Early Grading Drainage Report
Peaceful Ridge at Fountain Valley Subdivision
El Paso County, Colorado

Prepared for:
Fountain Valley Investment Partners, LLC
3 Widefield Boulevard
Colorado Springs, Colorado 80911

Prepared by:

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

PCD File No: EGP-213

Kiowa Project No. 04092 & 21031

Original Report: December 7, 2005
Revised: July 20, 2006
Addendum: February 10, 2022

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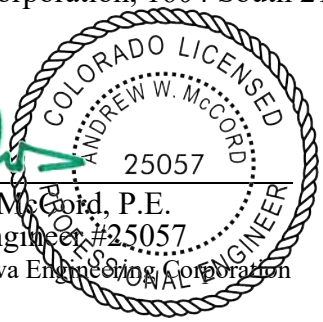
ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City/County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Kiowa Engineering Corporation, 1604 South 21st Street, Colorado Springs, Colorado 80904



2/14/22

Andrew W. McCord, P.E. — Date
Registered Engineer #25057
For and on Behalf of Kiowa Engineering Corporation

DEVELOPER'S STATEMENT:

I, the Developer, have read and will comply with all of the requirements specified in this drainage report and plan.

BY: _____ February 14th 2022

Date

PRINT NAME: J. Ryan Watson

ADDRESS: Fountain Valley Investment Partners, LLC
3 Widefield Boulevard
Colorado Springs, Colorado 80911

EL PASO COUNTY:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

Jennifer Irvine, P.E. — Date
El Paso County Engineer/ECM Administrator
Conditions:

I. General Location and Description

Peaceful Ridge at Fountain Valley Subdivision is to be developed as a single-family residential subdivision. The site lies within the Southeast ¼, Section 15, Township 15 South, Range 65 West of the 6th Principal Meridian, in El Paso County, Colorado. The property covers approximately 60.14 acres of which 2.34 acres will be dedicated as additional right-of-way along Marksheffel Road. The site is bounded to the north by unplatted land, to the east by Marksheffel Road, to the south by Cottonwood Meadows Filing No. 3 and to the west by unplatted land. A vicinity map showing the location of Peaceful Ridge is presented on Figure 1 on the following page.

The property is currently undeveloped and platted as Peaceful Ridge at Fountain Valley Subdivision with 255 single-family lots, a detention basin tract and roadway rights-of-ways. The construction plans for the overall site have been previously approved by the County and proposed drawings are being prepared to bring the construction drawings to current standards. Access to the development will be provided at Marksheffel Road at the northeast corner of the site with the construction of Peaceful Ridge Drive. A secondary access will be provided with the extension of Sleepy Meadows Drive at the southwest corner of the site.

The site slopes generally to the southeast at approximately 6%. The vegetation consists primarily of native grasses and weeds. According to the *Soil Survey for El Paso County, Colorado*, the site's soil, as shown on Figure 2, consists primarily of Kim Loam (#43), which is classified within Hydrologic Soil Group B. A small portion of the site consists of Nelson-Tassel Fine Sandy Loams (#56), Razor-Midway Complex (#75) and Stoneham Sandy Loam (#86). These soils are classified within Hydrologic Soil Groups C and D.

II. Previous Reports

1) *Final Drainage Report for Cottonwood Meadows, Filing No. 1*, prepared by HMS Group, LLC, approved November 4, 1999.
2) *Final Drainage Report for Cottonwood Meadows, Filings No. 2 and 3*, prepared by HMS Group, LLC, approved May 31, 2000.
3) *Preliminary and Final Drainage Report, Peaceful Ridge at Fountain Valley Subdivision*, prepared by Kiowa Engineering Corporation, approved October 17, 2006.
4) *City of Colorado Springs and El Paso County Drainage Criteria Manual*, current editions.
5) *City of Colorado Springs Drainage Criteria Manual Volume 2*, dated November 2002.
6) *Soil Survey of El Paso County Area, Colorado*, prepared by United States Department of Agriculture Soil Conservation Service, dated June 1981.

According to the Cottonwood Meadows drainage reports, historic offsite Basin H-3 which consists of the western and southern portions of the Peaceful Ridge site and a portion to the west of Peaceful Ridge drained in a southeasterly direction onto the Cottonwood Meadows site prior to the development of Cottonwood Meadows. A trapezoidal channel in the back of the

lots along the northern boundary line was constructed with the development of the Cottonwood Meadows property that now redirects this offsite runoff to the east to Marksheffel Road. A total of Q_5=21 cfs and Q_{100}=62 cfs from Basin H-3 drains to the trapezoidal channel and discharges to the northeast corner of the Cottonwood Meadows development. According to the Cottonwood Meadows drainage report, only historic runoff will be allowed to discharge to the trapezoidal channel.

Approximately Q_5=10.1 cfs and Q_{100}=29.5 cfs (Basin H-4) is generated offsite to the west of the Cottonwood Meadows development with a portion draining to Sleepy Meadows Drive. Runoff collected in this street gutter flows to the south to Fontaine Boulevard. Developed Basin 4 (Q_5=8.8 cfs and Q_{100}=18.0 cfs) consists of Sleepy Meadows Drive and the rear of the lots backing up to Fontaine Boulevard. A portion of Basin 4 drains to the street gutter while the remainder drains to a roadside ditch along Fontaine Boulevard. Runoff collected in the roadside ditch is conveyed to the east to the Fountain Mutual Irrigation Company (FMIC) ditch along Fontaine Boulevard.

III. Hydrology

The hydrology for this site was estimated using the methods outlined in the *City of Colorado Springs and El Paso County, Drainage Criteria Manual*. The topography for the site was compiled using a two-foot contour interval and is presented at a horizontal scale of 1-inch to 100-feet. Exhibit E-1 presents the historic drainage patterns for the area and Exhibit D-1 presents the developed drainage patterns for the area, including the sub-basins and the corresponding flow rates. The flow rates for the sub-basins were estimated by using the Rational Method. Detention basin volumes were estimated using the Rational Stored Rate Method. The 5-year and 100-year recurrence intervals were determined. The calculations can be found in the Appendix of this report.

The runoff coefficients for the development were determined using Table 5-1 of the *City of Colorado Springs and El Paso County, Drainage Criteria Manual*. A copy of Table 5-1 is located in the Appendix of this report. The hydrologic calculations were performed assuming Hydrologic Soil Groups B, C and D and are included in the Appendix of this report.

IV. Hydraulic Calculations

The sizing of the onsite hydraulic structures was done using the methods outlined in the *City of Colorado Springs and El Paso County, Drainage Criteria Manual*.

Culverts were sized assuming inlet control, a 100-year storm and a maximum headwater permitted by the *Colorado Springs and El Paso County, Drainage Criteria Manual*. The hydraulic capacities of the culverts were determined using EPA -SWMM Modelling along with the HY-8 culvert analysis and design program developed by the Federal Highway Administration and Pennsylvania State University. All road culverts are proposed to be reinforced concrete with flared end sections. The outlets of all culverts will be protected with riprap which will be sized to meet the outlet velocity condition at each culvert. The riprap at

the outlet of all the culverts has been sized to withstand the forces attributable to the 100-year design discharge.

The lining of swales was determined using the Hydrologic Engineering Circular No. 15, *Design of Roadside Ditches with Flexible Linings*. The use of grass-lined swales with erosion netting is suitable wherever the shear stress is calculated to be less than 2.1 pounds per square foot

The extended detention basin was designed taking into account the partially developed flows of the Peaceful Ridge development in an overlot graded condition for this report. Water quality capture volume is also incorporated into the design of the detention basin as a permanent feature. The detention basin was sized assuming that the outflow combined with runoff bypassing the basin would be restricted to historic 5-year and 100-year flows or less.

Supporting calculations associated with the sizing of hydraulic facilities for this development are located in the Appendix of this report.

V. Existing Drainage Patterns

Sub-basin E-1 contains approximately 27.76 acres and consists of the northern portion of the site. Approximately Q_5=16.4 cfs and Q_{100}=41.5 cfs generated from this sub-basin sheet flows to the east to a roadside ditch along Marksheffel Road. Runoff collected in this ditch travels to an existing 7'x4' concrete box culvert. Runoff intercepted by this culvert is directed under Marksheffel to the east and ultimately discharges into Jimmy Camp Creek.

Sub-basin E-2 contains approximately 33.34 acres and consists of the southern portion of the site. Approximately Q_5=18.6 cfs and Q_{100}=46.3 cfs generated from this sub-basin sheet flows in a southeasterly direction to the existing channel along the south boundary line. Runoff collected in the channel travels to the east to Marksheffel Road and discharges into the roadway corridor west side ditch.

Sub-basin OS-1 contains approximately 32.60 acres and is located the north of the proposed Peaceful Ridge development. Approximately Q_5=23.0 cfs and Q_{100}=61.4 cfs generated from this sub-basin sheet flows in an easterly and southeasterly direction to the roadside ditch alongside Marksheffel. Runoff from this basin does not enter the site until it nearly reaches Marksheffel Road. Runoff channel flows to the south to an existing 7'x4' concrete box culvert.

Sub-basin OS-2 contains approximately 3.05 acres and is located west of the proposed Peaceful Ridge development. Approximately Q_5=2.3 cfs and Q_{100}=6.0 cfs generated from this sub-basin sheet flows in a southeasterly direction to Sleepy Meadows Drive. Runoff gutter flows to the south towards Fontaine Boulevard.

Sub-basin OS-3 contains approximately 13.50 acres and is located north of the proposed Peaceful Ridge development along Marksheffel Road. Approximately Q_5=11.1 cfs and Q_{100}=28.6 cfs generated from this sub-basin sheet flows in a southeasterly direction to the roadside ditch alongside Marksheffel. Runoff channel flows to the south to an existing 7'x4' concrete box culvert. These flows will be captured and directed under Marksheffel Rd.

Sub-basin OS-4 contains 9.38 acres and is located west and south of the subject property. Flows from this basin accumulate in a broad natural channel which convey runoff to the south and away from the site. Some flows enter the west side borrow ditch for Sleepy Meadows Drive at a point several hundred feet south of the site. Some of these flows enter the Fontaine Boulevard Roadway Corridor, and some of these flows enter the FMIC Ditch. Sub-basin OS-4 is raw land and is heavily vegetated with native grasses and weeds.

VI. Site Drainage Plan

The drainage of the site will be accomplished through a combination of sheet flow, and temporary earthen swales which will be used in the Early Grading Plan phase to direct surface flows to a series of Temporary Sediment Basins (TSBs) and subsequently direct these flows to a permanent Extended Detention basin (EDB). Curb inlets and on-site storm pipes will be installed in the finished condition, but not at the time of Early Grading with the exception of the outfall system from the planned detention basin itself, and with the exception of a tie-off to a 48-inch RCP pipe lying under Markscheffel Road, which will serve the very northeast corner of the site. Flows will be intercepted at a series of TSBs as they generally flow southeast towards a low-point near the southeast corner that will ultimately represent the connecting point for Melting Sky Drive and Periwinkle Place. A proposed, full-spectrum, extended detention basin in the southeast corner of the site will be installed at the time of Early Grading except for the inflow forebay. The detention basin will collect partially developed flows from the majority of the site, which will be in an overlot graded condition, and discharge those flows at less than historic rates to an existing 7'x4' concrete box culvert on the east side of the site. Offsite basins OS-1 and OS-3 will drain to the northeast corner of the site. A new area inlet and connecting pipe will join onto an existing 48" RCP storm sewer system under Marksheffel Road to a point of discharge just east of Carriage Meadows North Filing No 1 (aka Lorson Ranch). Offsite basin OS-2 will continue to sheet flow to the site and enter the back of the lots on the west side of Sleepy Meadows Drive.

A2 is directed towards EDB

see comments on IRF-1

A Drainage Basins: The A drainage basins are located in the northern end of the site. Runoff from this area will sheet flow to Peaceful Ridge Drive and continue in an easterly direction to the roadside ditch along Marksheffel Road. A riprap rundown will direct gutter flow into the roadside ditch. Runoff from the north side of the street will drain to a proposed Type 'D' grated inlet and an existing 48-inch RCP will discharge the runoff to the east under Marksheffel Road. A small portion (less than 1 acre) of the planned Peaceful Ridge Drive cannot be captured due to grade and is exempted from treatment in accordance with El Paso County criteria. Runoff then will be routed under Marksheffel to the east and ultimately discharge into Jimmy Camp Creek.

The design of the existing 48-inch storm sewer was coordinated with the downstream property owner, Lorson Ranch (Carriage Meadows North Filing No 1). This developer developed the site on the east side of Marksheffel Road and is known as Carriage Meadows. Lorson Ranch agreed to accept the offsite runoff from the 48-inch RCP as well as the runoff discharging to an existing 7'x4' concrete box culvert under Marksheffel Road. Both of these discharging pipes have been constructed at the time of this report addendum.

Sub-basin A-0 contains 2.07 acres and is located along the north margin of the site. Approximately Q_5=2.7 cfs and Q_{100}=6.4 cfs generated from this sub-basin will sheet flow across backyard areas and will be released to the adjacent property to the north in an historic fashion. Water Quality Treatment is achieved for this sub-basin by Infiltration Reduction Factoring within the rear-yard areas. Calculations supporting treatment are provided in The IRF Appendix (Appendix C) in accordance with El Paso County requirement (Zones A-0-a & A-0-b).

A1 is concentrated, untreated flow. SW will need WQ treatment

Sub-basin A-1 contains approximately 3.218 acres and is located along the north side of Peaceful Ridge Drive at the north end of the site. Approximately Q_5=5.8 cfs and Q_{100}=12.3 cfs generated from this sub-basin will sheet flow to an earthen swale at Peaceful Ridge Drive and will be conveyed east to Marksheffel Road and to a planned 24" Temporary Culvert Crossing which will convey concentrated runoff south under planned Peaceful Ridge Drive (extended west). Off-site flows from Sub-basins OS-1 & OS-3 combine with flows from Sub-0basin A-1, historically at this point. These flows will also be passed under Peaceful Ridge Drive, which will be constructed to a rough-cut condition during Early Grading. The temporary culvert will convey all of the Minor Event (Q_5=38.7 cfs) for the combined flows. These Flows will continue south within the Marksheffel Rd side ditch in an historic fashion to the existing 7'x4' concrete box culvert. Flows will overtop the planned Peaceful Ridge Drive road cut in the major event and re-enter the existing side ditch and continue south in historic fashion. Calculations for this temporary 24" crossing are included in Appendix B. Riprap stabilization is planned at the pipe outlet as well as the side slopes surrounding the outlet as these form the receiving edge in the major event in the Early Grading Permit (EGP) Condition (Q_{100}=115.1 cfs).

south

Sub-basin A-2 contains approximately 3.35 acres and is located along the south side of Peaceful Ridge Drive at the north end of the site. Approximately Q_5=6.4 cfs and Q_{100}=13.4 cfs generated from this sub-basin will sheet flow to a north-side earthen swale at Peaceful Ridge Drive and will be conveyed east to a temporary sedimentation basin (TSB 'B'). Bypass and Overflow at TSB 'B' will release to earthen swales and turn south within continuous earthen swale lying along the west side of Periwinkle Place. These flows will be directed along stabilized channel to the EDB.

<u>B Drainage Basins:</u> The B drainage basins consist of the majority of the site. Runoff from these basins will sheet flow and then enter earthen channels: Sleepy Meadows Drive, Melting Sky Drive and Periwinkle Place. Runoff in these streets will be intercepted by one of several earthen swales within the undercut roadway section. At a minimum grade of 4.0%, Melting Sky has a capacity of 19 cfs for the 5-year event, respectively. The maximum flow in the channel is 13 cfs at TSB 'C' for the 5-year storm and 39 cfs at the end of the planned street and just ahead of its release to the extended detention basin (EDB).

Earthen Swales will convey runoff collected in the roadway section and direct ot to stabilized channel sections which will release directly into the proposed, full-spectrum, extended detention basin located at the southeast corner of the site. Water quality capture

volume (WQCV) will be incorporated into the EDB as required by El Paso County. Discharge from the detention basin will be restricted to historic rates. Runoff released from the detention basin will be conveyed to an existing 7'x4' concrete box culvert under Marksheffel Road via a 36-inch RCP outfall pipe installed as a part of the EDB.

Sub-basin B-1 contains approximately 6.51 acres and is located on either side of Black Powder Trail in the northern portion of the site. Approximately Q_5=12.9 cfs and Q_{100}=27.2 cfs generated from this sub-basin will sheet flow to Black Powder Drive and channel flow to the east to TSB 'D' just before its junction with the west side of Periwinkle Place. Approximately Q_5=12.9 cfs and Q_{100}=24.6 cfs will be intercepted and treated by TSB 'D'. Any Overtopping Flows will be directed south along Periwinkle Place to the EDB.

Sub-basin B-2 contains approximately 4.89 acres and is located between Mirador Lane and Periwinkle Place in the eastern portion of the site. Approximately Q_5=8.8 cfs and Q_{100}=18.7 cfs generated from this sub-basin will sheet flow to the southeast to Periwinkle Place and channel flow directly to the EDB. A combined flow from Periwinkle Place and Melting Sky Drive (Q_5=8.8 cfs and Q_{100}=23.4 cfs) will drain to the EDB within stabilized channel sections in both the minor event and the major event.

Sub-basin B-3 contains approximately 5.19 acres and is located in the central portion of the site on the west side of Mirador Lane. Approximately Q_5=8.3 cfs and Q_{100}=17.6 cfs generated from this sub-basin will sheet flow to the southeast to Mirador Lane. Runoff will channel flow to the south along the planned Mirador roadway cut and turn to the east along Melting Sky Drive. At this point, runoff combines and is directed to the EDB in stabilized temporary swale (TSW) channel. The combined flows (Q_5=17.1 cfs and Q_{100}=36.3 cfs) will drain directly to the EDB.

Sub-basin B-4 contains approximately 4.73 acres and is located in the central portion of the site on either side of Conundrum Court. Approximately Q_5=8.9 cfs and Q_{100}=18.9 cfs generated from this sub-basin will sheet flow to Conundrum Court. Runoff will channel flow to the south along Conundrum and to the east along Melting Sky Drive to proposed TSB 'C' near Mirador Lane. Approximately Q_5=8.6 cfs and Q_{100}=16.6 cfs will be intercepted by TSB 'C'. Overtopping flows will be conveyed directly to the EDB downstream along stabilized temporary swale conveyance (TSW).

Sub-basin B-5 contains approximately 6.09 acres and is located in the central portion of the site on either side of Panpipe Lane. Approximately Q_5=10.3 cfs and Q_{100}=21.9 cfs generated from this sub-basin will sheet flow to Panpipe Lane. Runoff will channel flow to the south along Panpipe and to the east along Melting Sky Drive to TSB 'C'. Approximately Q_5=10.9 cfs and Q_{100}=21.9 cfs will be intercepted by the TSB of flows from Sub-basin B-5. Overtopping flows will continue to travel in the channel along the north side of Melting Sky and enter the EDB as open channel flow.

Sub-basin B-6 contains approximately 7.25 acres and is located east of Sleepy Meadows Drive in the western portion of the site. Approximately Q_5=14.3 cfs and Q_{100}=30.2 cfs is generated from this sub-basin. A portion of the basin's runoff will drain to Sleepy Meadows and these flows will be conveyed within roadway cut channel sections along

Melting Sky Drive. The Majority of the runoff generated in this basin will sheet flow to Hazy Hollow Trail and channel flow to the south then to the east to TSB 'C'. The TSB will intercept approximately Q_5=13.7 cfs and Q_{100}=21.8 cfs of flows from Sub-basin B-6. Overtopping flows will continue to travel in the channel along the north side of Melting Sky and enter the EDB as open channel flow.

Sub-basin B-7 contains approximately 2.95 acres and is located on the south side of Melting Sky Drive in the southern portion of the site. Approximately Q_5=5.4 cfs and Q_{100}=11.7 cfs generated from this sub-basin will sheet flow to the northeast to Melting Sky and channel flow to the east to TSB 'C'. A combined flow from Periwinkle Place and Melting Sky Drive (Q_5=10.0 cfs and Q_{100}=21.3 cfs) will drain to TSB 'C' of flows from Sub-basin B-7. A proposed storm sewer system will convey runoff collected in the inlet to the southeast to the proposed detention basin at the southeast corner of the site. Overtopping flows will continue to travel in the channel along the north side of Melting Sky and enter the EDB as open channel flow.

Sub-basin B-8 contains approximately 2.72 acres and is located on the east side of Periwinkle Place in the eastern portion of the site. Approximately Q_5=4.6 cfs and Q_{100}=9.6 cfs generated from this sub-basin will sheet flow to the southwest to Periwinkle Place and channel flow to the south and enter the EDB via a stabilized riprap rundown.

Under final build conditions, inlets and storm sewers will be added at the low point in the intersection of Melting Sky Drive and Periwinkle Place and these have been sized for piped conveyance of the 5-year & 100-year storm events.

Discuss all C basins. i do not believe runoff reduction will work in this area.

C Drainage Basins: Sub-basin C-1 contains approximately 4.29 acres and is located on the west side of Sleepy Meadows Drive in the western end of the site. Approximately Q_5=8.0 cfs and Q_{100}=16.9 cfs generated from this sub-basin will sheet flow to the southeast to Sleepy Meadows. A combined runoff of Q_5=10.3 cfs and Q_{100}=22.9 cfs with a portion of offsite Sub-basin OS-2 will channel flow to the south to a TSB 'A'. Approximately Q_5=6.4 cfs and Q_{100}=17.4 cfs will be intercepted by TSB 'A'. Overtopping flows will be conveyed to the east along Melting Sky through TSB 'C' and then to the EDB. A small area which is unable to be captured by grade (5,000 s.f.) will escape at the SW corner, and will be directed along existing, hardened conveyances to the roadside ditch at Fontaine Boulevard. Water Quality for this sub-basin is achieved in the overlot condition by Infiltration Reduction Factor (IRF). An additional drainage easement has been set aside at the southwest corner to use for additional treatment, if needed. Sleepy Meadows has adequate capacity to handle additional flows. The street section of the existing roadway is 36-feet face of curb to face of curb with a 2-foot pan and 8-inch-high curb.

see comments on IRF-1

D Drainage Basins: The D drainage basins are located along the southern and eastern borders of the site. Runoff from this area will sheet flow and channel flow to Marksheffel Road.

Sub-basin D-1 contains approximately 2.61 acres and is located on the southern portion of the site. Approximately Q_5=3.4 cfs and Q_{100}=7.8 cfs generated from this sub-basin will sheet flow to the existing channel along the southern property line within the Cottonwood Meadows subdivision. The homeowners in Cottonwood Meadows have encroached upon

this channel. The encroachments into the existing swale have not been done collectively and the channel is potentially unstable. With the Peaceful Ridge development, however, less runoff will be draining to this swale which will still have the capacity to carry the developed flows from the Peaceful Ridge site. See capacity calculations in the Appendix of this report. Runoff intercepted by this swale will channel flow to the east to the roadside ditch along Marksheffel Road. Flows will travel in a southerly direction along Marksheffel in the roadside ditch. Water Quality Treatment is achieved in the rear yard areas. Calculations can be found in Appendix Z (Zones D-1-a & D-1-b).

Sub-basin D-2 contains approximately 2.25 acres and consists of the backside of the single-family lots on the east side of Periwinkle Place. Approximately Q_5=4.0 cfs and Q_{100}=8.9 cfs generated from this sub-basin will sheet flow to the roadside ditch along Marksheffel Road. Flows will drain to the existing 7'x4' concrete box culvert that runs under Marksheffel. Water Quality Treatment is achieved in the rear yard areas. Calculations can be found in Appendix Z (Zones D-2-a & D-2-b).

Sub-basin D-3 contains approximately 2.29 acres and consists of the west half of the right-of-way for Marksheffel Road including half of the road itself and the additional 50-foot of right-of-way that will be dedicated with the platting of Peaceful Ridge at Fountain Valley Subdivision. Approximately Q_5=4.4 cfs and Q_{100}=9.8 cfs generated from this sub-basin will sheet flow to the roadside ditch along Marksheffel Road. Flows will drain to the existing 7'x4' concrete box culvert that runs under Marksheffel.

There will be some offsite land disturbance related to the installation of a temporary culvert crossing at the very NE corner of the site near an existing well house. This is undeveloped raw land which shall otherwise remain in undeveloped condition. The temporary crossing shall be considered a TBMP installation. The surrounding and adjacent terrain will be stabilized and restored to its original condition. Planned Peaceful Valley Drive will be centered on the property line and the rough cut roadway portion will also disturb a small offsite area in the northeast corner of the site. The roadway will use a riprap rundown near its intersection with Marksheffel Rd, and this will stabilize concentrated runoff, and direct it south through the temporary culvert crossing and along the existing Marksheffel Road side ditch to the south along its historic course. In the Final Developed Condition these flows will all be intercepted at an area inlet and directed under Marksheffel Road along a new alignment.

Water Quality Treatment

Water Quality Treatment will be required for the proposed development. The proposed full spectrum extended detention basin will be used for permanent stormwater quality treatment. The required WQCV for a 40-hour drain time is 0.721 acre-feet. The storage volume required for EURV detention is 1.118 acre-feet. The storage volume for the 100-year Major Event is 1.961 acre-feet.

Water Quality Methodology (4-Step Process):

Step 1- Runoff reduction Practices

see comments on IRF-1

New construction will utilize existing and proposed grassed areas as buffers, allowing sediment to drop out of the storm runoff and helping to reduce runoff. Sub-basin D-3 contains portions of vegetated hillsides along with an existing, broad, meandering, five-foot, flat-bottom channel which will provide some runoff reduction benefit, along with some biofiltering. Runoff reduction calculations and *IRF Reduction Exhibit* are provided in Appendix C for Sub-basins A-0, D-1, D-2, C-0, C-1, C-2. IRF Reduction Analysis for this zone resulted in a treatment value of at least 60% of the expected overall WQCV.

Step 2- Implement BMP's That Slowly Releases Water Quality Capture Volume

Treatment and slow release of 40 hours of the water quality capture volume (WQCV) will be accomplished by the implementation of a new, private, full-spectrum, extended detention basin.

Step 3 - Stabilize Drainageways

There are no major drainageways affected by the development. No improvements to any downstream drainageways are required or anticipated, at this time. The project discharges to a large side ditch and directly enters downstream public storm sewer piping system at or below historic rates. Some additional ditch shaping, check dams and slope stabilization are planned in the Marksheffel Road side ditch where Peaceful Valley Road is extended west.

Step 4 - Implement Site Specific & Source Control BMPs

There are no potential sources of contaminants that could be introduced to the County's MS4 that will not be controlled by temporary construction BMPs. Maintenance and sweeping of parking areas is recommended to limit sediment transport to new inlets, pipes and detention areas. Construction BMPs in the form of vehicle tracking control, concrete washout area, inlet protection, rock socks, and silt fences will be utilized during construction activities to protect receiving waters.

Detention Facilities

The EDB will be mostly constructed at the time of the Early Grading excepting the inflow forebay, the trickle pan, and the lower maintenance road. It will act as a permanent Water Quality Treatment And Detention Facility. The proposed outlet structure will include two chambers: one for the 5-year and one for the 100-year storm event. An orifice plate will drain the water quality portion of the basin into the first chamber of the outlet structure. Approximately Q_5=62.8 cfs and Q_{100}=132.0 cfs (DP-7) will drain to the proposed detention basin. Runoff released from the detention basin will be restricted to 1.9 cfs and 69.8 cfs for the 5-year and 100-year storm events, respectively, in order to limit the total runoff draining to Marksheffel Road. A proposed 36-inch RCP will convey runoff released from the detention basin to an open channel discharge point near the existing 7'x4' concrete box culvert. If the outlet structure becomes plugged, a 75-foot-wide emergency spillway will convey the runoff to the roadside ditch along Marksheffel Road.

VII. Flood Plain Statement

According to the Federal Emergency Management Agency (FEMA), the proposed development does not lie within a designated floodplain. The Floodplain Insurance Rate Map (FIRM) for El Paso County panel 08041C0957 G, dated December 7, 2018, was reviewed to determine any potential floodplain delineation. A copy of the relevant portion of the FIRM panel is shown on Figure 3.

VIII. Cost Estimate and Fees

The proposed development lies within the Jimmy Camp Creek Drainage Basin. Drainage and Bridge Fees have been paid with the platting of the property. These fees were based on developed impervious area in El Paso County.

An updated calculation of fees is presented in the Final Drainage Report Addendum.

IX. Summary and Conclusions

The subject site contains approximately 60.14 acres and is located on the west side of Marksheffel Road just north of Fontaine Boulevard. The property is to be developed into 255 single-family lots, with 3 lots being incorporated into the detention basin tract. The majority of runoff generated from the site will sheet flow and then channel flow in earthen swales to a series of TSBs. These TSBs will allow sediments to drop out of the system. Overtopping flows will also be conveyed in earthen swales. Armored Stabilization of the swales is used increasingly as the flows approach the EDB. Runoff collected within the EDB will be released at or below historic rates via a 36-inch RCP and will discharge to an existing 7'x4' concrete box culvert under Marksheffel Road. The offsite runoff to the will be accommodated by a new Type 'D' area inlet to an existing 48-inch RCP culvert that will convey runoff to the east under Marksheffel Road.

Please state who will be responsible for maintaining the 36" RCP and part of the riprap spillway in the ROW, will it be a HOA or a district? The County will not be maintaining any infrastructure even though it is in the ROW. Please submit a license agreement to acknowledge a privately maintained pipe will be within the ROW. You can find a template for it here: https://planningdevelopment.elpasoco.com/planning-development-forms/#1584029763943-19bc4c03-3586. Please give me a call if you have any questions.

Please also confirm the pond will be privately maintained.

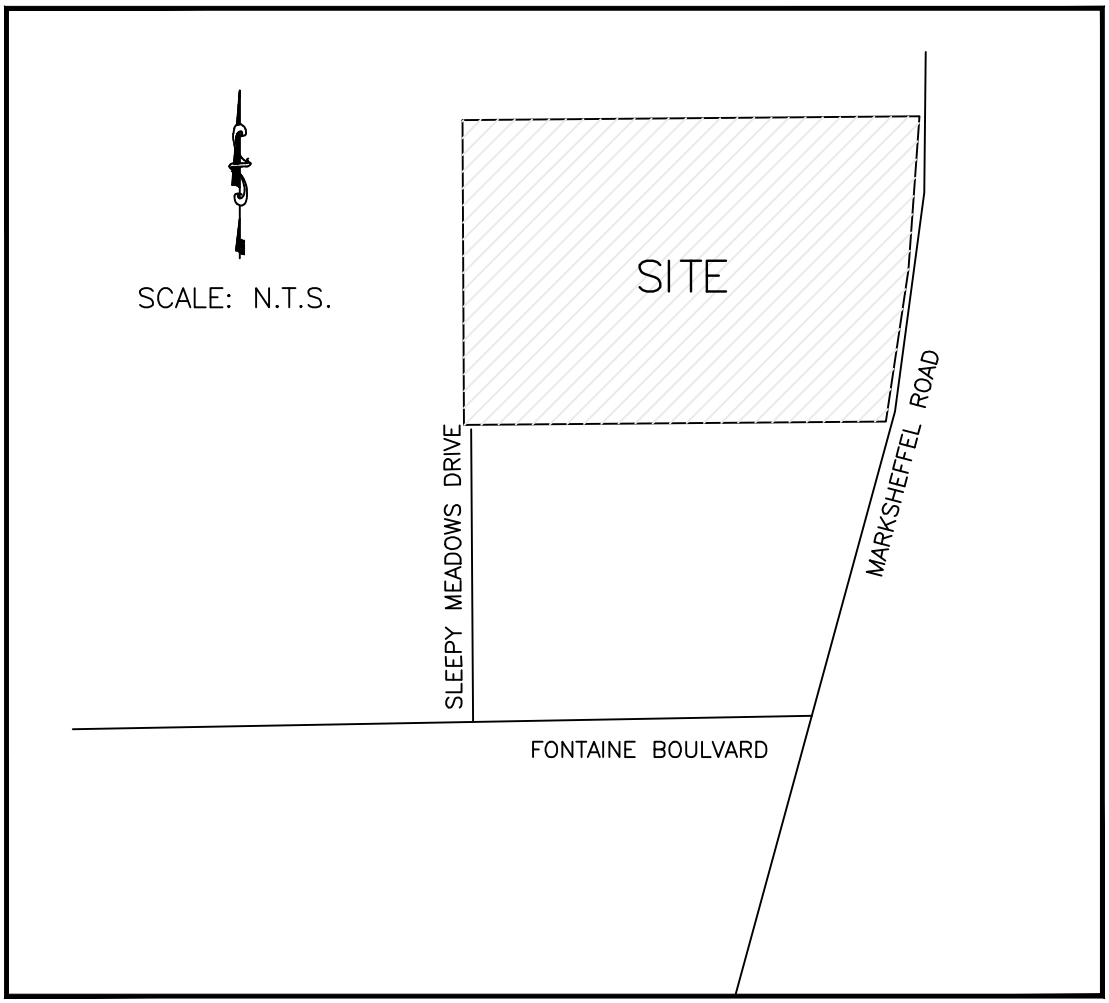
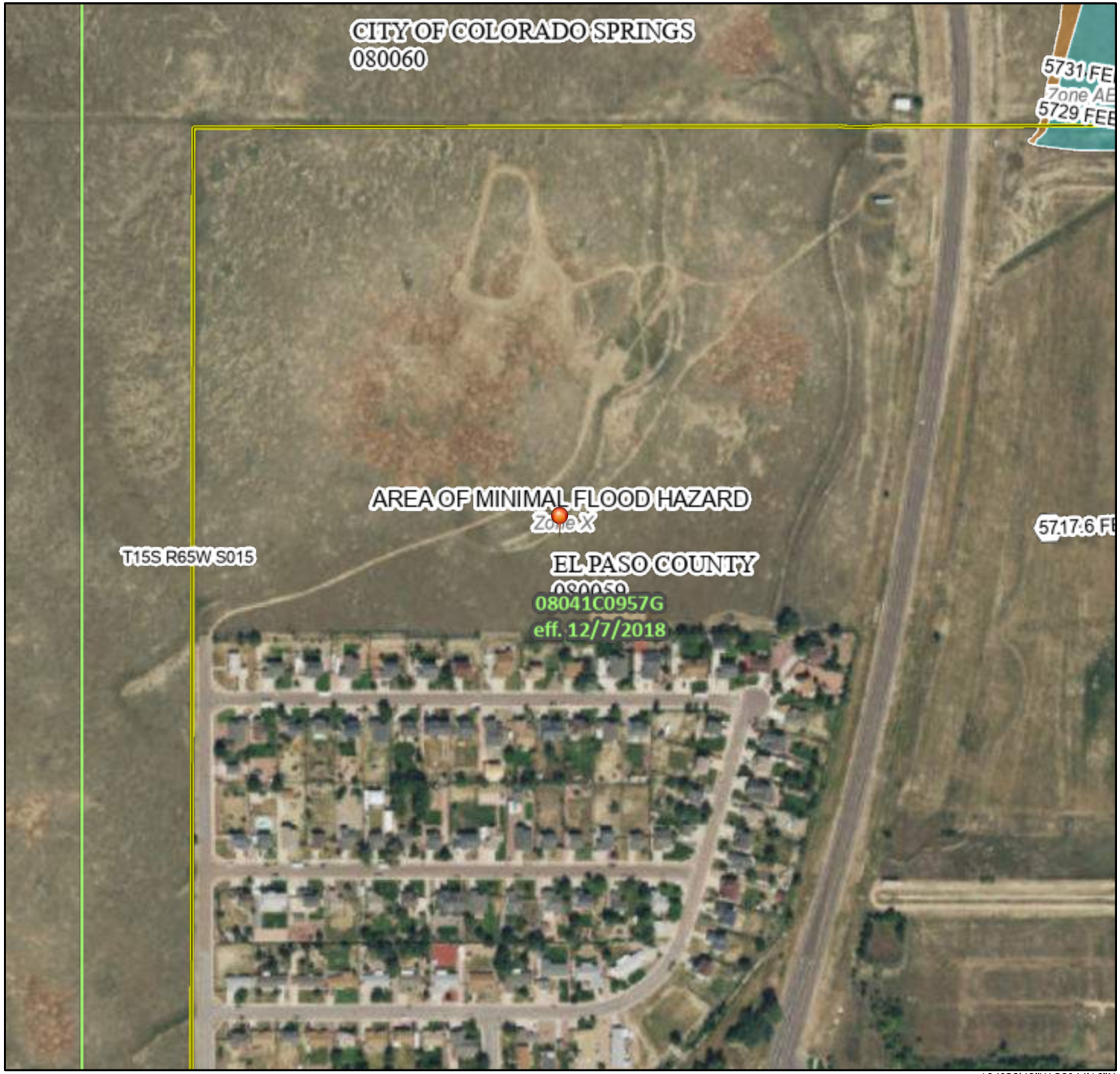


FIGURE 1
VICINITY MAP
PEACEFUL RIDGE at
FOUNTAIN VALLEY SUBDIVISION

National Flood Hazard Layer FIRMette

FEMA

104°39'25"W 38°44'44"N



104°38'48"W 38°44'16"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 Cross Sections with 1% Annual Chance
- 17.5 Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 10/15/2021 at 3:26 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Custom Soil Resource Report
Soil Map

FIGURE 3 - SOILS

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 1:24,000.

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: El Paso County Area, Colorado
Survey Area Data: Version 19, Aug 31, 2021

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

Date(s) aerial images were photographed: Aug 14, 2018—Sep 23, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
43	Kim loam, 1 to 8 percent slopes	56.2	90.2%
56	Nelson-Tassel fine sandy loams, 3 to 18 percent slopes	0.6	1.0%
75	Razor-Midway complex	3.8	6.1%
86	Stoneham sandy loam, 3 to 8 percent slopes	1.7	2.7%
Totals for Area of Interest		**62.3**	**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.

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.

El Paso County Area, Colorado

43—Kim loam, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 368k
Elevation: 5,300 to 5,600 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Kim and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kim

Setting

Landform: Fans, hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy alluvium

Typical profile

A - 0 to 6 inches: loam
C - 6 to 60 inches: loam

Properties and qualities

Slope: 1 to 8 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 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 20 percent
Maximum salinity: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R069XY006CO - Loamy Plains, LRU's A and B 10-14 Inches, P.Z.
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Pleasant

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

56—Nelson-Tassel fine sandy loams, 3 to 18 percent slopes

Map Unit Setting

National map unit symbol: 3690
Elevation: 5,600 to 6,400 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Nelson and similar soils: 55 percent
Tassel and similar soils: 40 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nelson

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous residuum weathered from interbedded sedimentary rock

Typical profile

A - 0 to 5 inches: fine sandy loam
Ck - 5 to 23 inches: fine sandy loam
Cr - 23 to 27 inches: weathered bedrock

Properties and qualities

Slope: 3 to 12 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.06 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: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Very low (about 2.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R067BY045CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY046CO)
Hydric soil rating: No

Description of Tassel

Setting

Landform: Hills
Landform position (three-dimensional): Side slope, crest
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous slope alluvium over residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: fine sandy loam
C - 4 to 10 inches: fine sandy loam
Cr - 10 to 14 inches: weathered bedrock

Properties and qualities

Slope: 3 to 18 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Available water supply, 0 to 60 inches: Very low (about 1.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: R067BY045CO - Shaly Plains
Other vegetative classification: SHALY PLAINS (069AY046CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

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

75—Razor-Midway complex

Map Unit Setting

National map unit symbol: 369p
Elevation: 5,300 to 6,100 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Razor and similar soils: 60 percent
Midway and similar soils: 35 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Razor

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear, concave
Across-slope shape: Linear
Parent material: Clayey slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 4 inches: stony clay loam
Bw - 4 to 22 inches: cobbly clay loam
Bk - 22 to 29 inches: cobbly clay
Cr - 29 to 33 inches: weathered bedrock

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
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: 5 percent
Maximum salinity: Moderately saline to strongly saline (8.0 to 16.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): 6e

Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: R069XY047CO - Alkaline Plains LRU's A and B
Other vegetative classification: ALKALINE PLAINS (069AY047CO)
Hydric soil rating: No

Description of Midway

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Slope alluvium over residuum weathered from shale

Typical profile

A - 0 to 4 inches: clay loam
C - 4 to 13 inches: clay
Cr - 13 to 17 inches: weathered bedrock

Properties and qualities

Slope: 3 to 25 percent
Depth to restrictive feature: 6 to 20 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
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: 15 percent
Maximum salinity: Very slightly saline to moderately saline (2.0 to 8.0 mmhos/cm)
Sodium adsorption ratio, maximum: 15.0
Available water supply, 0 to 60 inches: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: R069XY046CO - Shaly Plains LRU's A and B
Other vegetative classification: SHALY PLAINS (069AY045CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

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

86—Stoneham sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 36b2
Elevation: 5,100 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

Stoneham and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stoneham

Setting

Landform: Hills
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Calcareous loamy alluvium

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 8 inches: sandy clay loam
Btk - 8 to 11 inches: sandy clay loam
Ck - 11 to 60 inches: loam

Properties and qualities

Slope: 3 to 8 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 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): 4e
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains

Other vegetative classification: SANDY PLAINS (069AY026CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

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

Appendix A
Hydrologic Calculations
Runoff Coefficient Calculations
Time of Concentration
Detention

TABLE 5-1

RECOMMENDED AVERAGE RUNOFF COEFFICIENTS AND PERCENT IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	"C" FREQUENCY 10 A&B*	"C" FREQUENCY 10 C&D*	"C" FREQUENCY 100 A&B*	"C" FREQUENCY 100 C&D*
Business					
Commercial Areas	95	0.90	0.90	0.90	0.90
Neighborhood Areas	70	0.75	0.75	0.80	0.80
Residential					
1/8 Acre or less	65	0.60	0.70	0.70	0.80
1/4 Acre	40	0.50	0.60	0.60	0.70
1/3 Acre	30	0.40	0.50	0.55	0.60
1/2 Acre	25	0.35	0.45	0.45	0.55
1 Acre	20	0.30	0.40	0.40	0.50
Industrial					
Light Areas	80	0.70	0.70	0.80	0.80
Heavy Areas	90	0.80	0.80	0.90	0.90
Parks and Cemeteries	7	0.30	0.35	0.55	0.60
Playgrounds	13	0.30	0.35	0.60	0.65
Railroad Yard Areas	40	0.50	0.55	0.60	0.65
Undeveloped Areas					
Historic Flow Analysis- Greenbelts, Agricultural	2	0.15	0.25	0.20	0.30
Pasture/Meadow	0	0.25	0.30	0.35	0.45
Forest	0	0.10	0.15	0.15	0.20
Exposed Rock	100	0.90	0.90	0.95	0.95
Offsite Flow Analysis (when land use not defined)	45	0.55	0.60	0.65	0.70
Streets					
Paved	100	0.90	0.90	0.95	0.95
Gravel	80	0.80	0.80	0.85	0.85
Drive and Walks	100	0.90	0.90	0.95	0.95
Roofs	90	0.90	0.90	0.95	0.95
Lawns	0	0.25	0.30	0.35	0.45

* Hydrologic Soil Group

9/30/90

Site 60.14 Acres total
less 2.34 Acres Row dedication
less 1.21 Acres detention basin tract
56.59 AC total developed area

$\frac{255 \text{ lots}}{56.59 \text{ Acres}} = 4.5 \text{ du/AC}$

Use Runoff Coefficient between 1/8 Acre & 1/4 Acre

Soils - majority of site is soil B
Southwest & northeast corners are C/D

Runoff Coefficient - Existing Condition

Basin E-1 8% soil C/D, 1% Road 99% pasture

pasture $C_5 = 0.92(.25) + 0.08(.30) = 0.25$
$C_{100} = 0.92(.35) + 0.08(.45) = 0.36$

wtd $C_5 = 0.99(.25) + 0.01(.90) = 0.26$
$C_{100} = 0.99(.36) + 0.01(.95) = 0.37$

Runoff Coefficient – Existing Condition

Basin E-2 4% soil C/D 0.5% Road

pasture $C_5 = 0.96(.25) + 0.04(.30) = 0.25$

$C_{100} = 0.96(.35) + .04(.45) = 0.35$

wtd $C_5 = 0.995(.25) + .005(.90) = .25$

$C_{100} = .995(.35) + .005(.95) = .35$

Basin OS-1 1/3 soil B, 2/3 soil C/D

100% pasture/meadow

$C_5 = 1/3(.25) + 2/3(.30) = 0.28$

$C_{100} = 1/3(.35) + 2/3(.45) = 0.42$

Basin OS-2 Soil B 100% pasture

$C_5 = 0.25$ $C_{100} = 0.35$

Basin OS-3 Soil C/D 5% Road 95% pasture

$C_5 = 0.95(.30) + 0.05(0.90) = 0.33$

$C_{100} = 0.95(.45) + 0.05(0.95) = 0.48$

Runoff Coefficient - Existing Condition

DP-1 basins E-1, DS-1 & DS-3

Area: 27.76 + 32.60 + 13.50 = 73.86 Acres

$$C_5 = \frac{27.76(.26) + 32.60(.28) + 13.50(.33)}{73.86} = 0.28$$

$$C_{100} = \frac{27.76(.37) + 32.60(.42) + 13.50(.48)}{73.86} = 0.41$$

DP-2 basins E-2 & DS-2

Area: 33.34 + 9.30 = 42.64 Ac

$C_5 = 0.25$ $C_{100} = 0.35$

Runoff Coefficient - Developed Condition

for 4.5 du/Ac (44% impervious) soil B : $C_5 = 0.51$ $C_{100} = 0.61$
soil C/D : $C_5 = 0.61$ $C_{100} = 0.71$

Basin A-1 5% soil C/D

$C_5 = 0.95(.51) + .05(.61) = 0.52$

$C_{100} = 0.95(.61) + .05(.71) = 0.62$

Basin A-2 5% soil C/D

$C_5 = 0.95(.51) + .05(.61) = 0.52$

$C_{100} = .95(.61) + .05(.71) = 0.62$

Basin B-1 100% soil B

$C_5 = 0.51$ $C_{100} = 0.61$

Basin B-2 100% soil B

$C_5 = 0.51$ $C_{100} = 0.61$

Basin B-3 100% soil B

$C_5 = 0.51$ $C_{100} = 0.61$

Runoff Coefficient - Developed Condition

Basin B-4 Soil B $C_5 = 0.51$ $C_{100} = 0.61$

Basin B-5 Soil B $C_5 = 0.51$ $C_{100} = 0.61$

Basin B-6 Soil B $C_5 = 0.51$ $C_{100} = 0.61$

Basin B-7 19% soil C/D 81% soil B

$C_5 = 0.19(.61) + 0.81(.51) = 0.53$

$C_{100} = 0.19(.71) + 0.81(.61) = 0.63$

Basin B-8 19% soil C/D 81% soil B

$C_5 = 0.19(.61) + .81(.51) = 0.53$

$C_{100} = 0.19(.71) + 0.81(.61) = 0.63$

Basin C-1 100% soil B

$C_5 = 0.51$ $C_{100} = 0.61$

Basin D-1 23% soil C/D 20% pavement 80% lawn

lawn $C_5 = 0.77(.25) + 0.23(.30) = 0.26$

$C_{100} = 0.77(.35) + 0.23(.45) = 0.37$

wtd $C_5 = 0.80(.26) + 0.20(.90) = 0.39$

$C_{100} = 0.80(.37) + 0.20(.95) = 0.50$

Runoff Coefficient – Developed Condition

Basin D-2 24% soil C|D 20% roof/pavement
80% lawn

lawn $C_5 = 0.76(.25) + 0.24(.30) = 0.26$
$C_{100} = 0.76(.35) + 0.24(.45) = 0.37$

wtd $C_5 = 0.80(.26) + 0.20(.90) = 0.39$
$C_{100} = 0.80(.37) + 0.20(.95) = 0.50$

Basin D-3 50% soil C|D 15% pavement 85% lawn

lawn $C_5 = 0.50(.25) + 0.50(.30) = 0.28$
$C_{100} = 0.50(.35) + 0.50(.45) = 0.40$

wtd $C_5 = 0.85(.28) + .15(.90) = 0.37$
$C_{100} = 0.85(.40) + 0.15(.95) = 0.48$

Peaceful Ridge at Fountain Valley Subdivision
Existing Condition
Time of Concentration Calculation

Basin	Slope			Length			Run Coef.	Velocity			T_c			T_c	Basin
	O'land 1	Chan. 1	Chan. 2	O'land 1	Chan. 1	Chan. 2	(5-year)	O'land 1	Chan. 1	Chan. 2	O'land 1	Chan. 1	Chan. 2		
E-1	7.1 %	5.0 %	1.6 %	1,000 lf	1,100 lf	375 lf	0.26		5.0 ft/sec	4.0 ft/sec	25.9 min.	3.7 min.	1.6 min.	**31.1 min.**	E-1
E-2	6.2 %	4.8 %	1.5 %	1,000 lf	1,100 lf	260 lf	0.25		5.0 ft/sec	4.0 ft/sec	27.4 min.	3.7 min.	1.1 min.	**32.1 min.**	E-2
OS-1	8.2 %	5.6 %		1,000 lf	700 lf		0.28		6.0 ft/sec		24.1 min.	1.9 min.		**26.0 min.**	OS-1
OS-2	4.7 %	5.5 %		600 lf	400 lf		0.28		5.0 ft/sec		22.4 min.	1.3 min.		**23.8 min.**	OS-2
OS-3	10.0 %	0.7 %		400 lf	2,000 lf		0.33		2.5 ft/sec		13.4 min.	13.3 min.		**26.7 min.**	OS-3
OS-4	10.0 %	0.7 %		400 lf	1,560 lf		0.51		2.5 ft/sec		10.2 min.	10.4 min.		**20.6 min.**	OS-4
DP-1	7.1 %	5.0 %	1.6 %	1,000 lf	1,100 lf	375 lf	0.28		5.0 ft/sec	4.0 ft/sec	25.2 min.	3.7 min.	1.6 min.	**30.5 min.**	DP-1
DP-2	4.7 %	5.5 %	3.7 %	600 lf	400 lf	1,900 lf	0.25		3.5 ft/sec	5.0 ft/sec	23.3 min.	1.9 min.	6.3 min.	**31.5 min.**	DP-2

Equations:

Time of Concentration (Overland) = $1.87(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

Velocity (Road) = $10(10^{(0.5\log S + 0.5)})$

S = Slope of flow path in percent

Velocity (Channel) = $(1.49/n)R_n^{2/3} S^{1/2}$

Slope (S) = Slope of the channel

n = Manning's number

R_n = Hydraulic Radius (Reynold's Number)

Peaceful Ridge at Fountain Valley Subdivision
Developed Time of Concentration Calculation

Basin	Slope			Length			Run Coef.	Velocity			T_c			T_c	Basin
	O'land 1	Chan. 1	Chan. 2	O'land 1	Chan. 1	Chan. 2	(5-year)	O'land 1	Chan. 1	Chan. 2	O'land 1	Chan. 1	Chan. 2		
A-0	4.0 %	5.0 %		25 lf	25 lf		0.25		4.4 ft/sec		5.0 min.	0.1 min.		**5.1 min.**	A-0
A-1	4.0 %	5.0 %		100 lf	1,800 lf		0.52		4.4 ft/sec		6.8 min.	6.8 min.		**13.7 min.**	A-1
A-2	4.0 %	5.0 %		90 lf	1,645 lf		0.52		4.4 ft/sec		6.5 min.	6.2 min.		**12.7 min.**	A-2
B-1	4.0 %	5.0 %		100 lf	1,060 lf		0.51		4.4 ft/sec		7.0 min.	4.0 min.		**11.0 min.**	B-1
B-2	5.0 %	4.5 %	1.4 %	185 lf	280 lf	500 lf	0.51		4.3 ft/sec	2.3 ft/sec	8.8 min.	1.1 min.	3.6 min.	**13.5 min.**	B-2
B-3	5.0 %	5.0 %	2.8 %	300 lf	270 lf	970 lf	0.51		3.3 ft/sec	3.3 ft/sec	11.2 min.	1.4 min.	4.9 min.	**17.4 min.**	B-3
B-4	7.0 %	2.2 %	4.2 %	200 lf	500 lf	280 lf	0.51		2.8 ft/sec	4.1 ft/sec	8.2 min.	3.0 min.	1.1 min.	**12.3 min.**	B-4
B-5	5.0 %	2.8 %		300 lf	850 lf		0.51		3.3 ft/sec		11.2 min.	4.3 min.		**15.5 min.**	B-5
B-6	5.0 %	3.8 %		100 lf	1,050 lf		0.51		3.8 ft/sec		6.5 min.	4.6 min.		**11.1 min.**	B-6
B-7	6.0 %	4.2 %		80 lf	1,400 lf		0.53		4.1 ft/sec		5.2 min.	5.7 min.		**10.9 min.**	B-7
B-8	4.0 %	1.4 %		60 lf	1,100 lf		0.53		2.3 ft/sec		5.2 min.	8.0 min.		**13.2 min.**	B-8
C-1	4.0 %	3.2 %		100 lf	1,250 lf		0.51		3.6 ft/sec		7.0 min.	5.8 min.		**12.7 min.**	C-1
D-1	6.0 %	4.0 %		80 lf	1,525 lf		0.39		3.0 ft/sec		6.5 min.	8.5 min.		**15.0 min.**	D-1
D-2	5.0 %			85 lf			0.39				7.2 min.			**7.2 min.**	D-2
D-3		2.0 %			500 lf		0.37		2.2 ft/sec			3.8 min.		**5.0 min.**	D-3
OS-1	8.2 %	5.6 %		1,000 lf	700 lf		0.28		6.0 ft/sec		24.1 min.	1.9 min.		**26.0 min.**	OS-1
OS-2	4.7 %	5.5 %		600 lf	400 lf		0.28		5.0 ft/sec		22.4 min.	1.3 min.		**23.8 min.**	OS-2
OS-3	10.0 %	0.7 %		400 lf	2,000 lf		0.33		2.5 ft/sec		13.4 min.	13.3 min.		**26.7 min.**	OS-3
OS-4	10.0 %	0.7 %		400 lf	1,560 lf		0.28		2.5 ft/sec		14.2 min.	10.4 min.		**24.6 min.**	OS-4
DP-1*			3.2 %			70 lf	0.08			3.6 ft/sec		23.8 min.	0.3 min.	**24.1 min.**	DP-1*
DP-2	5.0 %	3.8 %	4.2 %	100 lf	1,050 lf	290 lf	0.51		3.8 ft/sec	4.1 ft/sec	6.5 min.	4.6 min.	1.2 min.	**12.2 min.**	DP-2
DP-3	5.0 %	3.8 %	4.2 %	100 lf	1,050 lf	770 lf	0.51		3.8 ft/sec	4.1 ft/sec	6.5 min.	4.6 min.	3.1 min.	**14.2 min.**	DP-3
DP-4	5.0 %	3.8 %	4.2 %	100 lf	1,050 lf	1,120 lf	0.51		3.8 ft/sec	4.1 ft/sec	6.5 min.	4.6 min.	4.6 min.	**15.6 min.**	DP-4
DP-5	4.0 %	5.0 %	1.4 %	100 lf	1,060 lf	700 lf	0.51		4.4 ft/sec	2.3 ft/sec	7.0 min.	4.0 min.	5.1 min.	**16.0 min.**	DP-5
DP-6	4.0 %	5.0 %	1.4 %	100 lf	1,060 lf	700 lf	0.33		4.4 ft/sec	2.3 ft/sec	9.1 min.	4.0 min.	5.1 min.	**18.2 min.**	DP-6
DP-7**			2.0 %			70 lf	0.38			5.0 ft/sec		18.2 min.	0.2 min.	**18.4 min.**	DP-7**
DP-8	10.0 %	0.7 %		400 lf	2,000 lf		0.32		2.5 ft/sec		13.6 min.	13.3 min.		**26.9 min.**	DP-8
DP-8a	8.2 %	5.6 %		1,000 lf	700 lf		0.31		6.0 ft/sec		23.2 min.	1.9 min.		**25.1 min.**	DP-8a
DP-9a	4.0 %	5.0 %	1.2 %	90 lf	1,645 lf	400 lf	0.77		4.4 ft/sec	2.0 ft/sec	3.7 min.	6.2 min.	3.3 min.	**13.3 min.**	DP-9a

Equations:

Time of Concentration (Overland) = $1.87(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for five-year flow

L = Length of overland flow in feet

S = Slope of flow path in percent

Velocity (Road) = $10(10^{(0.5\log S + 0.5)})$

S = Slope of flow path in percent

Velocity (Channel) = $(1.49/n)R_n^{2/3} S^{1/2}$

Slope (S) = Slope of the channel

n = Manning's number

R_n = Hydraulic Radius (Reynold's Number)

*Time of Concentration for Basin OS-2 plus additional curb & gutter flow

**Time of Concentration for DP-6 plus pipe flow

Peaceful Ridge at Fountain Valley Subdivision

Existing Condition

Runoff Calculation

Basin / Design Point	Contributing Basins	Area	C_5	C_{100}	Time of Concentration	Rainfall Intensity i_5	Rainfall Intensity i_{100}	Runoff Q_5	Runoff Q_{100}	Basin / Design Point
E-1		27.76 ac	0.26	0.37	31.1 min.	2.3 in/hr	4.0 in/hr	**16.4 cfs**	**41.5 cfs**	E-1
E-2		33.34 ac	0.25	0.35	32.1 min.	2.2 in/hr	4.0 in/hr	**18.6 cfs**	**46.3 cfs**	E-2
OS-1		32.60 ac	0.28	0.42	26.0 min.	2.5 in/hr	4.5 in/hr	**23.0 cfs**	**61.4 cfs**	OS-1
OS-2		3.05 ac	0.28	0.42	23.8 min.	2.6 in/hr	4.7 in/hr	**2.3 cfs**	**6.0 cfs**	OS-2
OS-3		13.50 ac	0.33	0.48	26.7 min.	2.5 in/hr	4.4 in/hr	**11.1 cfs**	**28.6 cfs**	OS-3
OS-4		9.38 ac	0.28	0.42	24.6 min.	2.6 in/hr	4.6 in/hr	**6.8 cfs**	**18.2 cfs**	OS-4
DP-1	E-1, OS-1 & OS-3	73.86 ac	0.28	0.41	30.5 min.	2.3 in/hr	4.1 in/hr	**47.5 cfs**	**123.8 cfs**	DP-1
DP-2	E-2 & OS-2	36.39 ac	0.25	0.35	31.5 min.	2.3 in/hr	4.0 in/hr	**20.5 cfs**	**51.1 cfs**	DP-2

Equations:

$i_5 = 54.6/(T_c^{0.83}+6.72)$

$i_{100} = 75/((10+T_c)^{0.786})$

i_5=Average 5-year Rainafall Intensity in inches per hou

i_{100}=Average 100-year Rainfall Intensity in inches per hou

T_c=Time of Concentration

$Q = CiA$

Q = Peak Runoff Rate, in cubic feet per second (cfs

C = Runoff coefficient representing a ration of peak runoff rate to average rainfa intensity for a duration equal to the runoff time of concentratio

i = average rainfall intensity in inches per hou

A = Drainage area in acres

Peaceful Ridge at Fountain Valley Subdivision
Developed Runoff Calculation

Basin / Design Point	Contributing Basins	Area	C_5	C_{100}	Time of Concentration	Rainfall Intensity i_5	Rainfall Intensity i_{100}	Runoff Q_5	Runoff Q_{100}	Basin / Design Point
A-0	A-0	2.07 ac	0.25	0.35	5.1 min.	5.2 in/hr	8.9 in/hr	**2.7 cfs**	**6.4 cfs**	A-0
A-1	A-1	3.18 ac	0.52	0.62	13.7 min.	3.5 in/hr	6.2 in/hr	**5.8 cfs**	**12.3 cfs**	A-1
A-2	A-2	3.41 ac	0.52	0.62	12.7 min.	3.6 in/hr	6.4 in/hr	**6.5 cfs**	**13.6 cfs**	A-2
B-1	B-1	6.51 ac	0.51	0.61	11.0 min.	3.9 in/hr	6.9 in/hr	**12.9 cfs**	**27.2 cfs**	B-1
B-2	B-2	4.89 ac	0.51	0.61	13.5 min.	3.5 in/hr	6.3 in/hr	**8.8 cfs**	**18.7 cfs**	B-2
B-3	B-3	5.19 ac	0.51	0.61	17.4 min.	3.1 in/hr	5.6 in/hr	**8.3 cfs**	**17.6 cfs**	B-3
B-4	B-4	4.73 ac	0.51	0.61	12.3 min.	3.7 in/hr	6.5 in/hr	**8.9 cfs**	**18.9 cfs**	B-4
B-5	B-5	6.09 ac	0.51	0.61	15.5 min.	3.3 in/hr	5.9 in/hr	**10.3 cfs**	**21.9 cfs**	B-5
B-6	B-6	7.25 ac	0.51	0.61	11.1 min.	3.9 in/hr	6.8 in/hr	**14.3 cfs**	**30.2 cfs**	B-6
B-7	B-7	2.95 ac	0.48	0.59	11.4 min.	3.8 in/hr	6.8 in/hr	**5.4 cfs**	**11.7 cfs**	B-7
B-8	B-8	2.72 ac	0.48	0.59	13.6 min.	3.5 in/hr	6.3 in/hr	**4.6 cfs**	**10.0 cfs**	B-8
C-1	C-1	4.29 ac	0.51	0.61	12.7 min.	3.6 in/hr	6.4 in/hr	**8.0 cfs**	**16.9 cfs**	C-1
D-1	D-1	2.61 ac	0.39	0.50	15.0 min.	3.4 in/hr	6.0 in/hr	**3.4 cfs**	**7.8 cfs**	D-1
D-2	D-2	2.22 ac	0.39	0.50	7.2 min.	4.6 in/hr	8.0 in/hr	**4.0 cfs**	**8.9 cfs**	D-2
D-3	D-3	2.29 ac	0.37	0.48	5.0 min.	5.2 in/hr	8.9 in/hr	**4.4 cfs**	**9.8 cfs**	D-3
OS-1	OS-1	32.60 ac	0.28	0.42	26.0 min.	2.5 in/hr	4.5 in/hr	**23.0 cfs**	**61.4 cfs**	OS-1
OS-2	3.05 Acres is tributary to C-1	3.05 ac	0.28	0.42	23.8 min.	2.6 in/hr	4.7 in/hr	**2.3 cfs**	**6.0 cfs**	OS-2
OS-3	OS-3	13.50 ac	0.33	0.48	26.7 min.	2.5 in/hr	4.4 in/hr	**11.1 cfs**	**28.6 cfs**	OS-3
OS-4	OS-4	9.38 ac	0.28	0.42	24.1 min.	2.6 in/hr	4.7 in/hr	**6.9 cfs**	**18.4 cfs**	OS-4
DP-1a	OS-2 & C-1	7.34 ac	0.41	0.53	24.1 min.	2.6 in/hr	4.7 in/hr	**8.0 cfs**	**18.2 cfs**	DP-1a
DP-1	OS-2 & C-1, B6	14.59 ac	0.46	0.57	25.3 min.	2.6 in/hr	4.6 in/hr	**17.3 cfs**	**37.9 cfs**	DP-1
DP-2	B-5, B-6	13.34 ac	0.51	0.61	12.2 min.	3.7 in/hr	6.6 in/hr	**25.3 cfs**	**53.4 cfs**	DP-2
DP-3	B-4, B-5, B-6	18.07 ac	0.51	0.61	14.2 min.	3.5 in/hr	6.1 in/hr	**31.9 cfs**	**67.6 cfs**	DP-3
DP-4	B-3, B-4, B-5, B-6	23.26 ac	0.51	0.61	15.6 min.	3.3 in/hr	5.9 in/hr	**39.3 cfs**	**83.2 cfs**	DP-4
DP-5	A-1, A-2, B-1 & B-2	17.99 ac	0.51	0.61	16.0 min.	3.3 in/hr	5.8 in/hr	**30.0 cfs**	**63.6 cfs**	DP-5
DP-6	A-1,A-2, All B Basins + OS-2 & C-1	54.26 ac	0.33	0.39	18.2 min.	3.1 in/hr	5.4 in/hr	**54.1 cfs**	**114.9 cfs**	DP-6
DP-7	A-1,A-2, All B Basins + OS-2 & C-1	54.26 ac	0.38	0.45	18.4 min.	3.0 in/hr	5.4 in/hr	**62.8 cfs**	**132.0 cfs**	DP-7
DP-8	A-0, OS-1, & OS-3	48.17 ac	0.32	0.46	26.9 min.	2.5 in/hr	4.4 in/hr	**38.1 cfs**	**97.5 cfs**	DP-8
DP-8a	A-0 & OS-1	34.67 ac	0.31	0.45	25.1 min.	2.6 in/hr	4.6 in/hr	**27.6 cfs**	**71.4 cfs**	DP-8a
DP-9a	D-2, D-3	4.51 ac	0.77	0.96	13.3 min.	3.6 in/hr	6.3 in/hr	**12.4 cfs**	**27.3 cfs**	DP-9a
DP-9*	All except A-0, D-1, OS-1, OS-3	58.77 ac						**32.3 cfs**	**82.6 cfs**	DP-9*

Equations:

$i_5 = 54.6/(T_c^{0.83}+6.72)$

$i_{100} = 75/((10+T_c)^{0.786})$

i_5=Average 5-year Rainafall Intensity in inches per hour

i_{100}=Average 100-year Rainfall Intensity in inches per hour

T_c=Time of Concentration

Q = CiA

Q = Peak Runoff Rate, in cubic feet per second (cfs)

C = Runoff coefficient representing a ration of peak runoff rate to average rainfall intensity for a duration equal to the runoff time of concentration.

i = average rainfall intensity in inches per hour

A = Drainage area in acres

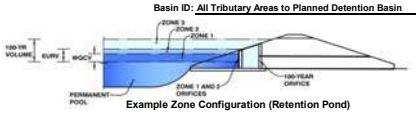
*DP-9a plus dishcarge from Detention Basin

Please provide a calculation to explain how watershed is 33%. Per table 6-6 in CSDCM Vol.1 1/8 acre developments (which is close to this proposal) is 65% impervious. There is minimal green space in this development

UD-Detention, Version 3.07 (February 2017)

Project: Peaceful Ridge Subdivion

Basin ID: All Tributary Areas to Planned Detention Basin



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	53.88	acres
Watershed Length =	3,200	ft
Watershed Slope =	0.035	ft/ft
Watershed Imperviousness =	33.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.721	acre-feet
Excess Urban Runoff Volume (EURV) =	1.839	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	1.423	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	2.010	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	2.992	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	4.827	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	6.040	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	7.628	acre-feet
500-yr Runoff Volume (P1 = 3.2 in.) =	11.014	acre-feet
Approximate 2-yr Detention Volume =	1.329	acre-feet
Approximate 5-yr Detention Volume =	1.886	acre-feet
Approximate 10-yr Detention Volume =	2.695	acre-feet
Approximate 25-yr Detention Volume =	3.085	acre-feet
Approximate 50-yr Detention Volume =	3.246	acre-feet
Approximate 100-yr Detention Volume =	3.799	acre-feet

Optional User Override 1-hr Precipitation	
1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.20	inches

Stage-Storage Calculation

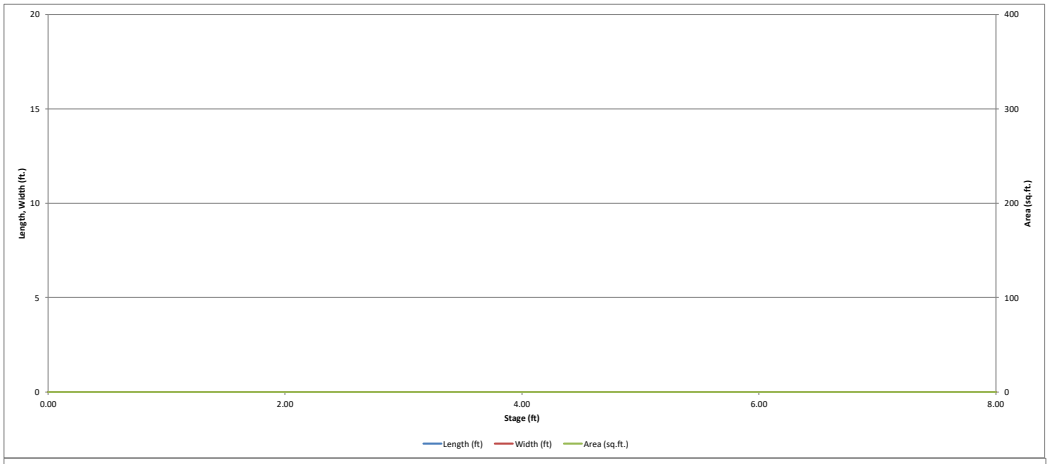
Zone 1 Volume (WQCV) =	0.721	acre-feet
Zone 2 Volume (EURV - Zone 1) =	1.118	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.961	acre-feet
Total Detention Basin Volume =	3.799	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

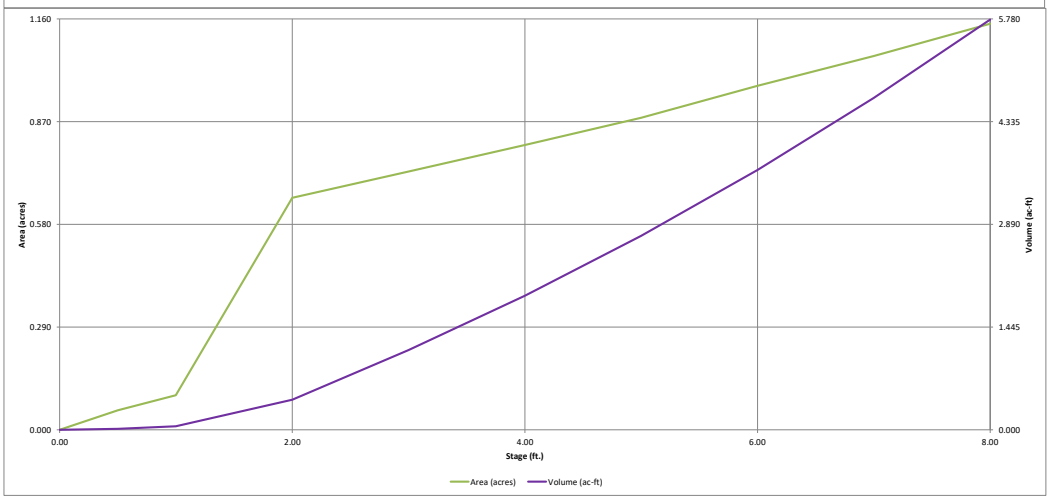
Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	26	0.001		
5731		0.50	--	--	--	2,400	0.055	583	0.013
5731.5	--	1.00	--	--	--	4,266	0.098	2,230	0.051
5732.5	--	2.00	--	--	--	28,535	0.655	18,389	0.422
5733.5	--	3.00	--	--	--	31,757	0.729	48,819	1.121
5734.5	--	4.00	--	--	--	35,011	0.804	82,203	1.887
5735.5	--	5.00	--	--	--	38,350	0.880	118,884	2.729
5736.5	--	6.00	--	--	--	42,287	0.971	159,202	3.655
5737.5	--	7.00	--	--	--	45,960	1.055	203,326	4.668
5738.5	--	8.00	--	--	--	49,930	1.146	251,271	5.768

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



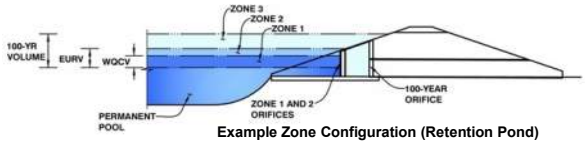


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Peaceful Valley Sub (Addendum 2021)

Basin ID: All Tributary



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.44	0.721	Orifice Plate
Zone 2 (EURV)	3.94	1.118	Rectangular Orifice
Zone 3 (100-year)	6.15	1.961	Weir&Pipe (Restrict)
		3.799	Total

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

			Calculated Parameters for Underdrain		
Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

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

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	2.44	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.67	1.33					
Orifice Area (sq. inches)	1.17	1.17	4.65					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Rectangular	Not Selected		**Calculated Parameters for Vertical Orifice**	Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	2.44	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	0.28	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	3.94	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.21	N/A	feet
Vertical Orifice Height =	5.00	N/A	inches				
Vertical Orifice Width =	8.00		inches				

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected		**Calculated Parameters for Overflow Weir**	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.94	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.94	N/A	feet
Overflow Weir Front Edge Length =	8.00	N/A	feet	Over Flow Weir Slope Length =	4.12	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	3.57	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	4.00	N/A	feet	Overflow Grate Open Area w/o Debris =	23.09	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	11.54	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Restrictor	Not Selected		**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	6.47	N/A	ft^2
Outlet Pipe Diameter =	36.00	N/A	inches	Outlet Orifice Centroid =	1.39	N/A	feet
Restrictor Plate Height Above Pipe Invert =	31.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	2.38	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

			Calculated Parameters for Spillway		
Spillway Invert Stage=	6.15	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.68	feet
Spillway Crest Length =	75.00	feet	Stage at Top of Freeboard =	7.83	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	1.13	acres
Freeboard above Max Water Surface =	1.00	feet			

Routed Hydrograph Results

Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.20
Calculated Runoff Volume (acre-ft) =	0.721	1.839	1.423	2.010	2.992	4.827	6.040	7.628	11.014
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.720	1.839	1.423	2.011	2.993	4.829	6.036	7.625	11.020
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.22	0.72	1.00	1.34	2.02
Predevelopment Peak Q (cfs) =	0.0	0.0	0.7	1.2	12.0	39.1	54.0	72.4	108.8
Peak Inflow Q (cfs) =	12.8	32.4	25.2	35.4	52.4	83.9	104.3	131.0	187.1
Peak Outflow Q (cfs) =	0.3	1.8	1.4	1.9	11.1	35.2	51.6	69.8	142.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	0.9	0.9	1.0	1.0	1.3
Structure Controlling Flow =	Plate	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.4	2.1	2.9	3.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	55	62	62	62	58	51	48	45	38
Time to Drain 99% of Inflow Volume (hours) =	**61**	71	70	72	70	66	64	61	55
Maximum Ponding Depth (ft) =	2.38	3.70	3.22	3.90	4.59	5.32	5.68	6.14	6.60
Area at Maximum Ponding Depth (acres) =	0.68	0.78	0.75	0.80	0.85	0.91	0.94	0.98	1.02
Maximum Volume Stored (acre-ft) =	0.676	1.649	1.283	1.799	2.375	3.006	3.349	3.792	4.252

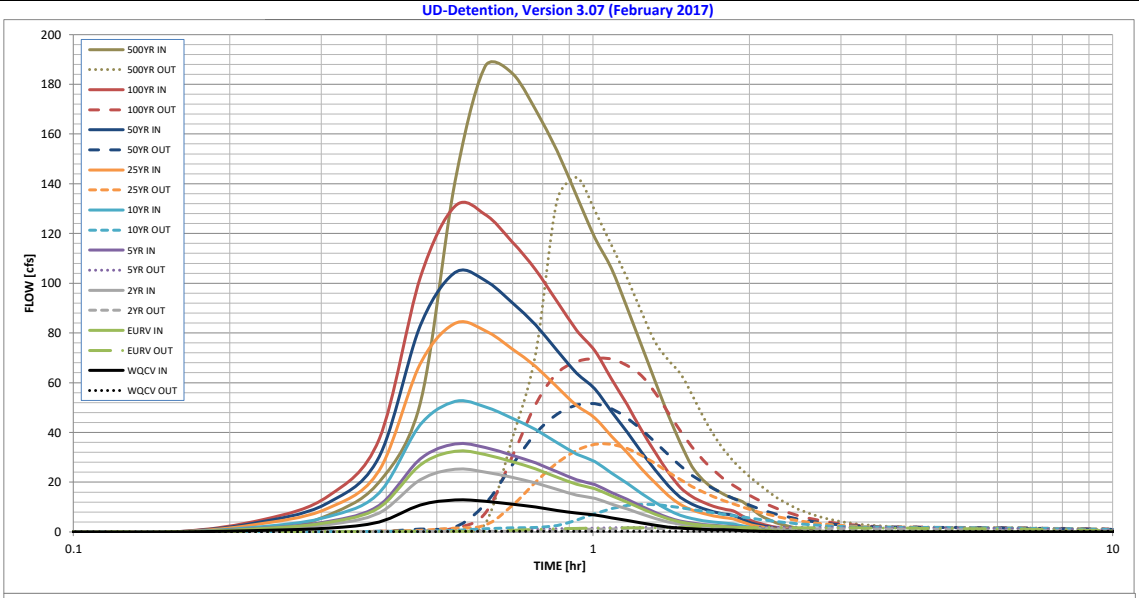
Please revise per Senate Bill 15-212. WQCV should not exceed 40 hours in detention.

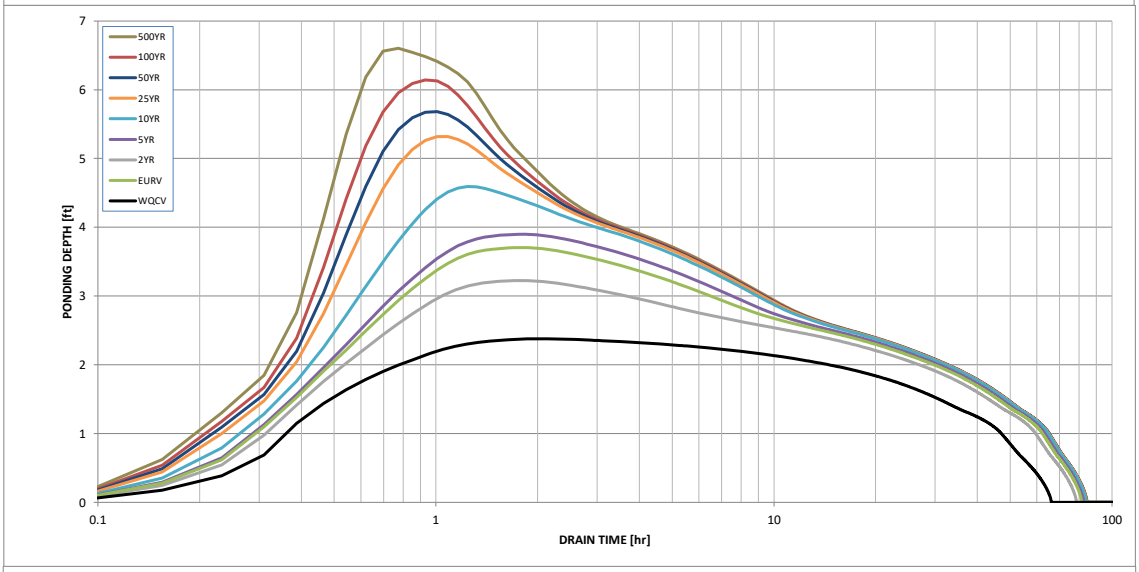
Ratio should be less than or equal to 1. unresolved.

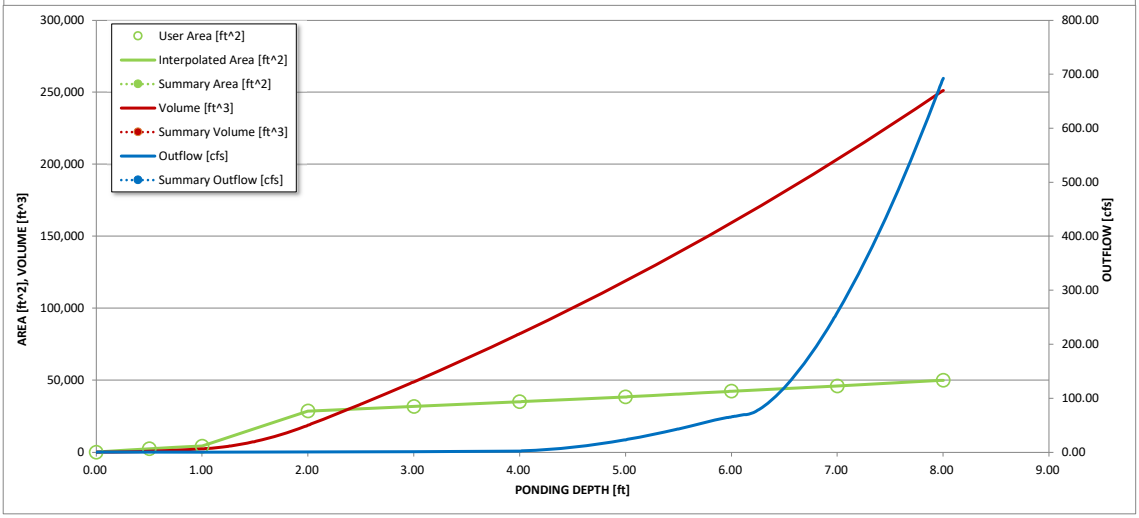
Staff recommends providing a safety rail on outlet structure since velocities are high for storm events.

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

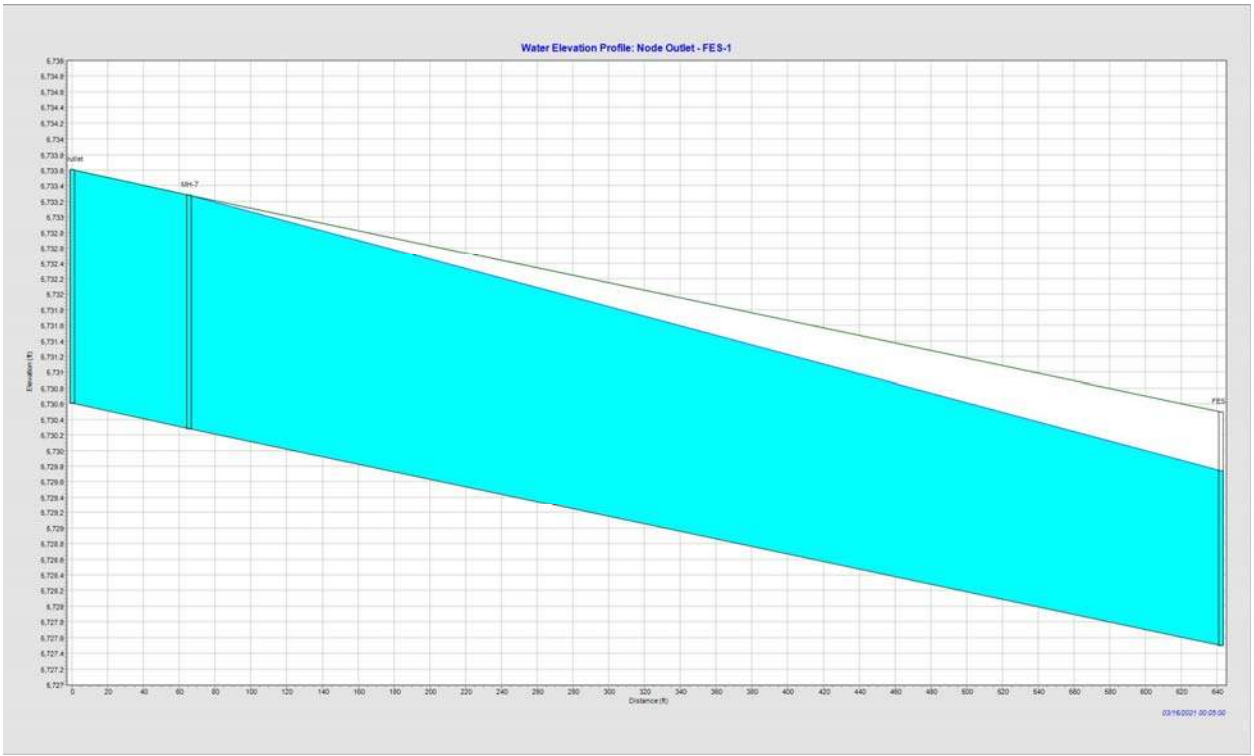
Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.65 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:09:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:13:57	0.57	1.40	1.09	1.52	2.22	3.43	4.16	5.05	6.74
1.076	0:18:36	1.53	3.81	2.97	4.16	6.11	9.60	11.78	14.54	20.07
	0:23:15	3.93	9.80	7.63	10.68	15.69	24.66	30.25	37.33	51.57
	0:27:54	10.81	26.90	20.96	29.32	43.06	67.58	82.86	102.16	140.85
	0:32:33	12.85	32.44	25.17	35.42	52.43	83.87	104.30	130.95	187.14
	0:37:12	12.27	31.06	24.08	33.92	50.29	80.89	101.05	127.64	184.61
	0:41:51	11.17	28.27	21.92	30.87	45.77	73.76	92.32	116.87	169.75
	0:46:30	9.98	25.37	19.65	27.72	41.18	66.47	83.22	105.41	153.23
	0:51:09	8.62	22.04	17.04	24.10	35.92	58.20	73.00	92.63	135.03
	0:55:48	7.51	19.14	14.82	20.95	31.30	50.85	63.83	81.06	118.28
	1:00:27	6.80	17.36	13.44	18.99	28.32	45.85	57.45	72.81	105.87
	1:05:06	5.62	14.47	11.17	15.83	23.67	38.49	48.37	61.52	90.01
	1:09:45	4.60	11.93	9.19	13.06	19.57	31.92	40.16	51.13	74.92
	1:14:24	3.55	9.34	7.17	10.24	15.44	25.35	32.00	40.89	60.28
	1:19:03	2.65	7.11	5.42	7.81	11.86	19.62	24.85	31.84	47.12
	1:23:42	1.91	5.22	3.96	5.74	8.80	14.70	18.68	24.03	35.74
	1:28:21	1.48	3.97	3.02	4.36	6.63	10.99	13.92	17.84	26.37
	1:33:00	1.22	3.23	2.47	3.54	5.36	8.82	11.13	14.21	20.88
	1:37:39	1.03	2.73	2.09	2.99	4.52	7.42	9.35	11.92	17.48
	1:42:18	0.91	2.39	1.83	2.62	3.94	6.45	8.11	10.33	15.10
	1:46:57	0.82	2.14	1.64	2.34	3.53	5.76	7.24	9.21	13.44
	1:51:36	0.75	1.97	1.51	2.15	3.23	5.27	6.62	8.41	12.26
	1:56:15	0.55	1.45	1.11	1.59	2.40	3.95	4.99	6.39	9.46
	2:00:54	0.41	1.06	0.81	1.16	1.74	2.85	3.61	4.61	6.82
	2:05:33	0.30	0.78	0.60	0.85	1.28	2.11	2.67	3.42	5.06
	2:10:12	0.22	0.58	0.44	0.63	0.95	1.57	1.99	2.54	3.76
	2:14:51	0.16	0.42	0.32	0.46	0.70	1.15	1.46	1.87	2.78
	2:19:30	0.11	0.30	0.23	0.33	0.50	0.83	1.05	1.35	2.01
	2:24:09	0.08	0.22	0.16	0.24	0.36	0.60	0.76	0.98	1.46
	2:28:48	0.05	0.15	0.11	0.16	0.25	0.42	0.54	0.69	1.04
	2:33:27	0.03	0.09	0.07	0.10	0.16	0.27	0.35	0.46	0.69
	2:38:06	0.02	0.05	0.04	0.06	0.09	0.16	0.20	0.27	0.41
	2:42:45	0.00	0.02	0.01	0.02	0.04	0.07	0.10	0.13	0.21
	2:47:24	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04	0.07
	2:52:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:56:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:01:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:06:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:10:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:15:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:19:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:29:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:38:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:52:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:57:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:06:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:11:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:06:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:11:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:16:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:34:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Appendix B
Hydraulic Calculations

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.015)

Peaceful Ridge Sub - STORM 'C' (DETENTION BASIN OUTFALL)

100-Year HGL/EGL Analysis



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NOTE: The summary statistics displayed in this report are

based on results found at every computational time step,

not just on results from each reporting time step.

****

****

Analysis Options

****

Flow Units ..... CFS

Process Models:

  Rainfall/Runoff ..... YES

```
  RDII ................... NO
  Snowmelt ............... NO
  Groundwater ............ NO
  Flow Routing ........... YES
  Ponding Allowed ........ YES
  Water Quality .......... NO
Flow Routing Method ...... DYNWAVE
Surcharge Method ......... EXTRAN
Starting Date ............ 03/16/2021 00:00:00
Ending Date .............. 03/16/2021 03:00:00
Antecedent Dry Days ...... 0.0
Report Time Step ......... 00:05:00
Routing Time Step ........ 30.00 sec
Variable Time Step ....... YES
Maximum Trials ........... 8
Number of Threads ........ 1
Head Tolerance ........... 0.005000 ft
```

Flow Routing Continuity	Volume acre-feet	Volume 10^6 gal
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.000	0.000
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	17.305	5.639
External Outflow	10.095	3.290
Flooding Loss	7.289	2.375
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.092	0.030
Continuity Error (%)	-0.989	

****

Highest Continuity Errors

****

Node MH-7 (-1.51%)

****

Time-Step Critical Elements

****

Link 27 (2069.23%)

Link 26 (80.77%)

Node Outlet (15.38%)

****

Highest Flow Instability Indexes

****

All links are stable.

****

Routing Time Step Summary

****

Minimum Time Step   :   0.96 sec

Average Time Step   :   2.00 sec

Maximum Time Step   :   3.31 sec

Percent in Steady State   :   99.52

Average Iterations per Step :   4.73

Percent Not Converging   :   11.54

Time Step Frequencies   :

   30.000 - 13.228 sec   :   0.00 %

   13.228 - 5.833 sec   :   0.00 %

    5.833 - 2.572 sec   :   8.00 %

    2.572 - 1.134 sec   :   80.00 %

    1.134 - 0.500 sec   :   12.00 %

****

Node Depth Summary

****

Node	Type	Average Depth Feet	Maximum Depth Feet	Maximum HGL Feet	Time of Max Occurrence days hr:min	Reported Max Depth Feet
Outlet	JUNCTION	2.99	3.00	5733.61	0 00:00	3.00
MH-7	JUNCTION	2.93	3.00	5733.28	0 00:00	3.00
FES-1	OUTFALL	2.03	2.08	5729.58	0 00:00	2.08

****

Node Inflow Summary

****

Node	Type	Maximum Lateral Inflow CFS	Maximum Total Inflow CFS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 gal	Total Inflow Volume 10^6 gal	Flow Balance Error Percent
Outlet	JUNCTION	69.80	69.80	0 00:00	5.64	5.64	0.936
MH-7	JUNCTION	0.00	78.35	0 00:00	0	5.18	-1.486
FES-1	OUTFALL	0.00	40.84	0 00:00	0	3.29	0.000

****

Node Surcharge Summary

****

Surcharging occurs when water rises above the top of the highest conduit.

Node	Type	Hours Surcharged	Max. Height Above Crown Feet	Min. Depth Below Rim Feet
Outlet	JUNCTION	2.99	0.000	0.000
MH-7	JUNCTION	2.99	0.000	0.000

****
Node Flooding Summary
****

Flooding refers to all water that overflows a node, whether it ponds or not.

Node	Hours Flooded	Maximum Rate CFS	Time of Max Occurrence days hr:min	Total Flood Volume 10^6 gal	Maximum Ponded Depth Feet
Outlet	2.99	46.16	0 00:00	0.409	0.000
MH-7	2.99	24.45	0 00:00	1.966	0.000

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
FES-1	99.82	39.74	40.84	3.289
System	99.82	39.74	40.84	3.289

****

Link Flow Summary

****

Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
26	CONDUIT	78.35	0 00:00	17.09	1.65	1.00
27	CONDUIT	40.84	0 00:00	6.41	0.88	0.85

****

Flow Classification Summary

****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
26	1.00	0.00	0.00	0.00	0.97	0.03	0.00	0.00	0.00	0.00
27	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00

****

Conduit Surcharge Summary

****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited

26	2.99	2.99	2.99	3.00	0.01
27	0.01	2.99	0.01	0.01	0.01

Analysis begun on: Mon Feb 14 10:09:13 2022

Analysis ended on: Mon Feb 14 10:09:13 2022

Total elapsed time: < 1 sec

Peaceful Ridge at Fountain Valley Subdivision
Riprap Design Calculation

Proposed Hydraulic Structure Location	Description	Design Flow	Channel Flow Velocity	Channel Slope	Riprap Value	Calculated Riprap Type	**Proposed Riprap Type**
Detention Outlet Pipe (#27)	36 inch RCP	69.8 cfs	5.0 ft/sec	2.0 %	1.9	VL	**M**

Equations:

Riprap Value = $VS^{0.17}/(S_s-1)^{0.66}$

V = mean channel flow velocity

S = Longitudinal channel slope (ft/ft)

S_s = Specific Gravity of stone (minimum S_s = 2.50)

S_s = 2.64 (most cases)

Riprap Value	Riprap Type	D50
1.4 to 3.2	VL	6 inches
3.3 to 3.9	L	9 inches
4.0 to 4.5	M	12 inches
4.6 to 5.5	H	18 inches
5.6 to 6.4	VH	24 inches

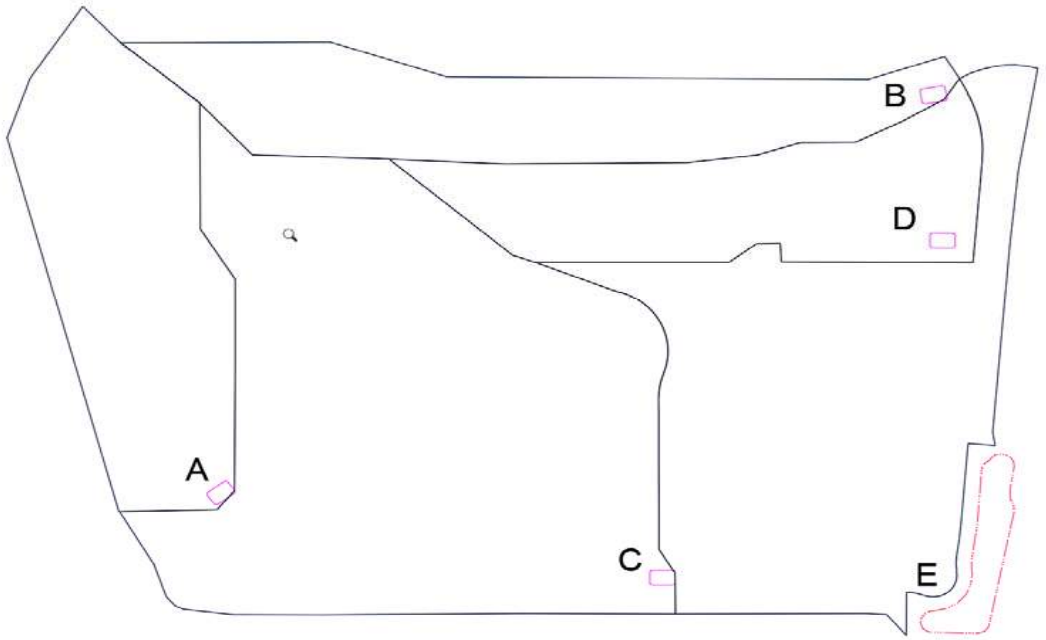
Equations taken from *Section 10.10.2, City of Colorado Springs & El Paso County Drainage Criteria Manual*

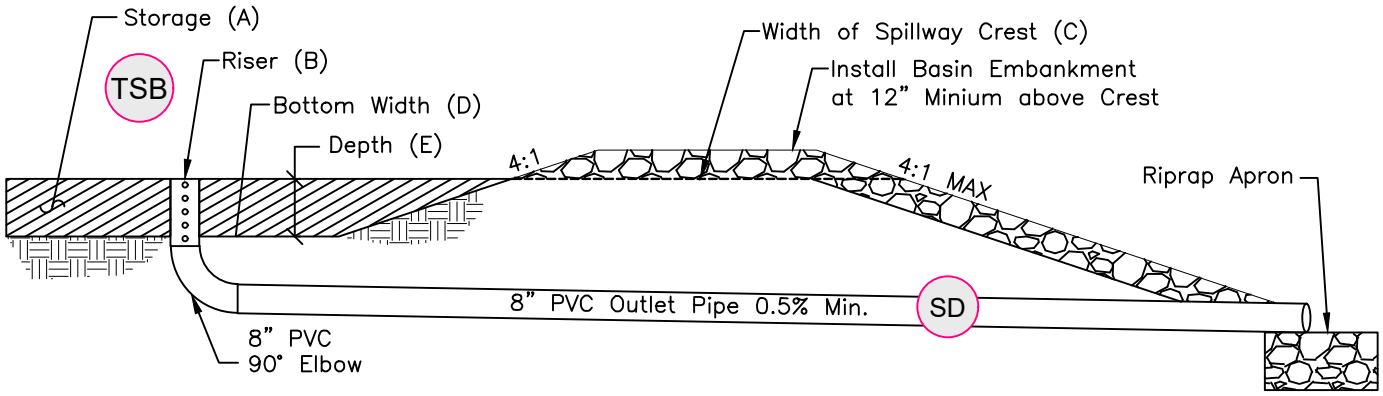
Project: Peaceful Ridge Subdivion

Basin ID: All Tributary Areas to Planned Detention Basin in Early Graded Condition

All Temporary Sediment Basins (A thru E) Designated and Sized

TSB Desig.	Trib. Ac.	Cu. Ft. Unit/Ac	Req'd. Cu. Ft	Req'd. Ac/Ft	
A	7.71	1,800.00	13,878.00	0.319	
B	6.66	1,800.00	11,988.00	0.275	
C	18.93	1,800.00	34,074.00	0.782	
D	6.05	1,800.00	10,890.00	0.250	
E	12.7	1,800.00	22,860.00	0.525	
Sum:	52.05	1,800.00	93,690.00	2.151	Required
			Basin 'E':	2.341	Provided





TEMPORARY SEDIMENT BASIN "A"

A. 0.32 ac–ft Required to Spillway Crest

B. Use 8" PVC Perforated Riser Pipe: Perforations Vertically Spacedf 4" Apart, 1 Column of 5 5/16" ø Holes.

C. 12' Long Spillway: 1' Depth, Lined With 12" Thick Type 'L' Riprap to toe of slope.

D. Basin Bottom Width = 51'

E. Depth = 2.0'

TEMPORARY SEDIMENT BASIN "B"

A. 0.28 ac–ft Required to Spillway Crest

B. Use 8" PVC Perforated Riser Pipe: Perforations Vertically Spacedf 4" Apart, 1 Column of 5 5/16" ø Holes.

C. 11' Long Spillway: 1' Depth, Lined With 12" Thick Type 'L' Riprap to toe of slope.

D. Basin Bottom Width = 47.25'

E. Depth = 2.0'

TEMPORARY SEDIMENT BASIN "C"

A. 0.78 ac–ft Required to Spillway Crest

B. Use 8" PVC Perforated Riser Pipe: Perforations Vertically Spacedf 4" Apart, 1 Column of 5 3/4" ø Holes.

C. 22' Long Spillway: 1' Depth, Lined With 12" Thick Type 'L' Riprap to toe of slope.

D. Basin Bottom Width = 75'

E. Depth = 3.0'

TEMPORARY SEDIMENT BASIN "D"

A. 0.53 ac–ft Required to Spillway Crest

B. Use 8" PVC Perforated Riser Pipe: Perforations Vertically Spacedf 4" Apart, 1 Column of 5 9/16" ø Holes.

C. 9' Long Spillway: 1' Depth, Lined With 12" Thick Type 'L' Riprap to toe of slope.

D. Basin Bottom Width = 43'

E. Depth = 2.5'

TEMPORARY SEDIMENT BASIN CALCULATIONS

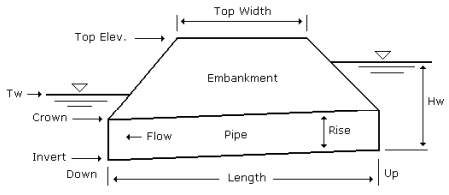
NTS

Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Feb 11 2022

Culvert Analysis at Temporary Crossing 24-inch CMP (or Equiv) Q5=38.7 cfs

Invert Elev Dn (ft)	= 5733.62	**Calculations**	
Pipe Length (ft)	= 56.00	Qmin (cfs)	= 5.00
Slope (%)	= 1.79	Qmax (cfs)	= 100.00
Invert Elev Up (ft)	= 5734.62	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 24.0		
Shape	= Circular	**Highlighted**	
Span (in)	= 24.0	Qtotal (cfs)	= 5.00
No. Barrels	= 1	Qpipe (cfs)	= 5.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Culvert	Veloc Dn (ft/s)	= 2.14
Culvert Entrance	= Smooth tapered inlet throat	Veloc Up (ft/s)	= 4.36
Coeff. K,M,c,Y,k	= 0.534, 0.555, 0.0196, 0.9, 0.2	HGL Dn (ft)	= 5735.01
		HGL Up (ft)	= 5735.41
Embankment		Hw Elev (ft)	= 5735.76
Top Elevation (ft)	= 5738.00	Hw/D (ft)	= 0.57
Top Width (ft)	= 36.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 6.00		



Culvert Profile

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Friday, Feb 11 2022

Temp Culvert Crossing

Circular

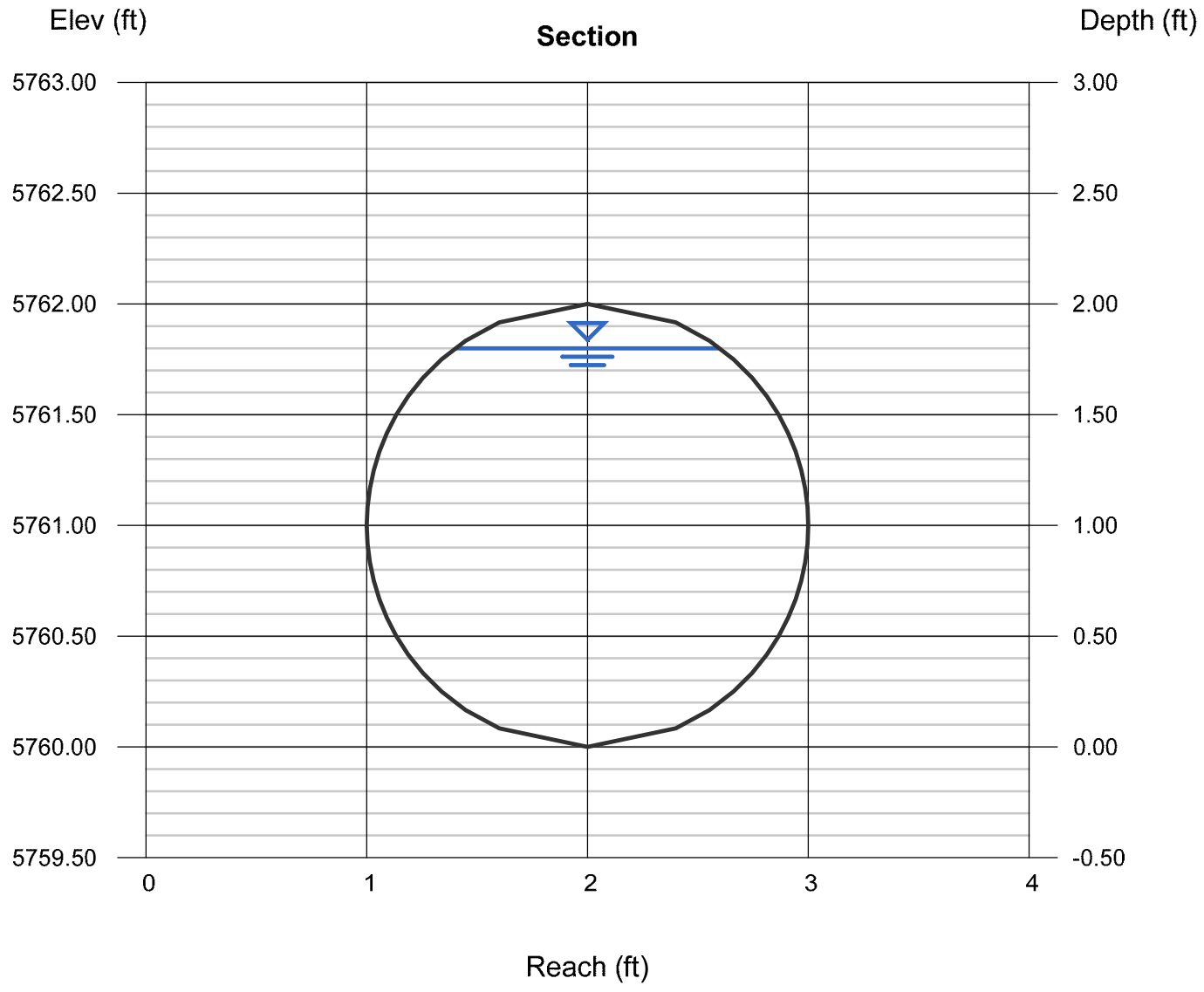
Diameter (ft)	= 2.00
Invert Elev (ft)	= 5760.00
Slope (%)	= 2.00
N-Value	= 0.013

Calculations

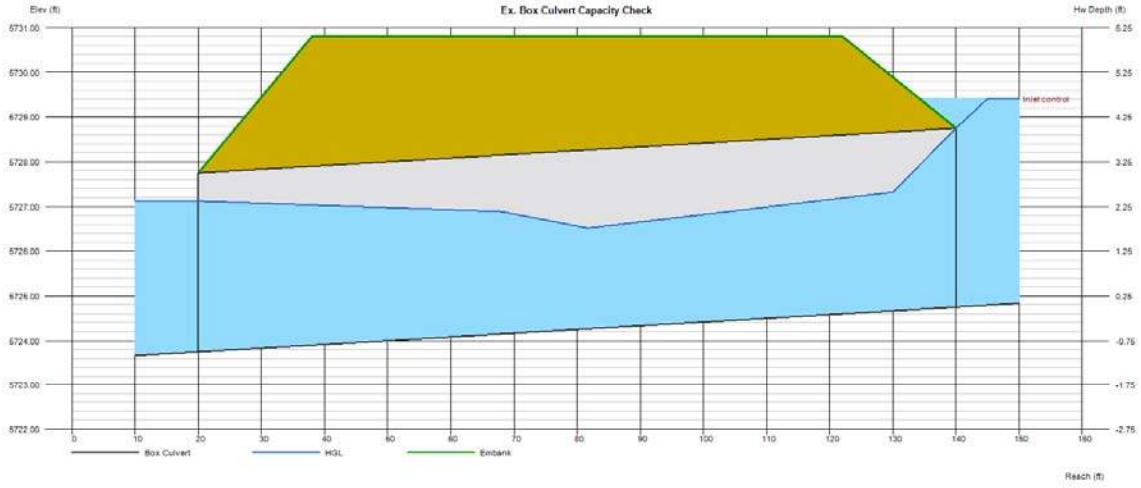
Compute by:	Known Q
Known Q (cfs)	= 34.10

Highlighted

Depth (ft)	= 1.80
Q (cfs)	= 34.10
Area (sqft)	= 2.98
Velocity (ft/s)	= 11.44
Wetted Perim (ft)	= 5.00
Crit Depth, Yc (ft)	= 1.92
Top Width (ft)	= 1.20
EGL (ft)	= 3.84



Capacity Check for Early Grading Permit Condition at EX. CBC (7'x4') for Major Event (Q_{100}=185 cfs)



Q			Veloc		Depth		HGL			
Total	Pipe	Over	Dn	Up	Dn	Up	Dn	Up	Hw	HwD
(cfs)	(cfs)	(cfs)	(ft/s)	(ft/s)	(in)	(in)	(ft)	(ft)	(ft)	
150.00	150.00	0.00	6.67	8.84	38.54	29.09	5726.86	5727.17	5728.66	0.98
160.00	160.00	0.00	7.00	9.03	39.18	30.38	5727.02	5727.28	5728.83	1.02
170.00	170.00	0.00	7.32	9.22	39.81	31.82	5727.07	5727.39	5729.01	1.08
180.00	180.00	0.00	7.63	9.40	40.42	32.84	5727.12	5727.49	5729.41	1.18
190.00	190.00	0.00	7.94	9.57	41.02	34.04	5727.17	5727.59	5729.57	1.21

Appendix C
IRF - Infiltration Reduction Factoring

there is not an adequate interface here. You cannot use runoff reduction. unresolved.

This can be your 1ac exemption but it is not a DCIA

roadway needs WQ

this isnt the RPA area, this is where the homes will be built (UIA).

similar interface issues to all other proposed runoff reduction basins

This can be your 1ac exemption but it is not a DCIA or SPA

Similar interface issues to all other proposed runoff reduction basins

show riprap rundown discussed in text for B8

why not add a riprap rundown to direct Basin B flows to the pond?

T15S R65W
SECTION 15

NW 1/4 NE 1/4
SW 1/4

UNPLATTED
CITY OF COLORADO SPRINGS

PEACEFUL RIDGE at Fountain Valley

PEACEFUL RIDGE DRIVE
PASSAGE WAY
BLACK POWDER TRAIL
ROCK ROSE TERRACE
HORNSTONE PATH
MELTING SKY DRIVE
HAZY HOLLOW TRAIL
PANPIPE LANE
CONUNDRUM COURT
MIRADOR LANE
PERIWINKLE PLACE
SLEEPY MEADOWS DRIVE

A-0 2.07 ac 2.7 cfs 6.4 cfs
A-1 3.18 ac 5.8 cfs 12.3 cfs
A-2 3.35 ac 6.4 cfs 13.4 cfs
OS-1 32.60 ac 23.0 cfs 61.4 cfs
OS-2 3.05 ac 2.3 cfs 6.0 cfs
OS-3 13.50 ac 11.1 cfs 28.6 cfs
B-1 5.51 ac 12.9 cfs 27.2 cfs
B-2 4.89 ac 8.8 cfs 19.7 cfs
B-3 5.19 ac 8.3 cfs 17.6 cfs
B-4 4.73 ac 8.9 cfs 18.9 cfs
B-5 6.09 ac 10.3 cfs 21.9 cfs
B-6 7.25 ac 14.3 cfs 30.2 cfs
B-7 2.95 ac 5.4 cfs 11.7 cfs
B-8 2.72 ac 4.6 cfs 9.6 cfs
C-1 4.29 ac 6.0 cfs 9.9 cfs
D-1 2.61 ac 3.4 cfs 7.8 cfs
D-2 2.22 ac 4.0 cfs 8.9 cfs
D-3 2.29 ac 4.4 cfs 9.8 cfs

ROADWAY EXEMPTION 15,000 s.f.

Drainage Easement 5,000± s.f.

Ex. Overflow Pond to be abandoned.

DETENTION BASIN

Type 'L' Riprap Rundowns to Temp Culvert Crossing

Type 'M' Riprap

Type 'VL' Buried Riprap

Type 'L' Riprap

Existing Channel

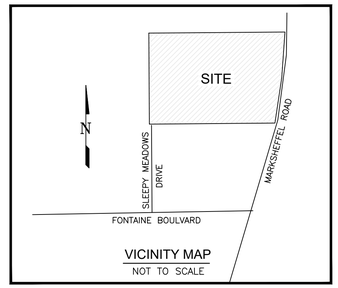
COTTONWOOD MEADOWS FILING NO. 3

PLATTED
COTTONWOOD MEADOWS NORTH FILING NO. 1

UNPLATTED
CITY OF COLORADO SPRINGS

N89°52'46"E
S89°53'03"W
N00°05'29"E
1795.06
1349.96'
D=07°42'26"
R=5649.75'
L=759.99'

LOT 1 LOT 2 LOT 3 LOT 4 LOT 5 LOT 6 LOT 7 LOT 8 LOT 9 LOT 10 LOT 11 LOT 12 LOT 13 LOT 14 LOT 15 LOT 16 LOT 17



VICINITY MAP
NOT TO SCALE

LEGEND

- R / 10.24 ac / 7.9 cfs / 28.9 cfs — Drainage Basin Designation; Drainage Basin Area; 5-year Basin Runoff; 100-year Basin Runoff
- 1 — Design Point
- Drainage Basin Boundary
- Flow Direction
- UIA A-0-b — UIA (Unconnected Impervious Area)
- UIA/RPA interface
- RPA A-0-b — RPA (Receiving Pervious Area)
- IRF Zone Designation
- SPA C-0 — SPA (Separate Pervious Area); IRF ZONE DESIGNATION = 5,000 S.F.
- DCIA — DCIA (Directly-Connected Impervious Area); ROADWAY EXEMPTION = 15,000 S.F.
- TSB D — Temporary Sediment Basin
- 9 — Design Point
- Flowline

0 100' 200'
SCALE: 1"=100'

IRF REDUCTION AREA SUMMARY

Basin	Area	Total Acres	UIA Acres	RPA Acres
DCIA				
UIA	213,628 sf	4.90ac	4.90ac	
RPA	240,074 sf	5.51ac		5.51ac
SPA				
SFR				
HIST				
TOTAL	453,701 sf	10.42ac	4.90ac	5.51ac
SUMM	On-Site Acres:	10.42	4.90	5.51

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719)630-7342

WILDEFIELD Investment Group

PEACEFUL RIDGE at FOUNTAIN VALLEY SUBDIVISION
EARLY GRADING PERMIT DRAINAGE REPORT
INFILTRATION REDUCTION FACTOR EXHIBIT
EL PASO COUNTY, COLORADO

Project No.:	21031
Date:	Feb 10, 2022
Design:	MJK
Drawn:	MJK
Check:	AWMc
Revisions:	

SHEET
IRF-1
3 OF 3 SHEETS

21031-pdrn-EGP.dwg/Feb 14, 2022/11:46am

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018)

Designer: M Kahnke / A McCord
Company: Kiowa Engineering
Date: February 1, 2022
Project: Peaceful Ridge Sub -EARLY GRADING PERMIT CONDITION
Location: Widefield, CO

SITE INFORMATION (User Input in Blue Cells)

WQCV Rainfall Depth = 0.60 inches
Depth of Average Runoff Producing Storm, d_6 = 0.43 inches (for Watersheds Outside of the Denver Region, Figure 3-1 in USDCM Vol. 3)

Area Type	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	UIA:RPA	SPA		
Area ID	A-0-a	A-0-b	D-1-a	D-1-b	D-2-a	D2-b	C-1	C-2	C-3	SW Cor		
Downstream Design Point ID	8a	8a	N/A	N/A	9a	9a	1a	1a	1a	None		
Downstream BMP Type	None	None	None	None	None	None	EDB	EDB	EDB	None		
DCIA (ft^2)	--	--	--	--	--	--	--	--	--	--		
UIA (ft^2)	24,264	22,675	18,847	21,988	26,287	26,565	23,027	24,141	25,835	--		
RPA (ft^2)	23,165	19,976	19,182	21,993	30,988	30,180	32,637	33,219	28,734	--		
SPA (ft^2)	--	--	--	--	--	--	--	--	--	5,000		
HSG A (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
HSG B (%)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
HSG C/D (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
Average Slope of RPA (ft/ft)	0.026	0.080	0.025	0.025	0.025	0.041	0.050	0.060	0.060	--		
UIA:RPA Interface Width (ft)	610.00	470.00	410.00	410.00	740.00	740.00	377.00	354.00	340.00	--		

CALCULATED RUNOFF RESULTS

Area ID	A-0-a	A-0-b	D-1-a	D-1-b	D-2-a	D2-b	C-1	C-2	C-3	SW Cor		
UIA:RPA Area (ft^2)	47,428	42,651	38,029	43,981	57,275	56,745	55,664	57,360	54,569	--		
L / W Ratio	0.13	0.19	0.23	0.26	0.10	0.10	0.39	0.46	0.47	--		
UIA / Area	0.5116	0.5316	0.4956	0.4999	0.4590	0.4681	0.4137	0.4209	0.4734	--		
Runoff (in)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Runoff (ft^3)	0	0	0	0	0	0	0	0	0	0		
Runoff Reduction (ft^3)	1011	945	785	916	1095	1107	959	1006	1076	250		

CALCULATED WQCV RESULTS

Area ID	A-0-a	A-0-b	D-1-a	D-1-b	D-2-a	D2-b	C-1	C-2	C-3	SW Cor		
WQCV (ft^3)	1011	945	785	916	1095	1107	959	1006	1076	0		
WQCV Reduction (ft^3)	1011	945	785	916	1095	1107	959	1006	1076	0		
WQCV Reduction (%)	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%		
Untreated WQCV (ft^3)	0	0	0	0	0	0	0	0	0	0		

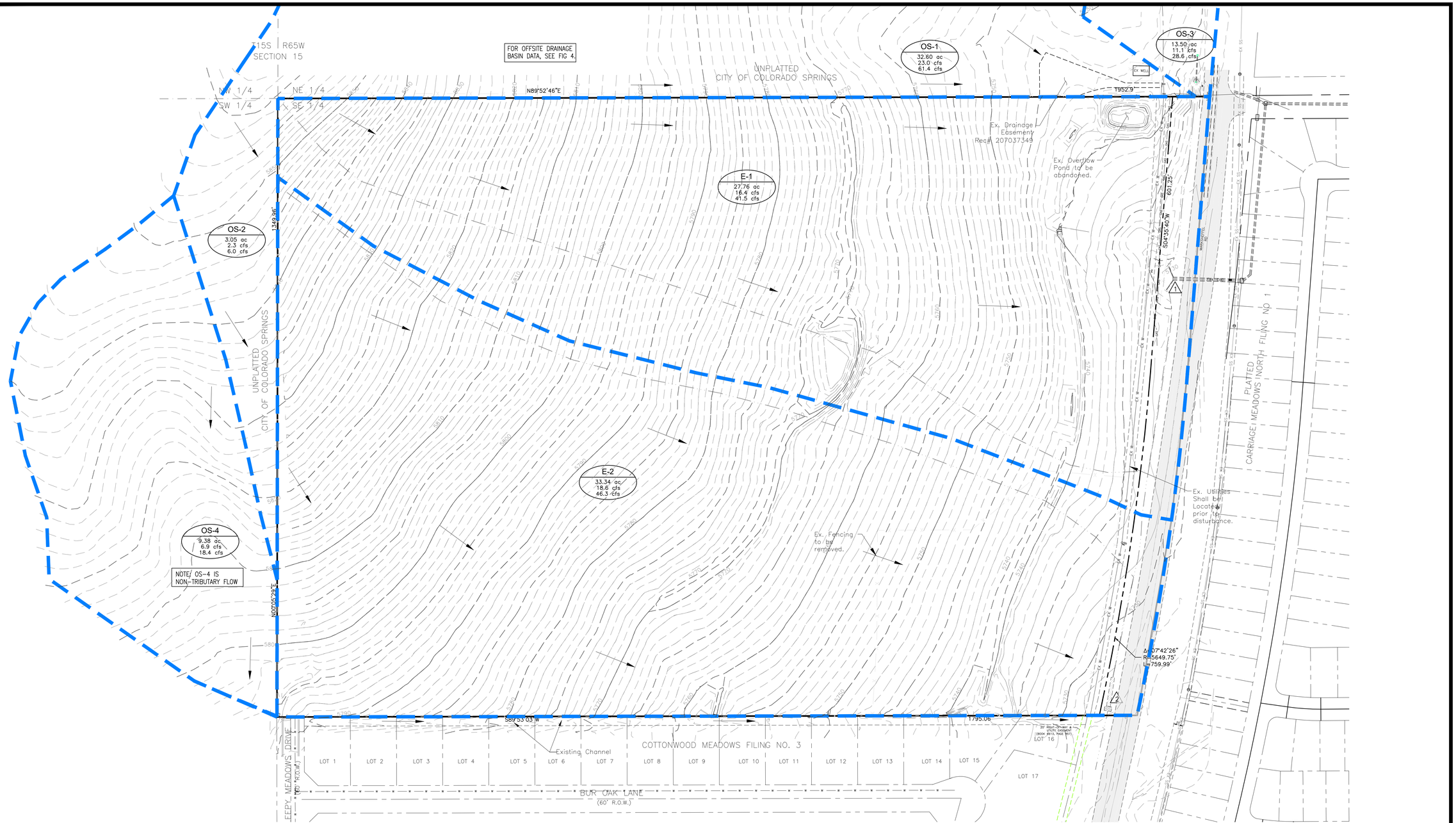
CALCULATED DESIGN POINT RESULTS (sums results from all columns with the same Downstream Design Point ID)

Downstream Design Point ID	8a	N/A	9a	1a	None							
DCIA (ft^2)	0	0	0	0	0							
UIA (ft^2)	46,938	40,835	52,852	73,003	0							
RPA (ft^2)	43,141	41,174	61,168	94,590	0							
SPA (ft^2)	0	0	0	0	5,000							
Total Area (ft^2)	90,080	82,010	114,020	167,593	5,000							
Total Impervious Area (ft^2)	46,938	40,835	52,852	73,003	0							
WQCV (ft^3)	1,956	1,701	2,202	3,042	0							
WQCV Reduction (ft^3)	1,956	1,701	2,202	3,042	0							
WQCV Reduction (%)	100%	100%	100%	100%	0%							
Untreated WQCV (ft^3)	0	0	0	0	0							

CALCULATED SITE RESULTS (sums results from all columns in worksheet)

Total Area (ft^2)	458,702
Total Impervious Area (ft^2)	213,629
WQCV (ft^3)	8,901
WQCV Reduction (ft^3)	8,901
WQCV Reduction (%)	100%
Untreated WQCV (ft^3)	0

Appendix D
Existing Conditions Map
Developed Conditions Map



0 100' 200'

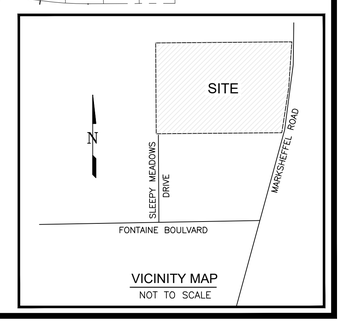
SCALE: 1"=100'

LEGEND

R	DRAINAGE BASIN DESIGNATION
10.24 ac 7.9 cfs 28.9 cfs	DRAINAGE BASIN AREA 5-YEAR BASIN RUNOFF 100-YEAR BASIN RUNOFF
2.2 cfs 4.3 cfs	5-YEAR RUNOFF 100-YEAR RUNOFF
1	DESIGN POINT
	DRAINAGE BASIN BOUNDARY
	FLOW DIRECTION
	TIME OF CONCENTRATION PATH
6020	EXISTING CONTOURS

DESIGN POINT FLOWS

DESIGN POINT	5-YR FLOW	100-YR FLOW
1	47.5 cfs	123.8 cfs
2	20.5 cfs	51.1 cfs



VICINITY MAP
NOT TO SCALE

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719)630-7342

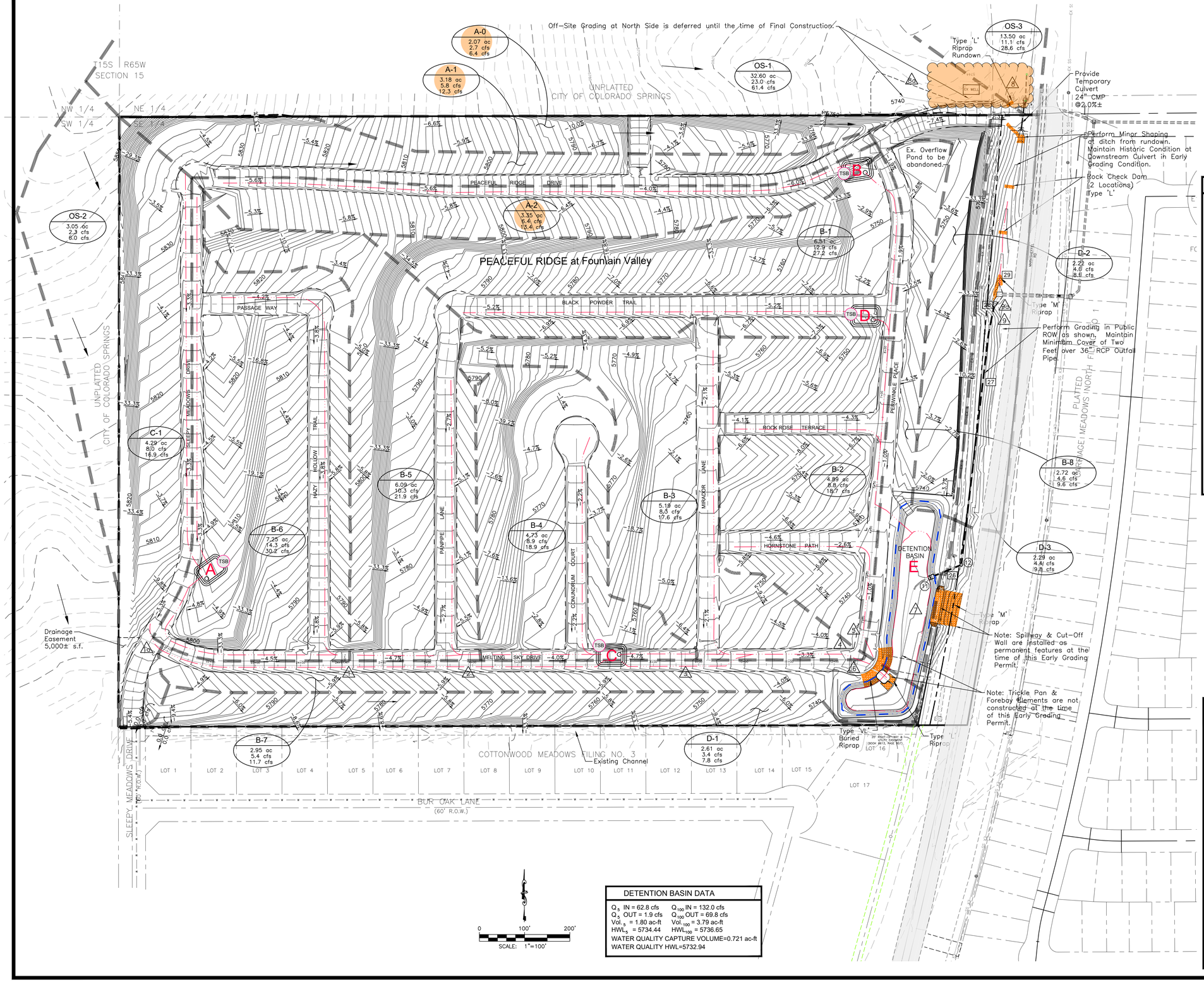
WIDEFIELD Investment Group

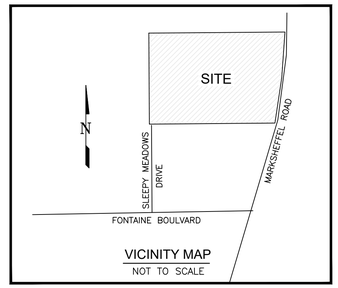
PEACEFUL RIDGE at FOUNTAIN VALLEY SUBDIVISION
EARLY GRADING PERMIT DRAINAGE REPORT
EXISTING CONDITIONS
EL PASO COUNTY, COLORADO

Project No.:	21031
Date:	Feb. 10, 2022
Design:	MJK
Drawn:	MJK
Check:	AWMc
Revisions:	
1.	01/22 Storm Revs

SHEET
E-1
1 OF 3 SHEETS

21031-pdrain-EGP.dwg/Feb 11, 2022/12:34pm





LEGEND

- R — 10.24 ac, 7.9 cfs, 28.9 cfs — Drainage Basin Designation; Drainage Basin Area; 5-year Basin Runoff; 100-year Basin Runoff
- 2.2 cfs / 4.3 cfs — 5-year Bypass & 100-year Bypass At Indicated Flowline
- 1 — Design Point
- Drainage Basin Boundary
- Off-Site Flow Direction
- 24 — Hydraulic Channel/Pipe Identifier
- 4 — Hydraulic Structure Identifier
- Time Of Concentration Path
- 6020 — Existing Contours
- 6020 — Proposed Contours
- 100-yr W.s.el.
- TSB — Temporary Sediment Basin
- 5.0% — On-Site Flow Direction & Slope

STRUCTURE IDENTIFIER	STRUCTURE DESCRIPTION
9	FOREBAY
10	2' TRICKLE CHANNEL
11	OUTLET STRUCTURE
12	6' ø MANHOLE
13	TYPE 'D' AREA INLET
14	6' ø MANHOLE
15	42-INCH F.E.S.
26	36-INCH RCP
27	36-INCH RCP
28	36-INCH FES

DEVELOPED DESIGN POINT FLOWS

DESIGN POINT	5-YEAR FLOW	100-YEAR FLOW
0a	6.7 cfs	17.4 cfs
1	17.3 cfs	37.9 cfs
2	25.3 cfs	53.4 cfs
3	31.9 cfs	67.6 cfs
4	39.3 cfs	83.2 cfs
5	30.0 cfs	63.6 cfs
6	54.1 cfs	114.9 cfs
7	62.8 cfs	132.0 cfs
8	11.1 cfs	28.6 cfs
8a	25.7 cfs	67.8 cfs
9*	12.4 cfs	27.3 cfs
9**	32.3 cfs	82.6 cfs

* EXCLUDES DETENTION BASIN 'E' DISCHARGE
** INCLUDES DETENTION BASIN 'E' DISCHARGE

DETENTION BASIN DATA

Q_5 IN = 62.8 cfs — Q_{100} IN = 132.0 cfs
Q_5 OUT = 1.9 cfs — Q_{100} OUT = 69.8 cfs
Vol_{100} = 1.80 ac-ft — Vol_{100} = 3.79 ac-ft
HWL_5 = 5734.44 — HWL_{100} = 5736.65
WATER QUALITY CAPTURE VOLUME=0.721 ac-ft
WATER QUALITY HWL=5732.94

Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, Colorado 80904
(719) 630-7342

WILDFIELD Investment Group

PEACEFUL RIDGE at FOUNTAIN VALLEY SUBDIVISION
EARLY GRADING PERMIT DRAINAGE REPORT
EARLY GRADING CONDITION
EL PASO COUNTY, COLORADO

Project No.:	21031
Date:	Feb 10, 2022
Design:	JGD/MJK
Drawn:	JGD/MJK
Check:	AWMc
Revisions:	

SHEET
D-1
2 OF 3 SHEETS

21031-patron-EGP.dwg/Feb 11, 2022/12:31pm