



**Phase I Drainage Report
for
Annexation of Crowfoot Valley Road
Douglas County, Colorado**

Project Address: Crowfoot Valley Rd. Right-of Way
from the intersection of Pradera Parkway
to the intersection of Macanta Boulevard

Prepared for Applicant:

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Crowsnest

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Document history and status

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Engineer's Certification Statement

"This report and plan for the Phase I drainage design of Crowsnest was prepared by me (or under my direct supervision) in accordance with the provisions of the City of Castle Pines Drainage Design and Technical Criteria for the owners thereof. I understand that the City of Castle Pines does not and will not assume liability for drainage facilities designed by others."

Kevin Lovelace, PE
Registered Professional Engineer
State of Colorado No. 54415

Date

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- C1 Existing Drainage Maps and Tabulation
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II. General Location & Description

A. Site Location

The property is comprised of approximately 2.65 miles of the Crowfoot Valley Rd., currently unincorporated Douglas County, which is being annexed into the City of Castle Pines. This section of Crowfoot Valley Rd. extends from approximately Macanta St. on the southern boundary and Pradera Pkwy. on the northern boundary. A section of the northern extent of Crowfoot Valley Rd. to be annexed is studied and discussed in the Phase I Drainage Report for Crowsnest (henceforth referred to as the Crowsnest Drainage Report), prepared by LJA Engineering, submitted for approval to the City of Castle Pines. This study reviewed drainage from the southern boundary of the annexation to the southern limits of the Crowsnest Study Area. The site is situated within Sections 8, 17, 18, 19, Township 7 South, Range 66 West of the 6th Principal Meridian, Douglas County Colorado and Sections 24 & 25, Township 7 South, Range 67 West of the 6th Principal Meridian, Douglas County Colorado.

The project subject to the annexation is shown outlined in red on the vicinity map below. However, the northern limits of the annexation have already been studied in The Crowsnest Drainage Report. Within the site, Crowfoot Valley Rd. intersects with Macanta Blvd., Longstory Ave., and Pradera Pkwy. Throughout the project site, a multitude of driveways and parcel access roadways connect to Crowfoot Valley Rd. Immediately south of the annexation limits, Sapphire Point Blvd intersects with Crowfoot Valley Rd. Further south is a major Castle Rock roadway, Founders Pkwy (CO-86). The proposed drainage improvements for this project will be focused on the Crowfoot Valley Rd.

Several surrounding developments were identified in the site investigation. At the southern limit of the annexation site, on the northwest side of the road is the Cutter's Ridge townhome development, which is a replat of a Maher Ranch development. Along the southern limits, extending north to Longstory Ave., is the Canyon's South development with multiple filings that appear to be in progress. Adjacent to the northeast of the Cutter's Ridge townhome development is a planned development for The Canyons in Douglas County; the main site for the development has begun construction however the 2nd amendment area which borders Crowfoot Valley Rd. does not appear to have begun development. At the northern limits of the annexation area, to the east of the site, is a large Pinery Subdivision off Pradera Pkwy.

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II.A.1 Vicinity Map

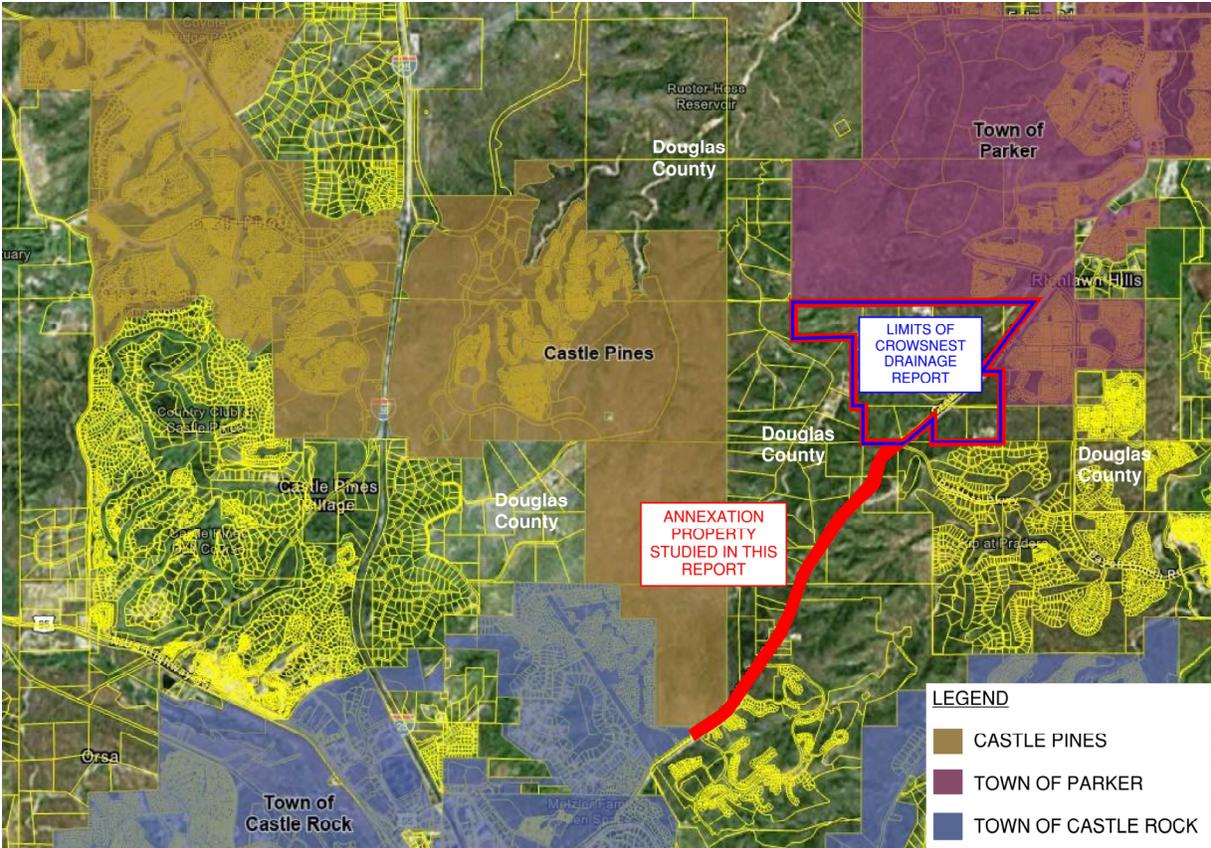


Figure 1 - Vicinity Map

B. Description of Property

As shown above in the vicinity map, the annexation area stretches along the linear Crowfoot Valley Rd. from R.O.W. to R.O.W. The site is developed with an existing Crowfoot Valley Rd. which varies in typical section and width through the annexation area. As noted, several driveway and access roads connect to Crowfoot Valley Rd. within the annexation area. Roadside ditches are present along a majority of the roadway. Culvert crossings beneath driveways have been identified and surveyed. The proposed annexation's land area is approximately 44.80 acres, however a large portion of this area has already been studied as part of the Crowsnest Drainage Report. The additional annexation area that was not previously studied is approximately 28.74 acres.

The site has varying slopes but generally the Crowfoot Valley Rd. slopes down at approximately 1% from south to north. The side slopes of the roadway vary based on the presence of a roadside ditch but vary between approximately 1%-33%. The Crowfoot Valley Rd. is crowned through most of the project site. Crowfoot Valley Rd. generally acts as a basin divide between Lemon Gulch and Scott Gulch, both of which ultimately drain to Cherry Creek. There are no structures within the project area; adjacent to the Crowfoot Valley Rd. are residential developments, rural residences, businesses, churches and a golf course. Per

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NRCS Soils Survey map, provided in Appendix B, the site consists of 100% Type C/D Hydrologic Soil Group soils. Type C/D soils were used for calculations in this study.

Both Lemon Gulch and Scott Gulch were identified with an associated FEMA designated floodplain Zone A. However, these FEMA designated floodplains are at least 0.5 miles away from the project site. No impacts on these drainageways are anticipated.

No existing irrigation canals were identified in the project site. Roadside ditches are frequently present along the proposed section of Crowfoot Valley Rd.

No significant geological features were identified in the site.

The ultimate proposed project area will improve and widen the Crowfoot Valley Rd. to a custom 4-lane major arterial roadway typical section with medians, bike lines, sidewalks, and curb and gutter. The proposed designs are in-progress currently. A typical section of the roadway was used to estimate the imperviousness of the proposed site, from R.O.W. to R.O.W.

III. Drainage Basins & Sub-Basins

A. Major Drainage Basins

The Crowfoot Valley Rd. is split into two major drainage basins, one which drains to the northwest to Lemon Gulch and one which drains to the southwest to Scott Gulch. The *Scott and Lemon Gulch Watersheds Outfall Systems Planning Study* prepared by CH2MHill, dated July 2006, was investigated as the governing document on the project site, excerpts included in Appendix B. This study identifies existing and potential future problems with the existing drainageways. Stabilization and energy dissipation measures are suggested for multiple stream reaches within the project vicinity to improve and prevent future issues; this is proposed in conjunction with the construction of regional detention facilities. Although it is now recognized that a more distributed stormwater management approach is currently desired by the local municipalities, in-lieu of regional facilities. Both drainageways are well beyond the site limits and no improvements to the drainageways will be proposed as part of this study.

Generally, Crowfoot Valley Rd. is crowned and drains each half of the roadway to the corresponding major drainage basin. There are a few locations where an existing culvert sends flows from one side of the road to the other, swapping the expected drainage basin. All drainage basins have been clearly delineated and defined in the hydrology calculations and drainage maps. In existing conditions, flows drain off the roadway as sheet flow off-site or into roadside ditches which lead to an eventual outfall, away from the road. All outfalls of flows from the site have been marked with design points on the drainage map. Once flows leave the site at the marked design points, they typically are routed into grassed channels which drain to the respective drainageways of Lemon Gulch and Scott Gulch.

The site's current land use is exclusively for the Crowfoot Valley Rd with adjacent R.O.W. The R.O.W. typically contains roadside ditches or natural grassland. In proposed conditions, the footprint for Crowfoot Valley Rd. will be expanded which causes additional pavement and landscaped areas to be added to the project site. Intersection, driveway and parcel access connections to Crowfoot Valley Rd. can be identified throughout the site and access will be maintained.

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The improvements and widening of Crowfoot Valley Rd. will result in an increase in impervious area causing additional runoff flows. Drainage patterns will be maintained where applicable and existing or proposed water quality and detention will be proposed as designs progress. Impacts to the downstream conveyance channels from the site based on the proposed stormwater facilities will be investigated as part of the Phase II Study. Where achievable, release rates for the proposed site will be constrained to below predeveloped flow rates.

III.A.1 Existing Basins

The Site has been divided into 2 major existing basins:

Basin HA: Basin HA is located generally on the northwestern side of the Crowfoot Valley Rd. within the project site, and drains to Lemon Gulch once flows leave the site. In existing conditions, the basin is primarily half of the roadway and the associated R.O.W. containing intersections and drives. A few locations exist where an existing culvert provides conveyance for a basin on the southeast side of Crowfoot Valley Rd. to be routed northwest and drain to Lemon Gulch. Lemon Gulch is tributary to Cherry Creek northeast of the site. Offsite basins draining into Basin HA are HOSA1 through HOSA10

Basin HB: Basin HB is located generally on the southeastern side of the Crowfoot Valley Rd. within the project site, and drains to Scott Gulch once flows leave the site. In existing conditions, the basin is primarily half of the roadway and the associated R.O.W. containing intersections and drives. Similar to HA, a location exists where an existing culvert provides conveyance for a basin on the northwest side of Crowfoot Valley Rd. to be routed southeast and drain to Scott Gulch. Scott Gulch is tributary to Cherry Creek east of the site. Offsite basins draining into Basin HB are HOSB1 through HOSB11.

Off-Site Basins: Basins beyond the project site limits that were found to be draining into the project site are identified on the drainage maps. Off-site basins have been denoted with an A or B in their ID to indicate whether the off-site is part of the Major Basin HA or Major Basin HB. Off-site drainage patterns will be maintained where applicable.

III.A.2 Proposed Basins

The proposed basins were designed to maintain historic drainage patterns and similar drainage areas to the existing conditions.

Basin A: In proposed conditions, Basin A will cover generally the same drainage area as the Basin HA except with a wider footprint for the ultimate buildout of the Crowfoot Valley Rd. Basin A is generally located on the northwestern half of the roadway and drains to Lemon Gulch. Water quality and detention will likely be required to preserve historic drainage patterns and will be further investigated in the Phase II report. Offsite basins draining into Basin A include: OSA1 through OSA10.

Basin B: In proposed conditions, Basin B will cover generally the same drainage area as the Basin HB except with a wider footprint for the ultimate buildout of the Crowfoot Valley Rd. Basin B is generally located on the southeastern half of the roadway and drains to Scott Gulch. Water quality and detention will likely be required to preserve historic drainage patterns and will be further investigated in the Phase II report. Offsite basins draining into Basin B include: OSB1 through OSB9.

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Off-Site Basins: Basins beyond the project site limits that were found to be draining into the project site are identified on the proposed drainage maps. Basins draining into the project area will be properly collected, managed, and/or rerouted within the project area in developed conditions, based on maintaining the historic drainage pattern as the design progresses.

An overall calculation of the total combined Major Basins HA versus Basin A and Major Basins HB versus Basin B was investigated to approximate an increase in flow due to the additional imperviousness from the final buildout of Crowfoot Valley Rd. The longest single time of concentration contained within the major basin was selected as the Tc for the calculations; this provides a conservative estimate for the flow increase. The results of the calculations are provided in the table below and shown on the overall drainage maps in Appendix C.

Calculated Existing vs. Proposed Runoff Rates									
Basin	Total Area	Comp. Imp.	Tc	Runoff Coeff.		Intensity		Peak Flow (cfs)	
ID	(Ac.)	(%)	(min)	C ₅	C ₁₀₀	I ₅	I ₁₀₀	Q ₅	Q ₁₀₀
HA	31.95	32%	31.73	0.30	0.61	2.17	3.95	20.51	77.51
A	33.08	43%	31.73	0.38	0.66	2.17	3.95	27.39	85.86
HB	17.11	37%	24.81	0.33	0.63	2.50	4.55	14.28	49.34
B	18.51	56%	24.81	0.49	0.71	2.50	4.55	22.67	59.96

B. Minor Drainage Basins

III.B.1 Existing Minor Basins

Basin HA1: Basin HA1 drains out from the Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining north along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A1 and drains to Lemon Gulch via an existing grassed drainageway. An existing Culvert SA1 is present in the basin but it is unclear how much water is conveyed by this structure.

Basin HA2: Basin HA2 drains out to the northwest from a small peak in the annexed area for Crowfoot Valley Rd., where it leaves the site. The basin land use contains R.O.W. and open space. Flow leaves the site at DP A2 and drains to Lemon Gulch via an existing grass drainageway.

Basin HA3: Basin HA3 drains out from the Crowfoot Valley Rd. to the northwest where it sheet flows out of the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A3 and drains to Lemon Gulch via an existing grassed drainageway. An existing Culvert SA2 is present in the basin but it is unclear how much water is conveyed by this structure.

Basin HA4: Basin HA4 drains out from the Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A3 and drains to Lemon Gulch via an existing grassed drainageway. HA4 continues flow out of the basin via an existing culvert, SA3.

Basin HA5: Basin HA5 drains out from the Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd.

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and associated R.O.W. Flows leave the site at DP A3 and drains to Lemon Gulch via an existing grassed drainageway. HA5 continues flow out of the basin via an existing culvert, SA5.

Basin HA6: Basin HA6 drains out from the Crowfoot Valley Rd. to the west where it enters a roadside ditch draining north along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A3 and drains to Lemon Gulch via an existing grassed drainageway. HA6 continues flow out of the basin via an existing culvert, SA6.

Basin HA7: Basin HA7 drains out from the Crowfoot Valley Rd. to the west where it enters a roadside ditch draining north along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A4 and drains to Lemon Gulch via an existing grassed drainageway. HA7 continues flow out of the basin via an existing culvert, SA7.

Basin HA8: Basin HA8 drains out from the Crowfoot Valley Rd. to the northwest where it sheet flows out of the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A5 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA9: Basin HA9 drains out from Crowfoot Valley Rd. to the southeast where it is routed to an existing culvert crossing from southeast to northwest under Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows travel through culvert SA8 before leaving the site at DP A5 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA10: Basin HA10 drains out from Crowfoot Valley Rd. to the west where it drains to an inlet structure near an existing pond. It is unclear if this culvert SA9 outfalls into the pond or diverts around it. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A6 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA11: Basin HA11 drains out from Crowfoot Valley Rd. to the northwest where is sheet flows directly into an existing pond structure on a property. The function of this pond structure will be investigated in subsequent drainage reports. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A6 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA12: Basin HA12 drains out from Crowfoot Valley Rd. to the southeast where is sheet flows into Basin HOSA7 where flow is routed to a culvert crossing from southeast to northwest under Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows travel through culvert SA10 before leaving the site at DP A6 (through the existing pond at the location) and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA13: Basin HA13 drains out from the Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A6 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA14: Basin HA14 drains out from Crowfoot Valley Rd. to the southeast where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. This ditch leads to a culvert crossing, SA12, which flows from southeast to northwest under Crowfoot Valley Rd. The basin land use is the Crowfoot Valley

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Rd. and associated R.O.W. Flows leave the site at DP A7 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA15: Basin HA15 drains out from Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. before flowing out of the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A7 and drains to Lemon Gulch via an existing grassed drainageway.

Basin HA16: Basin HA16 drains out from Crowfoot Valley Rd. to the north where it enters a roadside ditch draining east-northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP A7 and drains to Lemon Gulch via an existing grassed drainageway. HA16 continues flow out of the basin via an existing culvert, SA13.

Basin HB1: Basin HB1 drains out from Crowfoot Valley Rd. to the east where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. where it leaves the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B1 and drains to Scott Gulch via an existing grassed drainageway.

Basin HB2: Basin HB2 drains out from Crowfoot Valley Rd. to the east where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B1 and drains to Scott Gulch via an existing grassed drainageway. HB2 continues flow out of the basin via an existing culverts, SB1 and SB2.

Basin HB3: Basin HB3 drains out from Crowfoot Valley Rd. to the east where it sheet flows off site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B2 and drains to Scott Gulch via an existing grassed drainageway. A culvert crossing is located southeast of Crowfoot Valley Rd. to convey flows under the adjacent dirt roadway; this existing culvert is shown on the maps as SB3.

Basin HB4: Basin HB4 drains out from Crowfoot Valley Rd. to the east where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. where flows leave the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B2 and drains to Scott Gulch via an existing grassed drainageway.

Basin HB5: Basin HB5 drains out from Crowfoot Valley Rd. to the east where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B2 and drains to Scott Gulch via an existing grassed drainageway. HB5 continues flow out of the basin via an existing culvert, SB4.

Basin HB6: Basin HB6 drains out from Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. and is routed to a culvert crossing which flows from west to east under Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows conveyed through this culvert, SB5, leave the site at DP B4 and drain to Scott Gulch via an existing grassed drainageway.

Basin HB7: Basin HB7 drains out from Crowfoot Valley Rd. to the southwest where it enters a roadside ditch draining southwest along Crowfoot Valley Rd. Flows leave Basin HB7 and enter Basin HB6 via a

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culvert SB6, before leaving the site via the culvert crossing under Crowfoot Valley Rd., SB5. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows conveyed through this culvert, SB5, leave the site at DP B4 and drain to Scott Gulch via an existing grassed drainageway.

Basin HB8: Basin HB8 drains out from Crowfoot Valley Rd. to the east where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. where it leaves the site near DP B4. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B4 and drains to Scott Gulch via an existing grassed drainageway.

Basin HB9: Basin HB9 drains out from Crowfoot Valley Rd. to the northwest where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Basin HB9 flows into basin HB6 via culverts SB8 and SB9. Flows for this basin leave the site at DP B4 and drain to Scott Gulch via an existing grassed drainageway.

Basin HB10: Basin HB10 drains out from Crowfoot Valley Rd. to the southeast where it enters a roadside ditch draining northeast along Crowfoot Valley Rd. before outfalling from the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows for this basin leave the site at DP B5 and drain to Scott Gulch via an existing grassed drainageway.

Basin HB11: Basin HB11 drains out from Crowfoot Valley Rd. to the east where it is routed via curb and gutter to a nearby Type R inlet. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B6 via storm structure SB10 which routes the flows into the Canyons South development.

Basin HB12: Basin HB12 drains out from Crowfoot Valley Rd. to the west where it enters a roadside ditch draining west along Crowfoot Valley Rd. where it leaves the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B7 via storm structure SB11 which routes flows to the southern side of Crowfoot Valley Rd.

Basin HB13: Basin HB13 drains out from Crowfoot Valley Rd. to the south before being routed to the southwest via curb and gutter to the project site limits. Downstream from the project site limits is a Type R inlet to capture flows. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B8 and drain to Scott Gulch via an existing drainageway.

Basin HB14: Basin HB14 drains out from Crowfoot Valley Rd. to the east where it enters a roadside ditch draining north along Crowfoot Valley Rd. where it leaves the site. The basin land use is the Crowfoot Valley Rd. and associated R.O.W. Flows leave the site at DP B3 and drain to Scott Gulch via an existing drainageway.

Historic Off-Site Basins: Historic off-site basins delineated are areas where flow is entering the project site. The receiving basin for all off-site flows is provided in the Direct Runoff Table in the hydrology calculations. Off-site basins have the potential to be developed or changed post the review of existing conditions in this study; off-site basins time of concentration or imperviousness may change as development occurs along Crowfoot Valley Rd.

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III.B.2 Proposed Minor Basins

The proposed design for the roadway has not been completed, an assumed typical section is being used, shown on the drainage maps. It is assumed the roadway cross slope will be at least 2% and the longitudinal slope of the roadway will be at least 1%. Based on these values, assumed proposed basins were delineated using the existing outfall points found in the investigation. As designs progress, proposed basins may need to be further split based on roadway criteria of spread and depth.

Basin A1: Basin A1 drains out from the improved Crowfoot Valley Rd. to the northwest where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. areas. Flows leave the site at DP A1 and drains to Lemon Gulch via an existing grassed drainageway.

Basin A2: Basin A2 drains out from the improved Crowfoot Valley Rd. to the northwest where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. areas. Flows leave the site at DP A3 and drains to Lemon Gulch via an existing grassed drainageway.

Basin A3: Basin A3 drains out from the improved Crowfoot Valley Rd. to the northwest where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. areas. Flows leave the site at DP A4 and drains to Lemon Gulch via an existing grassed drainageway.

Basin A4: Basin A4 drains out from the improved Crowfoot Valley Rd. to the northwest where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. areas. Flows leave the site at DP A5 and drains to Lemon Gulch via an existing grassed drainageway.

Basin A5: Basin A5 drains out from the improved Crowfoot Valley Rd. to the southeast where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. This basin was historically routed to the northwest side of the road and outlet to the Lemon Gulch drainage basin. Historic drainage patterns will be maintained and flows will leave the site at DP A5 before draining to Lemon Gulch via existing drainageways.

Basin A6: Basin A6 drains out from the improved Crowfoot Valley Rd. to the northwest where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP A6 and drain to Lemon Gulch via an existing drainageway.

Basin A7: Basin A7 drains out from the improved Crowfoot Valley Rd. to the southeast where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. This basin was historically routed to the northwest side of the road and outlet to the Lemon Gulch drainage basin. Historic drainage patterns will be maintained and flows will leave the site at DP A6 before draining to Lemon Gulch via existing drainageways.

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Basin A8: Basin A8 drains out from the improved Crowfoot Valley Rd. to the north where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP A7 and drain to Lemon Gulch via an existing drainageway.

Basin A9: Basin A9 drains out from the improved Crowfoot Valley Rd. to the east where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. This basin was historically routed to the northwest side of the road and outlet to the Lemon Gulch drainage basin. Historic drainage patterns will be maintained and flows will leave the site at DP A7 before draining to Lemon Gulch via existing drainageways.

Basin B1: Basin B1 drains out from the improved Crowfoot Valley Rd. to the east where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B1 and drain to Scott Gulch via an existing drainageway.

Basin B2: Basin B2 drains out from the improved Crowfoot Valley Rd. to the east where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B2 and drain to Scott Gulch via an existing drainageway.

Basin B3: Basin B3 drains out from the improved Crowfoot Valley Rd. to the east where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B3 and drain to Scott Gulch via an existing drainageway.

Basin B4: Basin B4 drains out from the improved Crowfoot Valley Rd. to the east where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B4 and drain to Scott Gulch via an existing drainageway.

Basin B5: Basin B5 drains out from the improved Crowfoot Valley Rd. to the northwest where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. This basin was historically routed to the southeast side of the road and outlet to the Scott Gulch drainage basin. Historic drainage patterns will be maintained and flows will leave the site at DP B4 before draining to Scott Gulch via existing drainageways.

Basin B6: Basin B6 drains out from the improved Crowfoot Valley Rd. to the southeast where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B5 and drain to Scott Gulch via an existing drainageway.

Basin B7: Basin B7 drains out from the improved Crowfoot Valley Rd. to the southeast where it is captured by curb and gutter and routed northeast to an ultimate outfall from the project site. The basin

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land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B6 and drain to Scott Gulch via an existing drainageway within the Canyons South development.

Basin B8: Basin B8 drains out from the improved Crowfoot Valley Rd. to the west where it is captured by curb and gutter and routed southwest to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B7 and drain to Scott Gulch via an existing drainageway within the Canyons South development.

Basin B9: Basin B9 drains out from the improved Crowfoot Valley Rd. to the southeast where it is captured by curb and gutter and routed southwest to an ultimate outfall from the project site. The basin land use is the improved Crowfoot Valley Rd. and the remaining R.O.W. Flows leave the site at DP B8 and drain to Scott Gulch via an existing drainageway within the Canyons South development, via an existing Type R inlet on Crowfoot Valley Rd.

Off-Site Basins: Off-site basins delineated are areas where flow is entering the project site. The receiving basin for all off-site flows is provided in the Proposed Direct Runoff Table in the hydrology calculations.

IV. Existing Stormwater Conveyance or Storage Facilities

A. Existing Stormwater Conveyance Facilities

There are a multitude of street connections to Crowfoot Valley Rd. within the site limits that have placed culvert crossings to enable flows to continue along the roadside ditches. The approximate locations of these culvert crossings are shown on the Drainage Maps with given IDs. The size of these existing culverts within the project site are shown on the drainage maps in Appendix C when identified. It is expected a majority of these culverts will be removed with the widening and improvements of Crowfoot Valley Rd. and would need to be replaced or have an alternative drainage path determined.

There are no major or minor drainageways other than roadside ditches within the project site.

Culverts not required to be removed for the expanded roadway may be incorporated, modified, or rebuilt as designs progress.

B. Existing Stormwater Storage Facilities

There are no existing stormwater storage facilities within the project site. However, directly adjacent to the project site along Crowfoot Valley Rd., a few stormwater storage facilities were identified. At the southern end of the project, to the north of the site, is the Cutter's Ridge storage facility. South of the southern end of the project is multiple storage facilities proposed as part of the Canyons South development. Near the intersection of Crowfoot Valley Rd. and Longstory Ave., on the northwestern side of Crowfoot Valley Rd. are two storage facilities located on what appears to be residential properties. Two relatively recent developments containing churches are located adjacent to Crowfoot Valley Rd. in the center of the project site. Both developments appear to have stormwater storage facilities. At the very northern limits of the annexation area, associated with the Pinery subdivision is another stormwater storage facility.

All storage facilities with the capacity to accept additional flows will be investigated and stormwater storage may be satisfied by existing facilities based on availability. It is not determined at this Phase I

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stage which facilities will be incorporated, modified, rebuilt or abandoned. Subsequent drainage reports will investigate potential for adjacent facilities to provide storage for this annexation project.

V. Proposed Stormwater Conveyance or Storage Facilities

A. Stormwater Conveyance Facilities

Crowfoot Valley Rd. facilities will be designed per Douglas County Storm Drainage Design and Technical Criteria Manual. In proposed conditions, onsite runoff is anticipated to be conveyed through streets, swales, and grass-lined channels to roadway inlets and area inlet design points throughout the site. The proposed storm system is anticipated to be sized to convey the minor storm event without surcharging. Runoff in the 100-year storm event will be conveyed by a combination of street, swale, channel, and storm sewer to the ultimate outfall from the site. The presence of water quality and storage will be investigated in subsequent drainage reports.

The outfalls from the site in the existing conditions will be maintained and the proposed basins will drain in a similar manner to the existing conditions, maintaining drainage patterns. Detention will be investigated to reduce the increase in flow rates due to the increase in impervious area.

Off-site runoff will be conveyed into the site's drainage basin areas via sheet flow from adjacent undeveloped slopes and swales (natural and roadside), in both historic and proposed conditions. In proposed conditions the off-site flow will then be captured by the proposed surface conveyance or storm system for the project site. In existing conditions, off-site flows join with existing basin flows before typically outfalling to Lemon Gulch or Scott Gulch depending on the major basin for the drainage area.

Conveyance structure design and adequate capacity calculations will be provided with a future Phase II/Phase III Drainage Report.

No anticipated conveyance problems have been identified at this level of study. Improvements to the existing conveyance structures are undetermined at this time and expected to be analyzed for needs with a future Phase II/Phase III Drainage Report.

All storm conveyance elements shall be accessible via manhole or surface access for any maintenance needs. Drainage easements shall be utilized to provide constant access and will be sized consistently with the requirements outlined in Chapter 9 of the Douglas County Storm Drainage Design and Technical Criteria Manual.

B. Stormwater Storage Facilities

Future water quality and detention for the site is proposed to be provided at up to 14 design points where flows are being outlet from the site. The proposed storage facility types have not been determined at this level of the study. The detention facilities will be designed using the MHFD-Detention (current edition) spreadsheet and will be in accordance with the Douglas County Storm Drainage Design and Technical Criteria Manual. The approximate locations of facilities will be near the outfall points of the site. As designs progress, the location of these facilities may be moved to better fit the design needs. In the case a pond structure is utilized, the outlet structures for these ponds will be designed based on the provided details in Volume 3 of the MHFD Manual, in Chapter 4. The outlet structure will be designed to

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convey the flow for storm events up to 100-year for the drainage basin, storm events that exceed the 100-year will utilize the emergency spillway.

Anticipated storage concerns come from the low availability of space within the R.O.W. to R.O.W. limits of the site. Any adjacent existing facilities will be investigated for potential to receive flows and mitigate the need for facilities within the project site. Low impact development structures to provide water quality and detention will be investigated for potential use along the corridor.

Operation and Maintenance Manuals will be prepared for each stormwater storage facility in subsequent applications.

The CDPS General Permit COR080000 for Stormwater Discharges associated with Municipal Separate Storm Sewer Systems (MS4s) that discharge to the Cherry Creek Reservoir Drainage Basin was investigated to confirm water quality requirements for the proposed project activities. In the Post-Construction Stormwater Management in New Development and Redevelopment provide situations in which portions of the drainage area can be excluded from the water quality requirements. Based on Section 4.b.(C), since the proposed project activities do not increase the width of the roadway by two times or more, the original roadway area may be excluded for the development site.

Confirmation of the allowance of this exclusion shall be confirmed prior to any specific water quality and storage design as the required volumes and drainage areas differ significantly.

VI. Water Quality Enhancement Best Management Practices

A. Non-Structural Best Management Practices

At this level of design, no specific non-structural Best Management Practices are currently being proposed to reduce the pollutant load on anticipated water quality and storage facilities previously discussed; as design progresses, additional opportunities to reduce the pollutant load will be reviewed. However, although no specific non-structural BMP are proposed, typical source controls and good housekeeping practices as required by the MS4 permit will also be utilized for the development. As the design progresses, any proposed non-structural Best Management Practices added to the design will be detailed in this drainage report.

B. Structural Best Management Practices

The stormwater storage facilities discussed in Section V.B. shall be designed in accordance with the Douglas County Storm Drainage Design and Technical Criteria Manual and the MHFD Storm Drainage Criteria Manual Volumes 1, 2, and 3. The Detention Ponds/Water Quality Facilities will be designed to detain the Water Quality Control Volume, Excess Urban Runoff Volume, and the 100-year Detention Volume, restricted to 90% of existing flow in accordance with MHFD guidance. As design progresses, opportunities for LID development to reduce the required size of the corresponding water quality and lower the imperviousness of the drainage areas will be investigated; typical structural BMP/LID options that may be proposed include grass swales, grass buffers, or bioretention facilities.

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As previously noted, Operation and Maintenance Manuals will be prepared for each stormwater storage facility in subsequent applications. Access paths will be provided for each pond facility to allow for maintenance activities.

VII. Floodplain Modification

A. Major Drainageway – Undesignated Floodplain

No undesignated floodplains were observed in the project vicinity.

B. Major Drainageway – Designated Floodplain

The project site has been found to drain into two major drainageways in the project vicinity which contain FEMA Designated Floodplain areas, Lemon Gulch to the northwest and Scott Gulch to the southeast. There are no modifications proposed to either of these drainageways as they are at least 0.5 miles from the project area and no direct impacts are expected as part of this annexation and roadway improvements.

Lemon Gulch information was sourced from the FEMA Flood Insurance Rate Maps. Lemon Gulch flows from southwest to northeast to the west of the project site. Lemon Gulch is identified with a designated floodplain Zone A, which provides the 100-year floodplain extents but does not include Base Flood Elevations (BFEs).

Scott Gulch information was sourced from the FEMA Flood Insurance Rate Maps. Scott Gulch flows from southwest to northeast to the east of the project site. Scott Gulch was identified with a designated floodplain Zone A, which provides the 100-year floodplain extents but does not include the Base Flood Elevations (BFEs).

No floodplain modifications are anticipated. There will not be a need for any Conditional Letter of Map Revision (CLOMR) or Letter of Map Revision (LOMR) for either floodplain.

Floodplain Development Regulations are outlined in the Douglas County Storm Drainage Design and Technical Criteria Manual, Section 5.2.6. This section refers to a Douglas County Zoning Resolution, Section 18, Floodplain – Overlay District, which provides additional criteria for floodplain development. Additionally, a Floodplain Development Permit is required for any change of land use or proposed development within the floodplain, which is not anticipated at this time.

VIII. Additional Permitting Requirements

Permit requirements will be investigated in subsequent submittals as design progresses.

IX. References

- Douglas County Storm Drainage Design and Technical Criteria Manual
- Mile High Flood District Drainage Criteria Manual Volumes 1, 2, & 3, current version

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- Natural Resources Conservation Service Web Soil Survey, United States Department of Agriculture
- Federal Emergency Management Agency Flood Insurance Rate Map, Community Panel Number 08035C0183G, 08035C0180G, and 08035C0187G.
- *Scott and Lemon Gulch Watersheds Outfall Systems Planning – Preliminary Design Report*, prepared by CH2M Hill, and Dated July 2006.
- *Floodplain Overlay District – Section 18*, Douglas County Zoning Resolution, dated 05/10/2016.
- *Cutter’s Ridge – A Replat of Maher Ranch Filing No. 1, Tract R – Phase III Drainage Report*, prepared by Kirkham Michael Consulting Engineers, and dated July 7, 2003.
- *Canyons South Filing 2 – Phase II Drainage Report*, prepared by Calibre Engineering, Inc., and dated February 2021.

Appendix A. Hydrologic Calculations

A1 Runoff Coefficient Calculations



**Crowsnest Annex Phase I
Basin Weighted Runoff Coefficient Calculations**

Land Use Is Comprised of following Surface Characteristics:						
NRCS Soil Group	C	Imperviousness	C ₂	C ₃	C ₁₀	C ₁₀₀
A	Asphalt/Concrete/Roofs	95%	0.78	0.81	0.83	0.87
B	Gravel Road	80%	0.64	0.69	0.72	0.81
C	Undisturbed	5%	0.02	0.08	0.17	0.50
D	Landscaped	20%	0.12	0.20	0.28	0.57
E	Major Arterial ROW to ROW	65%	0.49	0.56	0.61	0.75
F	Major Intersection ROW to ROW	80%	0.64	0.69	0.72	0.81
G						
H						
I						
J						
K						

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Basin ID	Total Area (Ac.)	A Area (Ac.)	B Area (Ac.)	C Area (Ac.)	D Area (Ac.)	E Area (Ac.)	F Area (Ac.)	G Area (Ac.)	H Area (Ac.)	I Area (Ac.)	J Area (Ac.)	K Area (Ac.)	Weighted Imp. I (%)	Weighted Runoff Coefficients			
														C ₂	C ₃	C ₁₀	C ₁₀₀
Historic/Existing																	
HA1	1.52	0.57		0.95									39%	0.31	0.35	0.42	0.64
HA2	0.14			0.14									5%	0.02	0.08	0.17	0.50
HA3	1.50	0.61		0.89									42%	0.33	0.37	0.44	0.65
HA4	0.73	0.38	0.01	0.34									52%	0.42	0.46	0.52	0.70
HA5	0.76	0.49	0.01	0.27									63%	0.51	0.55	0.59	0.74
HA6	0.88	0.42		0.46									48%	0.39	0.43	0.49	0.68
HA7	0.52	0.25	0.04	0.24									53%	0.42	0.46	0.52	0.70
HA8	0.90	0.64	0.01	0.25									70%	0.57	0.60	0.64	0.77
HA9	0.77	0.43	0.02	0.31									58%	0.47	0.51	0.56	0.72
HA10	0.35	0.27		0.08									74%	0.61	0.64	0.68	0.79
HA11	0.26	0.18		0.07									69%	0.56	0.60	0.64	0.77
HA12	1.16	0.66		0.36	0.15								58%	0.46	0.51	0.56	0.72
HA13	0.46	0.33		0.12									71%	0.58	0.61	0.65	0.77
HA14	1.67	0.72		0.95									44%	0.35	0.39	0.45	0.66
HA15	2.00	1.22		0.78									60%	0.49	0.52	0.57	0.73
HA16	2.40	1.32	0.03	1.06									55%	0.45	0.49	0.54	0.71
Basin HA	16.01	8.48	0.10	7.28	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	53%	0.43	0.47	0.52	0.70
HB1	1.08	0.34	0.01	0.74									34%	0.26	0.31	0.38	0.62
HB2	1.89	0.68	0.03	1.17									39%	0.31	0.35	0.42	0.64
HB3	0.40	0.10		0.29									28%	0.22	0.26	0.34	0.60
HB4	0.35	0.15		0.20									44%	0.35	0.39	0.46	0.66
HB5	0.99	0.46		0.54									46%	0.37	0.41	0.47	0.67
HB6	0.68	0.31	0.01	0.35									48%	0.38	0.42	0.48	0.68
HB7	0.27	0.13		0.14									48%	0.38	0.42	0.48	0.68
HB8	2.13	0.81	0.02	1.30									40%	0.32	0.36	0.43	0.65
HB9	0.57	0.27	0.04	0.26									52%	0.42	0.46	0.52	0.70
HB10	1.82	0.77		1.06									43%	0.34	0.38	0.45	0.66
HB11	0.81	0.62		0.19									74%	0.61	0.64	0.68	0.79
HB12	0.43	0.26		0.17									59%	0.48	0.52	0.57	0.73
HB13	0.39	0.39											95%	0.78	0.81	0.83	0.87
HB14	0.95	0.33		0.62									36%	0.29	0.33	0.40	0.63
Basin HB	12.74	5.28	0.10	6.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43%	0.34	0.38	0.43	0.62
Existing Imp.	28.74	13.76	0.20	13.69	0.15	0.00	49%	0.39	0.43	0.48	0.67						
Historic Off-Site																	
HOSA1	0.23			0.23									5%	0.02	0.08	0.17	0.50
HOSA2	0.28		0.02	0.26									10%	0.06	0.12	0.20	0.52
HOSA3	0.82		0.03	0.79									8%	0.04	0.10	0.19	0.52
HOSA4	0.99		0.02	0.97									6%	0.03	0.09	0.18	0.51
HOSA5	0.43		0.09	0.34									20%	0.15	0.20	0.28	0.57
HOSA6	1.97	0.06	0.10	1.81									11%	0.08	0.13	0.22	0.53
HOSA7	3.54	0.43		2.31	0.80								19%	0.14	0.19	0.27	0.56
HOSA8	3.75	0.07		3.68									7%	0.04	0.09	0.18	0.51
HOSA9	1.22		0.00	1.22									5%	0.02	0.08	0.17	0.51
HOSA10	2.70	0.06	0.01	2.48	0.16								8%	0.05	0.10	0.19	0.52
HOSA Basin	15.94	0.61	0.26	14.10	0.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11%	0.07	0.12	0.21	0.53
HOSB1	0.04		0.00	0.04									8%	0.04	0.10	0.19	0.52
HOSB2	1.03		0.01	1.02									5%	0.03	0.08	0.17	0.51
HOSB3	0.07			0.07									5%	0.02	0.08	0.17	0.50
HOSB4	0.32			0.32									5%	0.02	0.08	0.17	0.50
HOSB5	0.38	0.00	0.01	0.37									7%	0.04	0.09	0.18	0.51
HOSB6	0.11	0.01		0.10									9%	0.06	0.11	0.20	0.52
HOSB7	0.24	0.01		0.23									10%	0.07	0.12	0.21	0.53
HOSB8	0.83		0.01	0.83									6%	0.03	0.08	0.17	0.51
HOSB9	0.05	0.01		0.04									18%	0.13	0.18	0.27	0.56
HOSB10	0.84	0.15	0.01	0.45	0.23								26%	0.19	0.24	0.32	0.59
HOSB11	0.45			0.45									20%	0.12	0.20	0.28	0.57
HOSB Basin	4.37	0.18	0.03	3.47	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12%	0.07	0.13	0.22	0.53
Off-site Imp.	20.31	0.79	0.30	17.57	1.65	0.00	11%	0.07	0.12	0.21	0.53						
Developed																	
A1	1.65					1.65							65%	0.49	0.56	0.61	0.75
A2	4.91					4.91							65%	0.49	0.56	0.61	0.75
A3	0.79					0.79							65%	0.49	0.56	0.61	0.75
A4	1.01					1.01							65%	0.49	0.56	0.61	0.75
A5	1.34					1.34							65%	0.49	0.56	0.61	0.75
A6	1.29					1.07	0.23						68%	0.41	0.47	0.50	0.62
A7	1.33					1.10	0.22						68%	0.41	0.47	0.51	0.62
A8	5.07					4.84	0.23						66%	0.47	0.54	0.58	0.72
A9	1.87					1.87							65%	0.49	0.56	0.61	0.75
Basin A	19.25	0.00	0.00	0.00	0.00	18.57	0.68	0.00	0.00	0.00	0.00	0.00	66%	0.48	0.54	0.59	0.72
B1	3.75					3.75							65%	0.49	0.56	0.61	0.75
B2	1.74					1.74							65%	0.49	0.56	0.61	0.75
B3	1.23					1.23							65%	0.49	0.56	0.61	0.75
B4	2.15					2.15							65%	0.49	0.56	0.61	0.75
B5	1.88					1.88							65%	0.49	0.56	0.61	0.75
B6	2.12					2.12							65%	0.49	0.56	0.61	0.75
B7	1.09					0.87	0.23						68%	0.39	0.45	0.48	0.59
B8	0.72					0.72							65%	0.49	0.56	0.61	0.75
B9	0.72					0.72							65%	0.49	0.56	0.61	0.75
Basin B	15.40	0.00	0.00	0.00	0.00	15.18	0.23	0.00	0.00								

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A2 Time of Concentration

Time of Concentration

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Basin ID	C _s	Initial Flow Time T _i			Travel Time T _t							Tc Check				Final T _c (min)
		Length Li (ft)	Slope (%)	T _i (min)	Length Lt (ft)	Slope (%)	Convey. Element	Convey. Coeff. K	Vel. (fps)	T _t (min)	Total T _c (min)	Imp. (dec)	Travel Length (ft)	Avg. Travel Slope (%)	T _c = 26 - 17i + [Lt/(60*(14i+9)*(S ^{0.5}))] (min)	
Existing Basins																
HA1	0.35	50	5.00	5.6	1015	0.90	GRASSED	15	1.4	11.9	17.5	0.4	1015	1.1	30.6	17.5
HA2	0.08	70	3.50	10.2	1	1.00	GRASSED	15	1.5	0.0	10.2	0.1	70	3.5	25.8	10.2
HA3	0.37	50	1.80	7.6	80	5.00	GRASSED	15	3.4	0.4	8.0	0.4	80	3.8	19.4	8.0
HA4	0.46	70	1.50	8.4	415	1.30	GRASSED	15	1.7	4.0	12.5	0.5	415	1.3	20.8	12.5
HA5	0.55	45	4.25	4.2	475	1.25	GRASSED	15	1.7	4.7	8.9	0.6	475	1.5	18.9	8.9
HA6	0.43	50	4.50	5.2	650	0.50	GRASSED	15	1.1	10.2	15.4	0.5	650	0.8	25.6	15.4
HA7	0.46	55	2.50	6.3	310	1.10	GRASSED	15	1.6	3.3	9.6	0.5	310	1.3	19.8	9.6
HA8	0.60	100	1.25	8.3	1	1.00	GRASSED	15	1.5	0.0	8.3	0.7	100	1.3	14.9	8.3
HA9	0.51	50	2.00	6.0	220	0.50	GRASSED	15	1.1	3.5	9.5	0.6	220	0.8	18.6	9.5
HA10	0.64	50	2.00	4.7	190	1.50	GRASSED	15	1.8	1.7	6.4	0.7	190	1.6	14.6	6.4
HA11	0.60	65	8.00	3.7	1	1.00	GRASSED	15	1.5	0.0	3.7	0.7	65	8.0	14.5	5.0
HA12	0.51	65	3.00	6.0	340	2.30	GRASSED	15	2.3	2.5	8.5	0.6	340	2.4	18.3	8.5
HA13	0.61	75	1.90	6.2	240	2.50	GRASSED	15	2.4	1.7	7.9	0.7	240	2.4	15.4	7.9
HA14	0.39	65	1.90	8.3	830	1.00	GRASSED	15	1.5	9.2	17.6	0.4	830	1.1	27.4	17.6
HA15	0.52	65	3.00	5.8	1040	1.10	GRASSED	15	1.6	11.0	16.9	0.6	1040	1.2	24.9	16.9
HA16	0.49	90	1.10	10.2	1575	0.70	GRASSED	15	1.3	20.9	31.1	0.6	1575	0.7	35.1	31.1
HB1	0.31	55	3.25	7.2	195	2.50	GRASSED	15	2.4	1.4	8.5	0.3	195	2.7	21.7	8.5
HB2	0.35	65	2.50	8.1	1350	1.00	GRASSED	15	1.5	15.0	23.1	0.4	1350	1.1	34.5	23.1
HB3	0.26	75	11.00	5.9	1	1.00	GRASSED	15	1.5	0.0	5.9	0.3	75	11.0	21.5	5.9
HB4	0.39	65	3.00	7.2	185	1.10	GRASSED	15	1.6	2.0	9.1	0.4	185	1.6	20.1	9.1
HB5	0.41	90	5.50	6.7	485	0.50	GRASSED	15	1.1	7.6	14.3	0.5	485	1.3	22.7	14.3
HB6	0.42	90	8.00	5.8	210	3.50	GRASSED	15	2.8	1.2	7.1	0.5	210	4.9	18.9	7.1
HB7	0.42	45	3.50	5.4	150	0.50	GRASSED	15	1.1	2.4	7.8	0.5	150	1.2	19.4	7.8
HB8	0.36	90	2.00	10.1	500	5.00	GRASSED	15	3.4	2.5	12.6	0.4	500	4.5	21.9	12.6
HB9	0.46	75	2.50	7.4	400	2.00	GRASSED	15	2.1	3.1	10.5	0.5	400	2.1	19.9	10.5
HB10	0.38	40	8.50	4.0	1300	0.80	GRASSED	15	1.3	16.1	20.2	0.4	1300	1.0	32.9	20.2
HB11	0.64	90	2.00	6.3	540	0.50	PAVED	20	1.4	6.4	12.7	0.7	540	0.7	18.9	12.7
HB12	0.52	75	1.00	9.1	95	1.00	GRASSED	15	1.5	1.1	10.2	0.6	95	1.0	16.8	10.2
HB13	0.81	55	1.00	3.9	280	0.80	GRASSED	20	1.8	2.6	6.5	1.0	280	0.8	12.1	6.5
HB14	0.33	55	2.50	7.6	500	0.90	GRASSED	15	1.4	5.9	13.5	0.4	500	1.1	25.6	13.5
Existing Off-Site																
HOSA1	0.08	60	10.00	6.7	1	1.00	GRASSED	15	1.5	0.0	6.7	0.1	60	10.0	25.5	6.7
HOSA2	0.12	120	1.25	18.1	1	1.00	GRASSED	15	1.5	0.0	18.1	0.1	120	1.3	26.0	18.1
HOSA3	0.10	160	4.00	14.5	1	1.00	GRASSED	15	1.5	0.0	14.5	0.1	160	4.0	26.0	14.5
HOSA4	0.09	140	4.00	13.7	100	2.00	GRASSED	15	2.1	0.8	14.5	0.1	100	3.2	25.9	14.5
HOSA5	0.20	160	3.50	13.6	1	1.00	GRASSED	15	1.5	0.0	13.6	0.2	160	3.5	23.7	13.6
HOSA6	0.13	350	2.50	24.3	1	1.00	PASTURE	7	0.7	0.0	24.3	0.1	350	2.5	27.5	24.3
HOSA7	0.19	420	1.75	27.9	1	1.00	PASTURE	7	0.7	0.0	27.9	0.2	420	1.8	27.2	27.2
HOSA8	0.09	490	2.00	32.1	1	1.00	PASTURE	7	0.7	0.0	32.2	0.1	490	2.0	30.7	30.7
HOSA9	0.08	110	6.10	10.7	1	1.00	PASTURE	7	0.7	0.0	10.7	0.1	110	6.1	25.9	10.7
HOSA10	0.10	500	3.50	26.7	1	1.00	GRASSED	15	1.5	0.0	26.7	0.1	500	3.5	29.0	26.7
HOSB1	0.10	45	6.60	6.5	1	1.00	GRASSED	15	1.5	0.0	6.5	0.1	45	6.6	25.0	6.5
HOSB2	0.08	160	2.80	16.6	1	1.00	PASTURE	7	0.7	0.0	16.6	0.1	160	2.8	26.7	16.6
HOSB3	0.08	65	2.00	11.9	1	1.00	PASTURE	7	0.7	0.0	11.9	0.1	65	2.0	25.9	11.9
HOSB4	0.08	130	3.50	13.9	1	1.00	PASTURE	7	0.7	0.0	14.0	0.1	130	3.5	26.3	14.0
HOSB5	0.09	105	12.00	8.2	1	1.00	GRASSED	15	1.5	0.0	8.2	0.1	105	12.0	25.4	8.2
HOSB6	0.11	45	13.00	5.1	1	1.00	GRASSED	15	1.5	0.0	5.2	0.1	45	13.0	24.7	5.2
HOSB7	0.12	55	3.00	9.1	1	1.00	GRASSED	15	1.5	0.0	9.1	0.1	55	3.0	24.7	9.1
HOSB8	0.08	500	5.00	24.2	1	1.00	PASTURE	7	0.7	0.0	24.2	0.1	500	5.0	28.8	24.2
HOSB9	0.18	50	4.00	7.4	1	1.00	PASTURE	7	0.7	0.0	7.4	0.2	50	4.0	23.2	7.4
HOSB10	0.24	120	6.00	9.4	1	1.00	PASTURE	7	0.7	0.0	9.4	0.3	120	6.0	22.3	9.4
HOSB11	0.20	180	9.50	10.4	130	0.80	GRASSED	15	1.3	1.6	12.0	0.2	130	5.9	23.4	12.0
Proposed Basins																
A1	0.56	50	2.00	5.4	1020	1.00	PAVED	20	2.0	8.5	13.9	0.7	1020	1.0	24.1	13.9
A2	0.56	50	2.00	5.4	3050	1.00	PAVED	20	2.0	25.4	30.9	0.7	3050	1.0	42.8	30.9
A3	0.56	50	2.00	5.4	460	1.00	PAVED	20	2.0	3.8	9.3	0.7	460	1.1	19.0	9.3
A4	0.56	50	2.00	5.4	610	1.00	PAVED	20	2.0	5.1	10.5	0.7	610	1.1	20.4	10.5
A5	0.56	50	2.00	5.4	820	1.00	PAVED	20	2.0	6.8	12.3	0.7	820	1.1	22.3	12.3
A6	0.47	50	2.00	6.4	780	1.00	PAVED	20	2.0	6.5	12.9	0.7	780	1.1	21.3	12.9
A7	0.47	50	2.00	6.4	810	1.00	PAVED	20	2.0	6.8	13.2	0.7	810	1.1	21.6	13.2
A8	0.54	50	2.00	5.7	3125	1.00	PAVED	20	2.0	26.0	31.7	0.7	3125	1.0	43.2	31.7
A9	0.56	50	2.00	5.4	1150	1.00	PAVED	20	2.0	9.6	15.0	0.7	1150	1.0	25.3	15.0
B1	0.56	50	2.00	5.4	2325	1.00	PAVED	20	2.0	19.4	24.8	0.7	2325	1.0	36.1	24.8
B2	0.56	50	2.00	5.4	1060	1.00	PAVED	20	2.0	8.8	14.3	0.7	1060	1.0	24.5	14.3
B3	0.56	50	2.00	5.4	750	1.00	PAVED	20	2.0	6.3	11.7	0.7	750	1.1	21.6	11.7
B4	0.56	50	2.00	5.4	1150	1.00	PAVED	20	2.0	9.6	15.0	0.7	1150	1.0	25.3	15.0
B5	0.56	50	2.00	5.4	1150	1.00	PAVED	20	2.0	9.6	15.0	0.7	1150	1.0	25.3	15.0
B6	0.56	50	2.00	5.4	1300	1.00	PAVED	20	2.0	10.8	16.3	0.7	1300	1.0	26.7	16.3
B7	0.45	50	2.00	6.6	650	1.00	PAVED	20	2.0	5.4	12.0	0.7	650	1.1	20.1	12.0
B8	0.56	50	2.00	5.4	430	1.00	PAVED	20	2.0	3.6	9.0	0.7	430	1.1	18.7	9.0
B9	0.56	50	2.00	5.4	430	1.00	PAVED	20	2.0	3.6	9.0	0.7	430	1.1	18.7	9.0
Proposed Off-Site																
OSA1	0.08	75	7.00	8.4	1	1.00	GRASSED	15	1.5	0.0	8.4	0.1	75	7.0	25.6	8.4
OSA2	0.08	50	5.00	7.7	1	1.00	GRASSED	15	1.5	0.0	7.7	0.1	50	5.0	25.5	7.7
OSA3	0.10	230	1.50	24.0	1	1.00	GRASSED	15	1.5	0.0	24.0	0.1	230	1.5	27.7	24.0
OSA4	0.09	190	2.50	18.5	1	1.00	GRASSED	15	1.5	0.0	18.6	0.1	190	2.5	26.8	18.6
OSA5	0.21	240	2.50	18.4	1	1.00	GRASSED	15	1.5	0.0	18.4	0.2	240	2.5	24.5	18.4
OSA6	0.14	350	2.20	25.0	1	1.00	GRASSED	15	1.5	0.0	25.0	0.1	350	2.2	27.5	25.0
OSA7	0.18	410	2.30	25.4	1	1.00	GRASSED	15	1.5	0.0	25.4	0.2	410	2.3	26.8	25.4
OSA8	0.08	480	2.00	32.0	1	1.00	GRASSED	15	1.5	0.0	32.0	0.1	480	2.0	30.8	30.8
OSA9	0.08	360	2.50	25.9	1	1.00	GRASSED	15	1.5	0.0	25.9	0.1	360	2.5	29.0	25.9
OSA10	0.10	770	2.40	37.4	1	1.00	GRASSED	15	1.5	0.0	37.4	0.1	770	2.4	32.7	32.7
OSB1	0.08	300	3.00	22.2	1	1.00	GRASSED	15	1.5	0.0	22.2	0.1	300	3.0	28.0	22.2
OSB2	0.08	100	1.75	15.4	1	1.00	GRASSED	15	1.5	0.0	15.4	0.1	100	1.8	26.4	15.4
OSB3	0.08	180	2.70	17.9	1	1.00	GRASSED	15	1.5	0.0	17.9	0.1	180	2.7	27.0	17.9</

PHASE I DRAINAGE REPORT
Annexation of Crowfoot Valley Rd.

A3 Existing Direct Runoff

Basin Runoff Calculations - Existing Direct Runoff

Project No.: 4080-0001

13-Mar-26

Basin ID	Inlet/Design Point Basin (via Storm)	Ultimate Outfall From Site	Total Area (Ac.)	Imp (%)	Tc (min)	Runoff Coeff.			Runoff Coeff.			Q ₅	Q ₁₀₀
						C ₂	C ₅	C ₁₀₀	I ₂	I ₅	I ₁₀₀		
Existing													
HA1	DP A1	DP A1	1.52	39%	17.50	0.31	0.35	0.64	2.23	3.01	5.48	1.61	5.36
HA2	DP A2	DP A2	0.14	5%	10.24	0.02	0.08	0.50	2.84	3.83	6.97	0.04	0.50
HA3	DP A3 (SA2)	DP A3	1.50	42%	8.03	0.33	0.37	0.65	3.11	4.20	7.63	2.35	7.47
HA4	BASIN HA3 (SA3)	DP A3	0.73	52%	12.48	0.42	0.46	0.70	2.62	3.53	6.42	1.18	3.25
HA5	BASIN HA4 (SA5)	DP A3	0.76	63%	8.87	0.51	0.55	0.74	3.00	4.05	7.36	1.70	4.17
HA6	BASIN HA5 (SA6)	DP A3	0.88	48%	15.43	0.39	0.43	0.68	2.37	3.20	5.82	1.21	3.50
HA7	DP A4 (SA7)	DP A4	0.52	53%	9.57	0.42	0.46	0.70	2.92	3.94	7.16	0.95	2.59
HA8	DP A5	DP A5	0.90	70%	8.35	0.57	0.60	0.77	3.07	4.14	7.53	2.24	5.20
HA9	BASIN HOSA6	DP A5	0.77	58%	9.50	0.47	0.51	0.72	2.93	3.95	7.18	1.53	3.96
HA10	DP A6 (SA9)	DP A6	0.35	74%	6.38	0.61	0.64	0.79	3.35	4.53	8.23	1.01	2.25
HA11	DP A6	DP A6	0.26	69%	5.00	0.56	0.60	0.77	3.60	4.85	8.82	0.75	1.75
HA12	BASIN HOSA7	DP A6	1.16	58%	8.50	0.46	0.51	0.72	3.05	4.11	7.48	2.42	6.26
HA13	DP A6 (SA11)	DP A6	0.46	71%	7.87	0.58	0.61	0.77	3.13	4.23	7.69	1.18	2.71
HA14	DP A7 (SA12)	DP A7	1.67	44%	17.56	0.35	0.39	0.66	2.23	3.01	5.47	1.96	6.04
HA15	DP A7	DP A7	2.00	60%	16.87	0.49	0.52	0.73	2.27	3.07	5.58	3.20	8.12
HA16	BASIN HA15 (SA13)	DP A7	2.40	55%	31.12	0.45	0.49	0.71	1.63	2.20	3.99	2.56	6.81
HB1	DP B1	DP B1	1.08	34%	8.54	0.26	0.31	0.62	3.04	4.11	7.47	1.38	5.03
HB2	BASIN HB1 (SB1)	DP B1	1.89	39%	23.06	0.31	0.35	0.64	1.93	2.61	4.74	1.73	5.75
HB3	DP B2 (SB3)	DP B2	0.40	28%	5.94	0.22	0.26	0.60	3.43	4.62	8.41	0.48	1.99
HB4	BASIN HB3	DP B2	0.35	44%	9.11	0.35	0.39	0.66	2.97	4.01	7.29	0.55	1.69
HB5	BASIN HB4 (SB4)	DP B2	0.99	46%	14.33	0.37	0.41	0.67	2.46	3.32	6.03	1.36	4.03
HB6	DP B4 (SB5)	DP B4	0.68	48%	7.07	0.38	0.42	0.68	3.25	4.38	7.97	1.26	3.66
HB7	BASIN HB6 (SB6)	DP B4	0.27	48%	7.79	0.38	0.42	0.68	3.14	4.24	7.71	0.48	1.41
HB8	DP B4	DP B4	2.13	40%	12.56	0.32	0.36	0.65	2.61	3.52	6.40	2.70	8.82
HB9	BASIN HB6 (SB8)	DP B4	0.57	52%	10.53	0.42	0.46	0.70	2.81	3.79	6.89	0.99	2.73
HB10	DP B5	DP B5	1.82	43%	20.18	0.34	0.38	0.66	2.08	2.80	5.09	1.96	6.12
HB11	DP B6 (SB10)	DP B6	0.81	74%	12.67	0.61	0.64	0.79	2.60	3.51	6.38	1.80	4.04
HB12	BASIN HOSB10	DP B7	0.43	59%	10.15	0.48	0.52	0.73	2.85	3.85	6.99	0.86	2.19
HB13	DP B8	DP B8	0.39	95%	6.50	0.78	0.81	0.87	3.34	4.50	8.18	1.40	2.75
HB14	DP B3	DP B3	0.95	36%	13.47	0.29	0.33	0.63	2.53	3.41	6.20	1.07	3.71
Existing Off-Site													
HOSA1	BASIN HA1	DP A1	0.23	5%	6.71	0.02	0.08	0.50	3.30	4.46	8.10	0.08	0.96
HOSA2	BASIN HA2	DP A2	0.28	10%	18.10	0.06	0.12	0.52	2.20	2.96	5.38	0.10	0.79
HOSA3	BASIN HA5	DP A3	0.82	8%	14.49	0.04	0.10	0.52	2.45	3.30	6.00	0.27	2.55
HOSA4	BASIN HA6	DP A3	0.99	6%	14.49	0.03	0.09	0.51	2.45	3.30	6.00	0.28	3.02
HOSA5	BASIN HA7	DP A4	0.43	20%	13.58	0.15	0.20	0.57	2.52	3.40	6.18	0.29	1.50
HOSA6	DP A5 (SA8)	DP A5	1.97	11%	24.28	0.08	0.13	0.53	1.88	2.53	4.61	0.64	4.82
HOSA7	DP A6 (SA10)	DP A6	3.54	19%	27.24	0.14	0.19	0.56	1.76	2.37	4.32	1.62	8.61
HOSA8	BASIN HA14	DP A7	3.75	7%	30.68	0.04	0.09	0.51	1.64	2.21	4.03	0.74	7.71
HOSA9	BASIN HA15	DP A7	1.22	5%	10.68	0.02	0.08	0.51	2.79	3.77	6.85	0.36	4.23
HOSA10	BASIN HA16	DP A7	2.70	8%	26.70	0.05	0.10	0.52	1.78	2.40	4.36	0.65	6.10
HOSB1	BASIN HB1	DP B1	0.04	8%	6.52	0.04	0.10	0.52	3.33	4.50	8.17	0.02	0.18
HOSB2	BASIN HB2	DP B1	1.03	5%	16.62	0.03	0.08	0.51	2.29	3.09	5.62	0.25	2.92
HOSB3	BASIN HB5	DP B2	0.07	5%	11.88	0.02	0.08	0.50	2.67	3.60	6.55	0.02	0.24
HOSB4	BASIN HB14	DP B3	0.32	5%	13.97	0.02	0.08	0.50	2.49	3.36	6.10	0.08	0.98
HOSB5	BASIN HB6	DP B4	0.38	7%	8.24	0.04	0.09	0.51	3.08	4.16	7.56	0.14	1.45
HOSB6	BASIN HB7	DP B4	0.11	9%	5.16	0.06	0.11	0.52	3.57	4.81	8.75	0.06	0.50
HOSB7	BASIN HB9	DP B4	0.24	10%	9.15	0.07	0.12	0.53	2.97	4.00	7.28	0.12	0.94
HOSB8	BASIN HB8	DP B4	0.83	6%	24.18	0.03	0.08	0.51	1.88	2.54	4.62	0.17	1.96
HOSB9	BASIN HB10	DP B5	0.05	18%	7.42	0.13	0.18	0.56	3.20	4.31	7.84	0.04	0.22
HOSB10	DP B7 (SB11)	DP B7	0.84	26%	9.39	0.19	0.24	0.59	2.94	3.96	7.21	0.82	3.58
HOSB11	BASIN HB13	DP B8	0.45	20%	12.01	0.12	0.20	0.57	2.66	3.59	6.52	0.32	1.68
Intensity = $\frac{28.5 * P_1}{(10 + T_c)^{0.786}}$											2 Year P ₁ =	1.06	
											5 Year P ₁ =	1.43	
											100 Year P ₁ =	2.60	

PHASE I DRAINAGE REPORT
Annexation of Crowfoot Valley Rd.

A4 Proposed Direct Runoff

Basin Runoff Calculations - Proposed Direct Runoff

Project No.: 4080-0001

13-Mar-26

Basin ID	Ultimate Outfall From Site	Total Area (Ac.)	Imp (%)	Tc (min)	Runoff Coeff.			Intensity				
					C ₂	C ₅	C ₁₀₀	I ₂	I ₅	I ₁₀₀	Q ₅	Q ₁₀₀
Existing												
A1	DP A1	1.65	65%	13.94	0.49	0.56	0.75	2.49	3.36	6.11	3.12	7.54
A2	DP A3	4.91	65%	30.85	0.49	0.56	0.75	1.64	2.21	4.01	6.12	14.79
A3	DP A4	0.79	65%	9.27	0.49	0.56	0.75	2.95	3.98	7.24	1.77	4.27
A4	DP A5	1.01	65%	10.52	0.49	0.56	0.75	2.81	3.79	6.89	2.16	5.22
A5	DP A5	1.34	65%	12.27	0.49	0.56	0.75	2.64	3.56	6.46	2.70	6.51
A6	DP A6	1.29	68%	12.94	0.41	0.47	0.62	2.58	3.47	6.32	2.09	5.05
A7	DP A6	1.33	68%	13.16	0.41	0.47	0.62	2.56	3.45	6.27	2.15	5.18
A8	DP A7	5.07	66%	31.73	0.47	0.54	0.72	1.61	2.17	3.95	5.93	14.32
A9	DP A7	1.87	65%	15.02	0.49	0.56	0.75	2.40	3.24	5.90	3.42	8.25
B1	DP B1	3.75	65%	24.81	0.49	0.56	0.75	1.86	2.50	4.55	5.30	12.80
B2	DP B2	1.74	65%	14.27	0.49	0.56	0.75	2.46	3.32	6.04	3.27	7.88
B3	DP B3	1.23	65%	11.69	0.49	0.56	0.75	2.69	3.63	6.60	2.52	6.10
B4	DP B4	2.15	65%	15.02	0.49	0.56	0.75	2.40	3.24	5.90	3.94	9.51
B5	DP B4	1.88	65%	15.02	0.49	0.56	0.75	2.40	3.24	5.90	3.44	8.30
B6	DP B5	2.12	65%	16.27	0.49	0.56	0.75	2.31	3.12	5.68	3.74	9.03
B7	DP B6	1.09	68%	12.04	0.39	0.45	0.59	2.66	3.58	6.52	1.75	4.24
B8	DP B7	0.72	65%	9.02	0.49	0.56	0.75	2.98	4.02	7.32	1.63	3.94
B9	DP B8	0.72	65%	9.02	0.49	0.56	0.75	2.98	4.02	7.32	1.64	3.95
Proposed Off-Site												
OSA1	DP A1	0.33	5%	8.44	0.02	0.08	0.50	3.06	4.12	7.50	0.10	1.23
OSA2	DP A3	0.05	5%	7.70	0.02	0.08	0.50	3.16	4.26	7.74	0.02	0.21
OSA3	DP A3	0.66	8%	23.96	0.05	0.10	0.52	1.89	2.55	4.64	0.17	1.58
OSA4	DP A3	0.63	7%	18.56	0.04	0.09	0.51	2.17	2.92	5.32	0.17	1.71
OSA5	DP A4	0.36	22%	18.40	0.16	0.21	0.57	2.18	2.94	5.34	0.22	1.10
OSA6	DP A5	1.41	13%	25.02	0.09	0.14	0.54	1.85	2.49	4.53	0.49	3.44
OSA7	DP A6	3.38	18%	25.45	0.13	0.18	0.56	1.83	2.47	4.49	1.53	8.47
OSA8	DP A7	3.56	6%	30.77	0.03	0.08	0.51	1.64	2.21	4.02	0.65	7.27
OSA9	DP A7	1.09	5%	25.92	0.02	0.08	0.50	1.81	2.44	4.44	0.20	2.45
OSA10	DP A7	2.35	8%	32.74	0.05	0.10	0.52	1.58	2.13	3.87	0.51	4.72
OSB1	DP B1	0.66	6%	22.20	0.03	0.08	0.51	1.97	2.66	4.84	0.14	1.62
OSB2	DP B2	0.06	5%	15.39	0.02	0.08	0.50	2.38	3.21	5.83	0.02	0.19
OSB3	DP B3	0.15	5%	17.89	0.02	0.08	0.50	2.21	2.98	5.42	0.03	0.40
OSB4	DP B4	0.66	6%	24.03	0.03	0.08	0.51	1.89	2.55	4.63	0.14	1.56
OSB5	DP B4	0.47	8%	8.16	0.04	0.10	0.51	3.09	4.17	7.59	0.19	1.86
OSB6	DP B4	0.20	9%	19.22	0.06	0.11	0.52	2.13	2.87	5.22	0.06	0.55
OSB7	DP B5	0.01	5%	6.89	0.02	0.08	0.50	3.28	4.42	8.03	0.00	0.05
OSB8	DP B7	0.56	12%	15.58	0.07	0.14	0.53	2.36	3.19	5.80	0.24	1.73
OSB9	DP B8	0.33	20%	10.30	0.12	0.20	0.57	2.83	3.82	6.95	0.25	1.28
Intensity = $\frac{28.5 * P_1}{(10 + T_c)^{0.786}}$										2 Year P ₁ = 1.06		
										5 Year P ₁ = 1.43		
										100 Year P ₁ = 2.60		

PHASE I DRAINAGE REPORT
Annexation of Crowfoot Valley Rd.

A5 Overall Runoff Rates

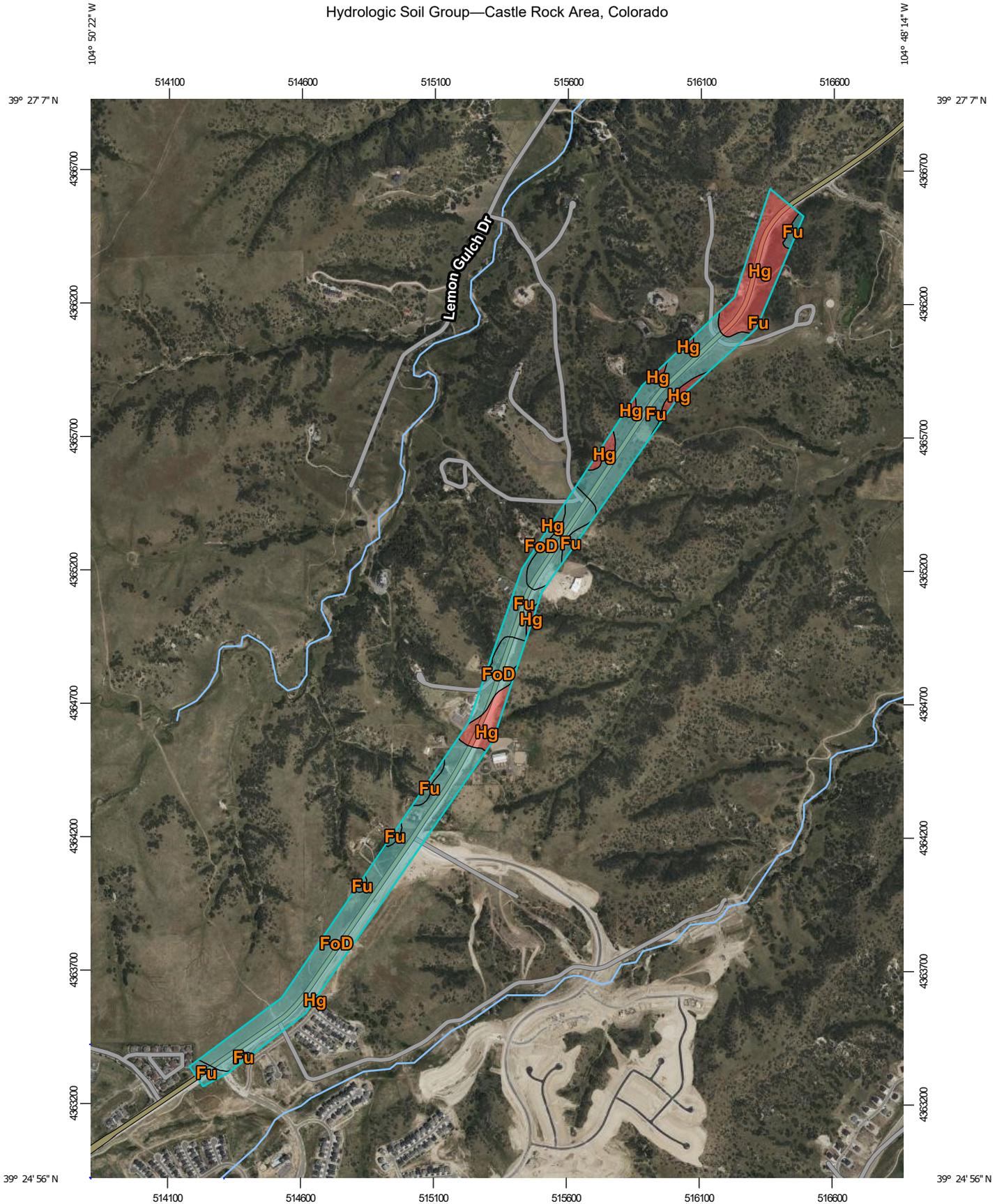
Calculated Existing vs. Proposed Runoff Rates									
Basin ID	Total Area (Ac.)	Comp. Imp. (%)	Tc (min)	Runoff Coeff.		Intensity		Peak Flow (cfs)	
				C ₅	C ₁₀₀	I ₅	I ₁₀₀	Q ₅	Q ₁₀₀
HA	31.95	32%	32.74	0.30	0.61	2.13	3.87	20.13	76.07
A	33.08	43%	32.74	0.38	0.66	2.13	3.87	26.88	84.27
HB	17.11	37%	24.81	0.33	0.63	2.50	4.55	14.28	49.34
B	18.51	56%	24.81	0.49	0.71	2.50	4.55	22.67	59.96

Appendix B. Referenced Information

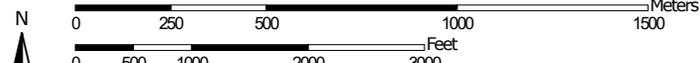
B1 **NRCS Soils Map**



Hydrologic Soil Group—Castle Rock Area, Colorado



Map Scale: 1:19,700 if printed on A portrait (8.5" x 11") sheet.



Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

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 18, Aug 29, 2025

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

Date(s) aerial images were photographed: Mar 1, 2023—Sep 1, 2023

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
FoD	Fondis clay loam, 3 to 9 percent slopes	C	54.4	46.5%
Fu	Fondis-Kutch association	C	36.0	30.8%
Hg	Hilly gravelly land	D	26.5	22.7%
Totals for Area of Interest			116.9	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

PHASE I DRAINAGE REPORT
Annexation of Crowfoot Valley Rd.

B2 FEMA FIRM



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee See Notes Zone X
	Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard Zone X
	Effective LOMRs
	Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	Cross Sections with 1% Annual Chance 20.2
	Water Surface Elevation 17.5
	Coastal Transect 8
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
OTHER FEATURES	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-6627) or visit the FEMA Flood Map Service Center website at <https://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 website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

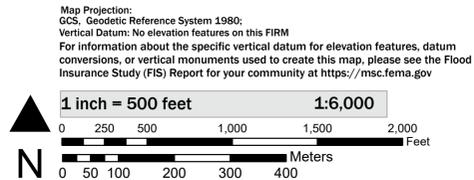
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on 2/26/2026 7:58 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE



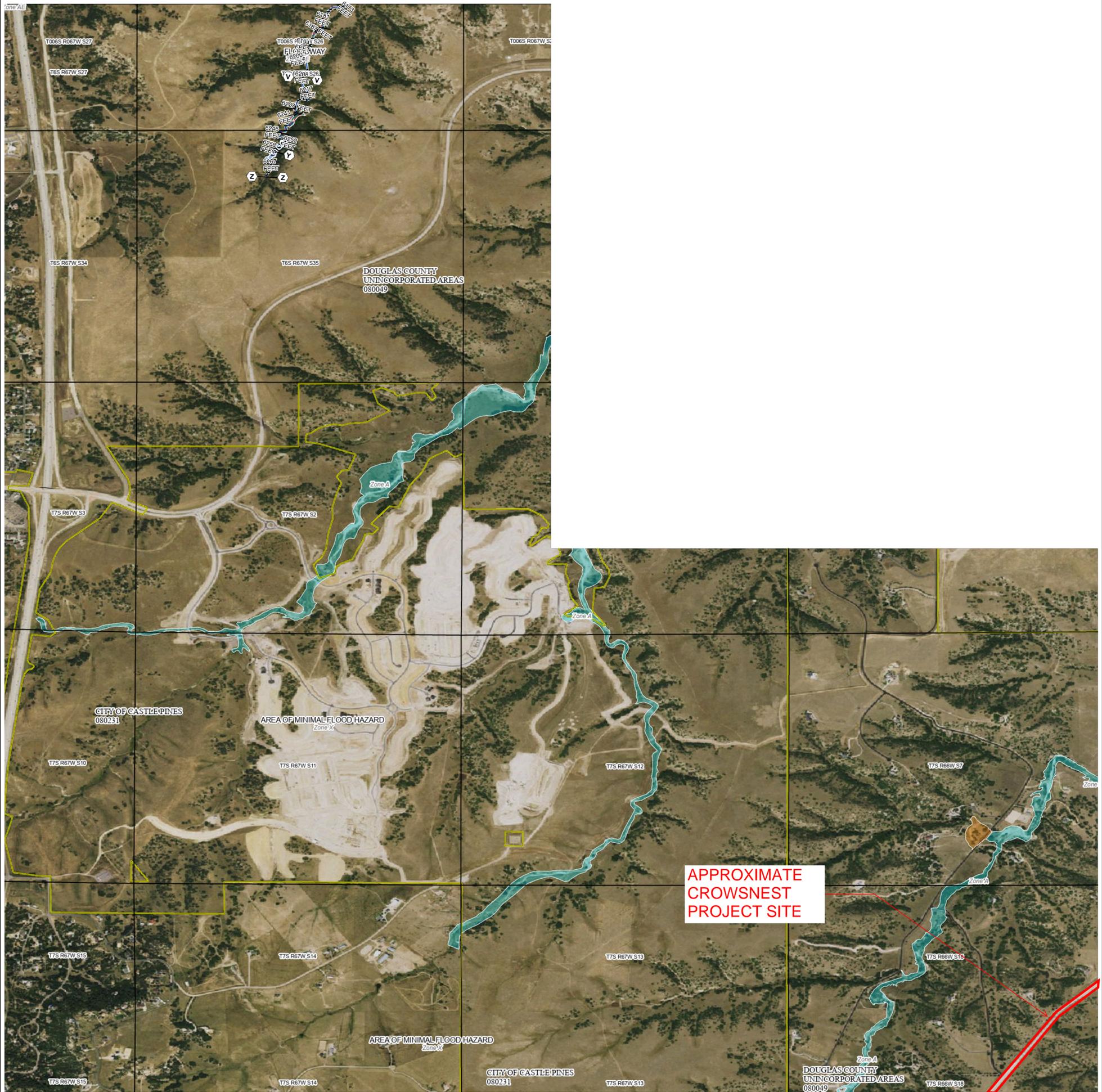
NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PANEL 183 OF 461

Panel Contains:	NUMBER	PANEL
COMMUNITY	080049	0183
TOWN OF PARKER		
DOUGLAS COUNTY		



PROJECT SITE CONTINUES TO SOUTHWEST ON FIRM PANEL 180



PROJECT SITE CONTINUES TO SOUTH ON FIRM PANEL 187

PROJECT SITE CONTINUES TO NORTHEAST ON FIRM PANEL 183

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee See Notes Zone X
	Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard Zone X
	Effective LOMRs
	Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	Cross Sections with 1% Annual Chance 20.2
	Cross Sections with 1% Annual Chance 17.5
	Water Surface Elevation 8
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
OTHER FEATURES	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

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For community and countywide map dates, refer to the Flood Insurance Study Report for this jurisdiction.

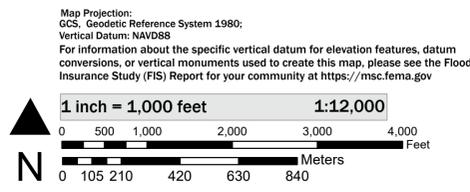
To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

This map was exported from FEMA's National Flood Hazard Layer (NFHL) on 2/26/2026 7:03 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time. For additional information, please see the Flood Hazard Mapping Updates Overview Fact Sheet at <https://www.fema.gov/media-library/assets/documents/118418>

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PANEL 180 OF 461

Panel Contains:	080231	0180
COMMUNITY	NUMBER	PANEL
CITY OF CASTLE PINES	080049	0180
TOWN OF PARKER		
DOUGLAS COUNTY		



PROJECT SITE CONTINUES TO NORTH ON FIRM PANEL 180

APPROXIMATE
CROWSNEST
PROJECT SITE

AREA OF MINIMAL FLOOD HAZARD
Zone X

DOUGLAS COUNTY
UNINCORPORATED AREAS
080049

TOWN OF CASTLE ROCK
080050

T7S R67W S25

T7S R66W S30

TOWN OF CASTLE ROCK
080050

T7S R67W S25

DOUGLAS COUNTY
UNINCORPORATED AREAS
080049

AREA OF MINIMAL FLOOD HAZARD
Zone X

T7S R66W S30

FLOOD HAZARD
Zone A, AE, AO, AH, VE, AR
FIRM

FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR DRAFT FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) Zone A, V, A99
	With BFE or Depth Zone AE, AO, AH, VE, AR
	Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
	Future Conditions 1% Annual Chance Flood Hazard Zone X
	Area with Reduced Flood Risk due to Levee See Notes Zone X
	Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard Zone X
	Effective LOMRs
	Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer
	Levee, Dike, or Floodwall
	Cross Sections with 1% Annual Chance 20.2
	Cross Sections with 1% Annual Chance 17.5
	Water Surface Elevation 8
	Coastal Transect
	Coastal Transect Baseline
	Profile Baseline
	Hydrographic Feature
OTHER FEATURES	Base Flood Elevation Line (BFE)
	Limit of Study
	Jurisdiction Boundary

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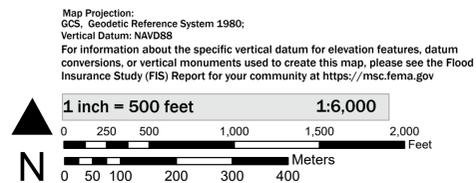
To determine if flood insurance is available in this community, contact your Insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Basemap information shown on this FIRM was provided in digital format by USDA, Farm Service Agency (FSA). This information was derived from NAIP, dated April 11, 2018.

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This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards. This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date.

SCALE



NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

PANEL 187 OF 461

Panel Contains:	080231	0187
COMMUNITY	NUMBER	PANEL
CITY OF CASTLE PINES	080050	0187
DOUGLAS COUNTY TOWN OF CASTLE ROCK		



PHASE I DRAINAGE REPORT
Annexation of Crowfoot Valley Rd.

B3 Scott and Lemon Gulch Watersheds OSP (July 2006)

OUTFALL SYSTEMS
PLANNING-
PRELIMINARY DESIGN
REPORT

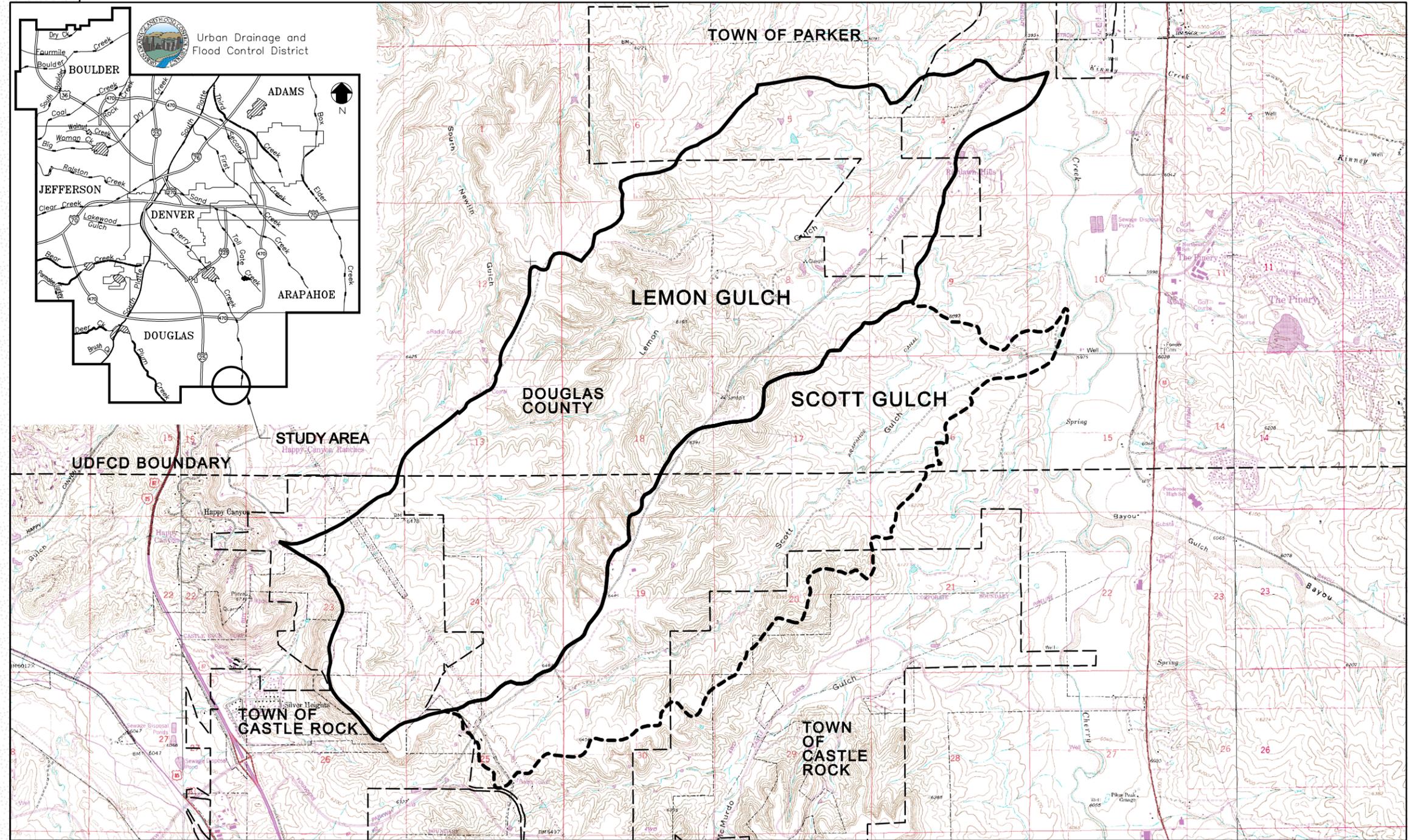
SCOTT AND LEMON GULCH WATERSHEDS

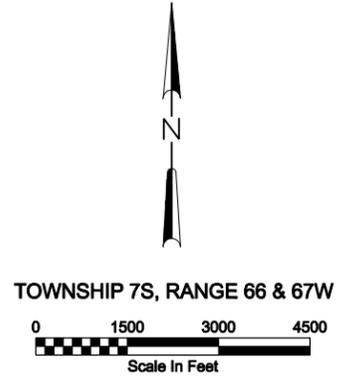
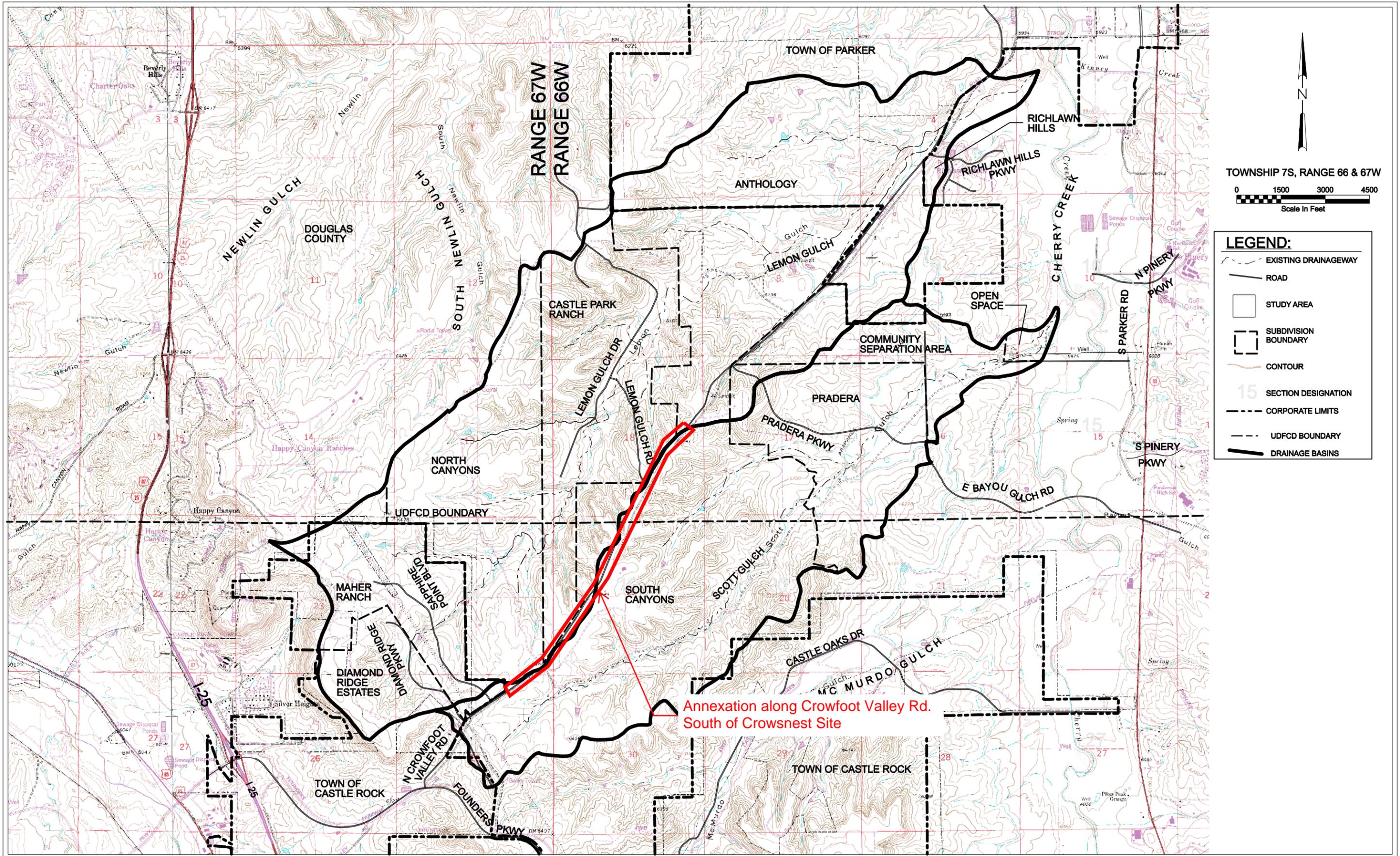
PREPARED FOR:
URBAN DRAINAGE AND
FLOOD CONTROL DISTRICT

DOUGLAS COUNTY

PREPARED BY
CH2MHILL
DENVER, CO

JULY 2006





LEGEND:

- EXISTING DRAINAGEWAY
- ROAD
- STUDY AREA
- SUBDIVISION BOUNDARY
- CONTOUR
- SECTION DESIGNATION
- CORPORATE LIMITS
- UDFCD BOUNDARY
- DRAINAGE BASINS

Annexation along Crowfoot Valley Rd.
South of Crowsnest Site

MAPPING PRODUCED BY: DOUGLAS COUNTY (DATE 2003)
 HORIZONTAL DATUM: NAD 83 FEET
 STATE PLANE COLORADO CENTRAL
 VERTICAL DATUM: NAVD 88

CH2M HILL
 9193 SOUTH JAMAICA STREET
 ENGLEWOOD, CO 80112

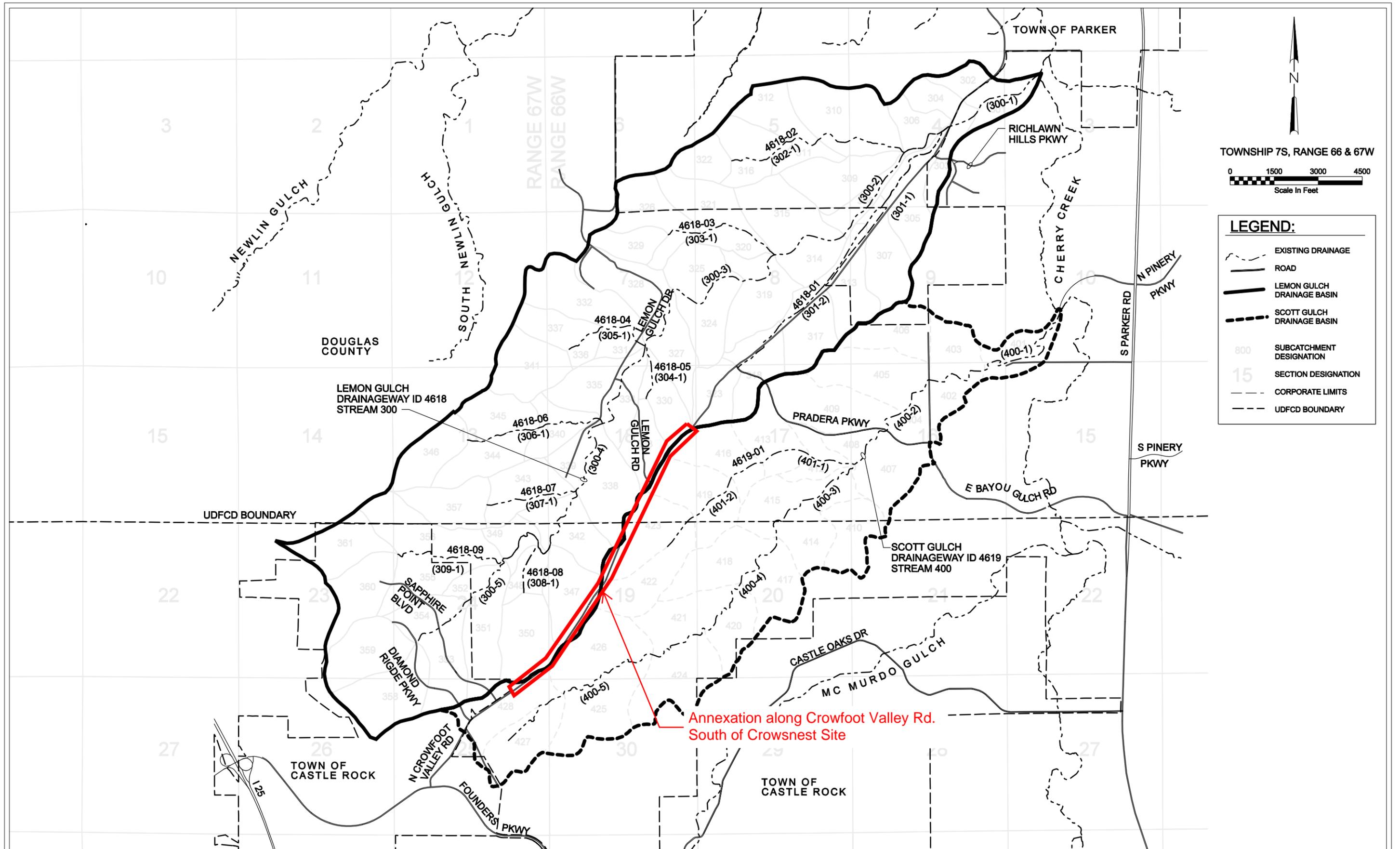
DESIGNED	CH	DATE	4/06
DRAWN	MM	DATE	4/06
CHECKED	BC	DATE	4/06
REVISED	MM	DATE	6/06

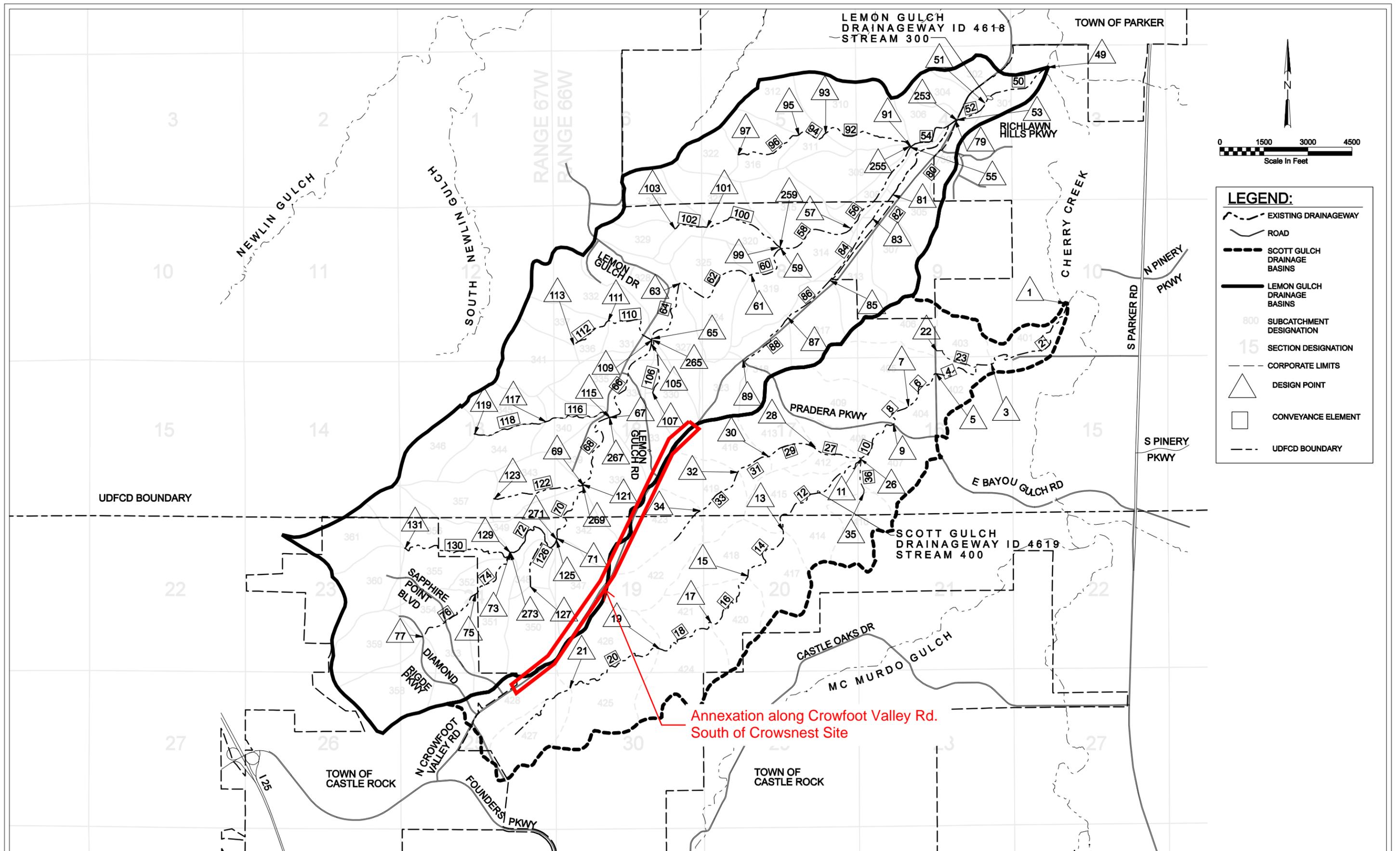
DOUGLAS COUNTY
 URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

SCOTT GULCH AND LEMON GULCH
 WATERSHEDS
 OUTFALL SYSTEM PLANNING

FIGURE ES-1
 SCOTT GULCH AND LEMON GULCH
 VICINITY MAP

PAGE
 ES-iv





MAPPING PRODUCED BY: DOUGLAS COUNTY (DATE 2003)
 HORIZONTAL DATUM: NAD 83 FEET
 STATE PLANE COLORADO CENTRAL
 VERTICAL DATUM: NAVD 88



CH2M HILL
 9193 SOUTH JAMAICA STREET
 ENGLEWOOD, CO 80112

DESIGNED	CH	DATE	4/06
DRAWN	MM	DATE	4/06
CHECKED	BC	DATE	4/06
REVISED	MM	DATE	6/06

DOUGLAS COUNTY
 URBAN DRAINAGE AND FLOOD CONTROL DISTRICT

SCOTT GULCH AND LEMON GULCH
 WATERSHEDS
 OUTFALL SYSTEM PLANNING

FIGURE 3-2
 SCOTT GULCH AND LEMON GULCH
 UDSWM CONVEYANCE MAP

PAGE
 3-5

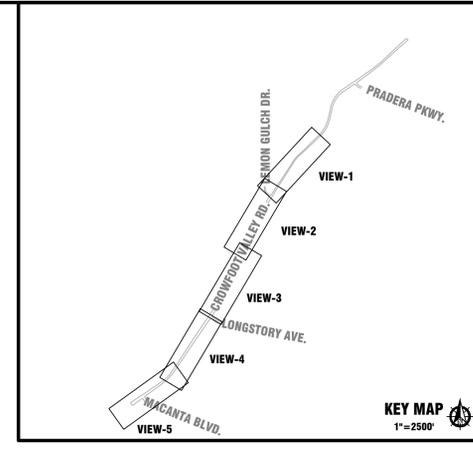
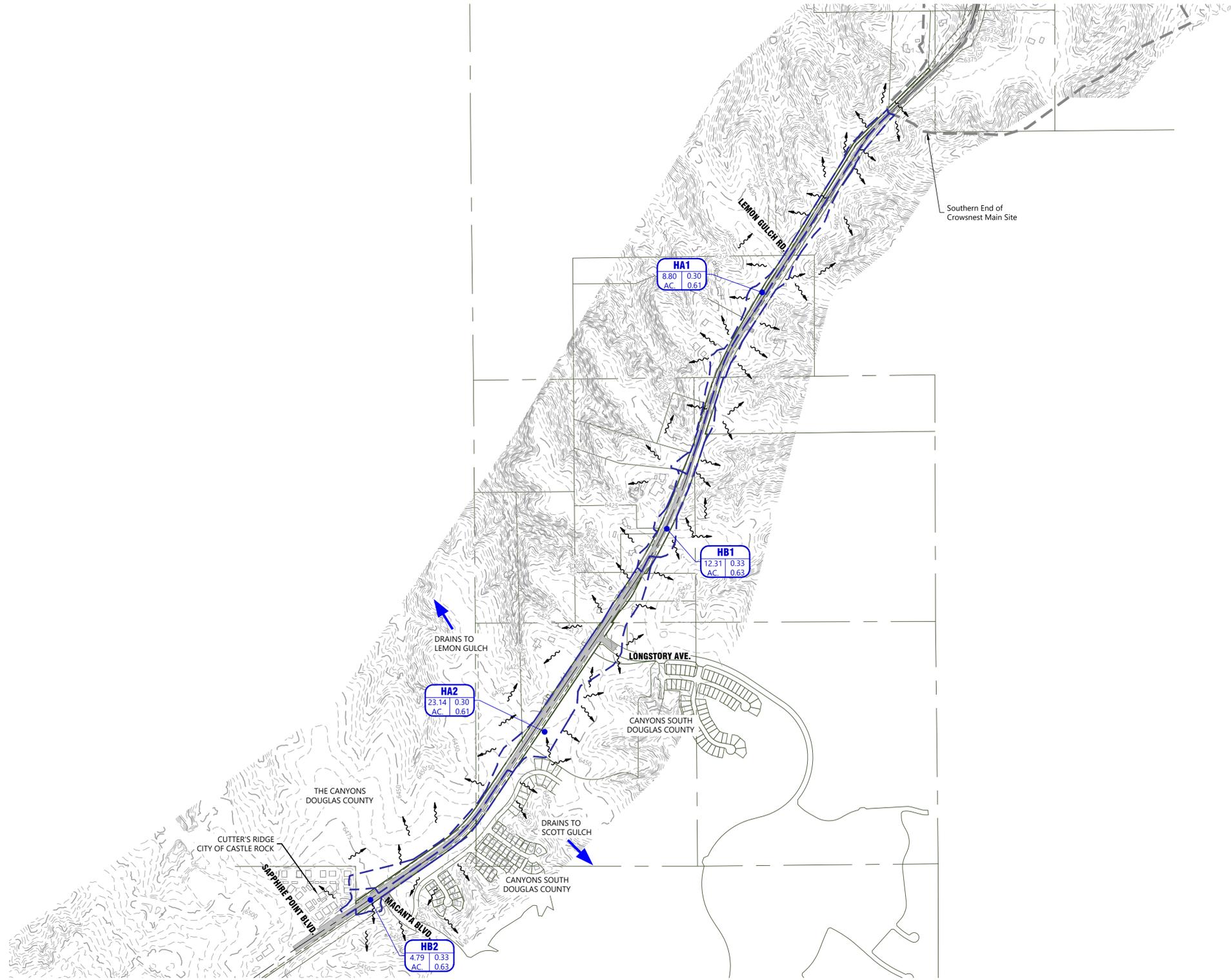
oefigconveyance.dlv

Appendix C. Drainage Maps

C1 Existing Drainage Maps and Tabulation



I:\JOB_FOLDERS\4080\4080-0001\CIVIL\PROD\DRAINAGE - ANEX. CIV\VIEW EX. ANEX. DRAINAGE MAP - PRINTED ON: 3/13/2026 12:31 PM

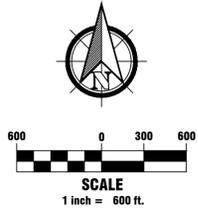


LEGEND

- Property Line
- Right of Way Line
- Centerline
- Lot Line
- Easement Line
- Major Basin Boundary
- Minor Basin Boundary
- Flow Arrow
- Existing Basin Designation
- Design Point
- Proposed Major Contour
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour

Calculated Existing vs. Proposed Runoff Rates

Basin ID	Total Area (Ac.)	Comp. Imp. (%)	Tc (min)	Runoff Coeff.		Intensity		Peak Flow (cfs)	
				C _s	C ₁₀₀	I _s	I ₁₀₀	Q _s	Q ₁₀₀
HA	31.95	32%	31.73	0.30	0.61	2.17	3.95	20.51	77.51
A	33.08	43%	31.73	0.38	0.66	2.17	3.95	27.39	85.86
HB	17.11	37%	24.81	0.33	0.63	2.50	4.55	14.28	49.34
B	18.51	56%	24.81	0.49	0.71	2.50	4.55	22.67	59.96





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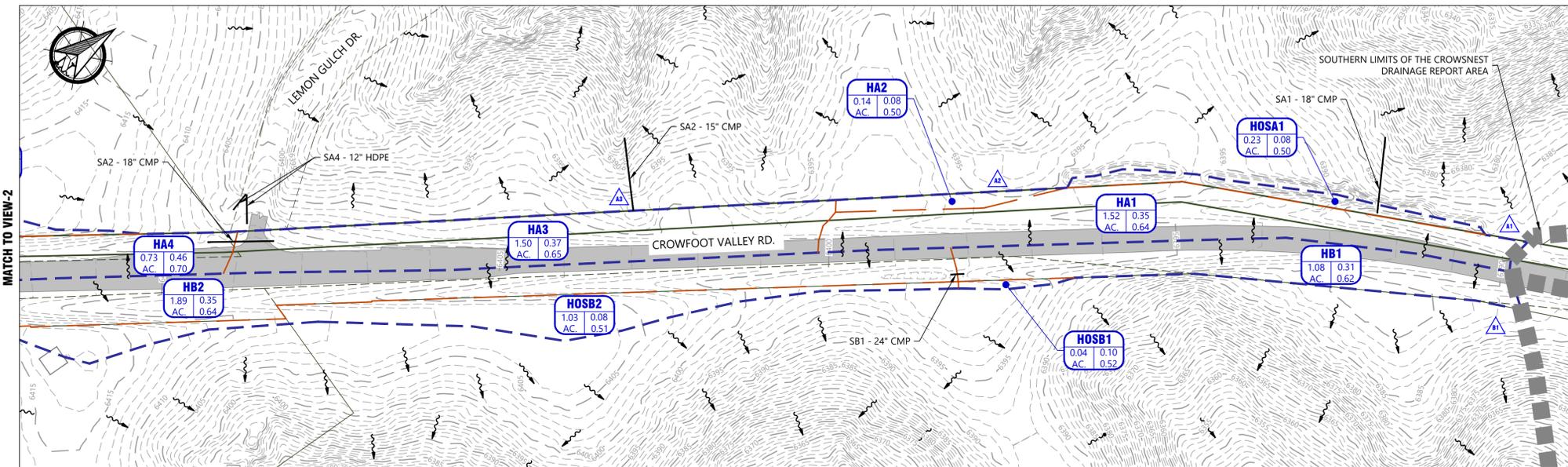
No.	Rev.	Date:	Revision Type:		Job No.: 4080-0001		Sheet:	1 of 8	
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Designed: RMW			Prepared: RMW			Approved: XWL			Date: March 13, 2026

Crowsnest Annexation
Douglas County, CO
Phase I Drainage Maps
Historic Overall Drainage Map

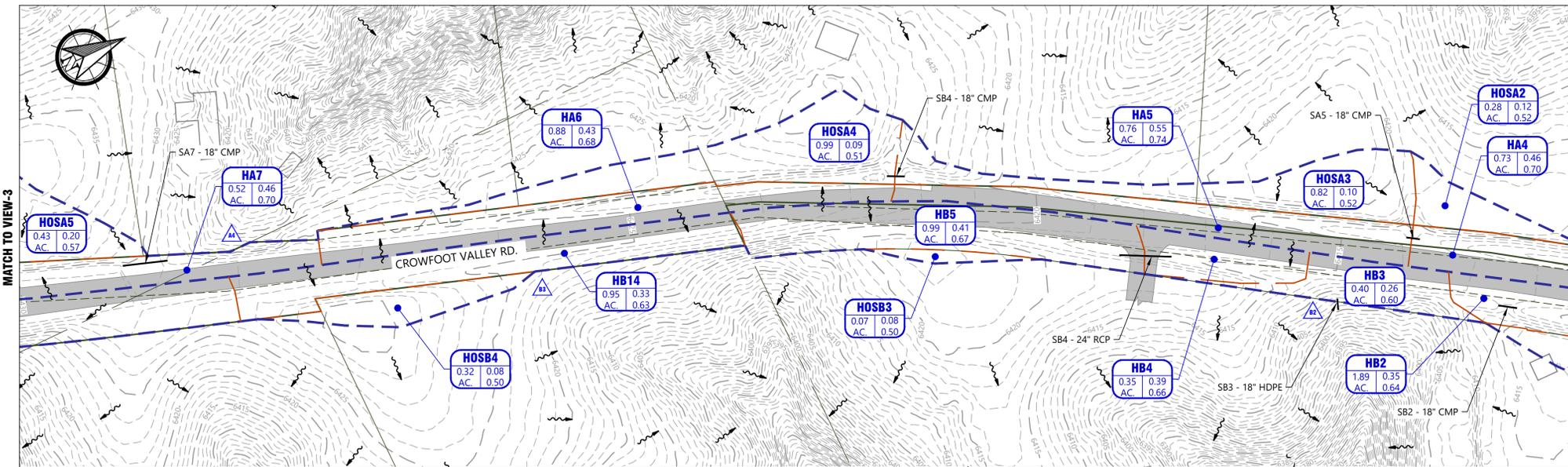


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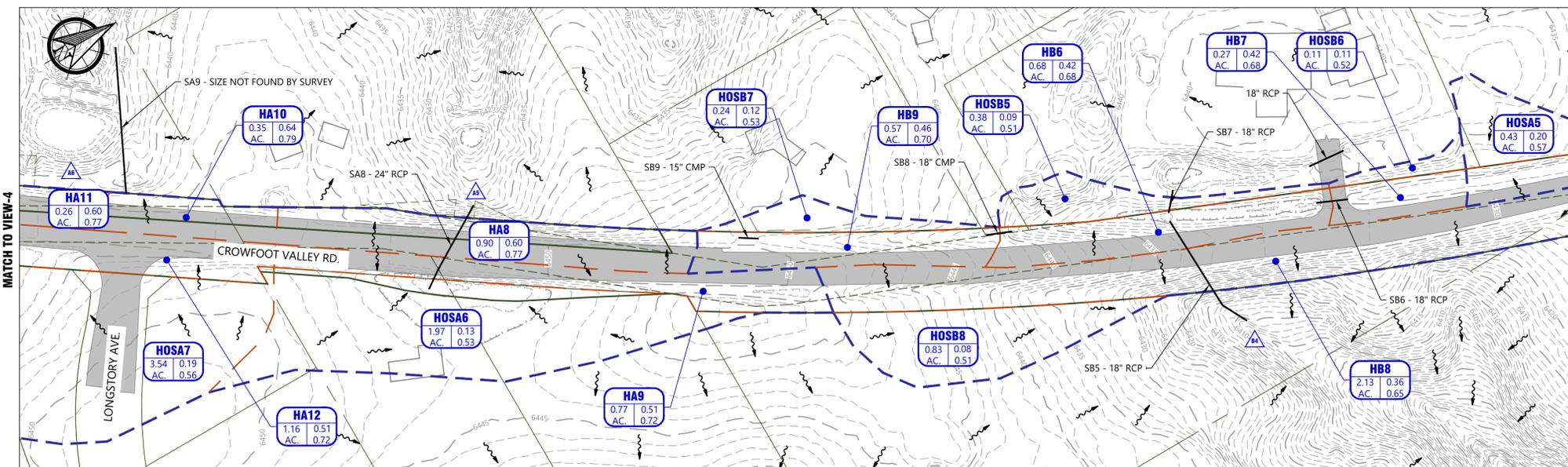
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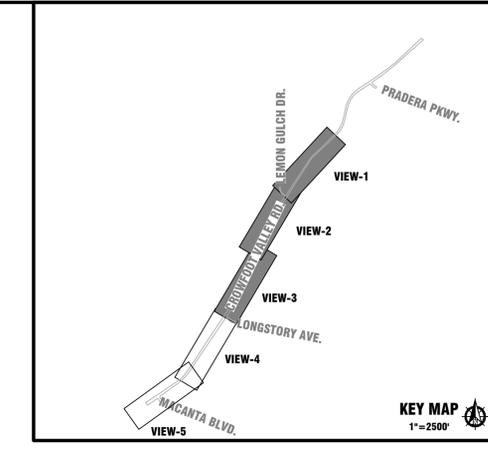
VIEW-1



VIEW-2



VIEW-3



LEGEND

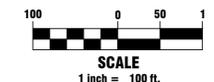
- Property Line
- Right of Way Line
- Centerline
- Lot Line
- Easement Line
- Major Basin Boundary
- Minor Basin Boundary
- Flow Arrow

Basin Designation

Name	Area AC	Imp. %
Existing Basin Designation		

Contours

- Design Point
- Proposed Major Contour
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour



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Job No.: 4080-0001
 Sheet: 2 of 8
 Date: March 13, 2026
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 Scale Vert: N/A
 Prepared: RMW
 Approved: XWL

Crowsnest Annexation
Douglas County, CO
Phase I Drainage Maps
Historic Drainage Map

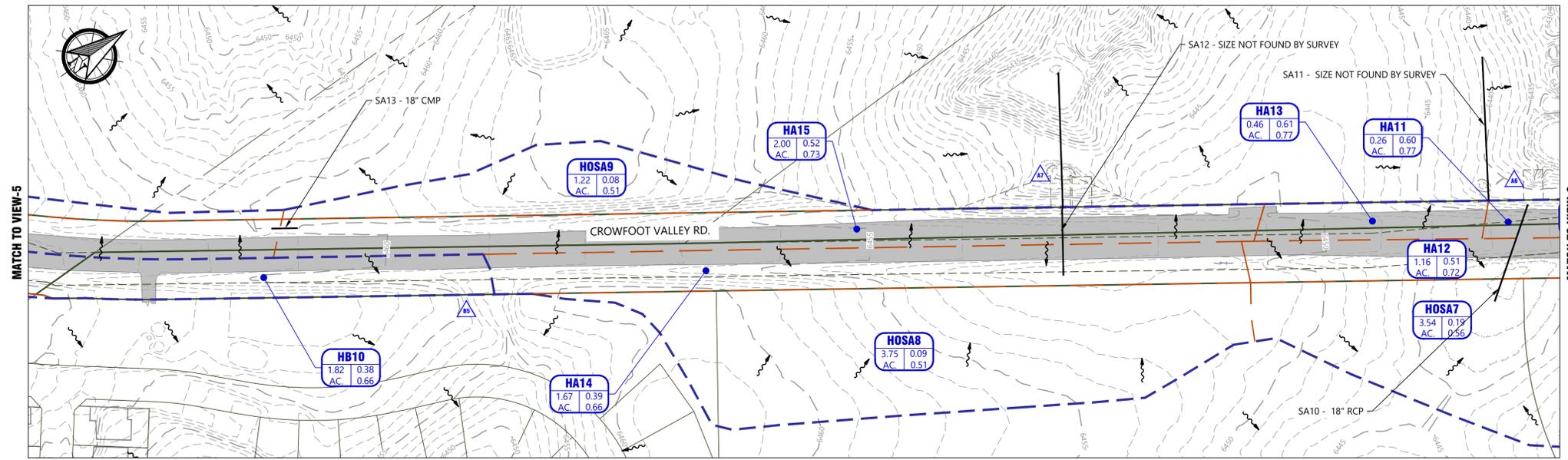
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Plan Set:
Sheet Name:



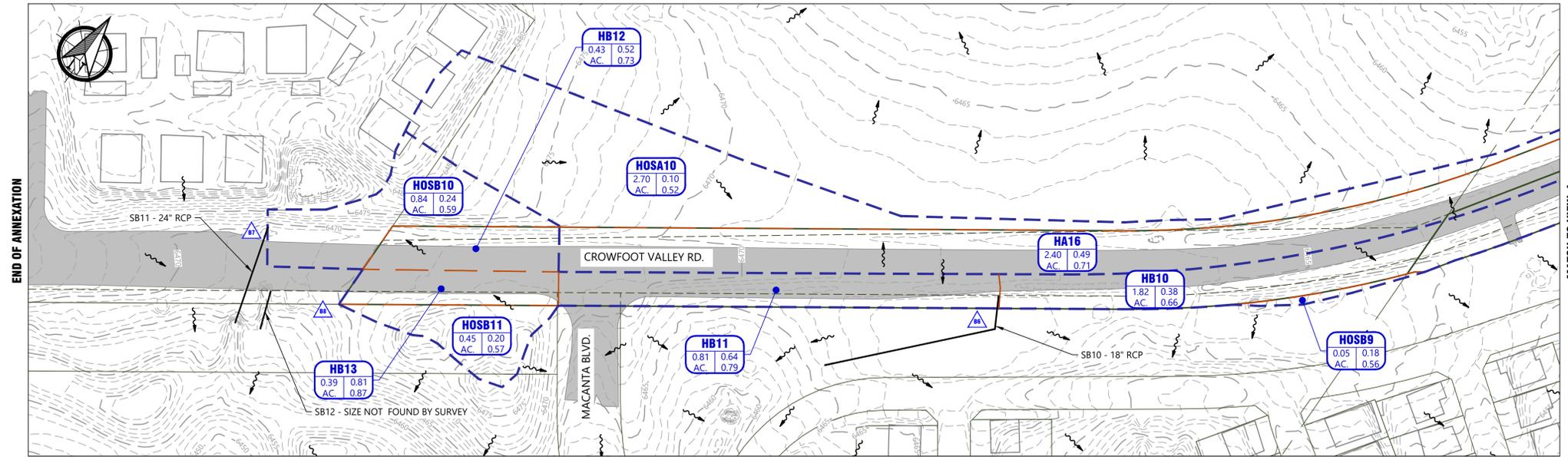
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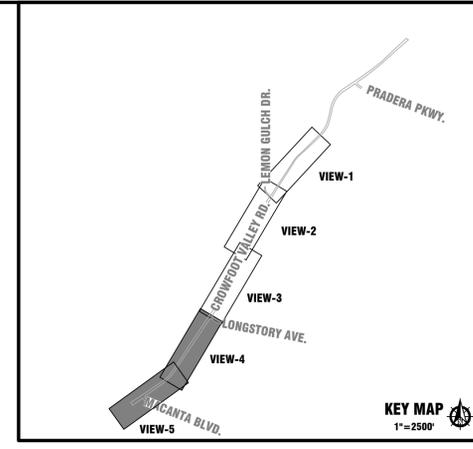


VIEW-4



VIEW-5

LEGEND	
	Property Line
	Right of Way Line
	Centerline
	Lot Line
	Easement Line
	Major Basin Boundary
	Minor Basin Boundary
	Flow Arrow
	Existing Basin Designation
	Design Point
	Proposed Major Contour
	Proposed Minor Contour
	Existing Major Contour
	Existing Minor Contour




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No.	Rev.	Date	Revision Type
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Designed: RMW Job No.: 4080-0001 Sheet: 3 of 8
 Prepared: RMW Scale Horiz: 1" = 100' Date: March 13, 2026
 Approved: XWL Scale Vert: N/A

Proj Name: **Crowsnest Annexation**
 Location: **Douglas County, CO**
 Plan Set: **Phase I Drainage Maps**
 Sheet Name: **Historic Drainage Map**



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No. **3**

Basin Runoff Calculations - Existing Direct Runoff

Project No.: 4080-0001

13-Mar-26

Basin ID	Inlet/Design Point Basin (via Storm ID)	Ultimate Outfall From Site	Total Area (Ac.)	Imp (%)	Tc (min)	Runoff Coeff.			Runoff Coeff.				
						C ₂	C ₅	C ₁₀₀	I ₂	I ₅	I ₁₀₀	Q ₅	Q ₁₀₀
Existing													
HA1	DP A1	DP A1	1.52	39%	17.50	0.31	0.35	0.64	2.23	3.01	5.48	1.61	5.36
HA2	DP A2	DP A2	0.14	5%	10.24	0.02	0.08	0.50	2.84	3.83	6.97	0.04	0.50
HA3	DP A3 (SA2)	DP A3	1.50	42%	8.03	0.33	0.37	0.65	3.11	4.20	7.63	2.35	7.47
HA4	BASIN HA3 (SA3)	DP A3	0.73	52%	12.48	0.42	0.46	0.70	2.62	3.53	6.42	1.18	3.25
HA5	BASIN HA4 (SA5)	DP A3	0.76	63%	8.87	0.51	0.55	0.74	3.00	4.05	7.36	1.70	4.17
HA6	BASIN HA5 (SA6)	DP A3	0.88	48%	15.43	0.39	0.43	0.68	2.37	3.20	5.82	1.21	3.50
HA7	DP A4 (SA7)	DP A4	0.52	53%	9.57	0.42	0.46	0.70	2.92	3.94	7.16	0.95	2.59
HA8	DP A5	DP A5	0.90	70%	8.35	0.57	0.60	0.77	3.07	4.14	7.53	2.24	5.20
HA9	BASIN HOSA6	DP A5	0.77	58%	9.50	0.47	0.51	0.72	2.93	3.95	7.18	1.53	3.96
HA10	DP A6 (SA9)	DP A6	0.35	74%	6.38	0.61	0.64	0.79	3.35	4.53	8.23	1.01	2.25
HA11	DP A6	DP A6	0.26	69%	5.00	0.56	0.60	0.77	3.60	4.85	8.82	0.75	1.75
HA12	BASIN HOSA7	DP A6	1.16	58%	8.50	0.46	0.51	0.72	3.05	4.11	7.48	2.42	6.26
HA13	DP A6 (SA11)	DP A6	0.46	71%	7.87	0.58	0.61	0.77	3.13	4.23	7.69	1.18	2.71
HA14	DP A7 (SA12)	DP A7	1.67	44%	17.56	0.35	0.39	0.66	2.23	3.01	5.47	1.96	6.04
HA15	DP A7	DP A7	2.00	60%	16.87	0.49	0.52	0.73	2.27	3.07	5.58	3.20	8.12
HA16	BASIN HA15 (SA13)	DP A7	2.40	55%	31.12	0.45	0.49	0.71	1.63	2.20	3.99	2.56	6.81
HB1	DP B1	DP B1	1.08	34%	8.54	0.26	0.31	0.62	3.04	4.11	7.47	1.38	5.03
HB2	BASIN HB1 (SB1)	DP B1	1.89	39%	23.06	0.31	0.35	0.64	1.93	2.61	4.74	1.73	5.75
HB3	DP B2 (SB3)	DP B2	0.40	28%	5.94	0.22	0.26	0.60	3.43	4.62	8.41	0.48	1.99
HB4	BASIN HB3	DP B2	0.35	44%	9.11	0.35	0.39	0.66	2.97	4.01	7.29	0.55	1.69
HB5	BASIN HB4 (SB4)	DP B2	0.99	46%	14.33	0.37	0.41	0.67	2.46	3.32	6.03	1.36	4.03
HB6	DP B4 (SB5)	DP B4	0.68	48%	7.07	0.38	0.42	0.68	3.25	4.38	7.97	1.26	3.66
HB7	BASIN HB6 (SB6)	DP B4	0.27	48%	7.79	0.38	0.42	0.68	3.14	4.24	7.71	0.48	1.41
HB8	DP B4	DP B4	2.13	40%	12.56	0.32	0.36	0.65	2.61	3.52	6.40	2.70	8.82
HB9	BASIN HB6 (SB8)	DP B4	0.57	52%	10.53	0.42	0.46	0.70	2.81	3.79	6.89	0.99	2.73
HB10	DP B5	DP B5	1.82	43%	20.18	0.34	0.38	0.66	2.08	2.80	5.09	1.96	6.12
HB11	DP B6 (SB10)	DP B6	0.81	74%	12.67	0.61	0.64	0.79	2.60	3.51	6.38	1.80	4.04
HB12	BASIN HOSB10	DP B7	0.43	59%	10.15	0.48	0.52	0.73	2.85	3.85	6.99	0.86	2.19
HB13	DP B8	DP B8	0.39	95%	6.50	0.78	0.81	0.87	3.34	4.50	8.18	1.40	2.75
HB14	DP B3	DP B3	0.95	36%	13.47	0.29	0.33	0.63	2.53	3.41	6.20	1.07	3.71
Existing Off-Site													
HOSA1	BASIN HA1	DP A1	0.23	5%	6.71	0.02	0.08	0.50	3.30	4.46	8.10	0.08	0.96
HOSA2	BASIN HA2	DP A2	0.28	10%	18.10	0.06	0.12	0.52	2.20	2.96	5.38	0.10	0.79
HOSA3	BASIN HA5	DP A3	0.82	8%	14.49	0.04	0.10	0.52	2.45	3.30	6.00	0.27	2.55
HOSA4	BASIN HA6	DP A3	0.99	6%	14.49	0.03	0.09	0.51	2.45	3.30	6.00	0.28	3.02
HOSA5	BASIN HA7	DP A4	0.43	20%	13.58	0.15	0.20	0.57	2.52	3.40	6.18	0.29	1.50
HOSA6	DP A5 (SA8)	DP A5	1.97	11%	24.05	0.08	0.13	0.53	1.89	2.55	4.63	0.64	4.84
HOSA7	DP A6 (SA10)	DP A6	3.54	19%	22.72	0.14	0.19	0.56	1.95	2.63	4.78	1.79	9.53
HOSA8	BASIN HA14	DP A7	3.75	7%	24.87	0.04	0.09	0.51	1.85	2.50	4.54	0.84	8.71
HOSA9	BASIN HA15	DP A7	1.22	5%	10.68	0.02	0.08	0.51	2.79	3.77	6.85	0.36	4.23
HOSA10	BASIN HA16	DP A7	2.70	8%	24.64	0.05	0.10	0.52	1.86	2.51	4.57	0.68	6.38
HOSB1	BASIN HB1	DP B1	0.04	8%	6.52	0.04	0.10	0.52	3.33	4.50	8.17	0.02	0.18
HOSB2	BASIN HB2	DP B1	1.03	5%	16.62	0.03	0.08	0.51	2.29	3.09	5.62	0.25	2.92
HOSB3	BASIN HB5	DP B2	0.07	5%	11.88	0.02	0.08	0.50	2.67	3.60	6.55	0.02	0.24
HOSB4	BASIN HB14	DP B3	0.32	5%	13.97	0.02	0.08	0.50	2.49	3.36	6.10	0.08	0.98
HOSB5	BASIN HB6	DP B4	0.38	7%	8.24	0.04	0.09	0.51	3.08	4.16	7.56	0.14	1.45
HOSB6	BASIN HB7	DP B4	0.11	9%	5.16	0.06	0.11	0.52	3.57	4.81	8.75	0.06	0.50
HOSB7	BASIN HB9	DP B4	0.24	10%	9.15	0.07	0.12	0.53	2.97	4.00	7.28	0.12	0.94
HOSB8	BASIN HB8	DP B4	0.83	6%	24.18	0.03	0.08	0.51	1.88	2.54	4.62	0.17	1.96
HOSB9	BASIN HB10	DP B5	0.05	18%	7.42	0.13	0.18	0.56	3.20	4.31	7.84	0.04	0.22
HOSB10	DP B7 (SB11)	DP B7	0.84	26%	9.39	0.19	0.24	0.59	2.94	3.96	7.21	0.82	3.58
HOSB11	BASIN HB13	DP B8	0.45	20%	12.01	0.12	0.20	0.57	2.66	3.59	6.52	0.32	1.68
Intensity = $\frac{28.5 * P_1}{(10 + T_c)^{0.786}}$										2 Year P ₁ = 1.06			
										5 Year P ₁ = 1.43			
										100 Year P ₁ = 2.60			



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Job No.: 4080-0001
 Scale Horiz: N/A
 Scale Vert: N/A
 Sheet: 4 of 8
 Date: March 13, 2026
 Prepared: RMW
 Approved: XWL

Proj Name: **Crowsnest Annexation**
 Location: **Douglas County, CO**
 Plan Set: **Phase I Drainage Maps**
 Sheet Name: **Historic Drainage Tabulation**

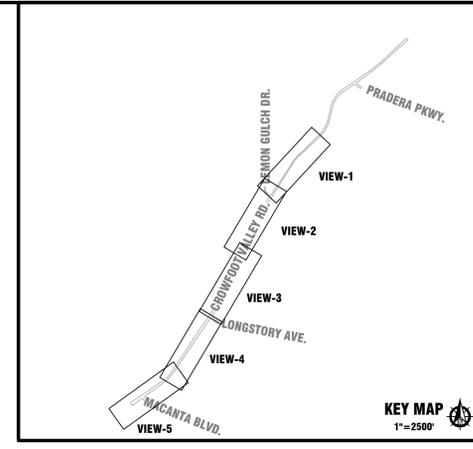
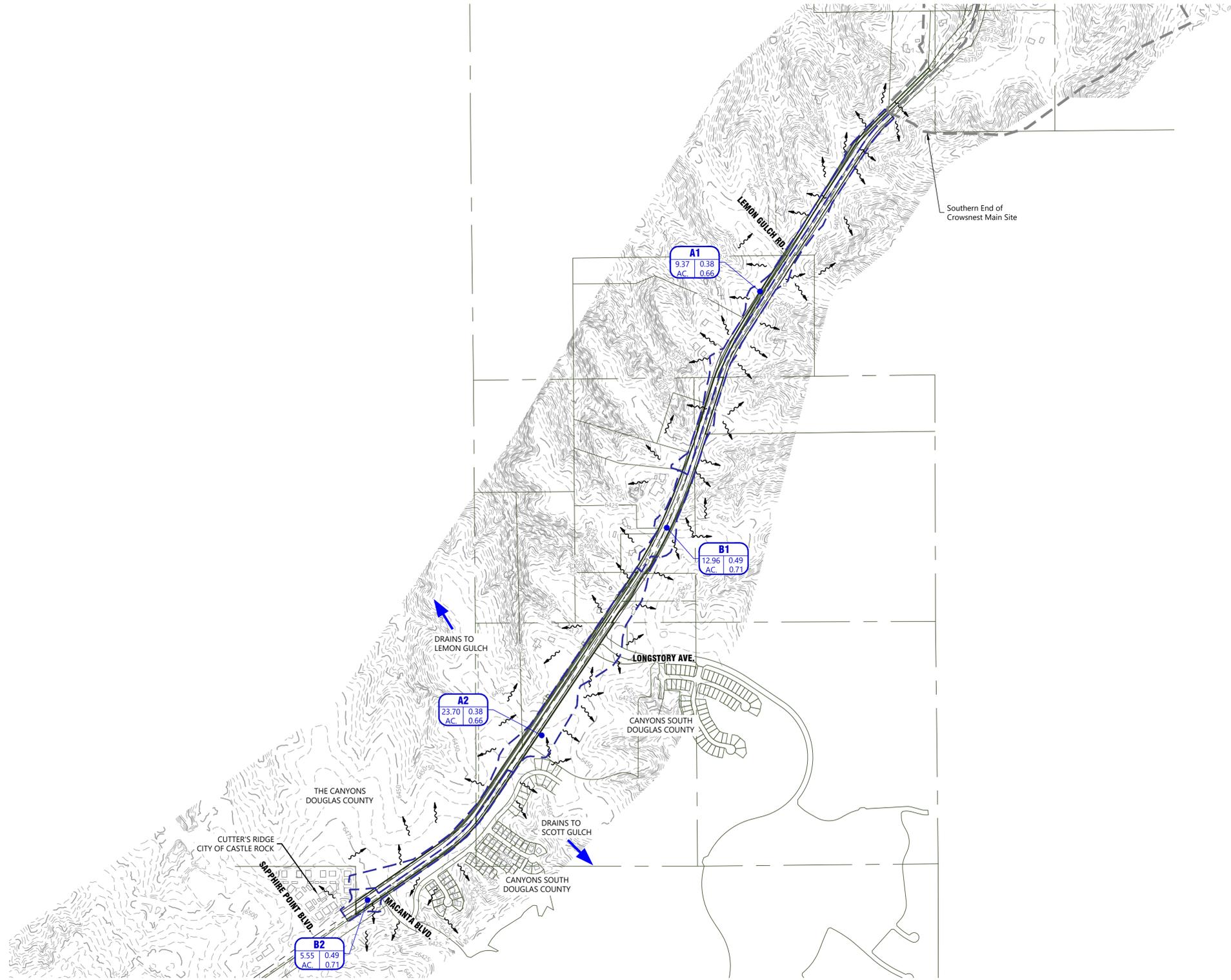


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PHASE I DRAINAGE REPORT
Annexation of Crowfoot Valley Rd.

C2 Proposed Drainage Maps and Tabulation

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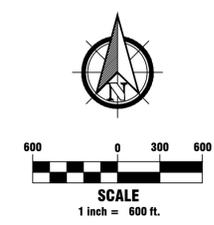
LEGEND

- Property Line
- Right of Way Line
- Centerline
- Lot Line
- Easement Line
- Major Basin Boundary
- Minor Basin Boundary
- Flow Arrow
- | Name | |
|------|--------|
| Area | Imp. % |
| AC | |

 Proposed Basin Designation
- Design Point
- Proposed Major Contour
- Proposed Minor Contour
- Existing Major Contour
- Existing Minor Contour

Calculated Existing vs. Proposed Runoff Rates

Basin ID	Total Area (Ac.)	Comp. Imp. (%)	Tc (min)	Runoff Coeff.		Intensity		Peak Flow (cfs)	
				C _s	C ₁₀₀	I _s	I ₁₀₀	Q _s	Q ₁₀₀
HA	31.95	32%	31.73	0.30	0.61	2.17	3.95	20.51	77.51
A	33.08	43%	31.73	0.38	0.66	2.17	3.95	27.39	85.86
HB	17.11	37%	24.81	0.33	0.63	2.50	4.55	14.28	49.34
B	18.51	56%	24.81	0.49	0.71	2.50	4.55	22.67	59.96



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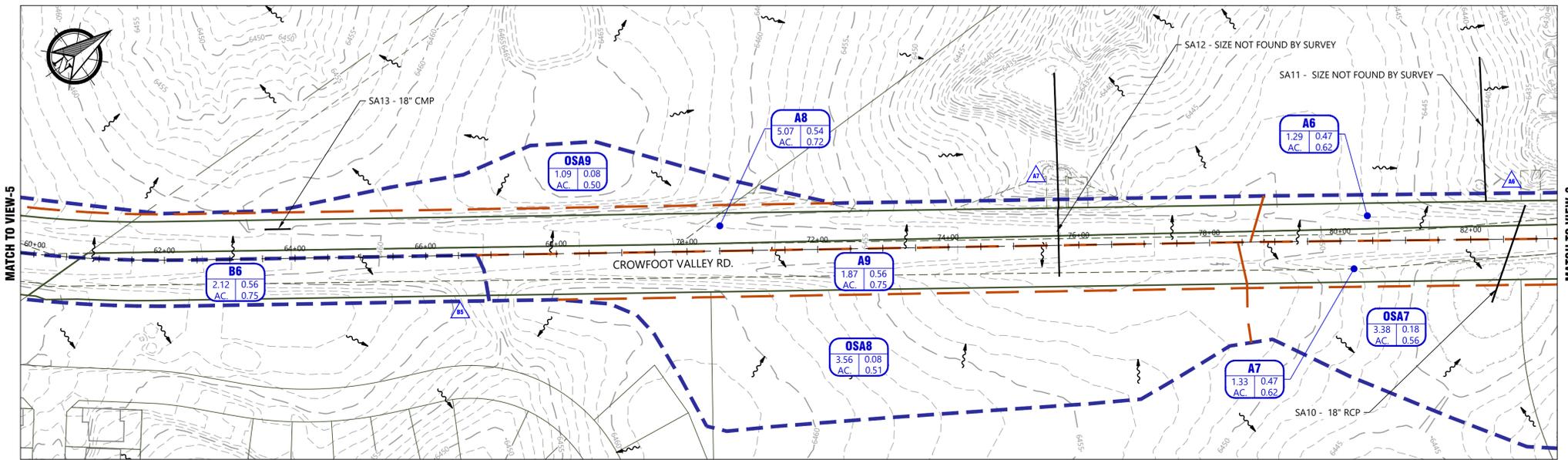
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1	2	3	4	5	6	
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				Prepared: RMW	Approved: XWL	

Crowsnest Annexation
Douglas County, CO
Phase I Drainage Maps
Proposed Overall Drainage Map

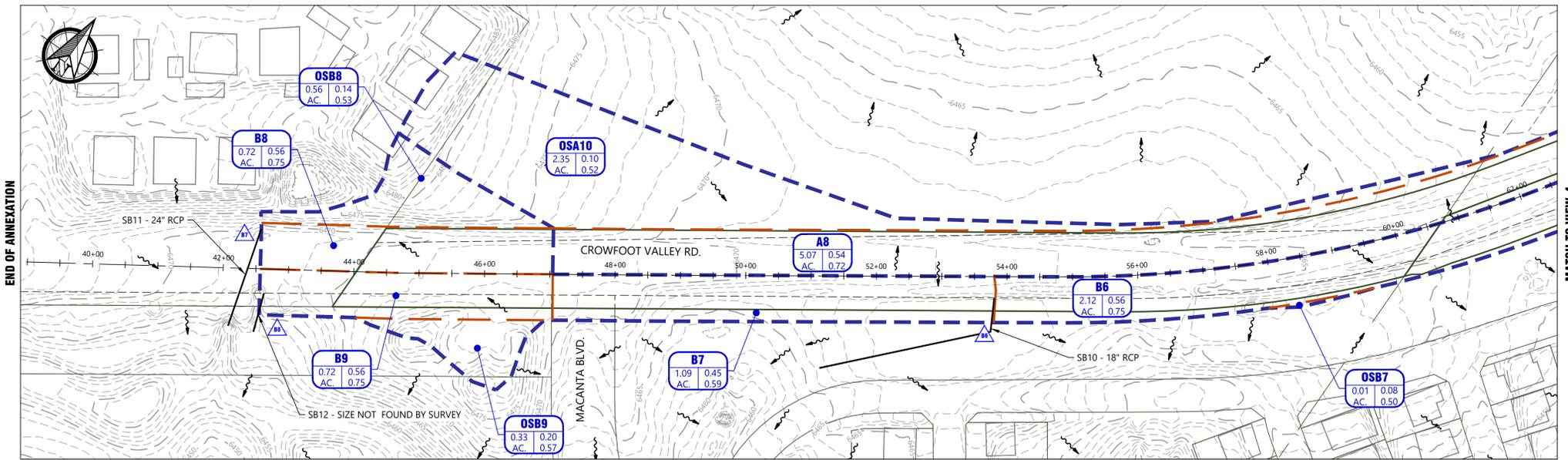
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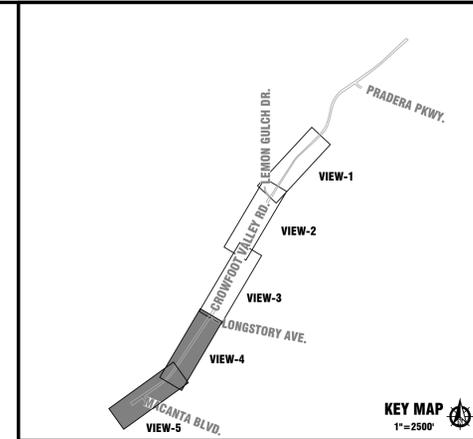
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VIEW-4



VIEW-5



LEGEND							
	Property Line						
	Right of Way Line						
	Centerline						
	Lot Line						
	Easement Line						
	Major Basin Boundary						
	Minor Basin Boundary						
	Flow Arrow						
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Name	Area	Imp. %					
	Design Point						
	Proposed Major Contour						
	Proposed Minor Contour						
	Existing Major Contour						
	Existing Minor Contour						

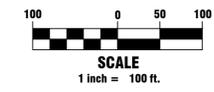


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Designed: RMW Job No.: 4080-0001 Sheet: 7 of 8
Prepared: RMW Scale Horiz: 1" = 100' Date: March 13, 2026
Approved: XWL Scale Vert: N/A

Proj. Name: Crownsnest Annexation
Location: Douglas County, CO
Plan Set: Phase I Drainage Maps
Sheet Name: Proposed Drainage Map




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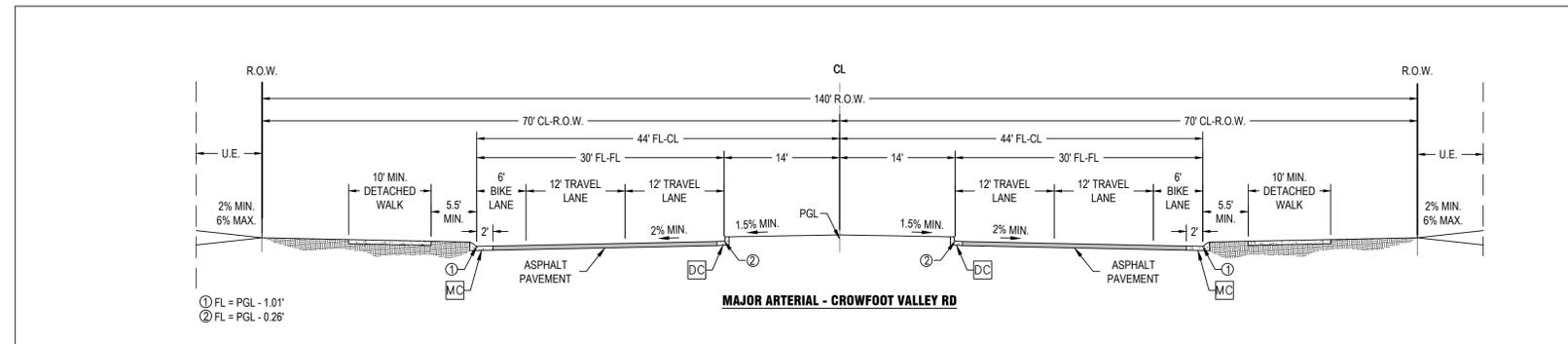
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Basin Runoff Calculations - Proposed Direct Runoff

Project No.: 4080-0001
13-Mar-26

Basin ID	Ultimate Outfall From Site	Total Area (Ac.)	Imp (%)	Tc (min)	Runoff Coeff.			Intensity				
					C ₂	C ₅	C ₁₀₀	I ₂	I ₅	I ₁₀₀	Q ₅	Q ₁₀₀
Existing												
A1	DP A1	1.65	65%	13.94	0.49	0.56	0.75	2.49	3.36	6.11	3.12	7.54
A2	DP A3	4.91	65%	30.85	0.49	0.56	0.75	1.64	2.21	4.01	6.12	14.79
A3	DP A4	0.79	65%	9.27	0.49	0.56	0.75	2.95	3.98	7.24	1.77	4.27
A4	DP A5	1.01	65%	10.52	0.49	0.56	0.75	2.81	3.79	6.89	2.16	5.22
A5	DP A5	1.34	65%	12.27	0.49	0.56	0.75	2.64	3.56	6.46	2.70	6.51
A6	DP A6	1.29	68%	12.94	0.41	0.47	0.62	2.58	3.47	6.32	2.09	5.05
A7	DP A6	1.33	68%	13.16	0.41	0.47	0.62	2.56	3.45	6.27	2.15	5.18
A8	DP A7	5.07	66%	31.73	0.47	0.54	0.72	1.61	2.17	3.95	5.93	14.32
A9	DP A7	1.87	65%	15.02	0.49	0.56	0.75	2.40	3.24	5.90	3.42	8.25
B1	DP B1	3.75	65%	24.81	0.49	0.56	0.75	1.86	2.50	4.55	5.30	12.80
B2	DP B2	1.74	65%	14.27	0.49	0.56	0.75	2.46	3.32	6.04	3.27	7.88
B3	DP B3	1.23	65%	11.69	0.49	0.56	0.75	2.69	3.63	6.60	2.52	6.10
B4	DP B4	2.15	65%	15.02	0.49	0.56	0.75	2.40	3.24	5.90	3.94	9.51
B5	DP B4	1.88	65%	15.02	0.49	0.56	0.75	2.40	3.24	5.90	3.44	8.30
B6	DP B5	2.12	65%	16.27	0.49	0.56	0.75	2.31	3.12	5.68	3.74	9.03
B7	DP B6	1.09	68%	12.04	0.39	0.45	0.59	2.66	3.58	6.52	1.75	4.24
B8	DP B7	0.72	65%	9.02	0.49	0.56	0.75	2.98	4.02	7.32	1.63	3.94
B9	DP B8	0.72	65%	9.02	0.49	0.56	0.75	2.98	4.02	7.32	1.64	3.95
Proposed Off-Site												
OSA1	DP A1	0.33	5%	8.44	0.02	0.08	0.50	3.06	4.12	7.50	0.10	1.23
OSA2	DP A3	0.05	5%	7.70	0.02	0.08	0.50	3.16	4.26	7.74	0.02	0.21
OSA3	DP A3	0.66	8%	23.96	0.05	0.10	0.52	1.89	2.55	4.64	0.17	1.58
OSA4	DP A3	0.63	7%	18.56	0.04	0.09	0.51	2.17	2.92	5.32	0.17	1.71
OSA5	DP A4	0.36	22%	18.40	0.16	0.21	0.57	2.18	2.94	5.34	0.22	1.10
OSA6	DP A5	1.41	13%	23.82	0.09	0.14	0.54	1.90	2.56	4.65	0.51	3.53
OSA7	DP A6	3.38	18%	22.89	0.13	0.18	0.56	1.94	2.62	4.76	1.63	8.98
OSA8	DP A7	3.56	6%	25.01	0.03	0.08	0.51	1.85	2.49	4.53	0.73	8.20
OSA9	DP A7	1.09	5%	25.13	0.02	0.08	0.50	1.84	2.48	4.52	0.21	2.49
OSA10	DP A7	2.35	8%	24.59	0.05	0.10	0.52	1.86	2.52	4.57	0.61	5.57
OSB1	DP B1	0.66	6%	22.20	0.03	0.08	0.51	1.97	2.66	4.84	0.14	1.62
OSB2	DP B2	0.06	5%	15.39	0.02	0.08	0.50	2.38	3.21	5.83	0.02	0.19
OSB3	DP B3	0.15	5%	17.89	0.02	0.08	0.50	2.21	2.98	5.42	0.03	0.40
OSB4	DP B4	0.66	6%	24.03	0.03	0.08	0.51	1.89	2.55	4.63	0.14	1.56
OSB5	DP B4	0.47	8%	8.16	0.04	0.10	0.51	3.09	4.17	7.59	0.19	1.86
OSB6	DP B4	0.20	9%	19.22	0.06	0.11	0.52	2.13	2.87	5.22	0.06	0.55
OSB7	DP B5	0.01	5%	6.89	0.02	0.08	0.50	3.28	4.42	8.03	0.00	0.05
OSB8	DP B7	0.56	12%	15.58	0.07	0.14	0.53	2.36	3.19	5.80	0.24	1.73
OSB9	DP B8	0.33	20%	10.30	0.12	0.20	0.57	2.83	3.82	6.95	0.25	1.28

Intensity = $\frac{28.5 * P_1}{(10 + T_c)^{0.786}}$ 2 Year P₁ = 1.06
 5 Year P₁ = 1.43
 100 Year P₁ = 2.60



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No.	Rev. Date	Revision Type
1		
2		
3		
4		
5		
6		

Job No.: 4080-0001
 Scale Horiz: N/A
 Scale Vert: N/A
 Sheet: 8 of 8
 Date: March 13, 2026
 Designed: RMW
 Prepared: RMW
 Approved: XWL

Crowsnest Annexation
 Douglas County, CO
 Phase I Drainage Maps
 Proposed Drainage Tabulation and Typ. Section

Proj. Name:
 Location:
 Plan Set:
 Sheet Name:



Know what's below.
Call before you dig.