-------------------------|---|---------------------------------------|
| Metal Bars, & Frame | trash & debris | accumulations of trash and debris that are plugging more than 20% of the openings | trash and debris removed |
| | damaged or missing bars | bars are bent out of shape more than 3 inches; loose; or missing | bars repaired or replaced to design |
| | rust | bars are visibly rusty, and causing 50% deterioration to any part of the trash rack or debris barrier | bars cleaned and repaired or replaced |

3.09 Grounds, Fences & Gates

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|-------------------|-------------------------|---|--|
| Vegetation | damage | trees and shrubs that are dead, diseased, badly damaged, broken, blown over or leaning, causing exposure of roots | dead or diseased trees and shrubs removed, and damaged plants repaired or replaced |
| | weeds | weeds in landscaped areas crowding out plants & shrubs | weeds removed, and dead plants replaced |
| General | missing or broken parts | any defect in a fence or gate that permits easy entry to a facility, including erosion that creates an opening under a fence or gate | fence, gate & grounds repaired and/or parts replace to design |
| | | broken or missing hinges; posts or gate out of plumb more than 6 in.; stretcher bar, stretcher bands, and ties are missing; gate is difficult to open and close | repair fence & gate so that posts are plumb, and gate opens and closes freely or replace to design |
| | | broken or missing locking devices | devices repaired or replaced to design |
| | | top rails bent; missing or loose tension wire; barbed wire loose or sagging between posts; or broken or missing parts | fence properly repaired and aligned, or replaced to design |
| | rusting & scaling | rusting or scaling condition that affects structural adequacy | rusting and scaling removed or affected parts replaced |
| | openings in fabric | openings in fabric are such that an 8 in. dia. ball could fit through | repair or replace fence to design |
| | trash/debris | excessive accumulations within landscaped area | trash/debris removed |

3.10 Access Roads

| <u>Component</u> | <u>Condition</u> | <u>Conditions Requiring Maintenance</u> | <u>Expected Result</u> |
|-------------------|------------------|--|---|
| General | trash/debris | accumulations exceeding 1 cubic foot per 1000 square feet within roadway areas; or debris which could damage tires | trash/debris removed |
| | potholes & ruts | any surface defect that may hinder or prevent maintenance access, such as potholes, ruts, & soft spots | road surface uniformly smooth, allowing all weather access |
| | obstructions | any obstructions that reduce clearance to less than 14 feet vertically or 12 feet horizontally | obstructions removed and proper clear distances restored |
| Vegetation | weeds & brush | weeds growing in road surface or shoulder that are more than 6 in. high or that could hinder maintenance access | road surface free of weeds taller than 2 in. or cleared to allow maintenance access |

CARSON CITY PUBLIC WORKS - STORM WATER MAINTENANCE PROGRAM

| INSPECTION CHECK LIST | | | | | DATE & TIME: |
|--|------------------|---|---|---|--|
| LOCATION: | | | | | WATERSHED: |
| FACILITY NAME: | | | | | INSPECTOR: |
| INSPECTION ITEMS | CONDITION ACTION | | | | DESCRIBE MAINTENANCE NEEDED, PROBLEM OR INSPECTION VALUE |
| | GOOD | A | B | C | |
| CHANNELS, DITCHES AND ROADSIDE SWALES: | | | | | REPAIR DATE |
| EROSION | | | | | |
| OBSTRUCTIONS | | | | | |
| VEGETATION GROWTH | | | | | |
| TRASH AND DEBRIS | | | | | |
| SEDIMENT | | | | | |
| | | | | | |
| OUTLETS, INLETS AND PIPES: | | | | | |
| OBSTRUCTIONS | | | | | |
| CRACKS | | | | | |
| SEEPAGE | | | | | |
| SEDIMENT LEVEL | | | | | |
| DAMAGE | | | | | |
| | | | | | |
| EARTHEN BERMS: | | | | | |
| SIGNS OF PIPING(LEAKAGE) | | | | | |
| SIGNS OF SEEPAGE OR WET SPOTS | | | | | |
| SIGNS OF SETTLING | | | | | |
| DETERIORATION OF PRINCIPAL SPILLWAY | | | | | |
| DETERIORATION OF EMERGENCY SPILLWAY | | | | | |
| BANK EROSION | | | | | |
| ACCESS ROADWAY | | | | | |
| SIGNS OF RODENT BURROWS | | | | | |
| | | | | | |
| BASINS: | | | | | |
| DEPTH OF WATER AT OUTLET | | | | | |
| DEPTH OF SEDIMENT | | | | | |
| VEGETATION GROWTH | | | | | |
| TRASH AND DEBRIS | | | | | |
| EROSION OF SIDE BANKS | | | | | |

ACTION: A- REPAIR AND MAINTAIN FACILITY AS SOON AS POSSIBLE; B- REPAIR AND MAINTAIN FACILITY WITHIN 6 MONTHS; C- ADD REPAIRS OR IMPROVEMENTS TO CAPITAL IMPROVEMENT PROJECTS.

USE N/A IF ITEMS DOES NOT APPLY October 28, 2008