



Phase III Drainage Report

Lot 2A, Metzler Ranch

Filing No. 2

11 Kellogg Court, Castle Rock, CO 80109

Prepared for:

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Project #: 196489001

Prepared: December 4, 2024

Castle Rock Project Number: CD24-0020

Kimley»Horn

CERTIFICATION

DESIGN ENGINEER'S STATEMENT

I affirm that this report and plan for the Phase III for the Phase III Drainage Design for parking improvements within Lot 2A, Metzler Ranch Filing. No. 2 was prepared by me (or under my direct supervision) in accordance with the provisions of the Town of Castle Rock Drainage Design and Technical Criteria for the owners thereof. I understand that the Town of Castle Rock does not and will not assume liability for drainage facilities designed by others.

SIGNATURE (Affix Seal): _____
Colorado P.E. No. 57234 Date

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INTRODUCTION

GENERAL PROJECT DESCRIPTION

The Project includes 23 paved parking spaces to be used by the existing U-Haul rental business for proper storage of their vehicles. The parking stalls will interface Kellogg Court (Privately Owned and maintained by RG Investments No. 1, LLLP, also the owner of Lot 2 of Metzler Ranch Filing No. 2. The project also proposes to plat a new lot, Lot 2A ("Property"), which is the subdivided portion of Tract B that will be adjoined with the existing Lot 2. The Property is approximately 4.70± acres total and 0.19± acres are anticipated to be disturbed.

PURPOSE AND SCOPE OF STUDY

The purpose of this Final Phase III Drainage Report is to provide the hydrologic and hydraulic calculations and to document and finalize the drainage design methodology in support of the proposed Project. This drainage study also proves compliance with the existing Phase III Drainage Report for Metzler Ranch Filing No. 2, by Inter-Mountain Engineering Ltd., dated May, 1998 (**Appendix F**). The Project is located within the jurisdictional limits of Castle Rock ("the Town"). Thus, the guidelines for the hydrologic and hydraulic design components were based on the criteria for the Town and the USDCM.

LOCATION

The Project is located at the proposed Lot 2A of Metzler Ranch Filing No. 2, 1st Amendment, at 11 Kellogg Court, Castle Rock, CO 80109. The site is accessed from Kellogg Court, a private road (60' right-of-way), which interfaces Liggett Road. Lot 2A is bounded by proposed Tract B1 (Kellogg Court) to the north and west, Interstate 25 right-of-way to the north and east, and an unplatted lot, owned by JRW Family Limited Partnership, to the south. Also accessed from Kellogg Court, to the north and west of proposed Lot 2A is Lot 1 of Metzler Ranch Filing No. 2, the Castle Rock Water Department. A vicinity map has been provided in **Appendix A** of this report.

DESCRIPTION OF PROPERTY

The Site is developed and is primarily asphalt pavement in land cover. The Lot 2A is an existing business, Castle Rock Self Storage & U-Haul. Areas that are not covered in asphalt pavement are best described as Lawns, Sandy Soil, per Table 6-3 of the USDCM Vol 1. As mentioned, the existing property, Lot 2 / proposed Lot 2A is the existing Castle Rock Self Storage and U-Haul. Users of this facility access the business via Kellogg Court, privately owned and dedicated as a public and emergency access & utility, storm drainage and waterline easement (Rec. No. 199848887). Metzler Ranch Filing No. 2 is inclusive of an existing full spectrum extended detention basin (EDB), located within Tract A. Slopes within the site vary from 1% - 5% and route flows via surface flows or concentrated flows within the existing underground stormwater sewer system, to the existing EDB (1.76 ac-ft). All infrastructure, asphalt, and vegetated ground cover is in good condition and do not require improvements at this time.

NRCS soil data is available for this Site, and it has been noted that soils onsite are generally USCS Type B. Soil Types A and D also exist and are located sporadically throughout Lot 1 and Lot 2/Lot 2A. The NRCS soil data can be found in **Appendix B**. There are no major drainage ways or irrigation facilities within the Site.

For the purpose of performing hydraulic calculations, NRCS Soil Type B runoff coefficients were used for drainage basins featuring multiple soil types, due to land cover material, that the majority area tributary to the existing EDB is NRCS Soil Type B, and conservativeness of the associated runoff coefficients.

DRAINAGE BASINS

MAJOR BASIN DESCRIPTIONS

The Site improvements are located in Zone X, as determined by the Flood Insurance Rate Map (FIRM) number 08035C0188G effective date, March 16, 2018 (see **Appendix C**).

The Project is located within Castle Rock Town Limits. The project vicinity is recognized to be within Tributary D and is also included in the 2022 Inspection & Maintenance Priority Group.

EXISTING SUB-BASIN DESCRIPTIONS

Historic and existing drainage patterns, and the existing underground storm sewer system is described in detail in the Phase III Drainage Report for Metzler Ranch Filing No. 2, by Inter-Mountain Engineering Ltd., dated May, 1998 (**Appendix G**). The existing Phase III Drainage Report provides runoff quantities and pond capacities for the 10-year and 100-year events. In the existing condition, runoff flows from north to south and east to west via sheet flow and concentrated flow over developed land, or as concentrated flows conveyed within the existing underground storm sewer system, to the existing EDB located within Tract A. Below is a description of the existing sub-basins within the project vicinity. Sub-basins E1 and E2 are included as a portion of the delineated developed sub-basin III.

Sub-Basin E1

Sub-Basin E1 consists of the proposed section of Tract B that is to be adjoined to Lot 2 via replat. This existing basin is lawn/sandy soil in land cover and slopes from north to south and east to west. E1 is 0.24 acres in size and yields an impervious value of 2.0%. Runoff generated during the 5-year and 100-year storm events are 0.01 and 0.80 cfs, respectively. These flows sheet flow to the south towards design point E1. These flows are then concentrated via the existing swale, parallel and adjacent to E1, flowing westwardly into the existing EDB within Tract A. See **Appendix H** for the Existing Drainage Map. These flows are determined to be included in the runoff quantities of 12.6 cfs and 26.4 cfs, for the 10-year and 100-year flows for existing Sub-Basin III as described in the existing Phase III Drainage Report.

Sub-Basin E2

Sub-Basin E2 consists of Lot 2, which is to be adjoined with a portion of Tract B as Lot 2A. Located within this Sub-Basin is the existing business: Castle Rock Self Storage & U-Haul. E2 is developed with numerous self-storage buildings and features asphalt pavement throughout. Sub-basin E2 is 3.34 acres in size yields an impervious value of 93.9%. Runoff generated

during the 5-year and 100-year storm events are 13.52 and 24.00 cfs, respectively. These flows sheet flow southwardly and westwardly via drainage pans and curb and gutter, before entering the underground storm system through a 24"x36" grated inlet at the southwest corner of Lot 2. Flows concentrated within the existing underground storm sewer system are discharged into the existing EDB (Tract A), through their respective forebay. See **Appendix H** for the Existing Drainage Map. These flows are determined to be included in the runoff quantities of 12.6 cfs and 26.4 cfs, for the 10-year and 100-year flows for existing sub-basin III as described in the existing Phase III Drainage Report.

PROPOSED SUB-BASIN DESCRIPTIONS

In the proposed condition, runoff flows from north to south and east to west via sheet and concentrated flows over developed land and within existing storm sewer infrastructure to the existing EDB (1.76 ac-ft), located in Tract A. Below are descriptions for the proposed sub-basins within the project vicinity. Sub-Basins P1 and P2 are include the proposed site improvements and resulting runoff generation in comparison to E1 and E2. All proposed site improvements are located within sub-basin P1; no site improvements, apart from the proposed replatting of Tract B and Lot 2, occur within sub-basin P2. Land area associated with P1 and P2 is included in as a portion of the area located within Sub-Basin III, as described in the existing Phase III Drainage Report. The existing Phase III Drainage Report provides runoff quantities and pond capacities for the 10-year and 100-year events. Hydrologic and hydraulic calculations provided in this report are for the 5-year and 100-year events, per the Castle Rock Storm Drainage Design and Technical Criteria Manual.

Sub-Basin P1

Sub-Basin P1 consists of the proposed section of Tract B that is to be adjoined to Lot 2 via replat and has 23 proposed paved parking spaces for u-haul vehicle storage. This existing basin is lawn/sandy soil in land cover and slopes from north to south and east to west. P1 is 0.16 acres in size and yields an impervious value of 99.5%. Runoff generated during the 5-year and 100-year storm events are 0.71 and 1.19 cfs, respectively. These flows sheet flow to the south towards design point P1. These flows are directed through a curb opening and area inlet, then piped directly into the existing EDB in Tract A. See **Appendix H** for the Proposed Drainage Map. These flows are determined to be included in or additional to the runoff quantities of 12.6 cfs and 26.4 cfs, for the 10-year and 100-year flows for existing sub-basin III as described in the existing Phase III Drainage Report.

Sub-Basin P2

Sub-Basin P2 consists of Lot 2, which is to be adjoined with a portion of Tract B as Lot 2A. Located within this Sub-Basin is the existing business: Castle Rock Self Storage & U-Haul. P2 is developed with numerous self-storage buildings and features asphalt pavement throughout. Sub-basin P2 is 3.34 acres in size yields an impervious value of 93.9%. Runoff generated during the 5-year and 100-year storm events are 13.52 and 24.00 cfs, respectively. These flows sheet flow southwardly and westwardly via drainage pans and curb and gutter, before entering the underground storm system through a 24"x36" grated inlet at the southwest corner of Lot 2. Flows concentrated within the existing underground storm sewer system are discharged into the existing EDB, through their respective forebay. See **Appendix H** for the Proposed Drainage Map. These flows are determined to be included in or additional to the runoff quantities of 12.6 cfs and 26.4 cfs, for the 10-year and 100-year flows for existing sub-basin III as described in the existing Phase III Drainage Report.

Sub-Basin P3

Sub-Basin P3 consists of the portion of Kellogg Court directly north of the proposed parking stalls. The purpose of studying this basin is to determine that whether flows generated on this side of the crowned roadway will overtop the proposed mountable curb and enter the pond via the proposed area inlet and 8" PVC storm pipe. This existing basin is paved and slopes north to south and east to west. P3 is 0.14 acres in size and yields an impervious value of 100.0%. Runoff generated during the 5-year and 100-year storm events are 0.64 and 1.08 cfs, respectively. These flows sheet flow to the south and are captured by the proposed mountable curb. Flows are then directed westwardly towards the existing curb opening inlet before discharging into the existing EDB in Tract A. See **Appendix H** for the Proposed Drainage Map. These flows are determined to be included in or additional to the runoff quantities of 12.6 cfs and 26.4 cfs, for the 10-year and 100-year flows for existing sub-basin III as described in the existing Phase III Drainage Report.

It was determined that the flows generated in sub-basin P3, for the 100-year event (1.08 cfs), would generate a normal depth of 2.6 in. Given the total height of Castle Rock Standard Curb & Gutter MS2 is 4", these flows do not overtop the curb in the 100-year storm event. That being said, the proposed 8" PVC Storm Pipe has capacity to convey additional flows into the pond, should overtopping ever occur. See **Appendix E** for Flowmaster Exhibits.

DRAINAGE DESIGN CRITERIA

DEVELOPMENT CRITERIA REFERENCE

The proposed storm facilities are designed to be in compliance with the Town of Castle Rock "Storm Drainage Design and Technical Criteria Manual" ("MANUAL") dated June 2019 and the Urban Drainage and Flood Control District's "Urban Storm Drainage Criteria Manual" ("USDCM").

There are no known master plans or studies for the Site.

HYDROLOGIC CRITERIA

Water quality and 100-year detention is provided for the site with the existing full spectrum detention pond, located in Tract A, directly west of Lot 2/2A. The existing detention pond is adequately sized for the proposed improvements. No modifications to the pond are anticipated or required.

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the existing and proposed condition drainage analysis per the MANUAL and USDCM. The rainfall depths for the Site were determined from Table 6-5 from the USDCM. Refer to **Table 1** below for the rainfall depths utilized for the Site and **Appendix D** for the hydrologic calculations for the Site.

Table 1: Rainfall Depths (IN)

	Duration (HRS)
Storm Event	1 HR
5 Year	1.43 IN
100 Year	2.60 IN

Calculations for the runoff coefficients and percent imperviousness are included in the **Appendix D**. The rational method was used to determine the peak flows for the Project. These flows were used to determine the size of the proposed inlets, culvert, storm drain system and on-site swales.

The proposed impervious values in Table 6-1 of the MANUAL were utilized in this report for the final design.

The existing Site provides one full spectrum extended detention basin. The Site is maintaining the historic drainage patterns as much as possible.

There are no additional provisions selected or deviations from the criteria in both the USDCM and Castle Rock MANUAL.

HYDRAULIC CRITERIA

Applicable design methods were utilized to confirm the size of the EDB, which includes the use of the UD-Detention spreadsheet and rational calculations spreadsheet.

Proposed drainage features on-site have been analyzed and sized for the following storm events:

- Major Storm: 100-year Storm Event

One EDB exists on Site and provides the required water quality capture volume, EURV volume and 100-year detention. The existing EDB is located within Tract A adjacent to the southeast corner of Liggett Road and Kellogg Court. The required 100-year capacity for the pond is 1.76 ac-ft respectively with a water surface elevation of 6033 ft, per the existing Phase III Drainage Report. The total provided capacity, shown in the existing Phase III Drainage Report, is 2.19 ac-ft with a water surface elevation of 6034 ft. It is also worth noting that contours shown in the existing report, show the embankment of the pond extending up to the 6036 contour, further increasing the total capacity of the existing EDB. Flows entering the pond do so via an existing underground storm sewer system, or overland flows via the existing swale located to the south of Kellogg Court and Lot 2/2A. Three area inlets accept flows from the eastern portion of Lot 1, and route flows southwards towards the existing pond. The central portion of Lot 1 contains a curb inlet to the south of the lot. Flows conveyed through this inlet are routed southwards and discharge into a concrete forebay for the pond. The western portion of Lot 1 accepts flows into grated area inlet within the existing landscape area, as well as a curb inlet at the southwest corner of the lot. Flows conveyed through these inlets are discharged into a concrete forebay for the EDB.

Flows leaving the existing EDB do so through the outlet structure and are further routed westwardly towards Liggett Rd. The 24" RCP pond outlet ties into a 5' Type R curb inlet in Liggett. Flows are then conveyed within the existing 30" RCP, southwardly, before discharging into Hangman's Gulch, approximately 663 LF south of the Site.

Improvements to the site include 23 paved parking stalls which interface Kellogg Court with Castle Rock Standard MS2 mountable curb and gutter, VC1 vertical curb and gutter (catch curb), and a curb opening and grouted rip rap pad. Runoff generated within the proposed parking area, for the 10-year and 100-year events, is 0.71 and 1.19 cfs, respectively. This is an increase of 0.39 cfs from the existing condition, for the 100-year event. No flows associated with these improvements will be routed through the existing underground storm sewer system. Drainage Maps are provided in **Appendix H**, and rip rap calculations are provided in **Appendix E**.

There are no improvements proposed for the pond or existing drainage patterns. Additional stormwater runoff associated with the proposed parking spaces is negligible and does not impact the existing stormwater infrastructure for the site.

THE FOUR STEP PROCESS

The Project was designed in accordance with the four-step process to minimize adverse impacts of urbanization, as outlined in the Town's "Four-Step Process" within the MANUAL.

Step 1. Reduce Runoff Volume to the Maximum Extent Practicable - The Project recognizes the importance of runoff reduction and reflects a design which does so the best it can. The proposed parking area will accumulate runoff within the proposed catch curb and gutter, and discharge flows through a grouted rip rap pad and into the existing grass-lined swale which runs into the existing EDB. The existing full spectrum detention pond will be used to capture and maintain flows discharging off Site. The existing pond is sized adequately, and no improvements are proposed for the pond, pond outlet structure, or historic flow patterns.

Step 2. Provide Water Quality Capture Volume and Flood Control Detention via Full-Spectrum Detention – Permanent water quality measures and detention facilities will be provided with the Project via the existing Full Spectrum EDB. No improvements are proposed for the EDB.

Step 3. Utilize Stream Channel Stabilization Techniques – A grouted riprap pad is used to dissipate flow velocities of the runoff generated in the parking area, before being routed to the pond via an existing grass lined swale. It is anticipated this will minimize erosion.

Step 4. Undertake Source Control – The Project is proposing 23 asphalt pavement parking stalls and therefore does not propose source control measures.

STORMWATER MANAGEMENT FACILITY DESIGN

GENERAL CONCEPT

In general, the existing condition of the Site consists of flows draining from the north to the south and east to west with an approximate average slope of 3.5%. Flows throughout Metzler Ranch Filing No. 2 are routed to the existing EDB in Tract A via overland flow or the existing underground storm sewer system.

The existing and proposed runoff conditions for the Site were calculated utilizing the Rational Method as described in the Hydrologic Criteria section of this report. Provided in **Appendix D** are the hydrologic calculations utilizing the Rational Method for the existing and proposed conditions.

The existing hydraulic conditions of the underground storm sewer system of the site were not verified, as no additional runoff is anticipated to enter the system at any location. The proposed parking area will convey flows within its catch curb (Castle Rock VC1, catch), and will discharge these flows over a riprap pad (Type L, 9in Depth) that is five (5) ft in width and nine (9) ft in length. This rundown is conservatively sized and is intended to reduce runoff velocity prior to entering the existing swale and discharging into the pond. Given that the increase in flows for the 5-year and 100-year events are 0.70 and 0.39 cfs, respectively, it is anticipated that no further improvements are necessary. The existing EDB is adequately sized to account for these additional flows. The existing and proposed drainage maps for the site can be found in **Appendix H**.

SPECIFIC DETAILS

Sub-basins P1 is the only sub-basin that is subject to improvements. P1 is located within proposed Lot 2A, Metzler Ranch Filing No. 1. Improvements in this area include 23 paved parking stalls (771 SY, 288 LF of Castle Rock Standard Mountable Curb (MS2), 340 LF of Castle Rock Standard Vertical Curb (VC1, Catch), and a 3'(W)X5'(L) grouted rip rap basin from the proposed curb opening and routing flows into a 12"x12" nyoplast area inlet. These flows are conveyed into the pond via a proposed 8" PVC pipe, daylighting into a 2'x2' riprap pad within the pond.

Modeling of the required pond capacity, based on the hydrologic calculations included in this report, were done using the MHFD-Detention Spreadsheet, Version 4.06: Detention Basin Design Workbook (**Appendix E**) and AutoCAD Civil 3D.

The hydrologic calculations and Drainage Maps are included in **Appendix D** and **Appendix H**, respectively, of this report for reference.

The Project will disturb less than 1 acre and will not require a Colorado Discharge Permit System (CDPS) General Permit for Stormwater Discharge Associated with Construction Activities from the Colorado Department of Public Health and Environment (CDPHE).

COMPLIANCE WITH PREVIOUS STUDIES

The Site area was previously included and studied as part of the existing Phase III Drainage Report for Metzler Ranch Filing No. 2, by Inter-Mountain Engineering Ltd. in May 1998 (**Appendix F**). Hydraulically, the proposed improvements to the Site will not impact the hydraulic design for the Pond or underground storm sewer system. Additional runoff is to be conveyed via overland flow, into the existing EDB as shown in the existing Phase III Drainage Report.

EXISTING CONDITON SUMMARY:

- Design Point E1 experiences a flow of 0.01 and 0.80 cfs for the 5-year and 100-year storm events.
- Existing EDB: 100-Year Required Capacity = 1.76 ac-ft @ 6033 contour elev.
- Existing EDB: Provided Capacity = 2.19 ac-ft @ 6034 contour elev.
- Existing EDB: Top of Pond / Top of Embankment @ 6036 contour elev.

PROPOSED CONDITION SUMMARY:

- Design Point P1 experiences a flow of 0.71 and 1.19 cfs for the 5-year and 100-year storm events.
- Existing EDB: 100-Year Required Capacity = 1.76 ac-ft @ 6033 contour elev.
- Existing EDB: Provided Capacity = 2.19 ac-ft @ 6034 contour elev.
- Existing EDB: Top of Pond / Top of Embankment @ 6036 contour elev.

Downstream infrastructure is not anticipated to be impacted, as the existing EDB is designed to adequately detain the anticipated additional flows.

SUMMARY

The proposed drainage design is to maintain the historic drainage patterns and release rates for the Site. Runoff from the Site will flow through the existing underground storm sewer system, or overland via historic drainage patterns, into the existing EDB located within Tract A. The existing EDB is currently functioning properly. The ultimate outfall for is detention facility is Hangman's Gulch located approximately 700 feet to the south of the project vicinity. The drainage design presented within this report conforms to the criteria presented in both the USDCM and Castle Rock MANUAL. The drainage design presented in this report also conforms to the existing Phase III Drainage Report for the Site. Proposed in conjunction with the 23 paved parking stalls is a grouted riprap "basin" (Type VL, 6in Depth) that is three (3) ft in width and five (5) ft in length. This riprap basin is to facilitate flows into the pond through the proposed 8" PVC storm pipe. Because the existing EDB is adequately sized to account for the 0.39 cfs in additional flows, no improvements are proposed for the EDB.

REFERENCES

1. Town of Castle Rock "Storm Drainage Design and Technical Criteria Manual", dated June, 2019
2. Urban Storm Drainage Criteria Manual Volume 1 (USDCM), Management Hydrology, and Hydraulics, Updated January, 2016. Prepared by the Urban Drainage and Flood Control District (UDFCD).
3. "Phase III Drainage Study for Metzler Ranch Filing No. 2" prepared by Inter-Mountain Engineering, Ltd., dated May, 1998.
4. Flood Insurance Rate Map, El Paso County, Colorado and Incorporated Areas, Map Number 08035C0188G, Effective Date March 16, 2016, prepared by the Federal Emergency Management Agency (FEMA).
5. "Custom Soil Resource Report for Caste Rock Area, Colorado, Metzler Ranch" Prepared March 12, 2024, by the Natural Resources Conservation Service (NRCS).

APPENDIX

APPENDIX A: VICINITY MAP

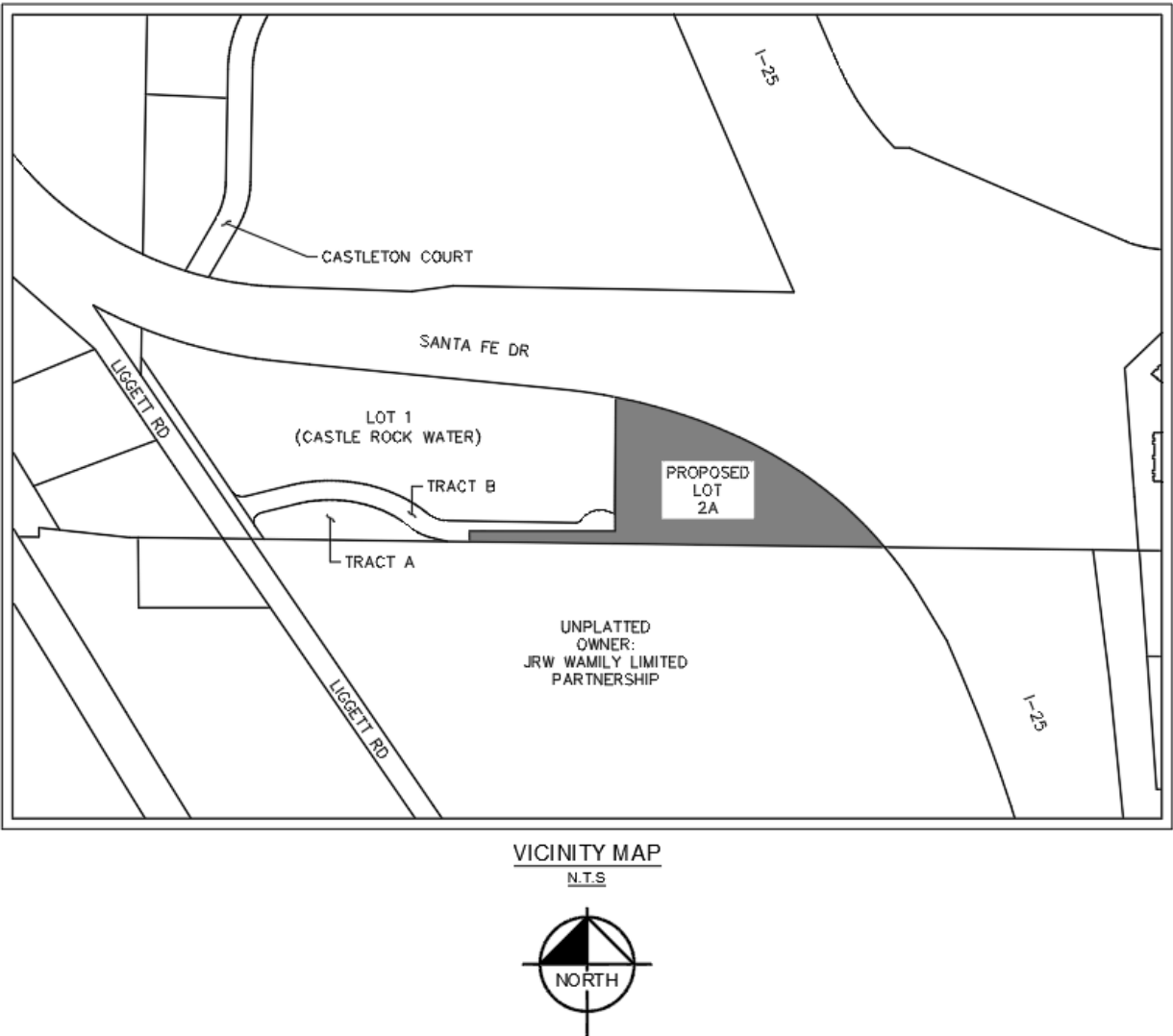


Figure 1: Vicinity Map (Not to Scale)

APPENDIX B: NRCS SOIL STUDY



United States
Department of
Agriculture

NRCS

Natural
Resources
Conservation
Service

A product of the National
Cooperative Soil Survey,
a joint effort of the United
States Department of
Agriculture and other
Federal agencies, State
agencies including the
Agricultural Experiment
Stations, and local
participants

Custom Soil Resource Report for **Castle Rock Area, Colorado**

Metzler Ranch



March 14, 2024

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (<http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/>) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (<https://offices.sc.egov.usda.gov/locator/app?agency=nrcs>) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

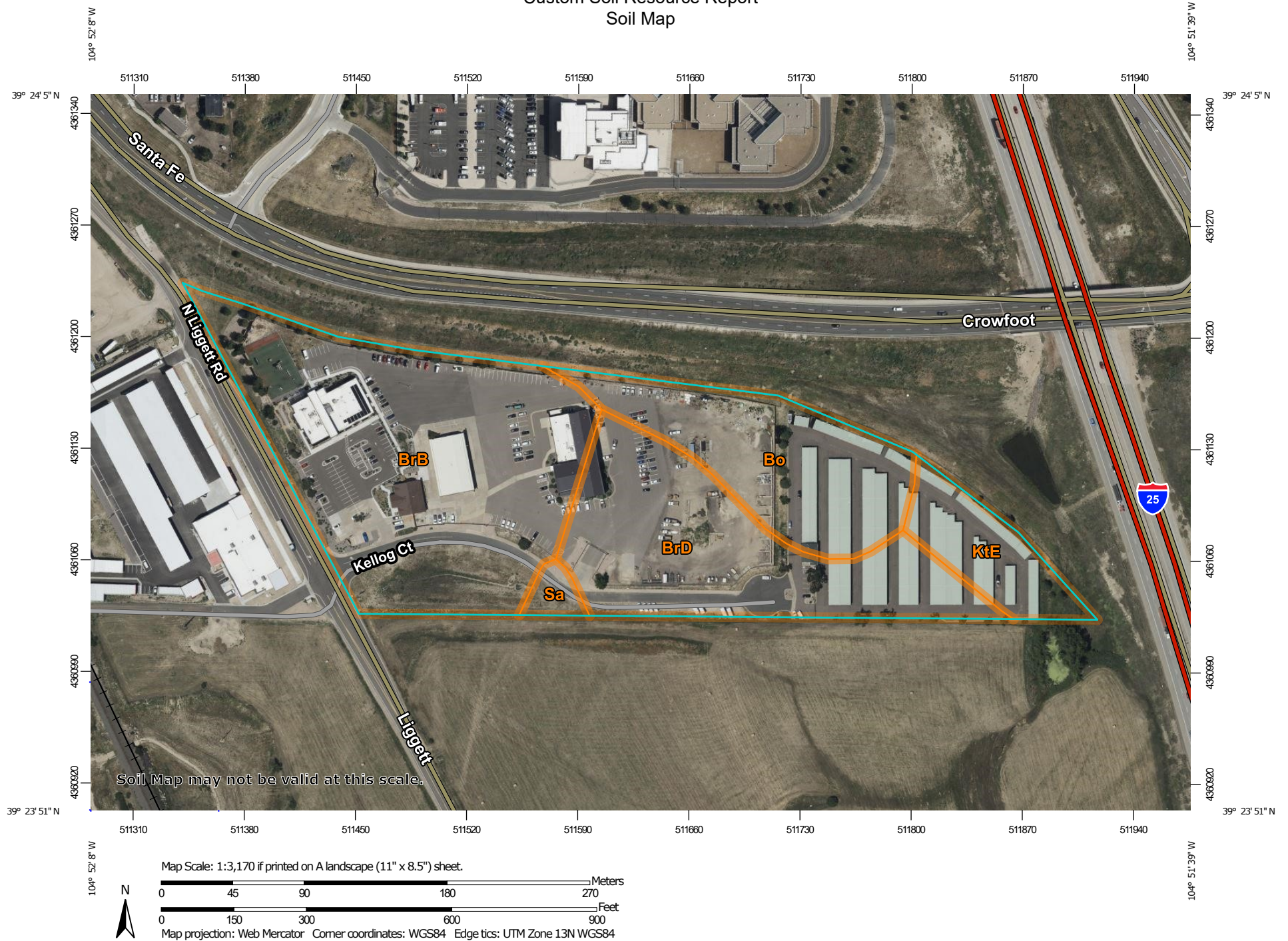
Custom Soil Resource Report

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report Soil Map



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

 Soil Map Unit Polygons

 Soil Map Unit Lines

 Soil Map Unit Points

Special Point Features

 Blowout

 Borrow Pit

 Clay Spot

 Closed Depression

 Gravel Pit

 Gravelly Spot

 Landfill

 Lava Flow

 Marsh or swamp

 Mine or Quarry

 Miscellaneous Water

 Perennial Water

 Rock Outcrop

 Saline Spot

 Sandy Spot

 Severely Eroded Spot

 Sinkhole

 Slide or Slip

 Sodic Spot

 Spoil Area

 Stony Spot

 Very Stony Spot

 Wet Spot

 Other

 Special Line Features

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 16, Aug 24, 2023

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	3.1	18.7%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	7.6	45.8%
BrD	Bresser sandy loam, cool, 5 to 9 percent slopes	4.4	26.4%
KtE	Kutch sandy loam, 5 to 20 percent slopes	1.3	7.6%
Sa	Sampson loam	0.2	1.4%
Totals for Area of Interest		16.7	100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

Custom Soil Resource Report

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Castle Rock Area, Colorado

Bo—Blakeland-Orsa association, 1 to 4 percent slopes

Map Unit Setting

National map unit symbol: jqy5
Elevation: 5,500 to 6,600 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 50 percent
Orsa and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, alluvial fans
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium and/or eolian deposits

Typical profile

H1 - 0 to 13 inches: sandy loam
H2 - 13 to 24 inches: loamy coarse sand
H3 - 24 to 60 inches: loamy coarse sand

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.9 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Orsa

Setting

Landform: Alluvial fans, hills
Landform position (three-dimensional): Base slope

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Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Alluvium derived from arkosic sedimentary rock

Typical profile

H1 - 0 to 20 inches: coarse sandy loam

H2 - 20 to 60 inches: gravelly loamy coarse sand

Properties and qualities

Slope: 1 to 2 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Somewhat excessively drained

Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water supply, 0 to 60 inches: Low (about 4.4 inches)

Interpretive groups

Land capability classification (irrigated): 4s

Land capability classification (nonirrigated): 4e

Hydrologic Soil Group: A

Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Minor Components

Bresser

Percent of map unit: 5 percent

Hydric soil rating: No

Kassler

Percent of map unit: 5 percent

Hydric soil rating: No

Sandy alluvial land

Percent of map unit: 5 percent

Hydric soil rating: No

BrB—Bresser sandy loam, cool, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2tlpj

Elevation: 5,500 to 6,500 feet

Mean annual precipitation: 15 to 19 inches

Mean annual air temperature: 48 to 52 degrees F

Frost-free period: 100 to 130 days

Farmland classification: Farmland of statewide importance

Map Unit Composition

Bresser, cool, and similar soils: 90 percent

Minor components: 10 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser, Cool

Setting

Landform: Hillslopes, terraces

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Base slope, tread

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Tertiary aged alluvium derived from arkose

Typical profile

Ap - 0 to 5 inches: sandy loam

Bt1 - 5 to 8 inches: sandy loam

Bt2 - 8 to 27 inches: sandy clay loam

Bt3 - 27 to 36 inches: sandy loam

C - 36 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 1 to 3 percent

Depth to restrictive feature: More than 80 inches

Drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Calcium carbonate, maximum content: 5 percent

Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)

Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 2e

Land capability classification (nonirrigated): 4s

Hydrologic Soil Group: B

Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Minor Components

Truckton

Percent of map unit: 5 percent

Landform: Hillslopes, terraces

Landform position (two-dimensional): Footslope

Landform position (three-dimensional): Base slope, tread

Down-slope shape: Linear

Across-slope shape: Linear

Ecological site: R049XB210CO - Sandy Foothill

Hydric soil rating: No

Sampson

Percent of map unit: 5 percent
Landform: Terraces, alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XC202CO - Loamy Foothill 14-19 PZ
Hydric soil rating: No

BrD—Bresser sandy loam, cool, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2tlpk
Elevation: 5,500 to 6,960 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 100 to 130 days
Farmland classification: Not prime farmland

Map Unit Composition

Bresser, cool, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser, Cool

Setting

Landform: Interfluves
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Tertiary aged alluvium derived from arkose

Typical profile

Ap - 0 to 5 inches: sandy loam
Bt1 - 5 to 8 inches: sandy loam
Bt2 - 8 to 27 inches: sandy clay loam
Bt3 - 27 to 36 inches: sandy loam
C - 36 to 80 inches: loamy coarse sand

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high
(0.60 to 6.00 in/hr)
Depth to water table: More than 80 inches

Custom Soil Resource Report

Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Maximum salinity: Nonsaline to very slightly saline (0.1 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Ascalon

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Truckton

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

KtE—Kutch sandy loam, 5 to 20 percent slopes

Map Unit Setting

National map unit symbol: jqz5
Elevation: 5,500 to 6,800 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Kutch and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kutch

Setting

Landform: Valley sides, alluvial fans, drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous fine-loamy clayey shale

Typical profile

H1 - 0 to 6 inches: sandy loam
H2 - 6 to 32 inches: clay
H3 - 32 to 36 inches: weathered bedrock

Properties and qualities

Slope: 5 to 20 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Bresser

Percent of map unit: 7 percent
Hydric soil rating: No

Newlin

Percent of map unit: 7 percent
Hydric soil rating: No

Aquic haplustolls

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Sa—Sampson loam

Map Unit Setting

National map unit symbol: jr02
Elevation: 5,500 to 6,600 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sampson and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampson

Setting

Landform: Stream terraces on drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 9 inches: loam
H2 - 9 to 28 inches: clay loam
H3 - 28 to 38 inches: loam
H4 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R049XC202CO - Loamy Foothill 14-19 PZ
Hydric soil rating: No

Minor Components

Englewood

Percent of map unit: 8 percent

Hydric soil rating: No

Bresser

Percent of map unit: 7 percent

Hydric soil rating: No

Loamy alluvial land

Percent of map unit: 4 percent

Hydric soil rating: No

Aquic haplustolls

Percent of map unit: 1 percent

Landform: Swales

Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Erosion Factors

Soil Erosion Factors are soil properties and interpretations used in evaluating the soil for potential erosion. Example soil erosion factors can include K factor for the whole soil or on a rock free basis, T factor, wind erodibility group and wind erodibility index.

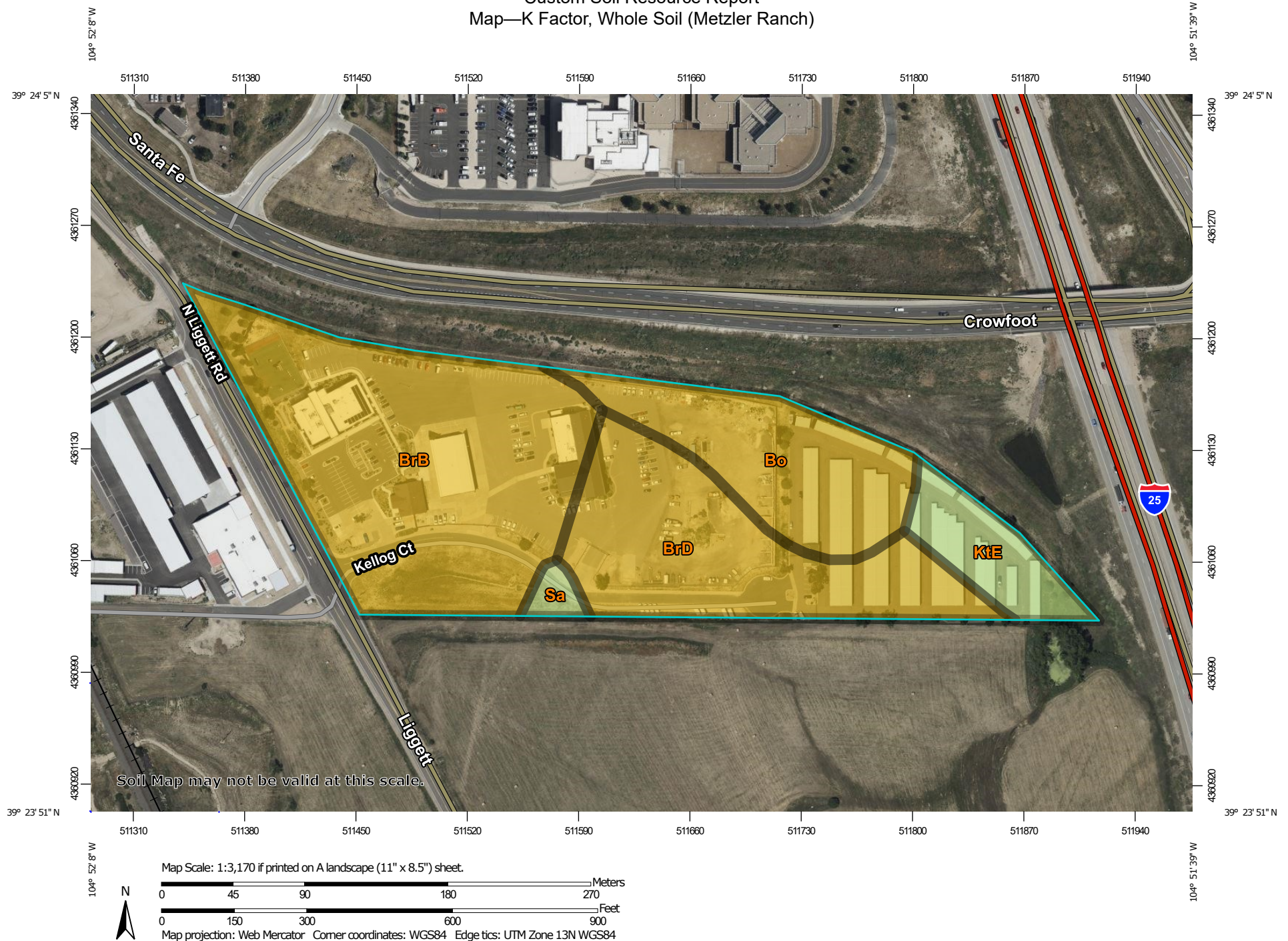
K Factor, Whole Soil (Metzler Ranch)

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Factor K does not apply to organic horizons and is not reported for those layers.

Custom Soil Resource Report Map—K Factor, Whole Soil (Metzler Ranch)



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

	.02
	.05
	.10
	.15
	.17
	.20
	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Soil Rating Lines

	.02
	.05
	.10
	.15
	.17
	.20

	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Soil Rating Points

	.02
	.05
	.10
	.15
	.17
	.20
	.24
	.28
	.32
	.37
	.43
	.49
	.55
	.64
	Not rated or not available

Water Features

	Streams and Canals
	Rails
	Interstate Highways
	US Routes
	Major Roads
	Local Roads
	Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 16, Aug 24, 2023

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.

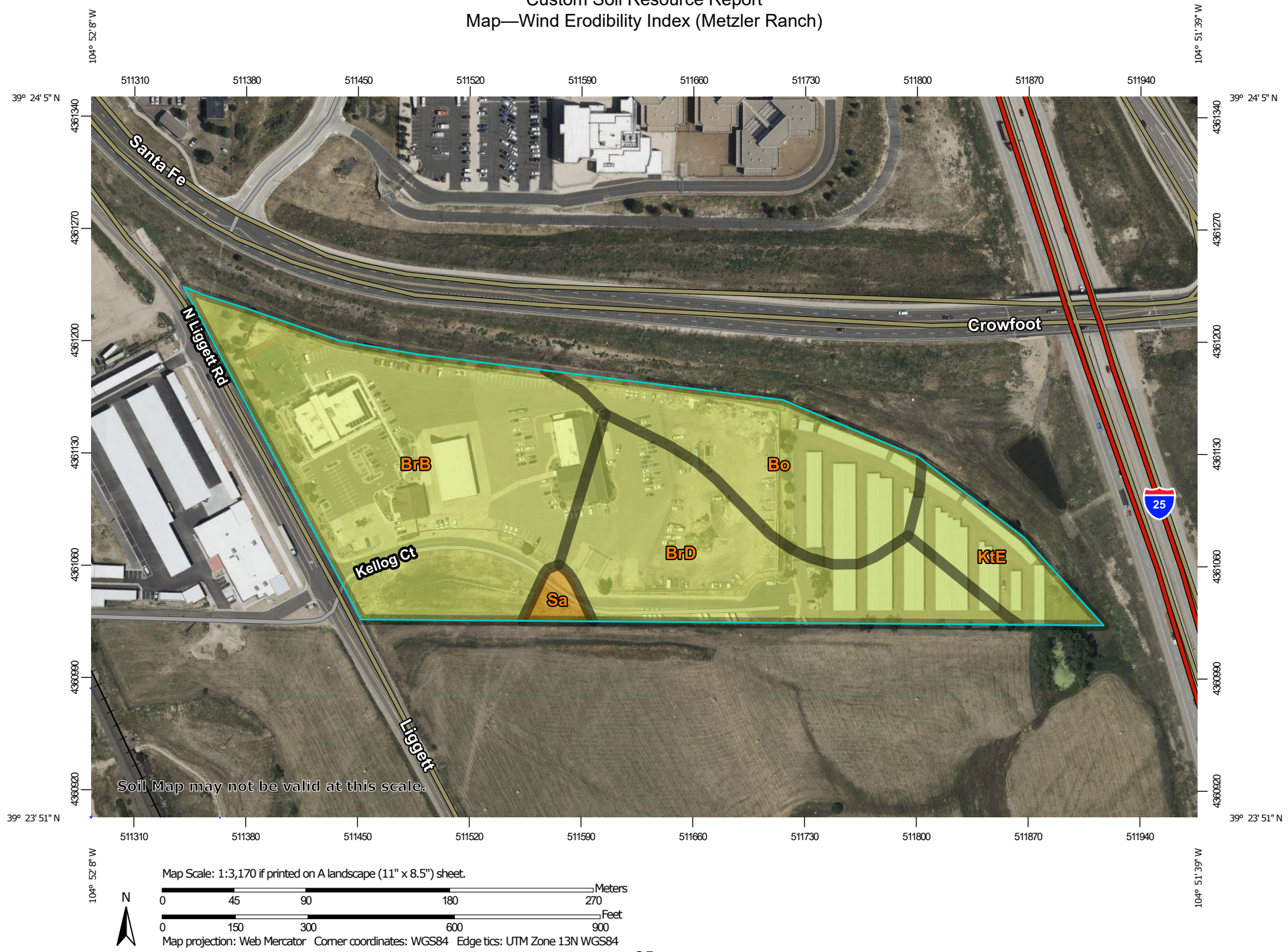
Table—K Factor, Whole Soil (Metzler Ranch)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	.15	3.1	18.7%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	.15	7.6	45.8%
BrD	Bresser sandy loam, cool, 5 to 9 percent slopes	.15	4.4	26.4%
KtE	Kutch sandy loam, 5 to 20 percent slopes	.24	1.3	7.6%
Sa	Sampson loam	.24	0.2	1.4%
Totals for Area of Interest			16.7	100.0%

Rating Options—K Factor, Whole Soil (Metzler Ranch)*Aggregation Method:* Dominant Condition*Component Percent Cutoff:* None Specified*Tie-break Rule:* Higher*Layer Options (Horizon Aggregation Method):* Surface Layer (Not applicable)**Wind Erodibility Index (Metzler Ranch)**

The wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Custom Soil Resource Report
Map—Wind Erodibility Index (Metzler Ranch)



Custom Soil Resource Report

MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)

Soils

Soil Rating Polygons

	0
	38
	48
	56
	86
	134
	160
	180
	220
	250
	310
	Not rated or not available

Soil Rating Lines

	0
	38
	48
	56
	86
	134
	160
	180
	220

 250

 310

 Not rated or not available

Soil Rating Points

	0
	38
	48
	56
	86
	134
	160
	180
	220
	250
	310
	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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 16, Aug 24, 2023

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.

Table—Wind Erodibility Index (Metzler Ranch)

Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	86	3.1	18.7%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	86	7.6	45.8%
BrD	Bresser sandy loam, cool, 5 to 9 percent slopes	86	4.4	26.4%
KtE	Kutch sandy loam, 5 to 20 percent slopes	86	1.3	7.6%
Sa	Sampson loam	48	0.2	1.4%
Totals for Area of Interest			16.7	100.0%

Rating Options—Wind Erodibility Index (Metzler Ranch)

Units of Measure: tons per acre per year

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (Metzler Ranch)

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:

Custom Soil Resource Report

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.

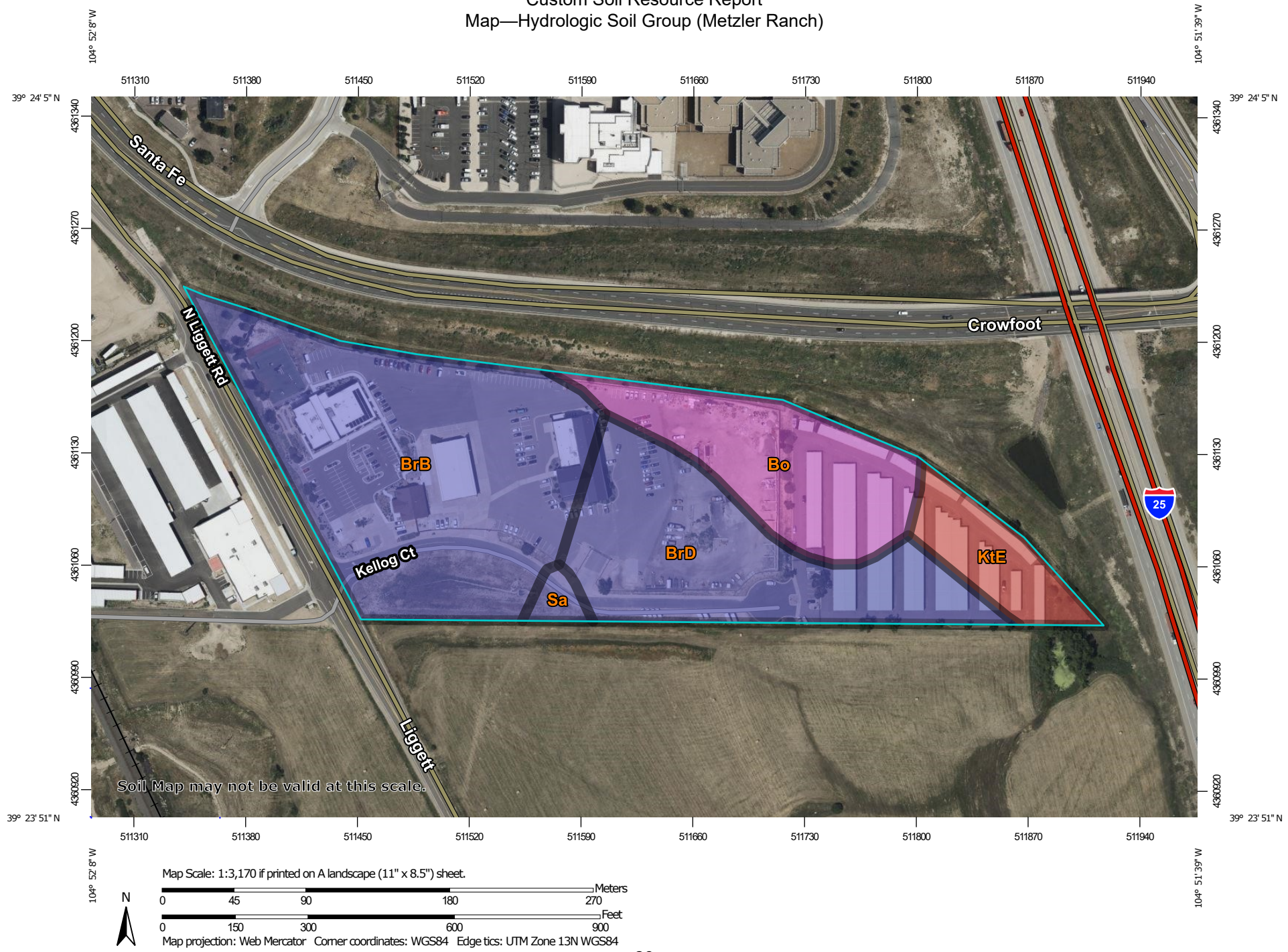
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group (Metzler Ranch)



Custom Soil Resource Report

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.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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 16, Aug 24, 2023

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.

Table—Hydrologic Soil Group (Metzler Ranch)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Bo	Blakeland-Orsa association, 1 to 4 percent slopes	A	3.1	18.7%
BrB	Bresser sandy loam, cool, 1 to 3 percent slopes	B	7.6	45.8%
BrD	Bresser sandy loam, cool, 5 to 9 percent slopes	B	4.4	26.4%
KtE	Kutch sandy loam, 5 to 20 percent slopes	D	1.3	7.6%
Sa	Sampson loam	B	0.2	1.4%
Totals for Area of Interest			16.7	100.0%

Rating Options—Hydrologic Soil Group (Metzler Ranch)*Aggregation Method: Dominant Condition**Component Percent Cutoff: None Specified**Tie-break Rule: Higher*

References

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- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

Custom Soil Resource Report

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

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APPENDIX C: FEMA FIRM MAP

NOTES TO USERS

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

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

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

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

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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

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

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

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

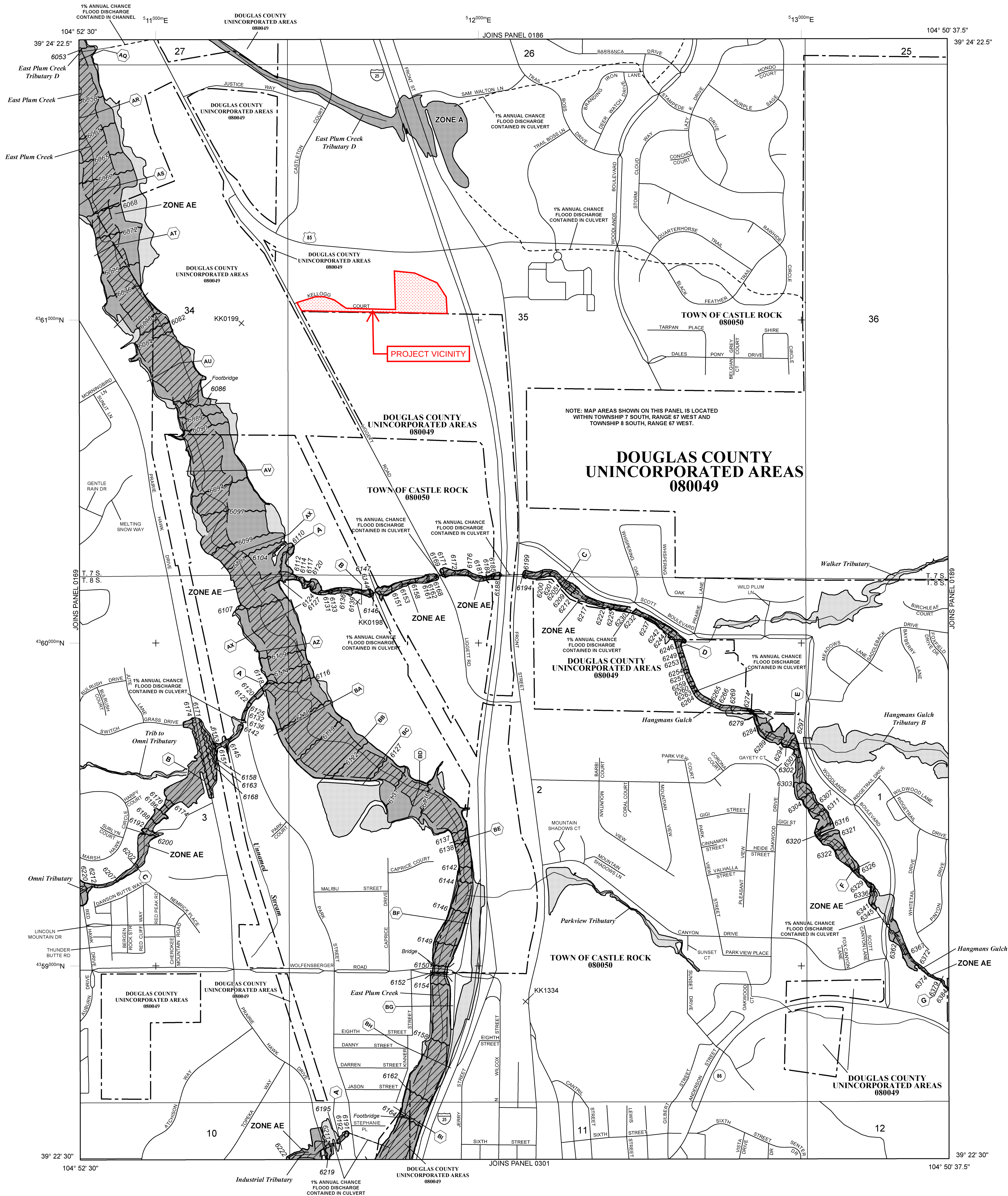
Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations** and **floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the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

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

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

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

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



LEGEND

- SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD**
- The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.
- ZONE A** No Base Flood Elevations determined.
- ZONE AE** Base Flood Elevations determined.
- ZONE AH** Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- ZONE AO** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- ZONE AR** Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently described. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- ZONE A99** Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- ZONE V** Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- ZONE VE** Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

- ZONE X** Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- OTHER AREAS**
- ZONE X** Areas determined to be outside the 0.2% annual chance floodplain.
- ZONE D** Areas in which flood hazards are undetermined, but possible.
- COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS**
- OTHERWISE PROTECTED AREAS (OPAs)**

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% Annual Chance Floodplain Boundary
- 0.2% Annual Chance Floodplain Boundary
- Floodway boundary
- Zone D boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
- Base Flood Elevation line and value; elevation in feet*
- Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

- Cross section line
- Transect line
- Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
- 1000-meter Universal Transverse Mercator grid values, zone 13
- Bench mark (see explanation in Notes to Users section of this FIRM panel)
- River Mile

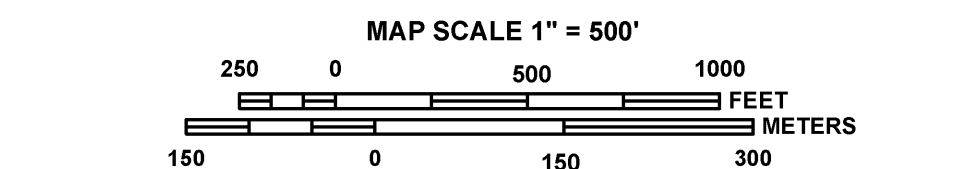
MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
SEPTEMBER 30, 2005

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
MARCH 16, 2016: to update corporate limits, to change base flood elevations, to add base flood elevations, to add special flood hazard areas, to update map format, to add roads and road names, to reflect updated topographic information, to incorporate previously issued letters of map revision.

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

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



NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0188G

FIRM

FLOOD INSURANCE RATE MAP

DOUGLAS COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 188 OF 495
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
CASTLE ROCK, TOWN OF	080050	0188	G
DOUGLAS COUNTY	080049	0188	G

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

MAP NUMBER 08035C0188G
MAP REVISED MARCH 16, 2016

Federal Emergency Management Agency

APPENDIX D: HYDROLOGIC ANALYSIS

Weighted Imperviousness Calculations: Existing Conditions

SUB-BASIN	AREA (SF)	AREA (Acres)	SOIL TYPE	LANDSCAPE AREA	LANDSCAPE IMP.	LANDSCAPE				GRAVEL AREA	GRAVEL IMP.	GRAVEL				ROOF AREA	ROOF IMP.	ROOF				PAVEMENT AREA	PAVEMENT IMP.	PAVEMENT				WEIGHTED IMP.	WEIGHTED COEFFICIENTS			
						C2	C5	C10	C100			C2	C5	C10	C100			C2	C5	C10	C100			C2	C5	C10	C100		C2	C5	C10	C100
E1	10,404	0.24	B	10,404	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	0	90%	0.74	0.76	0.78	0.84	0	100%	0.84	0.86	0.86	0.86	2.0%	0.01	0.01	0.07	0.44
E2	145,647	3.34	B	1,291	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	75,943	90%	0.74	0.76	0.78	0.84	68,413	100%	0.84	0.86	0.86	0.86	93.9%	0.78	0.80	0.81	0.85
Total	156,051	3.58		11,695	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	75,943	90%	0.74	0.76	0.78	0.84	68,413	100%	0.84	0.86	0.86	0.86	87.8%	0.73	0.75	0.76	0.82

<div> <div>Metzler Ranch Parking Lot</div> <div>Existing Runoff Calculations</div> <div>Time of Concentration</div> </div> <div> <div>Forest & Meadow</div> <div>Fallow or Cultivation</div> <div>2.50</div> <div>5.00</div> <div>ort</div> <div>Nearly Bare Ground</div> <div>7.00</div> <div>10.00</div> <div>Grassed Waterway</div> <div>Paved Area & Shallow Gutter</div> <div>15.00</div> <div>20.00</div> </div> <div>Watercourse Coefficient</div>																
SUB-BASIN DATA					INITIAL / OVERLAND TIME			TRAVEL TIME T(t)					T(c) CHECK (URBANIZED BASINS)			FINAL T(c)
DESIGN POINT	DRAINAGE BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
E1	E1	10,404	0.24	0.01	41	5.0%	7.5	0	0.0%	7.00	0.0	0.0	7.5	41	10.2	7.5
E2	E2	145,647	3.34	0.80	256	4.4%	5.4	0	0.0%	20.00	0.0	0.0	5.4	256	11.4	5.4

Metzler Ranch Parking Lot Existing Runoff Calculations (Rational Method Procedure)												
Design Storm 5 Year												
BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAINAGE BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
E1	E1	0.24	0.01	7.5	0.00	4.56	0.01					
E2	E2	3.34	0.80	5.4	2.68	5.05	13.52					

<div>Metzler Ranch Parking Lot</div> <div>Existing Runoff Calculations</div> <div>(Rational Method Procedure)</div> <div>Design Storm 100 Year</div>												
BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAINAGE BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
E1	E1	0.24	0.44	7.5	0.11	7.66	0.80					
E2	E2	3.34	0.85	5.4	2.83	8.49	24.00					

SUMMARY - EXISTING RUNOFF TABLE						
DESIGN POINT	SUB- BASIN	AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	WEIGHTED COEFF. (C100)	IMP. (%)
On-Site Basins						
E1	E1	0.24	0.01	0.80	0.44	2.0%
E2	E2	3.34	13.52	24.00	0.85	93.9%
TOTAL		3.58	13.53	24.80	0.82	87.8%

Weighted Imperviousness Calculations: Proposed Conditions

SUB-BASIN	AREA (SF)	AREA (Acres)	SOIL TYPE	LANDSCAPE AREA	LANDSCAPE IMP.	LANDSCAPE				GRAVEL AREA	GRAVEL IMP.	GRAVEL				ROOF AREA	ROOF IMP.	ROOF				PAVEMENT AREA	PAVEMENT IMP.	PAVEMENT				WEIGHTED IMP.	WEIGHTED COEFFICIENTS			
						C2	C5	C10	C100			C2	C5	C10	C100			C2	C5	C10	C100			C2	C5	C10	C100		C2	C5	C10	C100
P1	6,966	0.16	B	38	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	0	90%	0.74	0.76	0.78	0.84	6,928	100%	0.84	0.86	0.86	0.86	99.5%	0.84	0.86	0.86	0.86
P2	145,647	3.34	B	1,291	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	75,943	90%	0.74	0.76	0.78	0.84	68,413	100%	0.84	0.86	0.86	0.86	93.9%	0.78	0.80	0.81	0.85
P3	6,298	0.14	B	0	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	0	90%	0.74	0.76	0.78	0.84	6,298	100%	0.84	0.86	0.86	0.86	100.0%	0.84	0.86	0.86	0.86
On-Site	158,911	3.65		1,329	2%	0.01	0.01	0.07	0.44	0	40%	0.29	0.32	0.38	0.61	75,943	90%	0.74	0.76	0.78	0.84	81,639	100%	0.78	0.79	0.79	0.79	94.4%	0.75	0.77	0.78	0.81

Metzler Ranch Filing No. 1, Lot 2A
Castle Rock Self Storage - U-Haul Storage Parking

09/12/2024
 Calculated by: RES

Metzler Ranch Parking Lot Proposed Runoff Calculations Time of Concentration																
SUB-BASIN DATA					INITIAL / OVERLAND TIME			TRAVEL TIME T(t)				T(c) CHECK (URBANIZED BASINS)			FINAL T(c)	
DESIGN POINT	DRAINAGE BASIN	AREA sq. ft.	AREA ac.	C(5)	Length ft.	Slope %	T(i) min	Length ft.	Slope %	Coeff.	Velocity fps	T(t) min.	COMP. T(c)	TOTAL LENGTH	L/180+10	min.
P1	P1	6,966	0.16	0.86	25	3.5%	1.5	275	1.1%	20.00	2.1	2.2	5.0	300	11.7	5.0
P2	P2	145,647	3.34	0.80	256	4.4%	5.4	0	0.0%	20.00	0.0	0.0	5.4	256	11.4	5.4
P3	P3	6,298	0.14	0.86	60	2.0%	2.7	315	2.0%	20.00	2.8	1.9	5.0	375	12.1	5.0

<div>Metzler Ranch Parking Lot</div> <div>Proposed Runoff Calculations</div> <div>(Rational Method Procedure)</div> <div>Design Storm 5 Year</div>												
BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAINAGE BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
P1	P1	0.16	0.86	5.0	0.14	5.17	0.71					
P2	P2	3.34	0.80	5.4	2.68	5.05	13.52					
P3	P3	0.14	0.86	5.0	0.12	5.17	0.64					

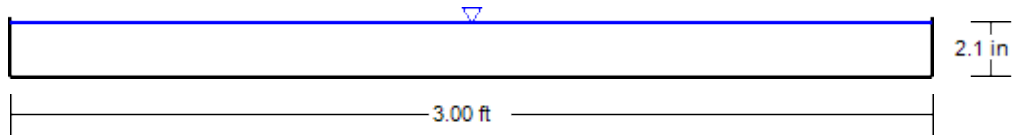
Metzler Ranch Parking Lot Proposed Runoff Calculations (Rational Method Procedure) Design Storm 100 Year												
BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAINAGE BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
P1	P1	0.16	0.86	5.0	0.14	8.68	1.19					
P2	P2	3.34	0.85	5.4	2.83	8.49	24.00					
P3	P3	0.14	0.86	5.0	0.12	8.68	1.08					

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	SUB-BASIN	AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	WEIGHTED COEFF. (C100)	IMP. (%)
On-Site Basins						
P1	P1	0.16	0.71	1.19	0.86	99.5%
P2	P2	3.34	13.52	24.00	0.85	93.9%
P3	P3	0.14	0.64	1.08	0.86	100.0%
TOTAL		3.65	14.87	26.27	0.81	94.4%

APPENDIX E: HYDRAULIC ANALYSIS

Metzler Ranch Parking Lot - Curb Opening

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.013
Channel Slope	0.010 ft/ft
Normal Depth	2.1 in
Bottom Width	3.00 ft
Discharge	1.68 cfs

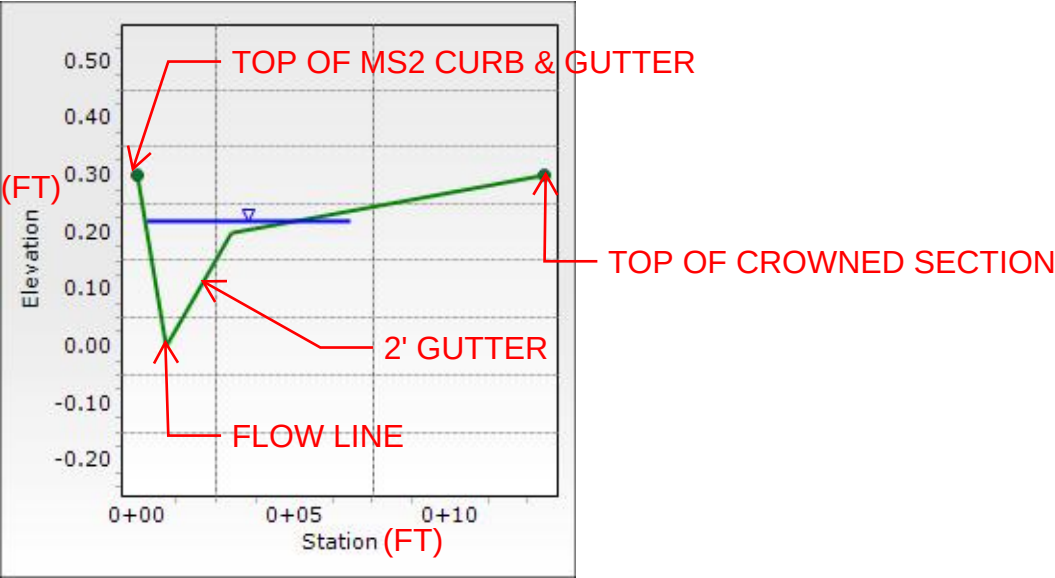


V: 1
H: 1

100-YR STORM EVENT

Metzler Ranch Parking Lot - MS2 Curb - P3 100-YR Event

Project Description	
Friction Method	Manning
Solve For	Formula
	Normal Depth
Input Data	
Channel Slope	0.020 ft/ft
Normal Depth	2.6 in
Discharge	1.08 cfs





Nyloplast Inlet Capacity Table

DISCLAIMER: SAFETY FACTORS ARE NOT INCLUDED IN THESE CALCULATIONS. ACTUAL CALCULATIONS SHOULD BE CARRIED OUT AND VERIFIED BY THE DESIGN ENGINEER TAKING INTO ACCOUNT ALL LOCAL CONDITIONS. NYLOPLAST RECOMMENDS USING A MINIMUM SAFETY FACTOR OF 1.25 FOR PAVED AREAS AND 2.0 FOR TURF AREAS. ADS/NYLOPLAST IS NOT RESPONSIBLE FOR MISUSE OF THIS TOOL.

Input	
Type of Grate	12" Drop In
Head (ft)	1
Properties	
Orifice Flow Area (in)	39.75
Orifice Flow Area (ft)	0.27
Weir Flow Perimeter (in)	33.31
Weir Flow Perimeter (ft)	2.78
Solution	
Capacity (cfs)	1.32
Capacity (gpm)	592.46

$$Q_{weir} = CLH^{3/2}$$

$C = 3.33$ Weir Discharge Coefficient

L = Perimeter of Grate Opening (ft)

H = Flow Height of Water Surface Above Weir (ft)

$$Q_{orifice} = CA\sqrt{2gh}$$

$C = 0.60$ Orifice Discharge Coefficient

A = Area of the Orifice (ft²)

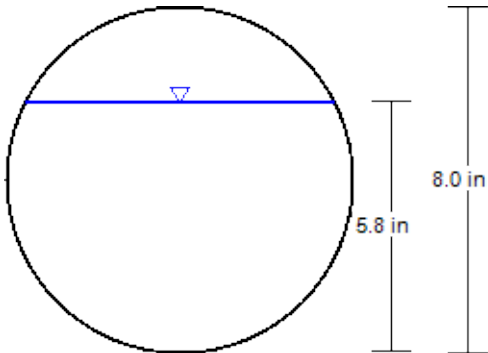
g = Gravitational Constant $\left(32.2 \frac{ft}{s^2}\right)$

H = Depth of Water Above Center of Orifice (ft)

100-YR STORM EVENT

Metzler Ranch Parking Lot - 8" PVC Storm Drain

Project Description	
Friction Method	Manning
	Formula
Solve For	Normal Depth
Input Data	
Roughness Coefficient	0.010
Channel Slope	0.008 ft/ft
Normal Depth	5.8 in
Diameter	8.0 in
Discharge	1.19 cfs



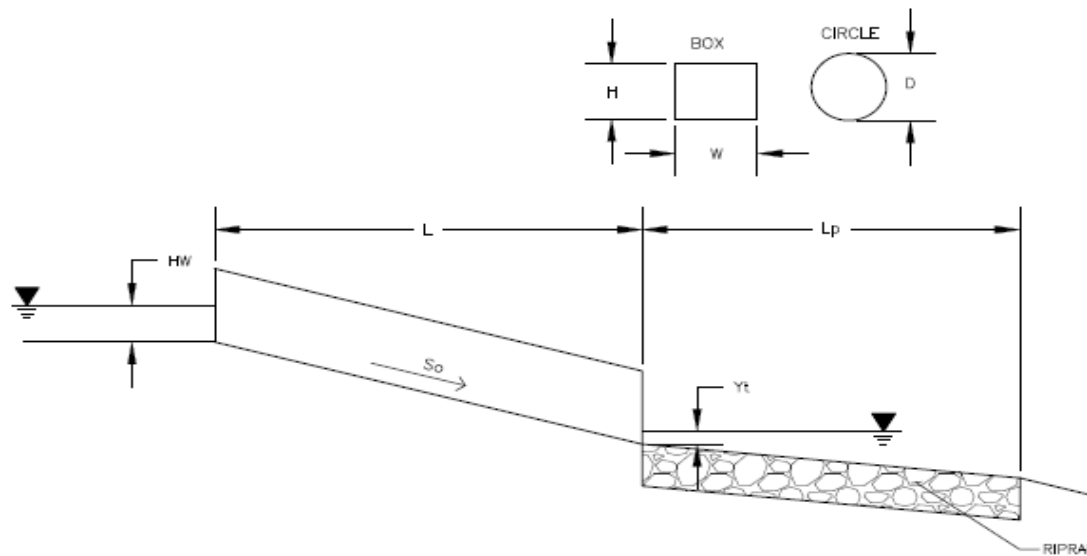
V: 1
H: 1

DETERMINATION OF CULVERT HEADWATER AND OUTLET PROTECTION

MHFD-Culvert, Version 4.00 (May 2020)

Project: Metzler Ranch Parking Lot - Parking Drainage Riprap Sizing

ID: _____



Soil Type:

Choose One:

☒ Sandy

☐ Non-Sandy

Design Information:

Design Discharge

Q = 1.19 cfs

Circular Culvert:

Barrel Diameter in Inches

D = 8 inches

Inlet Edge Type (Choose from pull-down list)

Square Edge Projecting

OR:

Box Culvert:

Barrel Height (Rise) in Feet

H (Rise) = OR

Barrel Width (Span) in Feet

W (Span) =

Inlet Edge Type (Choose from pull-down list)

Number of Barrels

Barrels = 1

Inlet Elevation

Elev IN = 6131.85 ft

Outlet Elevation OR Slope

Elev OUT = 6130.5 ft

Culvert Length

L = 180 ft

Manning's Roughness

n = 0.012

Bend Loss Coefficient

k_b = 0

Exit Loss Coefficient

k_x = 1

Tailwater Surface Elevation

Y_t Elevation =

Max Allowable Channel Velocity

V = 5 ft/s

Calculated Results:

Culvert Cross Sectional Area Available

A = 0.35 ft²

Culvert Normal Depth

Y_n = 0.58 ft

Culvert Critical Depth

Y_c = 0.52 ft

Froude Number

Fr = 0.77

Entrance Loss Coefficient

k_e = 0.20

Friction Loss Coefficient

k_f = 8.20

Sum of All Loss Coefficients

k_s = 9.40

Headwater:

Inlet Control Headwater

HW_I = 0.92 ft

Outlet Control Headwater

HW_O = 0.94 ft

Design Headwater Elevation

HW = 6132.79 ft

Headwater/Diameter OR Headwater/Rise Ratio

HW/D = 1.41

Outlet Protection:

Flow/(Diameter^{2.5})

Q/D^{2.5} = 3.28 ft^{0.5}/s

Tailwater Surface Height

Y_t = 0.27 ft

Tailwater/Diameter

Y_t/D = 0.40

Expansion Factor

1/(2*tan(θ)) = 4.14

Flow Area at Max Channel Velocity

A_t = 0.24 ft²

Width of Equivalent Conduit for Multiple Barrels

W_{eq} = - ft

Length of Riprap Protection

L_p = 2 ft

Width of Riprap Protection at Downstream End

T = 2 ft

Adjusted Diameter for Supercritical Flow

Da = - ft

Minimum Theoretical Riprap Size

d₅₀ min = 2 in

Nominal Riprap Size

d₅₀ nominal = 6 in

MHFD Riprap Type

Type = VL

APPENDIX F: MS4 AND WATER QUALITY DETERMINATION WORKSHEETS



Summary of Water Quality Conformance to MS4 Permit

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

Project Name Metzler Ranch Parking Lot

Project Owner RG Investments No. 1, LLLP

Project Location 11 Kellogg Court, Castle Rock 80918

ToCR Project Number SDP24-0016

Total Site Area 4.70 acre (0.88 Acre Disturbed) **acres**

Total Size of Common Plan of Development n/a **acres**

Check all that apply:

☒ **Project within Plum Creek Basin**

☐ **Project within Cherry Creek Basin**

Estimated construction completion date Winter 2024/2025

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

☒ WQCV standard

☐ Pollutant removal standard

☐ Runoff reduction standard

☐ Applicable site draining to regional WQVC control measure (accepts drainage prior to discharging to WOTS)

☐ Applicable site draining to regional WQVC control facility (with receiving pervious area control measure upstream of WOTS)

☐ Constrained redevelopment sites standard

• Imperviousness of existing site _____/_____ (Imp. Ac/Site Ac) = ____%

• Variance required TCV No. _____

☒ Existing control measure with WQCV per previous criteria standards

• Reference Construction Permit No. 97-9028

☐ Cherry Creek Basin only, choose one: ☐ Tier 1 ☐ Tier 2 ☐ Tier 3

☐ No control measures provided (See Permanent WQ Worksheet for applicability)

Summary of Water Quality Conformance to MS4 Permit

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

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

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

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

If yes, complete the following:

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

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

If yes, complete the following:

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

Applicant: RG Investments No 1 LLLP

Section	Question	Response	Instructions
3	Applicable Sites with Other Exclusions by Variance		
3.1	Category 1: Roadways, bridges and trails only		
3.1.1	Is the project a bike or pedestrian trail?	☐ Yes ☐ No	Proceed to next line. Proceed to 3.1.2.
	Is the trail for a roadway?	☐ Yes ☐ No	Proceed to 3.1.2. Project is excluded. Submit variance for <u>Trails Excluded from Permanent Water Quality Requirements</u> .
3.1.2	Is the project primarily used for parking or access to parking?	☐ Yes ☐ No	This exclusion does not apply. Permanent water quality is required. Proceed to 3.1.3.
3.1.3	Does the project add impervious area?	☐ No ☐ Yes	Project is excluded. Submit variance for <u>Pavement Management Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.1.4.
3.1.4	Does the project add more than 8.25 feet of paved width at any location to the existing roadway?	☐ No ☐ Yes	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Does the project add more than one acre of paved area per mile to an existing roadway?	☐ No ☐ Yes	Project is excluded. Submit variance for <u>Roadway Redevelopment Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Does the project increase the width by two times or more, on average, of the original roadway area?	☐ No ☐ Yes	Existing areas of site are excluded only. Submit variance for <u>Existing Roadway Surfaces Only Excluded from Permanent Water Quality Requirements</u> . This exclusion does not apply. Permanent water quality is required.
3.2	Category 2: Non-residential and non-commercial projects only		
3.2.1	Is the project associated with oil and gas exploration, production, processing, or treatment operations or transmission facilities, including activities necessary to prepare a site for drilling and the movement and placement of drilling equipment?	☐ Yes ☐ No	Project is excluded. Submit variance for <u>Oil and Gas Exploration Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.2.
3.2.2	Is the project for stream stabilization?	☐ Yes ☐ No	Project is excluded. Submit variance for <u>Stream Stabilization Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.3.
3.2.3	Is the project for installation or maintenance of aboveground or underground utilities or infrastructure that does not permanently alter the terrain, ground cover, or drainage patterns from those present prior to the construction activity including activities to install, replace or maintain utilities under roadways or other paved areas that return the surface to the same condition?	☐ Yes ☐ No	Project is excluded. Submit variance for <u>Aboveground and Underground Utilities Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.4.
3.2.4	Is the project on undeveloped land (land with no human-made structures such as buildings or pavement) that will remain undeveloped after the project?	☐ Yes ☐ No	Project is excluded. Submit variance for <u>Sites with Land Disturbances to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . Proceed to 3.2.5.
3.2.5	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	☐ No ☐ Yes	Project is excluded. Submit study along with variance for <u>Non-residential and Non-commercial Infiltration Conditions Excluded from Permanent Water Quality Requirements</u> . This exclusion does not apply. Permanent water quality is required.

Section	Question	Response	Instructions
3.3	Category 3: Residential, Agricultural and Commercial projects		
3.3.1	Is the project a single-family residential lot, or agricultural zoned lands, greater than or equal to 2.5 acres in size per dwelling unit?	☐ Yes ☐ No	Proceed to next line. Proceed to 3.3.2.
	Is the project site greater than 10% impervious?	☐ No ☐ Yes	Project is excluded. Submit variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> . Proceed to next line.
	Is the project site greater than 20% impervious?	☐ Yes ☐ No	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Will the post-project condition result in surface water discharge during the 80th percentile storm runoff event?	☐ No ☐ Yes	Project is excluded. Submit study along with variance for <u>Large Lot Single Family Sites Excluded from Permanent Water Quality Requirements</u> . This exclusion does not apply. Permanent water quality is required.
3.3.2	Will 100% of the runoff from the residential or commercial site be captured?	☐ Yes ☐ No	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is all or a portion of the site undeveloped or will it remain undeveloped after construction?	☐ Yes ☐ No	This portion of the project is excluded. Submit variance for <u>Sites with Land Disturbance to Undeveloped Land that will Remain Undeveloped Excluded from Permanent Water Quality Requirements</u> . Proceed to next line. Proceed to next line.
	Is the remaining untreated impervious area greater than 20% of the site?	☐ Yes ☐ No	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is the remaining untreated impervious area greater than one acre?	☐ Yes ☐ No	This exclusion does not apply. Permanent water quality is required. Proceed to next line.
	Is it practicable to capture runoff from portions of the site that will not drain to a control measure?	☐ No ☐ Yes	Document justification demonstrating that it is not practicable to capture runoff from this portion of the site in the drainage report . No further action is needed. This exclusion does not apply. Permanent water quality is required.

APPENDIX G: EX. PHASE III DRAINAGE STUDY FOR METZLER RANCH FILING NO. 2



830

PHASE III DRAINAGE STUDY
FOR
METZLER RANCH FILING NO. 2
TOWN OF CASTLE ROCK
DOUGLAS COUNTY, COLORADO

PREPARED FOR:

WINTERGREEN HOMES
305 MADISON STREET
DENVER, COLORADO 80206

PROJECT NO. 97-9028

MAY 1998



Town of Castle Rock
680 N. Wilcox Street, P.O. Box 8000
Castle Rock, CO 80104-8000

May 6, 1998

Re. Metzler Ranch Filing No. 2
Project No. 97-9028

Dear Mr. Rod Hamilton:

We are pleased to submit the Phase III Drainage Report and Construction Drawings, sheets one through twenty-five.

If you have any concerns or questions, please feel free to contact us .

Respectfully,

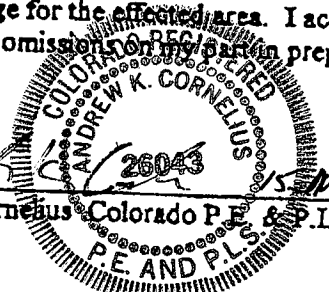
A handwritten signature in cursive script, appearing to read "Andrew K. Cornelius".

Andrew K. Cornelius, P.E. & P.L.S.
Project Engineer

DATE:
PROJECT NAME:
PROJECT NUMBER:

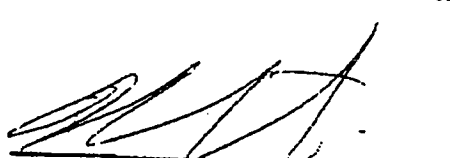
ENGINEER'S STATEMENT:

The enclosed drainage report, and exhibits, was prepared by me or under my direct supervision and is correct to the best of my knowledge and belief. Said drainage report has been prepared in accordance with applicable Town of Castle Rock criteria and is in-conformance with the master plan of drainage for the affected area. I accept responsibility for any liability caused by negligent acts, errors or omissions on my part in preparing this report.

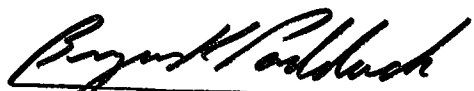

Andrew K. Cornelius Colorado P.E. & P.L.S. No. 26043

OWNER/DEVELOPER'S STATEMENT:

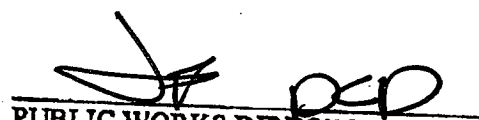
As Owner/Developer of land(s) identified within this report; I agree to proceed, implement and comply with all recommendations and requirements outlined herein.


Art Kleinstein for
Vista Villages, LLC

TOWN OF CASTLE ROCK APPROVALS:


ENGINEERING DIVISION

7/10/98
DATE


PUBLIC WORKS DIRECTOR

7/10/98
DATE

INTRODUCTION

The Proposed Metzler Ranch, filing No. 2 is located at the southwest corner of the Interstate Highway 25 and U.S. Highway 85 interchange, east of Liggett Road in the Town of Castle Rock, Colorado. The site is located in the northwest one-quarter of Section 35, Township 7 South, Range 67 West. This development is surrounded on the north by U.S. Highway 85, on the east by Interstate Highway 25, on the south by unplatted ranch land and on the west by Liggett Road. There are no major drainage improvements on the site except a ditch running north-south through the site. There is a culvert crossing U.S. Highway 85 from the north, near the center of the site.

The site contains 16.74 acres and is presently undeveloped with grass and weeds covering the site. An additional 9.79 acres contributes to runoff through the site. The site is presently graded with a slope of 3.5% from the east to the west with the high point on the east property line approximately 500 feet north of the southeast corner. The development receives runoff from the Highway Right of Way to the Northeast through the previously described culvert. A majority of U.S. Highway 85 slopes to the west from the previously described high point. Liggett Road slopes to the north from a high point approximately 250 feet north of the southwest corner.

The development will consist of light industrial buildings with appurtenant parking lots, driveways, storage areas, and landscaping.

DRAINAGE BASINS

The proposed development lies in the East Plum Creek Drainage. There are no existing drainage facilities on the site except as noted above. The Master Drainage Study for the Metzler Ranch P.D. previously stated that this site is in one on-site basin with an off-site basin draining through it to the southwest corner of the site. The Master Drainage Study has been revised. This report is a duplication thereof as far as storm water drainage calculations. The basin designations used for the historic basins are based on the basin designations in the Master Drainage Study. There are presently 3 basins on the site with 2 off-site basins. The northeastern off-site basin (ME) consists of the Interstate Highway 25 and U.S. Highway 85 rights of way and contains 8.24

acres. This basin drains to the culvert on the north side of the site. The second off-site basin (MW) is located in the southern portion of the U.S. Highway 85 right of way along the northwestern edge of the site. It contains 1.08 acres, draining to a low point at the northwest lot corner. The first on-site basin (2 SE) is located in the southeast part of the site with a large portion consisting of Interstate Highway 25 right of way. The basin contains approximately 1.03 acres, draining to the south to a stock pond south of the southeast corner of the site. The major on-site basin (2 C) is located in the central portion of the site, encompassing 13.2 acres and drains to the southwest corner of the site. The off-site basin ME drains through this basin. Basin 2 C drains to the existing roadside ditch on the East side of Liggett Road to a 6' by 6' box culvert crossing the road then on to East Plum Creek. The last on-site basin (2 NW) is located in the northwest portion of the site. This basin consists of 3.91 acres, draining to the northwest under Liggett Road then in a road side ditch on the west side of U.S. Highway 85, and eventually to East Plum Creek.

The soils on this site, for the offsite basin ME, are Kutch sandy loam and Blakeland-Orsa association and; for the onsite and remaining offsite basins, Bresser sandy loam, Sampson loam, and Blakeland-Orsa association. The Kutch soil is a hydrologic group D soil, the Bresser and Sampson soils are hydrologic group B soils; and the Blakeland-Orsa soil is a hydrologic Group A soil.

DRAINAGE CRITERIA

The design criteria used in this study have been set forth in Urban Drainage and Flood Control District's "Urban Storm Drainage Criteria Manual", "The Douglas County Storm Drainage Design and Technical Criteria", The Town of Castle Rock "Standard Construction Specifications for Public Works Improvements", and "The Town of Castle Rock, Metzler Ranch Master Drainage Study".

Due to the overall size of this development (27.5 acres) the Rational Method was utilized in the computation of the storm runoff quantities. The design storms analyzed were 10 and 100-year storms for runoff as required. The assumptions and calculations used to prepare this report are included in the appendix.

DRAINAGE SYSTEM

The proposed site has been divided into eleven (11) drainage sub-basins with two (2) off-site basin draining through the site and one off-site basin continuing its historic pattern. The first sub-basin (I) is the off-site basin to the northeast and is the same as historic off-site basin ME with an additional 0.56 acres, due to regrading in the U.S. Highway 85 Right of Way. This sub-basin contains 8.80 acres and retains the character of the historic basin draining via an inlet and storm drain into sub-basin VIII. The second sub-basin (II) is a truncation of historic basin 2 SE. This sub-basin contains 0.50 acres and drains to the south at the same point and in the same direction as the historic basin. The third sub-basin (III) is located in the eastern portion of the site and consists of a probable self storage complex with parking, driveways and landscaping. This sub-basin contains 4.35 acres, draining to the southwest into sub-basin VIII. The fourth sub-basin (IV) is located in the east-central portion of the site consisting of part of a building, parking lot, driveway, gravel surfaced storage area and landscaping and has been divided into two subbasins, Basin IV which contains 2.53 acres and Basin IV-A which contains 0.34 acres. Basin IV and IV-A drain via inlets and storm drains into sub-basin VIII. Sub-basin V, located in the west-central portion of the site, consists of parts of three buildings, parking and driveways, gravel surfaced storage area, and landscaping. This sub-basin contains 3.13 acres, draining through an inlet and storm drain into sub-basin VIII. Sub-basin VI is located in the northwest portion of the site. Parking, driveways, gravel surfaced storage area, and landscaping comprise this basin. Sub-basin VI contains 3.62 acres draining via a storm drain into Sub-basin VIII. The seventh sub-basin (VII) is located in the northwest corner of the site and consists of 0.78 acres. This sub-basin contains gravel surfaced storage area, landscaping, the northeast half of Liggett Road and drains undetained to the northwest, following the route of historic Basin 2 NW. Sub-basin VIII is located in the southern portion of the site. It contains the private road and detention pond. This sub-basin is 1.68 acres and drains via a control structure to a storm drain system then into the roadside ditch flowing south along the east side of Liggett Road, following the historic route of Basin 2 C. Sub-basin IX is located in the southern portion of the site, on the slopes of the road and pond berm, and sub-basin X consists of a portion of the private road and the southeastern portion of Liggett Road and landscaping. These sub-basins contains 0.41 acres (IX) and 0.41 acres (X) and drain undetained to the south and southwest.

The following table summarizing historic, developed, undetained and off site flows

Design		Contributing	Runoff Quantity (cfs)	
<u>Point</u>	<u>Basin</u>	<u>Area (Ac)</u>	<u>10-year</u>	<u>100-year</u>
<u>HISTORIC</u>				
A	ME	8.24	5.1	12.0
E	2 C	13.2	2.1	13.0
E	ME + 2 C	21.4	4.4	16.0
B	2 SE	1.03	1.0	3.0
D	2 NW	3.91	1.0	3.9
C	MW	1.08	0.8	2.2
<u>DEVELOPED</u>				
1	I	8.80	4.8	12.5
5	III	4.35	12.6	26.4
6	IV	2.53	6.2	12.5
6A	IV-A	0.34	1.5	2.5
7	V	3.13	10.1	16.2
8	VI	3.62	12.2	19.6
9	VIII	1.68	2.0	4.6
9	I,III,IV,V,VI, & VIII	24.45	16.5	64.3
<u>UNDETAINED</u>				
10	IX	0.41	0.1	0.6
10	X	0.40	2.0	3.5
<u>OFFSITE</u>				
2	II	0.50	0.6	1.7
3	MW	1.08	1.3	3.4
4	VII	0.78	1.2	2.4

Note: The summation of the incremental runoff quantities may not equal the runoff quantities of the combined basins due to an increase of the time of concentration and therefore a reduction in rainfall intensity. The calculations for this table are presented in the Appendix to this report.

Detention is required for the site. A detention pond will be constructed in the southwest corner of the site. This pond will have a minimum capacity of 43,079 and 76,547 cubic feet for the 10 and 100-year storms respectively.

The following table compares detention pond capacities from the revised Master Drainage Study and this study:

<u>STORM</u>	<u>MASTER STUDY</u>	<u>THIS STUDY</u>
10-Year	45,366 cubic feet	43,079 cubic feet
100-Year	80,443 cubic feet	76,547 cubic feet

HYDRAULIC DESIGN

A low profile berm encloses a 76,547 cubic foot (1.76 acre-foot) detention pond in the southwest corner of Filing Two (This tract is described above as part of sub basin VIII). Storm water is conveyed to the pond through three pipe systems as shown on the drainage map, and through direct runoff from the adjacent private street for routing through the pond. Within the detention pond a 32" wide trickle channel has been designed for greater than 3% of the 100 year storm event. Detention pond sideslopes have been designed with 3:1 slopes on the interior (wet) side of the pond, with 4:1 slopes on the exterior. On the north side, the private road's elevation nearly matches the 12 foot wide pond berm. This affords easy access to the pond for maintenance, as well as providing less visual impact.

Detained storm water will be released from the detention pond for the Q10 event at a maximum 5.78 CFS and for the 100 year storm at a maximum 21.35 CFS. Water leaving the pond will be conveyed through a dual detention outlet (type 2) through a 24" RCP pipe (with restrictor plate), that will carry the water for 65 feet to the west into an storm drainage manhole where it will turn and flow for approximately 338 feet to the south under the asphalt along Liggett

Road until it can daylight into a proposed drainage swale that parallels the east edge of the road. The proposed ditch will be graded at 1% for 325 feet to where it meets existing ground and follows the historic ditch into the existing box culvert. Rip-rap will be installed to aid in the control of erosion at the outfall of the pipe. The runoff will then follow the route of historic Basin 2 C. Details of these design concepts are presented in the Appendix.

CONCLUSION

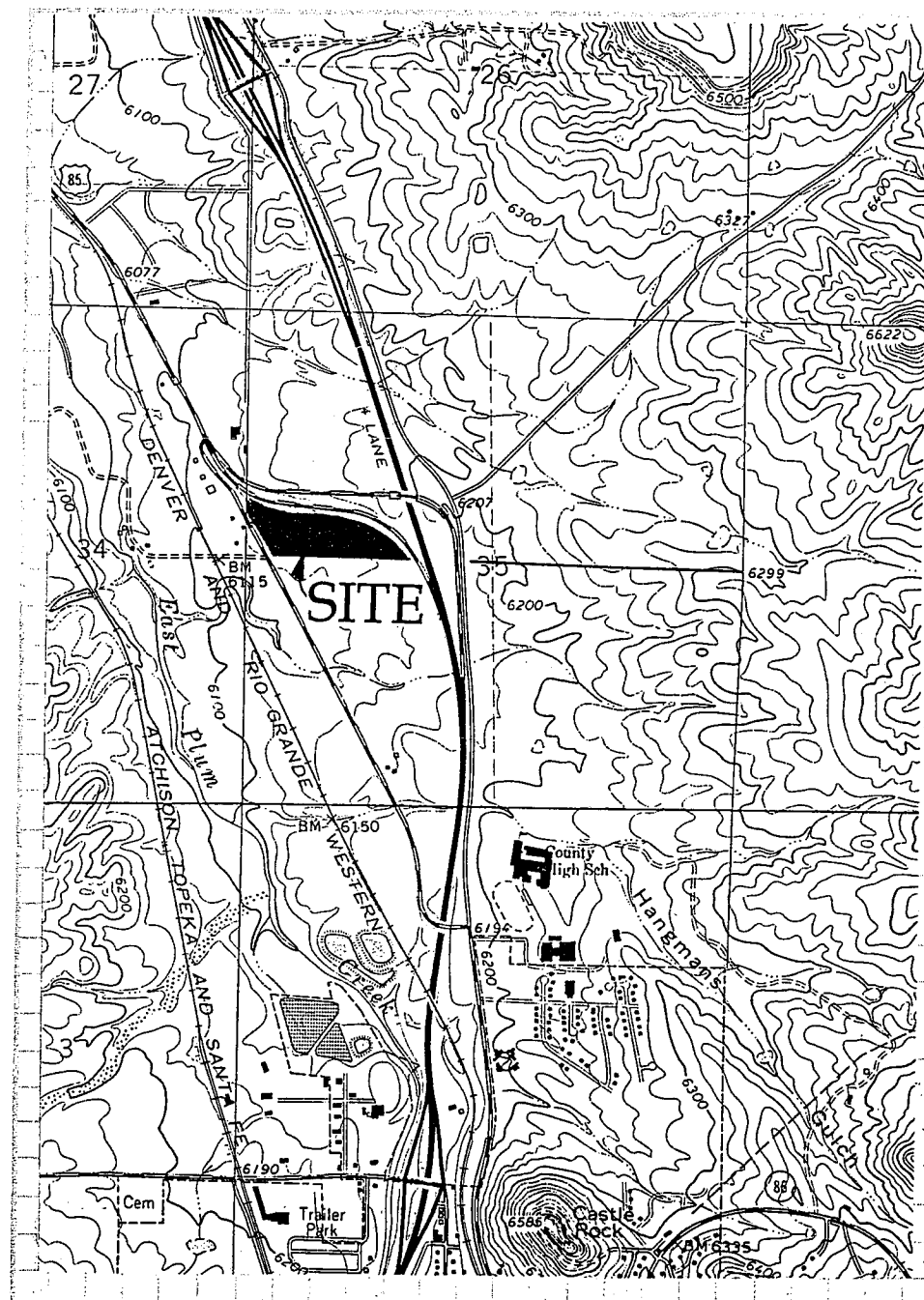
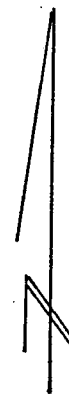
This report has been prepared in conformance with Town of Castle Rock "Standard Construction Specifications for Public Works Improvements", Douglas County's "Storm Drainage Design and Technical Criteria" and the Urban Drainage and Flood Control District's "Urban Storm Drainage Criteria Manual". The design concepts described above and in the following technical appendix represent best engineering judgment within the guidelines of the criteria set in the aforementioned manuals and specifications, as well as prevailing practice in the Denver metropolitan area. The improvements proposed in this report are an effective way of controlling storm runoff from the site.

The authorized use of this report and accompanying plans is held by Inter-Mountain Engineering (IME) and the client only. Any changes to this report and / or plans by a party other than the preparer will invalidate the intended use, and relieve IME from all responsibility. Although all reports and plans are prepared under professional supervision, discrepancies may occur. Any imperfections in this report or accompanying plans should be reported to the preparer immediately. Failure to report any findings to IME may cause complications in construction.

TECHNICAL APPENDIX



PROJECT Metzler Ranch PROJECT No. 97-9028
SUBJECT Drainage Vicinity Map



Scale: 1"=2000'

Vicinity Map

U.S.G.S. Topographic Map

Castle Rock North, Colorado

dated 1965, photo revised in 1980



METZLER RANCH

FILING NO.2

PROJECT No. 97-9028

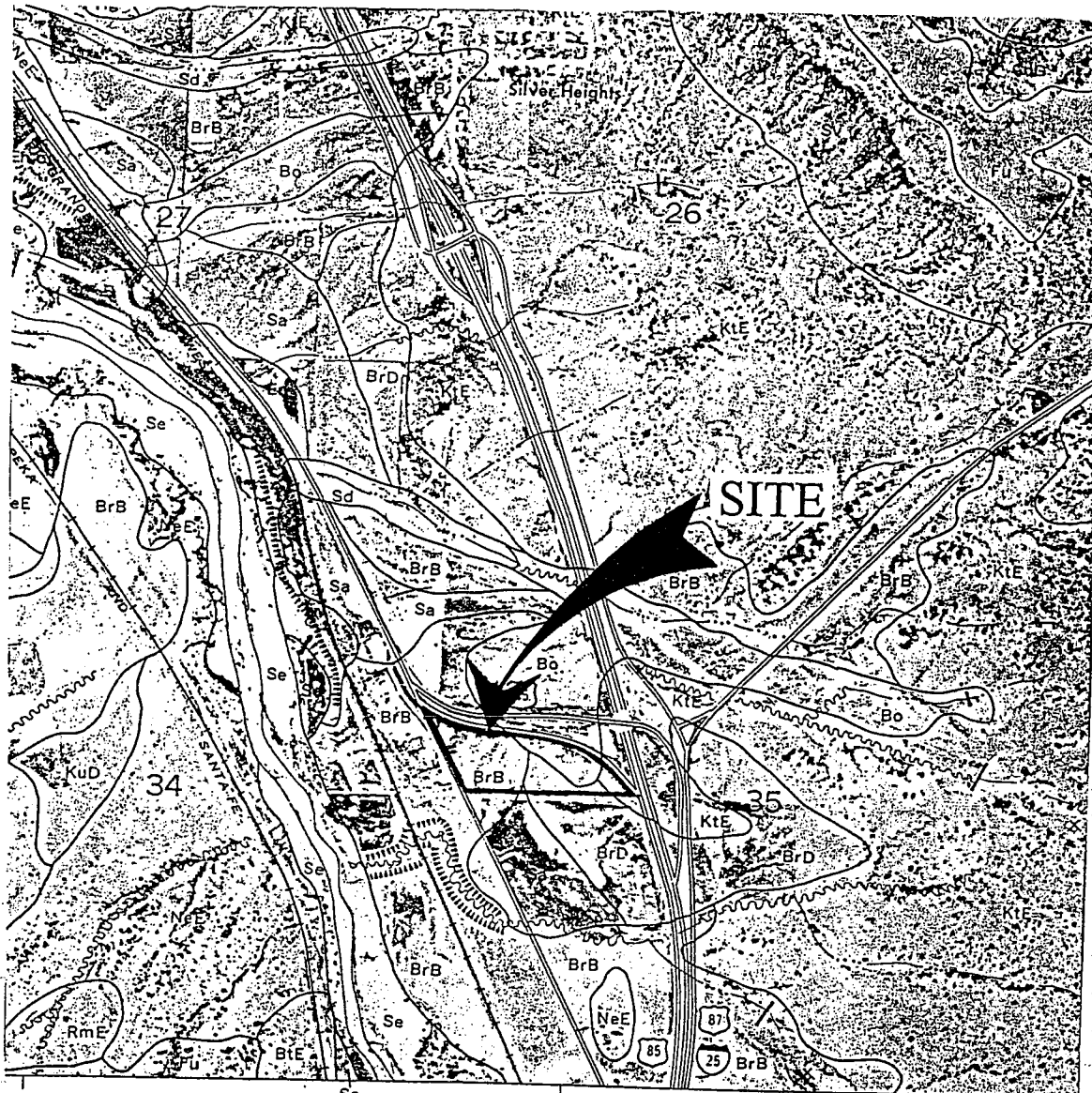
PROJECT

SUBJECT

SOILS LOCATION MAP

DATE / BY

SHEET No.



SOIL SURVEY OF CASTLE ROCK AREA, COLORADO

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

NOVEMBER 1974

SOIL LEGEND

PLATE 19

Bo	BLAKELAND-ORSA ASSOCIATION
BrB	BRESSER SANDY LOAM
BrD	BRESSER SANDY LOAM
KtE	KUTCH SANDY LOAM
Sa	SAMPSON LOAM

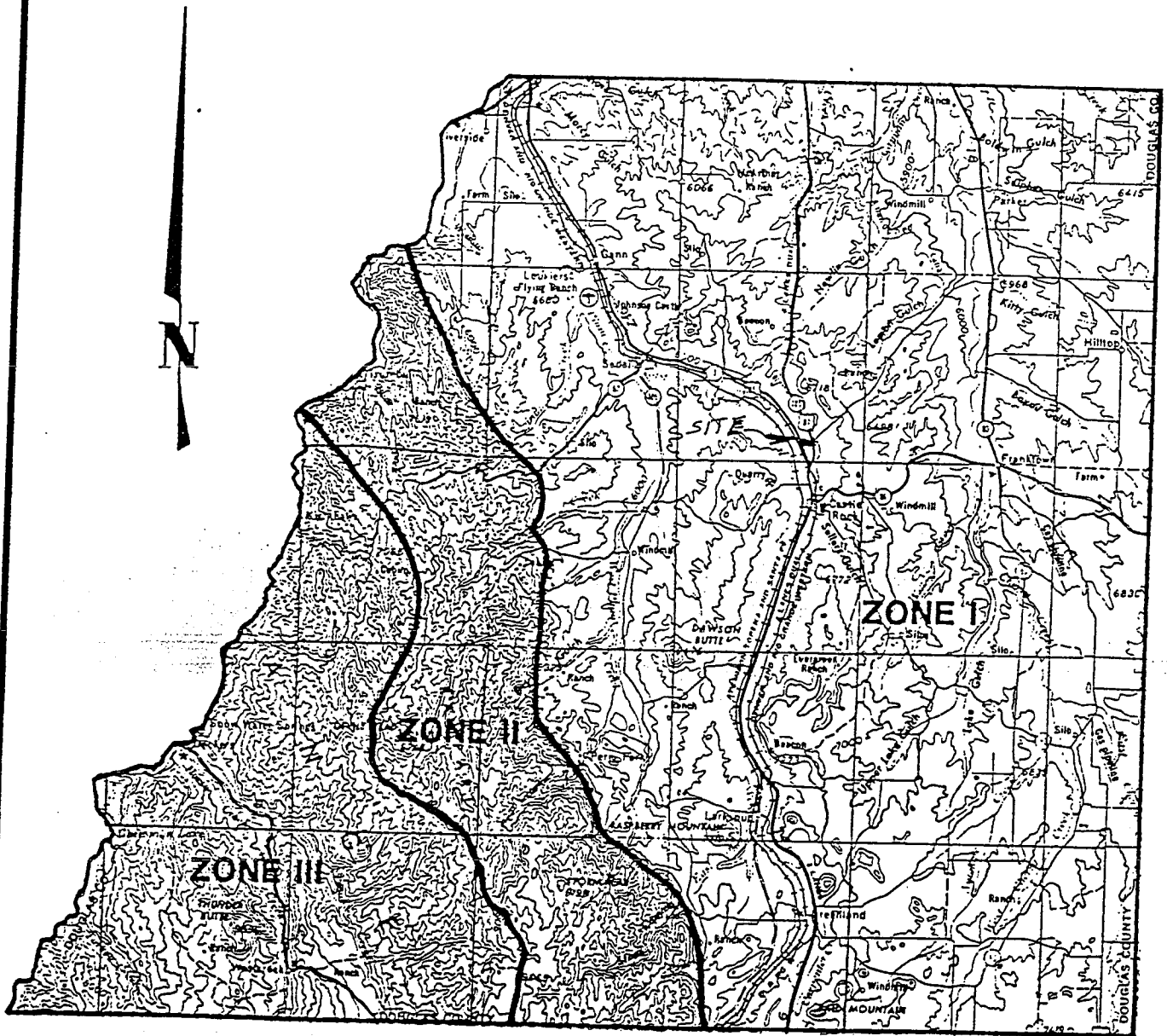
1 to 3% SLOPES

3 to 9% SLOPES

5 to 20% SLOPES

3 2 1 0 1 2 3 mi.

SCALE 1:250,000



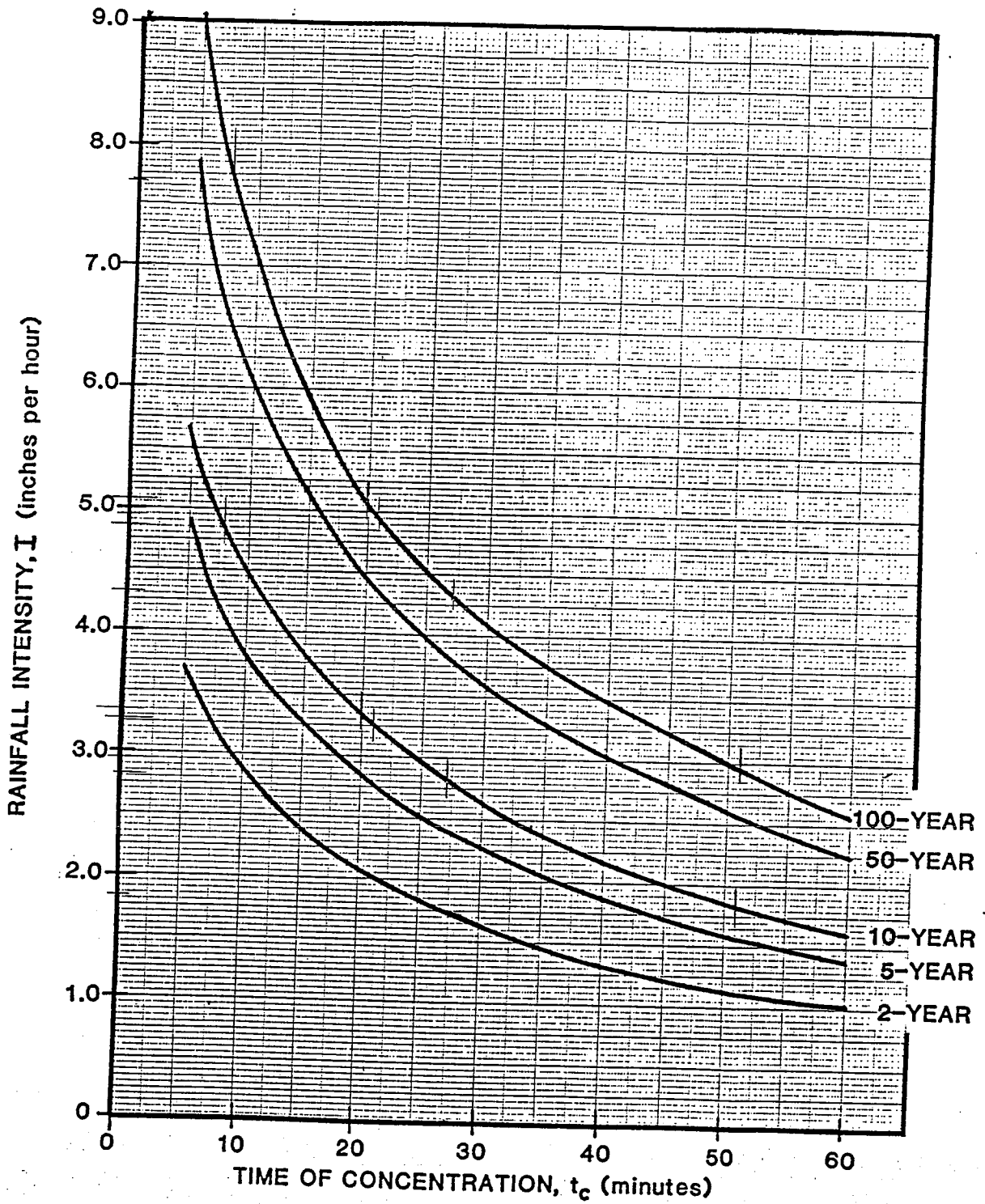
RAINFALL ZONES

Date: NOV 1984
Rev:

REFERENCE: WRC TM-1, 5-24-84

DCSDDTC

TIME - INTENSITY - FREQUENCY CURVES ZONE I



Date: NOV 1984
Rev:

REFERENCE: WRC TM-1, 5-24-1984

DCSDDTC

TABLE 3-1 (42)
RECOMMENDED RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR	PERCENT	FREQUENCY			
SURFACE CHARACTERISTICS	IMPERVIOUS	2	5	10	100
<u>Business:</u>					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	70	.60	.65	.70	.80
<u>Residential:</u>					
Single-Family	*	.40	.45	.50	.60
Multi-Unit (detached)	50	.45	.50	.60	.70
Multi-Unit (attached)	70	.60	.65	.70	.80
1/2 Acre Lot or Larger	*	.30	.35	.40	.60
Apartments	70	.65	.70	.70	.80
<u>Industrial:</u>					
Light Areas	80	.71	.72	.76	.82
Heavy Acres	90	.80	.80	.85	.90
<u>Parks, Cemeteries:</u>	7	.10	.18	.25	.45
<u>Playgrounds:</u>	13	.15	.20	.30	.50
<u>Schools:</u>	50	.45	.50	.60	.70
<u>Railroad Yard Areas</u>	20	.20	.25	.35	.45
<u>Undeveloped Areas:</u>					
Historic Flow Analysis-	2	(See "Lawns")			
Greenbelts, Agricultural					
Offsite Flow Analysis (when land use not defined)	45	.43	.47	.55	.65
<u>Streets:</u>					
Paved	100	.87	.88	.90	.93
Gravel (Packed)	40	.40	.45	.50	.60
<u>Drive and Walks:</u>	96	.87	.87	.88	.89
<u>Roofs:</u>	90	.80	.85	.90	.90
<u>Lawns, Sandy Soil</u>	0	.00	.01	.05	.20
<u>Lawns, Clayey Soil</u>	0	.05	.15	.25	.50

NOTE: These Rational Formula coefficients may not be valid for large basins.

*See Figure 2-1 for percent impervious.

RUNOFF COEFFICIENTS EXISTING SITE

EXISTING OFFSITE BASIN ME

SURFACE	AREA (AC)	C5	C10	C100
ASPHALT	1.60	0.88	0.90	0.93
LANDSCAPE	6.64	0.01	0.05	0.20
TOTAL	8.24	0.18	0.22	0.34

EXISTING OFFSITE BASIN MW

SURFACE	AREA (AC)	C5	C10	C100
ASPHALT	0.20	0.88	0.90	0.93
LANDSCAPE	0.88	0.01	0.05	0.20
TOTAL	1.08	0.17	0.21	0.34

EXISTING BASIN 2 SE

SURFACE	AREA (AC)	C5	C10	C100
ASPHALT	0.25	0.88	0.90	0.93
LANDSCAPE	0.78	0.01	0.05	0.20
TOTAL	1.03	0.22	0.26	0.38

EXISTING BASIN 2 C

SURFACE	AREA (AC)	C5	C10	C100
ASPHALT	0.00	0.88	0.90	0.93
LANDSCAPE	13.18	0.01	0.05	0.20
TOTAL	13.18	0.01	0.05	0.20

EXISTING BASIN 2 NW

SURFACE	AREA (AC)	C5	C10	C100
ASPHALT	0.13	0.88	0.90	0.93
LANDSCAPE	3.78	0.01	0.05	0.20
TOTAL	3.91	0.04	0.08	0.22

TIMES OF CONCENTRATION EXISTING SITE

EXISTING OFFSITE BASIN ME

OVERLAND FLOW LENGTH (FT)	19
OVERLAND FLOW SURFACE	ASPHALT
RUNOFF COEFFICIENT (C5)	0.88
OVERLAND SLOPE (%)	2.0
CHANNELIZED SURFACE	GRASS
CHANNELIZED LENGTH (FT)	551
CHANNELIZED SLOPE (%)	1.3
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	0.8
CHANNELIZED SURFACE	CULVERT
CHANNELIZED LENGTH (FT)	78
CHANNELIZED SLOPE (%)	3.8
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	3.8
CHANNELIZED SURFACE	GRASS
CHANNELIZED LENGTH (FT)	946
CHANNELIZED SLOPE (%)	2.8
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	1.2
CHANNELIZED SURFACE	CULVERT
CHANNELIZED LENGTH (FT)	104
CHANNELIZED SLOPE (%)	7.7
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	5.8

TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)	26.6 USE	27
--	----------	----

EXISTING OFFSITE BASIN MW

OVERLAND FLOW LENGTH/ SURFACE (FT)	13
OVERLAND FLOW SURFACE	ASPHALT
RUNOFF COEFFICIENT	0.88
OVERLAND SLOPE (%)	2.0
CHANNELIZED SURFACE	GRASS
CHANNELIZED LENGTH (FT)	803
CHANNELIZED SLOPE (%)	2.9
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	3.4

TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)	5.1 USE	5
--	---------	---

TIMES OF CONCENTRATION EXISTING SITE

EXISTING BASIN 2 SE

OVERLAND FLOW LENGTH/ SURFACE (FT)	24	
OVERLAND FLOW SURFACE	ASPHALT	
RUNOFF COEFFICIENT	0.88	
OVERLAND SLOPE (%)	3.2	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	458	
CHANNELIZED SLOPE (%)	3.2	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.2	
<u>TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)</u>	<u>7.7 USE</u>	<u>8</u>

EXISTING BASIN 2 C

OVERLAND FLOW LENGTH/ SURFACE (FT)	30	
OVERLAND FLOW SURFACE	GRASS	
RUNOFF COEFFICIENT	0.01	
OVERLAND SLOPE (%)	13.8	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	1326	
CHANNELIZED SLOPE (%)	3.2	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.3	
<u>TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)</u>	<u>21.5 USE</u>	<u>21</u>

EXISTING BASIN 2 NW

OVERLAND FLOW LENGTH/ SURFACE (FT)	43	
OVERLAND FLOW SURFACE	GRASS	
RUNOFF COEFFICIENT	0.01	
OVERLAND SLOPE (%)	2.3	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	813	
CHANNELIZED SLOPE (%)	2.9	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.2	
<u>TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)</u>	<u>21.0 USE</u>	<u>21</u>

TIMES OF CONCENTRATION EXISTING SITE

TOTAL TIME OF CONCENTRATION AT 2 SE FROM OFFSITE ME

TIME OF CONCENTRATION AT M	27
CHANNELIZED SURFACE	GRASS
CHANNELIZED LENGTH (FT)	1159
CHANNELIZED SLOPE (%)	1.1
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	0.8

<u>TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)</u>	<u>51 USE</u>	<u>51</u>
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**STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)**

CALCULATED BY AKG
DATE MAY 22, 1997
CHECKED BY _____

PROJECT NO. 97-9028 PAGE of
PROJECT METZLER RANCH 17 AC SOUTHWEST
DESIGN STORM 10 YR HISTORIC

STREET	DESIGN POINT	DIRECT RUNOFF				TOTAL RUNOFF				STREET			PIPE			TRAVEL TIME			REMARKS	
		AREA DESIGNATION	AREA (AC)	RUNOFF COEFF.	T _c (MIN)	C _s A (AC)	I (IN/HR)	Q (CFS)	t _c (MIN)	SUM (C _s A) (AC)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (IN)	LENGTH (FT)		VELOCITY (FPS)
	A	ME	8.24	0.22	27	1.81	2.8	5.1												
	E	2 C	13.2	0.05	21	0.66	3.25	2.1	51	2.47	1.8	4.4	1.1	8.8			1160	0.8	51	
	B	2 SE	1.03	0.26	8	0.27	3.85	1.0												
	D	2NW	3.91	0.08	21	0.31	3.35	1.0												
	C	MW	1.08	0.21	5	0.23	3.72	0.8												

STANDARD FORM SF-3
STORM DRAINAGE SYSTEM DESIGN
(RATIONAL METHOD PROCEDURE)

CALCULATED BY AKC
 DATE MAY 22, 1997
 CHECKED BY _____

PROJECT NO. 97-9028 PAGE of
 PROJECT METZLER RANCH 17 AC SOUTHWEST
 DESIGN STORM 100 YR HISTORIC

STREET	DESIGN POINT	DIRECT RUNOFF					TOTAL RUNOFF					STREET				PIPE				TRAVEL TIME			REMARKS
		AREA DESIGNATION	AREA (AC)	RUNOFF COEFF	Tc (MIN)	C*A (AC)	I (IN/HR)	Q (CFS)	to (MIN)	SUM (C*A)	I (IN/HR)	Q (CFS)	SLOPE (%)	STREET FLOW (CFS)	DESIGN FLOW (CFS)	SLOPE (%)	PIPE SIZE (IN)	LENGTH (FT)	VELOCITY (FPS)	#			
	A	ME	8.24	0.34	27	2.80	4.30	12.0															
	E	2 C	13.2	0.20	21	2.64	4.95	13.0	51	5.4	3.0	16.0					1160	0.8	24				
	B	2SE	1.03	0.38	8	0.39	7.70	3.0															
	D	2NW	3.91	0.20	21	0.78	5.05	3.9															
	C	MW	1.08	0.22	5	0.24	9.05	2.2															

RUNOFF COEFFICIENTS PROPOSED SITE

PROPOSED OFFSITE BASIN I

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
ASPHALT	1.65	0.88	0.90	0.89	100
LANDSCAPE	7.15	0.01	0.05	0.20	0
TOTAL	8.80	0.17	0.21	0.33	19

PROPOSED OFFSITE BASIN MW (UNDETAINED -HISTORIC)

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
ASPHALT	0.20	0.88	0.90	0.93	100
LANDSCAPE	0.88	0.01	0.05	0.20	0
TOTAL	1.08	0.17	0.21	0.34	19

PROPOSED BASIN II

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
ASPHALT	0.12	0.88	0.90	0.93	100
LANDSCAPE	0.38	0.01	0.05	0.20	0
TOTAL	0.50	0.22	0.25	0.38	24

PROPOSED BASIN VI

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
BUILDING	0.20	0.85	0.90	0.90	90
WALKS & ASPHALT	0.40	0.87	0.88	0.89	96
GRAVEL	2.60	0.88	0.90	0.93	40
LANDSCAPE	0.42	0.01	0.05	0.20	0
TOTAL	3.62	0.78	0.78	0.82	44

PROPOSED BASIN IV

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
BUILDING	0.30	0.85	0.90	0.90	90
WALKS & ASPHALT	0.50	0.87	0.88	0.89	96
GRAVEL	1.50	0.88	0.90	0.93	40
LANDSCAPE	0.23	0.01	0.05	0.20	0
TOTAL	2.53	0.80	0.82	0.85	53

RUNOFF COEFFICIENTS PROPOSED SITE

PROPOSED BASIN IV-A

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
WALKS & ASPHALT	0.30	0.87	0.88	0.89	96
LANDSCAPE	0.04	0.01	0.05	0.20	0
TOTAL	0.34	0.77	0.78	0.81	85

PROPOSED BASIN V

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
BUILDING	0.32	0.85	0.90	0.90	90
WALKS & ASPHALT	0.87	0.87	0.88	0.89	96
GRAVEL	1.70	0.88	0.90	0.93	40
LANDSCAPE	0.24	0.01	0.05	0.20	0
TOTAL	3.13	0.81	0.83	0.86	58

PROPOSED BASIN III

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
BUILDING & ASPHALT	4.18	0.80	0.85	0.90	90
LANDSCAPE	0.17	0.15	0.25	0.50	0
TOTAL	4.35	0.77	0.83	0.88	86

PROPOSED BASIN VII

(UNDETAINED)

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
GRAVEL	0.13	0.88	0.90	0.93	40
LANDSCAPE	0.46	0.01	0.05	0.20	0
ASPHALT	0.19	0.87	0.88	0.89	96
TOTAL	0.78	0.36	0.39	0.49	30

PROPOSED BASIN IX

(UNDETAINED)

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
LANDSCAPE	0.41	0.01	0.05	0.20	0
TOTAL	0.41	0.01	0.05	0.20	0

RUNOFF COEFFICIENTS PROPOSED SITE

PROPOSED BASIN VIII (DETENTION POND & PART of PRIVATE ROAD)

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
ASPHALT	0.45	0.87	0.88	0.89	100
LANDSCAPE	1.23	0.01	0.05	0.20	0
TOTAL	1.68	0.24	0.27	0.38	27

PROPOSED BASIN X (KELLOGG COURT & LIGGETT ROAD)

SURFACE	AREA (AC)	C5	C10	C100	% IMPERVIOUS
ASPHALT	0.40	0.87	0.88	0.89	100
TOTAL	0.40	0.87	0.88	0.89	100

OVERALL IMPERVIOUS BASIN 2 (INCLUDES UNDETAINED BASIN IX)

BASIN	AREA (AC)	% IMPERVIOUS
I	8.80	19
VI	3.62	44
IV	2.53	53
IV-A	0.34	85
V	3.13	58
III	4.35	86
VIII	1.68	27
IX	0.41	0
TOTAL	24.86	44

TIMES OF CONCENTRATION PROPOSED SITE

PROPOSED OFFSITE BASIN I

OVERLAND FLOW LENGTH (FT)	19	
OVERLAND FLOW SURFACE	ASPHALT	
RUNOFF COEFFICIENT (C5)	0.88	
OVERLAND SLOPE (%)	2.0	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	540	
CHANNELIZED SLOPE (%)	1.3	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	0.8	
CHANNELIZED SURFACE	CULVERT	
CHANNELIZED LENGTH (FT)	74	
CHANNELIZED SLOPE (%)	22.0	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	3.4	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	80	
CHANNELIZED SLOPE (%)	3.8	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	3.8	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	860	
CHANNELIZED SLOPE (%)	2.0	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	1.0	
TIME OF CONCENTRATION (MIN)	27.7 USE	28

TOTAL TRAVEL TIME TO DESIGN PT 6)

INITIAL TIME OF CONCENTRATION	27.7	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	450	
CHANNELIZED SLOPE (%)	1.0	
PIPE VELOCITY	5.3	
TIME OF CONCENTRATION (MIN)	29.1 USE	29

PROPOSED BASIN II

OVERLAND FLOW LENGTH/ SURFACE (FT)	22	
OVERLAND FLOW SURFACE	ASPHALT	
RUNOFF COEFFICIENT	0.88	
OVERLAND SLOPE (%)	2.0	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	193	
CHANNELIZED SLOPE (%)	8.3	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	2.0	
TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)	3.1 USE	5

TIMES OF CONCENTRATION PROPOSED SITE

PROPOSED BASIN III

OVERLAND FLOW LENGTH/ SURFACE (FT)	20	
OVERLAND FLOW SURFACE	GRASS	
RUNOFF COEFFICIENT	0.01	
OVERLAND SLOPE (%)	2.0	
CHANNELIZED SURFACE	ASPHALT	
CHANNELIZED LENGTH (FT)	600	
CHANNELIZED SLOPE (%)	2.0	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	2.6	
TIME OF CONCENTRATION (MIN)	10.8 USE	11

TOTAL TRAVEL TIME TO DESIGN PT 5A)

INITIAL TIME OF CONCENTRATION	10.8	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	271	
CHANNELIZED SLOPE (%)	1.0	
PIPE VELOCITY	9.3	
TOTAL TIME OF CONCENTRATION (MIN)	11.3 USE	11

PROPOSED BASIN IV

OVERLAND FLOW LENGTH/ SURFACE (FT)	195	
OVERLAND FLOW SURFACE	GRAVEL	
RUNOFF COEFFICIENT	0.45	
OVERLAND SLOPE (%)	2.5	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	350	
CHANNELIZED SLOPE (%)	0.6	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.6	
TIME OF CONCENTRATION (MIN)	15.7 USE	16

ADD TIME FROM DES. PT 5A TO POND

INITIAL TIME OF CONCENTRATION	15.7	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	305	
CHANNELIZED SLOPE (%)	1.0	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	4.0	
TOTAL TIME OF CONCENTRATION (MIN)	17.0 USE	17

TIMES OF CONCENTRATION PROPOSED SITE

PROPOSED BASIN IV-A

OVERLAND FLOW LENGTH/ SURFACE (FT)	10	
OVERLAND FLOW SURFACE	GRAVEL	
RUNOFF COEFFICIENT	0.01	
OVERLAND SLOPE (%)	1.0	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	220	
CHANNELIZED SLOPE (%)	1.0	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.9	
TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)	8.1 USE	8

ADD TIME FROM DES. PT 5A TO POND

INITIAL TIME OF CONCENTRATION	8.1	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	170	
CHANNELIZED SLOPE (%)	1.0	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	4.0	
TOTAL TIME OF CONCENTRATION (MIN)	8.8 USE	9

PROPOSED BASIN V

OVERLAND FLOW LENGTH/ SURFACE (FT)	50	
OVERLAND FLOW SURFACE	GRAVEL	
RUNOFF COEFFICIENT	0.45	
OVERLAND SLOPE (%)	2.0	
CHANNELIZED SURFACE	CONCRETE	
CHANNELIZED LENGTH (FT)	70	
CHANNELIZED SLOPE (%)	0.6	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.6	
CHANNELIZED SURFACE	GRAVEL	
CHANNELIZED LENGTH (FT)	340	
CHANNELIZED SLOPE (%)	1.8	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.0	
TIME OF CONCENTRATION (MIN)	13.0 USE	13

TOTAL TRAVEL TIME TO POND OUTLET (9)

INITIAL TIME OF CONCENTRATION	13.0	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	80	
CHANNELIZED SLOPE (%)	1.0	
CHANNELIZED VELOCITY (FT/SEC) (FIG 3-2)	2.0	
CHANNELIZED SURFACE	TRICKLE	
CHANNELIZED LENGTH (FT)	40	
CHANNELIZED SLOPE (%)	0.7	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.7	
CHANNELIZED SURFACE	TRICKLE	
CHANNELIZED LENGTH (FT)	240	
CHANNELIZED SLOPE (%)	0.7	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.7	
TIME OF CONCENTRATION (MIN)	14.1 USE	14

TIMES OF CONCENTRATION PROPOSED SITE

PROPOSED BASIN VI

OVERLAND FLOW LENGTH/ SURFACE (FT)	110	
OVERLAND FLOW SURFACE	GRASS	
RUNOFF COEFFICIENT	0.45	
OVERLAND SLOPE (%)	2.0	
CHANNELIZED SURFACE	GUTTER	
CHANNELIZED LENGTH (FT)	430	
CHANNELIZED SLOPE (%)	1.0	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	2.0	
CHANNELIZED SURFACE	PIPE	
CHANNELIZED LENGTH (FT)	150	
CHANNELIZED SLOPE (%)	0.5	
CHANNELIZED VELOCITY (FT/SEC)	3.0	
TIME OF CONCENTRATION (MIN)	13.3 USE	13

PROPOSED BASIN VII

OVERLAND FLOW LENGTH/ SURFACE (FT)	28	
OVERLAND FLOW SURFACE	GRASS	
RUNOFF COEFFICIENT	0.01	
OVERLAND SLOPE (%)	4.60	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	389	
CHANNELIZED SLOPE (%)	2.5	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.1	
TIME OF CONCENTRATION (MIN)	12.1 USE	12

PROPOSED BASIN VIII - DETENTION POND

CHANNELIZED SURFACE	GUTTER	
RUNOFF COEFFICIENT	0.87	
OVERLAND FLOW LENGTH/ SURFACE (FT)	50	
OVERLAND SLOPE (%)	1.1	
CHANNELIZED SURFACE	GUTTER	
CHANNELIZED LENGTH (FT)	560	
CHANNELIZED SLOPE (%)	1.1	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	2.1	
CHANNELIZED SURFACE	PIPE	
OVERLAND FLOW LENGTH/ SURFACE (FT)	35	
CHANNELIZED SLOPE (%)	1.0	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	6.0	
CHANNELIZED SURFACE	TRICKLE CHANNEL	
CHANNELIZED LENGTH (FT)	270	
CHANNELIZED SLOPE (%)	0.7	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	1.8	
TIME OF CONCENTRATION (MIN)	9.9 USE	10

TIMES OF CONCENTRATION PROPOSED SITE

PROPOSED BASIN IX

OVERLAND FLOW LENGTH/ SURFACE (FT)	20	
OVERLAND FLOW SURFACE	GRASS	
RUNOFF COEFFICIENT	0.01	
OVERLAND SLOPE (%)	2.0	
TIME OF CONCENTRATION (MIN)	7.0 USE	7

PROPOSED BASIN X

OVERLAND FLOW LENGTH/ SURFACE (FT)	20	
OVERLAND FLOW SURFACE	ASPHALT	
RUNOFF COEFFICIENT	0.87	
OVERLAND SLOPE (%)	3.8	
TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)	1.2 USE	5

PROPOSED BASIN MW

OVERLAND FLOW LENGTH/ SURFACE (FT)	13	
OVERLAND FLOW SURFACE	ASPHALT	
RUNOFF COEFFICIENT	0.88	
OVERLAND SLOPE (%)	2.0	
CHANNELIZED SURFACE	GRASS	
CHANNELIZED LENGTH (FT)	803	
CHANNELIZED SLOPE (%)	2.9	
CHANNELIZED VELOCITY (FT/SEC) FIG 3-2	3.4	
TIME OF CONCENTRATION (MIN) (5 MINUTE MINIMUM)	5.1 USE	5

STANDARD FORM SF-3										STORM DRAINAGE SYSTEM DESIGN (RATIONAL METHOD PROCEDURE)										
CALCULATED BY LPI/ACG			PROJECT NO. 97-9028			PAGE 2 OF 2			PROJECT METZLER RANCH NO. 2-PHASE3			DESIGN STORM 100 YR DEVELOPED								
DATE 05/05/98																				
CHECKED BY																				
STREET	DESIGN POINT	DESIGNATION	AREA (AC)	RUNOFF COEFF	T ₀ (MIN)	C ₀ A (AC)	I (IN/HR)	Q (CFS)	T ₀ (MIN)	SUM (C ₀ A)	I (IN/HR)	Q (CFS)	STREET SLOPE (%)	STREET FLOW (CFS)	PIPE SLOPE (%)	PIPE SIZE (IN)	LENGTH (FT)	VELOCITY (FPS)	# (MIN)	REMARKS
	1	I	8.80	0.33	28	2.9	4.3	12.5	28	2.90	4.2	12.5								
	5	III	4.35	0.88	11	3.83	6.9	26.4	11	6.73	6.8	45.8								
	6	IV	2.53	0.85	16	2.15	5.8	12.5	29	8.88	4.2	37.3								
	6A	IV-A	0.34	0.81	5	0.28	9.2	2.5	29	9.16	4.1	37.5								5' TYPE R
	7	V	3.13	0.86	14	2.69	6	16.2												BASN I-IVA SUM
	8	VI	3.91	0.82	13	3.21	6.1	19.6												
	9	VIII	1.68	0.38	10	0.64	7.2	4.6	30	15.7	4.1	64.3								USE 2 18" PIPES
	10	IX	0.41	0.20	7	0.08	7.8	0.6												BASIN I-VIII
	4	VII	0.78	.49	12	0.38	6.2	2.4												UNDETAINED
	2	II	0.50	0.38	5	0.19	9.2	1.7												UNDETAINED
	3	MW	1.08	0.34	5	0.37	9.2	3.4												OFFSITE
	10	X	.41	.93	5	0.38	9.2	3.5												OFFSTE
																				5' TYPE R

REQUIRED POND VOLUMES

USE EQ. $V = KA$

V = VOLUME (ACRE-FEET)

K = COEFFICIENT FROM EQ. 1405 OR 1406

A = AREA (ACRES)

IMPERVIOUS NESS (I) = 44
AREA (Ac) = 24.86

EQ. 1405 $K(100) = (1.78I - 0.002 \cdot \text{POWER}(I, 2) - 3.56) / 1000$
 $K(100) = 0.07$

EQ. 1406 $K(10) = (0.95I - 1.90) / 1000$
 $K(10) = 0.04$

100-YEAR VOLUME

$V = 1.76 \text{ AC-FT} = 76547 \text{ CUBIC FEET}$

10-YEAR VOLUME

$V = 0.99 \text{ AC-FT} = 43079 \text{ CUBIC FEET}$

POND VOLUME

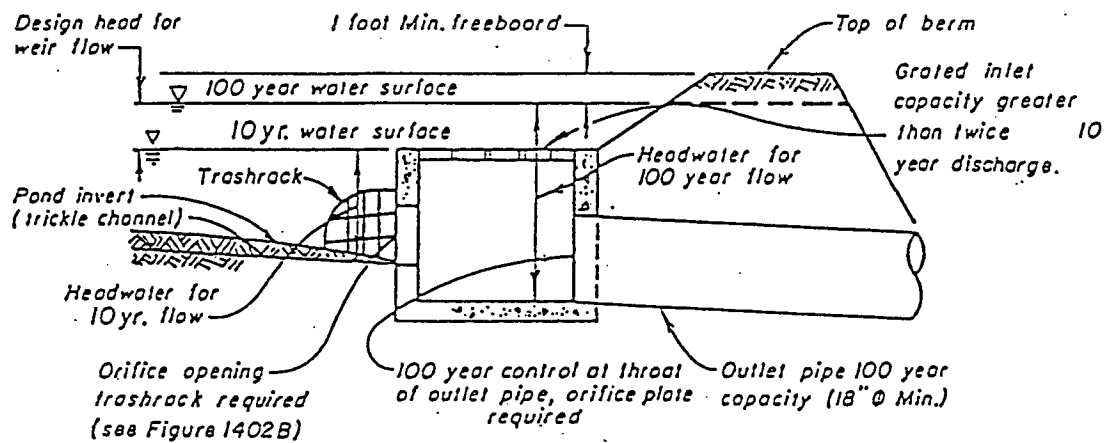
USE AVERAGE END AREA METHOD

(AREA CONTOUR 1 + AREA CONTOUR 2)/2 x CONTOUR ELEV. DIFFERENCE

CONTOUR	AREA (SF)	ELEV. DIFF. (FT)	CORRECTION	CUM. VOL. (CF)	POND MIN. (CF)
6127.3	0	0.0		0	
6128.0	1814	0.7	2/3	423	
6128.5	5175	0.5		2170	
6129.0	8536	0.5		5598	
6129.5	11897	0.5		10706	
6130.0	15258	0.5		17495	
6130.5	15643	0.5		25220	
6131.0	16028	0.5		33137	
6131.1	16412	0.1		34759	
6131.2	16797	0.1		36420	
6131.3	17182	0.1		38119	
6131.4	17567	0.1		39856	
6131.5	17952	0.1		41632	
6131.6	18337	0.1		43446	43,079 CF
6131.7	18722	0.1		45299	CUM. VOL. 0.99 AC-FT. Q10
6131.8	19106	0.1		47191	
6131.9	19491	0.1		49121	
6132.0	19876	0.1		51089	
6132.5	20262	0.5		61124	
6132.6	20649	0.1		63169	
6132.7	21035	0.1		65253	
6132.8	21421	0.1		67376	
6132.9	21807	0.1		69538	
6133.0	22193	0.1		71738	
6133.1	22579	0.1		73976	
6133.2	22965	0.1		76253	
6133.3	23351	0.1		78569	76,547 CF
6133.4	23737	0.1		80924	CUM. VOL. 1.76 AC-FT. Q100
6133.5	24123	0.1		83317	
6134.0	24510	0.5		95475	

6 MAY, 1998

DETENTION POND OUTLET CONFIGURATION

TYPE 2 OUTLET

No Scols

Date: July, 1990

Rev:

Reference:

WRC Engineering

ORIFICE AND WEIR FLOWS
POND OUTLET

POND OUTLET STRUCTURE DESIGN

	ALLOW RELEASE (CFS / AC)	DISCHARGE (CFS)
100 YEAR FLOW =	0.85	21.35
10 YEAR FLOW =	0.23	5.78
INVERT ELEV =	6127.30	
10-YR TOP =	6131.60	
100-YR TOP =	6133.30	

10-YEAR OUTLET

DIA. OF ORIFICE = 10.16" USE 10 5/32" DIA

10-YEAR OUTLET at 100-YEAR DEPTH

$Q = 6.93 \text{ CFS}$

100-YEAR WEIR

$Q = CLH^{3/2}$

FLOW (Q) = $21.35 - 6.93 = 14.42 \text{ CFS}$

HEIGHT OF WEIR = $33.30 - 31.60 = 1.70 \text{ FT.}$

WEIR COEFFICIENT = 3.4

LENGTH OF WEIR = 1.91 FT AS A MINIMUM SINCE CONTROL WILL BE WITH AN ORIFICE PLATE ON AN 18" dia OUTLET PIPE

100-YEAR CONTROL ORIFICE
ON THE 18" dia OUTLET PIPE

USE ORIFICE EQUATION

$Q = CdA(2gh)^{1/2}$

FLOW (Q) = 21.35 CFS

DIA. OF ORIFICE = 18.10" (USE 18" DIA.)

EXIST 24"RCP UNDER SH 85 FROM BASIN 1
Worksheet for Circular Channel

Project Description

Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	EXIST 24" RCP UNDER SH85 FROM BASIN 1
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data

Mannings Coefficient	0.013
Channel Slope	0.033500 ft/ft
Diameter	24.00 in
Discharge	12.50 cfs

Results

Depth	0.75	ft
Flow Area	1.08	ft ²
Wetted Perimeter	2.64	ft
Top Width	1.94	ft
Critical Depth	1.27	ft
Percent Full	37.68	
Critical Slope	0.005692	ft/ft
Velocity	11.54	ft/s
Velocity Head	2.07	ft
Specific Energy	2.82	ft
Froude Number	2.72	
Maximum Discharge	44.54	cfs
Full Flow Capacity	41.40	cfs
Full Flow Slope	0.003053	ft/ft

Flow is supercritical.

DESIGN PT 1 TO DESIGN PT 6
Worksheet for Circular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	DESIGN PT 1 TO DESIGN PT 6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.008000	ft/ft
Diameter	30.00	in
Discharge	37.00	cfs

Results		
Depth	24.8	in
Flow Area	4.34	ft ²
Wetted Perimeter	5.71	ft
Top Width	1.89	ft
Critical Depth	2.06	ft
Percent Full	82.76	
Critical Slope	0.008061	ft/ft
Velocity	8.52	ft/s
Velocity Head	1.13	ft
Specific Energy	3.20	ft
Froude Number	0.99	
Maximum Discharge	39.46	cfs
Full Flow Capacity	36.68	cfs
Full Flow Slope	0.008138	ft/ft
Flow is subcritical.		

BASIN 3 TO DESIGN PT 6
Worksheet for Circular Channel

Project Description ..

Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	BASIN 3 TO DESIGN PT 6
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data

Mannings Coefficient	0.013
Depth	24.0 in
Diameter	30.00 in
Discharge	26.40 cfs

Results

Channel Slope	0.004336 ft/ft
Flow Area	4.21 ft ²
Wetted Perimeter	5.54 ft
Top Width	2.00 ft
Critical Depth	1.75 ft
Percent Full	80.00
Critical Slope	0.005895 ft/ft
Velocity	6.27 ft/s
Velocity Head	0.61 ft
Specific Energy	2.61 ft
Froude Number	0.76
Maximum Discharge	29.05 cfs
Full Flow Capacity	27.01 cfs
Full Flow Slope	0.004143 ft/ft

Flow is subcritical.

DESIGN PT 6 TO DESIGN PT 6A
Worksheet for Circular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	DESIGN PT 6 TO DESIGN PT 6A
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data	
Mannings Coefficient	0.013
Depth	2.00 ft
Diameter	30.00 in
Discharge	37.00 cfs

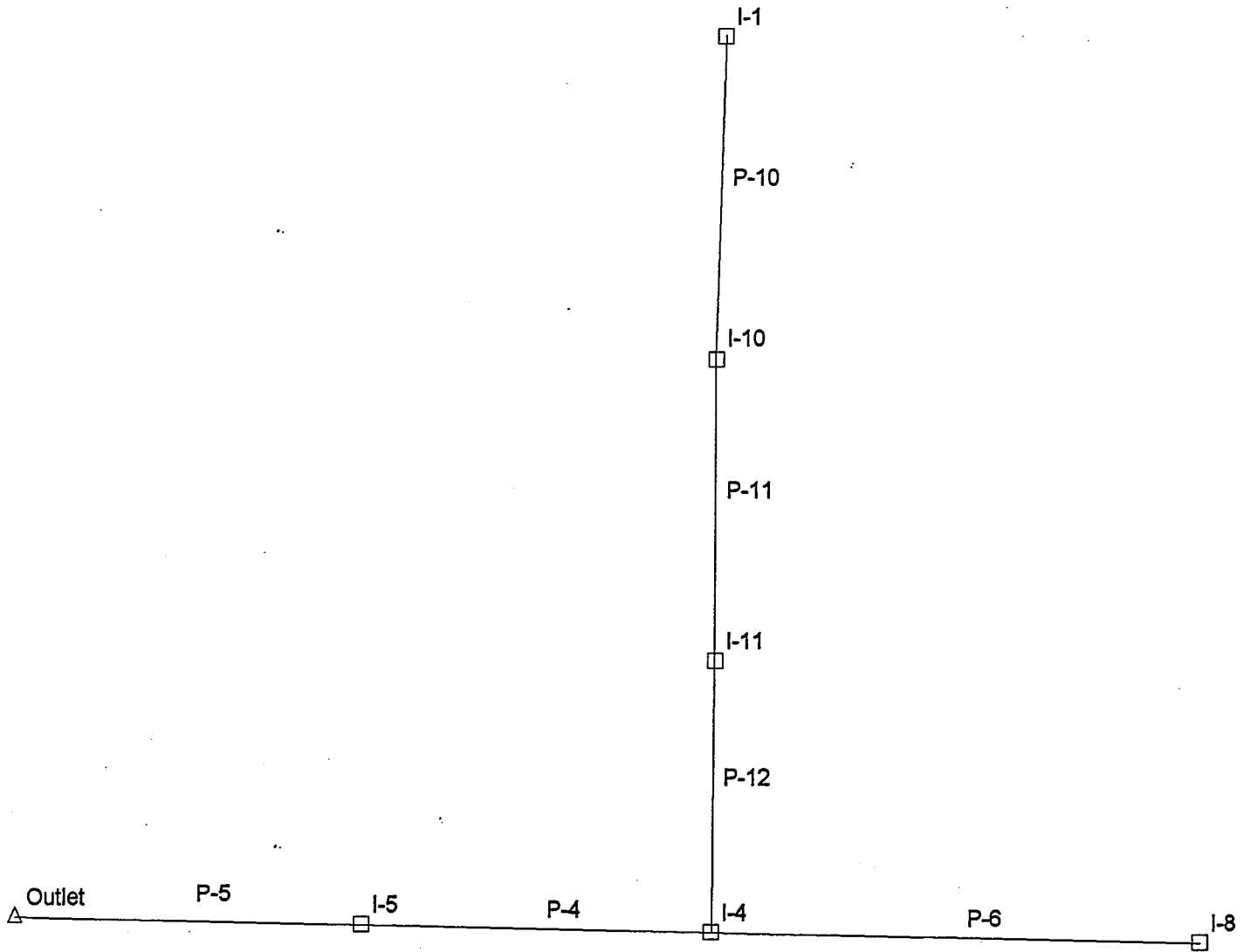
Results	
Channel Slope	0.008518 ft/ft
Flow Area	4.21 ft ²
Wetted Perimeter	5.54 ft
Top Width	2.00 ft
Critical Depth	2.06 ft
Percent Full	80.00
Critical Slope	0.008061 ft/ft
Velocity	8.79 ft/s
Velocity Head	1.20 ft
Specific Energy	3.20 ft
Froude Number	1.07
Maximum Discharge	40.72 cfs
Full Flow Capacity	37.85 cfs
Full Flow Slope	0.008138 ft/ft
Flow is supercritical.	

DESIGN PT 6A TO POND
Worksheet for Circular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	DESIGN 6A TO POND
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data	
Mannings Coefficient	0.013
Depth	28.8 in
Diameter	36.00 in
Discharge	37.30 cfs

Results	
Channel Slope	0.003274 ft/ft
Flow Area	6.06 ft ²
Wetted Perimeter	6.64 ft
Top Width	2.40 ft
Critical Depth	1.99 ft
Percent Full	80.00
Critical Slope	0.005184 ft/ft
Velocity	6.15 ft/s
Velocity Head	0.59 ft
Specific Energy	2.99 ft
Froude Number	0.68
Maximum Discharge	41.05 cfs
Full Flow Capacity	38.16 cfs
Full Flow Slope	0.003128 ft/ft
Flow is subcritical.	



Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)
P-10	I-1	I-10	130.00	8.88	0.54	4.80	4.80	21.04	24 inch	24.19	8.15	6,137.38
P-11	I-10	I-11	156.00	0.90	0.85	0.76	5.56	6.94	30 inch	36.71	5.92	6,135.64
P-12	I-11	I-4	129.00	1.10	0.85	0.94	6.49	10.02	30 inch	36.65	5.69	6,134.19
P-6	I-8	I-4	231.00	4.35	0.88	3.83	3.83	27.70	30 inch	38.07	5.91	6,135.15
P-4	I-4	I-5	162.00	0.63	0.85	0.54	10.86	2.30	30 inch	37.99	9.51	6,132.96
P-5	I-5	Outlet	147.00	0.34	0.85	0.29	11.15	1.23	36 inch	40.05	7.66	6,131.03

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (%)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-10	I-1	8.88	4.80	4.80	6,144.00	6,139.02	1.09	21.04	Circular	130.00	8.15	
	I-10				6,140.30	6,137.34	1.14	24.19	24 inch			
P-11	I-10	0.90	0.76	5.56	6,140.30	6,137.32	0.46	24.20	Circular	156.00	5.92	
	I-11				6,139.40	6,136.96	0.80	36.71	30 inch			
P-12	I-11	1.10	0.94	6.49	6,139.40	6,136.96	0.46	27.93	Circular	129.00	5.69	
	I-4				6,137.90	6,136.36	0.80	36.65	30 inch			
P-6	I-8	4.35	3.83	3.83	6,141.10	6,137.29	0.45	27.70	Circular	231.00	5.91	
	I-4				6,137.90	6,136.36	0.86	38.07	30 inch			
P-4	I-4	0.63	0.54	10.86	6,137.90	6,136.02	1.25	46.21	Circular	162.00	9.51	
	I-5				6,136.00	6,133.94	0.86	37.99	30 inch			
P-5	I-5	0.34	0.29	11.15	6,136.00	6,133.75	0.47	47.05	Circular	147.00	7.66	
	Outlet				6,130.50	6,132.73	0.36	40.05	36 inch			

Node Report

Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	External CA (acres)	Total CA (acres)	Inlet TC (min)	External TC (min)	Upstream Flow Time (min)	System Flow Time (min)	System Intensity (in/hr)	Total Watershed (CIA) (cfs)	Additional Flow (cfs)	Carryover (cfs)
I-1	8.88	0.54	4.80	0.00	4.80	28.00	0.00	0.00	28.00	4.35	21.04	0.00	0.00
I-10	0.90	0.85	0.76	0.00	5.56	5.00	0.00	28.27	28.27	4.32	- 24.20	0.00	0.00
I-11	1.10	0.85	0.94	0.00	6.49	0.00	0.00	28.70	28.70	4.27	27.93	0.00	0.00
I-8	4.35	0.88	3.83	0.00	3.83	11.00	0.00	0.00	11.00	7.18	27.70	0.00	0.00
I-4	0.63	0.85	0.54	0.00	10.86	29.00	0.00	29.08	29.08	4.22	46.21	0.00	0.00
I-5	0.34	0.85	0.29	0.00	11.15	29.00	0.00	29.37	29.37	4.19	47.05	0.00	0.00
Outlet	N/A	N/A	N/A	N/A	11.15	N/A	0.00	29.69	29.69	4.15	46.62	N/A	N/A

Pipe Report

Pipe	Upstream Node	Downstream Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (%)	Section Size	Roughness
P-10	I-1	I-10	8.88	0.54	4.80	4.80	4.35	21.04	130.00	1.14	24 inch	0.013
P-11	I-10	I-11	0.90	0.85	0.76	5.56	4.32	24.20	156.00	0.80	30 inch	0.013
P-12	I-11	I-4	1.10	0.85	0.94	6.49	4.27	27.93	129.00	0.80	30 inch	0.013
P-6	I-8	I-4	4.35	0.88	3.83	3.83	7.18	27.70	231.00	0.86	30 inch	0.013
P-4	I-4	I-5	0.63	0.85	0.54	10.86	4.22	46.21	162.00	0.86	30 inch	0.013
P-5	I-5	Outlet	0.34	0.85	0.29	11.15	4.19	47.05	147.00	0.36	36 inch	0.013

Project Title: METZLER RANCH 2 PHASE 3

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Inter Mountain Engineering

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Project Engineer: Inter-Mountain Engineering

StormCAD v1.0

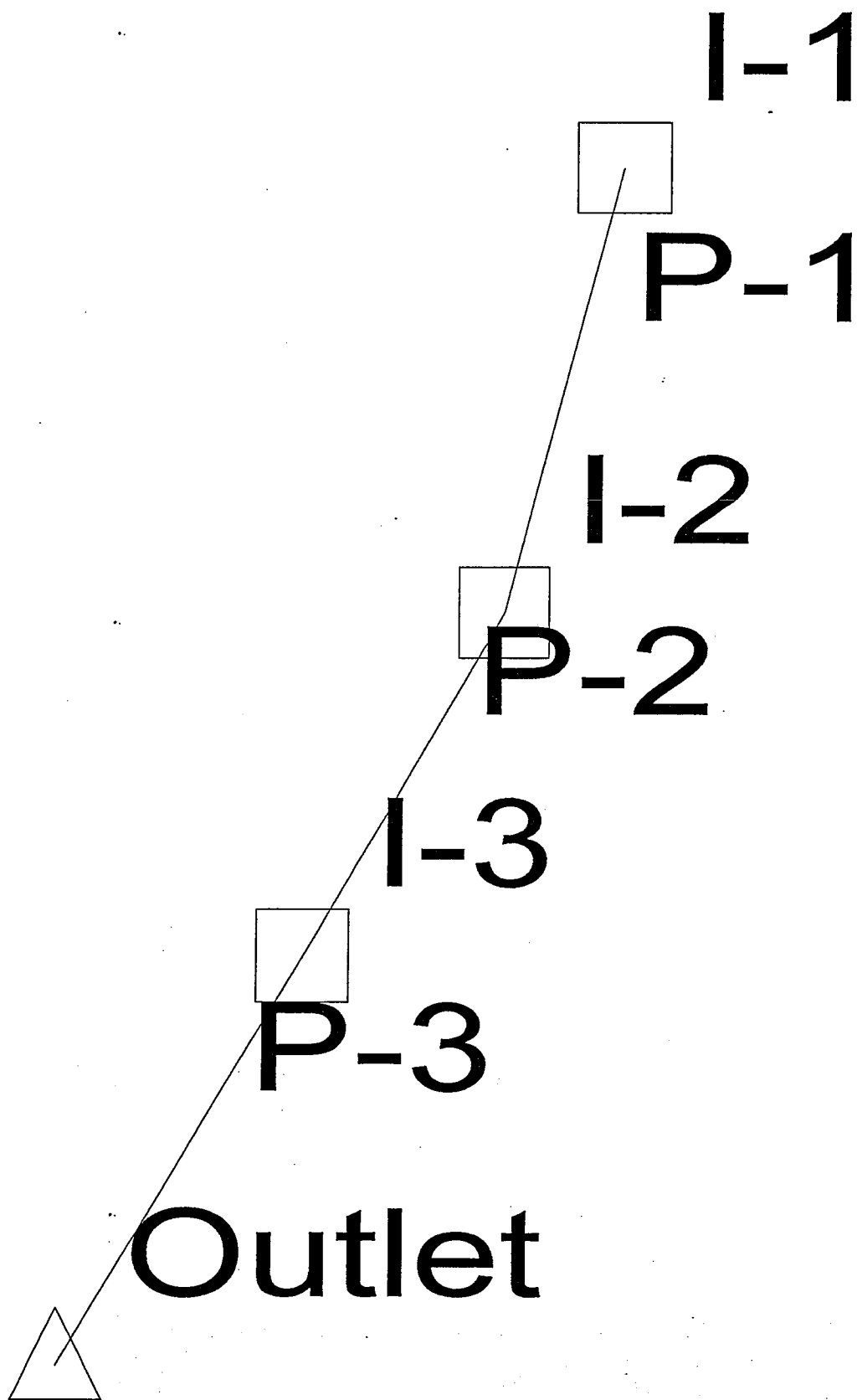
Page 1 of 1

DESIGN PT 7 TO POND
Worksheet for Circular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	DESIGN PT 7 TO POND
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data	
Mannings Coefficient	0.013
Depth	19.2 in
Diameter	24.00 in
Discharge	16.20 cfs

Results	
Channel Slope	0.005368 ft/ft
Flow Area	2.69 ft ²
Wetted Perimeter	4.43 ft
Top Width	1.60 ft
Critical Depth	1.45 ft
Percent Full	80.00
Critical Slope	0.006676 ft/ft
Velocity	6.01 ft/s
Velocity Head	0.56 ft
Specific Energy	2.16 ft
Froude Number	0.82
Maximum Discharge	17.83 cfs
Full Flow Capacity	16.57 cfs
Full Flow Slope	0.005129 ft/ft
Flow is subcritical.	



Pipe Report

Pipe	Upstream Node	Downstream Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Roughness
P-1	I-1	I-2	3.13	0.85	2.66	2.66	10.61	28.45	11.00	0.010909	24 inch	0.013
P-2	I-2	I-3	0.37	0.93	0.34	3.00	10.60	32.07	25.00	0.006400	24 inch	0.013
P-3	I-3	Outlet	0.37	0.93	0.34	3.34	10.59	35.65	33.00	184.855152	24 inch	0.013

Node Report

Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	External CA (acres)	Total CA (acres)	Inlet TC (min)	External TC (min)	Upstream Flow Time (min)	System Flow Time (min)	System Intensity (in/hr)	Total Watershed (CIA) (cfs)	Additional Flow (cfs)	Carryover (cfs)
I-1	3.13	0.85	2.66	0.00	2.66	0.00	0.00	0.00	0.00	10.61	28.45	0.00	0.00
I-2	0.37	0.93	0.34	0.00	3.00	0.00	0.00	0.02	0.02	10.60	32.07	0.00	0.00
I-3	0.37	0.93	0.34	0.00	3.34	0.00	0.00	0.06	0.06	10.59	35.65	0.00	0.00
Outlet	N/A	N/A	N/A	N/A	3.34	N/A	0.00	0.11	0.11	10.58	35.60	N/A	N/A

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-1	I-1	3.13	2.66	2.66	6,135.50	6,133.55	0.015822	28.45	Circular	11.00	9.06	
	I-2				6,134.87	6,133.38	0.010909	23.63	24 inch			
P-2	I-2	0.37	0.34	3.00	6,134.87	6,133.38	0.019882	32.07	Circular	25.00	10.32	
	I-3				6,134.87	6,132.81	0.006400	18.10	24 inch			
P-3	I-3	0.37	0.34	3.34	6,134.87	6,132.65	184.855152	35.65	Circular	33.00	11.49	
	Outlet				6,132.50	32.43	184.855152	3,075.61	24 inch			

Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)
P-1	I-1	I-2	11.00	3.13	0.85	2.66	2.66	28.45	24 inch	23.63	9.06	6,131.40
P-2	I-2	I-3	25.00	0.37	0.93	0.34	3.00	3.63	24 inch	18.10	10.32	6,131.08
P-3	I-3	Outlet	33.00	0.37	0.93	0.34	3.34	3.63	24 inch	3,075.61	11.49	6,130.72

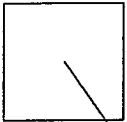
DESIGN PT 8 TO POND FOR 1/2 FLOW 2 PIPES
Worksheet for Circular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	DESIGN PT 8 TO POND FOR HALF FLOW
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

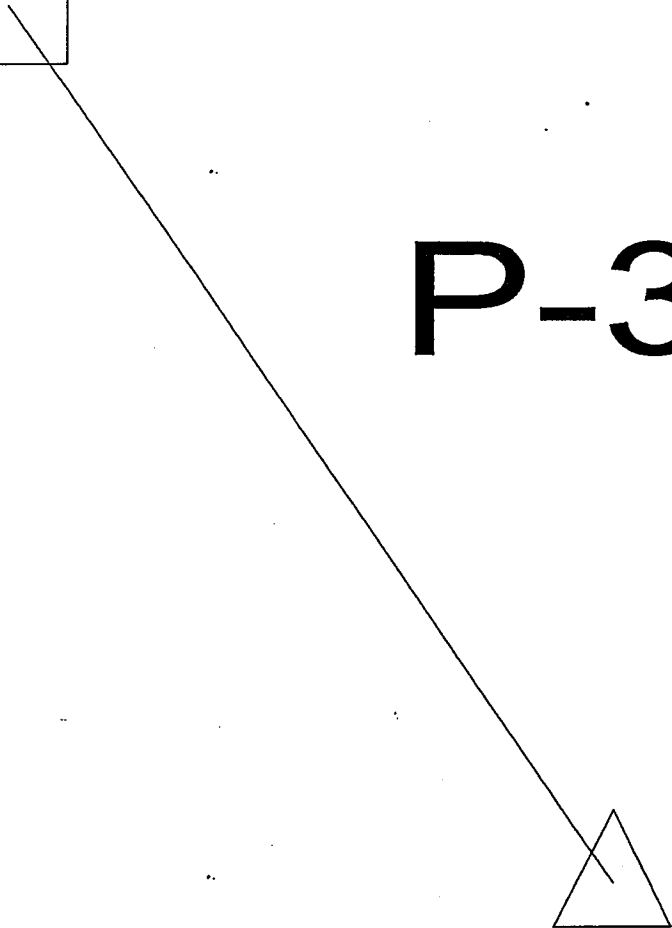
Input Data	
Mannings Coefficient	0.013
Depth	1.20 ft
Diameter	18.00 in
Discharge	9.10 cfs

Results	
Channel Slope	0.007856 ft/ft
Flow Area	1.52 ft ²
Wetted Perimeter	3.32 ft
Top Width	1.20 ft
Critical Depth	1.17 ft
Percent Full	80.00
Critical Slope	0.008319 ft/ft
Velocity	6.00 ft/s
Velocity Head	0.56 ft
Specific Energy	1.76 ft
Froude Number	0.94
Maximum Discharge	10.01 cfs
Full Flow Capacity	9.31 cfs
Full Flow Slope	0.007506 ft/ft
Flow is subcritical.	

I-3



P-3



Outlet

Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)
P-3	I-3	Outlet	140.00	3.62	0.88	3.19	3.19	29.06	18 inch	18.62	8.35	6,128.60

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-3	I-3 Outlet	3.62	3.19	3.19	6,133.50 0.00	6,131.64 6,128.89	0.019088 0.007857	29.06 18.62	Circular 18 inch	140.00	8.35	

Project Title: phase 3 basin vi outlet

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Project Engineer: Inter Mountain Engineering

StormCAD v1.0

Page 1 of 1

Node Report

Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	External CA (acres)	Total CA (acres)	Inlet TC (min)	External TC (min)	Upstream Flow Time (min)	System Flow Time (min)	System Intensity (in/hr)	Total Watershed (CIA) (cfs)	Additional Flow (cfs)	Carryover (cfs)
I-3	3.62	0.88	3.19	0.00	3.19	5.00	0.00	0.00	5.00	9.05	29.06	0.00	0.00
Outlet	N/A	N/A	N/A	N/A	3.19	N/A	0.00	5.28	5.28	8.96	-28.78	N/A	N/A

Project Title: phase 3 basin vi outlet

g:\drawings\979028\drainage\basin-vi.stm

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Pipe Report

Pipe	Upstream Node	Downstream Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Roughness
P-3	I-3	Outlet	3.62	0.88	3.19	3.19	9.05	29.06	140.00	0.007857	18 inch	0.013

P. O. BOX 978
0077 METCALF ROAD
AVON, COLORADO 81620
(393) 949-5072



SUITE 101
1420 VANCE STREET
LAKEWOOD, COLORADO 80215
(303) 232-0158

PROJECT No.
97-922B
DATE / BY
6/18/98 ACC
SHEET No.

TRICKLE CHANNEL IN POND

SOIL IS TYPE "B" SOIL SANDY

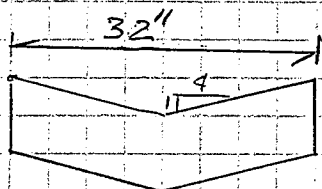
MINIMUM CAPACITY

1 TO 3% OF 100 YEAR FLOW
100 YEAR FLOW = 64.3 CFS

1% = 0.6 CFS

3% = 1.9 CFS

USE 1.0 CFS



@ 1.1% SLOPE

POND TRICKLE CHANNEL
Worksheet for Triangular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	POND TRICKLE CHANNEL
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	0.011000	ft/ft
Left Side Slope	4.00	H : V
Right Side Slope	4.00	H : V
Discharge	1.00	cfs

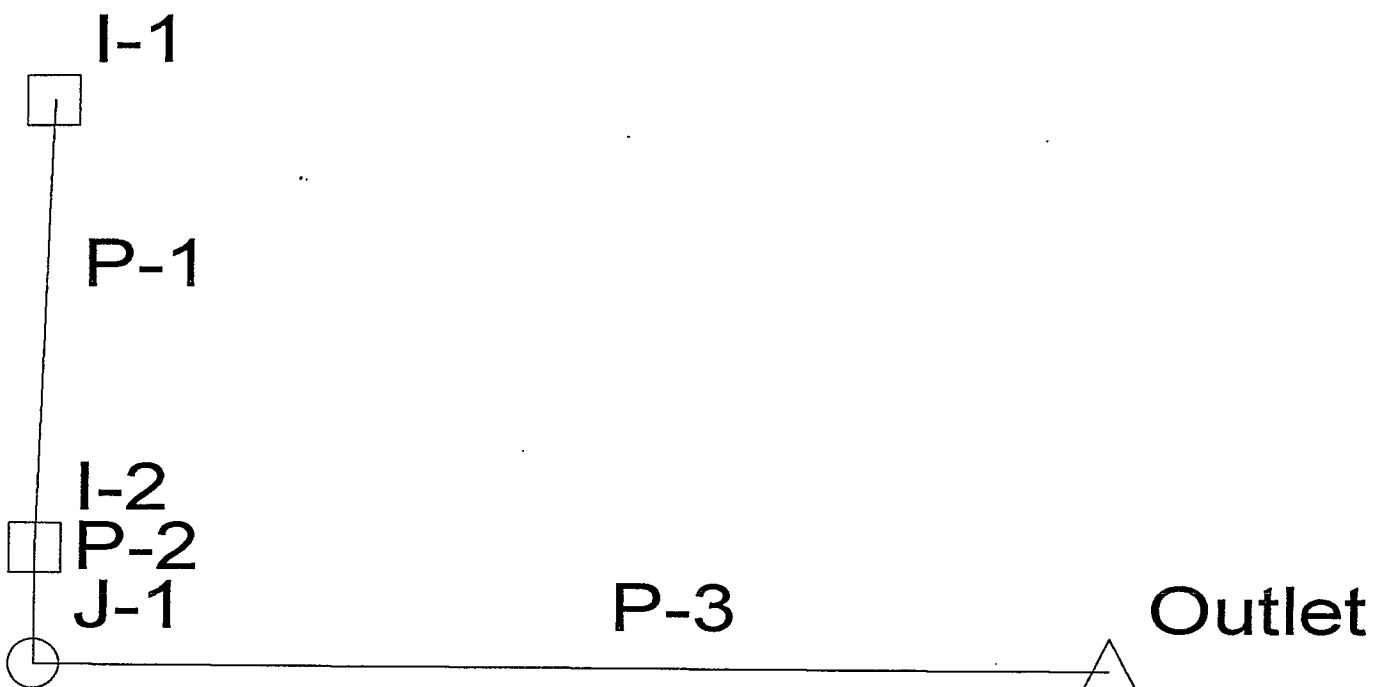
Results		
Depth	0.28	ft
Flow Area	0.32	ft ²
Wetted Perimeter	2.31	ft
Top Width	2.25	ft
Critical Depth	0.33	ft
Critical Slope	0.004677	ft/ft
Velocity	3.17	ft/s
Velocity Head	0.16	ft
Specific Energy	0.44	ft
Froude Number	1.49	
Flow is supercritical.		

POND OUTFALL PIPE
Worksheet for Circular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	POND OUTFALL PIPE
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Slope

Input Data	
Mannings Coefficient	0.013
Depth	2.00 ft
Diameter	24.00 in
Discharge	21.40 cfs

Results	
Channel Slope	0.008949 ft/ft
Flow Area	3.14 ft ²
Wetted Perimeter	6.28 ft
Top Width	0.00 ft
Critical Depth	1.66 ft
Percent Full	100.00
Critical Slope	0.008796 ft/ft
Velocity	6.81 ft/s
Velocity Head	0.72 ft
Specific Energy	FULL ft
Froude Number	FULL
Maximum Discharge	23.02 cfs
Full Flow Capacity	21.40 cfs
Full Flow Slope	0.008949 ft/ft



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Pipe Report

Pipe	Upstream Node	Downstream Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	System Intensity (in/hr)	Discharge (cfs)	Length (ft)	Constructed Slope (ft/ft)	Section Size	Roughness
P-1	I-1	I-2	0.00	0.00	0.00	0.00	10.61	21.35	65.00	0.024923	24 inch	0.013
P-2	I-2	J-1	0.40	0.93	0.37	0.37	10.56	28.36	10.00	0.010000	30 inch	0.013
P-3	J-1	Outlet	N/A	N/A	N/A	0.37	10.56	28.36	328.00	0.008902	30 inch	0.013

Node Report

Node	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	External CA (acres)	Total CA (acres)	Inlet TC (min)	External TC (min)	Upstream Flow Time (min)	System Flow Time (min)	System Intensity (in/hr)	Total Watershed (CIA) (cfs)	Additional Flow (cfs)	Carryover (cfs)
I-1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.61	0.00	0.00	0.00
I-2	0.40	0.93	0.37	0.00	0.37	0.00	0.00	0.15	0.15	10.56	3.96	0.00	0.00
J-1	N/A	N/A	N/A	N/A	0.37	N/A	0.00	0.17	0.17	10.56	3.96	N/A	N/A
Outlet	N/A	N/A	N/A	N/A	0.37	N/A	0.00	0.91	0.91	10.33	3.87	N/A	N/A

DOT Report

Pipe	-Node- Upstream Downstream	Inlet Area (acres)	Inlet CA (acres)	Total CA (acres)	-Ground- Upstream Downstream (ft)	-HGL- Upstream Downstream (ft)	-Slope- Energy Constructed (ft/ft)	-Section- Discharge Capacity (cfs)	-Section- Shape Size	Length (ft)	Average Velocity (ft/s)	Description
P-1	I-1	0.00	0.00	0.00	6,161.70	6,128.95	0.023874	21.35	Circular	65.00	7.32	
	I-2				6,129.39	6,127.57	0.024923	35.71	24 inch			
P-2	I-2	0.40	0.37	0.37	6,129.39	6,127.30	0.009430	28.36	Circular	10.00	7.27	
	J-1				6,129.30	6,127.27	0.010000	41.01	30 inch			
P-3	J-1	N/A	N/A	0.37	6,129.30	6,127.00	0.008902	28.36	Circular	328.00	7.43	
	Outlet				6,124.25	6,124.08	0.008902	38.70	30 inch			

Combined Pipe/Node Report

Pipe	Upstream Node	Downstream Node	Length (ft)	Inlet Area (acres)	Weighted Roughness Coefficient	Inlet CA (acres)	Total CA (acres)	Inlet Discharge (cfs)	Section Size	Capacity (cfs)	Average Velocity (ft/s)	Upstream Invert Elevation (ft)
P-1	I-1	I-2	65.00	0.00	0.00	0.00	0.00	0.00	24 inch	35.71	7.32	6,127.30
P-2	I-2	J-1	10.00	0.40	0.93	0.37	0.37	3.98	30 inch	41.01	7.27	6,125.48
P-3	J-1	Outlet	328.00	N/A	N/A	N/A	0.37	N/A	30 inch	38.70	7.43	6,125.18

LIGGETT DITCH
Worksheet for Triangular Channel

Project Description	
Project File	g:\drawings\979028\drainage\9028.fm2
Worksheet	METZLER RANCH POND OUTLET DITCH LIGGETT
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.033	
Channel Slope	0.010000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Discharge	21.40	cfs

Results		
Depth	1.69	ft
Flow Area	5.72	ft ²
Wetted Perimeter	7.57	ft
Top Width	6.77	ft
Critical Depth	1.48	ft
Critical Slope	0.020355	ft/ft
Velocity	3.74	ft/s
Velocity Head	0.22	ft
Specific Energy	1.91	ft
Froude Number	0.72	
Flow is subcritical.		

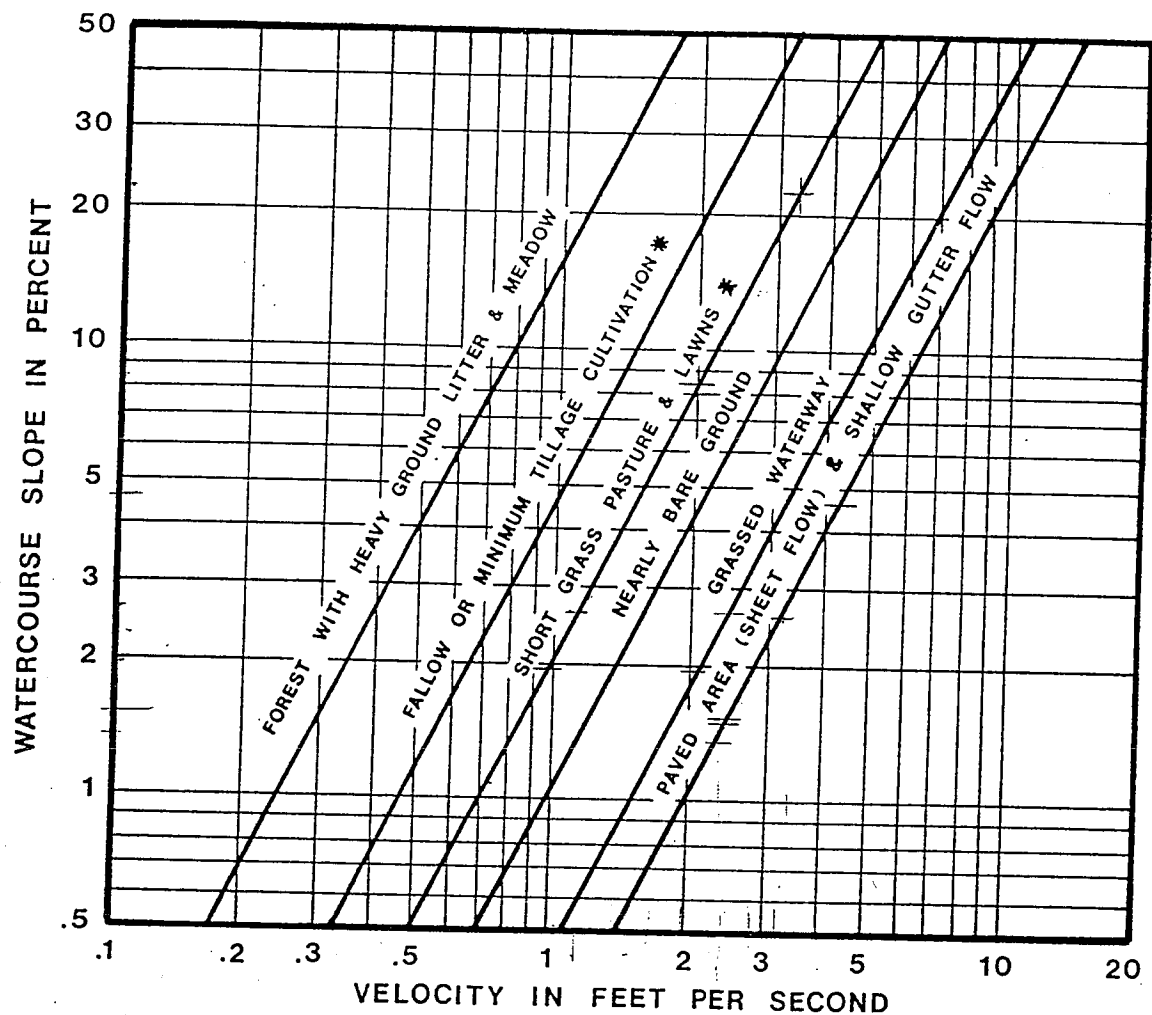


FIGURE 3-2. ESTIMATE OF AVERAGE FLOW VELOCITY FOR
USE WITH THE RATIONAL FORMULA.

* MOST FREQUENTLY OCCURRING "UNDEVELOPED"
LAND SURFACES IN THE DENVER REGION.

REFERENCE: "Urban Hydrology For Small Watersheds" Technical
Release No. 55, USDA, SCS Jan. 1975.

5-1-84

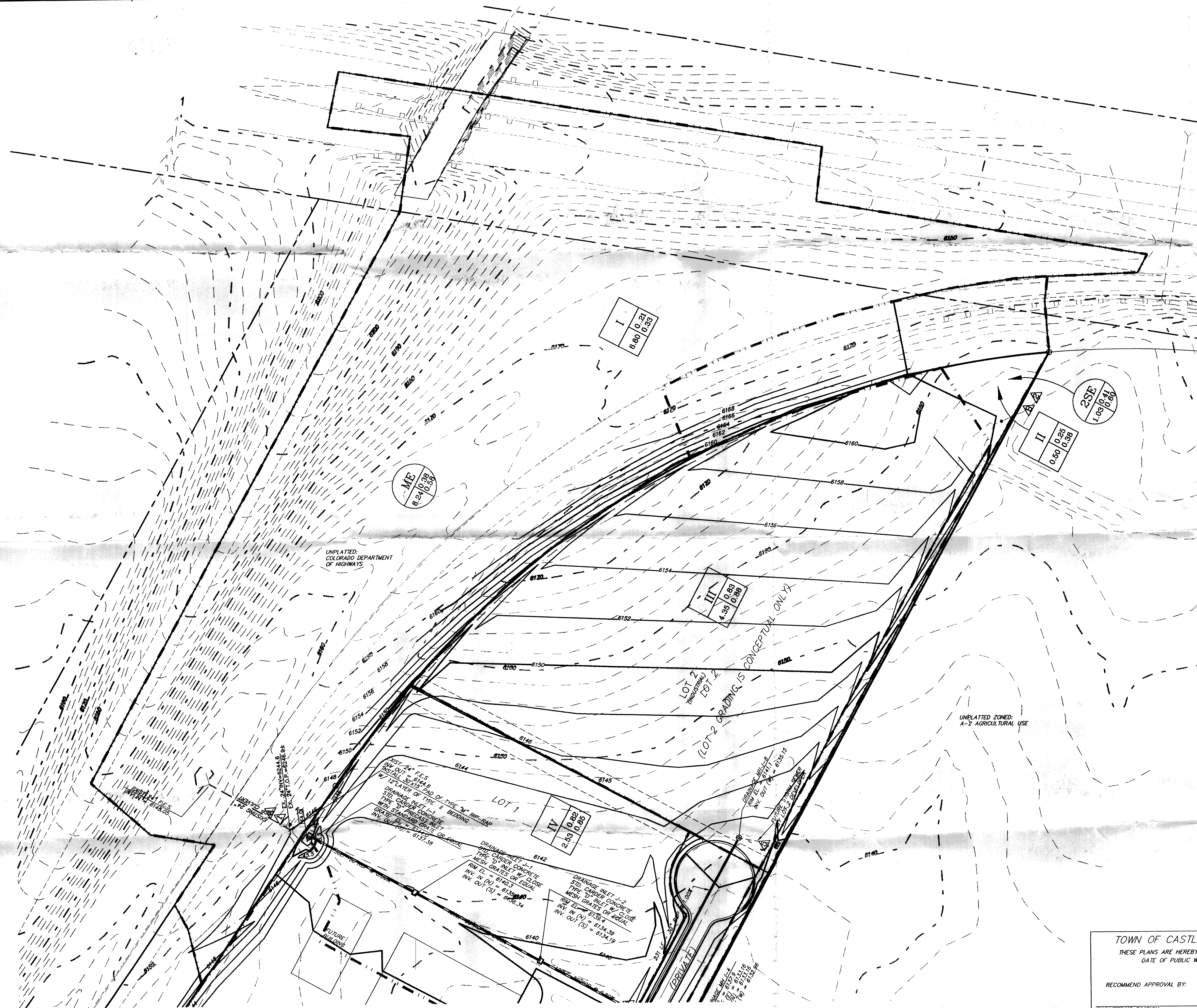
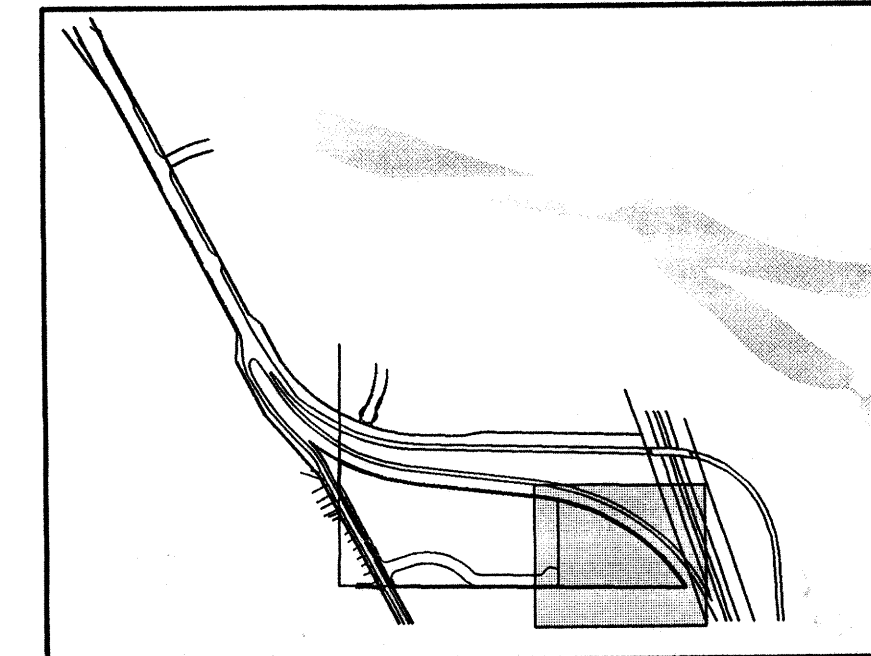
URBAN DRAINAGE & FLOOD CONTROL DISTRICT

A8

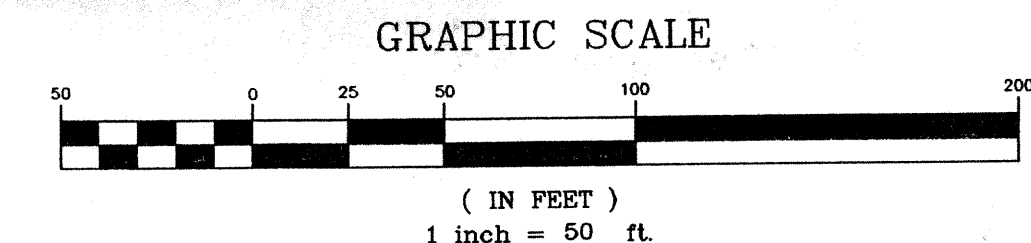
I HEREBY AFFIRM THAT THESE FINAL CONSTRUCTION PLANS WERE PREPARED UNDER MY DIRECT SUPERVISION, IN ACCORDANCE WITH APPLICABLE TOWN OF CASTLE ROCK AND STATE OF COLORADO ENGINEERING STATUTES, RESPECTIVELY, AND THAT I AM FULLY RESPONSIBLE FOR ANY REVISIONS AND AS-BUILT CONDITIONS RELATIVE TO THESE PLANS.

ANDREW K. CORNELIUS P.E. & P.L.S. DATE: 05/04/98

DATE: 05/04/98



KEY MAP



LEGEND:

SYMBOL:	EXPLANATION:
	PROPOSED CULVERT/STORM SEWER
	EXISTING CULVERT
	PROPOSED 10' CONTOUR
	PROPOSED 2' CONTOUR
	EXISTING 10' CONTOUR
	EXISTING 2' CONTOUR
	SPOT ELEVATION
	PROPOSED SLOPE
	PROPOSED STORM SEWER MANHOLE
	PROPOSED STORM SEWER INLET
	HISTORIC BASIN DESIGNATION
	10 YR. RUNOFF COEFFICIENT
	100 YR. RUNOFF COEFFICIENT
	BASIN AREA (AC)
	PROPOSED BASIN DESIGNATION
	10 YR. RUNOFF COEFFICIENT
	100 YR. RUNOFF COEFFICIENT
	BASIN AREA (AC)
	DRAINAGE DESIGN POINT
	HISTORIC DRAINAGE BASIN BOUNDARY
	PROPOSED DRAINAGE BASIN BOUNDARY

TOWN OF CASTLE ROCK APPROVALS

THESE PLANS ARE HEREBY APPROVED FOR ONE YEAR FROM DATE OF PUBLIC WORKS DIRECTOR APPROVAL

RECOMMEND APPROVAL BY:

ENGINEERING DIVISION DATE

APPROVED BY:

PUBLIC WORKS DIRECTOR DATE

COUNTY ENGINEER

DATE

THESE CONSTRUCTION PLANS HAVE BEEN REVIEWED BY DOUGLAS COUNTY FOR STREET AND DRAINAGE IMPROVEMENTS ONLY.

ENGINEERING DIVISION ACCEPTANCE BLOCK

NO.	DATE	PER. TOWN COMMENTS	SDM	BY
1	6/12/98			

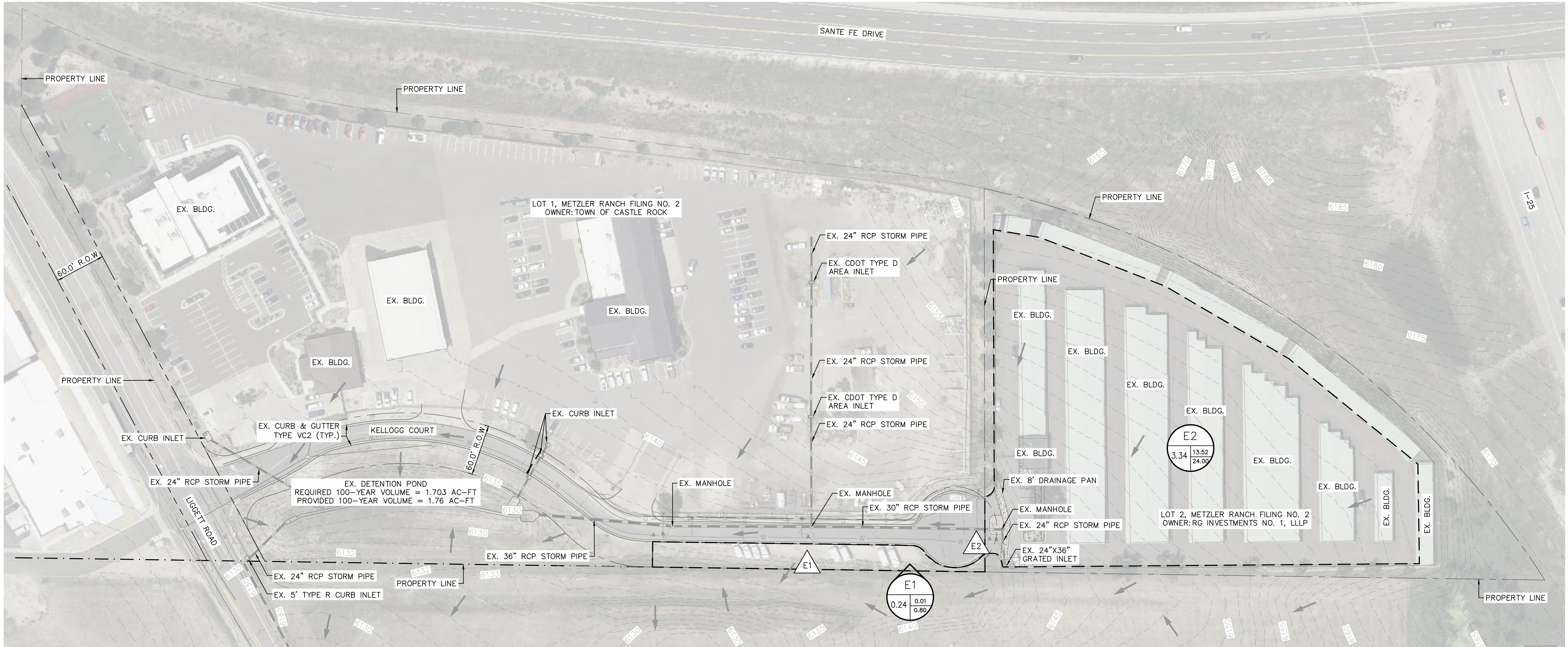
Inter-Mountain Engineering Ltd.

VISTA VILLAGE, LLC
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PHASE III DRAINAGE PLAN
FLYING NO. 6 WETZLER RANCH COUNTY,
TOWN OF CASTLE ROCK & DOUGLAS COUNTY,
COLORADO

DESIGNED BY:	LP
DRAWN BY:	LP
CHECKED BY:	AKC
SCALE:	1" = 50'
DATE ISSUED:	05/04/98
PROJECT NO.	97-9028
SHEET NO.	2 OF 2

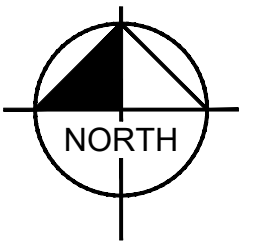
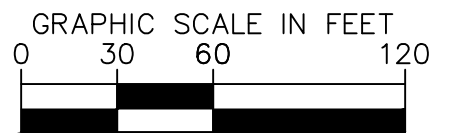
APPENDIX H: DRAINAGE MAPS



LEGEND

- PROPERTY LINE
 - LEASED PARCEL BOUNDARY
 - EXISTING UTILITY & DRAINAGE EASEMENT
 - EXISTING FENCE
 - EXISTING STORM SEWER
 - EXISTING GAS MAIN
 - EXISTING UNDG ELECTRIC
 - EXISTING WATER MAIN
 - EXISTING MAJOR CONTOUR
 - EXISTING MINOR CONTOUR
 - PROPOSED MAJOR CONTOUR
 - PROPOSED MINOR CONTOUR
 - EXISTING BASIN BOUNDARY
- A = SUB-BASIN NAME
B = BASIN SIZE (ACRE)
C = 5-YEAR RUNOFF
D = 100-YEAR RUNOFF
- # DESIGN POINT
- EXISTING FLOW ARROW

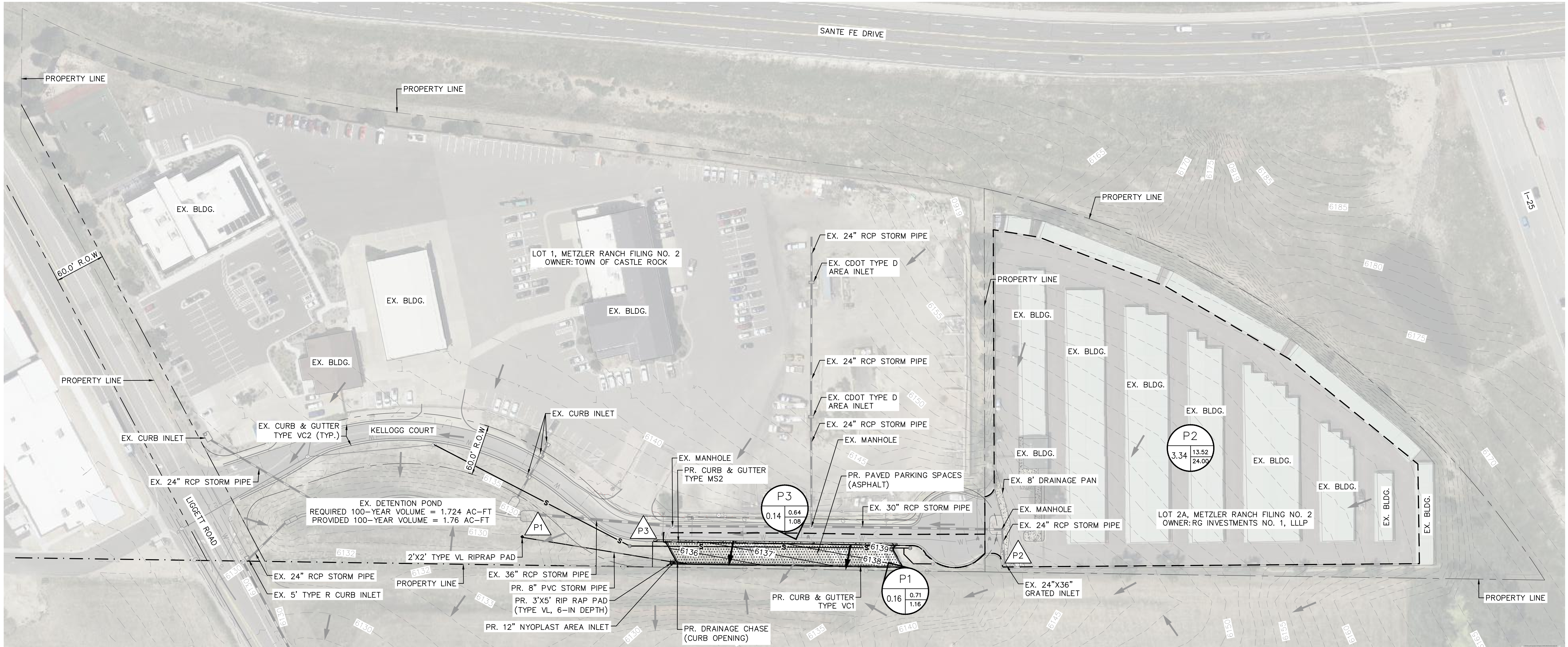
SUMMARY - EXISTING RUNOFF TABLE						
DESIGN POINT	SUB-BASIN	AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	WEIGHTED COEFF. (C100)	IMP. (%)
On-Site Basins						
E1	E1	0.24	0.01	0.80	0.44	2.0%
E2	E2	3.34	13.52	24.00	0.85	93.9%
TOTAL		3.58	13.53	24.80	0.82	87.8%



EXISTING DRAINAGE MAP

Kimley»Horn

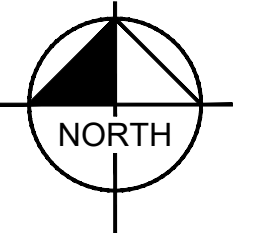
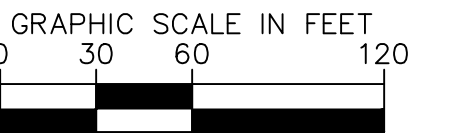
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2 N. NEVADA AVE, SUITE 900, COLORADO SPRINGS, CO 80903
PHONE: 719-453-0180



LEGEND

- PROPERTY LINE
 - LEASED PARCEL BOUNDARY
 - EXISTING UTILITY & DRAINAGE EASEMENT
 - EXISTING FENCE
 - EXISTING STORM SEWER
 - EXISTING GAS MAIN
 - EXISTING UNDG ELECTRIC
 - EXISTING WATER MAIN
 - EXISTING MAJOR CONTOUR
 - EXISTING MINOR CONTOUR
 - PROPOSED MAJOR CONTOUR
 - PROPOSED MINOR CONTOUR
 - PROPOSED BASIN BOUNDARY
 - PROPOSED ASPHALT
- DESIGN POINT
- EXISTING FLOW ARROW
- EXISTING FLOW ARROW

SUMMARY - PROPOSED RUNOFF TABLE						
DESIGN POINT	SUB-BASIN	AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)	WEIGHTED COEFF. (C100)	IMP. (%)
On-Site Basins						
P1	P1	0.16	0.71	1.19	0.86	99.5%
P2	P2	3.34	13.52	24.00	0.85	93.9%
P3	P3	0.14	0.64	1.08	0.86	100.0%
TOTAL		3.65	14.87	26.27	0.85	98.3%



PROPOSED DRAINAGE MAP