



PRELIMINARY DRAINAGE REPORT

VISTA WEST SUBDIVISION

LOCATED IN THE SOUTHWEST QUARTER OF SECTION 26,
TOWNSHIP 2 NORTH, RANGE 64 WEST OF THE 6TH P.M.
TOWN OF KEENESBURG
COUNTY OF WELD
STATE OF COLORADO

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Engineering · Planning · Surveying

CERTIFICATION

This report for the final design of the Vista West Subdivision was prepared by me or under my direct supervision in accordance with the provisions of the Town of Keenesburg and Weld County criteria. I understand that the Town of Keenesburg and its designated city authority do not and will not assume liability for drainage facilities designed by others.

Signature

Colorado P.E. License No.

Seal and Date

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Introduction

Site Location

1. The property is located in the southwest quarter of Section 26, Township 2 North, Range 64 West of the 6th Principal Meridian, Town of Keenesburg, County Weld, State of Colorado.
2. The property is bounded to the north by residential lots, to the east Cedar Street which is lined with residential houses, to the south by undeveloped land, and to the southwest by a parcel of undeveloped land and by County Road 16 to the northwest.
3. The proposed site is currently zoned as R-1 for single family residential development. A PUD overlay is being requested for the property.

Site Description

1. For the purposes of this report, the developed property shall be referred to as “Basin P”, which has been broken into 13 smaller basins; P1-P13. Historical drainage basins for the property shall be referred to as “Basin H1”. Onsite drainage basins that drain off the property shall be referred to as “Basin PO”, which has been broken into 3 smaller basins; PO1 to PO3. There is one offsite drainage basin that will drain onto the property referred to as basin OS1. Right-of-way drainage basins on the west half of Cedar Street shall be referred to as “Basin ROW”, which has been broken up into 3 smaller basins; ROW1-ROW3. Basin ROW2 will drain onto the site and be detained within the detention pond. The total area for the property is 31.55 acres.
2. Historical ground cover for the on-site basin consists of native grasses which generally slope from the northwest corner of the site to the southeast corner. On-site hydraulic soil grouping is primarily a type ‘C’ (Weld loam) and a type ‘B’ (Colby loam). The type ‘C’ hydraulic soil grouping was used for drainage calculations as a conservative approach. A soil map for the entire drainage basin developed using the online NRCS Web Soil Survey mapping tool can be found in **Appendix A**.
3. The site slopes gradually towards the southeast with slopes ranging from 1.8% to 10%. There is an existing irrigation pond at the center of the site and an existing wetland area to the south of the site.

Proposed Project Description

1. The proposed improvements consist of single-family residential homes with lot sizes varying from 5,500 SF to 8,400 SF. Additional improvements include the associated roadways, trail system, community park, open space, and a proposed detention pond.
2. Flood Hazard and Drainage Studies Relevant to the Site

- A. The site is not within a flood hazard area according to FEMA FIRM Map No. 08123C2157E revised January 20, 2016 (see **Appendix A**).

Historic Drainage System

Major Basin

1. The existing site is within a larger drainage basin that ultimately reaches Lost Creek via surface flow.
2. The site is not located within a FEMA delineated flood zone.
3. See the Drainage Plans (**Appendix C**) for existing and proposed contours. Runoff drainage patterns for the on-site basins and the off-site basins were defined based on ground topography surveyed using GPS and conventional survey methods.

Sub-Basin and Site Drainage

1. Historically the site generally drains from its northwest corner towards the southeast corner. In historic conditions, all the flows are transmitted overland via sheet flow across the property. The hydrologic analysis and hydraulic design for the site is based on the criteria established in the Urban Storm Drainage Criteria Manual (Mile High Flood District, 2017/2018) as well as the Town of Keenesburg. The Rational Method was used to calculate peak runoff flows for the sub-basins (refer to forms SF-2 and SF-3 in **Appendix B**). Runoff flows were analyzed for the 5-yr and 100-yr storms.

Proposed (Developed) Drainage System

Criteria

1. The regulations, guidelines and drainage design criteria used for this report are those contained within the Urban Storm Drainage Criteria Manual, Volumes 1, 2 and 3 (**Reference 1&2**).

Hydrology Criteria

1. In accordance with MHFD criteria, the design storms analyzed for this site were the 5-year storm (minor storm) and the 100-year storm (major storm). One-hour rainfalls of 1.14 and 2.65 inches have been used for the 5-Year and 100-Year runoff calculations respectively using the NOAA Atlas 14 Point Precipitation Frequency Estimates (**Reference 6**) for the Vista West Subdivision site. Refer to **Appendix A** for supporting information.

2. The peak discharge for sizing the onsite storm sewer and for the street capacity calculations was calculated using the following Rational Method formula:

$$Q = CIA$$

Where:

Q = peak discharge (cfs)
C = runoff coefficient
I = rainfall intensity (inches/hour)
A = drainage area (acres)

See **Appendix B** for Rational Method flow calculations.

These flows were routed through the site using the UDFCD SF-3 form to determine the total flow at respective design points. See **Appendix B** for routing spreadsheets.

Hydraulic Criteria

1. The MHFD Full-Spectrum Detention method was used to determine the required detention volume for this project.
2. Stormwater quality and detention for the on-site detention pond will be provided using the MHFD methods for full spectrum detention in accordance with the Mile High Flood District Detention Basin Design Workbook (MHFD-Detention, Version 4.04). In coordination with the Town of Keenesburg the maximum allowable 100-year release rate for a full spectrum detention facility shall be no greater than the predevelopment 100-year storm water discharge of the upstream watershed. The predevelopment 100-year unit discharge for specific soil types per acre of tributary catchment varies based on the watershed slope and watershed shape. The peak unit flow rate is based on one-hour precipitation depth from NOAA Atlas 14, watershed flow path slope, watershed flow path length, the tributary area, and coefficients dependent on event frequency tables for a soil with a hydraulic soil grouping of 'C'. Please refer to the EURV and 100-year detention volume calculations in **Appendix B** of this report.
3. The 100-yr release rate for the proposed detention pond was calculated as 46.5 cfs. However, the proposed detention pond does not capture all onsite flows. Proposed basins PO flow offsite and cannot vertically drain to the proposed pond. The total off-site flows from the basins that are not captured by the detention pond are 20.17 cfs for the 100-yr storm. There are offsite flows from basin OS1 and ROW2 that will drain to and be detained within the proposed detention pond totaling 4.94 cfs. To counteract the total flow not routed through the pond from the site, the pond outlet structure has been restricted which has been detailed in the detention portion of this report.

4. The proposed detention pond will be installed with the initial phase of construction. The detention pond has been designed based on the Town Criteria specified below and will act as a permanent stormwater facility that will remain in place.
5. Storm sewers will be installed for the proposed site and for the proposed detention pond outfall. The proposed storm sewer is discussed in more detail in the applicable section.

Variance from Criteria

1. This project has no requests for variances from criteria.

Runoff

1. The developed site will consist of 16 basins consisting of single-family residences with piped roof drainage and associated private driveways, proposed roadways and right-of-way improvements, and the open space & trail network. The site will consist of public streets with curb & gutter, infrastructure, and open space tracts. The Rational Method was used for this analysis, and design storm frequencies of 5-yr and 100-yr storms were (see **Appendix B**).
2. The majority of stormwater runoff from the project site will be directed to the proposed detention pond which will be located along the south property line of the site. Stormwater will be conveyed to the pond by surface flow or a proposed storm sewer network. The pond will provide full-spectrum detention and will outfall directly to the existing surface to the south of the site and overland flow in its historical fashion to the existing wetland areas south of the site. A 4-foot-wide concrete trickle channel and outlet structure will be designed for the pond. A Restrictor plate for the outlet structure was designed to release the runoff from the 100-year storm at a controlled rate in accordance with Urban Storm Drainage Criteria Manual Volume 2, Storage Chapter (**Reference 1**). This design can be found in **Appendix B**. The pond has an emergency spillway which has been designed to spill to the south of the proposed site. The pond has been sized for compensatory storage for the runoff that is not detained on site. The 100-year release rate of the detention pond has been restricted by reducing the release rate by 15.23 cfs in order to account for the 20.17 cfs that will not be detained by the pond and will flow offsite, and the 4.94 cfs off offsite flow that will be detained within the detention pond. The pond has been sized for entirety of the development.
3. The pond is sized based on the contributing impervious area which determined the water quality capture volume (Excess Urban Runoff Volume - EURV) plus the 100 year detention volumes.
4. Developed runoff onsite follows the typical pattern in which roof drainage will be collected in gutters and piped into downspouts. Flows will then sheet flow across landscaped areas and be conveyed into the curb and gutter system in the proposed

roadways. Flows will then enter into the proposed storm sewer network and ultimately be conveyed to the detention pond at the south of the site for all basins except for Basins PO.

Flows from Basin P will flow to the proposed local streets curb and gutter and continue into the proposed storm sewer system. Flows will then outfall into the proposed detention pond at design point 13. These flows will be detained and released following the criteria stated in the Detention section of this report. These flows will ultimately outfall on the south end of the site, and flow to the existing floodplain located south of the property.

Flows from Basin PO will flow onto Cedar Street and be conveyed offsite. The proposed detention pond release rate has been restricted to account for offsite flows from basin PO. Flows from basin PO1 will outfall at the northeast corner of the site onto Cedar Street. Flows from basin PO2 & PO3 will outfall at the southeast corner of the site onto Cedar Street.

Flows from Basin OS will flow onto the site at the northwest corner of the property and be captured in a Type 'C' inlet, where it will be captured by the proposed storm sewer system for the site. Flows will then outfall into the proposed detention pond at design point 13. These flows will be detained and released following the criteria stated in the Detention section of this report. These flows will ultimately outfall on the south end of the site, and flow to the existing floodplain located south of the property.

Flow from Basin ROW will flow into the proposed curb and gutter system on the west half of Cedar Street and follow historical drainage patterns. Except for basin ROW2, which will flow onto the site, and be captured within the proposed storm sewer system. Flows will then outfall into the proposed detention pond at design point 13. These flows will be detained and released following the criteria stated in the Detention section of this report. These flows will ultimately outfall on the south end of the site, and flow to the existing floodplain located south of the property.

Curb & gutter, storm sewer pipe, and inlet design calculations can be found in **Appendix B**.

5. Offsite flows from the vacant land to the west of the site has been accounted for as Basin OS1 within the SF2&3. Flows from this basin are anticipated to flow onto the site and have been accounted for in the calculations for Basin OS1 in **Appendix B**. These flows have been accounted for within the detention pond.

Detention

1. The structural BMP to be utilized for water quality will be a Full Spectrum Detention Basin.

2. The required and provided volumes for the Excess Urban Runoff (EURV) and 100-yr stages are as follows:
 - A. Required WQCV = 0.572 acre-ft
 - B. Required EURV volume = 1.122 acre-ft.
 - C. Required 100-yr volume = 1.512 acre-ft.

These calculations include the mandatory one-foot of freeboard. One foot of freeboard is provided above the emergency overflow water surface elevation (WSEL).

3. The WQCV water surface elevation will be 4943.18, the EURV water surface elevation will be 4945.91, and the 100-year water surface elevation will be 4948.49.
4. The release rates for the 100-yr (31.27 CFS) is based the maximum allowable 100-year release rate, equal the predevelopment discharge for the upstream watershed. The 100-year release has been restricted from 46.5 cfs down to 31.27 cfs to account for the offsite flows from basins PO1-3 that cannot be conveyed to the proposed pond and offsite flows being detained within the proposed pond from basins OS1 and ROW2.
5. The release rate for the 100 year storm will be controlled with an orifice plate inside the outlet structure.
6. A 4 ft. wide concrete trickle channel with a 0.5% longitudinal slope has been incorporated into the pond design to promote drainage of the pond.
7. The pond will be graded with a minimum pond bottom slope of 2% toward the trickle channel.
8. Excess stormwater will pass through the pond, overtop the berm and spill to the south of the site and maintain historic drainage patterns from there.
9. The emergency overflow for the pond has been designed to be 90-feet in length at elevation 4948.5 and will be protected with Type 'VL' riprap for the entire length.
10. The outlet structure and 100-yr restrictor plate will is designed to provide appropriate release rates (see MHFD spreadsheet in **Appendix C**). The outlet structure will consist of an orifice plate containing a vertical column of small, equally spaced orifices. The proposed orifice plate will consist of four rows of 1-3/4" inch diameter orifices spaced 12.1 inches apart. The ground at the outfall of the pipe from the detention pond will be protected from erosion with the installation of a riprap pad. The riprap is type VL which is sized to handle the flows that will be released from the detention pond (see calculation for sizing of riprap pad in **Appendix C**).

Streets

1. Street capacity for the minor storm was based on flows not overtopping the curb and gutter for all private streets on-site. Flows in local streets can spread to the crown of the street in major storm events. The spread criteria control the flow depth for the Residential Collector Street that runs through the site. Refer to **Appendix B** for calculations.

Storm Sewer System

1. The MHFD drainage criteria requires that the minor storm be conveyed into the storm system with no curb overtopping, and flow may spread to the crown of the street, while the major storm shall be conveyed into the system with a depth less than or equal to 12" above the gutter flowline. Depth of ponding at the storm inlets has been limited to the curb height, except at storm inlets A06 & A07 where ponding depth was permitted to the crown of the street. The major storm criterion has been met and the adjacent buildings have been sufficiently graded so that a 100-yr storm will not have any negative impacts.
2. The MHFD drainage criteria requires that the minor storm be conveyed within the storm sewer pipe, while the major storm shall be conveyed in the roadway with a depth less than or equal to 12" above the gutter flowline. This criterion has been met, refer to **Appendix B** for calculations.
3. All proposed storm sewer located within the Town of Keenesburg's Right Of Way has been sized to meet a minimum standard of 18" RCP.

Conclusions

Compliance with Applicable Code

The drainage conveyance and detention volume has been designed in compliance with The Town of Keenseburg design standards, and the MHFD manual.

Flood Hazard

No floodplains shall be impacted by this project.

Impact of the Improvements

- i. This proposed development will provide sedimentation and filtration of runoff through a proposed Full Spectrum Detention pond and controlled release rates for the WQCV and 100-yr events meeting UDFCD release rates for the soil type to mimic predeveloped release rates. The proposed street improvements along Cedar Street will provide curb and gutter for major and minor storm flows.
- ii. The 100-yr release rate for the proposed detention pond was calculated as 46.5 cfs. However, the detention pond does not capture all offsite flows. Proposed basins PO1-P03 have offsite flows not directed to the pond. The pond release has been restricted

to account for the offsite flows and should have no negative affect downstream of the development.

Maintenance of Improvements

- i. The proposed improvements shall be maintained in order to ensure runoff is appropriately routed. The property owners shall be responsible for the maintenance of all drainage infrastructure on their property up to the edge of the sidewalk or roadway. The Town of Keenesburg has the right to enter an owner's property in order to maintain the drainage infrastructure when deemed fit.
- ii. The proposed detention pond shall be maintained by the Homeowners Association. The maintenance responsibility will eventually be transferred to a metropolitan district once one is established.

References

1. *Urban Storm Drainage Criteria Manual, Volumes 1 & 2*; Urban Drainage and Flood Control District, Denver, CO. Updated March 2017, with updates on September 2017.
2. *Urban Storm Drainage Criteria Manual, Volumes 3*; Urban Drainage and Flood Control District, Denver, CO. November 2010, with updates on April 2018.
3. *Weld County Engineering and Construction Guidelines*; Weld County, CO. April 2012, with updates on July 2017.
4. *Natural Resources Conservation Center Web Soil Survey, United States Department of Agriculture, site visited May 2021.*
5. *Federal Emergency Management Agency Flood Insurance Rate Map, Community-Panel Number 08123C2157E revised January 20, 2016.*
6. *NOAA's National Weather Service, Hydrometeorological Design Studies Center, Precipitation Frequency Data Server (PFDS), site visited November 2020.*

APPENDIX

Appendix A:

Vicinity Map

Hydrologic Soils Group

FIRM Map

NOAA Atlas Rainfall Data

Appendix B:

Hydrologic and Hydraulic Computations

Detention Pond Calculations

Appendix C:

Drainage Plans