

PHASE II DRAINAGE REPORT

FOR

TERRAIN NORTH BASIN (PHASE 2)
TERRAIN PLANNING AREA (PA) 8
TOWN OF CASTLE ROCK, COLORADO
PROJECT NO. SDP20-0033

EAST HALF OF SECTION 31 AND THE WEST HALF OF SECTION 32,
TOWNSHIP 7 SOUTH, RANGE 66 WEST OF THE SIXTH PRINCIPAL
MERIDIAN, TOWN OF CASTLE ROCK, COUNTY OF
DOUGLAS, STATE OF COLORADO

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CORE Project Number: 14-001

February 03, 2023

ENGINEER'S STATEMENT

I affirm that this report and plan for the Phase II drainage design of Terrain North Basin (Phase 2), Planning Area 8, was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.

Andrew Kidder, P.E.
Colorado Professional Engineer
License #38465

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I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

Terrain (Formerly Castle Oaks Estates) is a proposed Planned Development Plan (PDP) consisting of single-family homes on approximately 12 +/- acres (with 16 +/- acres of offsite tributary flows) in Castle Rock, Colorado. The portion of the Terrain PDP addressed in this report is named 'Terrain North Basin (Phase 2)' and will be referred to herein as the Site.

The Site is a portion of the east half of Section 31 and the west half of Section 32, Township 7 South, Range 66 West of the Sixth Principal Meridian, Town of Castle Rock, County of Douglas, and State of Colorado.

The Site is located on the south side of Castle Oaks Drive, generally between Autumn Sage Street and North Rocky View Road. McMurdo Gulch is an existing drainageway that runs from south to north adjacent to Castle Oaks Drive, starting on the east side of the road and crossing to the west side via an existing culvert. An existing wastewater lift station is located on the west side of the intersection of North Rocky View Road and Castle Oaks Drive near the north side of the Site, conveying wastewater flows from the area to the south towards the Town's Wastewater Treatment Facility via existing force main.

A vicinity map is included in Appendix A.

B. Description of Property

The approximately 12-acre Site is currently undeveloped with naturally occurring slopes ranging from 2 to 33 percent due to rocky ridgelines to the east and west sloping down to McMurdo Gulch. Site vegetation includes native grasses and sparsely spaced shrubs and trees. Vegetation density increases within naturally formed channels and drainageways.

Soils on-site are predominately Fondis-Kutch association, Hilly gravelly land, and Peyton-Pring-Crowfoot sandy loams, which are classified as Hydrologic Soil Groups C and D. A Hydrologic Soil Group Map is included in Appendix A.

An existing FEMA mapped 100-Year floodplain is located within McMurdo Gulch and its tributary adjacent to the Site. FEMA floodplain maps are included in Appendix A.

The proposed Planning Area PA 8 is located to the southeast of McMurdo Gulch, with the gulch separating the Site from Castle Oaks Drive. Proposed site improvements include 29 single-family detached homes with associated roadways, open space, site utilities, and a regional trail extension.

Approximately 500 feet of Castle Oaks Drive adjacent to the Site will be improved from the current unpaved condition. Castle Oaks Drive will receive curb and gutter to capture flows from the roadway and match existing drainage patterns.

Developed flows will be treated for water quality and detained in a proposed extended detention pond onsite.

Culverts are proposed within FEMA regulated floodplains where proposed roadways cross the drainageway. A preliminary Floodplain Modification Study (FMS) that demonstrates the proposed culvert crossings and associated channel improvements will not have negative impacts on the proposed development has been prepared separately by CORE and is being submitted concurrently with this report and the SDP. Conditional Letter of Map Revision (CLOMR) approval from FEMA will be required prior to project construction.

There is one detention pond proposed for this site. Pond G, located at the north end of PA 8 serves PA 8. The proposed pond has been designed as Extended Detention Basins (EDB) to provide full-spectrum detention, incorporating an outlet structure to provide attenuation storage for the Water Quality Capture Volume (WQCV), excess urban runoff volume (EURV), and the 100-year storm event. The pond ultimately releases to McMurdo Gulch at less than the predeveloped runoff rates.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

The Site lies within the McMurdo Gulch major drainage basin that ultimately flows into Cherry Creek. There are FEMA FIRM map updates currently under study by CORE as well as by a 2016 report from Muller entitled 'McMurdo Gulch 2016 Reach Assessment Report', relocating the boundaries of the FEMA Floodplain due to culvert additions and channel stabilization of McMurdo Gulch.

B. Minor Drainage Basins

The proposed minor basins are described below:

G-1

Consists of lot area, paved street sections, and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed triple Type 16 combo inlet on-grade at Design Point G1, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Any flows bypassing the inlet will be conveyed by proposed curb and gutter to the proposed Type 16 combo inlet at Design Point G9.

G-2

Consists of lot area, paved street sections, and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed triple Type 16 combo inlet on-grade at Design Point G2, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Any flows bypassing the inlet will be conveyed by proposed curb and gutter to the proposed Type 16 combo inlet at Design Point G3.

G-3

Consists of lot area, paved street sections, and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed double Type 16 combo inlet on-grade at Design Point G3, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Any flows bypassing the inlet will be conveyed by proposed curb and gutter to the proposed Type 16 combo inlet at Design Point G8.

G-4

Consists of lot area and landscape area. Runoff flows overland into a proposed grass lined swale, where it is captured by a proposed flared end section at Design Point G4, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Emergency overflow overtops the swale side to the north into McMurdo Gulch.

G-4.1

Consists of lot area and landscape area. Runoff flows overland into a proposed grass lined swale at Design Point G4.1.

G-5

Consists of lot area, paved street sections, and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed double Type 16 combo inlet in-sump at Design Point G5, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Emergency overflow overtops the road crown to the north and is captured by a proposed Type 16 combo inlet in-sump at Design Point G6.

G-6

Consists of paved street sections and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed single Type 16 combo inlet in-sump at Design Point G6, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Emergency overflow overtops the curb to the north and is captured by a proposed Type C at Design Point G7.

G-7

Consists of lot area and landscape area. Runoff flows overland into a proposed Type C inlet at Design Point G7, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Emergency overflow drains west into McMurdo Gulch.

G-8

Consists of paved street sections. Runoff flows overland into the proposed roadway, where it is captured by a proposed triple Type 16 combo inlet on-grade at Design Point G8, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Any flows bypassing the inlet will be conveyed by proposed curb and gutter to the proposed Type 16 combo inlet at Design Point G9.

G-9

Consists of lot area, paved street sections, and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed triple Type 16 combo inlet in-sump at Design Point G9, and conveyed northeast by proposed storm sewer to proposed Pond G. The pond releases directly into McMurdo Gulch to the west. Emergency overflow overtops the curb to the north and drains into Pond G.

G-10

Consists of ponded water, concrete and gravel access roads, and landscape area. Runoff flows overland into proposed Pond G at Design Point G10. The pond releases directly into McMurdo Gulch to the west. Emergency overflow is directed west via embankment spillway to McMurdo Gulch.

J-1

Consists of paved street sections and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed triple Type 16 combo inlet in-sump at Design Point J1. Flows are conveyed south by proposed storm sewer to proposed Pond J that releases to an existing series of swales and culverts and ultimately to McMurdo Gulch. Overflow overtops the road crown to the south and is captured by a Type 16 combo inlet in-sump at Design Point J2.

J-2

Consists of paved street sections and landscape area. Runoff flows overland into the proposed roadway, where it is captured by a proposed triple Type 16 combo inlet in-sump at Design Point J1. Flows are conveyed south by proposed storm sewer to proposed Pond J that releases to an existing series of swales and culverts and ultimately to McMurdo Gulch. Overflow overtops the curb to the south and drains into Pond J.

N-1

Consists of landscape area. Runoff flows overland, where it is captured by a proposed Type D inlet at Design Point N1. Flows are conveyed north via proposed storm sewer, bypassing the Site, and released to McMurdo Gulch. Overflow overtops the curb to the northeast and is captured by an on-grade Type 16 combo inlet at Design Point G1.

O-4

Consists of off-site undeveloped area, roadway section, and large residential lots. Runoff flows overland, where it is captured by an existing channel, and conveyed east to a proposed culvert crossing North Rocky View Road at Design Point O4. The culvert releases into the existing swale within Basin O-2.

O-5

Consists of off-site undeveloped area. Runoff flows overland, where it is captured by a proposed Type D inlet at Design Point O5. Flows are conveyed north through proposed storm sewer, bypassing the Site, and released to McMurdo Gulch. Overflows enter the proposed concrete lined swale to the north and are conveyed to a proposed Type D inlet at Design Point O6.

O-6

Consists of off-site undeveloped area. Runoff flows overland, where it is captured by a proposed concrete lined swale and conveyed east to a proposed Type D inlet at Design Point O6. Flows are conveyed east and north through proposed storm sewer, bypassing the Site, and released to McMurdo Gulch. Overflows enter the proposed Pond G to the northeast.

O-7

Consists of off-site undeveloped area. Runoff flows overland, where it is captured by a proposed Type D inlet at Design Point O7. Flows are conveyed east and north through proposed storm sewer, bypassing the Site, and released to McMurdo Gulch. Overflows enter the proposed Pond G to the northeast.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

This Phase II Drainage Report is in accordance with the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual, the Mile High Flood District (MHFD) Storm Drainage Criteria Manual, and CDOT Drainage Design Manual. These manuals were used as a basis of design for the site. The drainage design also complies with the Cherry Creek Basin Water Quality Authority (CCBWQA) regulations. This report analyzes the minor (5-year) and major (100-year) storm events.

B. Drainage Studies, Master Plans, Site Constraints

The design of the culverts located within the 100-Year Floodplain was performed under the preliminary FMS by CORE, submitted concurrently with this report and the SDP. The FMS references and conforms to the concepts set forth by the McMurdo Gulch Reach Assessment Memorandum, by Muller, dated January 2017.

C. Hydrology

On-site hydrologic calculations were performed using a proprietary rational method workbook, developed by CORE in Microsoft Excel, to estimate peak

overland runoff flows resulting from the minor (5-year) and major (100-year) storm events. The workbook utilizes rainfall data provided by the Town of Castle Rock and conforms to the guidance set forth by MHFD Manual Volume 1, Chapter 6. Castle Rock 1-hour point rainfall table and hydrologic calculations are included in Appendix A.

D. Hydraulics

Detailed hydraulic calculations will be provided in the Phase III Drainage Report in the Appendix. These will generally consist of the following:

- Street and inlet capacity design calculations
- Storm sewer sizing and HGL calculations
- Culvert sizing calculations
- Swale/channel sizing calculations
- Riprap & toewall sizing calculations
- Outlet structure design calculations
- Forebay and trickle channel sizing calculations
- Existing Water Quality and Detention Pond 375 Volume Analysis – Not included in this submittal

E. Storage and Water Quality Enhancement

Storage water quality enhancement measures for the entirety of the developed Site conform to the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual, the Mile High Flood District (MHFD) Storm Drainage Criteria Manual, and the Cherry Creek Basin Water Quality Authority (CCBWQA) regulations.

IV. STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities

The general concept for the drainage design is to maintain the historic drainage patterns and match or decrease historic release rates for the site while also providing water quality enhancement for the entirety of the developed site. Runoff from the entirety of the developed site will be conveyed to a proposed water quality and detention facilities (full-spectrum pond) via proposed storm sewer, swales, and curb and gutter.

The culvert crossings and targeted channel improvements are proposed within the 100-year floodplain at this project site. The analysis and design for these features are included in the Preliminary Floodplain Modification Study (FMS) for Terrain North Basin Phase II, prepared by CORE, and have been submitted in concurrence with this report. At the upstream end of the project, a new crossing over McMurdo Gulch, at Weststrand St., will be constructed to allow for access to PA-8. Triple reinforced concrete box culverts (RCBs) will be required to pass the 100-year flows. The center barrel has been designed as a 12' x 8' RCB, while the left and right barrels have been designed as 12' x 7' RCBs

B. Stormwater Storage Facilities

Pond G has been designed as Extended Detention Basin (EDB) for full-spectrum detention. This pond incorporates an outlet structure that provides attenuation storage for the Water Quality Capture Volume (WQCV), the Excess Urban Runoff Volume (EURV), and the 100-year storm event. Pond sizing calculations can be found in Appendix C. The pond ultimately releases to McMurdo Gulch at less than the predeveloped runoff rates.

C. Water Quality Enhancement Control Measures

Low Impact Design Considerations:

The four-step process for stormwater quality management, as outlined in Volume 3, Chapter 1, Section 4.0 of the MHFD USDCM, has been applied to the drainage design of the site. This has resulted in the implementation of Low Impact Design (LID) strategies and conscientious placement of drainage infrastructure described below:

Step 1. Employ Runoff Reduction Practices:

A priority of the overall development is the preservation of the natural features of the property. The design of the project maintains these intentions by arranging the site to minimize grading, minimize impacts to existing vegetation and wetlands, and fit within the natural topography. The many relatively small detention ponds on site have been located to conform to natural drainage patterns, minimize the subsurface drainage system, and reduce peak runoff rates prior to entering the established drainageways. Other measures considered to minimize adverse impacts include designing driveways, sidewalks, and planning areas to the minimum widths necessary, implementing sheet flow, and increasing the lengths of flow paths where possible.

Structural Best Management Practices (BMPs), including Grass Swales (GS) and Grass Buffers (GB), are under evaluation to Minimize Directly Connected Impervious Areas (MDCIA). The implementation of these measures can reduce the volume of runoff that is required to be detained in the downstream facilities. The ultimate allocation and configuration of these BMPs will be determined in subsequent reports.

Step 2. Implement BMPs That Provide a Water Quality Capture Volume with Slow Release:

One Extended Detention Basin (EDB) is located south of the gulch and is designed for water quality treatment and flood attenuation. The pond will ultimately incorporate an outlet structure that controls the release of flows for the Water Quality Capture Volume (WQCV), Excess Urban Runoff Volume (EURV), and the 100-year storm event at or below historic rates, in accordance with MHFD and TOCR drainage criteria.

Step 3. Stabilize Streams:

Stabilization measures are proposed within Tributary 3 and McMurdo Gulch and discussed in Section IV. A. above. A separate Preliminary FMS for these improvements are being prepared by CORE and is included with the SDP submittal.

Step 4. Implement Site Specific and Other Source Control BMPs:

Source control practices, such as materials coverage and spill containment procedures, will be implemented post-construction in accordance with Douglas County ordinance.

Pond sizing calculations can be found in Appendix C.

D. Floodplain Modification

Three culvert crossings and targeted channel improvements are proposed within the 100-year floodplain. The 2016 McMurdo Gulch Reach Assessment, along with coordination with Town of Castle Rock, is the basis for the design of the proposed channel improvements associated with the culvert crossings.

Improvements within the floodplain, described in detail in Section IV. A. above, include:

- Two 12-foot (H) by 7-foot (V) and one 12-foot (H) by 8-foot (V) concrete box culverts at Westrand Street.
- One boulder drop structure within McMurdo Gulch

The analysis and design for these features are included in the Preliminary Floodplain Modification Study (FMS) for Terrain North Basin Phase II, prepared by CORE, and submitted concurrently with this report and the SDP. The preliminary FMS addresses the floodplain impacts for the project and demonstrates that the proposed culvert crossings and channel improvements will not have negative impacts on the proposed development.

Since the proposed Terrain North Basin Phase 2 development will impact the currently mapped Zone AE floodplain, a detailed CLOMR will be required during final design to remap the effective flood hazard areas for the portion of McMurdo Gulch that fall within the project site boundary as well as tributary 4, and subsequently show that the proposed development does not cause any adverse impacts on the surrounding insurable structures along McMurdo Gulch.

A floodway encroachment analysis will also be required during final design. This analysis will show that the proposed development will not cause any floodway rises (no rise) above the standard set forth by the State of Colorado, and that the floodway will be appropriately contained within the study boundary.

E. Geotechnical Investigation and Sub-surface Collection System Design

A geotechnical report for the Site was prepared by RMG on January 15, 2020. Underdrains were not recommended beyond perimeter drains around building foundations; however, a 6" underdrain is proposed along the frontage of lots 13-28 of PA 8. The underdrain is applied to this area to capture excess sub-surface drainage that may exist due to the significant size of the upstream off-site area draining toward the lots from the back. The single underdrain line follows Cholla Wood Way along the back of walk, within the 10' utility easement, and ties into the proposed storm sewer system at inlet ING1-5.

A concrete channel is proposed to divert this off-site runoff around the Site. The underdrain outfalls into proposed Pond G to the north.

F. Operation and Maintenance

The Owner will be the responsible party for operation and maintenance of water quality enhancement control measures and stormwater management facilities. EDBs have low to moderate maintenance requirements on a routine basis but may require significant maintenance once every 15 to 25 years.

Inspect the EDB at least twice annually, observing the amount of sediment in the forebay and checking for debris at the outlet structure. Remove debris and litter from the detention area as required to minimize clogging of the outlet.

Mowing should be done as needed to maintain appropriate height (minimum six inches) and control weeds. Aeration should be performed at least once per year when the ground is not frozen. The Town provides annual mosquito control for all public and private facilities. This program includes larvae control only. Irrigation may be needed to establish full vegetation. Native grass and other drought tolerant plantings should not require irrigation after establishment. Check for broken sprinkler heads and repair them, as needed. Completely drain the irrigation system before the first winter freeze each year. Upon reactivation of the irrigation system in the spring, inspect all components and replace damaged parts, as needed.

Remove sediment from the forebay and trickle channel annually. If portions of the watershed are not developed or if roadway or landscaping projects are taking place in the watershed, the required frequency of sediment removal in the forebay may be as often as after each storm event. The forebay should be maintained in such a way that it does not provide a significant source of resuspended sediment in the stormwater runoff. Sediment removal from the micropool is required approximately once every one to four years and should occur when the depth of the pool has been reduced to approximately 18 inches. Small micropools may be vacuumed and larger pools may need to be pumped to remove all sediment from the micropool bottom. Ensure that the sediment is disposed of properly and not placed elsewhere in the basin.

Remove sediment from the bottom of the basin when accumulated sediment occupies about 20% of the water quality design volume or when sediment accumulation results in poor drainage within the basin. The required frequency may be every 15 to 25 years or more frequently in basins where construction activities are occurring. Erosion and Structural Repairs Repair basin inlets, outlets, trickle channels, and all other structural components required for the basin to operate as intended. Repair and vegetate eroded areas as needed following inspection. See the Operation and Maintenance (O&M) Manual for further discussion.

G. Additional Permitting Requirements

The drainage design of Terrain North Basin (Phase 2) will adhere to the requirements of Section 404 of the Clean Water Act and the Endangered Species Act. Additionally, the drainage design will conform to all applicable local, state, and federal requirements for drainage design and stormwater discharge.

H. General

Applicable tables and figures from the criteria manuals used in the drainage design of the site can be found in Appendix A.

V. CONCLUSIONS

A. Compliance with Standards

The drainage design for Terrain North Basin (Phase 2) conforms to the Town of Castle Rock's Storm Drainage Design and Technical Criteria Manual, and the Urban Drainage and Flood Control Districts' Drainage Criteria Manual where applicable, and Cherry Creek Reservoir Control Regulation No. 72.

B. Variances

There are no variances requested for this project.

C. Drainage Concept

The Rational Method was used to determine the developed peak runoff from the minor (5-year) and major (100-year) storm events for the minor drainage basins throughout the Site. These basins were delineated based on the natural topography and the proposed grading. Once the runoff values were identified, storm sewer pipes and other drainage conveyances were designed to capture and transport runoff to the proposed Extended Detention Basin for attenuation storage and water quality treatment. The proposed extended detention basin will release water at or below the historic rate. Off-site flows were diverted around the Site where possible with swales, storm sewer, and culverts. Runoff from the Site ultimately drains to the existing McMurdo Gulch drainage way adjacent to the Site.

VI. REFERENCES

TOCR (Town of Castle Rock). June 2019. Storm Drainage Design and Technical Criteria Manual.

MHFD (Mile High Flood District). Revised August 2018. Urban Storm Drainage Criteria Manual. Volume I.

MHFD (Mile High Flood District). Revised September 2017. Urban Storm Drainage Criteria Manual. Volume II.

MHFD (Mile High Flood District). Revised October 2019. Urban Storm Drainage Criteria Manual. Volume III.

NRCS Soil Survey Staff. (Natural Resources Conservation Service). United States Department of Agriculture. Web Soil Survey. Available online at the following link: <https://websoilsurvey.sc.egov.usda.gov/>. Accessed July 1, 2020.

FEMA (Federal Emergency Management Agency). Revised March 16, 2016. Flood Insurance Rate Map (FIRM) No. 08035C0187G, 08035C0189G, & 08035C0191G. Available online at the following link: <https://msc.fema.gov/portal/home>. Accessed July 1, 2020.

RMG (Rocky Mountain Group). January 15, 2020. Subsurface Soil Investigation Terrain North.

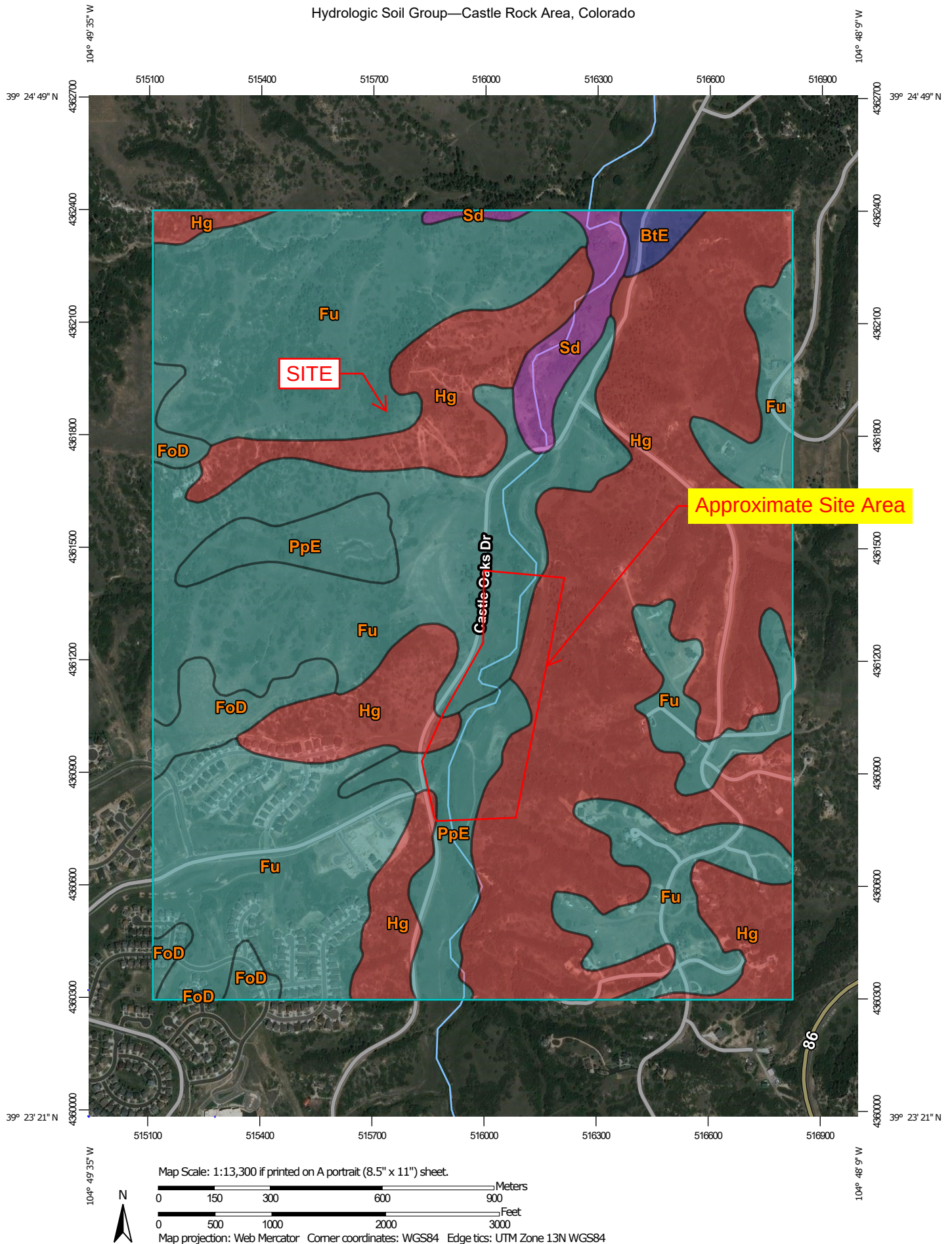
CORE March 11, 2022. Preliminary Floodplain Modifications Study for Terrain North Basin Phase II.

Muller Engineering Company. January 2017. McMurdo Gulch Reach Assessment Memorandum.

APPENDIX A

HYDROLOGIC COMPUTATIONS

Hydrologic Soil Group—Castle Rock Area, Colorado



Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

7/1/2020
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MAP LEGEND**Area of Interest (AOI)**
 Area of Interest (AOI)
Soils**Soil Rating Polygons**

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Lines

-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

Soil Rating Points

-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

Water Features
 Streams and Canals
Transportation

-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads

Background
 Aerial Photography
MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service

Web Soil Survey URL:

Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Castle Rock Area, Colorado

Survey Area Data: Version 13, Jun 5, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 24, 2018—Nov 19, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	5.8	0.7%
FoD	Fondis clay loam, 3 to 9 percent slopes	C	26.9	3.0%
Fu	Fondis-Kutch association	C	429.5	48.1%
Hg	Hilly gravelly land	D	358.1	40.1%
PpE	Peyton-Pring-Crowfoot sandy loams, 5 to 25 percent slopes	C	54.2	6.1%
Sd	Sandy alluvial land	A	19.4	2.2%
Totals for Area of Interest			893.8	100.0%

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The community map repository should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations (BFEs)** and/or **footways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables shown on this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **footways** were computed at cross sections and interpolated between cross sections. The footways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Footway widths and other pertinent floodway data are provided in the Floodway Data table shown on this FIRM.

The projection used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The horizontal datum was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same vertical datum. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at <http://www.ngs.noaa.gov> or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NNGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242, or visit its website at <http://www.ngs.noaa.gov>.

Base map information shown on this FIRM was provided by the Douglas County GIS Department and the Town of Castle Rock GIS Department. Additional input was provided by the City of Lone Tree and Town of Parker. These data are current as of 2010.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the profile baseline, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

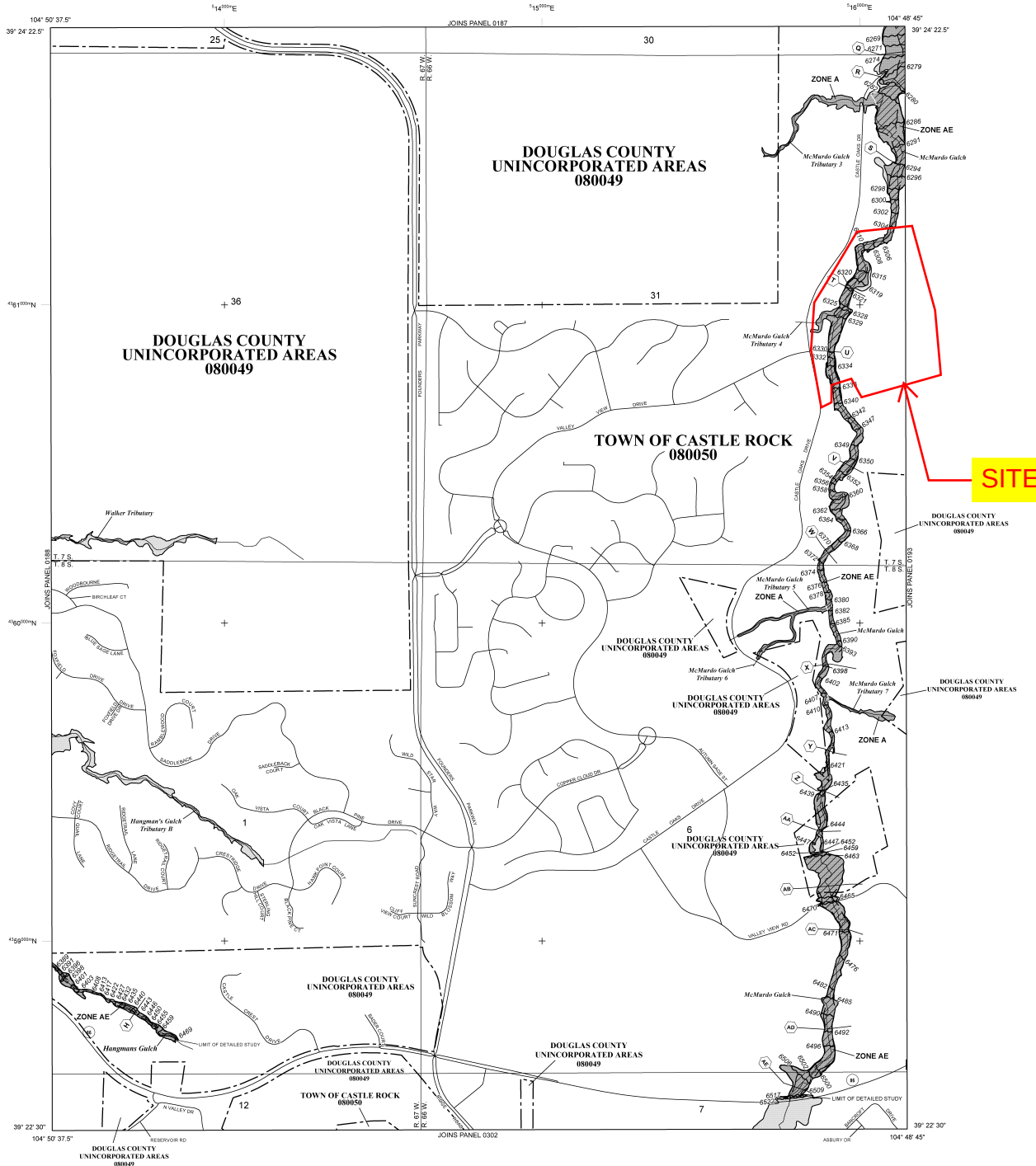
Based on updated topographic information, this map reflects more detailed and up-to-date stream channel configurations and floodplain delineations than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unreviewed streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels, community map repository addresses, and a listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels at which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at <http://msc.fema.gov>. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have questions about this map, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA website at <http://www.fema.gov/businessinfo>.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD
The 1% annual chance flood (100-year flood), also known as the **base flood**, is the flood that has a 1% chance of being equaled or exceeded in any given year. The 1% annual chance flood is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zone A, AE, AH, AO, AR, AV, V, and VE. The **Base Flood Elevation** is the water-surface elevation of the 1% annual chance flood.

- ZONE A**
No Base Flood Elevations determined.
- ZONE AE**
Base Flood Elevations determined.
- ZONE AH**
Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO**
Flood depths of 1 to 3 feet (usually sheet flow or sloping terrain); average depths determined; areas of shallow flooding; velocities also determined.
- ZONE AR**
Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently identified. Zone AR indicates that the former flood control system is being retained to provide protection from the 1% annual chance or greater flood. Areas to be protected from the 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE AV**
Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE**
Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.
- FLOODWAY AREAS IN ZONE AE**

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

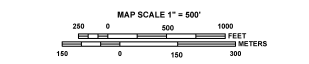
- OTHER FLOOD AREAS**
- ZONE X**
Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from the 1% annual chance flood.
- OTHER AREAS**
- ZONE X**
Areas determined to be outside the 0.2% annual chance floodplain. Areas in which flood hazards are undetermined, but possible.
- ZONE D**
Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPAs)**
- CBRS areas and OPAs** are normally located within or adjacent to Special Flood Hazard Areas.
- 1% Annual Chance Floodplain Boundary**
- Floodway boundary**
- Zone D boundary**
- CBRS and OPA boundary**
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevation, flood depths, or flood velocities.**
- Base Flood Elevation line and value; elevation in feet***
- Base Flood Elevation value where uniform within zone; elevation in feet***

- *Referenced to the North American Vertical Datum of 1988
- Cross section line**
- Transect line**
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere**
- 1000-meter Universal Transverse Mercator grid values, zone 13**
- Bench mark** (see explanation in Notes to Users section of this FIRM panel)
- River Mile**
- Map Repositories**
- Refer to Map Repositories list on Map Index
- EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP**
- SEPTEMBER 30, 2005
- EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL**

MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.



NFIP **PANEL 189G**

FIRM
FLOOD INSURANCE RATE MAP
DOUGLAS COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 189 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	189B	G
DOUGLAS COUNTY	080049	0800	G

Notice to User: The **Map Number** shown below should be used when placing map orders, the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
08035C0189G
MAP REVISED
MARCH 16, 2016
Federal Emergency Management Agency

Prepared By: JNK

-REFERENCE UDFCD Vol.1 RUNOFF Table 6-3

[illegible]

EXISTING RATIONAL CALCULATION

CORE Project #: 14-001

Prepared By: JNK

WEIGHTED "C" CALCULATIONS

C_A = Runoff coefficient for NRCS HSG A soils

C_{CD} = Runoff coefficient for NRCS HSG C and D soils.

Basin ID	% Improv	i
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NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	C_A^{a}	C_A^{a}	C_A^{a}	C_A^{a}	C_A^{a}	C_A^{a}	C_A^{a}
	0.84 ^{i,1302}	0.86 ^{i,1276}	0.87 ^{i,1232}	0.84 ^{i,1124}	0.85 ^{i+0.025}	0.78 ^{i+0.110}	0.65 ^{i+0.254}
B	C_B^{a}	C_B^{a}	C_B^{a}	C_B^{a}	C_B^{a}	C_B^{a}	C_B^{a}
	0.84 ^{i,1160}	0.86 ^{i,1088}	0.81 ^{i+0.057}	0.63 ^{i+0.249}	0.56 ^{i+0.328}	0.47 ^{i+0.426}	0.37 ^{i+0.536}
C/D	$C_{C/D}^{\text{a}}$	$C_{C/D}^{\text{a}}$	$C_{C/D}^{\text{a}}$	$C_{C/D}^{\text{a}}$	$C_{C/D}^{\text{a}}$	$C_{C/D}^{\text{a}}$	$C_{C/D}^{\text{a}}$
	0.83 ^{i,1122}	0.82 ^{i+0.035}	0.74 ^{i+0.132}	0.56 ^{i+0.319}	0.49 ^{i+0.393}	0.41 ^{i+0.484}	0.32 ^{i+0.588}

Total Weighted Runoff Coefficients, C			
2-Year	5-Year	10-Year	100-Year
0.02	0.07	0.16	0.50

[illegible]

North Basin PH2CORE Project #: 14-001Prepared By: JNK**RATIONAL METHOD PEAK RUNOFF**

5-Year STORM Rainfall Depth-Duration-Frequency (1-hr) = 1.43
SF-3

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	5yr Runoff COEFF	T(c) min	C x A	I in/hr	Q cfs
1	OS-1	4.34	0.08	12.8	0.35	3.49	1.22
2	OS-2	3.54	0.09	18.6	0.30	2.92	0.89
3	OS-3	31.00	0.06	30.2	1.86	2.24	4.16
4	OS-4	15.58	0.06	19.7	0.86	2.83	2.43
5	OS-5	31.23	0.08	31.7	2.37	2.17	5.14
6	OS-6	9.52	0.06	19.9	0.59	2.82	1.66

North Basin PH2CORE Project #: 14-001Prepared By: JNK**RATIONAL METHOD PEAK RUNOFF**

100-YR STORM Rainfall Depth-Duration-Frequency (1-hr) = 2.60
SF-3

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	100YR RUNNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
1	OS-1	4.34	0.51	12.8	2.20	6.35	13.94
2	OS-2	3.54	0.51	18.6	1.80	5.31	9.57
3	OS-3	31.00	0.50	30.2	15.39	4.07	62.58
4	OS-4	15.58	0.49	19.7	7.70	5.15	39.66
5	OS-5	31.23	0.50	31.7	15.75	3.95	62.17
6	OS-6	9.52	0.50	19.9	4.73	5.12	24.25

PROPOSED RATIONAL CALCULATIONS

TERRAIN NORTH BASIN (PHASE 2)

CORE Project #: 14-001

Prepared By: JNK

IMPERVIOUS CALCULATIONS

-REFERENCE UDFCD Vol.1 RUNOFF Table 6-3

		Residential												Soil Type		
		Single Family			Other									Soil Type A Area	Soil Type B Area	Soil Type C/D Area
		0.25 acres or less	0.25 - 0.75 acres	2.5 acres or larger	N/A	Roof/ Concrete	Asphalt/ Ponded Water	Packed Gravel	2-7% Slope	>7% Slope	Historic					
% Imperv.	Design Point	45.00%	30.00%	12.00%	75.00%	90.00%	100.00%	40.00%	2.00%	2.00%	2.00%	Total Area	Percent Impervious			
BASIN		Area	Area	Area	Area	Area	Area	Area	Area	Area	Area			Area	Area	Area
G-1	G1	1.50	-	-	-	-	0.33	-	0.13	-	-	1.96	51.3%	-	-	1.96
G-2	G2	0.65	-	-	-	-	0.34	-	0.04	-	-	1.04	61.2%	-	-	1.03
G-3	G3	0.06	-	-	-	-	0.03	-	-	-	-	0.09	63.2%	-	-	0.09
G-4	G4	1.08	-	-	-	-	-	-	0.31	-	-	1.39	35.5%	-	-	1.39
G-4.1	G4.1	0.26	-	-	-	-	-	-	0.10	-	-	0.36	33.4%	-	-	0.36
G-5	G5	0.06	-	-	-	-	0.49	-	0.11	-	-	0.67	78.2%	-	-	0.66
G-6	G6	-	-	-	-	-	0.38	-	0.07	-	-	0.45	84.7%	-	-	0.45
G-7	G7	0.19	-	-	-	-	-	-	0.05	-	-	0.24	36.7%	-	-	0.24
G-8	G8	-	-	-	-	-	0.06	-	0.00	-	-	0.06	98.8%	-	-	0.06
G-9	G9	0.99	-	-	-	-	0.35	-	0.07	-	-	1.41	56.7%	-	-	1.41
G-10	G10	-	-	0.58	-	0.11	0.45	0.07	1.78	-	-	3.00	23.0%	-	-	3.00
BASIN G SUBTOTAL		4.79	-	0.58	-	0.11	2.43	0.07	2.65	-	-	10.64	45.5%	-	-	10.64
J-1	J1	-	-	-	-	0.04	0.18	-	0.30	-	-	0.53	42.4%	-	-	0.53
J-2	J2	-	-	-	-	-	0.12	-	-	-	-	0.14	81.9%	-	-	0.14
BASIN J SUBTOTAL		-	-	-	-	0.04	0.30	-	0.30	-	-	0.67	50.8%	-	-	0.67
N-1	N1	-	-	-	-	-	0.02	-	0.32	-	-	0.34	6.6%	-	-	0.34
O-4	O4	-	-	-	-	-	-	-	0.00	-	-	3.68	0.0%	-	-	3.68
O-5	O5	-	-	17.27	-	-	-	-	10.22	-	-	27.49	8.3%	-	-	27.49
O-6	O6	-	-	0.42	-	0.14	-	0.12	6.39	-	-	7.07	5.0%	-	-	7.07
O-7	O7	-	-	24.66	-	-	0.02	-	2.17	-	-	26.84	11.2%	-	-	26.84
		-	-	-	-	-	-	-	-	-	-	-		-	-	-
BASIN O SUBTOTAL		-	-	42.35	-	0.14	0.02	0.12	18.78	-	-	65.08	8.7%	-	-	65.08

Basin ID	% Imperv.	<i>i</i>	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
G-1	51.3%	0.51	A	0.35	0.37	0.38	0.51	1.96	1.96	0.39	0.46	0.51	0.69
			B	0.38	0.42	0.47	0.67						
			C or D	0.39	0.46	0.51	0.69						
G-2	61.2%	0.61	A	0.44	0.46	0.48	0.59	1.03	1.03	0.48	0.54	0.59	0.74
			B	0.47	0.50	0.55	0.71						
			C or D	0.48	0.54	0.59	0.74						
G-3	63.2%	0.63	A	0.46	0.48	0.49	0.60	0.09	0.09	0.50	0.55	0.60	0.74
			B	0.49	0.52	0.57	0.72						
			C or D	0.50	0.55	0.60	0.74						
G-4	35.5%	0.35	A	0.22	0.23	0.24	0.39	1.39	1.39	0.26	0.33	0.39	0.63
			B	0.25	0.28	0.34	0.59						
			C or D	0.26	0.33	0.39	0.63						
G-4.1	33.4%	0.33	A	0.20	0.21	0.22	0.37	0.36	0.36	0.24	0.31	0.38	0.62
			B	0.23	0.26	0.33	0.58						
			C or D	0.24	0.31	0.38	0.62						
G-5	78.2%	0.78	A	0.61	0.63	0.64	0.72	0.66	0.66	0.63	0.68	0.71	0.80
			B	0.63	0.66	0.69	0.79						
			C or D	0.63	0.68	0.71	0.80						
G-6	84.7%	0.85	A	0.68	0.70	0.71	0.77	0.45	0.45	0.69	0.73	0.76	0.83
			B	0.69	0.72	0.74	0.82						
			C or D	0.69	0.73	0.76	0.83						
G-7	36.7%	0.37	A	0.23	0.24	0.25	0.40	0.24	0.24	0.27	0.34	0.40	0.63
			B	0.26	0.29	0.35	0.60						
			C or D	0.27	0.34	0.40	0.63						
G-8	98.8%	0.99	A	0.83	0.85	0.86	0.88	0.06	0.06	0.82	0.84	0.86	0.89
			B	0.83	0.85	0.86	0.89						
			C or D	0.82	0.84	0.86	0.89						
G-9	56.7%	0.57	A	0.40	0.42	0.43	0.55	1.41	1.41	0.44	0.50	0.55	0.72
			B	0.43	0.46	0.52	0.69						
			C or D	0.44	0.50	0.55	0.72						
G-10	23.0%	0.23	A	0.12	0.13	0.14	0.29	3.00	3.00	0.16	0.22	0.30	0.58
			B	0.15	0.17	0.24	0.53						
			C or D	0.16	0.22	0.30	0.58						

PROPOSED RATIONAL CALCULATIONS

Basin ID	% Imperv.	<i>i</i>	Soil Type	Runoff Coefficients, <i>C</i>				Basin Area	Total Area	Weighted Runoff Coefficients, <i>C</i>			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
J-1	42.4%	0.42	A	0.27	0.29	0.30	0.44	0.53	0.53	0.32	0.38	0.45	0.66
			B	0.31	0.34	0.40	0.63						
			C or D	0.32	0.38	0.45	0.66						
J-2	81.9%	0.82	A	0.65	0.67	0.68	0.75	0.14	0.14	0.66	0.71	0.74	0.82
			B	0.66	0.69	0.72	0.81						
			C or D	0.66	0.71	0.74	0.82						

PROPOSED RATIONAL CALCULATIONS

Basin ID	% Imperv.	<i>i</i>	Soil Type	Runoff Coefficients, C				Basin Area	Total Area	Weighted Runoff Coefficients, C			
				2-Year	5-Year	10-Year	100-Year			2-Year	5-Year	10-Year	100-Year
N-1	6.6%	0.07	A	0.02	0.03	0.03	0.16	0.34	0.34	0.04	0.09	0.18	0.51
			B	0.04	0.05	0.11	0.46						
			C or D	0.04	0.09	0.18	0.51						
O-4	0.0%	0.00	A	0.00	0.00	0.00	0.11	3.68	3.68	0.00	0.04	0.13	0.48
			B	0.00	0.00	0.06	0.43						
			C or D	0.00	0.04	0.13	0.48						
O-5	8.3%	0.08	A	0.03	0.04	0.04	0.17	27.49	27.49	0.05	0.10	0.19	0.52
			B	0.05	0.06	0.12	0.46						
			C or D	0.05	0.10	0.19	0.52						
O-6	5.0%	0.05	A	0.02	0.02	0.02	0.15	7.07	7.07	0.03	0.08	0.17	0.50
			B	0.03	0.03	0.10	0.45						
			C or D	0.03	0.08	0.17	0.50						
O-7	11.2%	0.11	A	0.05	0.05	0.06	0.20	26.84	26.84	0.07	0.13	0.22	0.53
			B	0.07	0.08	0.15	0.48						
			C or D	0.07	0.13	0.22	0.53						
										-	-	-	-

PROPOSED RATIONAL CALCULATIONS

TERRAIN NORTH BASIN (PHASE 2)

CORE Project #: 14-001

Prepared By: JNK

TIME OF CONCENTRATION CALCULATIONS

-REFERENCE UDFCD Vol.1 Section 2.4

NRCS Conveyance factors, K -REFERENCE UDFCD Vol.1 RUNOFF Table 6-2

SF-2

Heavy Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Tillage/field	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

SUB-BASIN DATA			INITIAL / OVERLAND TIME			CHANNEL / TRAVEL TIME T(t)						T(c) CHECK (URBANIZED BASINS)		FINAL T(c)
DRAIN BASIN	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	% IMPER-VIOUS	USDCM Eq . 6-5	min.
G-1	1.96	0.46	150	4.5	8.7	551	2.3	20	3.0	3.1	11.7	51.3%	21.1	11.7
G-2	1.04	0.54	73	2.0	6.9	581	2.3	20	3.0	3.2	10.1	61.2%	19.3	10.1
G-3	0.09	0.55	50	2.0	5.6	50	2.3	20	3.0	0.3	5.8	63.2%	15.6	5.8
G-4	1.39	0.33	80	18.0	4.8	617	1.1	7	0.7	13.8	18.6	35.5%	26.9	18.6
G-4.1	0.36	0.31	80	18.0	4.9	922	0.2	7	0.3	47.1	52.1	33.4%	44.5	44.5
G-5	0.67	0.68	23	2.0	2.9	590	3.9	20	4.0	2.5	5.4	78.2%	15.2	5.4
G-6	0.45	0.73	36	2.0	3.2	471	4.8	20	4.4	1.8	5.0	84.7%	13.3	5.0
G-7	0.24	0.34	123	3.0	10.7	76	2.0	20	2.8	0.4	11.1	36.7%	20.4	11.1
G-8	0.06	0.84	29	2.0	2.0	100	2.3	20	3.0	0.6	2.5	98.8%	9.7	5.0
G-9	1.41	0.50	121	5.8	6.7	406	2.1	20	2.9	2.4	9.0	56.7%	19.1	9.0
G-10	3.00	0.22	300	34.1	8.6	165	20.7	7	3.2	0.9	9.4	23.0%	22.6	9.4
J-1	0.53	0.38	57	17.0	3.8	48	59.0	20	15.4	0.1	3.9	42.4%	18.9	5.0
J-2	0.14	0.71	26	5.6	2.1	314	6.4	20	5.0	1.0	3.1	81.9%	13.1	5.0
N-1	0.34	0.09	85	10.5	7.7	40	1.5	7	0.9	0.8	8.5	6.6%	25.4	8.5
O-4	3.68	0.04	278	20.5	11.8	259	13.9	7	2.6	1.7	13.5	0.0%	27.3	13.5
O-5	27.49	0.10	300	4.6	18.8	1629	8.0	7	2.0	13.7	32.6	8.3%	34.0	32.6
O-6	7.07	0.08	300	24.3	11.2	514	11.8	7	2.4	3.6	14.7	5.0%	27.7	14.7
				0.0			0.0							

PROPOSED RATIONAL CALCULATIONS

TERRAIN NORTH BASIN (PHASE 2)

CORE Project #: 14-001

Prepared By: JNK

RATIONAL METHOD PEAK RUNOFF

5-Year STORM Rainfall Depth-Duration-Frequency (1-hr) = 1.43

SF-3

-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	5yr Runoff COEFF	T(c) min	C x A	I in/hr	Q cfs
G1	G-1	1.96	0.46	11.7	0.89	3.62	3.23
G2	G-2	1.04	0.54	10.1	0.56	3.85	2.14
G3	G-3	0.09	0.55	5.8	0.05	4.65	0.23
G4	G-4	1.39	0.33	18.6	0.45	2.92	1.32
G4.1	G-4.1	0.36	0.31	44.5	0.11	1.76	0.19
G5	G-5	0.67	0.68	5.4	0.45	4.75	2.14
G6	G-6	0.45	0.73	5.0	0.33	4.85	1.58
G7	G-7	0.24	0.34	11.1	0.08	3.71	0.29
G8	G-8	0.06	0.84	5.0	0.05	4.85	0.26
G9	G-9	1.41	0.50	9.0	0.70	4.02	2.83
G10	G-10	3.00	0.22	9.4	0.67	3.96	2.65
J1	J-1	0.53	0.38	5.0	0.20	4.85	0.98
J2	J-2	0.14	0.71	5.0	0.10	4.85	0.49
N1	N-1	0.34	0.09	8.5	0.03	4.11	0.12
O4	O-4	3.68	0.04	13.5	0.13	3.41	0.44
O5	O-5	27.49	0.10	32.6	2.83	2.14	6.05
O6	O-6	7.07	0.08	14.7	0.54	3.27	1.76

PROPOSED RATIONAL CALCULATIONS

TERRAIN NORTH BASIN (PHASE 2)

CORE Project #: 14-001

Prepared By: JNK

RATIONAL METHOD PEAK RUNOFF

100-YR STORM

SF-3 Rainfall Depth-Duration-Frequency (1-hr) = 2.60

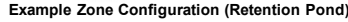
-REFERENCE UDFCD Vol.1 EQ 5-1 & EQ 6-1

BASIN INFORMATON				DIRECT RUNOFF			
DESIGN POINT	DRAIN BASIN	AREA ac.	100YR RUNNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs
G1	G-1	1.96	0.69	11.7	1.36	6.59	8.96
G2	G-2	1.04	0.74	10.1	0.76	7.00	5.32
G3	G-3	0.09	0.74	5.8	0.07	8.45	0.56
G4	G-4	1.39	0.63	18.6	0.87	5.31	4.64
G4.1	G-4.1	0.36	0.62	44.5	0.22	3.20	0.71
G5	G-5	0.67	0.80	5.4	0.54	8.64	4.62
G6	G-6	0.45	0.83	5.0	0.37	8.82	3.27
G7	G-7	0.24	0.63	11.1	0.15	6.74	1.01
G8	G-8	0.06	0.89	5.0	0.06	8.82	0.50
G9	G-9	1.41	0.72	9.0	1.01	7.31	7.38
G10	G-10	3.00	0.58	9.4	1.73	7.20	12.47
J1	J-1	0.53	0.66	5.0	0.35	8.82	3.07
J2	J-2	0.14	0.82	5.0	0.12	8.82	1.03
N1	N-1	0.34	0.51	8.5	0.17	7.47	1.30
O4	O-4	3.68	0.48	13.5	1.78	6.20	11.04
O5	O-5	27.49	0.52	32.6	14.24	3.89	55.31
O6	O-6	7.07	0.50	14.7	3.57	5.95	21.23
O7	O-7	26.84	0.53	23.8	14.23	4.65	66.22

RUNOFF SUMMARY TABLE				
DIRECT RUNOFF				
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)
G1	G-1	1.96	3.23	8.96
G2	G-2	1.04	2.14	5.32
G3	G-3	0.09	0.23	0.56
G4	G-4	1.39	1.32	4.64
G4.1	G-4.1	0.36	0.19	0.71
G5	G-5	0.67	2.14	4.62
G6	G-6	0.45	1.58	3.27
G7	G-7	0.24	0.29	1.01
G8	G-8	0.06	0.26	0.50
G9	G-9	1.41	2.83	7.38
G10	G-10	3.00	2.65	12.47
J1	J-1	0.53	0.98	3.07
J2	J-2	0.14	0.49	1.03
N1	N-1	0.34	0.12	1.30
O4	O-4	3.68	0.44	11.04
O5	O-5	27.49	6.05	55.31
O6	O-6	7.07	1.76	21.23
O7	O-7	26.84	8.74	66.22

MHFD-Detention, Version 4.05 (January 2022)

Basin ID: Pond G



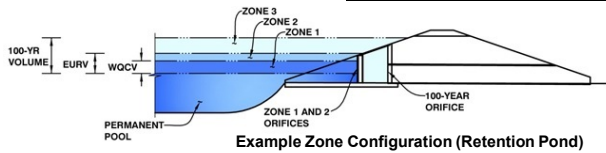
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DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)

Project: Terrain North Basin (Phase 2)

Basin ID: Pond G



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.29	0.172	Orifice Plate
Zone 2 (EURV)	3.45	0.282	Not Utilized
Zone 3 (100+1/2WQCV)	5.26	0.563	Weir&Pipe (Restrict)
Total (all zones)		1.018	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = ft (distance below the filtration media surface)
Underdrain Orifice Diameter = inches

Calculated Parameters for Underdrain
Underdrain Orifice Area = ft²
Underdrain Orifice Centroid = feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Centroid of Lowest Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing = inches
Orifice Plate: Orifice Area per Row = sq. inches

Calculated Parameters for Plate
WQ Orifice Area per Row = ft²
Elliptical Half-Width = feet
Elliptical Slot Centroid = feet
Elliptical Slot Area = ft²

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.50	1.00					
Orifice Area (sq. inches)	0.40	0.50	1.50					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orif
Vertical Orifice Area = ft²
Vertical Orifice Centroid = feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Gate and Outlet Pipe OR Rectangular/Trapezoidal Weir and No Outlet Pipe)

Overflow Weir Front Edge Height, H_o = ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length = feet
Overflow Weir Gate Slope = H:V
Horiz. Length of Weir Sides = feet
Overflow Gate Type =
Debris Clogging % = %

Calculated Parameters for Overflow W
Height of Gate Upper Edge, H_u = feet
Overflow Weir Slope Length = feet
Gate Open Area / 100-yr Orifice Area =
Overflow Gate Open Area w/o Debris =
Overflow Gate Open Area w/ Debris =

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

Depth to Invert of Outlet Pipe = ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter = inches
Restrictor Plate Height Above Pipe Invert = inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Pl
Outlet Orifice Area = ft²
Outlet Orifice Centroid = feet
Half-Central Angle of Restrictor Plate on Pipe = degrees

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage = ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length = feet
Spillway End Slopes = H:V
Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway
Spillway Design Flow Depth = feet
Stage at Top of Freeboard = feet
Basin Area at Top of Freeboard = acres
Basin Volume at Top of Freeboard = acre-ft

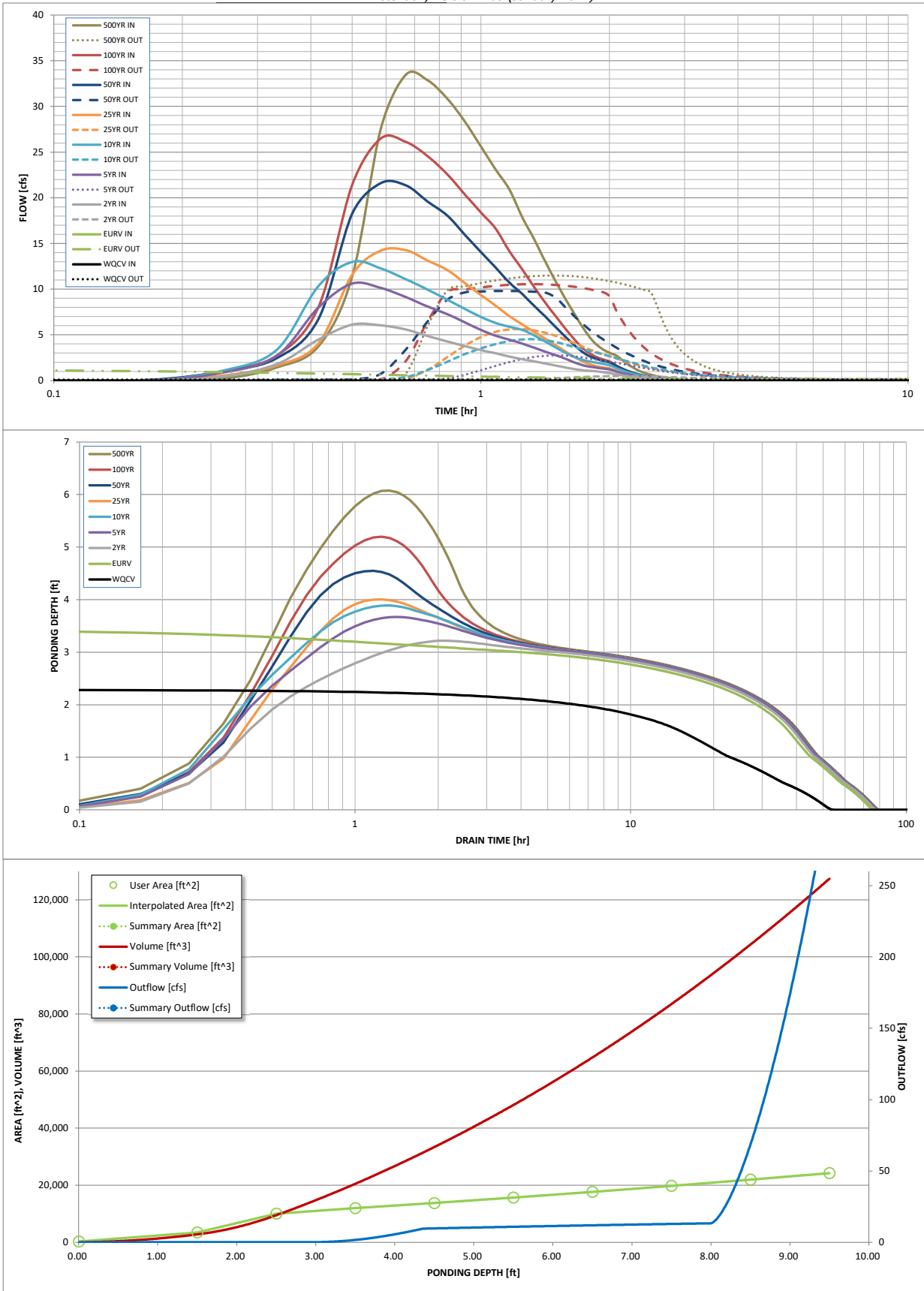
Routed Hydrograph Results

The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through A)

	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year
Design Storm Return Period =	N/A	N/A	1.06	1.43	1.66	1.69	2.26	2.60
One-Hour Rainfall Depth (in) =	N/A	N/A	1.06	1.43	1.66	1.69	2.26	2.60
CUHP Runoff Volume (acre-ft) =	0.172	0.455	0.438	0.727	0.922	0.984	1.494	1.839
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.438	0.727	0.922	0.984	1.494	1.839
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.0	3.6	5.1	6.5	11.2	14.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A						
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.09	0.34	0.48	0.61	1.05	1.38
Peak Inflow Q (cfs) =	N/A	N/A	6.1	10.6	13.0	14.3	21.6	26.5
Peak Outflow Q (cfs) =	0.1	1.3	0.5	2.7	4.5	5.6	9.8	10.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.9	0.9	0.9	0.7
Structure Controlling Flow =	Plate	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Gate 1 (fps) =	N/A	0.18	0.05	0.4	0.6	0.8	1.4	1.5
Max Velocity through Gate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	42	55	57	52	49	48	44	42
Time to Drain 99% of Inflow Volume (hours) =	48	65	67	64	61	60	57	55
Maximum Ponding Depth (ft) =	2.29	3.45	3.22	3.67	3.89	4.00	4.55	5.19
Area at Maximum Ponding Depth (acres) =	0.20	0.27	0.26	0.28	0.29	0.30	0.32	0.35
Maximum Volume Stored (acre-ft) =	0.173	0.457	0.393	0.515	0.578	0.613	0.779	0.995

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.05 (January 2022)



S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

APPENDIX B

HYDRAULIC COMPUTATIONS

(NOT INCLUDED WITH THIS SUBMITTAL)

APPENDIX C

WATER QUALITY ENHANCEMENT CONTROL MEASURES

Permanent Water Quality Determination Worksheet (Taken from 2019 SDDTCM Sections 13.1.4 and 13.1.5)

Project: Terrain North Basin (Phase 2)

CRW# SDP 20-0033

Applicant: Stratus Terrain, LLC

Section	Questions	Response	Check those that apply	Instructions
1	Non-applicable Sites			
	Will the project result in a temporary disturbance of greater than one acre?	No	☐	Proceed to next line.
		Yes	☒	Proceed to section 2.
	Is the project part of a larger common plan of development or sale where multiple separate and distinct construction activities may be taking place at different times on different schedules, but remain related and are within 1/4 mile of each other? (A common plan of development will generally be documented on a site development plan, master plan, or equivalent, for the property/project)	No	☐	Proceed to next line.
		Yes	☐	Proceed to section 2.
	Is the project within the Cherry Creek Watershed?	Yes	☐	Exclusions do not apply. Permanent water quality is required per Control Regulation 72.7.
		No	☐	Permanent water quality is not required. No further action is required.
2	Applicable Site Types and Exclusions by Variance			
	Does the project have more than 35% impervious area on the existing site?	No	☒	Project is an applicable Development Site. Proceed to section 3.
		Yes	☐	Proceed to next line.
	Does the project have greater than 75% impervious area on the existing site?	No	☐	Project is an applicable Redevelopment Site. Proceed to section 3.
		Yes	☐	Proceed to next line.
	Will 100% of the runoff from the existing and proposed site be captured and treated for permanent water quality?	Yes	☐	Document in drainage report. No further action required.
		No	☐	Proceed to next line.
	Do any other water quality exclusions apply to the site?	No	☐	Portions of the project are excluded. Proceed with design in accordance with Constrained Redevelopment standards and apply for variance for <u>Constrained Redevelopment Sites</u> .
		Yes	☐	Proceed to next section. Following approval of other variances, design remaining site in accordance with Constrained Redevelopment standards and apply for variance for <u>Constrained Redevelopment Sites</u> .
3	Applicable Sites with Other Exclusions by Variance			
3.1	Category 1: Roadways, bridges and trails only			
3.1.1	Is the project a bike or pedestrian trail?	Yes	☐	Proceed to next line.
		No	☒	Proceed to 3.1.2.
	Is the trail for a roadway?	Yes	☐	Proceed to 3.1.2.
		No	☐	Project is excluded. Submit variance for <u>Trails Excluded from Permanent Water Quality Requirements</u> .
3.1.2	Is the project primarily used for parking or access to parking?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☒	Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	No	☐	Project is excluded. Submit variance for <u>Pavement Management Sites Excluded from Permanent Water Quality Requirements</u> .
		Yes	☒	Proceed to 3.1.4.

3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	No	☐	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> .
		Yes	☒	Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	No	☐	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> .
		Yes	☒	Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	No	☐	Existing areas of site are excluded only. Submit variance for <u>Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements</u> .
		Yes	☒	This exclusion does not apply. Permanent water quality is required.
3.2	Category 2: Non-residential and non-commercial projects only			
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	Yes	☐	Project is excluded. Submit variance for <u>Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements</u> .
		No	☐	Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	Yes	☐	Project is excluded. Submit variance for <u>Stream Stabilization Sites Excluded from Permanent Water Quality Requirements</u> .
		No	☐	Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	Yes	☐	Project is excluded. Submit variance for <u>Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements</u> .
		No	☐	Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	Yes	☐	Project is excluded. Submit variance for <u>Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> .
		No	☐	Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit study along with variance for <u>Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements</u> .
		Yes	☐	This exclusion does not apply. Permanent water quality is required.
3.3	Category 3: Residential and Commercial projects			
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	Yes	☐	Proceed to next line.
		No	☒	Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	No	☐	Project is excluded. Submit variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> .
		Yes	☐	Proceed to next line.
	Is the project site greater than 20% impervious?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	No	☐	Project is excluded. Submit study along with variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> .
		Yes	☐	This exclusion does not apply. Permanent water quality is required.

3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☒	Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	Yes	☐	This portion of the project is excluded. Submit variance for <u>Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
		No	☒	Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	Yes	☒	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	Yes	☐	This exclusion does not apply. Permanent water quality is required.
		No	☐	Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	No	☐	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the drainage report . No further action is needed.
		Yes	☐	This exclusion does not apply. Permanent water quality is required.



Summary of Water Quality Conformance to MS4 Permit

The purpose of this worksheet is to document conformance with the Town of Castle Rock's MS4 permit with regard to permanent water quality on land disturbance projects.

Project Name Terrain North Basin (Phase II)

Project Owner Stratus Terrain LLC

Project Location Castle Oaks Drive & Autumn Sage Street

ToCR Project Number SDP 20-0033

Total Site Area 12 acres

Total Size of Common Plan of Development 12 acres

Check all that apply:

- ☐ Project within Plum Creek Basin
- ☒ Project within Cherry Creek Basin

Estimated construction completion date Spring 2024

1. The water quality control measure(s) for applicable development sites shall meet one of the following base design standards as per the SDDTCM Section 14.4. Please select all design standards that were applied to meet conformance with the MS4 on this site.

- ☒ WQCV standard
- ☐ Pollutant removal standard
- ☐ Runoff reduction standard
- ☐ Applicable site draining to regional WQVC control measure (accepts drainage prior to discharging to WOTS)
- ☐ Applicable site draining to regional WQVC control facility (with receiving pervious area control measure upstream of WOTS)
- ☐ Constrained redevelopment sites standard
- Imperviousness of existing site _____/_____ (Imp. Ac/Site Ac) = ____%
 - Variance required TCV No. _____
- ☐ Existing control measure with WQCV per previous criteria standards
- Reference Construction Permit No. _____
- ☐ Cherry Creek Basin only, choose one: ☐ Tier 1 ☐ Tier 2 ☐ Tier 3
- ☐ No control measures provided (See Permanent WQ Worksheet for applicability)

Summary of Water Quality Conformance to MS4 Permit

2. Was an exclusion to water quality applied as per SDDTCM Section 13.1.5? ☐ Yes ☒ No

i. If yes, please select all that apply, provide total excluded impervious area(s) and submit variance, as applicable: TCV No. _____

- ☐ Pavement management site
Excluded impervious area: _____ acres
- ☐ Excluded roadway redevelopment
Excluded impervious area: _____ acres
- ☐ Excluded existing roadway areas
Excluded impervious area: _____ acres
- ☐ Above ground and below ground utilities
- ☐ Large lot single family home
- ☐ Non-residential and non-commercial infiltration
Excluded impervious area: _____ acres
- ☐ Land disturbance for land to remain undeveloped
Excluded impervious area: _____ acres
- ☐ Stream Stabilization Sites
Excluded impervious area: _____ acres
- ☐ Trails
Excluded impervious area: _____ acres
- ☐ Oil and Gas Exploration

3. For Development and Redevelopment sites, following any exclusions claimed above, was any portion of the site excluded up to 20% of the site and not to exceed one acre? ☐ Yes ☒ No

If yes, complete the following:

Excluded area: _____ acres
Total Site area: _____ acres, _____ % site excluded

4. For Constrained sites, was any portion of the site excluded up to 50% of the site and not to exceed 50% of the impervious area? ☐ Yes ☒ No

If yes, complete the following:

Excluded area: _____ acres
Excluded impervious area: _____ acres
Total Site area: _____ acres, _____ % site excluded
Total Impervious area: _____ acres, _____ % impervious excluded

APPENDIX D

REFERENCED MATERIAL

(NOT INCLUDED WITH THIS SUBMITTAL)

APPENDIX E

CHECKLIST



Phase II Drainage Report Checklist

The Phase II Drainage Report must be in conformance with the latest Town of Castle Rock Storm Drainage Design and Technical Criteria Manual available on the Town's website.

The Phase II Drainage Report must be signed and sealed by a Professional Engineer licensed in the State of Colorado. The purpose of the Phase II Drainage Report is to identify and refine conceptual storm-water management solutions to the challenges that may be present or occur on-site and off-site.

The preparer should contact and work with the Town Stormwater Engineering Staff regarding any design, master planning and existing system questions (720-733-6000). The following outline sets forth the **required minimum** content to be provided in the Phase II Drainage Report that shall be submitted with the Planned Development Plan or Straight Zoning documents. A copy of this checklist must be submitted with the Phase II Drainage Report.

Please see Chapter 4 of the Town of Castle Rock Storm Drainage Design and Technical Criteria Manual for additional details and information. Please check off the following items to assure your report is complete. Appropriate notations shall be provided with the checklist. For example, if a specific item is not addressed or not applicable, an explanation needs to be provided.

Included	N/A	
✓		I. COVER SHEET
✓		A. Name of Project, including legal name of development
✓		B. Address
✓		C. Owner
✓		D. Developer
✓		E. Engineer
✓		F. Submittal date and revision dates as applicable
✓		II. GENERAL LOCATION AND DESCRIPTION
✓		A. Site Location
✓		B. Description of Property and Land Use
✓		III. DRAINAGE BASIN AND SUB-BASINS
✓		A. Major Drainage Basins
✓		B. Minor Drainage Basins
✓		IV. DRAINAGE DESIGN CRITERIA
✓		A. Regulations
✓		B. Drainage Studies, Master Plans, Site Constraints
✓		C. Hydrology
✓		D. Hydraulics
✓		E. Water Quality Enhancement

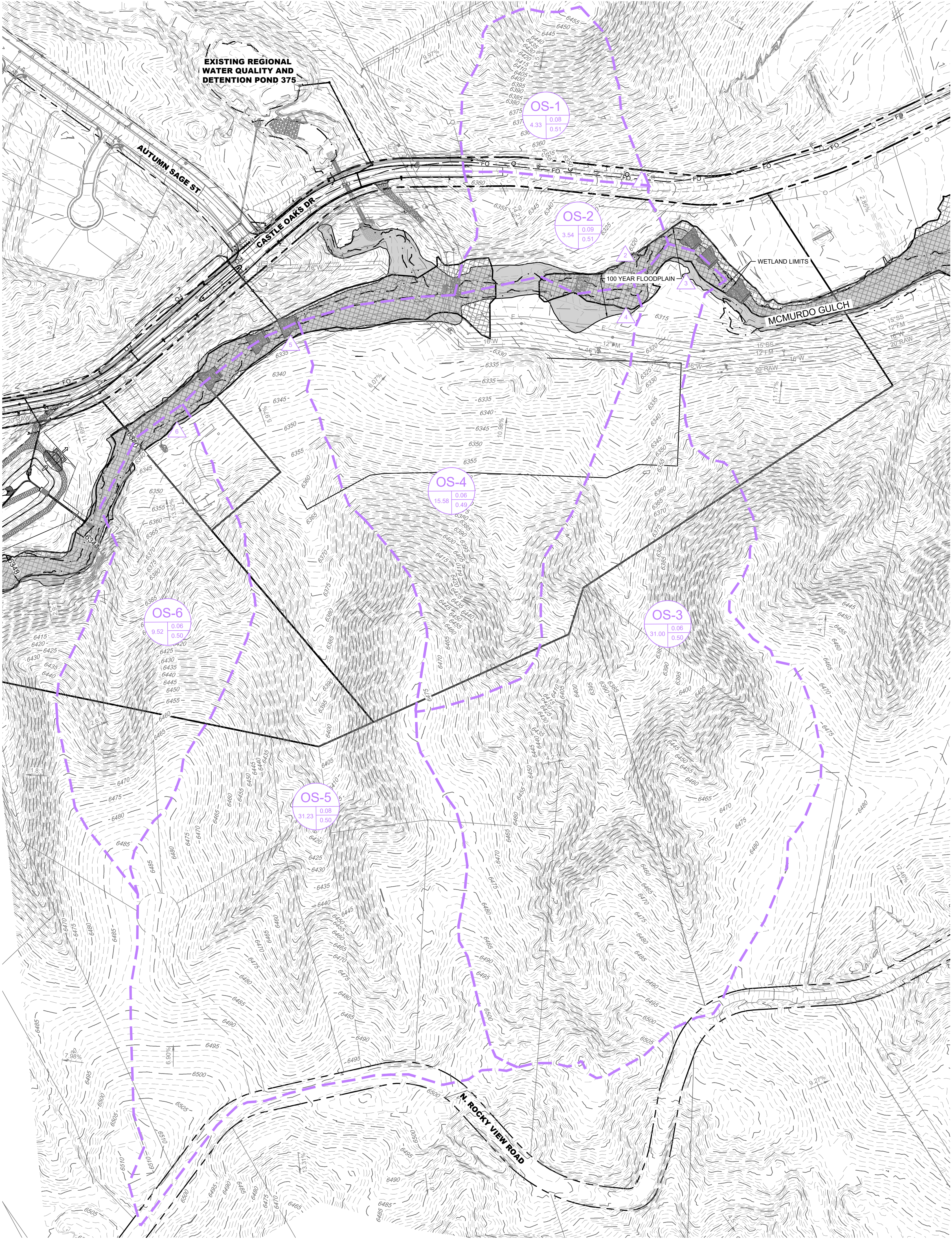
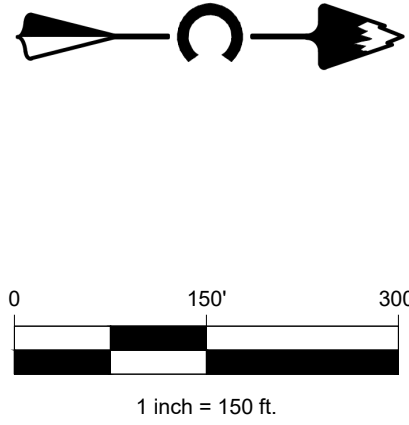
Phase II Drainage Report Checklist

Included	N/A	
✓		V. STORMWATER MANAGEMENT FACILITY DESIGN
✓		A. Stormwater Conveyance Facilities
✓		B. Stormwater Storage Facilities
✓		C. Water Quality Enhancement Best Management Practices
✓		D. Floodplain Modification
✓		E. Additional Permitting Requirements
✓		F. General
		VI. CONCLUSIONS
✓		A. Compliance with Standards
✓		B. Variances
✓		C. Drainage Concept
✓		VII. REFERENCES
✓		VIII. APPENDICES
✓		A. Hydrologic Computations
	✓	B. Hydraulic Computations (If known at this time—not required)
✓		C. Water Quality Enhancement Best Management Practices
✓		D. Referenced Information
✓		OVERALL DRAINAGE PLAN (IN POCKET)
✓		DETAILED DRAINAGE PLANS (IN POCKET)

Notes/Comments:

BACK POCKET

DRAINAGE MAPS



LEGEND

- EXISTING PROPOSED
- EXISTING DRAINAGE BASIN
PROPOSED DRAINAGE BASIN
EXISTING MAJOR CONTOUR
PROPOSED MAJOR CONTOUR
EXISTING MINOR CONTOUR
PROPOSED MINOR CONTOUR
EASEMENT
RIGHT OF WAY (R.O.W.)
CENTERLINE
PROJECT BOUNDARY
PROPOSED STORM & STUB OUT
EXISTING STORM & STUB OUT
STORM MANHOLES
STORM INLETS
FES, FOREBAY, & TRICKLE CHANNEL
OUTLET STRUCTURE
CRUSHER FINES
MAINTENANCE ACCESS
RIPRAP
100 YEAR FLOODPLAIN
DRAINAGE SWALE

RUNOFF SUMMARY TABLE				
DIRECT RUNOFF				
DESIGN POINT	BASIN	AREA (AC)	5-Year RUNOFF (CFS)	100-Year RUNOFF (CFS)
1	OS-1	4.34	1.22	13.94
2	OS-2	3.54	0.89	9.57
3	OS-3	31.00	4.16	62.58
4	OS-4	15.58	2.43	39.66
5	OS-5	31.23	5.14	62.17
6	OS-6	9.52	1.66	24.25

TERRAIN NORTH BASIN PH 2
TOWN OF CASTLE ROCK, COLORADO
PHASE II DRAINAGE REPORT
EXISTING CONDITIONS DRAINAGE MAP

NOT FOR
CONSTRUCTION

DESIGNED BY: LMK
DRAWN BY: JCP
CHECKED BY: AK

JOB NO.
14-001

SHEET
1 OF 3

#	REVISION DESCRIPTION	DATE	BY
1	PHASE III REPORT	12/27/22	JNK



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