FINAL DRAINAGE REPORT

FALCON MEADOWS AT BENT GRASS
FILING NO. 1

El Paso County, Colorado

Engineering Review

Galloway responses

PREPARED FOR:
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west property line of the site at **DP 9**. The runoff will continue to sheet flow through Basin EX-6 to the south until entering the existing drainage swale on the southern boundary of Basin EX-6 at **DP 11**.

Basin OS-3 (10.62 AC, Q5 = 4.7 cfs, Q100 = 22.7 cfs) is associated with The Meadows Filing No. 1 lot 11 and The Meadows Filing No. 2 Lots 1 & 2. Runoff from this basin sheet flows from the northwest to the southeast, crossing the west property line of the site at **DP 10**. The runoff will continue to sheet flow through Basin EX-6 to the south until entering the existing drainage ditch on the southern boundary of Basin EX-6 at **DP 11**.

Basin OS-4 (4.46 AC, Q5 = 5.6 cfs, Q100 = 14.0 cfs) is associated with The Bent Grass Residential Filing No. 2, lots 152-160, lots 163-168, Tract D, and portions of Thedford Court & Willmore Drive. Runoff from this basin flows via curb & gutter south on Thedford Court then continues flowing west along the northern curb & gutter along Willmore Drive before discharging into southeast corner of Basin EX-2 at **DP 1**.

Basin OS-5 (0.46 AC, Q5 = 1.1 cfs, Q100 = 2.3 cfs): is associated with The Bent Grass Residential Filing No. 2, lots 161 & 162 along with a portion of Silky Thread Road. Runoff from this basin generally flows to the west via curb & gutter along Silky Thread Road before discharging into the northeast corner of Basin EX-2 at **DP 2**.

Basin OS-6 (1.17 AC, Q5 = 2.0 cfs, Q100 = 4.3 cfs): is associated with The Bent Grass Residential Filing No. 2, the northern halves of Lots 170-178 and a portion of the southern side of Willmore Drive. Runoff from this basin generally flows to the west via curb & gutter along Willmore Drive before discharging into the northeast corner of Basin EX-3 at **DP 3**.

Basin E-1 (1.71 AC, Q5 = 3.6 cfs, Q100 = 7.7 cfs): a basin that is east of Falcon Meadows and encompasses the north portion of Bent Grass Meadows Drive. A high point on the far East of the basin at the near the Filing No. 2 boundary, forces water to flow to a low point at **DP-8**, which represents an existing 20' CDOT Type R sump inlet, which conveys stormwater via proposed 36" RCP storm sewer to the existing Filing No. 2 north water quality detention pond. Emergency overflow will spill over the crown of the road and enter into an existing 10' CDOT Type R sump inlet on the south side of Bent Grass Meadows Drive.

Basin E-2 (0.68 AC, Q5 = 2.4 cfs, Q100 = 4.6 cfs): a basin that is in west of Basin E-1 and encompasses a portion of the north section Bent Grass Meadows Drive. A high point on the far West of the basin forces water to flow to a low point at **DP-8**, which represents an existing 20' CDOT Type R sump inlet, which conveys stormwater via a proposed 36" RCP storm sewer to the existing Filing No. 2 north water quality detention pond. Emergency overflow will spill over the crown of the road and enter into an existing 10' CDOT Type R sump inlet on the south side of Bent Grass Meadows Drive.

Basin E-3 (0.78 AC, Q5 = 2.9 cfs, Q100 = 5.3 cfs): a basin that is south of Basin E-2 and encompasses a portion of the south half of Bent Grass Meadows Drive. A high point on the far West of the basin forces water to flow to a low point, which is an existing 10' CDOT Type R sump inlet, which [illegible] via an existing 24" storm sewer to **DP-8**. This inlet receives emergency overflow fro[illegible]

Text added

at DP7?

Basin E-4 (0.91 AC, Q5 = 3.0 cfs, Q100 = 5.7 cfs): a basin that is in the Southwest area of the Bent Grass Filing No. 2 site and encompasses a portion of the north and west sections of Bent Grass Meadows Drive. Runoff from this basin is captured by existing curb and gutter and then routed South where the 5 yr. and 100 yr. flows will be captured by an existing 25' CDOT Type R (1-10' and 1-15' inlet) on-grade inlet, **DP-24**. Captured flow will be routed by a 24" RCP storm drain piped to DP-25. A

Basin OS-4 (4.46 AC, Q5 = 5.6 cfs, Q100 = 14.0 cfs) is associated with The Bent Grass Residential Filing No. 2, lots 152-160, lots 163-168, Tract D, and portions of Thedford Court & Willmore Drive. Runoff from this basin flows via curb & gutter south on Thedford Court then continues flowing west along the northern curb & gutter along Willmore Drive before discharging into Basin A-1 at **DP 2**.

Basin OS-5 (0.46 AC, Q5 = 1.1 cfs, Q100 = 2.3 cfs): is associated with The Bent Grass Residential Filing No. 2, lots 161 & 162 along with a portion of Silky Thread Road. Runoff from this basin generally flows to the west via curb & gutter along Silky Thread Road before discharging into Basin A-1 at **DP 1**.

Basin OS-6 (1.17 AC, Q5 = 2.0 cfs, Q100 = 4.3 cfs): is associated with The Bent Grass Residential Filing No. 2, the northern halves of Lots 170-178 and a portion of the southern side of Willmore Drive. Runoff from this basin generally flows to the west via curb & gutter along Willmore Drive before discharging into Basin A-1 at **DP 3**.

Basin A-1 (2.16 AC, Q5 = 4.9 cfs, Q100 = 11.7 cfs): a basin for a future Falcon Meadows filing that will include residential lots, portions of 2 tracts & the east half of Lemon Grass Road. It encompasses single-family residential lots. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 4**. Flows will then enter a proposed CDOT Type 'R' inlet and will be piped into the existing Bent Grass Filing No. 2 WQCV pond located in Basin A-2 at **DP 6**.

Basin A-2 (0.86 AC, Q5 = 2.0 cfs, Q100 = 4.4 cfs): a basin for a future Falcon Meadows filing that will include the back ¾ of single-family residential lots. Runoff will flow from each lot into the existing channel (RWT204). These flows will not be detained but are less than 1.0 acre max allowed untreated runoff area per criteria.

Basin A-3 (0.92 AC, Q5 = 2.6 cfs, Q100 = 5.2 cfs): a basin for a future Falcon Meadows filing that will include the west half of Lemon Grass Road and the front ¼ of single-family residential lots. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 5**. Flows will then enter a proposed CDOT Type 'R' inlet where it will be piped into the existing Bent Grass Filing No. 2 WQCV pond.

Basin A-4 (0.82 AC, Q5 = 0.4 cfs, Q100 = 2.6 cfs): a basin that includes the existing north water quality facility (Pond 1) built with Bent Grass Filing No. 2 (Tract K). This basin will combine with the other flows being diverted to this facility at **DP 6** and upon treatment, will be released into the existing channel (RWT204).

Basin C-6 (1.37 AC, Q5 = 2.1 cfs, Q100 = 5.1 cfs): a basin for a future Falcon Meadows filing that will include a portion of residential lots between Henzlee Place and Channel RWT204. These lots drain towards the east, towards the channel. A proposed swale with intercept these flows at the top bank of the channel and divert the flows towards the south to **DP 19**, where an area inlet will capture the flows and release into the future north water quality pond at **DP 13**. This pond will be part of the next filing of the Falcon Meadows development.

Basin B-1 (4.32 AC, Q5 = 2.1 cfs, Q100 = 7.8 cfs): a basin that is in the center of the site and encompasses the existing rerouted channel RWT202 and channel RWT204. Flows will continue south in the existing channel where they will then be conveyed to **DP AA**.

Basin C-1 (9.07 AC, Q5 = 16.9 cfs, Q100 = 36.0 cfs): a basin for a future Falcon Meadows filing that will include Sophia Lane, the west half of Henzlee Place, north portion of Kittrick Place, and encompasses

All of the basins with the dots, if not contributing to Filing 1, can be deleted from discussion.

Basins noted have been removed from discussion

single-family residential lots. Runoff will flow from each lot onto the future public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 15.** Flows will then enter a proposed CDOT Type 'R' inlet where it will be piped to the proposed north WQCV pond at **DP 13**.

Basin C-2 (1.11 AC, Q5 = 2.8 cfs, Q100 = 6.2 cfs): Is a basin for a future Falcon Meadows filing which will encompass single-family residential lots including the east half of Henzlee Place. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 12.** Flows will then enter a proposed CDOT Type 'R' inlet where it will be piped to the future north WQCV pond at **DP 13**.

Basin C-3 (1.52 AC, Q5 = 5.3 cfs, Q100 = 9.9 cfs): Is a basin for a future Falcon Meadows filing which will encompass Kittrick Place between Henzlee Place & Daelyn Drive, as well as single-family residential lots. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 15.** Flows will then enter an existing CDOT Type 'R' inlet on the north side of Bent Grass Meadows Drive, where it will be piped to the future north WQCV pond at **DP 13**.

Basin C-4 (3.99 AC, Q5 = 6.6 cfs, Q100 = 17.4 cfs): Is a basin for a future Falcon Meadows filing which will encompass residential lots and open space between Henzlee Place & Bent Grass Meadows Drive. Runoff will flow from each lot onto the proposed open space, eventually releasing into the public R.O.W. of Bent Grass Meadows Drive, where existing curb and gutter will convey flows to **DP 8.** Flows will then enter an existing CDOT Type 'R' inlet where it will then be released into the existing Filing No. 2 North WQCV Pond.

Basin C-5 (0.51 AC, Q5 = 0.3 cfs, Q100 = 1.6 cfs): Is a basin for a future Falcon Meadows filing which will encompass the future north WQCV pond area. The stormwater within the future north WQCV pond will be released at a controlled rate, via an outlet structure with orifice holes, into the existing channel RWT204.

Basin OS-2 (20.07 AC, Q5 = 9.0 cfs, Q100 = 43.4 cfs): is associated with The Meadows Filing No. 1 lots 1, 2, 3, 4, 5, and 6. Runoff from this basin sheet flows from the northwest to the southeast, crossing the west property line of the site at **DP 9**. Flows will then be conveyed via a future drainage swale (Swale D) to the south where it will enter Basin D-3 and tie-into the existing drainage swale (Swale E) along the southern boundary of Basin D-3. It will then continue flowing east before entering an existing area inlet at **DP 11** where it will be piped, ultimately outfalling into the proposed south WQCV pond at **DP 31**.

Basin OS-3 (10.61 AC, Q5 = 4.7 cfs, Q100 = 24.3 cfs): is associated with The Meadows Filing No. 1 lot 11 and The Meadows Filing No. 2 Lots 1 & 2. Runoff from this basin sheet flows from the northwest to the southeast, crossing the west property line of the site into Basin D-3 at **DP 10**. Flows will then be conveyed via an existing drainage swale to the east where it will enter an existing area inlet at **DP 11** where it will be piped, ultimately outfalling into the proposed south WQCV pond at **DP 31**.

Basin D-1a (3.40 AC, Q5 = 4.1 cfs, Q100 = 11.1 cfs): a basin for a future Falcon Meadows filing at the northeast corner of the future intersection of Isabel Place and Daelyn Drive. It encompasses single-family residential lots, east half of Isabel Place, & a portion of the north half of Daelyn Drive. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 16a.**

Basin D-1b (4.72 AC, Q5 = 6.8 cfs, Q100 = 15.0 cfs): a basin for a future Falcon Meadows filing along the west property line of the site. It encompasses single-family residential lots & the remaining west half

flows to an existing area inlet at **DP 11**. From there, flows will be piped and ultimately outfall at the south WQCV pond at **DP 31**.

Basin D-4a (0.98 AC, Q5 = 2.2 cfs, Q100 = 4.6 cfs): a basin for Falcon Meadows Filing No. 2 that is east of Bent Grass Meadows Drive. It encompasses single-family residential lots, north half of Rowena Way, & a portion of the west half of Nico Way. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 17a**. Flow will continue as gutter flow in Nico Way, Linley Way and Jayla Trail to **DP 17b.**

Basin D-4b (0.96 AC, Q5 = 2.6 cfs, Q100 = 5.0 cfs): a basin for Falcon Meadows Filing No. 2 that is east of Bent Grass Meadows Drive. It encompasses single-family residential lots, Rowena Way, & portions of Linley Way and Jayla Trail. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP** Flow rates at DP added e south side of the proposed structure at **DP 17**.

provide the flow values

Basin D-4c (1.00 AC, Q5 = 2.3 cfs, Q100 = 4.5 cfs): a basin for Falcon Meadows Filing No. 2 that is east of Henzlee Place and south of Bent Grass Meadows Drive. It encompasses single-family residential lots, & portions of Nico Way, Jayla Trail, and Henzlee Place. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 17c**, the north side of **DP 17**. Flows at **DP 17** (combined flows from **DP 17b** & **DP 17c** with bypass from **DP 18**) will then enter a proposed 15' sump CDOT Type 'R' inlet where it will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**. Overflow from this inlet will overtop the curb and then continue via a proposed swale, following the same path as the proposed pipe, to the east until flows are released into the proposed south water quality pond.

Basin D-5 (1.08 AC, Q5 = 2.2 cfs, Q100 = 4.6 cfs): a basin that is located at the southwest corner of Bent Grass Meadows Drive and Henzlee Place. It includes residential lots, as well as a portion of the north half of Nico Way and west half of Henzlee Place. Flows will be directed towards the public R.O.W. where proposed curb and gutter will convey flows to the south along Henzlee Place to **DP 18**. Flows will then enter a proposed 15' sump CDOT Type 'R' inlet where it will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**.

Basin D-6a (1.33 AC, Q5 = 3.8 cfs, Q100 = 7.5 cfs): a basin for a future Falcon Meadows filing that is south of Basin D-6b & east of Basin D-4a. It encompasses single-family residential lots & half of Linley Way, Jayla Trail, Henzlee Place, & Nico Way. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 18.**

Basin D-6b (2.69 AC, Q5 = 5.6 cfs, Q100 = 11.4 cfs): a basin for a future Falcon Meadows filing that is south of Basin D-5 & east of Basin D-4a. It encompasses single-family residential lots & half of Linley Way, Jayla Trail, Henzlee Place, & Nico Way. Runoff will flow from each lot onto the proposed public R.O.W. where proposed mountable curb and gutter will convey flows to **DP 18**, along with flows from Basin D-6a. Flows will then enter a proposed sump CDOT Type 'R' inlet where it will then be piped and ultimately outfall in the proposed south WQCV pond at **DP 31**.

Basin D-7 (7.84 AC, Q5 = 3.3 cfs, Q100 = 16.3 cfs): a basin that is in the south end of the site, east of Bent Grass Meadows Drive & west of the existing channel. It encompasses the back half of several single-family residential lots as well as the proposed south WQCV pond, an existing temporary sediment basin, and an existing drainage swale (Swale F), which is to be relocated. Runoff will flow, via sheet flow,

until it enters the reloacted drainage swale (Swale F) and is conveyed to the proposed south WQCV pond or will directly flow into the proposed south WQCV pond at **DP 30**.

Basin D-8 (1.69 AC, Q5 = 1.3 cfs, Q100 = 4.5 cfs): a basin that is west of the existing channel & south of Bent Grass Meadows Drive. It encompasses the back half of single-family residential lots. Runoff will flow from each lot and discharge into a proposed drainage swale. The drainage swale (Swale C) will then convey flows to the south, ultimately discharging into the proposed south WQCV pond at **DP 32**.

Basin D-9 (0.70 AC, Q5 = 1.0 cfs, Q100 = 3.0 cfs): a basin for a future Falcon Meadows filing that is east of Basin D-2f & west of Bent Grass Meadows Drive. It encompasses the back half of single-family residential lots. Runoff will flow from each lot and release into Bent Grass Meadows Drive. This flow will be conveyed as gutter flow to the south in the roadway, where it will be intercepted by an exiswting at grade inlet at **DP 24**.

Basin B-2 (1.17 AC, Q5 = 0.4 cfs, Q100 = 2.5 cfs): a basin that is in the south area of the site and encompasses channel reach RWT204/ RWT210. Flows will sheet flow into the channel where they will then be conveyed to **DP BB**.

Basins E-1 thru E-5 and I-1 are the same as discussed under the Existing Conditions Section, as these basins represent the already built Bent Grass Meadows Drive through the proposed site.

Basin RWT202 (1574.4 AC,Q5 = 200 cfs, Q100 = 1000 cfs), RWT204 (38.4 AC, Q5 = 7 cfs, Q100 = 43 cfs) and WT200 (192 AC, Q5 = 52 cfs, Q100 = 190 cfs) represent larger offsite basins to the north of the proposed project. These areas were studied as part of the Falcon Basin DBPS prepared by Matrix and were also part of the Bent Grass MDDP, submitted in June for review. Refer to the MDDP for the discussion of the revisions made to the HEC-HMS model. There have been no changes to these basins as they are offsite and existing.

Design Point CC is the location in MDDP and FIS Report flows added Bent Grass Site, including the offsite flows from RWT202, RWT204 and WT200. The minor flows are 268.5 cfs and the major flows are 1179.4 cfs.

Flows from the MDDP at this location based on the HEC-HMS model are 1075.3 cfs for the 100-year storm and 191.8 cfs for the 5-year storm under the proposed/ future conditions. The FEMA FIS report had a design flow of 1400 cfs in channel reach RWT210.

VIII. Storm Sewer System

All development is anticipated to be urban and will include storm sewer & street inlets. Storm sewers collect storm water runoff and convey the water to water quality facilities prior to discharging. Storm sewer systems will be designed to the 100-year storm and checked with the 5-year storm. Inlets will be placed at sump areas and intersections where street flow is larger than street capacity. UDFCD Inlet spreadsheet will be used to determine the size of all at-grade and sump inlets. There will be a minimum of 1 proposed storm system and two existing system within the site. There will be two future storm systems with subsequent filings of Falcon Meadows, as the area develops north of Bent Grass Meadows Drive. The first future storm system will collect flows on the north and east side of the project, prior to entering Bent Grass Meadows Drive. Intercepted flows will be released into the Bent Grass Filing No. 2 water quality facility, Pond 1. Any bypass flows will travel west in Bent Grass Meadows Drive to an existing storm system in the roadway.

The second future storm system will collect the north and west portion of the site, intercepting flows prior to entering Bent Grass Meadows Drive. These flows will be released into the future North water quality

Swale C is located along the east boundary of the site and will convey flows to the south towards the proposed WQCV pond. The swale will be a trapezoidal ditch with a bottom width of 1', minimum depth of 1.50' and 4:1 side slopes. Longitudinal slope will be 1.5%, generating a flow depth of 0.53' and a velocity of 2.75 fps.

Swale F is located along the south boundary of the site and will convey flows to the east towards the proposed WQCV pond. The swale will be a trapezoidal ditch with a bottom width of 6', minimum depth of 4.0' and 4:1 side slopes. Longitudinal slope will be 1.0%, generating a flow depth of 1.16' and a velocity of 4.24 fps.

Swales A and D are all part of the Falcon Meadows future development and final design of these facilities will be done with the corresponding FDR's.

Refer to Appendix C for channel design calculations.

Channel

Currently, final design plans and design report are being prepared for the channel improvements within the Falcon Meadows development. These plans and report and other supporting documentation will be submitted under a separate cover as their own submittal package. The channel design will cover channel reaches RWT202, RWT204 & RWT210, extending south to Woodmen Road.

The Falcon Area DBPS made recommendations for the channels as they transverse the project site. Bent Grass Residential Filing No. 2 included rerouting RWT202 along the north property line to convey flows to RWT204. Improvements to RWT202 were also included in Bent Grass Residential Filing No. 2.

RWT204 is grossly oversized for the actual anticipated flows. The Falcon Basin DBPS included a 5-year flow of 7 cfs and a 100-year flow for 43 cfs. The proposed rational calculations have a total flow of 270 cfs for the 5-year flow and 1189 cfs for the 100-year flow at DP AA (box culvert crossing at Bent Grass Meadows Drive in Reach RWT204). The FEMA flow reported in this section of channel is 1,400 cfs. Improvements to RWT204, north of Bent Grass Meadows Drive, will adhere and be equivalent to the recommendations in the Falcon Basin DBPS.

RWT204 will generally stay in its existing location but will have new designed channel sections. The channel will have longitudinal slopes flattened to below 1% in order to reduce the scour potential of the channel. Grouted Sloping Boulder Drops may be utilized within the channel as grade controls (maximum height of 4' with 4:1 slope). 3 grade control structures are anticipated within the channel. This may change when final design of the channel is completed.

7?

Number of structures changed

RWT210 is the section of the channel south of Bent Grass Meadows Drive and continues south to Woodmen Road. The channel location will shift slightly to the east and "straighten" out the overall flow path. It will be located within a drainage easement. The channel will have a design including a longitudinal slope less than 1.5%, bottom width of 38', and 4:1 side slopes. The Falcon DBPS recommendations for the channel are to remain as a natural drainage channel. Grade control structures may be utilized within the channel to meet design requirements.

At this time, it is assumed that the DBPS recommended channel improvements will be sufficient to handle the final developed channel flow. DBPS report and channel plans currently show approximately 16 rock

cross vanes in channel Section RWT210. See Appendix F for preliminary location and detail of structures. Final design will be included in the channel improvement package submittal.

The West Trib Channel (RWT202, RWT204 & RWT210) will be maintained by the Bent Grass Metropolitan District. For channel improvements offsite of the Falcon Meadows at Bent Grass Filing No. 1 and Bent Grass Residential Filing 2 property, specifically south of the development, it is agreed that the developer will be responsible future channel improvements, south of the development, to the existing improvements north of Woodmen Road if the current property owners have not initiated the future improvements themselves. Or the developer will work with the current property owners to reach an agreement on design/construction, costs, and timing of the channel improvements. An agreement and schedule will be in place prior to approval of Falcon Meadows at Bent Grass Filing No. 1. And improvements shall be complete within three years of the recordation of Falcon Meadows at Bent Grass Filing No. 4.

XI. Maintenance

The channel is to be a private facility until all DBPS identified improvements are complete. Once the DBPS improvements are completed, maintenance for the channel will transition to El Paso County. The proposed water quality pond is to be privately maintained. Private facilities will be maintained by the Bent Grass Metropolitan District. After completion of construction and upon the Board of County Commissioners acceptance, all public drainage facilities within easements and public Right-of-Way will be owned and maintained by El Paso County. Channel improvements will be considered under the final drainage report for the channel improvement design package.

XII. Wetlands Mitigation

No wetlands are located on site.

XIII. Floodplain Statement

A portion of the project site lies within Zone AE Special Flood Hazard Area as defined by the FIRM Map number 08041C0553G effective December 7, 2018. A copy of the FIRM Panel is included in Appendix A.

The portion of channel that has a floodplain designation is only the RWT210 and RWT204 portions of the channel. It is unknown why the western channel, RWT202 is unmapped since it is the larger contributor regarding flow rates. Discussions have occurred with PPRBD and a no rise certificate will be required for the existing channel. Models have been obtained from FEMA which show that the FEMA discharges are higher than the DBPS. Therefore, the culvert crossing at Bent Grass Meadows Parkway was sized per the FEMA flows and not the DBPS. The no rise certification will be provided under a separate report, when channel improvements are addressed with future filings.

Mention the future development tract

XIV. Drainage/Bridge Fees and Credits/Reimburse

Statement added addressing Tract C which will be platted with a future filing and will be removed from the floodplain with an approved LOMR.

The site lies within the Falcon Drainage Basin. The DBPS was approve
bridge fees associated with the basin.

The project site has a total area of 21.31 acres. The tracts account for a

The percent impervious for the subdivision has been calculated with this report to be approximately 33.2 percent.

Calculations for impervious acreage has been updated

seems high if including Tract E (staff calculates ~26% overall)

Verify that there is no imperviousness in already-platted tracts that Tract E is replacing.

No imperviousness in previous areas which Tract E is replacing

21.31 acres x 33.2% = 7.07 Impervious Acres

The following calculations are based on an interpolated rate between 2021 Falcon Basin drainage/bridge fees:

Calculations updated and fees revised accordingly

Provide an additional line calculating the impervious acreage based on the lots and ROW only 8.84 Ac. x 60%(?) = 5.3-5.5 Ac.

Drainage

$31,885 x 7.07 Imp. Acres = $225,426.95

Bridge Fees

$4,380 x 7.07 Imp. Acres = $30,966.60

as approved in a drainage report addendum reviewed prior to plat recording

Text added

Per discussions with El Paso County the fees will be offset by the cost of regional improvements

Below is a cost estimate for the improvements proposed with this filing.

Item	Quantity	Unit	Unit Cost	Cost
Storm Drain Improvements (Public)				
10' CDOT Type R Inlet (Public)	2	EA	$ 8,000.00	$ 16,000.00
15' CDOT Type R Inlet (Public)	2	EA	$ 9,800.00	$ 19,600.00
CDOT Type D Area Inlet (Public)	1	EA	$ 7,900.00	$ 7,900.00
7' Manhole - Type II (Public)	6	EA	$ 4,500.00	$ 27,000.00
8' Manhole - Type II (Public)	1	EA	$ 5,000.00	$ 5,000.00
18" RCP Storm Drain (Public)	28	LF	$ 60.00	$ 1,680.00
24" RCP Storm Drain (Public)	45	LF	$ 70.00	$ 3,150.00
42" RCP Storm Drain (Public)	451	LF	$ 160.00	$ 72,160.00
48" RCP Storm Drain (Public)	492	LF	$ 190.00	$ 93,480.00
54" RCP Storm Drain (Public)	225	LF	$ 225.00	$ 57,150.00
Subtotal				$ 303,120.00
WQCV Detention Ponds (Private)				
Pond (South)	1	EA	$ 80,000.00	$ 80,000.00
Subtotal				$ 80,000.00
Total				$ 383,120.00
Contingency			10%	$ 38,312.00
Grand Total				$ 421,432.00

XV. Conclusion

The Bent Grass Residential Subdivision lies within the West Tributary of the Falcon Area Watershed. Detention for the site is provided in one proposed and one future on-site WQCV ponds to provide water quality for the entire tributary area. The proposed development will not have any adverse impacts on downstream developments or existing drainageways. Permission letters are being obtained from downstream property owners for maintenance of the channel, as it leaves the Bent Grass site.

APPENDIX A

Exhibits and Figures

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

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

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

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

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

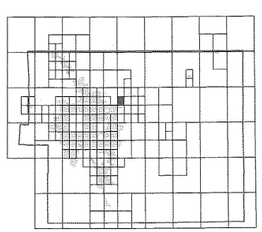
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1-877-FEMA MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

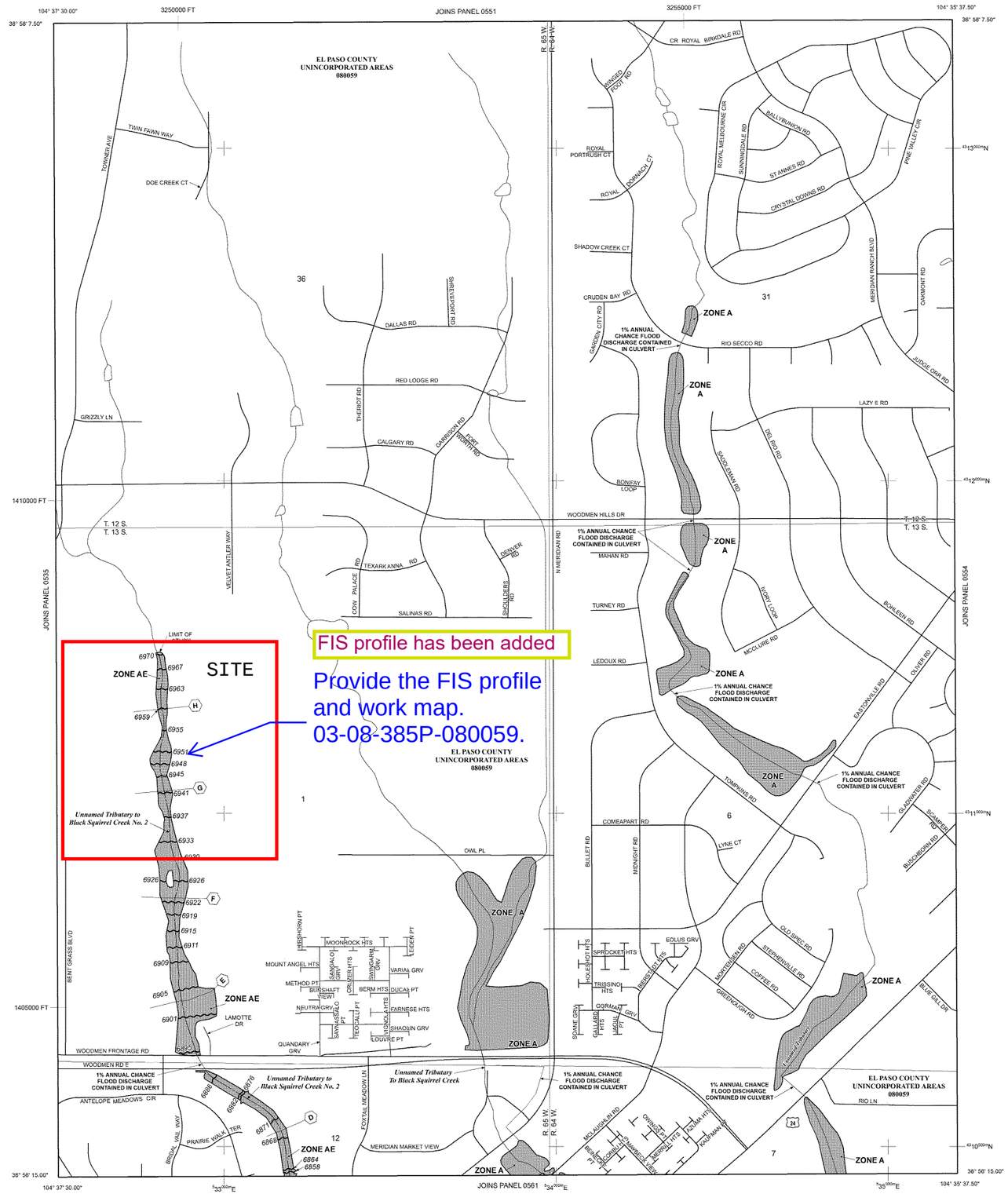
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area Formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

	Floodplain boundary
	Floodway boundary
	Zone D Boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - - 23	Transect line
97° 07' 30.00" 32° 22' 30.00"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid ticks, zone 13
6000000 FT	5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

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

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

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0553G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 553 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0553	G

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

MAP NUMBER
08041C0553G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

APPENDIX B

Hydrologic Computations

Proposed Computations

DESIGN POINT	CONTRIBUTING BASINS	CA(equivalent) CA(5)	CA(100)	Tc (min)	INTENSITY I(5) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(5) (cfs)	Q(100) (cfs)	NOTES
7	E-3	0.63	0.69						
		0.63	0.69	Type/flow					
8	E-1	0.94	1.18						
	E-2	0.52	0.58						
	C-4	1.32	2.07						
	FB DP 12	0.13	2.05						
	FB DP 5	0.00	1.11	TRAVEL TIME					
		2.91	6.99	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	11.8	
AA	DP 21	157.60	398.43	50.1	1.7	2.9	270.4	1194.5	CHANNEL FLOW & EX BOX CULVERTS @ BGMD
	B-1	0.39	1.56						
	DP 8	2.91	6.99	TRAVEL TIME					
	DP 15A	2.35	4.08						
		160.90	406.98	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				CULVERTS	135	5.1	0.4	50.6	
BB	B-2	0.12	0.44	50.6	1.7	2.9	269.0	1188.9	@ GRADE INLET (FUTURE)
	DP AA	160.90	406.98	TRAVEL TIME					
		161.02	407.42	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				CHANNEL	900	5.0	3.0	53.6	
12	C-2	0.54	0.72	5.0	5.2	9.1	9.0	30.4	@ GRADE INLET (FUTURE)
	FB DP 15	1.19	2.64	TRAVEL TIME					
		1.73	3.36	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				STREET	350	2.5	2.3	7.3	
15	C-1	4.63	5.90	13.9	3.5	6.1	20.1	43.7	@ GRADE INLET (FUTURE)
	C-3	1.11	1.25	TRAVEL TIME					
		5.74	7.15	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				STREET	40	2.0	0.3	14.2	
19	C-6	0.51	0.74	10.3	4.0	7.0	2.0	5.2	AREA INLET (FUTURE)
				TRAVEL TIME					
		0.51	0.74	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						3.2	0.0	10.3	
13	DP 12	1.73	3.36	14.2	3.5	6.0	27.7	68.0	TOTAL FLOW INTO PR NORTH WQ POND
	DP 15	5.74	7.15						
	DP 19	0.51	0.74	TRAVEL TIME					
		7.98	11.25	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	14.2	
13A	NORTH WQ POND RELEASE	0.64	2.47	5.0	5.2	9.1	3.3	22.4	
				TRAVEL TIME					
		0.64	2.47	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						2.6	0.0	5.0	
9	OS-2	2.81	8.03	18.3	3.1	5.3	8.6	42.8	
				TRAVEL TIME					
		2.81	8.03	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				SWALE	1150	5.6	3.4	21.8	
10	OS-3	1.49	4.24	18.9	3.0	5.2	4.5	22.2	
				TRAVEL TIME					
		1.49	4.24	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
				SWALE	3.33	6.1	0.0	18.9	
11	D-3	0.67	1.00	21.8	2.8	4.9	13.8	64.5	AREA INLET
	DP 9	2.81	8.03						
	DP 10	1.49	4.24	TRAVEL TIME					
		4.97	13.27	Type/flow	Length (ft)	Velocity (fps)	d. Time (min)	T. Time (min)	
						6.0	0.0	21.8	

Did not update with sheets from the PDR as there are additional smaller basins in the FDR to check street capacity, etc. However, spreadsheet was checked against PDR to ensure routing and basin contributing to design points "match" between the 2 reports.

Update with PDR sheets

APPENDIX C

Hydraulic Computations

Inlet Calculations

Proposed Inlet Calculations

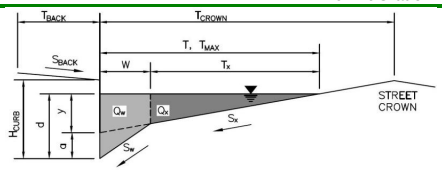
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Filing No. 3**

Inlet ID: **DP 16 - At Grade Inlet**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.013	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☐	check = yes

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Spread Criterion				
MAJOR STORM Allowable Capacity is based on Spread Criterion	**Q_{allow} =**	**12.4**	**12.4**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

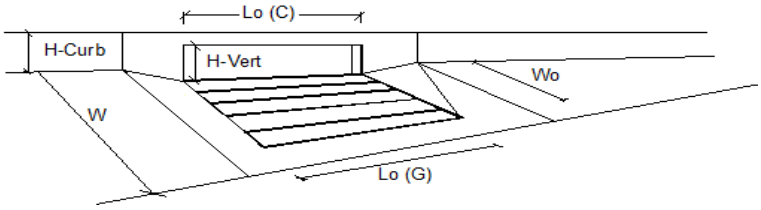
WARNING: MAJOR STORM max. allowable capacity is less than the design flow given on sheet 'Inlet Management'

Update with PDR sheets

Updated with revised flow in routing spreadsheet

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	10.00	10.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	

Street Hydraulics: WARNING: Q > ALLOWABLE Q FOR MAJOR STORM		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**6.8**	**11.4**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**2.4**	**16.7**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**74**	**41**	**%**

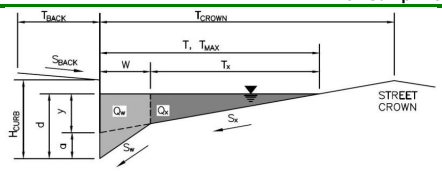
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Filing No. 3**

Inlet ID: **DP 18 - Sump Inlet**



Gutter Geometry (Enter data in the blue cells)

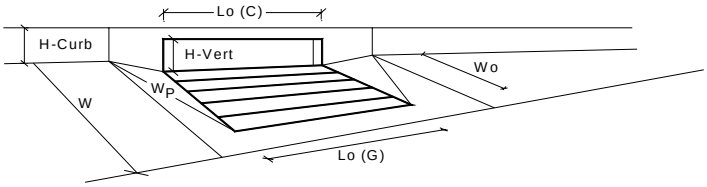
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.0**	**39.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	8.0	17.0	cfs

Update with PDR sheets

Updated with revised flow in routing spreadsheet

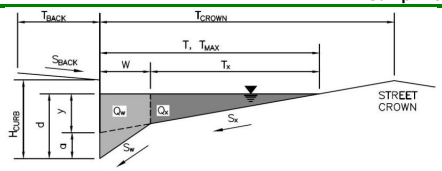
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Bent Grass Filing No. 3**

Inlet ID: **DP 17 - Sump Inlet**



Gutter Geometry (Enter data in the blue cells)

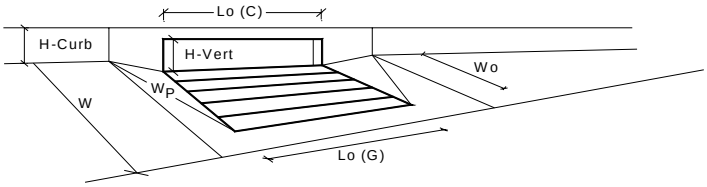
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	8.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	17.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	17.0	17.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	5.6	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	15.00	15.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.30	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.53	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.76	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**8.0**	**39.1**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.6	9.5	cfs

Update with PDR sheets

Updated with revised flow in routing spreadsheet

Existing Inlet Calculations

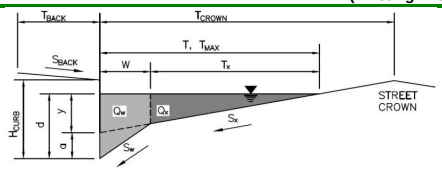
Version 4.06 Released August 2018

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: **Falcon Meadows at Bent Grass**

Inlet ID: **DP 24 (Existing Inlet)**



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	14.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.013	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	26.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.028	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	26.0	26.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Allow Flow Depth at Street Crown (leave blank for no)		☐	☑	check = yes

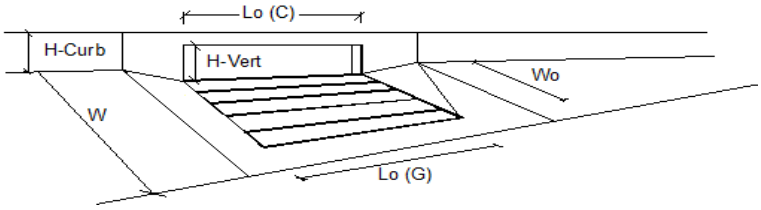
		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**18.1**	**152.7**	**cfs**

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.06 Released August 2018



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT Type R Curb Opening)	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	1	1	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	25.00	25.00	ft
Width of a Unit Grate (cannot be greater than W, Gutter Width)	W_o =	N/A	N/A	ft
Clogging Factor for a Single Unit Grate (typical min. value = 0.5)	C_f-G =	N/A	N/A	
Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1)	C_f-C =	0.10	0.10	
Street Hydraulics: OK - Q < Allowable Street Capacity'		MINOR	MAJOR	
Total Inlet Interception Capacity	**Q =**	**4.3**	**19.7**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**1.2**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**94**	**%**

Update with PDR sheets

Updated with revised flow in routing spreadsheet

APPENDIX D

On-Site Pond Calculations

Proposed Pond (South) Calculations

POND RIPRAP EMBANKMENT SIZING

Subdivision: Bent Grass
Location: El Paso County

Project Name: Bent Grass Filing No. 3
Project No.: CLH000018
Calculated By: CMD
Checked By: CD
Date: 8/6/20

Pond	Riprap Type	D50*	Slope, S	Concentration Factor	Unit discharge	Spillway Flow***	Spillway Width
		(in)	(ft/ft)	(1.0 to 3.0)	(cfs/ft)**	(cfs)	(ft)
South Pond	M	9.0	25.00%	2	2.85	71.2	25

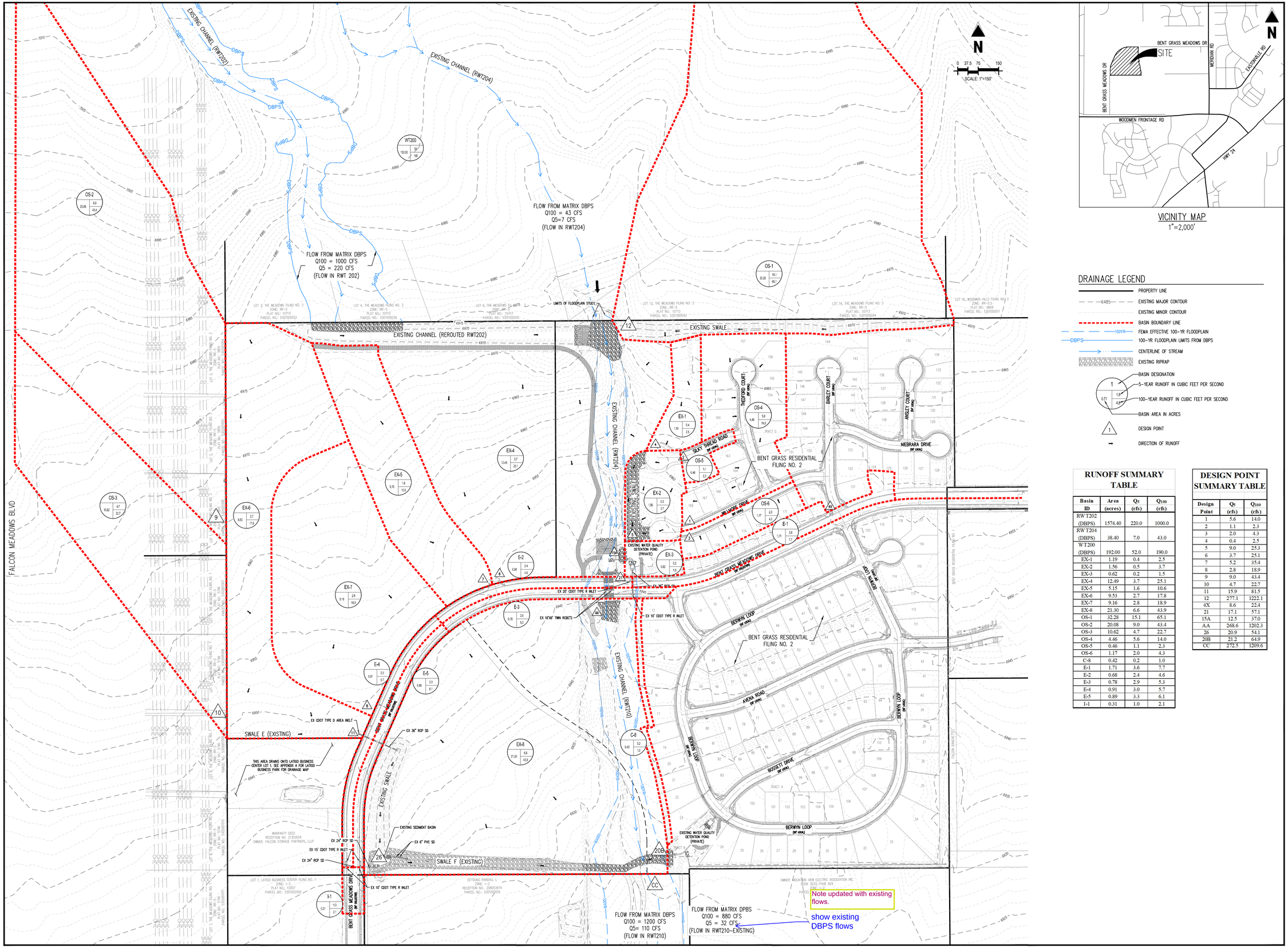
*From DCM Chapter 13 Eqn 13-9
** Spillway Flow/Spillway Width
***Peak Inflow Q100

Should this be 119?

UDFCD Pond spreadsheet has 100 year inflow of 71.2 cfs and routing spreadsheet has 100 year inflow of 79.8 cfs. Updated spreadsheet with 79.8 cfs as it's more conservative. Not sure where the 119 cfs reference is from.

APPENDIX E

Drainage Maps



VICINITY MAP
1"=2,000'

DRAINAGE LEGEND

- PROPERTY LINE
- 6485 — EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR
- BASIN BOUNDARY LINE
- 100YR — FEMA EFFECTIVE 100-YR FLOODPLAIN
- DBPS — 100-YR FLOODPLAIN LIMITS FROM DBPS
- CENTERLINE OF STREAM
- EXISTING RIPRAP
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
RWT202 (DBPS)	1574.40	220.0	1000.0
RWT204 (DBPS)	38.40	7.0	43.0
WT200 (DBPS)	192.00	52.0	190.0
EX-1	1.19	0.4	2.5
EX-2	1.56	0.5	3.7
EX-3	0.62	0.2	1.5
EX-4	12.49	3.7	25.1
EX-5	5.15	1.6	10.6
EX-6	9.53	2.7	17.8
EX-7	9.16	2.8	18.9
EX-8	21.30	6.6	43.9
OS-1	32.28	15.1	65.1
OS-2	20.08	9.0	43.4
OS-3	10.62	4.7	22.7
OS-4	4.46	5.6	14.0
OS-5	0.46	1.1	2.3
OS-6	1.17	2.0	4.3
C-8	0.42	0.2	1.0
E-1	1.71	3.6	7.7
E-2	0.68	2.4	4.6
E-3	0.78	2.9	5.3
E-4	0.91	3.0	5.7
E-5	0.89	3.3	6.1
I-1	0.31	1.0	2.1

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
1	5.6	14.0
2	1.1	2.3
3	2.0	4.3
4	0.4	2.5
5	9.0	25.3
6	3.7	25.1
7	5.2	35.4
8	2.8	18.9
9	9.0	43.4
10	4.7	22.7
11	15.9	81.5
12	277.1	1222.1
4X	8.6	22.4
21	17.1	57.1
15A	12.5	37.0
AA	268.6	1202.3
26	20.9	54.1
20B	21.2	64.9
CC	272.5	1209.6

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CHALLENGER HOMES

FINAL DRAINAGE REPORT
FALCON MEADOWS AT BENT GRASS FILING NO. 1
FOR
CHALLENGER COMMUNITIES, LLC

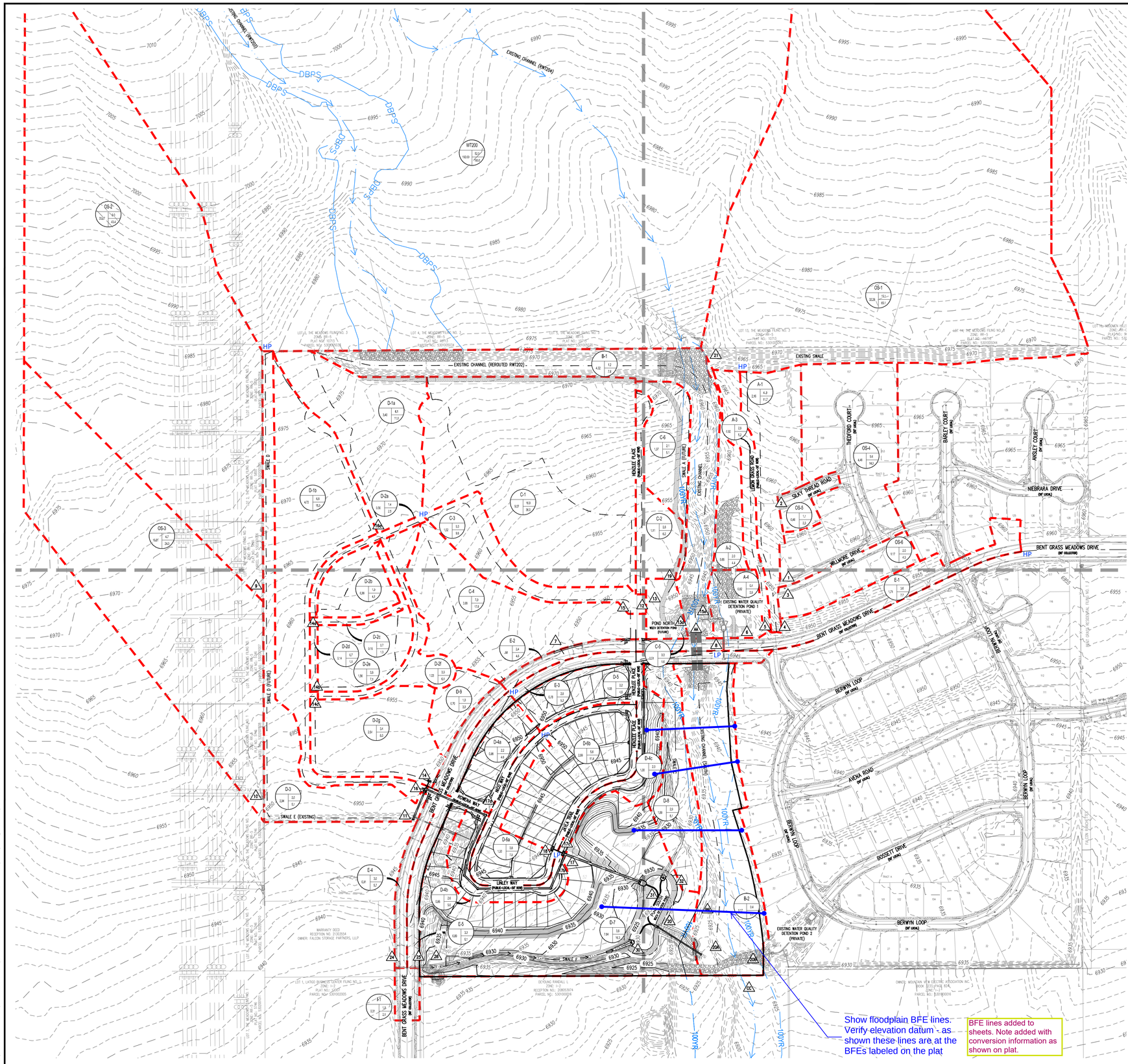
BENT GRASS MEADOWS DRIVE
FALCON, CO 80831 - EL PASO COUNTY

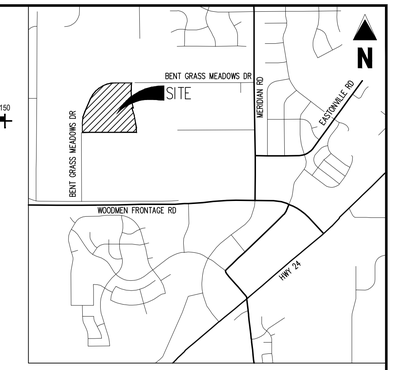
#	Date	Issue / Description	Init.

Project No:	CLH000017
Drawn By:	CMWJ
Checked By:	RGD
Date:	08/05/2020

EXISTING DRAINAGE MAP

DR-1





0 37.5 75 150
SCALE: 1"=150'

VICINITY MAP
1"=2,000'

DRAINAGE LEGEND

- PROPERTY LINE
- 6480 — EXISTING MAJOR CONTOUR
- 6482 — EXISTING MINOR CONTOUR
- 6480 — PROPOSED MAJOR CONTOUR
- 6482 — PROPOSED MINOR CONTOUR
- BASIN BOUNDARY LINE
- DRAINAGE TRAVEL PATH
- 100YR — FEMA EFFECTIVE 100-YR FLOODPLAIN
- DBPS — 100-YR FLOODPLAIN PER MATRIX DBPS
- CENTERLINE OF STREAM
- EXISTING RIPRAP
- EXISTING ACCESS
- PROPOSED RIPRAP
- PROPOSED ACCESS
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
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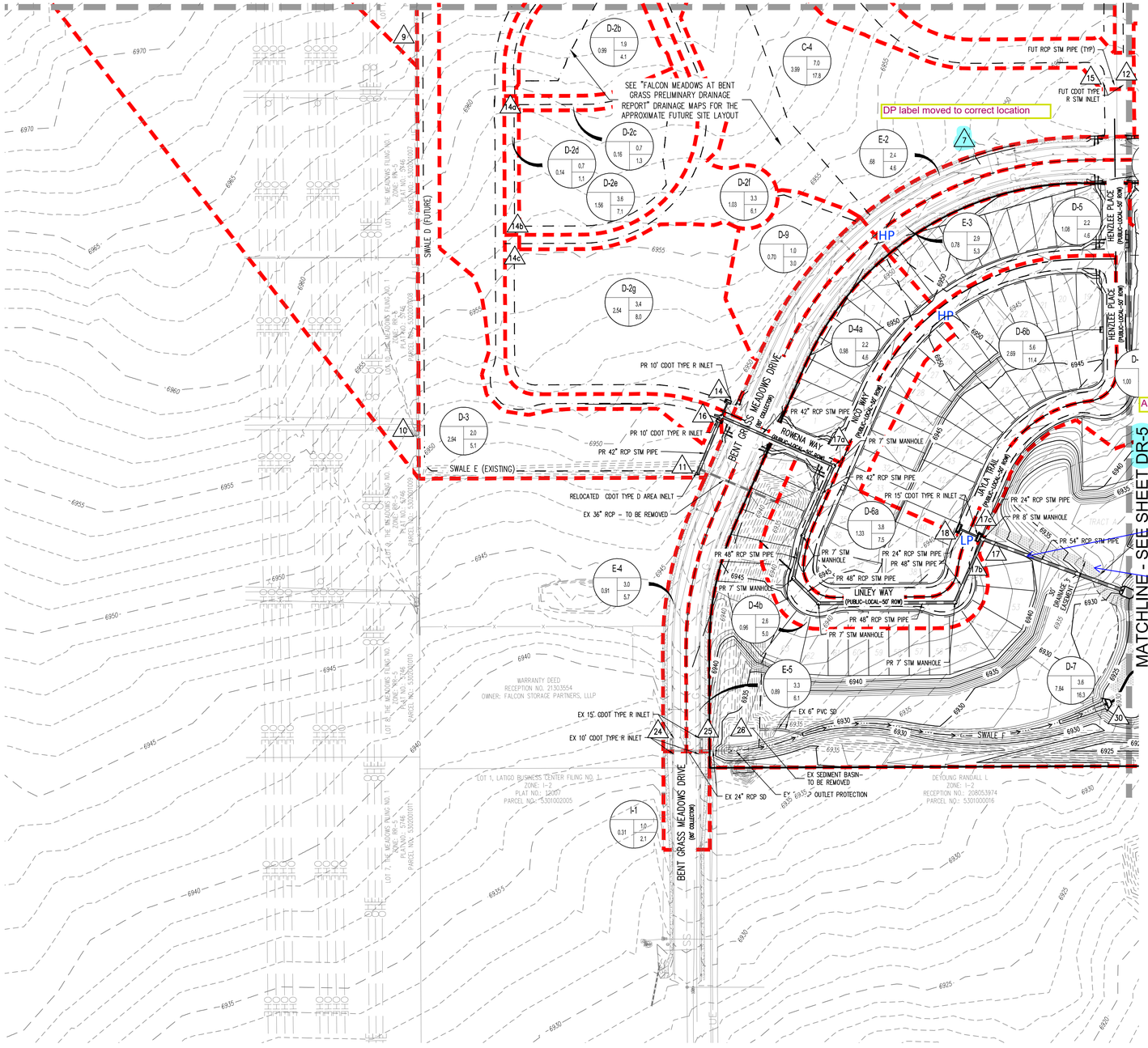
Checked By:	RGD
Date:	08/05/2020

PROPOSED DRAINAGE MAP

DR-2

MATCHLINE - SEE SHEET DR-2



All sheet references updated

Swale calculation added in Appendix C. Cross section included in GEC plan set along with other swale sections.

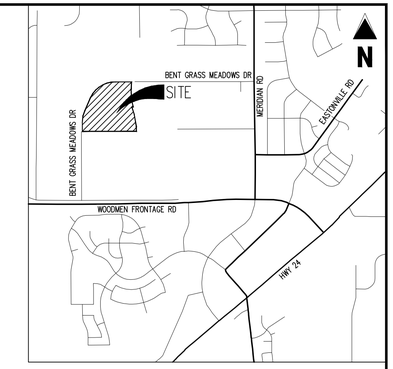
Provide swale cross-section and calculations

show the drainage easement

Easement turned back on.

MATCHLINE - SEE SHEET DR-5

SCALE: 1"=100'



VICINITY MAP
1"=2,000'

DRAINAGE LEGEND

- PROPERTY LINE
- 6480 EXISTING MAJOR CONTOUR
- 6482 EXISTING MINOR CONTOUR
- 6480 PROPOSED MAJOR CONTOUR
- 6482 PROPOSED MINOR CONTOUR
- BASIN BOUNDARY LINE
- DRAINAGE TRAVEL PATH
- 100YR FEMA EFFECTIVE 100-YR FLOODPLAIN
- DBPS 100-YR FLOODPLAIN PER MATRIX DBPS
- CENTERLINE OF STREAM
- EXISTING RIPRAP
- EXISTING ACCESS
- PROPOSED RIPRAP
- PROPOSED ACCESS
- BASIN DESIGNATION
- 5-YEAR RUNOFF IN CUBIC FEET PER SECOND
- 100-YEAR RUNOFF IN CUBIC FEET PER SECOND
- BASIN AREA IN ACRES
- DESIGN POINT
- DIRECTION OF RUNOFF

RUNOFF SUMMARY TABLE

Basin ID	Area (acres)	Q_5 (cfs)	Q_{100} (cfs)
RWT202	1574.40	220.0	1000.0
RWT204	38.40	7.0	43.0
WT200	192.00	52.0	190.0
A-1	2.16	4.9	11.7
A-2	0.86	2.0	4.4
A-3	0.92	2.6	5.2
A-4	0.82	0.4	2.6
B-1	4.32	1.2	7.8
B-2	1.17	0.4	2.5
C-1	9.07	16.9	36.0
C-2	1.11	2.8	6.2
C-3	1.52	5.3	9.9
C-4	3.99	6.6	17.4
C-5	0.51	0.3	1.6
C-6	1.37	2.1	5.1
D-1a	3.40	4.1	11.1
D-1b	4.72	6.8	15.0
D-2a	0.30	1.4	2.5
D-2b	0.99	1.9	4.1
D-2c	0.16	0.7	1.3
D-2d	0.14	0.7	1.1
D-2e	1.56	3.6	7.1
D-2f	1.03	3.3	6.1
D-2g	2.54	3.4	8.0
D-3	2.94	2.0	5.1
D-4a	0.98	2.2	4.6
D-4b	0.96	2.6	5.0
D-4c	1.00	2.3	4.5
D-5	1.08	2.2	4.6
D-6a	1.33	3.8	7.5
D-6b	2.69	5.6	11.4
D-7	7.84	3.6	16.3
D-8	1.69	1.3	4.5
D-9	0.70	1.0	3.0
OS-1	32.28	15.1	65.1
OS-2	20.07	9.0	43.4
OS-3	10.61	4.7	24.3
OS-4	4.46	5.6	14.0
OS-5	0.46	1.1	2.3
OS-6	1.17	2.0	4.3
E-1	1.71	3.6	7.7
E-2	0.68	2.4	4.6
E-3	0.78	2.9	5.3
E-4	0.91	3.0	5.7
E-5	0.89	3.3	6.1
I-1	0.31	1.0	2.1

DESIGN POINT SUMMARY TABLE

Design Point	Q_5 (cfs)	Q_{100} (cfs)
21	277.8	1226.8
1	5.8	15.0
2	5.3	13.9
3	7.5	18.7
4	11.1	27.7
5	3.6	16.5
6	13.9	41.2
7	2.9	5.5
8	11.0	46.0
9	8.6	42.8
10	4.5	22.2
11	13.8	64.5
12	9.0	30.4
13	27.7	68.0
13A	3.3	22.4
14a	3.4	7.1
14b	6.9	14.2
14c	9.6	19.5
14	6.4	16.8
15	20.1	43.7
16a	4.0	11.2
16	9.2	28.1
17a	1.6	3.4
17b	3.0	6.2
17c	1.8	3.7
17	4.6	9.5
18	8.0	17.0
19	2.0	5.2
15A	12.2	37.0
AA	270.4	1194.5
BB	269.0	1188.9
30	12.6	54.1
31	18.1	48.2
32	1.2	4.5
24	4.3	20.9
25	3.3	7.5
26	5.9	24.6
20	27.0	86.1
20A	9.6	47.1
20B	21.3	66.0
CC	268.5	1179.4

Updated with revised flow in routing spreadsheet

update based on PDR

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Checked By:	RGD
Date:	08/05/2020

PROPOSED DRAINAGE MAP

DR-5