EPC STORMWATER REVIEW COMMENTS
IN ORANGE BOXES WITH BLACK TEXT

Final Drainage Report
The Glen at Widefield Filing No. 12
El Paso County, Colorado

Prepared for:
Widefield Investment Group
3 Widefield Boulevard
Colorado Springs, Colorado 80911

Prepared by:

Kiowa
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Kiowa Project No. 19016

December 9, 2022

PCD Project No. SF-22-024

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List of Figures and Tables (Refer to the Appendix Table of Contents)

STATEMENTS AND APPROVALS

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 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

_____ _____

Andrew W. McCord (PE #25057) Date

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: _____ _____

Date

Print Name: J. Ryan Watson, Glen Development Company

Address: 3 Widefield Boulevard
Colorado Springs, Colorado 80911

EL PASO COUNTY:

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

_____ _____

Joshua Palmer, P.E. Date

El Paso County Engineer/ECM Administrator

I. GENERAL LOCATION AND DESCRIPTION

The Glen at Widefield Filing No. 12 (Filing 12) subdivision will be developed as a single-family residential subdivision located in the Widefield area of El Paso County. The subject property is located to the west of Marksheffel Road and north of Mesa Ridge Parkway. The site is located in the southwest portion of Section 22, Township 15 South, Range 65 West of the 6th Principal Meridian, in El Paso County, Colorado. The site is bounded on east by Glen at Widefield Filing No. 11 and further to the east by Marksheffel Road, to the south and west by the Glen at Widefield Filing Nos. 8 thru10, and to the to the north by undeveloped raw land, currently unplatted.

Filing 12 contains 27.23 acres of single-family residential lot development for 79 planned lots. Detention and water quality is provided for the site with the extended detention basin, referred to as Detention Basin 'D' which was constructed with The Glen at Widefield Filing No. 11.

The property is currently overlot-graded under grading permit to approximate finished grade conditions. Extended Detention Basin 'D' lies to the south of the site. A vicinity map of the site is shown on Figure 1 included in Appendix A.

With Filing No. 11, Detention Basin 'D' received final grading, perimeter maintenance roads, and a low-flow trickle channel. Slight modification to the outlet plate is planned with Filing 11 and is expected within the outlet structure.

has this been completed? provide pond design spreadsheets

With Filing No. 12, the orifice plate at the detention pond outlet structure reflects 'Ultimate Condition' which represents a full build-out condition, and which accommodates final calculated values for the tributary areas impacted by new development including Filing 11 and Filing 12.

The existing vegetative cover within the development is in poor to fair condition with minimal grasses throughout the site. The existing ground slopes within the property range from 0.2 to 25 percent. Soils within the subject site are mostly classified to be within Hydrologic Soils Group B as shown in the *El Paso County Soils Survey*. For the purposes of computing the existing and proposed hydrology for the site, Hydrologic Soil Groups B and C were used with weighted coefficients.

Existing utilities within or adjacent to the site include a pair of thirty-inch (30") Colorado Interstate Gas (CIG now Kinder-Morgan), mains that run along portions of the westerly property boundary (see maps in Appendix D).

Golden Buffs Drive will be extended west into earlier Filings 8 and 9 of The Glen at Widefield development. A dead-end barricade will be remov ys improvements with sidewalks and pedestrian ram ch previous work (flowline to flowline).

This is not an accurate statement. Basin B's within this filing contain lots that are tributary to pond B, Similarly Basins A-6, A7, A-8 are tributary to pond A per the Glen 9 FDR. The only basin that does not appear to be captured by a pond is Basin E1. Please revise the text accordingly.

II. MAJOR DRAINAGE BASINS AND SUBBA

The site lies within the West Fork Jimmy Camp Cre te presently drains towards the south and southeast th curb, gutter, pipe and open channel conveyances st Fork of Jimmy Camp Creek just downstream of Me st and south within proposed roadway corridors to proposed extended Detention Basin 'D'. The tributary basins to Basin 'D' are prefaced with the letter 'D' and are numbered sequentially D1 to D24.

The remaining portions of the site consist of rear lot margins which cannot be captured due to topography. These marginal areas are expected to consist of lawn and rear slope areas which will substantially match historic conditions. These marginal areas will achieve ~~60%~~ Water Quality treatment through best practices of ~~bioinfiltration (Permanent BMP - IRF).~~ The existing drainage patterns for the site are shown on Drainage Plan Sheet 1 provided in a map pocket at the end of this

runoff reduction

report, and developed flows are compared on Sheets H-1 & D-2 to reflect pre- and post-development impacts (See Appendix D).

The drainage reports that were reviewed in the process of preparing this drainage report are included in the References section. The Glen at Widefield East area was studied as a part of the *Master Development Drainage Plan (MDDP) for the Glen at Widefield* and the *West Fork Jimmy Camp Creek Drainage Basin Planning Study (DBPS).* A detention basin shown on the west side of the creek (DP 3101) was designed and constructed as part of the Filing No. 6 improvements. Two additional regional detention basins were identified for the site in the *MDDP*: one to serve the westerly side of the site with flows released west to the West Fork Jimmy Camp Creek (DP 3091), and the other to serve the easterly side of the site with flows released east across Marksheffel Road to a channel along the north side of Peaceful Valley Road and ultimately to the Jimmy Camp Creek main branch (DP 4021). The detention basin shown in the *MDDP* and *DBPS* at DP 3091 was designed and constructed as part of the Glen at Widefield Filing No. 7 improvements as Basin C. However, due to the proposed grading and drainage patterns north of Filing No. 7, two additional detention basins to serve the westerly side of the site were planned and constructed: one for Filing No. 8 (Basin B) and one for Filing No. 9 (Basin A), which is located just north of the Filing No. 8 area. The detention basin shown in the *MDDP* and *DBPS* at DP 4021 (Basin D) is designed herein and will be constructed to serve Filing 10, Filing 11, and Filing 12 within the Glen at Widefield master planned area.

The subject property limits are shown on Flood Insurance Rate Maps (FIRMs) 08041C0956G and 08041C0957G (both with effective dates of December 7, 2018) that are included in the Appendix. The FIRMs also show that the property to be developed with buildable lots is located outside of the FEMA regulated floodplain in an unshaded Zone X area, which is described as "Area of Minimal Flood Hazard."

see comment above regarding basins A and B and revise accordingly

The Following is a description of the on-site drainage sub-basins:

Basin D

Please discuss all basins in filing 12, including A-6, A-7, A-8, B-1, B-1.1, B-2, B-3, B-8, B-9 and B-9.1

Sub-basins D-1 thru D-24 are not all located within Filing No. 12 but are all tributary to Detention Basin 'D'. Basins D1-D24 comprise approximately 60 acres. Some edge areas are released undetained and these are accounted for in the A-Series, B-Series and E-Series of sub-basins discussed in earlier reports for various Glen at Widefield Subdivision Filings. These series of sub-basins are unchanged with this reporting in terms of physical boundary and Flow Prediction (Rational Method). These sub-basins include; A-6, A-7, A-8, B1, B1.1, B-2, B-3, B-8, B9 & B9.1. The A-Series of sub-basins are tributary to EDB 'A', the B-Series are tributary to EDB 'B' lying to the west. These downstream facilities are discussed and approved with The Glen Filing No 9 and 8, respectively.

The E-Series 'edge area' basins are adjacent to the subject property at the extreme west marginsof Sub-basin E-1, but all E-Series basins were evaluated as part of the overall IRF analysis for Filings 10 through 11, and are included herein for the sake of continuity and overall understanding of the analysis along with some narrative description of downstream conveyances.

The Sub-basins herein are generally organized and map-labeled in the order they sit from highest in elevation to lowest.

Detained flows released from Detention Basin 'D' are ultimately conveyed to the existing roadside ditch along Marksheffel Road north of Mesa Ridge Parkway. Design Point D10-1 released flows are discharged from the outlet structure of the Extended Detention Basin 'D' within a reinforced trapezoidal channel. The channel discharges 59.6 cfs during the Major Event. Downstream Culverts have been analyzed for expected flow volume and channel capacity. Flow declarations are provided on the Developed Map Exhibit along both sides of Marksheffel Rd. Capacity appears to be adequate.

Basin E within filing 12 was not analyzed in the filing 11 runoff reduction calculation. revise.

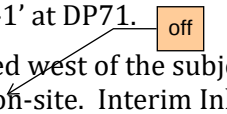
Sub-basins D-1 thru D-19 have similar characteristics with a mix of street, and residential lot area. Refer to Map Sheet 3 of 3 (D-2). The Following is a description of these sub-basins:

Sub-basin D-1 is approximately 1.40 acres in area and is located in the northwest of the subject property (Filing 12). Runoff from this basin will sheet flow south and concentrate in the street flowline. This basin combines with Sub-basin D-2via crosspan at DP68.

Sub-basin D-2 is approximately 1.46 acres in area and is located almost entirely within the subject property excepting a small area at the east margin where the sub-basin's downstream end terminates at existing 10' curb inlet 'E-2'. Runoff from this basin will sheet flow south and concentrate in street sections until reaching 10 ft curb inlet 'E-2' at DP69.

Sub-basin D-3 is approximately 1.69 acres in area and is located in the northwest area of the subject property (Filing 12). Runoff from this basin will sheet flow south and concentrate in the street flowline. This basin combines with Sub-basin D-4 via crosspan at DP70.

Sub-basin D-4 is approximately 2.07 acres in area and is located within the subject property (Filing 12) with the exception of its extreme eastern corner which is off-site. Runoff from this basin will sheet flow south and concentrate in the street flowline. It will also combine with concentrated runoff from upstream Sub-basin D-3 until reaching 10 ft curb inlet 'E-1' at DP71.



Sub-basin D-5 is approximately 1.56 acres in area and is located west of the subject property (Filing 12) with the exception of its extreme eastern corner which is on-site. Interim Inlet A-4 is converted from an interim area inlet to a closed manhole with the development of Filing No 12. Runoff from this basin will sheet flow north and concentrate in the south half of the street flowline until reaching curb inlet 'D-4' at DP82.

Sub-basin D-6 is approximately 0.41 acres in area and off-site and east of Filing 12. Runoff from this basin will sheet flow south and concentrate in Pennycress Drive and be conveyed by curb and gutter to the south (DP73) where it will continue across a crosspan at the intersection of Lance Leaf Drive and combine with additional surface flows from Sub-basin D-7.

Sub-basin D-7 is approximately 3.12 acres in area and is located along the east margin of the subject property. Some of the northwesterly margins of this sub-basin lie within Future Filing No. 12 and consist of rear yard areas. Runoff from this basin sheet flows south and east and concentrates in Pennycress Drive and is conveyed by curb and gutter to the south to on-grade inlet E-6 at DP75. In the Major storm event, 2.0 cfs of bypass flow will continue across a crosspan at the intersection of Marsh Elder Drive and combine with additional surface flows from Sub-basin D-8.

Sub-basin D-8 is approximately 1.76 acres in area and is located along the easterly margin of the subject property. Some of the northwesterly margins of this sub-basin lie within ~~Future~~ Filing No. 12 consisting of rear yard areas. Runoff from this basin will sheet flow south and east and concentrate within The Marsh Elder Place cul-de-sac and within Pennycress Drive and be further conveyed by curb and gutter to the south within the Pennycress roadway corridor at DP76. In the Minor event, 2.2 cfs of bypass flow will continue south as gutter flow. In the Major storm event, 9.7 cfs of bypass flow will continue south as gutter flow (at DP 78) and combine with additional surface flows from Sub-basin D-10.

Sub-basin D-9 is approximately 2.11 acres in area and is located entirely within the subject property. Runoff from this basin will sheet flow southeast and concentrate in street flowline until captured by a new 10 ft Curb Inlet 'F-1' lying at the southeasterly edge of planned Dwarf Clover Court's cul-de-sac. This inlet will connect to a new 18" RCP pipe to convey flows to Interim Area Inlet 'F-2' described in the Filing 11 Drainage Report. This Interim Inlet consists of a manhole barrel section which will be completed with a cone section and closed lid for fully-built out conditions.

The temporary diversion ditch which terminated at Structure F-2 – and began at Structure F-1 (New 10' Curb Inlet) will be demoed at the time of Filing 12 construction (DP77).

Sub-basin D-10 is approximately 2.99 acres in area and is located along the easterly margin of the subject property. Some rear yard areas within Filing 12 find their way to this sub-basin. General Runoff from this basin sheet flows south and east and concentrate within Pennycress Drive and is further conveyed by curb and gutter to the south within the Pennycress roadway corridor to a 20-foot curb inlet (Inlet H-2) at DP79. In the Minor event, 2.2 cfs of bypassed flow from upstream sub-basins D7 & D-8 will combine with flows from this sub-basin and continue south as gutter flow. In the Major storm event, 9.7 cfs of bypassed flow is received and will continue south as gutter flow to DP 79. Inlet H-2 lies in a sump condition along with a series of other inlets at this intersection which are all hydrostatically interconnected in the Major Event. These inlets collectively intercept one hundred percent (100%) of the Major Event. Hydraulic Analysis (HGL/EGL) using EPA SWMM was performed to validate the storm system's performance at this final junction in the Major Event. The SWMM Model results are included in Appendix C.

Sub-basin D-11 is approximately 3.96 acres in area and is located east of the subject property. Runoff from this basin sheet flows south and west and concentrates in Pennycress Drive and is conveyed by curb and gutter to the south (DP80) where it continues across a crosspan at a knuckle cul-de-sac (See Sub-basin D-12).

Sub-basin D-12 is approximately 1.39 in area and is located east of the subject property. Runoff from this basin sheet flows south and west and concentrates in Pennycress Drive and is combined with gutter flow from Sub-basin D-11. 4.50 cfs in the Minor event, and 13.0 cfs in the Major event combines with Sub-basin D-11 flows and these are conveyed by curb and gutter to the south to Inlet G-4 (DP81). Inlet G-4 lies in a sump condition along with a series of other inlets at this intersection which are all hydraulically connected. These inlets collectively intercept one hundred percent (100%) of the Major storm event.

Sub-basin D-13 is approximately 2.06 acres in area and is located east of the subject property. Runoff from this basin sheet flows south and east and concentrates in Golden Buffs Drive and is conveyed by curb and gutter to the south to on-grade curb inlet D-4 at DP82.

Sub-basin D-14 is approximately 3.30 acres in area and is located southeast of the subject property. Runoff from this basin sheet flows south and east and concentrates in Golden Buffs Drive and is conveyed by curb and gutter to the south to on-grade curb inlet G-3 at DP83. Some bypass flows (2.3 cfs) from Sub-basin D-13 combines within the street's gutter section in the Major storm event.

Sub-basin D-15 is approximately 2.80 acres in area and is located entirely within the subject property (Filing 12). Runoff from this basin will sheet flow south and east and concentrate in street sections at DP84. This basin combines with Sub-basin D-16 via crosspan. New 10 ft curb inlet 'A-1' lies just past the crosspan and captures the concentrated runoff from Sub-basin D-15. Some bypass flow will continue east (0.9 cfs) to Sub-basin D-16 in the Major storm event.

Sub-basin D-16 is approximately 2.27 acres in area and is located in the northeast of the subject property (Filing 12) excepting a very small portion of its easternmost edge. Runoff from this basin will sheet flow south and concentrate in street sections. This basin combines with upstream Sub-basin D-15 at the point of a planned crosspan. Combined flows continue east in the north half of the street section (Golden Buffs Drive) to the beginning of improved street Golden Buffs Drive. Combined flows continue east about another 80 feet to Inlet B-1 (DP84.1). Some bypass flow will continue east (2.6 cfs) to Sub-basin D-16.1 in the Major storm event.

Sub-basin D-16.1 is approximately 2.08 acres in area and is located east of the subject property. Runoff from this basin will sheet flow southwest and concentrate within Golden Buffs Drive. Flows

from this basin combine with concentrated gutter flow from upstream Sub-basin D-16 at the point of a planned crosspan (DP84.1). Combined flows continue east in the north half of Golden Buffs Drive to Mouse Ear Place cul-de-sac and the location of Inlet 'C-1' at DP85. Some bypass flow will continue southeast (1.4 cfs) to Sub-basin D-17 in the Major storm event.

Sub-basin D-17 is approximately 3.45 acres in area and is located east of the subject property. Runoff from this basin sheet flow west and concentrate in Golden Buffs Drive, and within cul-de-sac gutter sections at Mouse Ear Place, and Kitten Tail Court. These flows combine at Inlet D-1 (DP86). Some bypass flows continue south; 0.1 cfs bypasses this inlet in the Minor event, and 6.0 cfs to Sub-basin D-18 in the Major storm event.

Sub-basin D-18 is approximately 2.13 acres in area and is located east of the subject property. Runoff from this basin sheet flows west and concentrates in Golden Buffs Drive, and within cul-de-sac gutter sections at Horse Mint Trail. These flows combine at the east half of Golden Buffs Drive within the gutter section and ahead of an unnamed knuckle cul-de-sac at DP87. Some bypass flows continue south to Sub-basin D-19; 2.8 cfs in the Minor storm event, and 13.4 cfs in the Major event.

Sub-basin D-19 is approximately 2.97 acres in area and is locate east of the subject property. Runoff from this basin sheet flows west and concentrates in Golden Buffs Drive, and within an unnamed knuckle cul-de-sac. Concentrated gutter flows combines with upstream bypassed flows from Sub-basin D-18. These combined flows will continue south to Inlet G2 at DP88. Bypassing flows from Inlet G-2 are expected to overtop to Inlet G-1 in the Minor storm event and overtop to inlet G-1 and H-1 and J-2 in the Major storm event.

Sub-basin D-19.1 is approximately 0.17 acres in area and is located southeast of the subject property. Runoff from this basin will sheet flow west and concentrate in Pennycress Drive. These flows combine at Inlet G-1 (DP89). Some bypass flows will contribute to this inlet in both the Minor storm (0.1 cfs) and the Major storm event (5.7 cfs).

basin D19.1 is listed above

Sub-basins D20-24 have varying surface characteristics and these are reflected in the weighted coefficients assigned to each basin through Rational methodology. These basins comprise the tributary areas inflowing to Basin 'D' from areas off-site and far to the south.

these basins were captured by the pond in filing 11. Revise the text accordingly.

Refer to Map Sheet D-1. The Following is a description of the southerly sub-basins:

Sub-basin D19.1, D20c & D23

These basins are now detained and are part of the the Filing 10 through 12 Ultimate Condition. These basins consist of small portions of Pennycress Drive near EDB 'D" along with the emergency spillway structure. An inlet pair (J1-J2) captures developed flows and conveys them directly to Detention Basin 'D'.

Sub-Basin D20a

Is located along the southerly margin of the site and contains portions of residential lot, along with a portion of proposed Pennycress Drive. A new crosspan will convey flows from this basin to the temporary outflow ditch and Detention Basin 'D'. Flows from this sub-basin combine with flows from Sub-basins D21 & D22 at the outflow ditch. Combined flow at the temporary outflow ditch is 6.2 cfs for the 5-year event, and 17.9 cfs for the 100-year event.

The Existing Report for Markscheffel Road[12] (*Final Drainage Report Marksheffel Road South - Link Road to US-24, El Paso County, CO, HDR Engineering, August 2015*) evaluated and reported on the trapezoidal channel planned with the Markscheffel Roadway Improvements Project at a point just north of Peaceful Valley Road and provided the design value of 118.82 cfs for the

This paragraph is oddly placed and appears to be a part of a previous report as there is no appendix B provided in the report. Revise accordingly

This appears to be text from a previous report that no longer applies. Revise accordingly.

basin 20a is no longer captured by pond D per the drainage report amendment for filing 10. Revise.

Downstream Flows cross under Mesa Ridge Parkway within an 8'x3' Box Culvert (Q_{MAX}=175 cfs) at Invert Elevation 5650.02 (Centerline Mesa Ridge Parkway Ref: Kiowa Job #08082 for Mesa Ridge Parkway Improvements: '*WEST FORK JIMMY CAMP CREEK PROPOSED BRIDGE AND CHANNEL IMPROVEMENTS*'). No adverse impacts are expected from the detention pond discharge pipe. A channel-reinforcing riprap transition is planned at the release junction. Design calculations are provided in Appendix B.

Sub-basin D-20a-c contains 1.64 acres in area and is located south of the subject property. It is comprised of Pennycress Drive and some captured landscape areas. Runoff from these basins sheet flows west and concentrate in Pennycress Drive at Inlet J-1 (DP92a). These flows combine at Inlet J-2 with flows from Sub-basin D-23 and inflow directly to Detention basin 'D'. There are no bypass flows.

Sub-basin D-21 is approximately 4.02 acres in area and is located south of the subject property within Filing No. 10. Sub-basin D-21 has similar surface characteristics to Sub-basins D-1 thru D-19. Runoff from this basin sheet flows south and east and concentrates first within Peaceful Valley Road, and Buffalo Bur Trail, and then within Pennycress Drive existing street sections (DP90). These flows currently combine with flows from Sub-basin D-22 and are conveyed to the intersection of Pennycress Drive and Peaceful Valley Road. A crosspan conveys the flows to the northeast and directly to Basin 'D'.

Sub-basin D-22 is approximately 1.15 acres in area and is located south of the subject property within Filing No. 10. It is comprised of existing sections of Peaceful Valley Road and some captured overlot areas. Runoff from this basin sheet flows southwest and concentratea in Peaceful Valley Road (DP91). These flows combine with flows from Sub-basin D-21 and inflow directly to Detention Basin 'D'. There are no inlets. All flows from this sub-basin contribute to the north side gutter section of Pennycress Drive and are no longer ditch flow, but rather gutter flow within Sub-basin D-23.

Sub-basin D-23 is approximately 0.28 acres in area and is located south of the subject property. It is comprised of Pennycress Drive and some captured landscape areas. Runoff from this basin sheet flows east and concentrates in Pennycress Drive at Inlet J-2 (DP92b). These flows combine at Inlet J-1 with flows from Sub-basin D-23 and inflow directly to Detention basin 'D'. There are no bypass flows.

Sub-basin D-24 is approximately 9.79 acres in area and is adjacent to and along the southwest side of the subject property. This sub-basin encompasses all of the planned detention basin area, as well as off-site flows received from the west which traverse the Colorado Interstate Gas Pipeline Easement (C.I.G. Easement). These flows will remain unchanged from historic condition excepting roadway improvements. Flows from this sub-basin accumulate within rear lot areas north and west of the detention basin and are conveyed along shallow slopes with minimal velocity. There are no bypass flows, or inlets.

10.18 acres is shown on the drainage plan. Revise accordingly.

Basin E

The 'E' Series Basins are located along the easterly edge of the site between the property and Marksheffel Road. Sub-basins E-1 through E-5 drain offsite to the existing roadside ditch along Marksheffel Road.

A description of each of the 'E' Series Sub-basins is included in a reduced form from previous reports for clarity and to accurately describe the condition of downstream conveyances associated with Filings 10 through 12:

and Filing 12

Sub-basin E-1 contains 5.27 acres and is located within Filing No 11. This basin abuts existing Marksheffel Road and is historically tributary to the west-side ditch for the roadway. The overall

north to an existing grass swale, and then travel south east

characteristics of these basins is unchanged from historic conditions. A narrow strip along the north margin discharges nuisance flows to an east-west drainage that ends at Marksheffel Rd. For purposes of water quality treatment, that portion of these sub-basins discharging from within the Filing No 12 Boundary was analyzed using the IRF Runoff Reduction Method. An Exhibit and MHFD Calculation Sheet (*UD-BMP_v3.07.xls*) are provided in Appendix E. Developed Runoff from this basin will sheet flow southeast to the existing roadside ditch along Marksheffel Road (DP 95) as it does currently. A new box culvert crossing at Poa Annua was installed with Filing No. 11 to receive and discharge ditch flows. The Poa Annua Culvert consists of a two-foot high by three-feet wide double box culvert with wingwalls at each end, and aprons with cutoff walls. The culvert passes flows from the Minor Event, and overtops some flow in the Major Event. Full Capacity (Q_{pipe}) is calculated to be 93.58 cfs (See Appendix C), with an additional 6.42 cfs overtopping ($Q_{overtop}$)in the Major Event

Sub-basin E-2 contains 0.50 acres and is located within Filing No 11 along the north side of planned Poa Annua Street. This basin also partially abuts existing Marksheffel Road and is historically tributary to the west-side ditch for the roadway. The overall characteristics of these basins is unchanged from historic conditions. Runoff from this basin sheet flows southeast to the existing roadside ditch along Marksheffel Road (DP 96).

Sub-basin E-3 contains 1.67 acres and is located within Filing No 11 along the south side of planned Poa Annua Street. This basin also abuts existing Marksheffel Road and is historically tributary to the west-side ditch for the roadway. The overall characteristics of these basins is unchanged from historic conditions. Runoff from this basin sheet flows southeast to the existing roadside ditch along Marksheffel Road (DP 97).

Sub-basin E-4 contains 1.17 acres and is located within Filing No 11 and lies between planned Pennycress Drive and existing Marksheffel Rd. It is historically tributary to the west-side ditch for the roadway. The overall characteristics of these basins is unchanged from historic conditions. Runoff from this basin sheet flows southeast to the existing roadside ditch along Marksheffel Road (DP 98). Sub-basin E-4 terminates at an existing six-foot wide by two-foot-high concrete box culvert with two barrels (6'x2' Double CBC) at Design Point 10-2. Just upstream a small eighteen-inch culvert crosses Marksheffel Road and connects the east and west borrow ditches hydraulically (Ref: HDR Report, Structure 'CV152'). This culvert appears to function as a transfer pipe to allow for redundant outflow.

III. DRAINAGE DESIGN CRITERIA

Hydrologic and hydraulic calculations for the site were performed using the methods outlined in the *El Paso County Drainage Criteria Manual*. Topography for the site was compiled using a two-foot contour interval and is presented on the Historic Conditions map. The hydrologic calculations were made for the historic and proposed site conditions. The Drainage Plan presents the drainage patterns for the site, including the 'D'-series sub-basins. The peak flow rates for the sub-basins were estimated using the Rational Method. The 5-year (Minor storm) and 100-year (Major storm) recurrence intervals were determined. The one-hour rainfall depth was determined from Table 6-2 of the *Drainage Criteria Manual*. These depths are shown in the runoff calculations spreadsheet. The peak flow data generated using the rational method was used to verify street capacities and to size inlets and storm sewers within the subdivision. The drainage basin area, time of concentration, and rainfall intensity were determined for each of the sub-basins within the property. The onsite soils were assumed to be mostly Hydrologic Soil Group B, based on the *Soil Survey* and the result of earth-moving operations. For existing conditions, runoff coefficients were determined using a land use of pasture/meadow. The land use for the proposed development will be residential with a density of approximately 4 lots per acre.

The onsite hydraulic structures were sized using the methods outlined in the *El Paso County Drainage Criteria Manual*. The hydraulic capacities of the streets and curb inlets were determined using the UD-Inlet spreadsheet developed by the Urban Drainage and Flood Control District (UDFCD), considering the County criteria for the Minor (5-year) and Major (100-year) storms. Ramp curbs will be used throughout the development, except for curb returns, where a 6-inch vertical curb will be used.

The off-site Detention Basin 'D' is Extended Detention Basin (EDB) that uses Full Spectrum Detention. The UD-Detention spreadsheets created by UDFCD were used to size and design the detention basin with water quality enhancement, per the County's recommendation.

The supporting calculations associated with hydraulic functioning for this development's storm system were accepted and approved as a part of Filing 11 and have been included herein for reference in Appendix C of this report. Appendix C includes UD_Sewer and EPA-SWMM report summaries. The system was analyzed in EPA-SWMM in order to capture surface flows and pipe flows simultaneously. The major event results in some inlet flooding at the intersection of Pennycress Drive and Golden Buffs Drive. The Depth of Node Flooding is calculated to be 0.427' above the lowest inlets at Peak Flow (T_{PK}) which occurs at about 55 minutes. This demonstrates that the overall capture is theoretically 100% as Depth of Flow does not exceed the depth of the surrounding roadway corridor. The Node Flooding Value is the critical value for determination of function in this case and is highlighted in Appendix C for clarity.

IV. DRAINAGE FACILITY DESIGN

The drainage of the site will be accomplished through a combination of sheet flow, gutter flow and pipe conveyance systems which will outlet directly to the planned extended detention basin (Basin 'D').

The proposed drainage patterns for the site are shown on the Final Drainage Plan for the developed condition (Sheets D-1 and D-2) provided in the map pocket at the end of this report. The hydrologic and hydraulic calculations are provided in the Appendix. Refer to the Drainage Design Criteria section for additional information on the hydrologic and hydraulic calculations.

Evaluations related to sizing of onsite drainage improvements was carried out in accordance with the *County Storm Drainage Criteria Manual*. The capacities of the proposed onsite facilities were calculated in accordance with the *Criteria Manual* and current UDFCD supporting software.

Will flows that aren't going to Pond D (Basins A and B) be treated at a different pond?

The detention basin includes two pre-sedimentation forebays along with trickle channel to a planned three-stage outlet structure.

The detention basin will be a private facility and will be maintained by the district.

The following is a general description of the on-site and offsite storm sewer system serving Detention Basin 'D':

The system will begin with sheet flow at the lot areas. Some sheet flow will reach the EDB in historic pattern across unplatted and undeveloped land. However, most of the flows will begin as sheet flow on the lot areas and will be directed via overlot grades to existing and proposed street corridors. Inlets and pipes planned with this filing will convey the Minor event (5-year) and most of the Major event (100-year) directly to the planned detention basin.

Two principal storm trunklines are planned, at Pennycress Drive and at Golden Buffs Drive that will convey captured flow to 100-year capacity curb inlets in a sump condition at DP 79, DP 81, DP 89 and DP 93a, and 93b, and ultimately convey those flows directly to existing Detention Basin 'D' (DP 94 is the Outlet Structure). Runoff from Sub-basins D19.1, D20, D-21, D-22 and D-23 will be captured in

Engineer must confirm in the Drainage Report that the existing ponds are functioning as intended.

new curb and gutter of Pennycress Drive and conveyed to Detention Basin 'D' from the south. The flows from the south rely on surface conveyance, and inflow to Basin 'D' at a low point along Pennycress Drive identified as 'Inflow J'. An inlet pair at this location (Inlets J-1 & J-2) capture both Minor storm event (5yr) and Major storm event (100yr) flows.

Detention Basin 'D' is designed to fully accommodate water quality separation and the emergency conveyance of flow associated with Filing 10, Filing 11, and Filing 12.

The storm sewer system will provide storage and intercept most of the flows with some 100-year flows exceeding and by-passing inlets in the Major event These bypassed flows are contained within the street corridors and eventually enter the detention pond under increased hydraulic pressure associated with curb depth. The Minor event is fully intercepted by the inlet and pipe systems.

WATER QUALITY METHODOLOGY (4-STEP PROCESS):

STEP 1: RUNOFF REDUCTION PRACTICES

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. The existing grassed swales along the west side of the site (Gas Mains) shall remain undisturbed. Vegetated Hillsides provide some runoff reduction benefit, along with some biofiltering. Runoff Reduction calculations and IRF Reduction Exhibit are provided in Appendix E for the zone encompassing the subject property's north margin and Sub-basin E-1. 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 RELEASE THE WATER QUALITY CAPTURE VOLUME

Treatment and slow release of 40 hours of the water quality capture volume (WQCV) will be accomplished by the completed implementation of the proposed, 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 into an existing EDB via new and existing storm pipe systems.

STEP 4: IMPLEMENT SITE SPECIFIC & SOURCE CONTROL BMP'S

There are no potential sources of contaminants that could be introduced to the County 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.

WATER QUALITY

Storm water quality measures are required by the County in Volume 2 of the County's *Drainage Criteria Manual*. The water quality measures to be instituted for the development will include:

1. Water quality enhancement of the detention basin. Existing Sedimentation Basin 'D' was operating as a temporary sedimentation basin prior to construction of the Extended Detention Basin. Final improvements at this basin impacted water quality through the addition of pre-sedimentation forebays, trickle channel, and perimeter surface treatments to serve The Glen Filing No 10 through 12.

2. Water Quality Treatment via IRF Methodology at the north and east margin of the site.
3. The outlet structure includes water quality orifice plate modification to match Ultimate (Full Build-out) Design.

A. COST OF PROPOSED DRAINAGE FACILITIES

Table 2 presents a cost estimate for the construction of drainage improvements (Public) for The Glen at Widefield Filing No. 12 development.

B. DRAINAGE AND BRIDGE FEES

The site lies within the West Fork Jimmy Camp Creek Drainage Basin. The current drainage basin fee associated with the West Fork Jimmy Camp Creek Drainage Basin is $14,470 per impervious acre. The current bridge fee associated with the West Fork Jimmy Camp Creek Drainage Basin is $4,281 per impervious acre. The Glen at Widefield Filing No. 12 subdivision encompasses 27.23 acres. Table 1 details the fees due as part of this development.

V. CONCLUSIONS

The Glen at Widefield Filing No. 12 will be a single-lot family residential subdivision covering approximately 27.23 acres. Onsite drainage will include the use of surface conveyance elements such as gutter, crosspan, and inlets to route the runoff from the site to Detention Basin 'D'. and B? what about Basin A?

Basin D serves Filing 10 along with northern tributary area Filing 11 and Filing 12 (see maps). Detained runoff from the site will be conveyed to the West Fork Jimmy Camp Creek. With detention serving the site and existing downstream conveyance elements in place, the development of the Glen at Widefield Filing No. 12 property will not adversely impact or deteriorate improvements or natural drainageways downstream of the property.

VI. REFERENCES

1) Preliminary Drainage Report, The Glen at Widefield East, prepared by Kiowa Engineering Corporation, dated December 16, 2015.

2) Final Drainage Report, The Glen at Widefield Filing No. 7, prepared by Kiowa Engineering Corporation, dated January 11, 2016.

3) Amended Master Development Drainage Plan, The Glen at Widefield, prepared by Kiowa Engineering Corporation, dated June 21, 2007.

4) Final Drainage Report, The Glen at Widefield Filing No. 6, prepared by Kiowa Engineering Corporation, dated December 6, 2007.

5) Preliminary and Final Drainage Report, Mesa Ridge Parkway Final Design, prepared by Kiowa Engineering Corporation, dated November 29, 2010.

6) Mesa Ridge Parkway Roadway Design, Autumn Glen Avenue to Marksheffel Road and Widening from Powers Boulevard to Autumn Glen Avenue, prepared by Kiowa Engineering Corporation, dated December 8, 2010.

7) Master Development Drainage Plan for the Glen at Widefield, prepared by Kiowa Engineering Corporation, dated December 10, 1999.

8) West Fork Jimmy Camp Creek Drainage Basin Planning Study, prepared by Kiowa Engineering Corporation, dated October 17, 2003.

9) City of Colorado Springs and El Paso County Flood Insurance Study, prepared by the Federal Emergency Management Agency, dated March 1997.

10) El Paso County Drainage Criteria Manual (Volumes 1 and 2) and Engineering Criteria Manual, current editions.

11) Soil Survey of El Paso County Area, Colorado, prepared by United States Department of Agriculture Soil Conservation Service, dated June 1981.

12) Final Drainage Report Marksheffel Road South - Link Road to US-24, El Paso County, CO, HDR Engineering, August 2015.

13) Final Drainage Report The Glen Filing No 10 Kiowa Engineering, September 2019

14) Final Drainage Report The Glen Filing No 11 Kiowa Engineering, June 2022

APPENDIX A

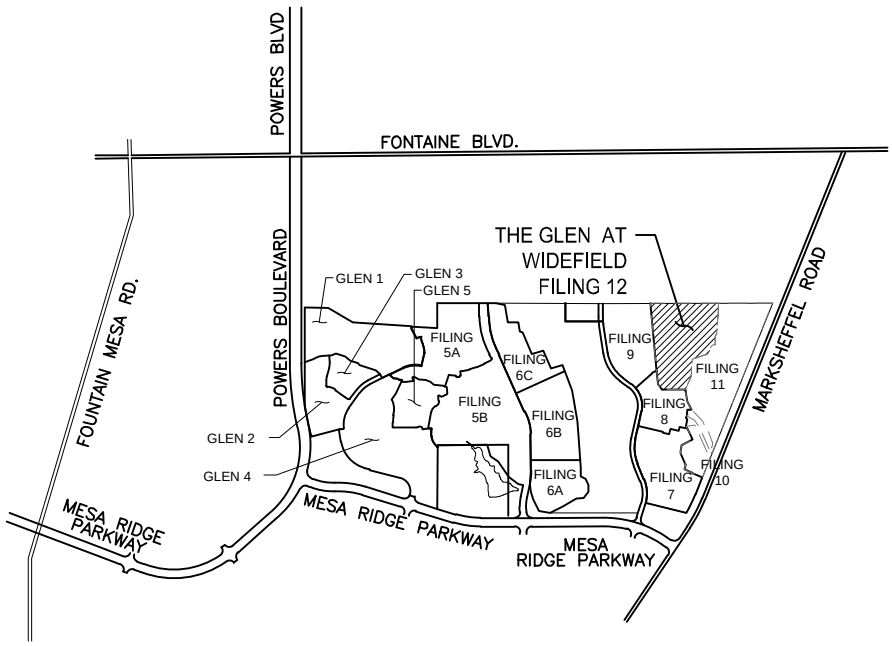
Figure 1: Vicinity Map

Figure 2: Soils Map

FEMA Flood Insurance Rate Map (Panels 956 and 957)

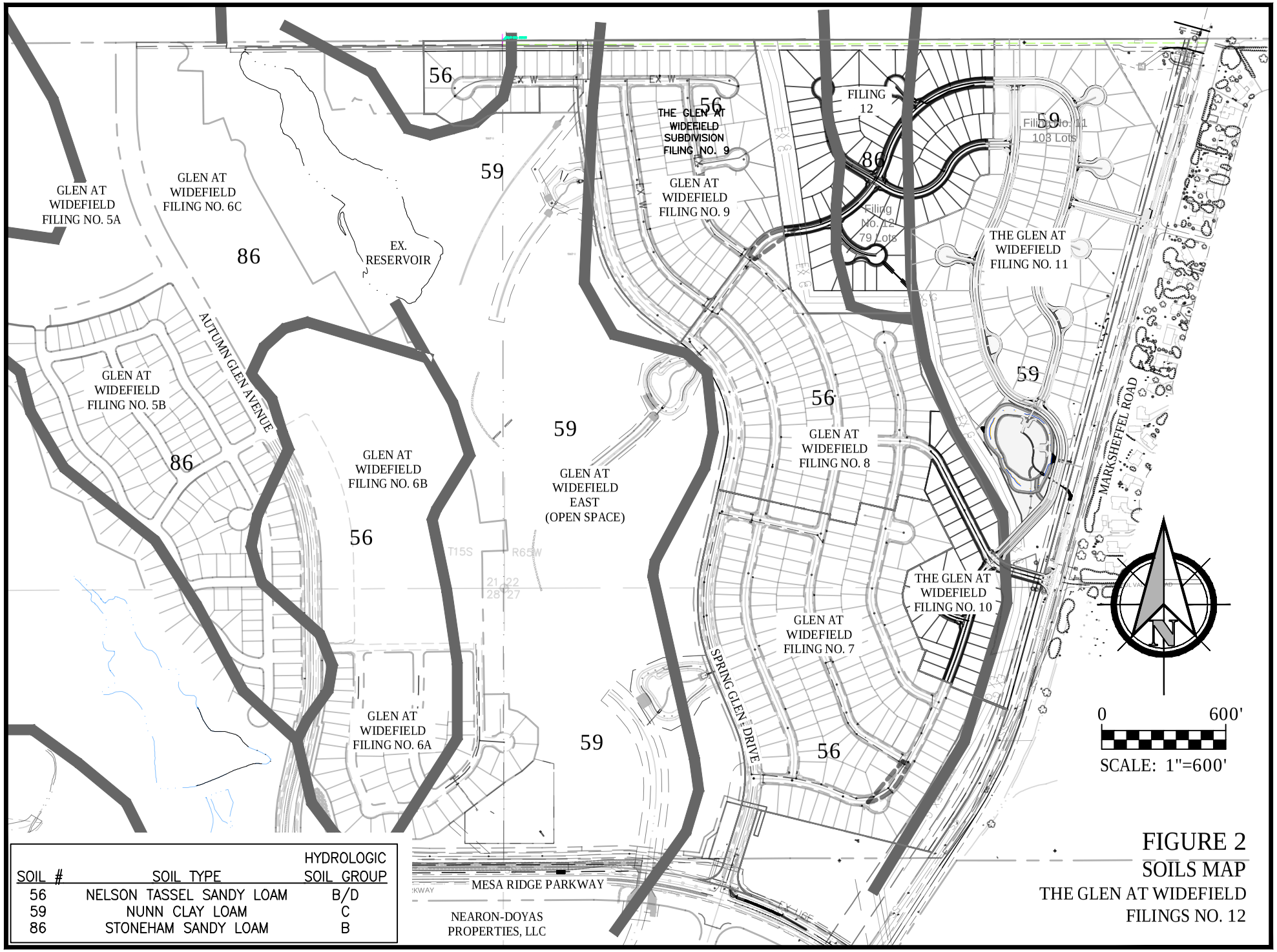
and Geotech Report

SCALE: NTS



VICINITY MAP
SCALE: N.T.S.

FIGURE 1
VICINITY MAP
THE GLEN AT WIDEFIELD FILING NO. 12



SOIL #	SOIL TYPE	HYDROLOGIC SOIL GROUP
56	NELSON TASSEL SANDY LOAM	B/D
59	NUNN CLAY LOAM	C
86	STONEHAM SANDY LOAM	B

FIGURE 2

SOILS MAP

THE GLEN AT WIDEFIELD FILINGS NO. 12

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PRELIMINARY GEOTECHNICAL INVESTIGATION
FOR PROPOSED DEVELOPMENT
THE GLEN AT WIDEFIELD
FILING NO. 7
WIDEFIELD, COLORADO

JOB NUMBER: 215292A

NOVEMBER 4, 2015

PREPARED FOR:
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COLORADO SPRINGS, COLORADO 80911

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PURPOSE AND SCOPE OF STUDY

This report presents the findings of our preliminary geotechnical engineering study for the proposed residential development located at The Glen at Widefield, Filing No. 7. The site location is shown on Figure 1. The study was conducted to evaluate the potential influence of the site geology on the proposed development and to develop preliminary geotechnical engineering recommendations. The study was conducted in accordance with our agreement for professional engineering services to Widefield Investment Group dated September 9, 2015. Site specific geotechnical investigations should be conducted at each lot and within proposed roadways to determine the appropriate foundation type and construction considerations of each individual residence planned.

A review of prior geotechnical investigations conducted by Soil testing and Engineering, Inc. has been conducted. The following reports have been reviewed:

1. Preliminary Subsurface Soil Investigation, Sunrise Ridge, Phase II, Colorado Springs, Colorado, Job Number 80415, and Dated June 10, 1998
2. Preliminary Subsurface Soil Investigation, Marksheffel Road and Peaceful Valley Road, Job Number 90235, and Dated May 5, 1999
3. Preliminary Subsurface Soil Investigation, The Glen at Widefield, Filing 7, Widefield, Colorado, Job Number 060933, and dated April 16, 2007.

Additionally, the mapped geology shown in the following map was consulted:

1. Scott, G.R., Taylor, R.B., Epis, R.C., and Wobus, R.A., 1976, Geologic map of the Pueblo 1 degree x 2 degrees quadrangle, south-central Colorado: U.S. Geological Survey, Miscellaneous Field Studies Map MF-775, scale 1:187,500

In addition to the review of the available information listed above, a field exploration program consisting of a site reconnaissance and nine borings was conducted to obtain general information on subsurface conditions. Samples from the borings were tested in the laboratory to determine their engineering characteristics. The previous reports, along with the results of our geologic observations, field exploration, and laboratory testing were analyzed to develop a report on the potential geologic hazards and preliminary geotechnical recommendations. This report summarizes the data obtained during the study and presents our conclusions and preliminary recommendations.

PROPOSED DEVELOPMENT

We understand that this project is part of a larger proposed residential development to be located in the vicinity west of Marksheffel near the intersection with Peaceful Valley Road in El Paso County, Colorado. The scope of this study is limited to the area bound by Marksheffel Road to the east, The Fountain Corporate Boundary to the North (the northern border of Section 22, Township 15 South, Range 65 West), and the rerouted gas line easement to the west and south. This portion of the project has an area of about 53.5 acres, and will potentially include about 185 single family residences and 1.6 miles of roadway. We understand that the houses in this area will be single story units with no basements. As mentioned above, site specific geotechnical studies should be conducted after final grading and platting has been established.

SITE CONDITIONS

The project area is located to the northeast of the intersection of Marksheffel Road and Peaceful Valley Road. A detailed description of the project boundaries was given in the above section. In general, the western portion of the site is located on a ridge extending south. The ground slopes moderately to the east in this area. The eastern portion of the site (approximately 2/3 of the area) is flat with a very mild slope to the east. Based on the available USGS topographic maps, the elevation varies across the site from about 5680 to 5720 feet MSL. Jimmy camp creek is located about 1,200 feet east of the site at its nearest point.

The majority of the site was vacant at the time of our investigation, but several small well houses are located near the northwest corner, which will be outside of the considered development. Overhead power lines run along the east and north sides of the site. Vegetation on the site consists mostly of weeds and grass with some small deciduous trees, and prairie dog holes were noted throughout. A irrigation ditch was noted at the toe of the slope separating the ridge from the flatter area. Peaceful Valley Country Club Estates (Filing 1), is located just east of the project site.

FIELD EXPLORATION

The field exploration for this project was conducted on September 23 and 24, 2015. Nine exploratory borings were drilled with an all-terrain CME 550X drill rig equipped with an automatic hammer to evaluate the subsurface conditions in the soils. The boring locations are shown in Figure 2. The exploratory borings were logged by a representative of Hepworth-Pawlak Geotechnical, Inc.

Samples of the soils were taken with a nominal 2-inch I.D. California spoon sampler and 1-3/8 inch I.D. split spoon sampler. The samplers were driven into the subsoils at various depths with blows from a 140-pound hammer falling 30 inches. This test is similar to the standard penetration test described by ASTM Method D-1586. The penetration resistance values are an indication of the relative density or consistency of the subsoils. Depths at which the samples were taken and the penetration resistance values are shown on the Boring Logs, Figure 3 and 4. The samples were returned to our laboratory for review by the project engineer and testing.

SUBSURFACE CONDITIONS

GENERAL

Under a thin layer of topsoil up to about 1 foot thick, four major subsurface materials were identified in our investigation. These include sandy clay, clayey sand, silty sand, and claystone bedrock. Claystone was encountered at relatively shallow depths along the west side of the site, and dropped off steeply towards the east side, where it was encountered at depths of over 50 feet below the existing ground surface. A detailed discussion of each soil/bedrock type encountered follows.

Sandy Clay (CL):

Sandy clay was found under the topsoil in all nine borings and extended to depths of about 4 to 35 feet below the ground surface. Sandy clay cover was generally shallower at the west side of the site. The sandy clay was medium stiff to very stiff, with an average penetration resistance blow count of 15 that ranged from 6 to 38 blows required for 12 inches of sampler penetration. Swell-compression test results indicate the sandy clay has

a low to very high swell potential based on vertical expansion ranging from 0.3 to 9.1 percent under a surcharge of 1 ksf when wetted.

Clayey Sand (SC):

Clayey sand was encountered under the sandy clay in all Borings except Borings B-3 and B-4. The clayey sand was found to be loose to medium dense, with an average penetration resistance blow count of 11 that ranged from 6 to 18 blows required for 12 inches of sampler penetration. The clayey sand encountered was generally wet, and the samples tested had an in situ water content that ranged from 26.9 to 31.5 percent.

Silty Sand (SM):

Slightly silty to silty sand with some gravel was encountered below the clayey sand in all Borings except Borings B-3 and B-4. The silty sand was found to be medium dense to dense, with an average penetration resistance blow count of 26 that ranged from 13 to 42 blows required for 12 inches of sampler penetration. In situ water content ranging from 10.0 to 12.7 percent was recorded in the samples tested.

Claystone:

Claystone was found at depths as shallow as 4 feet below the ground surface at the west side of the site, and as deep as 53 feet elsewhere. It was generally hard to very hard, with an average penetration of 5½ inches after 50 blows. The sample of claystone taken at 4 feet at Boring B-4 was softer, with a blow count of 31 for 12 inches of sampler penetration.

LABORATORY TESTING:

Laboratory testing included moisture content, unit weight, Atterberg limits, sieve analysis, percent passing #200 sieve, swell-compression, and water soluble sulfate concentration. Detailed results of swell-compression testing are shown on Figures 6-13 and gradation analyses on Figures 14 and 15. Test results are shown on the boring logs, Figures 3 and 4, and are summarized in Table 1

The concentration of water-soluble sulfates in the samples tested ranged from 0.065 to 0.813 percent. According to the Portland Cement Association's publication "Design and Control of Concrete Mixtures, 14th Edition" sulfate concentrations between 0.2 and 2.0 percent represent a severe sulfate exposure to concrete. To limit the effects of sulfate attack, Type V concrete is recommended. Additionally, a water to cementitious material ratio not exceeding 0.42 is recommended.

GROUNDWATER:

Groundwater was generally found at a depth of about 20 feet below the ground surface when measured several days after drilling. The table below lists the specific depths at which ground water was encountered.

Boring	Water Depth at time of Drilling	Water Depth Several Days After Drilling	Cave Depth
B-1	(no water found)	21 feet	21.5 feet
B-2	22 feet	20 feet	20 feet
B-3	(no water found)	(no water found)	19 feet
B-4	(no water found)	(no water found)	14 feet
B-5	(omitted from drilling program)		
B-6	15 feet	(no water found)	20 feet
B-7	22 feet	22 feet	22 feet
B-8	(no water found)	22 feet	24 feet
B-9	44 feet	21 feet	22 feet
B-10	(no water found)	22 feet	26 feet

Our review of previous studies conducted by STE indicate that groundwater depths were significantly shallower in the past. Perched groundwater and water contained in lenses of relatively permeable sands within less permeable clays are likely to be encountered.

It is anticipated that the depth to ground water will fluctuate with time based on seasonal, climatic, and other factors including irrigation.

GEOLOGIC SITE ASSESSMENT

The geologic formations in the vicinity of the project area include Quaternary Piney Creek Alluvium, Colluvium, and Pierre Shale below a thin layer of colluvium on the western side of the proposed development. Geologic hazards include moisture sensitive soils.

MOISTURE SENSITIVE SOILS

Our laboratory testing shows that the clay layers and the Pierre Shale have a medium to very high expansion potential when wetted and some of the soils have a collapse potential. These conditions must be considered in the design of building foundations and road pavements. The previous reports issued by STE have noted the hazards and some of our borings have encountered them. Both compression and swell can be remediated by removal and replacement with suitable material. For the clay, replacement at moisture contents above optimum is a common method. More detailed exploration and testing is required to better define the limits and their effect on the development.

EARTHQUAKE CONSIDERATIONS

The project area could experience earthquake related ground shaking. Modified Mercalli Intensity VI ground shaking should be expected during a reasonable exposure time for the development, but the probability for stronger ground shaking is low. Intensity VI ground shaking is felt by most people and causes general alarm, but results in negligible damage to structures of good design and construction. Occupied structures should be designed to withstand moderately strong ground shaking with little or no damage, and not to collapse under stronger ground shaking. According to the 2003 IBC and local codes, the property is considered to be Site Class C where the overburden is less than 15 feet and Site Class D where the overburden is greater than 15 feet. The Seismic Design Category is considered to be B.

ENGINEERING ANALYSIS

Because of the relatively large area considered within the proposed development, different conditions were identified within different areas of the site. At the western portion, expansive clay over shallow expansive claystone will be the dominant subsurface materials encountered at the anticipated foundation levels. Overburden consisting of

collapsible to expansive soils will encountered throughout the remainder of the site. Though no exceedingly soft/loose areas were identified in our study, such conditions have been identified in past studies, and it is possible that areas requiring significant remediation will be identified when site specific studies are conducted. Particularly, if shallow groundwater is identified, additional fill placement may be necessary to elevate foundations to a suitable distance from the groundwater.

Generally, the moisture sensitive soils should be remediated under all roadways, utility infrastructure, paved walks, drives, and flatwork, and under foundations. This can be accomplished in large part by removing, moisture conditioning, and replacing the existing soils in controlled compacted lifts. Unsuitable material, which includes the expansive claystone bedrock and some highly expansive clay should not be used below foundations. Because of the shallow depth of the bedrock along the western portion of the site, deep foundations, such as drilled piers may be a more cost effective option than over-excavation and replacement. In areas where the existing expansive material is replaced with a more permeable granular material, a toe drain at the base of the fill will be necessary to prevent the accumulation of surface water at this interface.

Structural floors built above crawlspaces will perform the best in the moisture sensitive soils encountered, but if the increased risk of slab movement can be tolerated, on-grade slabs can be used for the garage areas provided the area below has been over-excavated and replaced with suitable material. A more detailed discussion of floor types has been provided in the *Floors* subsection of the *Preliminary Design Recommendations* section below.

We recommend that the potential homeowner be supplied with, read and follow the recommendations presented in the Colorado Geologic Survey's Special Publication 43 "Home Landscaping and Maintenance on Swelling Soil". This publication provides a thorough description of the construction of homes on expansive soil, and includes information about the additional maintenance and care required for such homes. In particular, information about surface drainage and irrigation should be reviewed.

Because high concentrations of water soluble sulfates were found, special cement will likely be necessary for concrete in contact with the native soils. Because special cement could potentially add substantial construction costs, additional testing during the site specific investigations is recommended to determine the extent of these high concentrations.

Roadways will require subgrade improvement, which could be accomplished via over-excavation and replacement, and/or the use of geogrid below the pavement section. Lime stabilization of the native soils with high sulfate concentrations is not recommended due to the potential formation of calcium-sulfate-aluminate-hydrates, and the soil heave associated with the formation of these crystalline compounds.

PRELIMINARY DESIGN RECOMMENDATIONS

Based on the subsurface conditioned encountered, and our understanding of the proposed development, the following preliminary design recommendations have been provided.

SITE GRADING

We anticipate relatively shallow cuts and fills. We should have the opportunity to review construction plans for consistency with our recommendations.

Site Preparation:

The following preliminary recommendations should be observed for site preparation.

1. Permanent cut and fill slopes should be no steeper than 3:1 (horizontal to vertical). Any man-made slopes higher than 10 feet should be evaluated for slope stability.
2. All unsuitable organic material, debris or soft soils should be removed from areas to receive fill. This applies particularly to the placement of fill on slopes. If grading creates any slope steeper than 4 horizontal to 1 vertical, the ground should be benched to provide a relatively level surface for compaction. The exposed soils should be scarified, moisture conditioned, and compacted to the same density as the overlying fill.

3. All fill and backfill should be approved by the geotechnical engineer, placed in uniform lifts with a thickness compatible with the type of compaction equipment being used, moisture conditioned within 0 to +3 percent of optimum moisture content for the clay soil, and ±2 percent of optimum for the sand soils. The soils should be compacted with the appropriate equipment for the lift thickness used. The following minimum percentages of the maximum dry density, as determined by ASTM D698 (standard Proctor), are considered suitable for the anticipated development.

    a) Below foundations……..95%
    b) Below slabs and pavements……95%
    c) Landscaped area fill……90%
    d) Retaining or Foundation Wall Backfill……..95%

Suitability of On-Site Soil:

The clay soils encountered in the borings were found to have a relatively high swell potential at their in-situ moisture content and density, and will likely be expansive when placed as fill. Moisture conditioning to optimum and above can reduce the swell potential, but will not eliminate the risk of heaving caused by expansive soils. For fills that contain these clay soils, we recommend Standard Proctor criteria (ASTM D698) as opposed to modified Proctor criteria (ASTM D1557), because its use generally yields fill at higher optimum moisture content at a lower density and hence a lower expansion potential. All soils proposed for use below slabs or foundations should be tested for suitability. Bedrock will not be suitable for placement under structures.

Borrow areas should be stripped and segregated so that the fill will be free of deleterious materials. The on-site soil should be processed so that the fill does not contain rock or soil fragments larger than 4 inches in diameter. Any soils imported to the site should be approved by the geotechnical engineer.

EXCAVATIONS:

The sandy clay overburden, and the bedrock encountered in our borings can be excavated with typical heavy duty excavation equipment. Relatively shallow excavations are

anticipated for the construction of the proposed residences, but deeper excavations may be required for utility trenches.

It is the responsibility of the Contractor to provide safe working conditions and to comply with the regulations in OSHA Standards, Excavations, 29CFS Part 1926. The on-site native clay will likely classify as "Type B" in accordance with OSHA regulations. The regulations allow slopes of 1:1 horizontal to vertical for Type B soils for temporary excavations less than 20 feet deep. Some of the hard native sandy clay and claystone or sandstone bedrock will classify as "Type A" in accordance with OSHA regulations. The regulation allows for slopes of ¾:1 for temporary excavations less than 20 feet deep. The native sands encountered below the clay will likely classify as "Type C" in accordance with OSHA regulations. The regulations allow slopes of 1½:1 horizontal to vertical (34°) for Type C soils for temporary excavations less than 20 feet deep. The presence of water, seepage, fissuring, vibrations or surcharge loads will require temporary excavation to have slopes flatter than those allowed by OSHA regulations. The Contractor's competent person should make decisions regarding cut slopes. A qualified Geotechnical engineer should observe any questionable slopes or conditions. Temporary shoring or trench boxes may be necessary. Trench cut slopes in cohesive soils and bedrock should stand at near vertical for a sufficient length of time to install any required temporary shoring unless adversely affected by groundwater seepage, vibrations or surcharge loads. Trenches cut in non-cohesive sand may not stand at a near vertical slope during the time required to install trench boxes, and these areas may require the trench to be sloped instead.

FOUNDATIONS

Considering the subsurface conditions encountered in our investigation and the nature of the proposed construction, either deep foundation systems or over-excavation and replacement should be utilized for proposed structures. Deep foundations consisting of typical drilled shaft piers will likely be suitable at the west side of the site. Helical piers bearing in the overburden materials will be necessary for areas where deep bedrock exists. Particularly in the east portion of the site, deep foundations will not likely be required if over-excavation and replacement is conducted.

These criteria are presented for preliminary planning purposes only. Actual design criteria should be established by drilling closely-spaced borings within each building footprint and performing laboratory testing.

FLOOR SLABS

Floor slabs present a difficult problem where expansive materials are near the proposed floor slab elevation because sufficient dead load cannot be imposed on them to resist the uplift pressure generated when the materials become wet and expand. The only positive method to control floor slab movement on these soils is to construct a structural floor system above a crawl space. The evaluation of mold hazards is beyond the scope of this study and H-P Geotech does not provide recommendations regarding mold mitigation.

Garage floors are subject to the same difficult soils conditions as described above, but are difficult to construct over crawlspaces due to the relatively high live loading conditions anticipated. Slab-on-grade construction can be used for the garage floors provided that the risk of distress resulting from floor slab movement is recognized and accepted by the builder/potential homeowner. In areas with high swell potential, over-excavation of the native soils, and replacement with suitable moisture conditioned soils will be required.

DRAINAGE

Underdrains

Though groundwater was found at relatively low elevations compared to those of the anticipated foundations, it has been known to be significantly higher in the past. Additionally, surface water infiltration due to storm events and irrigation will change the groundwater depth. Therefore, we recommend below-grade construction, including crawlspaces be protected from excessive wetting by an underdrain system. The drain also will act to prevent buildup of hydrostatic pressures behind foundation walls.

Surface Drainage and Erosion Control:

Moisture-sensitive and erodible subsoils were identified at this site. The satisfactory performance of foundations, floor slabs and pavements are directly related to positive surface and subsurface drainage systems to prevent subgrade wetting. Surface grades should be maintained such that irrigation, snowmelt and precipitation water will easily

run off away from the structures and pavement. A 10 percent slope adjacent to foundations is commonly used. Positive drainage away from all structures and roadways should be maintained.

Additionally, good surface drainage should be provided around all fill areas and cut slopes to direct surface runoff away from these areas. Slopes and other stripped areas should be protected against erosion by paving, re-vegetation or other means.

CONTINUING SERVICES

Two additional elements of geotechnical engineering service are important for the successful completion of this project.

1. Consultation with design professionals during the design phases. This is important so the intentions of our recommendations are properly incorporated in the design, and that any changes in the design concept properly consider geotechnical aspects. A design-level geotechnical study should be undertaken once siting and configuration of the project is final.
2. Observation and monitoring during construction. A geotechnical engineer from our firm should observe the excavation, earthwork, and foundation phases of the work to judge that subsurface conditions are compatible with those used in the analysis and design. During site grading, placement of fill should be observed and tested to confirm that the proper placement conditions have been achieved.

LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering principles and practices in this area at this time. We make no warranty either express or implied. The conclusions and recommendations submitted in this report are based upon the data obtained from widely-spaced exploratory borings drilled at the locations indicated on Figure 2, the proposed type of construction and our experience in the area, and the review of previous studies conducted in the area. Our findings are preliminary in nature and include interpolation and extrapolation of the subsurface conditions identified at the exploratory borings and variations in the subsurface

conditions may not become evident until further exploration or excavation is performed. A site specific geotechnical study should be performed for each lot.

This report has been prepared for the exclusive use by our client for preliminary design purposes. We are not responsible for technical interpretations by others of our exploratory information which has not been described or documented in this report. As the project evolves, we should provide continued consultation and field services during construction to review and monitor the implementation of our recommendations, and to verify that the recommendations have been appropriately interpreted.

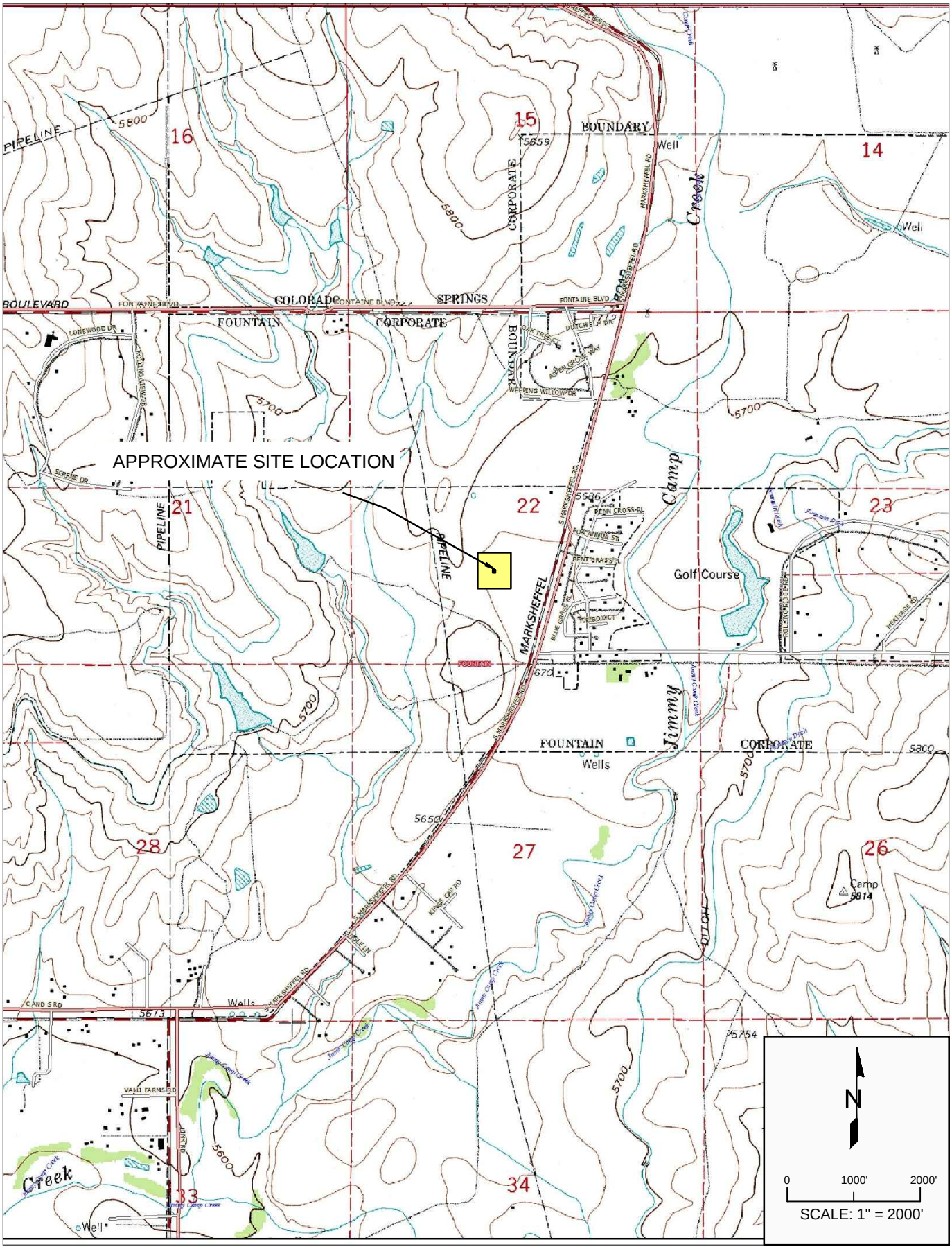
If you have any questions or if we can be of further service, please call. We appreciate the opportunity to have worked on this project.

Sincerely,
HEPWORTH - PAWLAK GEOTECHNICAL, INC.

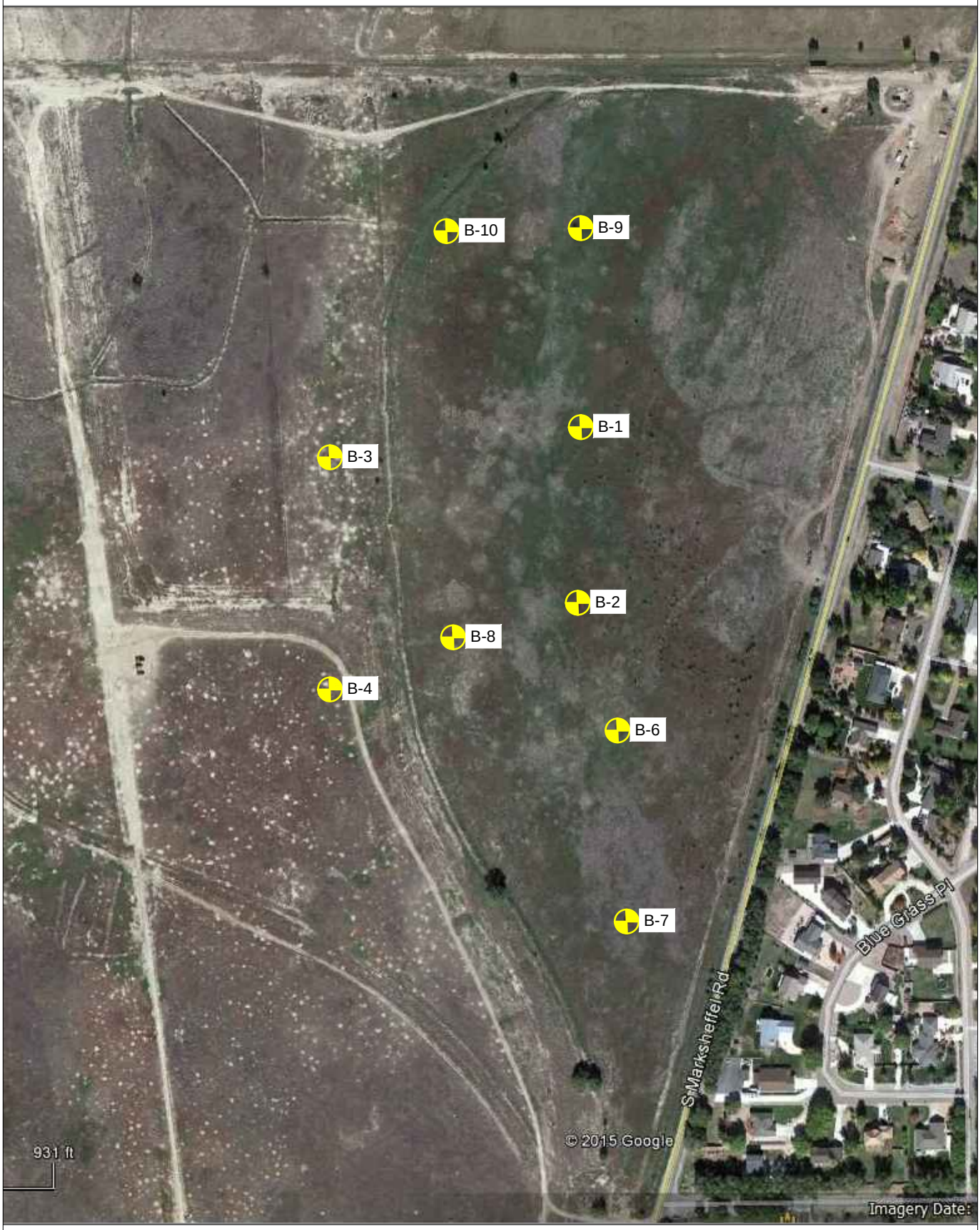
Cuong Vu, Ph.D., P.E.

and

Arben Kalaveshi, P.E.

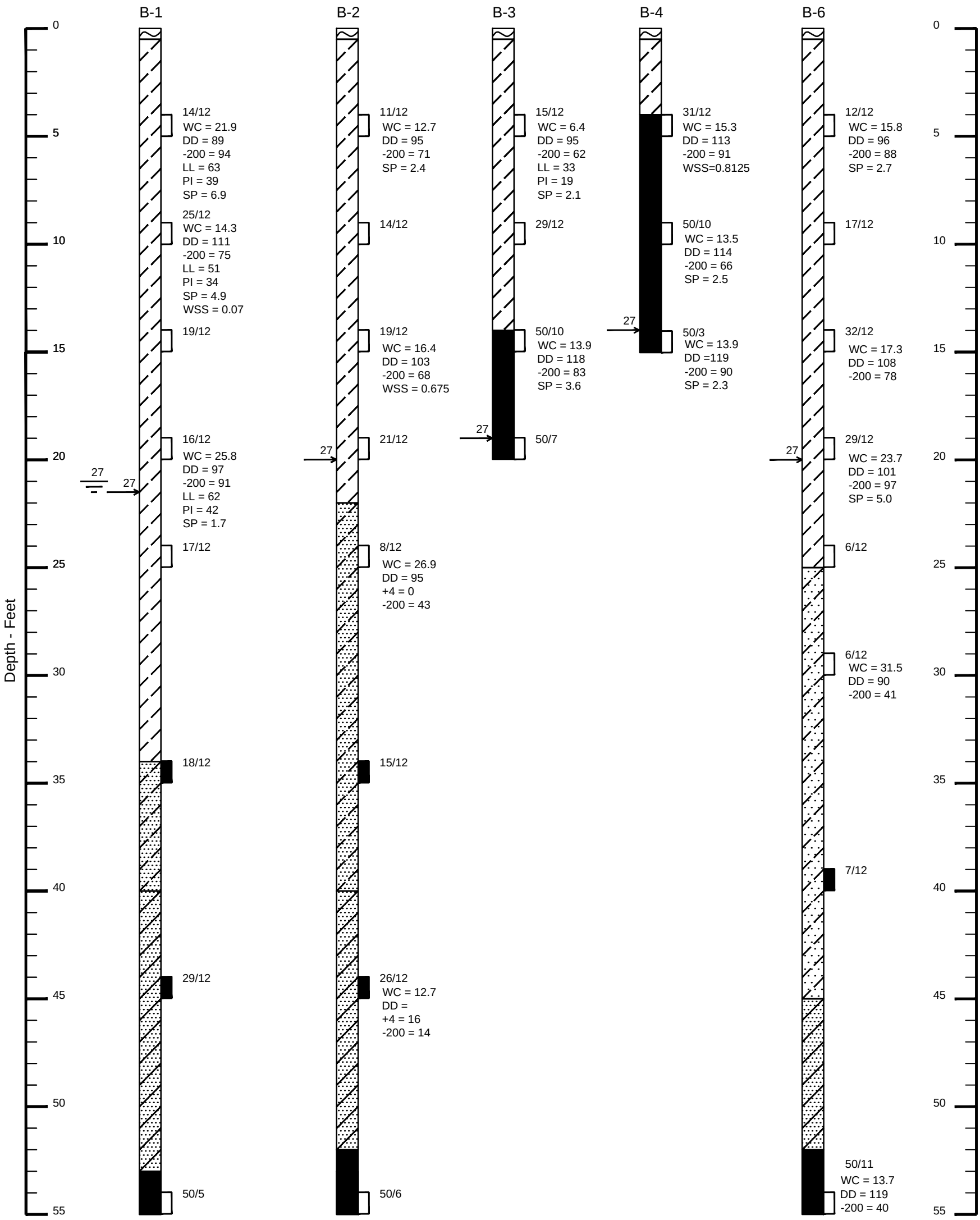


215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 SITE LOCATION	FIG. 1

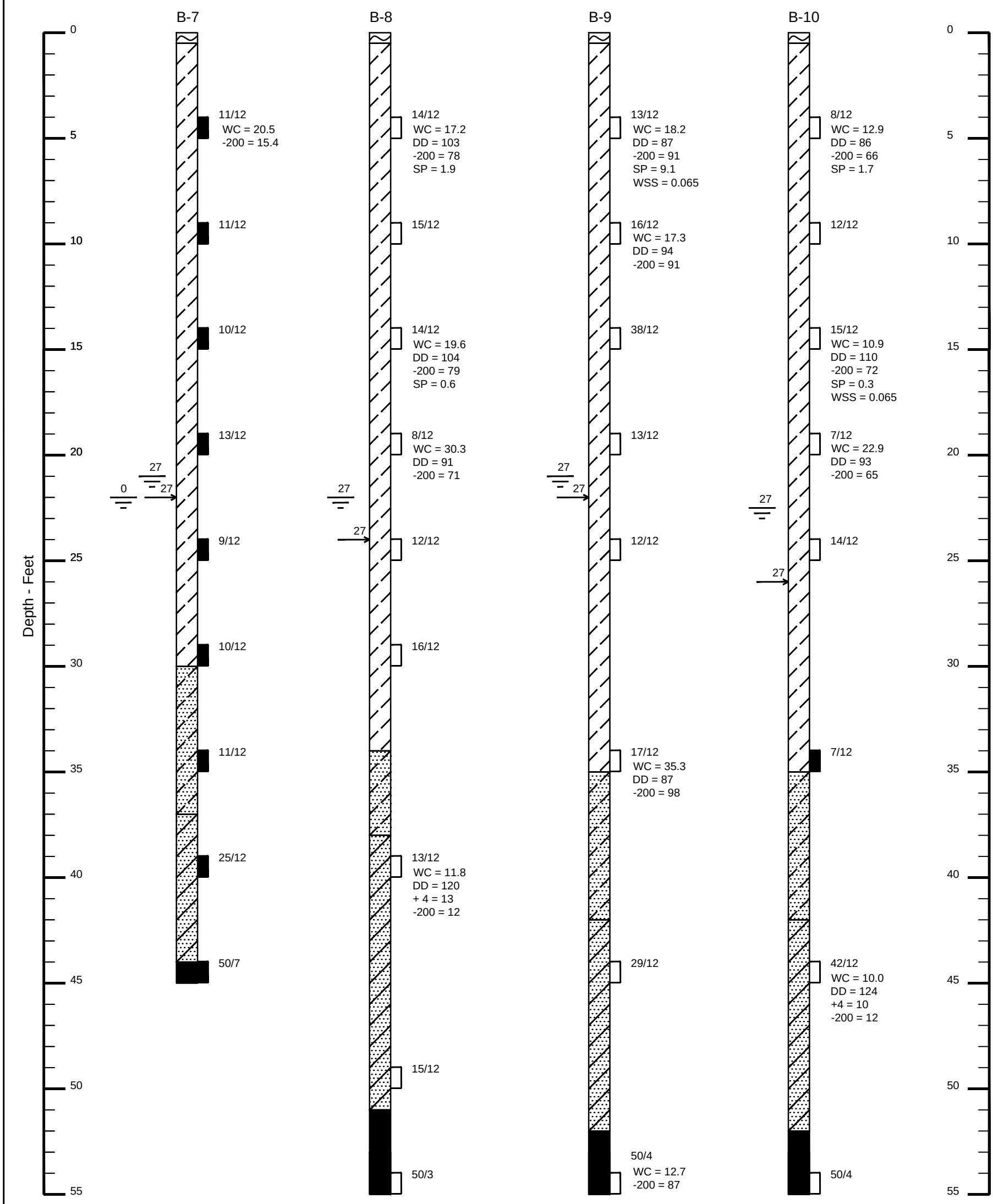


215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 BORING LOCATIONS	FIG. 2

215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 BORING LOCATIONS	FIG. 2a



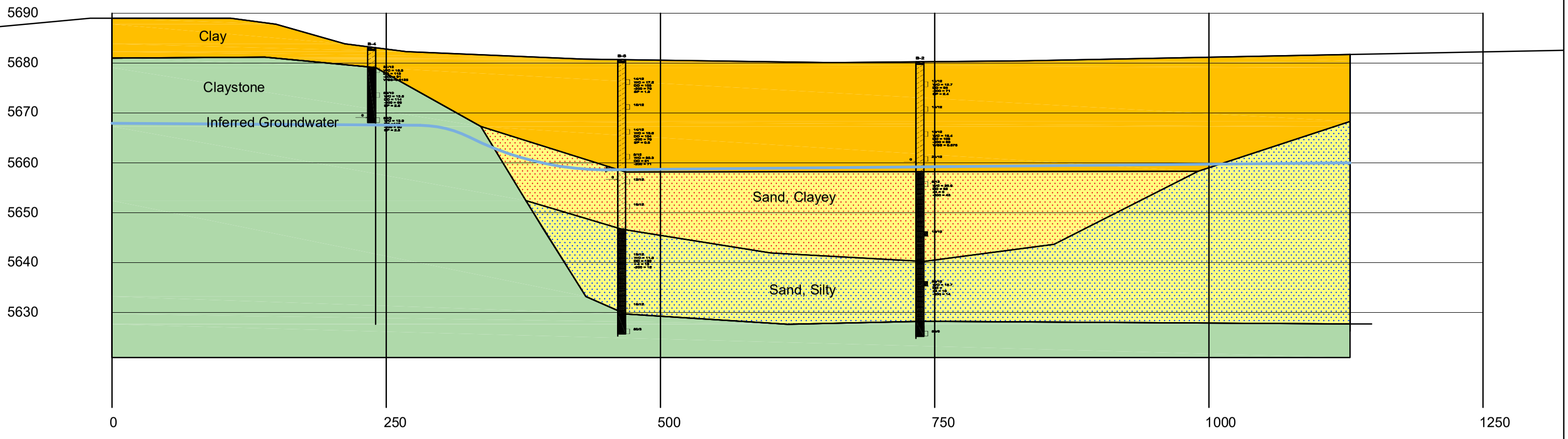
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 BORING LOGS	FIG. 3



213116A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 BORING LOGS	FIG. 4

NOTES:

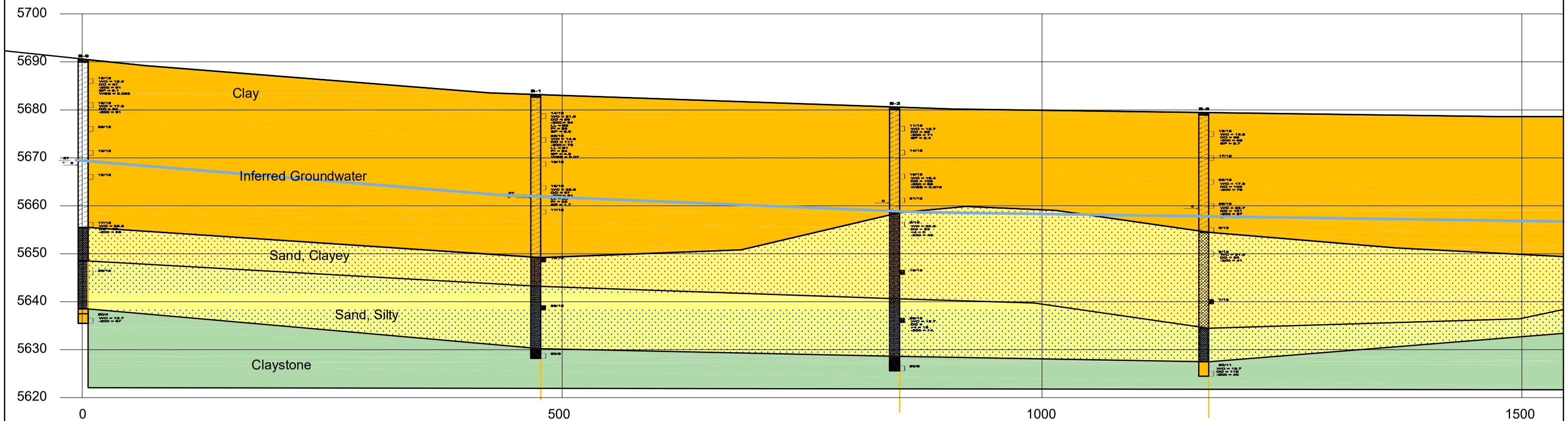
1. The materials shown and their boundaries have been inferred and interpreted from the boring data available and the surface conditions observed, and may differ from the actual subsurface conditions.
2. The surface topography end elevations are approximate.
3. The free water line shown is an extrapolation of the water level shown in boreholes when measured at least 1 day after drilling was completed.



215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 SOIL CROSS SECTIONS	FIG. 4A

NOTES:

1. The materials shown and their boundaries have been inferred and interpreted from the boring data available and the surface conditions observed, and may differ from the actual subsurface conditions.
2. The surface topography end elevations are approximate.
3. The free water line shown is an extrapolation of the water level shown in boreholes when measured at least 1 day after drilling was completed.



215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 SOIL CROSS SECTIONS	FIG. 5

LEGEND

TOPSOIL: Clay (CL), sandy, slightly moist to moist, brown, with grass/weed cover.

CLAY (CL), sandy, fine to medium grained, medium stiff to very stiff, medium plasticity, moist to wet, brown.

SAND (SC), clayey, fine to coarse grained, low plasticity, loose to medium dense, very moist moist to wet, brown.

SAND (SP-SM), silty, gravelly, fine to coarse grained, medium dense, moist, brown.

Claystone, fine grained, medium hard to very hard, moist, brown to blue.

Indicates 1⅜ inch I.D. Split Spoon sampler. 17/12 indicates 17 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

Indicates 2-inch I.D. California sampler. 17/12 indicates 17 blows of a 140-pound hammer falling 30 inches were required to drive the sampler 12 inches.

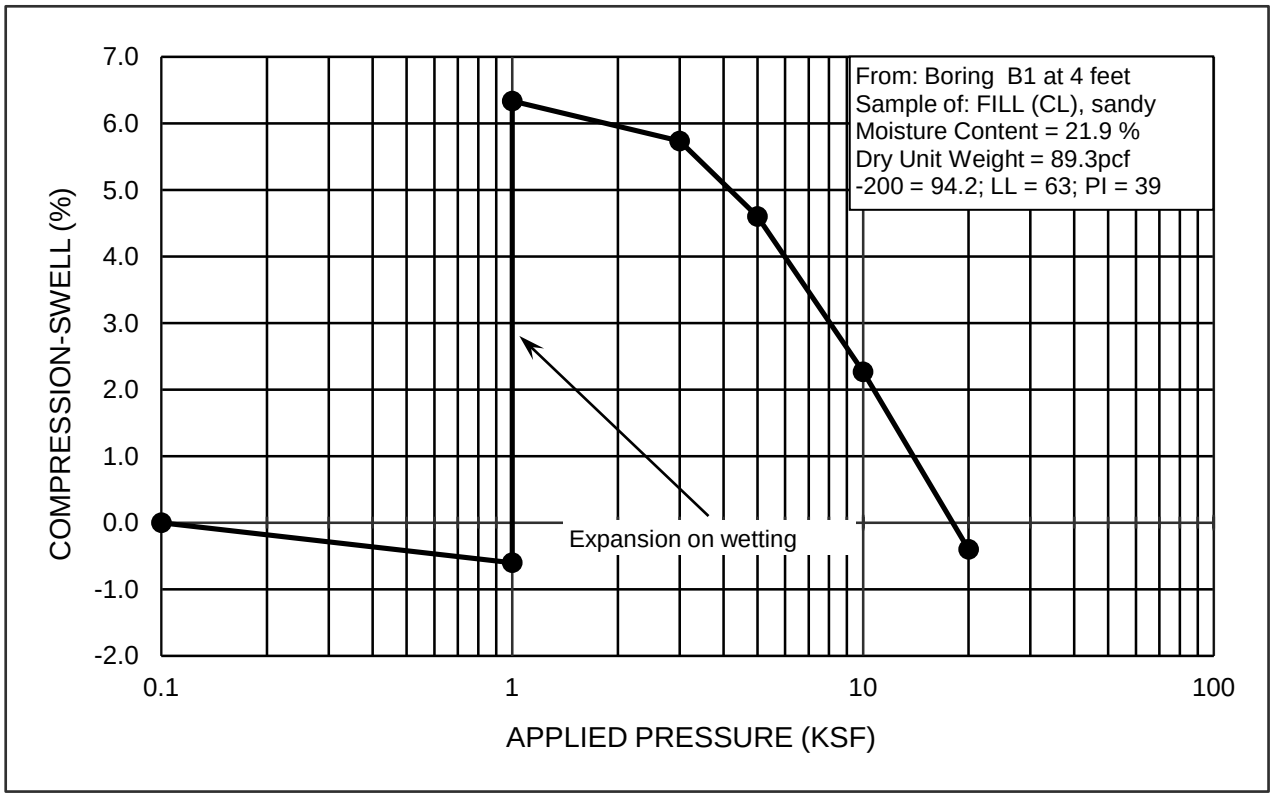
Indicates depth of cave and number of days after drilling measurement was made.

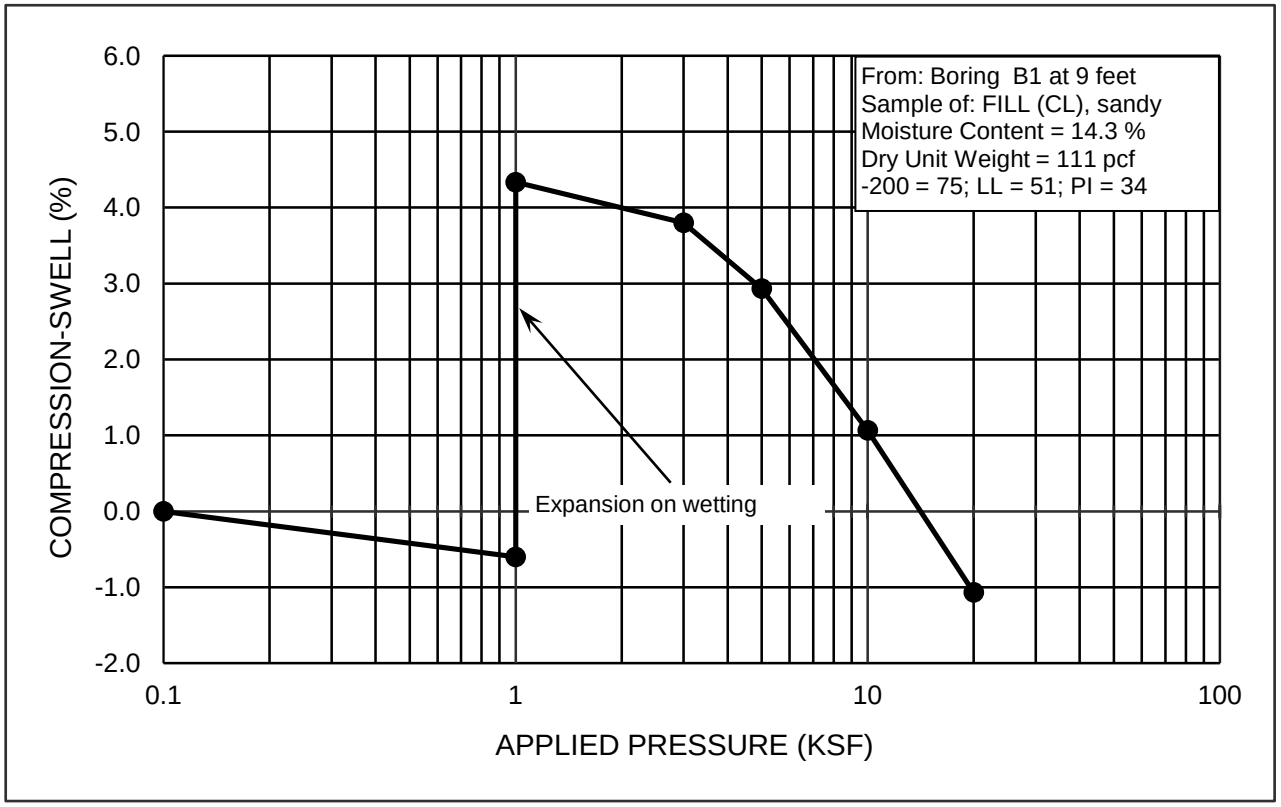
Indicates depth of free water and number of days after drilling measurement was made.

NOTES:

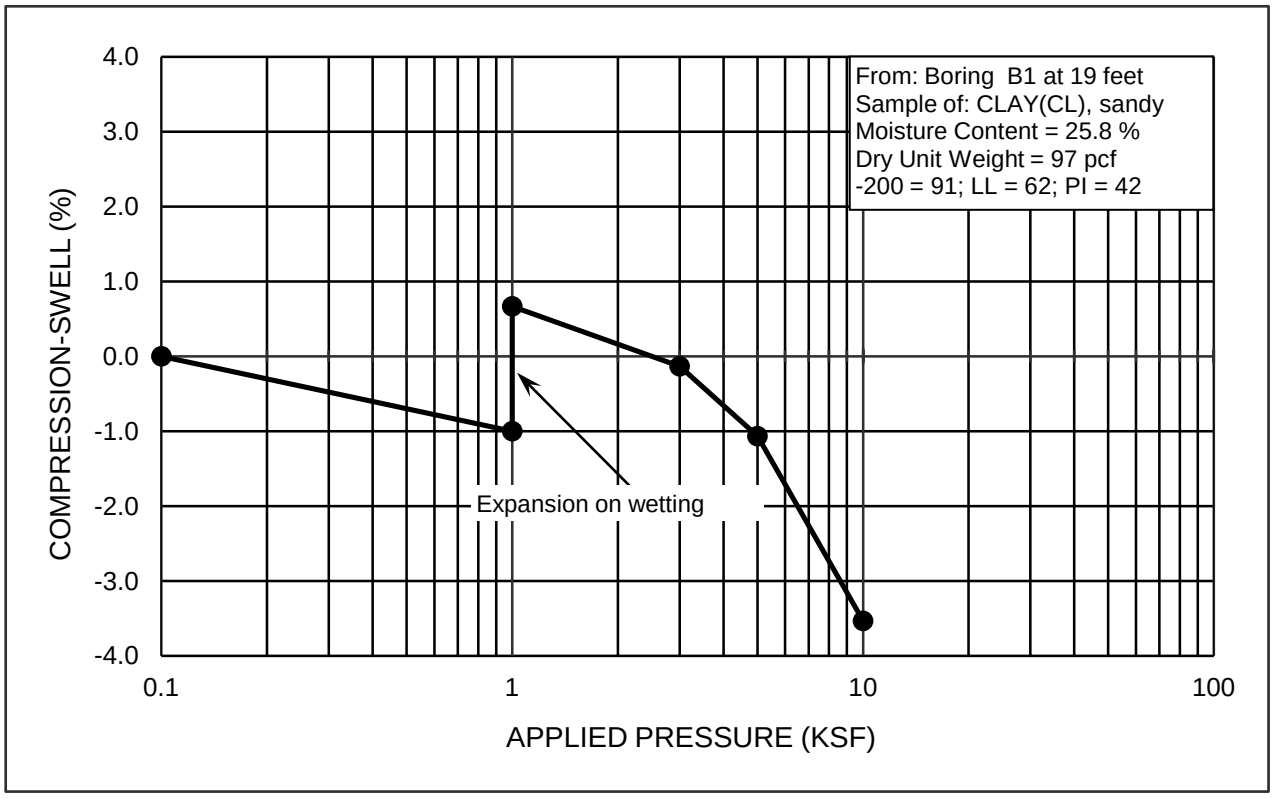
1. FIeld work was conducted on September 23 and 24, 2015. The Boring was drilled and sampled using a truck mounted CME 550X All Terrain Drill Rig.
2. Location of borings shown on Figure 2 are approximate.
3. Elevations of borings were not measured during our site visit.
4. The lines between strata represent approximate boundaries and transitions may be gradual.
5. Laboratory Testing Results:
   - MC=Moisture content (%).
   - DD=Dry density (pcf).
   - +4 = Percent of gravel fraction
   - -200 = Percent of silt and clay fraction.
   - LL = Liquid limit.
   - PI = Plastic index.
   - SP = Percent swell under a surcharge of 1,000 psf when wetted.
   - WSS = Water Soluble Sulfates in Percent.

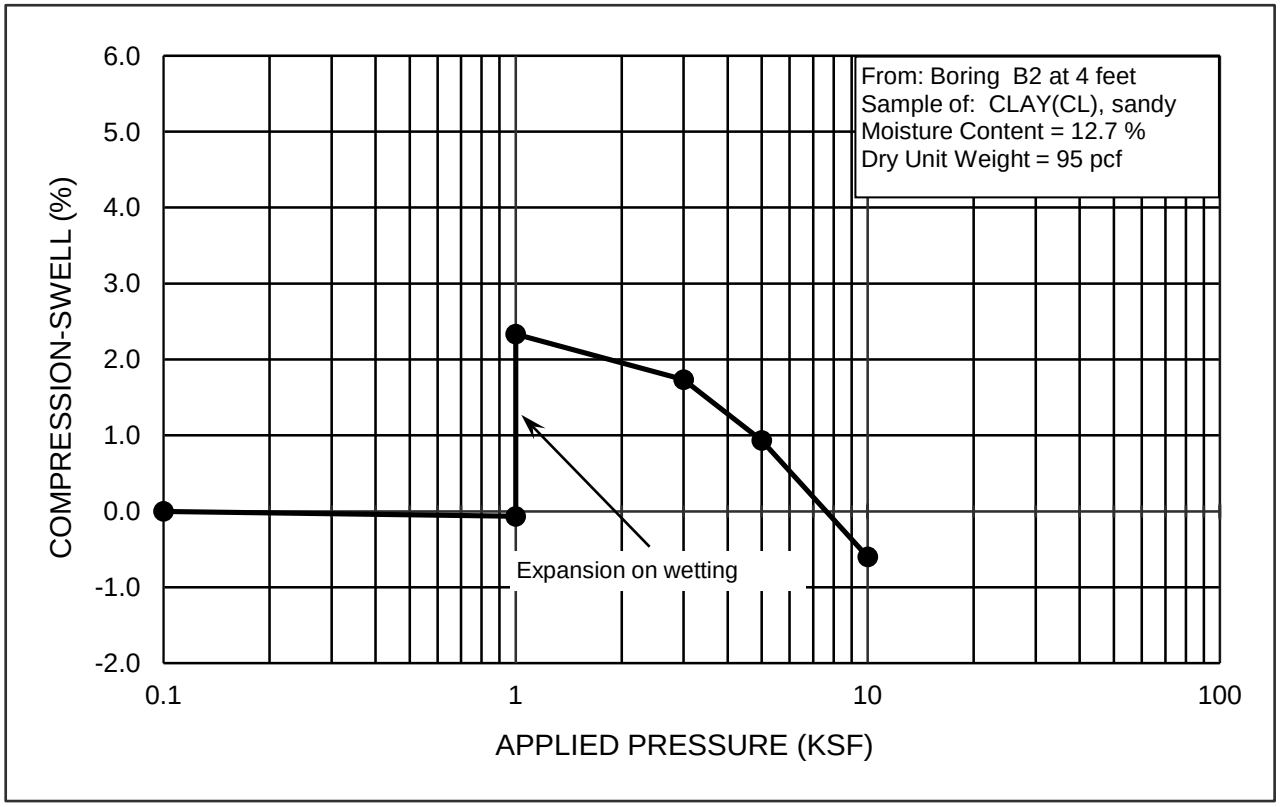
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, Inc.	THE GLEN AT WIDEFIELD, FILING 7 LEGEND AND NOTES	FIG. 5



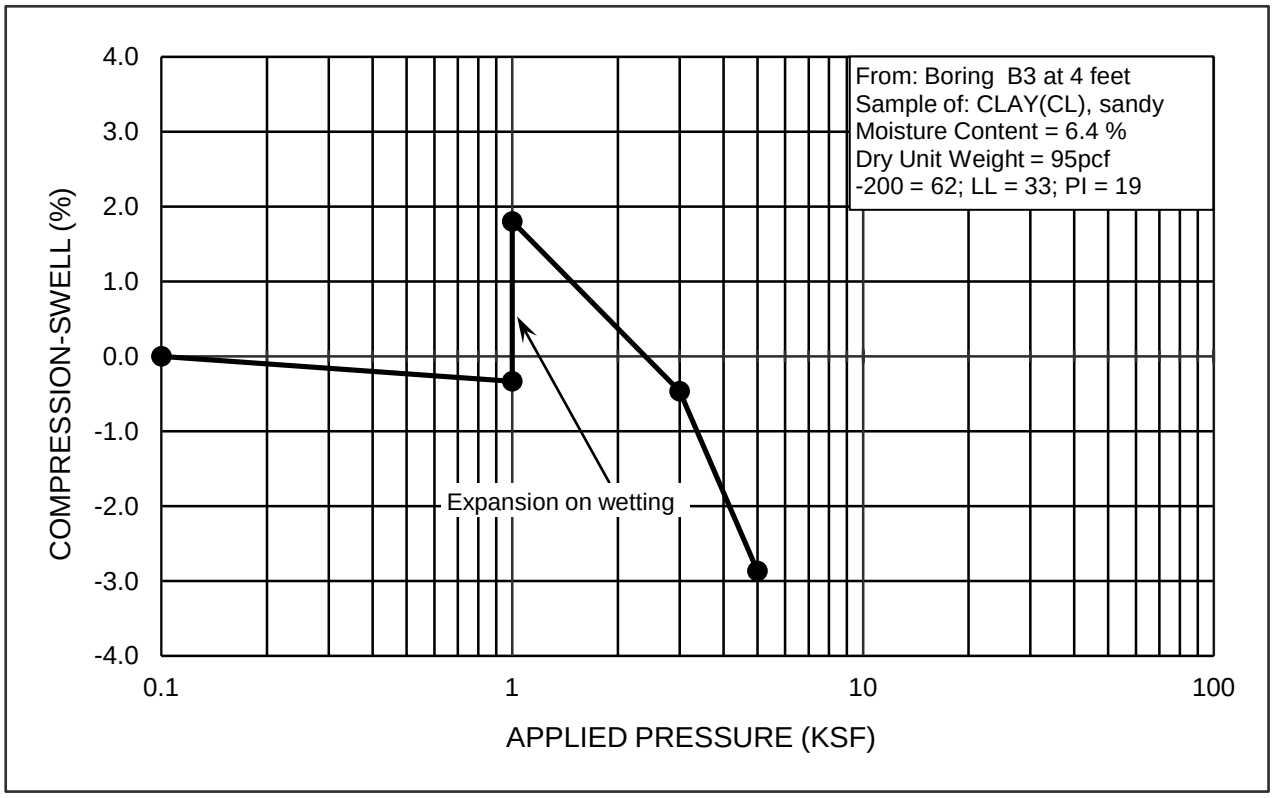


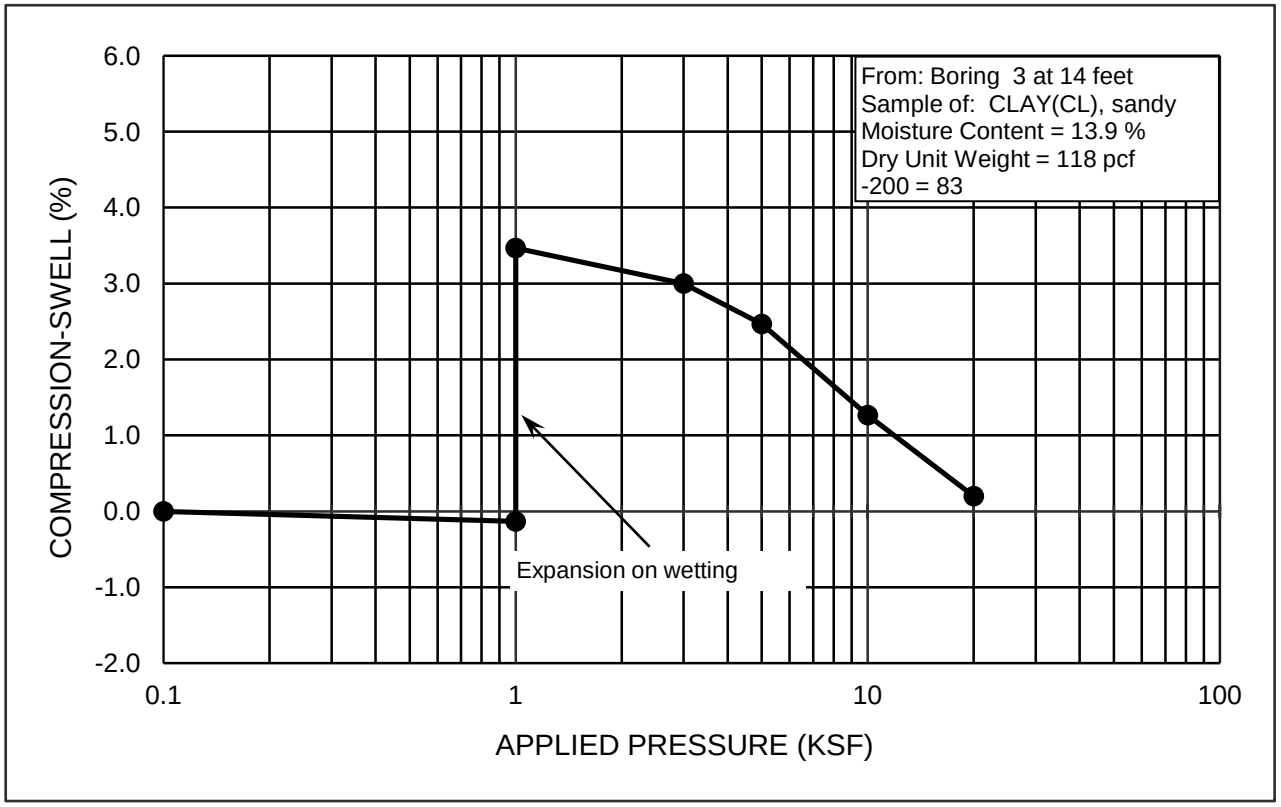
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 6



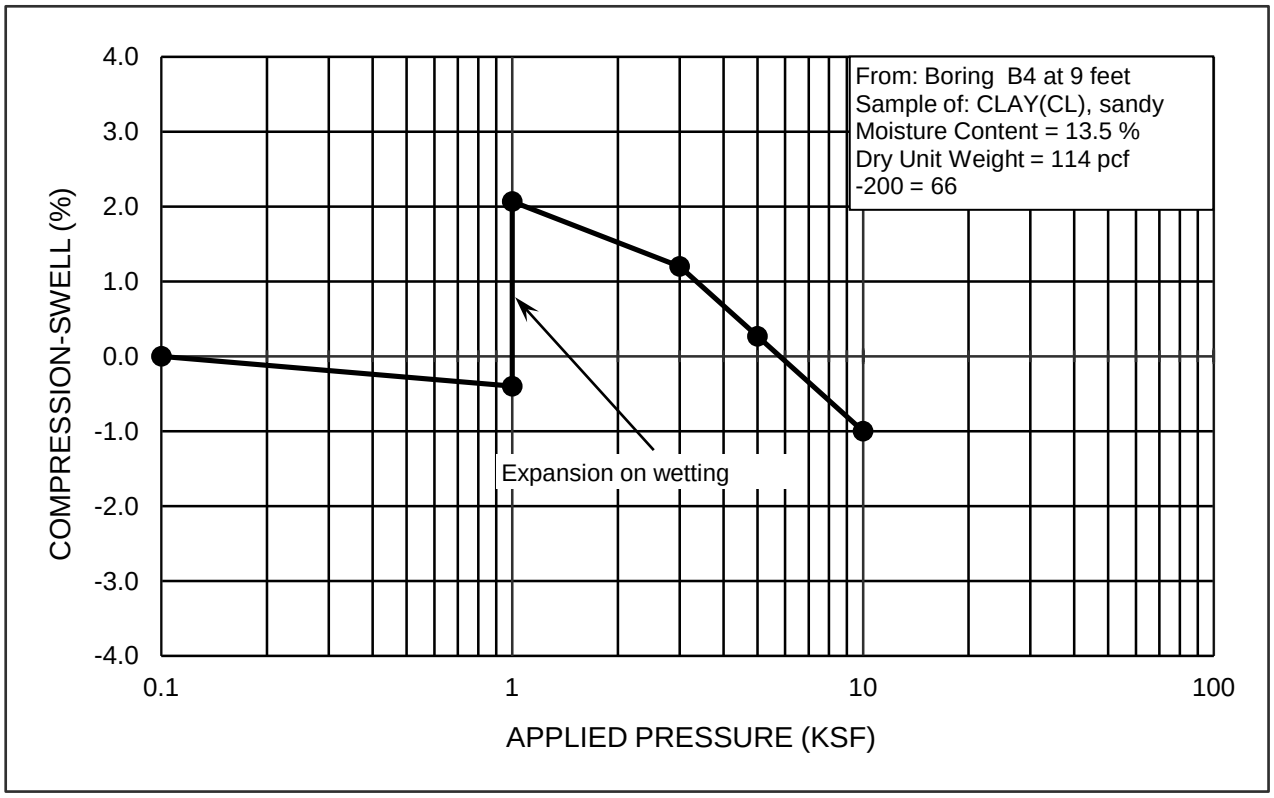


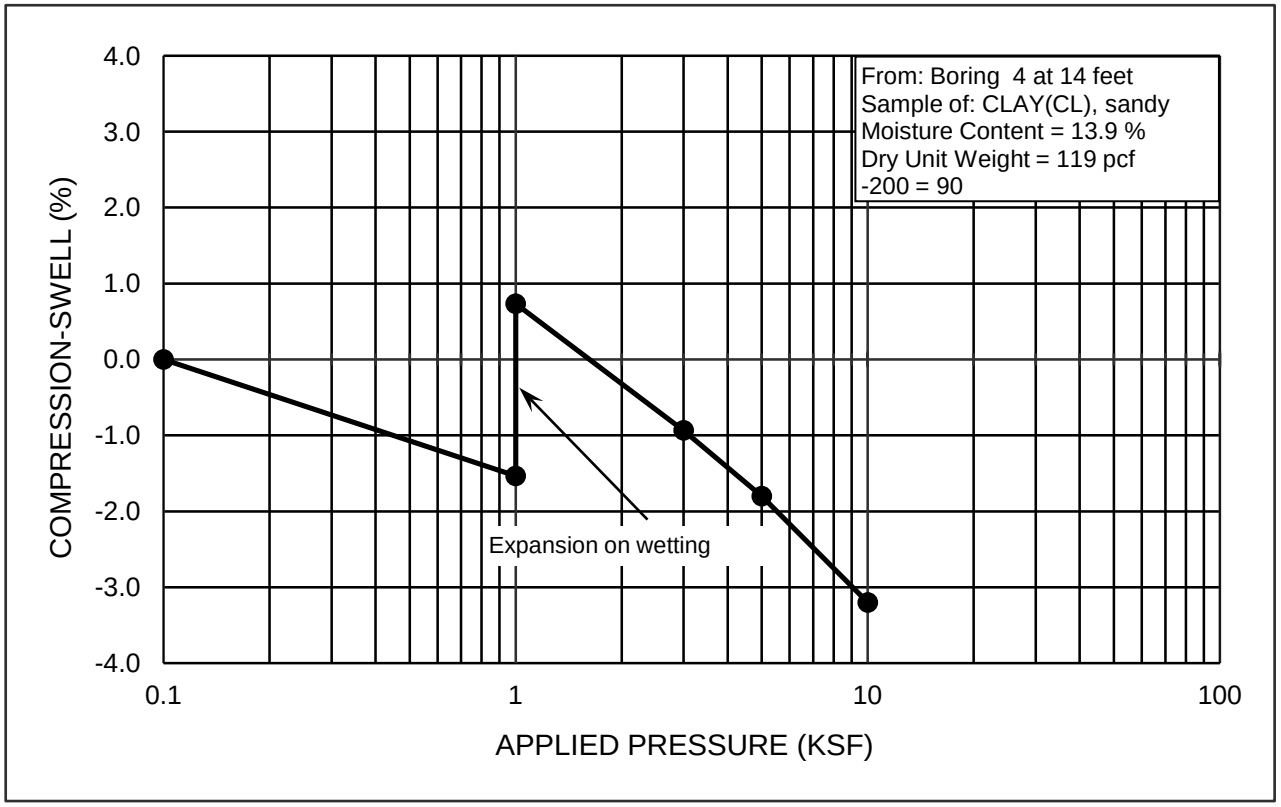
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 7



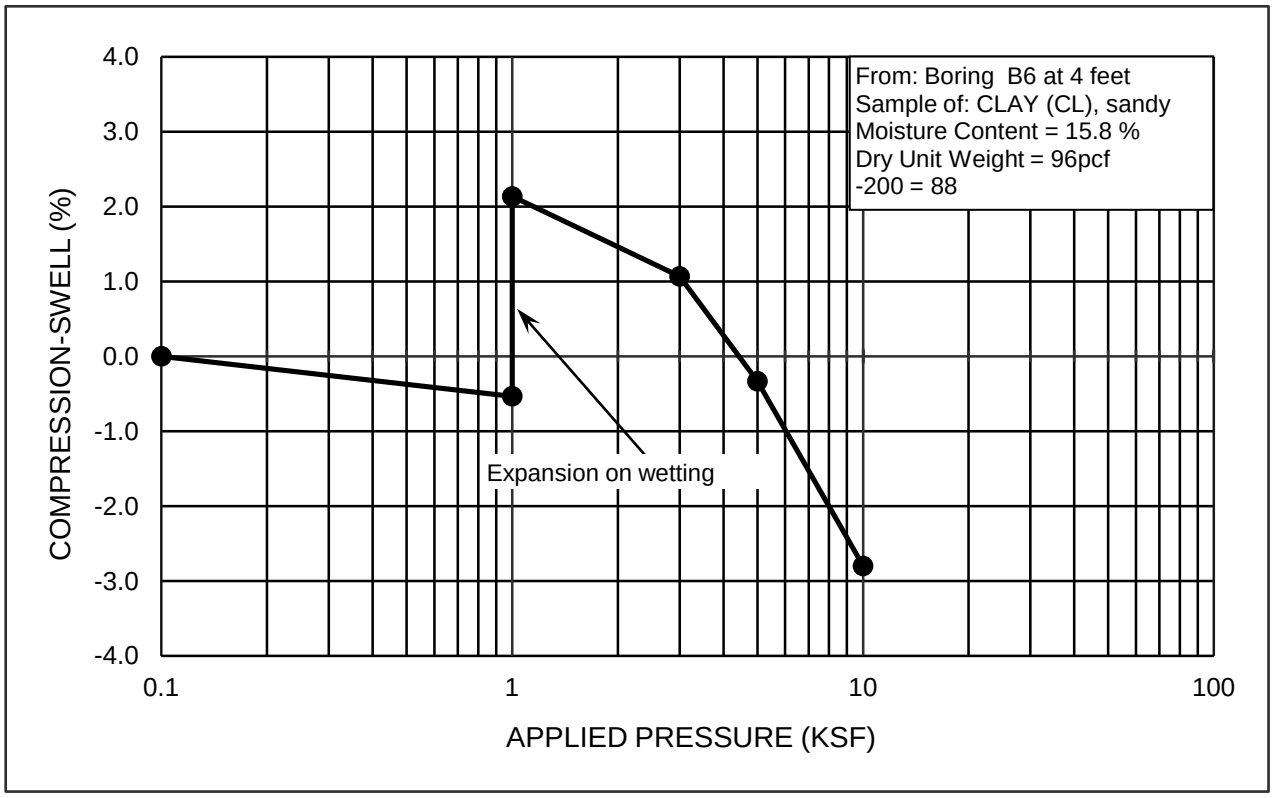


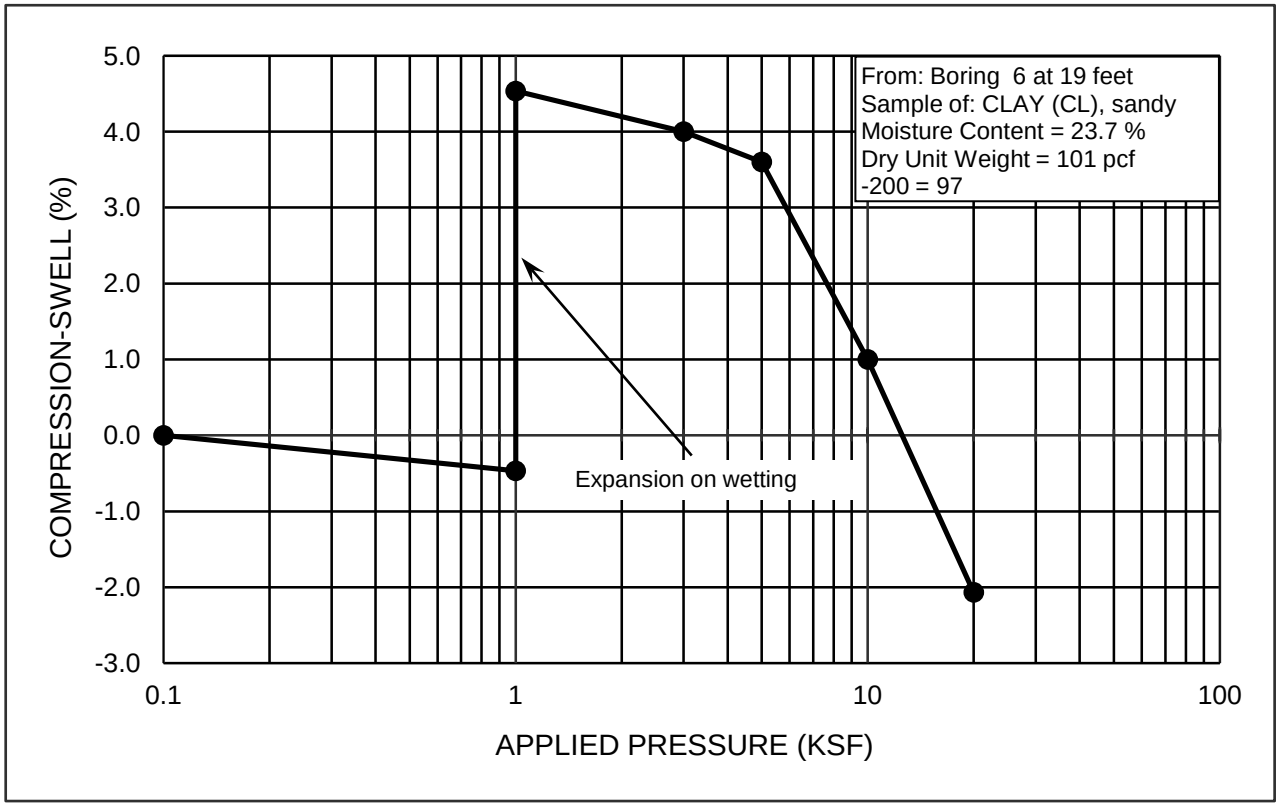
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 8



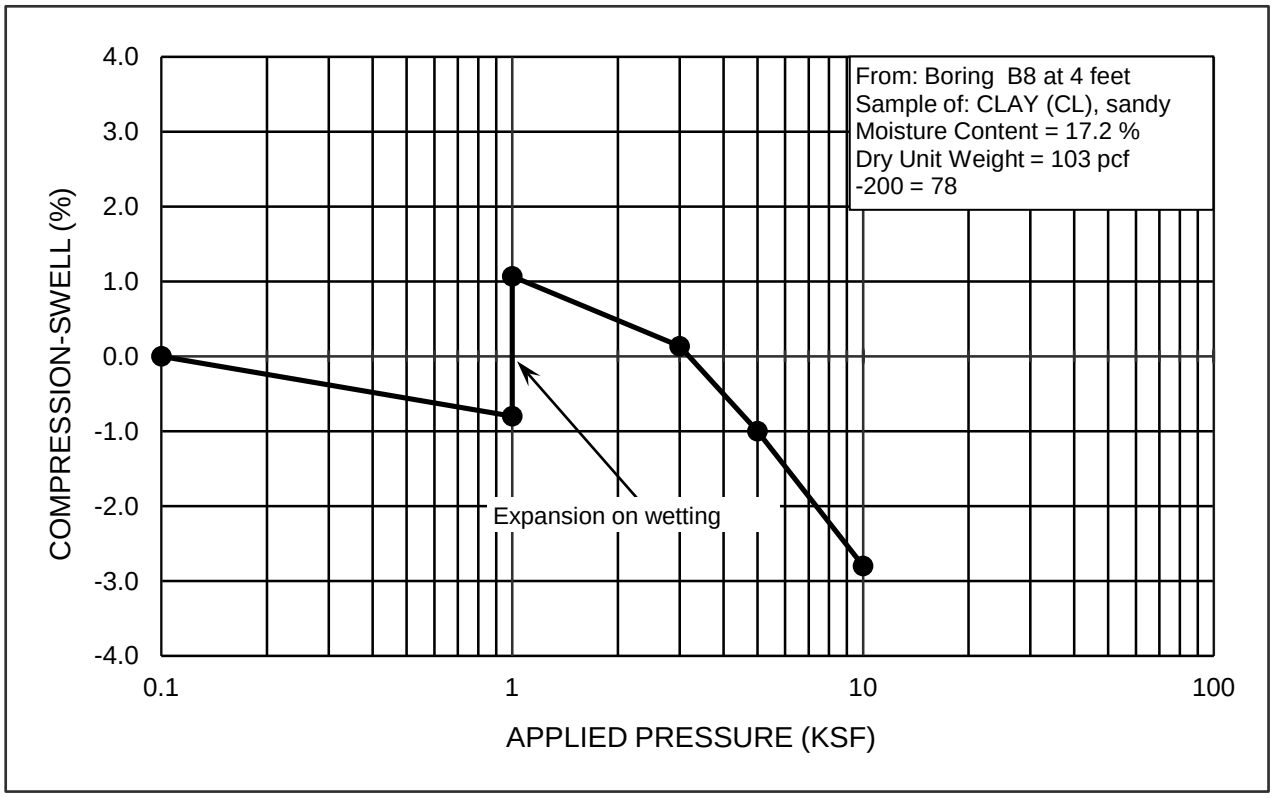


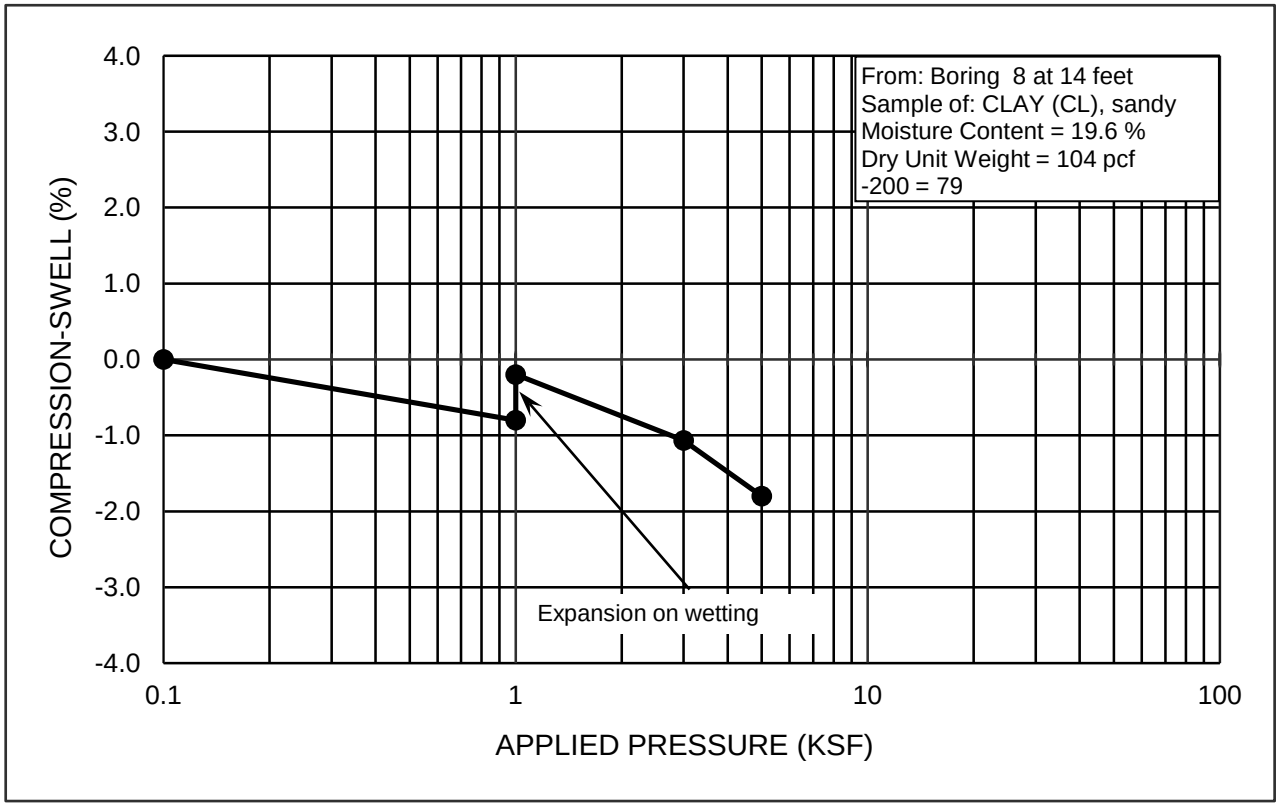
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 9



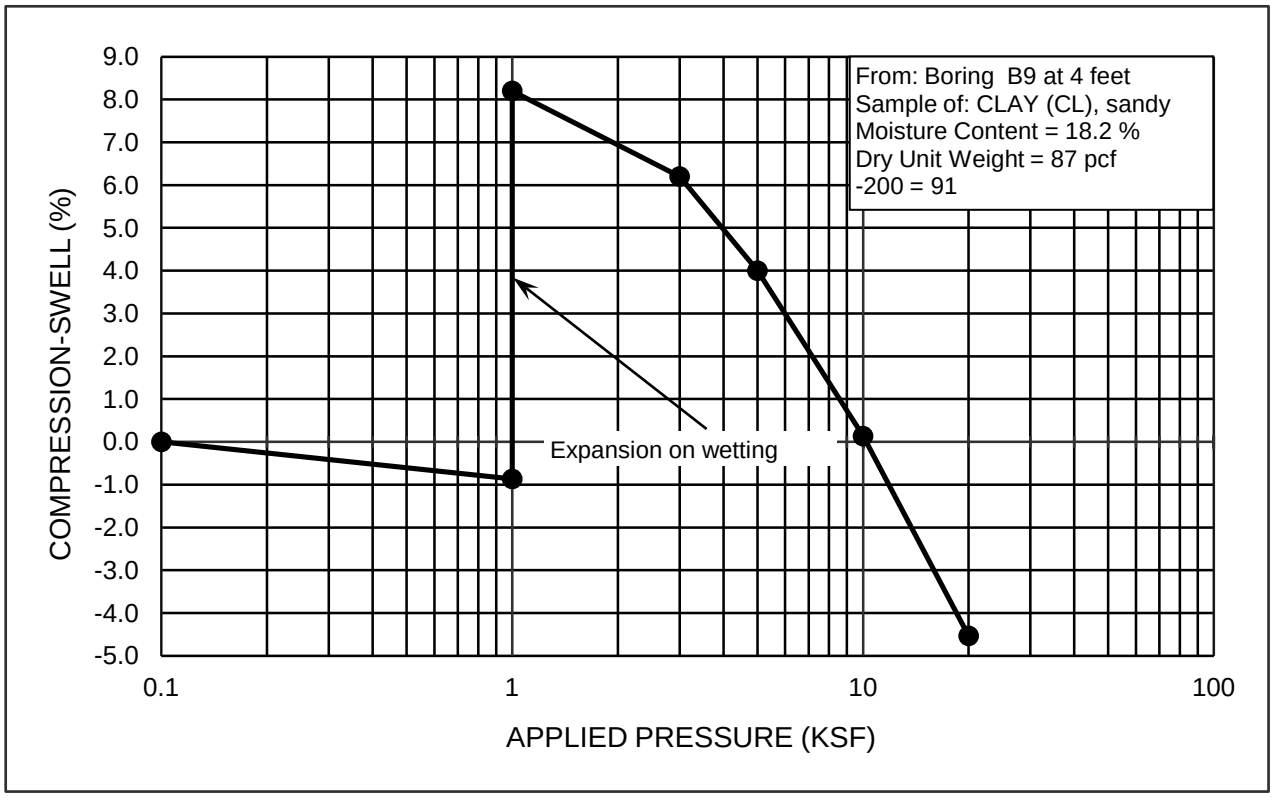


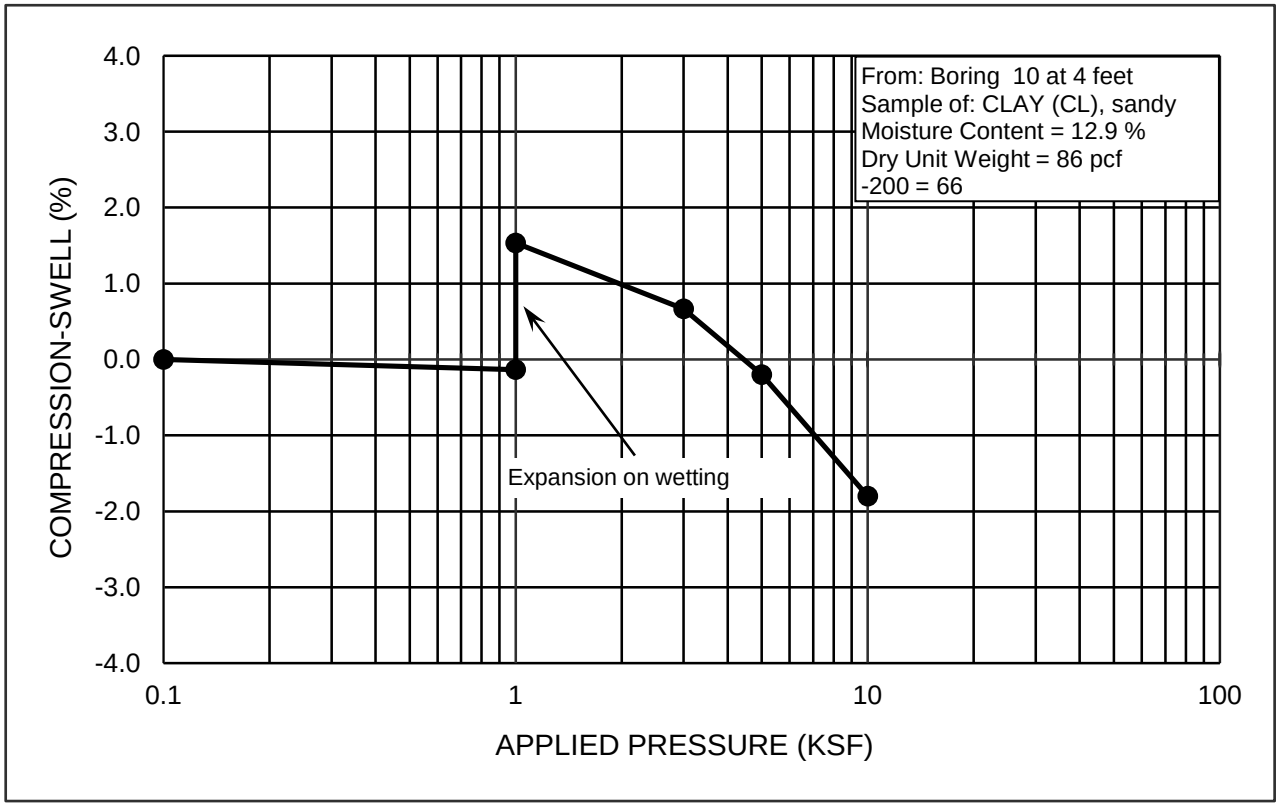
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 10



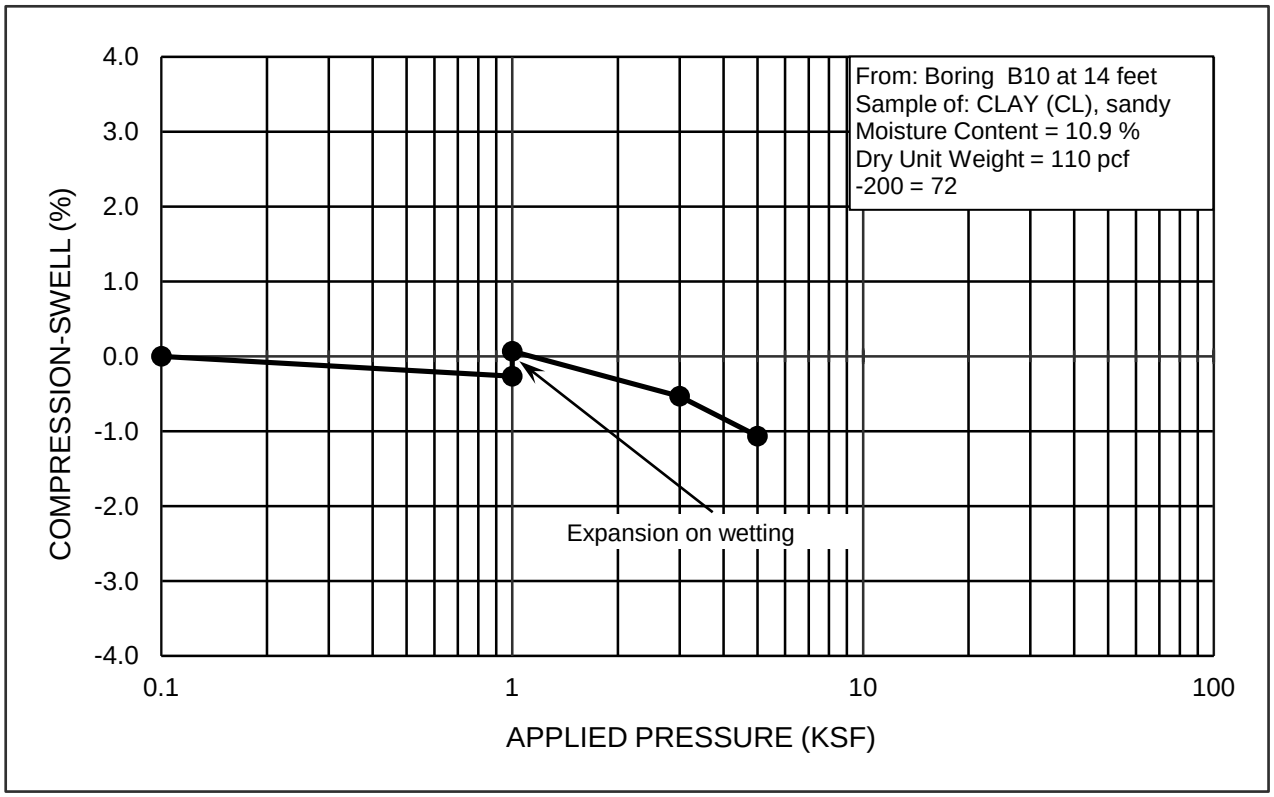


215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 11

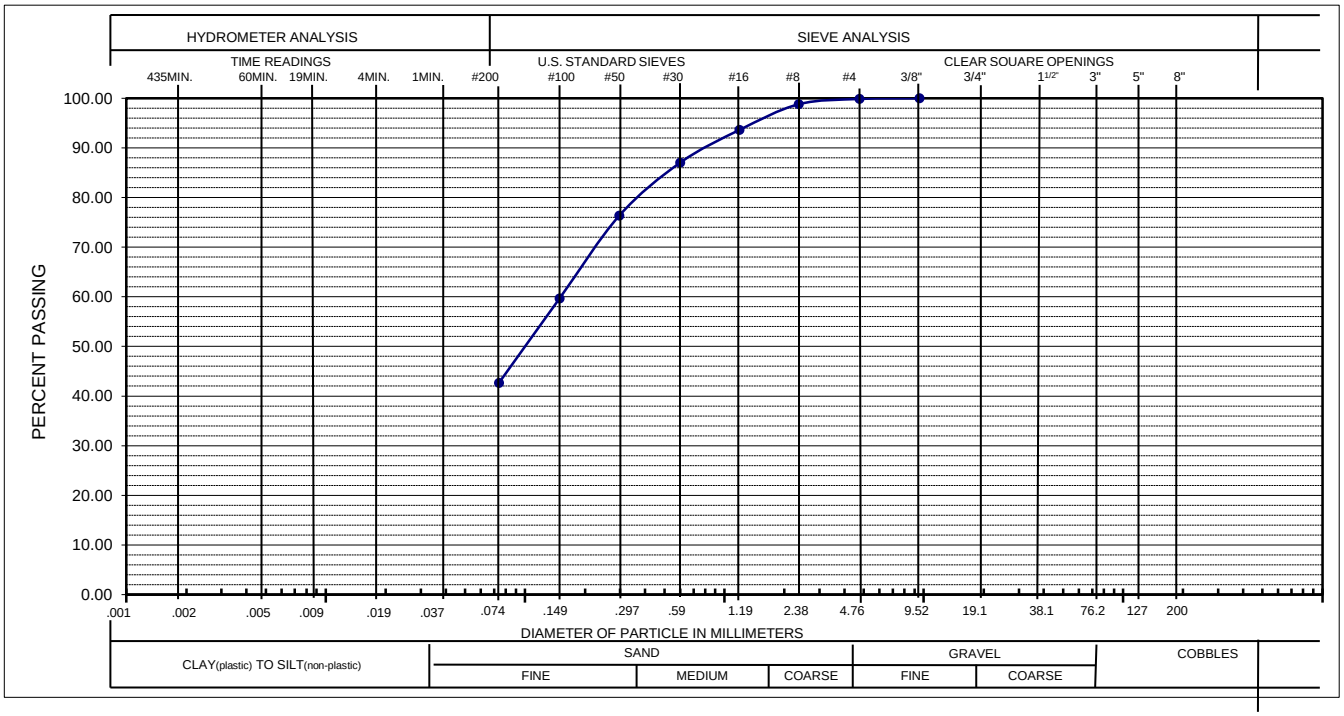




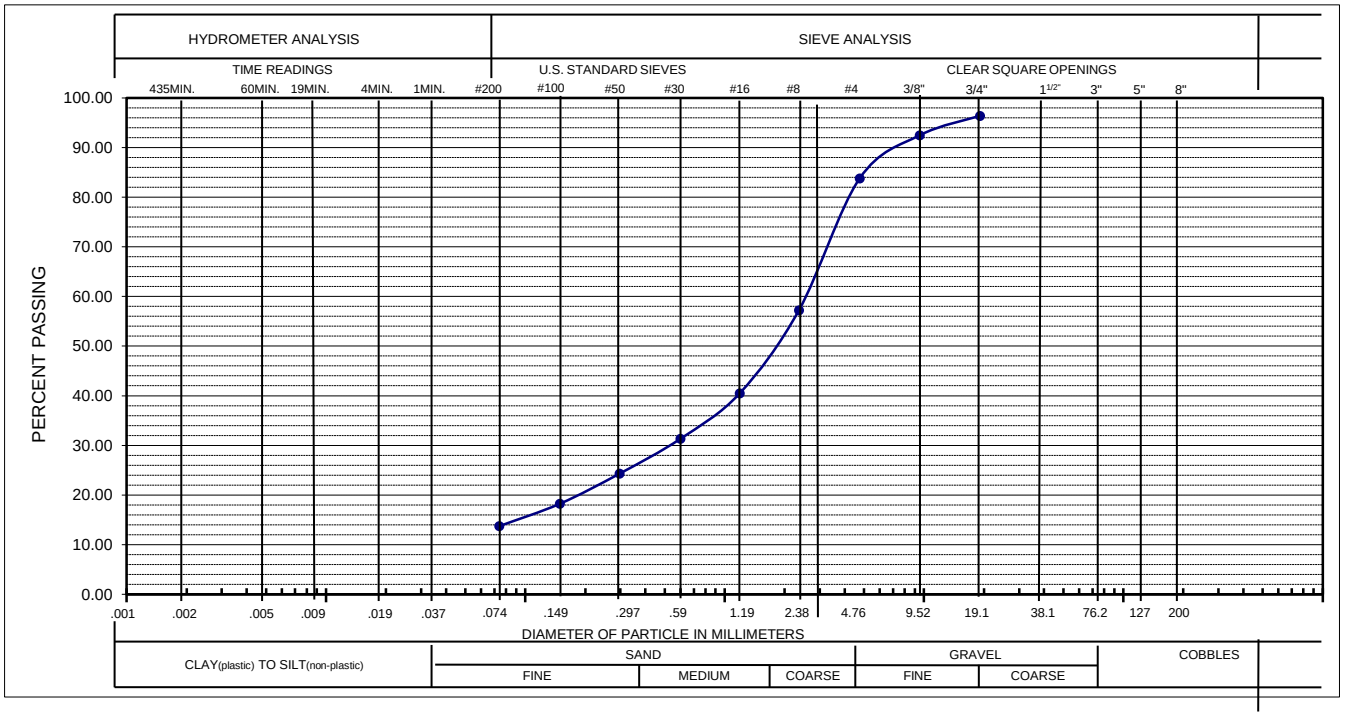
215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 12



215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD SWELL-COMPRESSION TEST RESULTS	FIG. 13

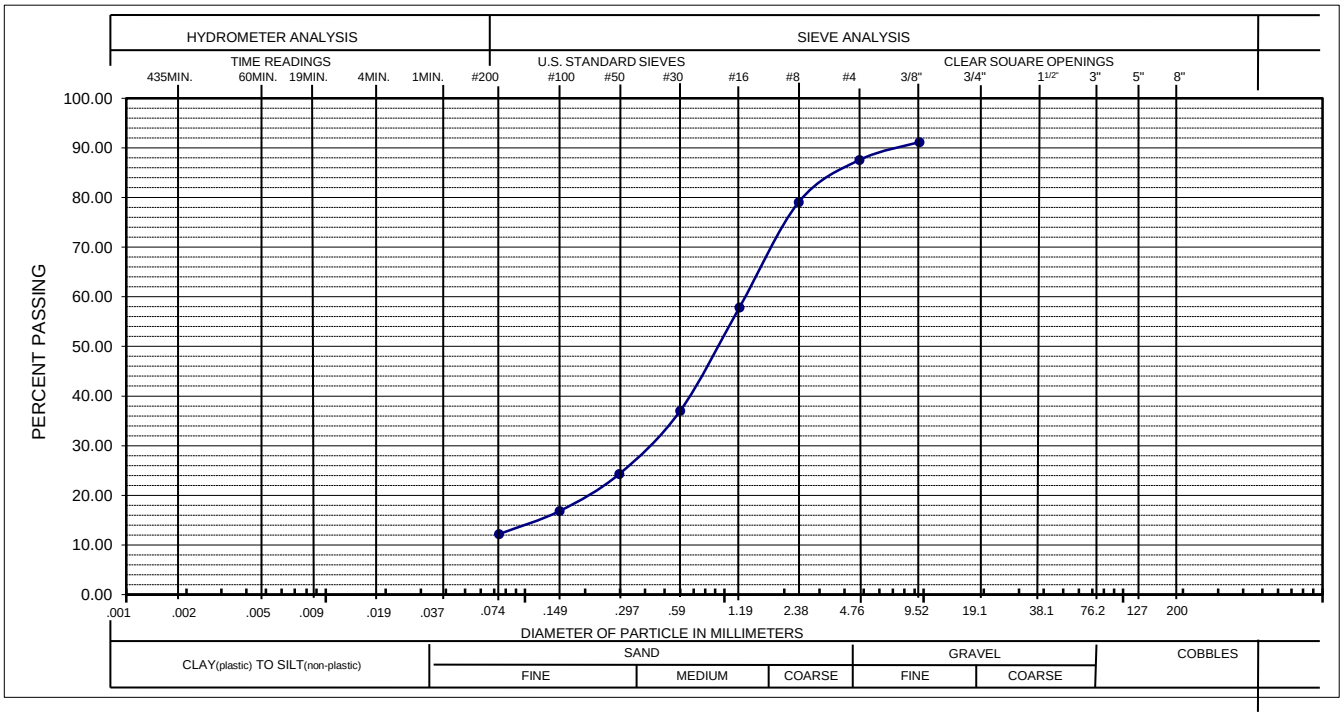


GRAVEL: 0% SAND: 57% SILT AND CLAY: 43%
LIQUID LIMIT: PLASTICITY INDEX:
SAMPLE OF: SAND (SC), clayey FROM: B2 @ 24 feet

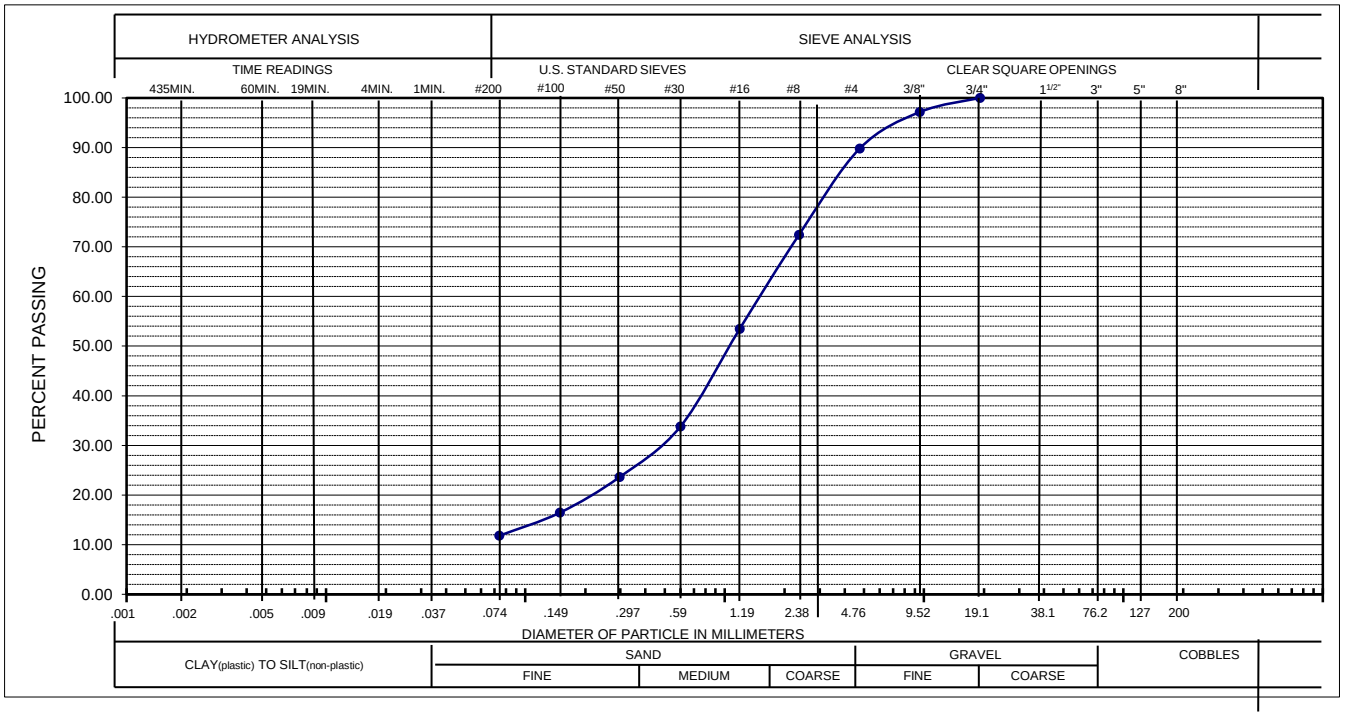


GRAVEL: 16% SAND: 70% SILT AND CLAY: 14%
LIQUID LIMIT: PLASTICITY INDEX:
SAMPLE OF: SAND (SP-SM), gravelly, silty FROM: B2 @ 44 feet

215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD GRADATION ANALYSIS	FIG. 14



GRAVEL: 13% SAND: 75% SILT AND CLAY: 12%
LIQUID LIMIT: PLASTICITY INDEX:
SAMPLE OF: SAND (SP-SM), gravelly, sandy FROM: B8 @ 39 feet



GRAVEL: 10% SAND: 78% SILT AND CLAY: 12%
LIQUID LIMIT: PLASTICITY INDEX:
SAMPLE OF: SAND (SP-SM), gravelly, silty FROM: B2 @ 44 feet

215292A	HEPWORTH-PAWLAK GEOTECHNICAL, INC.	WIDEFIELD GRADATION ANALYSIS	FIG. 15

HEPWORTH-PAWLAK GEOTECHNICAL, INC.

JOB NO. 215292A

PROJECT: WIDEFIELD

TABLE 1

SUMMARY OF LABORATORY TEST RESULTS

SAMPLE LOCATION		NATURAL MOISTURE	NATURAL DRY	GRADATION			ATTERBERG LIMITS		SWELL/COMP WITH 1,000 psf	WATER SOLUBLE	SOIL OR BEDROCK TYPE
BORING	DEPTH (feet)	CONTENT (%)	UNIT WEIGHT (PCF)	GRAVEL (%)	SAND (%)	SILT & CLAY (%)	LIQUID LIMIT (%)	PLASTIC INDEX (%)	SURCHARGE (%)	SULFATES (%)	(USCS CLASSIFICATION)
B-1	4	21.9	89			94	63	39	6.9		CLAY (CL), sandy
	9	14.3	111			75	51	34		0.07	CLAY (CL), sandy
	19	25.8	97			91	62	42	1.7		CLAY (CL), sandy
B-2	4	12.7	95			71			2.4		CLAY (CL), sandy
	14	16.4	103			68				0.675	CLAY (CL), sandy
	24	26.9	95	0	57	43					SAND (SM), silty
	44	12.7		16	70	14					SAND (SP-SM), gravelly, silty
B-3	4	6.4	95			62	33	19	2.1		CLAY (CL), sandy
	14	13.9	118			83			3.6		CLAYSTONE
B-4	4	15.3	113			91				0.813	CLAYSTONE
	9	13.5	114			66			2.5		CLAYSTONE
	14	13.9	118			83			2.3		CLAYSTONE
B-6	4	15.8	96			88			2.7		CLAY (CL), sandy
	14	17.3	108			78					CLAY (CL), sandy
	19	23.7	101			97			5.0		CLAY (CL), sandy
	29	31.5	90			41					SAND (SC), clayey
	54	13.7	119			40					CLAYSTONE
B-7	34	20.5	15								CLAY (CL), sandy
B-8	4	17.2	103			78			1.9		CLAY (CL), sandy
	14	19.6	104			79			0.6		CLAY (CL), sandy
	19	30.3	91			71					CLAY (CL), sandy
	39	11.8	120	13	75	12					SAND (SP-SM), gravelly, silty
B-9	4	18.2	87			91			9.1	0.065	CLAY (CL), sandy
	9	17.3	94			91					CLAY (CL), sandy
	34	35.3	87			98					CLAY (CL), sandy
	54	12.7				87					CLAYSTONE
B-10	4	12.9	86			66			1.7		CLAY (CL), sandy
	14	10.9	110			72			0.3	0.065	CLAY (CL), sandy
	19	22.9	93			65					CLAY (CL), sandy
	44	10.0	124	10	88	12					SAND (SC), clayey

National Flood Hazard Layer FIRMette

FEMA

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 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 — 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

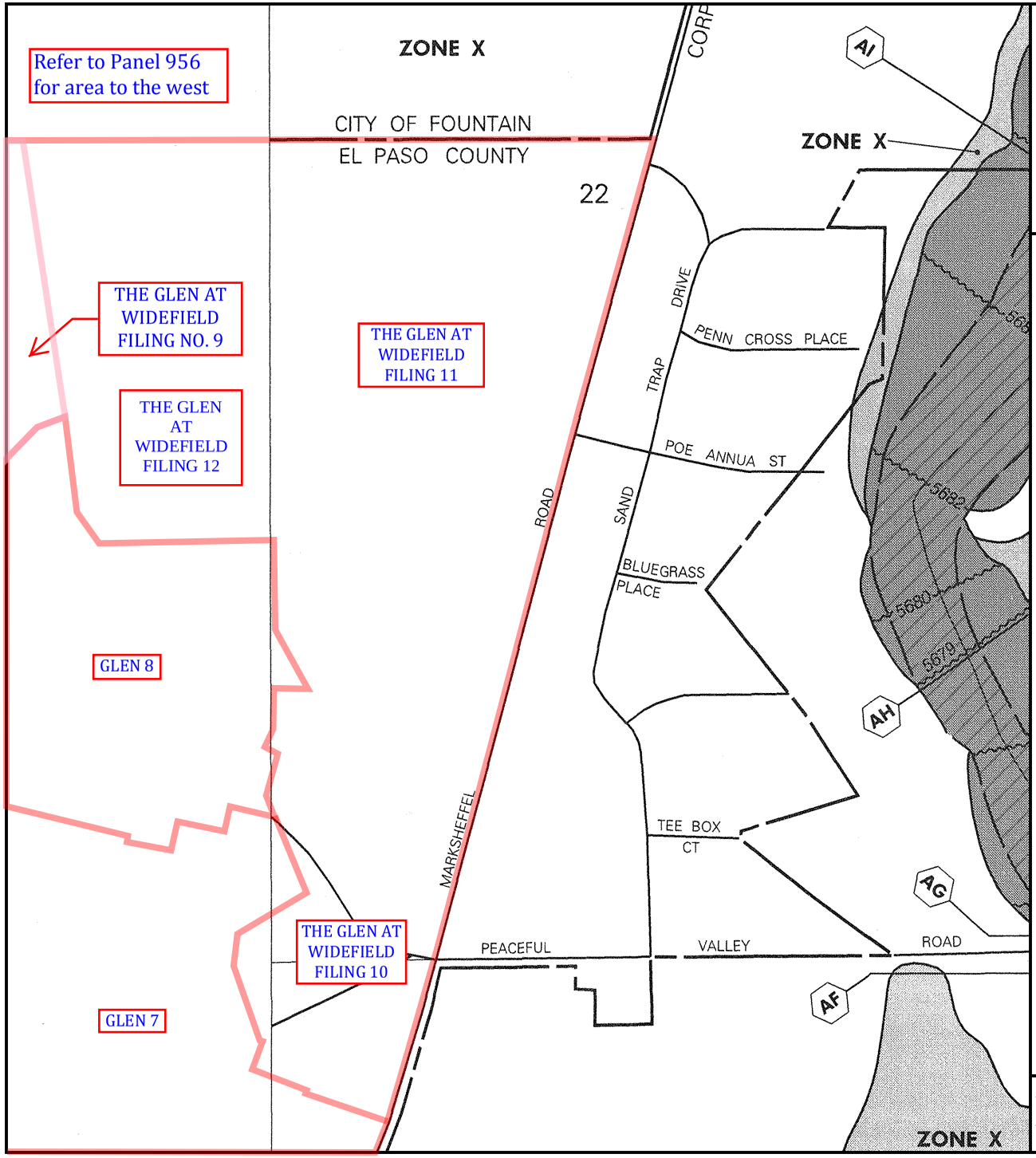
N

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 9/26/2019 at 12:16:52 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.



N

APPROXIMATE SCALE IN FEET

500 0 500

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 957 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0957	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0957	F
FOUNTAIN, CITY OF	080061	0957	F

MAP NUMBER 08041C0957 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

APPENDIX A.1

Supporting Hydrologic Tables and Figures

Table 1: Impervious Area and Drainage Basin & Bridge Fee Calc

Table 2: Opinion of Cost – Drainage Facilities

Glen at Widefield Filing No. 12
Drainage Basin and Bridge Fees

Please verify the undeveloped area calculated as the total tract acreage is only +5.5acres (per plat).

Table 1: Impervious Area and Drainage Basin & Bridge Fee Calculation

Total Lots =	79 lots
Total Development Area =	27.229 ac
Total Undeveloped Acres =	9.523 ac
Total Developed Area =	**17.7 ac**
Building/Patio/Drive Per Lot =	2,100 sf
Total Building/Patio/Drive Area =	3.809 ac
Total Street/Sidewalk Area =	4.000 ac
Total Impervious Area =	7.809 ac
% Impervious Area =	**44.10 %**

Please explain why the square footage changed from the other filings (2500s.f.) when the average lot size is similar to filings 10 and 11. revise accordingly.

West Fork Jimmy Camp Creek Drainage Basin

Drainage Basin Fee and Bridge Fee Calculations			
Drainage Basin Fee =	$14,470 / ac	**Drainage Basin Fee =**	**$ 112,989.57**
Bridge Fee =	$4,281 / ac	**Bridge Fee =**	**$ 33,428.36**

Less Previous Drainage Fee Credit (Carry Over from Glen at Widefield Filing No. 7)	**$0.00**	$ 0.00
Drainage Basin Fee Reimbursement	**$0.00**	
Total Drainage Basin Fee Credit Available	**$0.00**	

	Drainage Basin	**Bridge**
Total Fees Due for the Glen at Widefield Filing No. 11	**$112,989.57**	**$ 33,428.36**

revise to filing 12

Table 2- The Glen at Widefield Filing No 12
Ultimate Developed Condition - EOPC

Basin 'D' Storm Pipe Quantities -DONE/12/05/2022 -mjk

Mat'l.	Pipe Size	Total LF		Unit Cost	Total
RCP	18"	**1014.49**	LF	$72	**$ 73,043**
RCP	21"	**595.72**	LF	$84	**$ 50,040**
RCP	24"	**411.17**	LF	$96	**$ 39,472**
HERCP	24" equiv	**112.46**	LF	$105	**$ 11,808**
RCP	27"	**0.00**	LF	$105	**$ -**
RCP	30"	**504.98**	LF	$110	**$ 55,548**
RCP	36"	**1288.76**	LF	$128	**$ 164,961**
RCP	36"	**78.14**	LF	$128	**$ 10,002**
RCP IV	36"	**249.41**	LF	$142	**$ 35,416**
HERCP	48 equiv	**101.50**	LF	$140	**$ 14,210**
C.B.C.	3'x2'	**180.00**	LF	$140	**$ 25,200**
		4536.63		Grand Total:	$ 479,702

FILING 12 ONLY - Storm Pipe Quantities -

Mat'l.	Pipe Size	Total LF		Unit Cost	Total
RCP	18"	**482.32**	LF	$72	**$ 34,727**
		482.32		Grand Total:	$ 34,727

For Colorado Springs and much of the Fountain Creek watershed, the 1-hour depths are fairly uniform and are summarized in Table 6-2. Depending on the location of the project, rainfall depths may be calculated using the described method and the NOAA Atlas maps shown in Figures 6-6 through 6-17.

Table 6-2. Rainfall Depths for Colorado Springs

Return Period	1-Hour Depth	6-Hour Depth	24-Hour Depth
2	1.19	1.70	2.10
5	1.50	2.10	2.70
10	1.75	2.40	3.20
25	2.00	2.90	3.60
50	2.25	3.20	4.20
100	2.52	3.50	4.60

Where Z= 6,840 ft/100

These depths can be applied to the design storms or converted to intensities (inches/hour) for the Rational Method as described below. However, as the basin area increases, it is unlikely that the reported point rainfalls will occur uniformly over the entire basin. To account for this characteristic of rain storms an adjustment factor, the Depth Area Reduction Factor (DARF) is applied. This adjustment to rainfall depth and its effect on design storms is also described below. The UDFCD UD-Rain spreadsheet, available on UDFCD's website, also provides tools to calculate point rainfall depths and Intensity-Duration-Frequency curves[2] and should produce similar depth calculation results.

2.2 Design Storms

Design storms are used as input into rainfall/runoff models and provide a representation of the typical temporal distribution of rainfall events when the creation or routing of runoff hydrographs is required. It has long been observed that rainstorms in the Front Range of Colorado tend to occur as either short-duration, high-intensity, localized, convective thunderstorms (cloud bursts) or longer-duration, lower-intensity, broader, frontal (general) storms. The significance of these two types of events is primarily determined by the size of the drainage basin being studied. Thunderstorms can create high rates of runoff within a relatively small area, quickly, but their influence may not be significant very far downstream. Frontal storms may not create high rates of runoff within smaller drainage basins due to their lower intensity, but tend to produce larger flood flows that can be hazardous over a broader area and extend further downstream.

- **Thunderstorms**: Based on the extensive evaluation of rain storms completed in the Carlton study (Carlton 2011), it was determined that typical thunderstorms have a duration of about 2 hours. The study evaluated over 300,000 storm cells using gage-adjusted NEXRAD data, collected over a 14-year period (1994 to 2008). Storms lasting longer than 3 hours were rarely found. Therefore, the results of the Carlton study have been used to define the shorter duration design storms.

  To determine the temporal distribution of thunderstorms, 22 gage-adjusted NEXRAD storm cells were studied in detail. Through a process described in a technical memorandum prepared by the City of Colorado Springs (City of Colorado Springs 2012), the results of this analysis were interpreted and normalized to the 1-hour rainfall depth to create the distribution shown in Table 6-3 with a 5 minute time interval for drainage basins up to 1 square mile in size. This distribution represents the rainfall

Table 6-6. Runoff Coefficients for Rational Method
(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis--Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

* For buried riprap, select C_v value based on type of vegetative cover.

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional "calibration" of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

APPENDIX B

Rational Calculations

Existing Condition – Runoff Co-eff, Time of Concentration and Runoff Calcs
Excerpts from Markscheffel Road Improvements Project South - Link Road to US-24
Developed Condition – Runoff Co-eff, Time of Concentration and Runoff Calcs

Clarify the discrepancy

geotech report identified clay (Type D) soils.

The Glen at Widefield
Developed Condition
Runoff Coeficient and Percent Impervious Calculation

Filings 10-12 Ultimate Condition

					PV	Area 1 Land Use			LA	Area 2 Land Use			RS2	Area 3 Land Use			RS1	Area 4 Land Use					
Basin	DP	Basin or DP Area (DP contributing basins)		Soil Type	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	Basin % Imperv	Basin Runoff Coeficient C_5	Basin Runoff Coeficient C_{100}
D-1	DP 68	61,148 sf	1.40ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.40ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-2		63,184 sf	1.45ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.45ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-3	DP 70	73,555 sf	1.69ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.69ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-4		90,208 sf	2.07ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.07ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-5	DP 72	68,122 sf	1.56ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.56ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-6	DP 73	18,040 sf	0.41ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	0.41ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-7		130,015 sf	2.98ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.98ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-8		70,452 sf	1.62ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.62ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-9	DP 77	91,788 sf	2.11ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.11ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-10		130,320 sf	2.99ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.99ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-11	DP 80	172,355 sf	3.96ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.96ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-12		60,400 sf	1.39ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.39ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-13		89,754 sf	2.06ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.06ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-14		143,954 sf	3.30ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.30ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-15	DP 84	122,155 sf	2.80ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.80ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-16		98,963 sf	2.27ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.27ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-16.1		90,495 sf	2.08ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.08ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-17		150,208 sf	3.45ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.45ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-18		92,997 sf	2.13ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.13ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-19		129,215 sf	2.97ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.97ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-19.1	DP89	7,235 sf	0.17ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	0.17ac	100%	37%	**37.0%**	**0.34**	**0.58**
D-20a	DP 92a	35,151 sf	0.81ac	C	100%	0.34ac	42%	42%	0%	0.37ac	46%	0%	46%		0%	0%	37%	0.10ac	12%	4%	**46.6%**	**0.38**	**0.60**
D-20b	DP 92b	20,481 sf	0.47ac	C	100%	0.40ac	85%	85%	0%	0.07ac	15%	0%	46%		0%	0%	37%		0%	0%	**85.1%**	**0.68**	**0.79**
D-20c	DP 92d	15,896 sf	0.36ac	C	100%	0.17ac	47%	47%	0%	0.19ac	52%	0%	46%		0%	0%	37%		0%	0%	**46.6%**	**0.38**	**0.60**
D-21	DP 91	175,102 sf	4.02ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.02ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-22	DP 90	50,194 sf	1.15ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	1.15ac	100%	37%	**37.0%**	**0.28**	**0.49**
D-23	DP92e	12,393 sf	0.28ac	C	100%	0.24ac	84%	84%	0%	0.04ac	16%	0%	46%		0%	0%	37%		0%	0%	**84.4%**	**0.67**	**0.78**
D-24		443,273 sf	10.18ac	C	100%		0%	0%	0%	8.18ac	80%	0%	46%		0%	0%	37%	2.00ac	20%	7%	**7.3%**	**0.20**	**0.52**
Combined Design Point Summary																							
	DP 69	D1, D2	2.85ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.85ac	100%	37%	**37.0%**	**0.28**	**0.49**
	DP 71	D3, D4	3.76ac	B	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.76ac	100%	37%	**37.0%**	**0.28**	**0.49**
	DP 74	D3, D4, D6	4.17ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.17ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 75	D1-D4, D6, D7	10.01ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	10.01ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 76	D1-D4, D6-D8	11.63ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	11.63ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 78	D1-D4, D6-D9	13.74ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	13.74ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 79	D8, D10	4.61ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	4.61ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 81	D11, D12	5.34ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	5.34ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 82	D5, D13	3.62ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	3.62ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 83	D5, D13, D14	6.93ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	6.93ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 85	D15,D16, D16.1	7.15ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	7.15ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 86	D15 - D17	10.60ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	10.60ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 87	D15 - D18	12.74ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	12.74ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 88	D15 - D19	15.70ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	15.70ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 92a	D20a	0.81ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	2.94ac	364%	135%	**134.7%**	**1.73**	**1.69**
	DP 92b	D21,D22,D23	5.46ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	5.46ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 93a	D1 -D19.1	44.87ac	C	100%		0%	0%	0%		0%	0%	46%		0%	0%	37%	44.87ac	100%	37%	**37.0%**	**0.34**	**0.58**
	DP 93b	D20b,D20c,D23	1.12ac	C	100%	0.56ac	50%	50%	0%	0.56ac	50%	0%	46%		0%	0%	37%		0%	0%	**50.0%**	**0.40**	**0.60**
D1-24	**DP 94**	**ULTIMATE**	**62.15ac**	C	100%	1.15ac	2%	2%	0%	8.85ac	14%	0%	37%		0%	0%	37%	52.14ac	84%	31%	**32.9%**	**0.32**	**0.57**

Basin Runoff Coefficient is based on UDFCD % Imperviousness Calculation

Runoff Coefficients and Percents Impervious

Hydrologic Soil Type:	C		Runoff Coef Calc Method					%Imp
Land Use	Abb	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}
Commercial Area	CO	95%	0.80	0.82	0.84	0.87	0.89	0.89
Drives and Walks	DR	90%	0.73	0.75	0.77	0.80	0.83	0.83
Streets - Gravel (Packed)	GR	40%	0.28	0.35	0.42	0.50	0.55	0.58
Historic Flow Analysis	HI	2%	0.06	0.16	0.26	0.38	0.45	0.51
Lawns	LA	0%	0.04	0.15	0.25	0.37	0.44	0.50
Off-site flow-Undeveloped	OF	45%	0.31	0.37	0.44	0.51	0.56	0.59
Park	PA	7%	0.09	0.19	0.29	0.40	0.47	0.52
Playground	PL	13%	0.13	0.23	0.32	0.42	0.49	0.54
Streets - Paved	PV	100%	0.89	0.90	0.92	0.94	0.96	0.96
Roofs	RO	90%	0.73	0.75	0.77	0.80	0.83	0.83
Residential: 3.7 Lots/Acre	RS1	37%	0.26	0.34	0.41	0.49	0.54	0.58
Residential: 1/5 Acre	RS2	46%	0.31	0.38	0.44	0.51	0.56	0.59

Equations (% Impervious Calculation):

$C_A = K_A + (1.31\,i^3 - 1.44\,i^2 + 1.135\,i - 0.12)$ [Eqn RO-6]

$C_{CD} = K_{CD} + (0.858\,i^3 - 0.786\,i^2 + 0.774\,i + 0.04)$ [Eqn RO-7]

$C_B = (C_A + C_{CD}) / 2$

I = % imperviousness/100 as a decimal (See Table RO-3)

C_A = Runoff coefficient for NRCS Type A Soils

C_B = Runoff coefficient for NRCS Type B Soils

C_{CD} = Runoff coefficient for NRCS Type C and D Soils

Correction Factors - Table RO-4

K_A = For Type A Soils

K_A (2-yr)= 0

K_A (5-yr)= -0.08i + 0.09

K_A (10-yr)= -0.14i + 0.17

K_A (25-yr)= -0.19i + 0.24

K_A (50-yr)= -0.22i + 0.28

K_A (100-yr)= -0.25i + 0.32

K_{CD}=For Type C & D Soils

K_{CD} (2-yr)= 0

K_{CD} (5-yr)= -0.10i + 0.11

K_{CD} (10-yr)= -0.18i + 0.21

K_{CD} (25-yr)= -0.28i + 0.33

K_{CD} (50-yr)= -0.33i + 0.40

K_{CD} (100-yr)= -0.39i + 0.46

The Glen at Widefield
Developed Condition
Runoff Coeficient and Percent Impervious Calculation

					PV	Area 1 Land Use			LA	Area 2 Land Use			RS1	Area 3 Land Use			RS2	Area 4 Land Use				Basin Runoff	
Basin	DP	Basin or DP Area (DP contributing basins)		Soil Type	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	% Imperv	Land Use Area	% Area	Comp Land Use % Imp	Basin % Imperv	C_5	C_{100}
E-1	DP 95	229,727 sf	5.27ac	C	100%		0%	0%	0%	5.27ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-2	DP 96	21,807 sf	0.50ac	B	100%	0.19ac	37%	37%	0%	0.09ac	19%	0%	40%		0%	0%	28%		0%	0%	**37.4%**	**0.28**	**0.49**
E-3	DP 97	69,766 sf	1.60ac	B	100%	0.19ac	12%	12%	0%	1.41ac	88%	0%	40%		0%	0%	28%		0%	0%	**11.7%**	**0.15**	**0.41**
E-4	DP 98	50,997 sf	1.17ac	C	100%	0.22ac	19%	19%	0%	0.95ac	81%	0%	40%		0%	0%	28%		0%	0%	**18.7%**	**0.25**	**0.55**
E-5	DP 99	57,314 sf	1.32ac	C	100%	0.10ac	8%	8%	0%	1.08ac	82%	0%	40%		0%	0%	28%	0.14ac	11%	3%	**10.6%**	**0.21**	**0.53**
E-6	DP 100	187,508 sf	4.30ac	C	100%		0%	0%	0%	4.30ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-7	DP 101	192,653 sf	4.42ac	C	100%	0.42ac	9%	9%	0%	3.81ac	86%	0%	40%		0%	0%	28%	0.19ac	4%	1%	**10.7%**	**0.21**	**0.53**
E-8		382,642 sf	8.78ac	C	100%		0%	0%	0%	7.97ac	91%	0%	40%		0%	0%	28%	0.81ac	9%	3%	**2.6%**	**0.17**	**0.51**
E-9	DP 103	157,940 sf	3.63ac	C	100%		0%	0%	0%	3.63ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-10	DP 104	643,830 sf	14.78ac	C	100%		0%	0%	0%	14.78ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-11	DP 105	742,594 sf	17.05ac	C	100%		0%	0%	0%	17.05ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-12	DP 106	151,866 sf	3.49ac	C	100%		0%	0%	0%	3.49ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-13	DP 107	145,662 sf	3.34ac	C	100%		0%	0%	0%	3.34ac	100%	0%	40%		0%	0%	28%		0%	0%	**0.0%**	**0.15**	**0.50**
E-14	DP 108	15,862 sf	0.36ac	B	100%	0.33ac	91%	91%	0%	0.03ac	9%	0%	40%		0%	0%	28%		0%	0%	**90.6%**	**0.74**	**0.82**
	DP 102	OS-1, E-8																					

Basin Runoff Coefficient is based on UDFCD % Imperviousness Calculation

Runoff Coefficients and Percents Impervious									
Hydrologic Soil Type:	**B**		**Runoff Coef Calc Method**						**%Imp**
Land Use	Abb	%	C_2	C_5	C_{10}	C_{25}	C_{50}	C_{100}	Weighted %Imp
Commercial Area	CO	95%	0.79	0.81	0.83	0.85	0.87	0.88	A
Drives and Walks	DR	90%	0.71	0.73	0.75	0.78	0.80	0.81	B
Streets - Gravel (Packed)	GR	40%	0.23	0.30	0.36	0.42	0.46	0.50	C
Historic Flow Analysis	HI	2%	0.03	0.08	0.17	0.26	0.31	0.36	D
Lawns	LA	0%	0.02	0.08	0.15	0.25	0.30	0.35	
Off-site flow-Undeveloped	OF	45%	0.26	0.32	0.38	0.44	0.48	0.51	
Park	PA	7%	0.05	0.12	0.20	0.29	0.34	0.39	
Playground	PL	13%	0.07	0.16	0.24	0.32	0.37	0.42	
Streets - Paved	PV	100%	0.89	0.90	0.92	0.94	0.95	0.96	
Roofs	RO	90%	0.71	0.73	0.75	0.78	0.80	0.81	
Residential: 1/4 Acre	RS1	40%	0.23	0.30	0.36	0.42	0.46	0.50	
Residential: 2.5 Lots/Acre	RS2	28%	0.16	0.24	0.31	0.38	0.43	0.46	

Equations (% Impervious Calculation):

$C_A = K_A + (1.31\,i^3 - 1.44\,i^2 + 1.135\,i - 0.12)$ [Eqn RO-6]

$C_{CD} = K_{CD} + (0.858\,i^3 - 0.786\,i^2 + 0.774\,i + 0.04)$ [Eqn RO-7]

$C_B = (C_A + C_{CD}) / 2$

I = % imperviousness/100 as a decimal (See Table RO-3)

C_A = Runoff coefficient for NRCS Type A Soils

C_B = Runoff coefficient for NRCS Type B Soils

C_{CD} = Runoff coefficient for NRCS Type C and D Soils

Correction Factors - Table RO-4

K_A = For Type A Soils

K_A (2-yr)= 0

K_A (5-yr)= -0.08i + 0.09

K_A (10-yr)= -0.14i + 0.17

K_A (25-yr)= -0.19i + 0.24

K_A (50-yr)= -0.22i + 0.28

K_A (100-yr)= -0.25i + 0.32

K_{CD}=For Type C & D Soils

K_{CD} (2-yr)= 0

K_{CD} (5-yr)= -0.10i + 0.11

K_{CD} (10-yr)= -0.18i + 0.21

K_{CD} (25-yr)= -0.28i + 0.33

K_{CD} (50-yr)= -0.33i + 0.40

K_{CD} (100-yr)= -0.39i + 0.46

The Glen at Widefield
Developed Condition
Time of Concentration Calculation

Sub-Basin Data					Time of Concentration Estimate													
					Initial/Overland Time (t_i)			Travel Time (t_t)						Comp.	Min. Tc in Urban Tc Check (urban)		Final t_c	
Basin	Design Point	Contributing Basins	Area	C_5	Length	Slope	t_i	Length	Slope	Land Type	Cv	Velocity	t_t	t_c	Total Length	t_c Check		
D-1	DP 68		1.40ac	0.28	100lf	2.4%	11.2 min.	600lf	3.5%	PV	20	3.7 ft/sec	2.7 min.	13.9 min.	700lf	13.9 min.	**13.9 min.**	
D-2			1.45ac	0.28	85lf	1.5%	12.1 min.	655lf	0.9%	PV	20	1.9 ft/sec	5.8 min.	17.8 min.	740lf	14.1 min.	**14.1 min.**	
D-3	DP 70		1.69ac	0.28	100lf	2.4%	11.2 min.	600lf	3.5%	PV	20	3.7 ft/sec	2.7 min.	13.9 min.	700lf	13.9 min.	**13.9 min.**	
D-4			2.07ac	0.34	50lf	1.0%	9.9 min.	610lf	0.9%	PV	20	1.9 ft/sec	5.4 min.	15.3 min.	660lf	13.7 min.	**13.7 min.**	
D-5	DP 72		1.56ac	0.34	60lf	2.0%	8.6 min.	790lf	0.5%	PV	20	1.4 ft/sec	9.3 min.	17.9 min.	850lf	14.7 min.	**14.7 min.**	
D-6	DP 73		0.41ac	0.34	90lf	1.0%	13.3 min.	140lf	0.8%	PV	20	1.8 ft/sec	1.3 min.	14.6 min.	230lf	11.3 min.	**11.3 min.**	
D-7			2.98ac	0.34	100lf	1.5%	12.2 min.	430lf	1.3%	PV	20	2.3 ft/sec	3.1 min.	15.4 min.	530lf	12.9 min.	**12.9 min.**	
D-8			1.62ac	0.34	100lf	1.0%	14.0 min.	330lf	1.5%	PV	20	2.4 ft/sec	2.2 min.	16.2 min.	430lf	12.4 min.	**12.4 min.**	
D-9	DP 77		2.11ac	0.28	100lf	2.0%	11.9 min.	300lf	1.3%	PV	20	2.3 ft/sec	2.2 min.	14.1 min.	400lf	12.2 min.	**12.2 min.**	
D-10			2.99ac	0.34	100lf	1.5%	12.2 min.	660lf	1.1%	PV	20	2.1 ft/sec	5.2 min.	17.5 min.	760lf	14.2 min.	**14.2 min.**	
D-11	DP 80		3.96ac	0.34	70lf	1.5%	10.2 min.	1095lf	1.2%	PV	20	2.2 ft/sec	8.3 min.	18.6 min.	1165lf	16.5 min.	**16.5 min.**	
D-12			1.39ac	0.34	100lf	1.3%	12.8 min.	450lf	1.2%	PV	20	2.2 ft/sec	3.4 min.	16.3 min.	550lf	13.1 min.	**13.1 min.**	
D-13			2.06ac	0.34	55lf	1.0%	10.4 min.	660lf	0.6%	PV	20	1.5 ft/sec	7.1 min.	17.5 min.	715lf	14.0 min.	**14.0 min.**	
D-14			3.30ac	0.34	100lf	1.8%	11.5 min.	980lf	1.6%	PV	20	2.5 ft/sec	6.5 min.	18.0 min.	1080lf	16.0 min.	**16.0 min.**	
D-15	DP 84		2.80ac	0.28	100lf	2.0%	11.9 min.	185lf	2.0%	PV	20	2.8 ft/sec	1.1 min.	13.0 min.	285lf	11.6 min.	**13.0 min.**	Backyard IRF
D-16			2.27ac	0.34	100lf	2.0%	11.1 min.	660lf	0.8%	PV	20	1.8 ft/sec	6.1 min.	17.3 min.	760lf	14.2 min.	**17.3 min.**	Backyard IRF
D-16.1			2.08ac	0.34	100lf	1.4%	12.5 min.	360lf	0.8%	PV	20	1.8 ft/sec	3.4 min.	15.9 min.	460lf	12.6 min.	**15.9 min.**	Backyard IRF
D-17			3.45ac	0.34	60lf	1.5%	9.5 min.	410lf	1.5%	PV	20	2.4 ft/sec	2.8 min.	12.3 min.	470lf	12.6 min.	**12.6 min.**	Backyard IRF
D-18			2.13ac	0.34	60lf	1.5%	9.5 min.	510lf	2.2%	PV	20	3.0 ft/sec	2.9 min.	12.3 min.	570lf	13.2 min.	**13.2 min.**	Backyard IRF
D-19			2.97ac	0.34	100lf	2.6%	10.2 min.	510lf	1.1%	PV	20	2.1 ft/sec	4.1 min.	14.2 min.	610lf	13.4 min.	**14.2 min.**	Backyard IRF
D-19.1			0.17ac	0.34	45lf	2.0%	7.5 min.	36lf	1.1%	PV	20	2.1 ft/sec	0.3 min.	7.7 min.	81lf	10.5 min.	**7.7 min.**	
D-20a	DP 92a		0.81ac	0.38	100lf	3.3%	8.8 min.	1300lf	0.8%	PV	20	1.8 ft/sec	12.1 min.	20.9 min.	1400lf	17.8 min.	**17.8 min.**	
D-20b	DP 92b		0.47ac	0.68	100lf	3.3%	5.1 min.	1300lf	0.8%	PV	20	1.8 ft/sec	12.1 min.	17.2 min.	1400lf	17.8 min.	**17.2 min.**	
D-20c	DP 92d		0.36ac	0.38	100lf	3.3%	8.8 min.	1300lf	0.8%	PV	20	1.8 ft/sec	12.1 min.	20.9 min.	1400lf	17.8 min.	**17.8 min.**	
D-21	DP 91		4.02ac	0.28	50lf	2.0%	8.4 min.	610lf	2.1%	PV	20	2.9 ft/sec	3.5 min.	11.9 min.	660lf	13.7 min.	**11.9 min.**	
D-22	DP 90		1.15ac	0.28	50lf	2.0%	8.4 min.	610lf	2.1%	PV	20	2.9 ft/sec	3.5 min.	11.9 min.	660lf	13.7 min.	**11.9 min.**	
D-23			0.28ac	0.67	100lf	2.5%	5.7 min.	660lf	1.0%	PV	20	2.0 ft/sec	5.5 min.	11.2 min.	760lf	14.2 min.	**11.2 min.**	
D-24			10.18ac	0.20	100lf	4.9%	9.8 min.	800lf	0.5%	GW	15	1.1 ft/sec	12.6 min.	**22.3 min.**	900lf	15.0 min.	**22.3 min.**	Mostly Historic
Combined Design Point Summary																		
	DP 69	D1, D2	2.85ac	0.28	100lf	2.4%	11.2 min.	1385lf	2.0%	PV	20	2.8 ft/sec	8.2 min.	19.3 min.	1485lf	18.3 min.	**18.3 min.**	
	DP 71	D3, D4	3.76ac	0.28	100lf	2.4%	11.2 min.	1370lf	2.0%	PV	20	2.8 ft/sec	8.1 min.	19.3 min.	1470lf	18.2 min.	**18.2 min.**	
	DP 74	D3, D4, D6	4.17ac	0.34	100lf	2.4%	10.5 min.	1370lf	2.0%	PV	20	2.8 ft/sec	8.1 min.	18.5 min.	1470lf	18.2 min.	**18.2 min.**	
	DP 75	D1-D4, D6, D7	10.01ac	0.34	100lf	2.4%	10.5 min.	1970lf	1.8%	PV	20	2.7 ft/sec	12.2 min.	22.7 min.	2070lf	21.5 min.	**21.5 min.**	
	DP 76	D1-D4, D6-D8	11.63ac	0.34	100lf	2.4%	10.5 min.	2110lf	1.8%	PV	20	2.7 ft/sec	13.1 min.	23.6 min.	2210lf	22.3 min.	**22.3 min.**	
	DP 78	D1-D4, D6-D9	13.74ac	0.34	100lf	2.4%	10.5 min.	2110lf	1.8%	PV	20	2.7 ft/sec	13.1 min.	23.6 min.	2210lf	22.3 min.	**22.3 min.**	
	DP 79	D8, D10	4.61ac	0.34	100lf	2.4%	10.5 min.	896lf	1.6%	PV	20	2.5 ft/sec	5.9 min.	16.4 min.	996lf	15.5 min.	**15.5 min.**	
	DP 81	D11, D12	5.34ac	0.34	70lf	1.5%	10.2 min.	1545lf	1.2%	PV	20	2.2 ft/sec	11.8 min.	22.0 min.	1615lf	19.0 min.	**19.0 min.**	
	DP 82	D5, D13	3.62ac	0.34	60lf	2.0%	8.6 min.	1590lf	0.6%	PV	20	1.5 ft/sec	17.7 min.	26.3 min.	1650lf	19.2 min.	**19.2 min.**	
	DP 83	D5, D13, D14	6.93ac	0.34	60lf	2.0%	8.6 min.	2640lf	0.9%	PV	20	1.9 ft/sec	23.2 min.	31.8 min.	2700lf	25.0 min.	**25.0 min.**	
	DP 85	D15,D16, D16.1	7.15ac	0.34	100lf	2.0%	11.1 min.	847lf	0.6%	PV	20	1.5 ft/sec	9.3 min.	20.5 min.	947lf	15.3 min.	**20.5 min.**	Backyard IRF
	DP 86	D15 - D17	10.60ac	0.34	100lf	2.0%	11.1 min.	1035lf	0.8%	PV	20	1.8 ft/sec	9.6 min.	20.8 min.	1135lf	16.3 min.	**20.8 min.**	Backyard IRF
	DP 87	D15 - D18	12.74ac	0.34	100lf	2.0%	11.1 min.	1320lf	0.7%	PV	20	1.7 ft/sec	13.1 min.	24.3 min.	1420lf	17.9 min.	**24.3 min.**	Backyard IRF
	DP 88	D15 - D19	15.70ac	0.34	100lf	2.0%	11.1 min.	2080lf	1.0%	PV	20	2.0 ft/sec	17.3 min.	28.4 min.	2180lf	22.1 min.	**28.4 min.**	Backyard IRF
	DP 92a	D20a	0.81ac	1.73	100lf	2.0%	-9.1 min.	2080lf	1.0%	PV	20	2.0 ft/sec	17.3 min.	8.2 min.	2180lf	22.1 min.	**28.4 min.**	Backyard IRF
	DP 92b	D21,D22,D23	5.46ac	0.34	124lf	2.5%	11.5 min.	825lf	1.0%	PV	20	2.0 ft/sec	6.9 min.	18.4 min.	949lf	15.3 min.	**15.3 min.**	
	DP 93a	D1 -D19.1	44.87ac	0.34	168lf	2.5%	13.4 min.	2820lf	1.0%	PV	20	2.0 ft/sec	23.5 min.	36.9 min.	2988lf	26.6 min.	**36.9 min.**	Cumulative Reduction
	DP 93b	D20b,D20c,D23	1.12ac	0.40	14lf	2.4%	3.6 min.	56lf	1.6%	PV	20	2.5 ft/sec	0.4 min.	5.0 min.	70lf	10.4 min.	**5.0 min.**	
	DP 94	**ULTIMATE**	**62.15ac**	0.32	100lf	2.4%	10.7 min.	3110lf	1.0%	PV	20	2.0 ft/sec	25.9 min.	36.6 min.	3210lf	27.8 min.	**27.8 min.**	

Equations:

t_i (Overland) = $0.395(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for 5-year

L = Length of overland flow (ft)

S = Slope of flow path (ft/ft)

tc Check = (L/180)+10 (Developed Cond. Only)

L = Overall Length

Velocity (Travel Time) = $CvS^{0.5}$

Cv = Conveyance Coef (see Table RO-2)

S = Watercourse slope (ft/ft)

Land Surface Type	Type	Cv
Grassed Waterway	GW	15
Heavy Meadow	HM	2.5
Nearly Bare Ground	NBG	10
Paved Area	PV	20
Riprap (Not Buried)	RR	6.5
Short Pasture/Lawns	SP	7
Tillage/Fields	TF	5

The Glen at Widefield
Developed Condition
Time of Concentration Calculation

Sub-Basin Data					Time of Concentration Estimate										Min. Tc in Urban		Final t_c
					Initial/Overland Time (t_i)			Travel Time (t_t)						Comp.	Tc Check (urban)		
Basin	Design Point	Contributing Basins	Area	C_5	Length	Slope	t_i	Length	Slope	Land Type	Cv	Velocity	t_t	t_c	Total Length	t_c Check	
E-1	DP 95		5.27ac	0.15	100lf	2.3%	13.2 min.	1800lf	1.9%	GW	15	2.1 ft/sec	14.5 min.	27.7 min.	1900lf	20.6 min.	**20.6 min.**
E-2	DP 96		0.50ac	0.28	100lf	1.5%	13.0 min.	675lf	0.8%	PV	20	1.8 ft/sec	6.3 min.	19.3 min.	775lf	14.3 min.	**14.3 min.**
E-3	DP 97		1.60ac	0.15	70lf	1.2%	13.7 min.	260lf	0.5%	PV	20	1.4 ft/sec	3.1 min.	16.8 min.	330lf	11.8 min.	**11.8 min.**
E-4	DP 98		1.17ac	0.25	50lf	2.4%	8.2 min.	160lf	1.9%	PV	20	2.8 ft/sec	1.0 min.	9.1 min.	210lf	11.2 min.	**9.1 min.**
E-5	DP 99		1.32ac	0.21	100lf	4.0%	10.2 min.	200lf	1.9%	PV	20	2.8 ft/sec	1.2 min.	11.4 min.	300lf	11.7 min.	**11.4 min.**

Equations:

t_i (Overland) = $0.395(1.1-C_5)L^{0.5} S^{-0.333}$

C_5 = Runoff coefficient for 5-year

L = Length of overland flow (ft)

S = Slope of flow path (ft/ft)

tc Check = (L/180)+10 (Developed Cond. Only)

L = Overall Length

Velocity (Travel Time) = $CvS^{0.5}$

Cv = Conveyance Coef (see Table RO-2)

S = Watercourse slope (ft/ft)

Land Surface Type	Type	Cv
Grassed Waterway	GW	15
Heavy Meadow	HM	2.5
Nearly Bare Ground	NBG	10
Paved Area	PV	20
Riprap (Not Buried)	RR	6.5
Short Pasture/Lawns	SP	7
Tillage/Fields	TF	5

The Glen at Widefield
Developed Condition
Runoff Calculation

Basin	Design Point	Contributing Basins	Drainage Area	C_5	C_{100}	Time of Concentration	Rainfall Intensity i_5	Rainfall Intensity i_{100}	Runoff Q_5	Runoff Q_{100}	Basin / DP
D-1	DP 68		1.40 ac	0.28	0.49	13.9 min.	3.6 in/hr	6.1 in/hr	**1.4 cfs**	**4.2 cfs**	D-1
D-2			1.45 ac	0.28	0.49	14.1 min.	3.6 in/hr	6.1 in/hr	**1.5 cfs**	**4.3 cfs**	D-2
D-3	DP 70		1.69 ac	0.28	0.49	13.9 min.	3.6 in/hr	6.1 in/hr	**1.7 cfs**	**5.0 cfs**	D-3
D-4			2.07 ac	0.34	0.58	13.7 min.	3.7 in/hr	6.1 in/hr	**2.5 cfs**	**7.4 cfs**	D-4
D-5	DP 72		1.56 ac	0.34	0.58	14.7 min.	3.5 in/hr	6.0 in/hr	**1.9 cfs**	**5.4 cfs**	D-5
D-6	DP 73		0.41 ac	0.34	0.58	11.3 min.	3.9 in/hr	6.6 in/hr	**0.5 cfs**	**1.6 cfs**	D-6
D-7			2.98 ac	0.34	0.58	12.9 min.	3.7 in/hr	6.3 in/hr	**3.7 cfs**	**10.8 cfs**	D-7
D-8			1.62 ac	0.34	0.58	12.4 min.	3.8 in/hr	6.4 in/hr	**2.1 cfs**	**6.0 cfs**	D-8
D-9	DP 77		2.11 ac	0.28	0.49	12.2 min.	3.8 in/hr	6.4 in/hr	**2.3 cfs**	**6.6 cfs**	D-9
D-10			2.99 ac	0.34	0.58	14.2 min.	3.6 in/hr	6.0 in/hr	**3.6 cfs**	**10.5 cfs**	D-10
D-11	DP 80		3.96 ac	0.34	0.58	16.5 min.	3.4 in/hr	5.7 in/hr	**4.5 cfs**	**13.0 cfs**	D-11
D-12			1.39 ac	0.34	0.58	13.1 min.	3.7 in/hr	6.3 in/hr	**1.7 cfs**	**5.0 cfs**	D-12
D-13			2.06 ac	0.34	0.58	14.0 min.	3.6 in/hr	6.1 in/hr	**2.5 cfs**	**7.3 cfs**	D-13
D-14			3.30 ac	0.34	0.58	16.0 min.	3.4 in/hr	5.7 in/hr	**3.8 cfs**	**11.0 cfs**	D-14
D-15	DP 84		2.80 ac	0.28	0.49	13.0 min.	3.7 in/hr	6.3 in/hr	**3.0 cfs**	**8.6 cfs**	D-15
D-16	DP84.1		2.27 ac	0.34	0.58	17.3 min.	3.3 in/hr	5.6 in/hr	**2.5 cfs**	**7.3 cfs**	D-16
D-16.1			2.08 ac	0.34	0.58	15.9 min.	3.4 in/hr	5.8 in/hr	**2.4 cfs**	**6.9 cfs**	D-16.1
D-17			3.45 ac	0.34	0.58	12.6 min.	3.8 in/hr	6.3 in/hr	**4.4 cfs**	**12.7 cfs**	D-17
D-18			2.13 ac	0.34	0.58	13.2 min.	3.7 in/hr	6.2 in/hr	**2.7 cfs**	**7.7 cfs**	D-18
D-19			2.97 ac	0.34	0.58	14.2 min.	3.6 in/hr	6.0 in/hr	**3.6 cfs**	**10.4 cfs**	D-19
D-19.1	DP 89		0.17 ac	0.34	0.58	7.7 min.	4.5 in/hr	7.6 in/hr	**0.3 cfs**	**0.7 cfs**	D-19.1
D-20a	DP 92a		0.81 ac	0.38	0.60	17.8 min.	3.3 in/hr	5.5 in/hr	**1.0 cfs**	**2.6 cfs**	D-20a
D-20b	DP 92b		0.47 ac	0.68	0.79	17.2 min.	3.3 in/hr	5.6 in/hr	**1.1 cfs**	**2.1 cfs**	D-20b
D-20c	DP 92d		0.36 ac	0.38	0.60	17.8 min.	3.3 in/hr	5.5 in/hr	**0.5 cfs**	**1.2 cfs**	D-20c
D-21	DP 91		4.02 ac	0.28	0.49	11.9 min.	3.9 in/hr	6.5 in/hr	**4.4 cfs**	**12.7 cfs**	D-21
D-22	DP 90		1.15 ac	0.28	0.49	11.9 min.	3.9 in/hr	6.5 in/hr	**1.3 cfs**	**3.6 cfs**	D-22
D-23			0.28 ac	0.67	0.78	11.2 min.	4.0 in/hr	6.6 in/hr	**0.8 cfs**	**1.5 cfs**	D-23
D-24			10.18 ac	0.20	0.52	22.3 min.	2.9 in/hr	4.9 in/hr	**5.8 cfs**	**26.2 cfs**	D-24
Combined Design Point Summary							**Direct Summation:**		**67.3 cfs**	**202.0 cfs**	
	DP 69	D1, D2	2.85 ac	0.28	0.49	18.3 min.	3.2 in/hr	5.4 in/hr	**2.6 cfs**	**7.5 cfs**	DP 69
	DP 71	D3, D4	3.76 ac	0.28	0.49	18.2 min.	3.2 in/hr	5.4 in/hr	**3.4 cfs**	**9.9 cfs**	DP 71
	DP 74	D3, D4, D6	4.17 ac	0.34	0.58	18.2 min.	3.2 in/hr	5.4 in/hr	**4.5 cfs**	**13.1 cfs**	DP 74
	DP 75	D1-D4, D6, D7	10.01 ac	0.34	0.58	21.5 min.	3.0 in/hr	5.0 in/hr	**10.0 cfs**	**29.0 cfs**	DP 75
	DP 76	D1-D4, D6-D8	11.63 ac	0.34	0.58	22.3 min.	2.9 in/hr	4.9 in/hr	**11.4 cfs**	**33.0 cfs**	DP 76
	DP 78	D1-D4, D6-D9	13.74 ac	0.34	0.58	22.3 min.	2.9 in/hr	4.9 in/hr	**13.5 cfs**	**39.0 cfs**	DP 78
	DP 79	D8, D10	4.61 ac	0.34	0.58	15.5 min.	3.5 in/hr	5.8 in/hr	**5.4 cfs**	**15.5 cfs**	DP 79
	DP 81	D11, D12	5.34 ac	0.34	0.58	19.0 min.	3.2 in/hr	5.3 in/hr	**5.7 cfs**	**16.4 cfs**	DP 81
	DP 82	D5, D13	3.62 ac	0.34	0.58	19.2 min.	3.2 in/hr	5.3 in/hr	**3.8 cfs**	**11.1 cfs**	DP 82
	DP 83	D5, D13, D14	6.93 ac	0.34	0.58	25.0 min.	2.8 in/hr	4.6 in/hr	**6.4 cfs**	**18.5 cfs**	DP 83
	DP 85	D15,D16, D16.1	7.15 ac	0.34	0.58	20.5 min.	3.1 in/hr	5.1 in/hr	**7.3 cfs**	**21.2 cfs**	DP 85
	DP 86	D15 - D17	10.60 ac	0.34	0.58	20.8 min.	3.0 in/hr	5.1 in/hr	**10.8 cfs**	**31.2 cfs**	DP 86
	DP 87	D15 - D18	12.74 ac	0.34	0.58	24.3 min.	2.8 in/hr	4.7 in/hr	**12.0 cfs**	**34.6 cfs**	DP 87
	DP 88	D15 - D19	15.70 ac	0.34	0.58	28.4 min.	2.6 in/hr	4.3 in/hr	**13.5 cfs**	**39.0 cfs**	DP 88
	DP 92a	D20a	0.81 ac	1.73	1.69	28.4 min.	2.6 in/hr	4.3 in/hr	**3.6 cfs**	**5.9 cfs**	DP 92a
	DP 92b	D21,D22,D23	5.46 ac	0.34	0.58	15.3 min.	3.5 in/hr	5.9 in/hr	**6.4 cfs**	**18.5 cfs**	DP 92b
	DP 93a	D1 -D19.1	44.87 ac	0.34	0.58	36.9 min.	2.2 in/hr	3.6 in/hr	**32.7 cfs**	**94.5 cfs**	DP 93a
	DP 93b	D20b,D20c,D23	1.12 ac	0.40	0.60	5.0 min.	5.2 in/hr	8.7 in/hr	**2.3 cfs**	**5.9 cfs**	DP 93b
	DP 94	**ULTIMATE**	**62.15 ac**	**0.32**	**0.57**	**27.8 min.**	2.6 in/hr	4.4 in/hr	**51.3 cfs**	**154.8 cfs**	**FINAL**

Equations (taken from Fig 6-5, City of Colorado Springs DCM):

i_2=-1.19 ln(T_c) + 6.035
i_5=-1.50 ln(T_c) + 7.583
i_{10}=-1.75 ln(T_c) + 8.847
i_{25}=-2.00 ln(T_c) + 10.111
i_{50}=-2.25 ln(T_c) + 11.375
i_{100}=-2.52 ln(T_c) + 12.735

Q = CiA
Q = Peak Runoff Rate (cubic feet/second)
C = Runoff coef representing a ration of peak runoff rate to ave 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

P1	Inches
WQCV	0.60 in
2 yr	1.19 in
5 yr	1.50 in
10 yr	1.75 in
25 yr	2.00 in
50 yr	2.25 in
100 yr	2.52 in

The Glen at Widefield
Developed Condition
Runoff Calculation

Basin	Design Point	Contributing Basins	Drainage Area	C_5	C_{100}	Time of Concentration	Rainfall Intensity							Runoff		Basin / DP
							i_{WQCV}	i_2	i_5	i_{10}	i_{25}	i_{50}	i_{100}	Q_5	Q_{100}	
E-1	DP 95		5.27 ac	0.15	0.50	20.6 min.	1.2 in/hr	2.4 in/hr	3.0 in/hr	3.6 in/hr	4.1 in/hr	4.6 in/hr	5.1 in/hr	**2.4 cfs**	**13.5 cfs**	E-1
E-2	DP 96		0.50 ac	0.28	0.49	14.3 min.	1.4 in/hr	2.9 in/hr	3.6 in/hr	4.2 in/hr	4.8 in/hr	5.4 in/hr	6.0 in/hr	**0.5 cfs**	**1.5 cfs**	E-2
E-3	DP 97		1.60 ac	0.15	0.41	11.8 min.	1.5 in/hr	3.1 in/hr	3.9 in/hr	4.5 in/hr	5.2 in/hr	5.8 in/hr	6.5 in/hr	**0.9 cfs**	**4.3 cfs**	E-3
E-4	DP 98		1.17 ac	0.25	0.55	9.1 min.	1.7 in/hr	3.4 in/hr	4.3 in/hr	5.0 in/hr	5.7 in/hr	6.4 in/hr	7.2 in/hr	**1.3 cfs**	**4.6 cfs**	E-4
E-5	DP 99		1.32 ac	0.21	0.53	11.4 min.	1.6 in/hr	3.1 in/hr	3.9 in/hr	4.6 in/hr	5.2 in/hr	5.9 in/hr	6.6 in/hr	**1.1 cfs**	**4.6 cfs**	E-5
													Summ:	**6.2 cfs**	**28.5 cfs**	

Equations (taken from Fig 6-5, City of Colorado Springs DCM):

i_2=-1.19 ln(T_c) + 6.035

i_5=-1.50 ln(T_c) + 7.583

i_{10}=-1.75 ln(T_c) + 8.847

i_{25}=-2.00 ln(T_c) + 10.111

i_{50}=-2.25 ln(T_c) + 11.375

i_{100}=-2.52 ln(T_c) + 12.735

Q = CiA

Q = Peak Runoff Rate (cubic feet/second)

C = Runoff coef representing a ration of peak runoff rate to ave 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

P1	Inches
WQCV	0.60 in
2 yr	1.19 in
5 yr	1.50 in
10 yr	1.75 in
25 yr	2.00 in
50 yr	2.25 in
100 yr	2.52 in

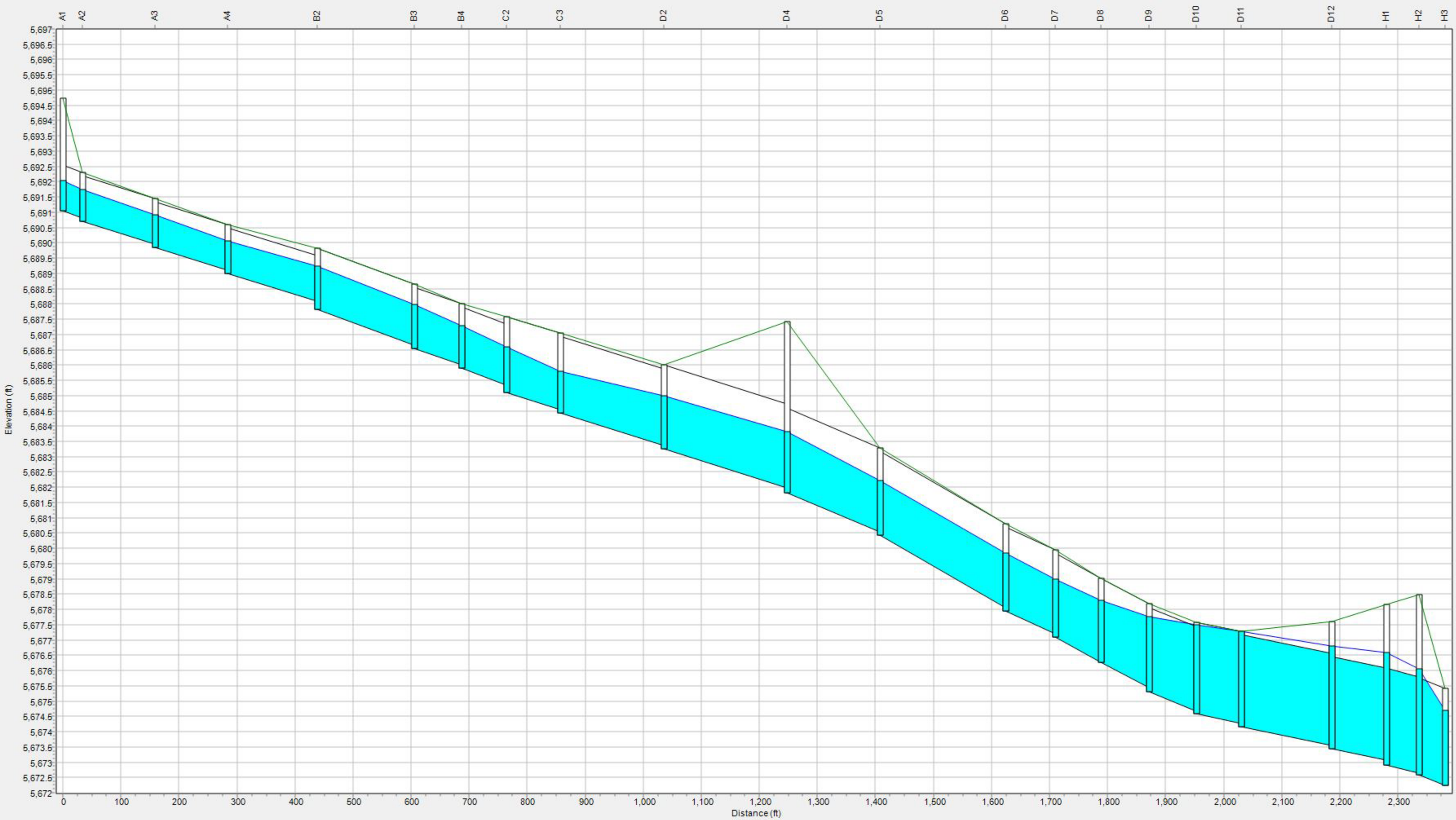
APPENDIX C

Hydraulic Calculations

EPA-SWMM HGL/EGL Open Channel and Pipe System Report
UD_Sewer HGL Analysis and Report
MHFD Inlet Summaries & Calculations

The Glen Filing No 11 & 12 Golden Buffs Trunkline (Ultimate Condition)

Water Elevation Profile: Node A1 - H3



03/16/2021 00:05:00

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

The Glen Filing No 12. 100-Year HGL/EGL Analysis

100-Year HGL/EGL Analysis

WARNING 10: crest elevation raised to downstream invert for regulator Link H2-HighPtS
WARNING 02: maximum depth increased for Node HighPtN
WARNING 02: maximum depth increased for Node 68
WARNING 02: maximum depth increased for Node 73
WARNING 02: maximum depth increased for Node 76
WARNING 02: maximum depth increased for Node 87
WARNING 02: maximum depth increased for Node 80
WARNING 02: maximum depth increased for Node 72

****
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

********** Volume Volume
Flow Routing Continuity acre-feet 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 62.847 20.480
External Outflow 33.918 11.053
Flooding Loss 25.749 8.391
Evaporation Loss 0.000 0.000

Exfiltration Loss 0.000 0.000
Initial Stored Volume 0.001 0.000
Final Stored Volume 0.416 0.136
Continuity Error (%) 4.400

****
Highest Continuity Errors
****
Node G1 (41.52%)
Node F5 (7.58%)
Node D9 (5.32%)
Node D2 (-3.17%)
Node C3 (2.77%)

****
Time-Step Critical Elements
****
Link H2-H3 (1810.24%)
Link G4-H1 (83.73%)
Link H1-H2 (2.36%)
Link G2-H1 (1.84%)

****
Highest Flow Instability Indexes
****
Link G4-G3-Gutter (9)
Link H2-G3-Overtopping (9)
Link G2-H1 (9)
Link G4-H1 (9)
Link G3-G4 (7)

****
Routing Time Step Summary
****
Minimum Time Step : 0.12 sec
Average Time Step : 0.65 sec
Maximum Time Step : 1.79 sec
Percent in Steady State : 97.69
Average Iterations per Step : 2.71
Percent Not Converging : 7.09
Time Step Frequencies :
30.000 - 13.228 sec : 0.00 %
13.228 - 5.833 sec : 0.00 %
5.833 - 2.572 sec : 0.00 %
2.572 - 1.134 sec : 14.55 %
1.134 - 0.500 sec : 85.45 %

****
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
H2	JUNCTION	3.39	3.47	5676.06	0 00:04	3.47
H1	JUNCTION	3.62	3.69	5676.60	0 00:04	3.69
F7	JUNCTION	3.12	4.63	5677.76	0 00:03	3.21
D12	JUNCTION	3.26	3.44	5676.89	0 00:02	3.34
D11	JUNCTION	3.00	3.10	5677.27	0 00:04	3.10
D10	JUNCTION	2.80	2.91	5677.49	0 00:04	2.90
D9	JUNCTION	2.36	2.44	5677.76	0 00:04	2.44
D8	JUNCTION	1.96	2.02	5678.30	0 00:04	2.02
D7	JUNCTION	1.85	1.90	5678.99	0 00:04	1.90
D6	JUNCTION	1.84	1.89	5679.85	0 00:04	1.89
D5	JUNCTION	1.74	1.78	5682.22	0 00:04	1.78
D4	JUNCTION	1.95	2.00	5683.83	0 00:03	1.98
D2	JUNCTION	1.73	1.84	5685.09	0 00:03	1.75
D1	JUNCTION	0.95	1.12	5685.45	0 00:00	0.95
C3	JUNCTION	1.32	1.48	5685.92	0 00:03	1.34
C2	JUNCTION	1.50	1.59	5686.68	0 00:02	1.52
B4	JUNCTION	1.36	1.46	5687.37	0 00:02	1.38
B3	JUNCTION	1.41	1.49	5688.04	0 00:02	1.43
B2	JUNCTION	1.39	1.46	5689.29	0 00:02	1.40
B1	JUNCTION	1.11	1.39	5689.77	0 00:00	1.12
A4	JUNCTION	1.05	1.21	5690.21	0 00:01	1.07
A3	JUNCTION	1.04	1.14	5690.99	0 00:01	1.05
A2	JUNCTION	1.05	1.11	5691.81	0 00:00	1.05
A1	JUNCTION	0.99	1.19	5692.23	0 00:00	0.99
E1	JUNCTION	1.06	1.30	5687.01	0 00:00	1.06
E2	JUNCTION	1.31	1.59	5686.86	0 00:00	1.31
E3	JUNCTION	1.17	1.54	5686.35	0 00:00	1.17
E4	JUNCTION	1.16	1.21	5684.12	0 00:01	1.17
E5	JUNCTION	1.10	1.19	5682.11	0 00:01	1.12
E6	JUNCTION	1.56	1.67	5680.29	0 00:02	1.58
E7	JUNCTION	1.52	1.63	5679.27	0 00:02	1.54
F3	JUNCTION	1.64	1.76	5678.76	0 00:02	1.67
F2	JUNCTION	1.05	1.07	5680.15	0 00:02	1.07
F1	JUNCTION	0.58	0.58	5688.11	0 00:00	0.58
F4	JUNCTION	1.64	1.88	5678.27	0 00:02	1.68
F5	JUNCTION	2.43	2.51	5676.80	0 00:04	2.51
F6	JUNCTION	3.03	5.24	5678.67	0 00:03	3.12
G3	JUNCTION	2.53	2.58	5676.68	0 00:04	2.58
G4	JUNCTION	2.93	2.98	5676.64	0 00:04	2.98
G2	JUNCTION	2.99	3.05	5676.65	0 00:04	3.05
G1	JUNCTION	2.39	2.43	5676.66	0 00:04	2.43
C1	JUNCTION	0.73	0.77	5686.95	0 00:02	0.73
J2	JUNCTION	0.67	0.98	5673.75	0 00:00	0.67
J1	JUNCTION	0.99	1.12	5673.61	0 00:00	0.99
PA1	JUNCTION	1.83	2.00	5679.81	0 00:00	1.83
PA2	JUNCTION	1.99	2.00	5679.36	0 00:00	2.00
HighPtN	JUNCTION	0.00	0.00	5677.88	0 00:00	0.00
HighPtS	JUNCTION	0.00	0.00	5677.88	0 00:00	0.00
68	JUNCTION	0.00	0.00	5698.00	0 00:00	0.00

70	JUNCTION	0.00	0.00	5698.00	0	00:00	0.00
84	JUNCTION	0.00	0.00	5695.00	0	00:00	0.00
73	JUNCTION	0.00	0.00	5690.25	0	00:00	0.00
76	JUNCTION	0.00	0.00	5682.75	0	00:00	0.00
87	JUNCTION	0.00	0.00	5682.00	0	00:00	0.00
80	JUNCTION	0.00	0.00	5680.75	0	00:00	0.00
72	JUNCTION	0.00	0.00	5692.00	0	00:00	0.00
H3	OUTFALL	2.41	2.45	5674.70	0	00:04	2.45
Forebay-J	OUTFALL	0.00	0.00	5671.61	0	00:00	0.00

****
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
H2	JUNCTION	13.70	127.30	0	00:04	1.11	10.2	1.383
H1	JUNCTION	0.00	77.12	0	00:04	0	6.17	0.252
F7	JUNCTION	0.00	31.99	0	00:03	0	2.43	0.022
D12	JUNCTION	0.00	37.06	0	00:04	0	2.96	0.471
D11	JUNCTION	0.00	38.17	0	00:04	0	3.04	0.118
D10	JUNCTION	0.00	38.77	0	00:03	0	3.03	-0.181
D9	JUNCTION	0.00	40.15	0	00:04	0	3.2	5.615
D8	JUNCTION	0.00	40.68	0	00:04	0	3.25	1.407
D7	JUNCTION	0.00	40.78	0	00:04	0	3.26	0.297
D6	JUNCTION	0.00	41.20	0	00:04	0	3.29	1.120
D5	JUNCTION	0.00	41.24	0	00:04	0	3.3	0.233
D4	JUNCTION	9.90	41.53	0	00:03	0.8	3.21	-2.594
D2	JUNCTION	0.00	31.89	0	00:03	0	2.34	-3.072
D1	JUNCTION	8.10	8.10	0	00:00	0.654	0.654	0.014
C3	JUNCTION	0.00	22.96	0	00:03	0	1.73	2.847
C2	JUNCTION	0.00	22.66	0	00:02	0	1.74	0.356
B4	JUNCTION	0.00	16.69	0	00:02	0	1.27	0.092
B3	JUNCTION	0.00	16.50	0	00:02	0	1.28	0.175
B2	JUNCTION	0.00	16.62	0	00:01	0	1.28	0.393
B1	JUNCTION	9.00	9.00	0	00:00	0.727	0.727	0.052
A4	JUNCTION	0.00	7.40	0	00:01	0	0.555	0.080
A3	JUNCTION	0.00	7.24	0	00:01	0	0.556	0.212
A2	JUNCTION	0.00	7.89	0	00:00	0	0.557	0.227
A1	JUNCTION	6.90	6.90	0	00:00	0.557	0.557	0.060
E1	JUNCTION	8.50	8.50	0	00:00	0.687	0.687	0.047
E2	JUNCTION	6.10	15.82	0	00:00	0.493	1.18	0.052
E3	JUNCTION	0.00	17.06	0	00:00	0	1.18	0.105
E4	JUNCTION	0.00	18.21	0	00:00	0	1.18	0.371
E5	JUNCTION	0.00	15.10	0	00:01	0	1.17	0.144
E6	JUNCTION	11.10	26.69	0	00:02	0.897	2.07	0.196
E7	JUNCTION	0.00	27.33	0	00:02	0	2.06	0.090
F3	JUNCTION	0.00	34.18	0	00:02	0	2.59	0.127
F2	JUNCTION	0.00	6.64	0	00:00	0	0.532	0.441
F1	JUNCTION	6.60	6.60	0	00:00	0.533	0.533	0.177
F4	JUNCTION	0.00	33.99	0	00:02	0	2.59	0.019
F5	JUNCTION	0.00	35.76	0	00:02	0	2.59	8.202
F6	JUNCTION	0.00	35.80	0	00:03	0	2.39	-1.256

G3	JUNCTION	16.40	16.40	0	00:00	1.32	1.32	0.098
G4	JUNCTION	7.10	25.53	0	00:00	0.574	1.57	0.371
G2	JUNCTION	13.60	32.09	0	00:00	1.1	1.68	0.551
G1	JUNCTION	16.30	16.30	0	00:00	1.32	1.32	71.009
C1	JUNCTION	5.80	5.80	0	00:00	0.469	0.469	0.033
J2	JUNCTION	3.70	3.70	0	00:00	0.299	0.299	0.485
J1	JUNCTION	8.70	13.80	0	00:00	0.703	1	-0.115
PA1	JUNCTION	102.00	102.00	0	00:00	8.24	8.24	-0.791
PA2	JUNCTION	0.00	107.99	0	00:00	0	8.3	0.000
HighPtN	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
HighPtS	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
68	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
70	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
84	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
73	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
76	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
87	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
80	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
72	JUNCTION	0.00	0.00	0	00:00	0	0	0.000 gal
H3	OUTFALL	0.00	125.61	0	00:04	0	10.1	0.000
Forebay-J	OUTFALL	0.00	13.58	0	00:01	0	1	0.000

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Node Surcharge Summary
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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
H1	JUNCTION	2.95	0.523	1.550
F7	JUNCTION	2.95	1.777	0.000
D12	JUNCTION	2.95	0.339	0.701
D11	JUNCTION	2.93	0.000	0.000
F6	JUNCTION	2.93	2.142	0.000
PA1	JUNCTION	0.01	0.000	0.000
PA2	JUNCTION	3.00	0.000	0.000

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

Node	Hours Flooded	Maximum Rate CFS	Total Time of Max Occurrence days hr:min	Maximum Flood Volume 10^6 gal	Ponded Depth Feet
D11	2.93	1.12	0 00:04	0.089	0.000
G1	2.95	10.91	0 00:03	0.559	0.427
PA1	0.01	84.62	0 00:00	0.007	0.000
PA2	3.00	107.99	0 00:00	8.294	0.000

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Outfall Loading Summary
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Outfall Node	Flow Freq Pcnt	Avg Flow CFS	Max Flow CFS	Total Volume 10^6 gal
H3	100.00	122.31	125.61	10.050
Forebay-J	100.00	12.37	13.58	1.001
System	100.00	134.68	138.02	11.052

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Link Flow Summary
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Link	Type	Maximum |Flow| CFS	Time of Max Occurrence days hr:min	Maximum |Veloc| ft/sec	Max/ Full Flow	Max/ Full Depth
A1-A2	CONDUIT	7.89	0 00:00	5.83	0.89	0.75
A2-A3	CONDUIT	7.24	0 00:01	5.41	0.89	0.71
A3-A4	CONDUIT	7.40	0 00:01	5.32	0.91	0.74
A4-B2	CONDUIT	7.72	0 00:01	5.23	0.95	0.78
B1-B2	CONDUIT	10.54	0 00:00	7.07	1.00	0.84
B2-B3	CONDUIT	16.50	0 00:02	6.81	0.87	0.72
B3-B4	CONDUIT	16.69	0 00:02	6.73	0.90	0.74
B4-C2	CONDUIT	16.87	0 00:02	6.96	0.87	0.72
C1-C2	CONDUIT	5.87	0 00:00	8.16	0.39	0.62
C2-C3	CONDUIT	22.96	0 00:03	7.06	0.72	0.63
C3-D2	CONDUIT	23.79	0 00:03	7.36	0.58	0.63
D10-D11	CONDUIT	38.17	0 00:04	5.43	0.91	0.98
D11-D12	CONDUIT	37.06	0 00:04	5.24	0.88	1.00
D12-H1	CONDUIT	36.97	0 00:04	5.77	0.67	1.00
D1-D2	CONDUIT	10.48	0 00:00	9.75	0.71	0.76
D2-D4	CONDUIT	31.63	0 00:03	7.54	0.77	0.67
D4-D5	CONDUIT	41.24	0 00:04	8.98	0.87	0.72
D5-D6	CONDUIT	41.20	0 00:04	10.10	0.74	0.65
D6-D7	CONDUIT	40.78	0 00:04	9.39	0.81	0.69
D7-D8	CONDUIT	40.68	0 00:04	9.07	0.76	0.71
D8-D9	CONDUIT	40.15	0 00:04	8.49	0.76	0.79
D9-D10	CONDUIT	38.77	0 00:03	6.95	0.82	0.94
E1-E2	CONDUIT	9.72	0 00:00	5.47	0.64	0.74
E2-E3	CONDUIT	17.06	0 00:00	7.04	0.90	0.75
E3-E4	CONDUIT	18.21	0 00:00	10.81	0.80	0.59
E4-E5	CONDUIT	15.10	0 00:01	7.72	0.67	0.60
E5-E6	CONDUIT	15.59	0 00:02	8.19	0.64	0.59
E6-E7	CONDUIT	27.33	0 00:02	8.03	0.77	0.66
E7-F3	CONDUIT	27.55	0 00:02	8.16	0.75	0.65
F1-F2	CONDUIT	6.64	0 00:00	10.56	0.32	0.39
F2-F3	CONDUIT	6.64	0 00:02	4.69	0.86	0.78
F3-F4	CONDUIT	33.99	0 00:02	8.67	0.72	0.64
F4-F5	CONDUIT	35.76	0 00:02	7.99	0.76	0.74
F5-F6	CONDUIT	35.80	0 00:03	5.64	0.85	0.92

F6-F7	CONDUIT	31.99	0	00:03	5.39	1.17	1.00
F7-H2	CONDUIT	32.06	0	00:03	5.40	0.86	1.00
G1-G2	CONDUIT	18.49	0	00:00	7.01	1.19	1.00
G2-H1	CONDUIT	35.02	0	00:00	9.10	0.88	1.00
G3-G4	CONDUIT	18.43	0	00:00	6.67	0.86	1.00
G4-H1	CONDUIT	27.43	0	00:00	9.12	1.30	1.00
H1-H2	CONDUIT	77.08	0	00:04	9.78	1.41	1.00
H2-H3	CONDUIT	125.61	0	00:04	10.36	1.01	0.89
J1-EDB	CONDUIT	13.58	0	00:01	5.76	0.82	0.66
J2-J1	CONDUIT	5.10	0	00:00	3.13	0.29	0.62
PA1-PA2	CONDUIT	107.99	0	00:00	9.46	0.74	1.00
68-69	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
70-71	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
84-A1	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
80-G3	CHANNEL	0.00	0	00:00	0.00	0.00	0.00
H2-HighPtS	WEIR	0.00	0	00:00		0.00	
87-G2	WEIR	0.00	0	00:00		0.00	
HighPtN-J2	WEIR	0.00	0	00:00		0.00	
D4-G4	WEIR	0.00	0	00:00		0.00	
H2-G1-Overtopping	WEIR	2.36	0	00:04		0.11	
H2-G3-Overtopping	WEIR	4.09	0	00:04		0.16	
73-E6	WEIR	0.00	0	00:00		0.00	
76-H2	WEIR	0.00	0	00:00		0.00	
HighPtS-J1	WEIR	0.00	0	00:00		0.00	
72-D4	WEIR	0.00	0	00:00		0.00	
G4-G3-Gutter	WEIR	0.41	0	00:04		0.04	
G2-G1-Gutter	WEIR	0.80	0	00:04		0.10	
HighPtN-G1	WEIR	0.00	0	00:00		0.00	

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Flow Classification Summary
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	Adjusted	---------- Fraction of Time in Flow Class ----------								
	/Actual	Up	Down	Sub	Sup	Up	Down	Norm	Inlet	
Conduit	Length	Dry	Dry	Dry	Crit	Crit	Crit	Crit	Ltd	Ctrl
A1-A2	1.00	0.00	0.00	0.00	0.00	0.01	0.00	0.99	0.00	0.00
A2-A3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
A3-A4	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.99	0.00	0.00
A4-B2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.01	0.00
B1-B2	1.00	0.00	0.00	0.00	0.01	0.96	0.00	0.03	0.00	0.00
B2-B3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
B3-B4	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
B4-C2	1.00	0.00	0.00	0.00	0.01	0.00	0.00	0.98	0.00	0.00
C1-C2	1.00	0.00	0.00	0.00	0.00	0.98	0.00	0.02	0.00	0.00
C2-C3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
C3-D2	1.00	0.00	0.00	0.00	0.03	0.97	0.00	0.00	0.00	0.00
D10-D11	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
D11-D12	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
D12-H1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
D1-D2	1.00	0.00	0.00	0.00	0.95	0.02	0.00	0.02	0.00	0.00
D2-D4	1.00	0.00	0.00	0.00	0.03	0.97	0.00	0.00	0.98	0.00
D4-D5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
D5-D6	1.00	0.00	0.00	0.00	0.00	0.97	0.00	0.03	0.00	0.00
D6-D7	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00

D7-D8	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.00	0.00
D8-D9	1.00	0.00	0.00	0.00	0.95	0.02	0.00	0.03	0.00	0.00
D9-D10	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.00	0.00
E1-E2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
E2-E3	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
E3-E4	1.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.01	0.00
E4-E5	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
E5-E6	1.00	0.00	0.00	0.00	0.01	0.01	0.00	0.98	0.00	0.00
E6-E7	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
E7-F3	1.00	0.00	0.00	0.00	0.00	0.97	0.00	0.03	0.00	0.00
F1-F2	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
F2-F3	1.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02	0.99	0.00
F3-F4	1.00	0.00	0.00	0.00	0.00	0.01	0.00	0.99	0.00	0.00
F4-F5	1.00	0.00	0.00	0.00	0.95	0.01	0.00	0.03	0.00	0.00
F5-F6	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.01	0.00	0.00
F6-F7	1.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00
F7-H2	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
G1-G2	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.00	0.00
G2-H1	1.00	0.00	0.00	0.00	0.97	0.02	0.00	0.01	0.00	0.00
G3-G4	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
G4-H1	1.00	0.00	0.00	0.00	0.97	0.00	0.00	0.03	0.00	0.00
H1-H2	1.00	0.00	0.00	0.00	0.96	0.00	0.00	0.04	0.00	0.00
H2-H3	1.00	0.00	0.00	0.00	0.96	0.04	0.00	0.00	0.00	0.00
J1-EDB	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
J2-J1	1.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
PA1-PA2	1.00	0.00	0.00	0.00	0.01	0.99	0.00	0.00	0.00	0.00
68-69	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
70-71	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
84-A1	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
80-G3	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

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Conduit Surcharge Summary
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Conduit	Hours Full: Both Ends	Hours Full: Upstream	Hours Above Full: Dnstream	Capacity Normal Flow	Limited
D10-D11	0.01	0.01	2.93	0.01	0.01
D11-D12	2.94	2.94	2.95	0.01	0.01
D12-H1	2.95	2.95	2.95	0.01	0.01
D9-D10	0.01	0.01	2.93	0.01	0.01
F5-F6	0.01	0.01	2.93	0.01	0.01
F6-F7	2.95	2.95	2.95	2.95	2.95
F7-H2	2.95	2.95	2.95	0.01	0.01
G1-G2	2.95	2.95	2.95	0.04	0.01
G2-H1	2.95	2.95	2.95	0.01	0.01
G3-G4	2.95	2.95	2.95	0.01	0.01
G4-H1	2.95	2.95	2.95	0.06	0.01
H1-H2	2.95	2.95	2.95	2.96	2.95
H2-H3	0.01	2.95	0.01	2.93	0.01
PA1-PA2	0.01	0.01	3.00	0.01	0.01

Analysis begun on: Wed Apr 14 12:42:25 2021
Analysis ended on: Wed Apr 14 12:42:25 2021

revise the title of the calculation to reflect the contents provided (pipe calcs)

The Glen at Widefield
Developed Condition
Runoff Coeficient and Percent Impervious Calculation

Pipe #	5yr Rat'l	100yr Rat'l	5yr Capture	100yr Capture	Contributing Flows	Manning 'n'	Pipe Slope	Calculated Pipe Diameter	Pipe Diameter	Minimum Slope of Pipe	A (sf)	Wp (ft)	Rh (ft)	Full Pipe Flow Velocity	Head above Pipe Flowline	H	Pipe Inlet Control Capacity	Mannings Pipe Capacity	Capacity Check	Notes		Length (2D Center-to-Center)
Golden Buffs Drive Trunkline																						
A1-A2	3.0 cfs	8.6 cfs	3.0 cfs	6.9 cfs	N/A	0.013	0.70%	16-inch	18-inch	0.43%	1.77 sf	4.7 ft	0.4 ft	5.0 ft/sec		----	----	8.8 cfs	OK	DP84	Future	33.67
A2-A3	3.0 cfs	8.6 cfs	3.0 cfs	6.9 cfs	N/A	0.013	0.60%	17-inch	18-inch	0.43%	1.77 sf	4.7 ft	0.4 ft	4.6 ft/sec		----	----	8.2 cfs	OK	DP84	Future	124.91
A3-A4	3.0 cfs	8.6 cfs	3.0 cfs	6.9 cfs	N/A	0.013	0.60%	17-inch	18-inch	0.43%	1.77 sf	4.7 ft	0.4 ft	4.6 ft/sec		----	----	8.2 cfs	OK	DP84	Future	125.80
A4-B2	3.0 cfs	8.6 cfs	3.0 cfs	6.9 cfs	N/A	0.013	0.60%	17-inch	18-inch	0.43%	1.77 sf	4.7 ft	0.4 ft	4.6 ft/sec		----	----	8.2 cfs	OK	DP84		153.59
B1-B2	2.5 cfs	7.3 cfs	5.0 cfs	9.0 cfs	A1 Bypass	0.013	1.00%	17-inch	18-inch	0.73%	1.77 sf	4.7 ft	0.4 ft	6.0 ft/sec		----	----	10.5 cfs	OK			29.70
B2-B3	7.3 cfs	21.2 cfs	8.0 cfs	15.9 cfs	N/A	0.013	0.70%	22-inch	24-inch	0.49%	3.14 sf	6.3 ft	0.5 ft	6.0 ft/sec		----	----	19.0 cfs	OK			168.24
B3-B4	7.3 cfs	21.2 cfs	8.0 cfs	15.9 cfs	N/A	0.013	0.70%	22-inch	24-inch	0.49%	3.14 sf	6.3 ft	0.5 ft	6.0 ft/sec		----	----	19.0 cfs	OK			80.62
B4-C2	7.3 cfs	21.2 cfs	8.0 cfs	15.9 cfs	N/A	0.013	0.70%	22-inch	24-inch	0.49%	3.14 sf	6.3 ft	0.5 ft	6.0 ft/sec		----	----	19.0 cfs	OK			77.97
C1-C2	7.3 cfs	21.2 cfs	2.4 cfs	5.8 cfs	B1 Bypass	0.013	2.00%	18-inch	18-inch	0.31%	1.77 sf	4.7 ft	0.4 ft	8.4 ft/sec		----	----	14.9 cfs	OK	DP85		29.14
C2-C3	10.8 cfs	31.2 cfs	10.4 cfs	21.7 cfs	N/A	0.013	0.60%	26-inch	30-inch	0.28%	4.91 sf	7.9 ft	0.6 ft	6.5 ft/sec		----	----	31.9 cfs	OK	DP85		92.14
C3-D2	10.8 cfs	31.2 cfs	10.4 cfs	21.7 cfs	N/A	0.013	0.60%	26-inch	30-inch	0.28%	4.91 sf	7.9 ft	0.6 ft	6.5 ft/sec		----	----	31.9 cfs	OK			177.80
D1-D2	1.4 cfs	4.2 cfs	4.3 cfs	8.1 cfs	C1 Bypass	0.013	2.00%	14-inch	18-inch	0.60%	1.77 sf	4.7 ft	0.4 ft	8.4 ft/sec		----	----	14.9 cfs	OK			27.71
D2-D4	12.0 cfs	34.6 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.60%	33-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	7.3 ft/sec		----	----	51.8 cfs	OK			212.13
D4-D5	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.80%	31-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	8.5 ft/sec		----	----	59.8 cfs	OK	DP86		161.24
D5-D6	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	1.10%	29-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	9.9 ft/sec		----	----	70.1 cfs	OK			216.49
D6-D7	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.90%	30-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	9.0 ft/sec		----	----	63.4 cfs	OK			85.26
D7-D8	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.90%	30-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	9.0 ft/sec		----	----	63.4 cfs	OK			78.72
D8-D9	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	1.00%	30-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	9.5 ft/sec		----	----	66.9 cfs	OK	DP87		83.20
D9-D10	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.80%	31-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	8.5 ft/sec		----	----	59.8 cfs	OK			80.51
D10-D11	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.40%	35-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	6.0 ft/sec		----	----	42.3 cfs	OK			78.14
D11-D12	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	N/A	0.013	0.40%	35-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	6.0 ft/sec		----	----	42.3 cfs	OK			155.35
D12-H1	15.8 cfs	45.7 cfs	18.5 cfs	39.7 cfs	C1, D1 & D2 Bypass	0.013	0.40%	35-inch	36-inch	0.35%	7.07 sf	9.4 ft	0.8 ft	6.0 ft/sec		----	----	42.3 cfs	OK			94.06
H1-H2	32.9 cfs	77.9 cfs	46.1 cfs	86.0 cfs		0.013	0.50%	45-inch	48-inch	0.36%	12.57 sf	12.6 ft	1.0 ft	8.1 ft/sec		----	----	101.8 cfs	OK			55.96
PennyCress Drive Trunkline																						
E1-E2	4.5 cfs	13.1 cfs	3.4 cfs	8.5 cfs	N/A	0.013	0.60%	18-inch	21-inch	0.29%	2.41 sf	5.5 ft	0.4 ft	5.1 ft/sec		----	----	12.3 cfs	OK			37.39
E2-E3	7.1 cfs	20.6 cfs	6.0 cfs	14.6 cfs	N/A	0.013	0.90%	21-inch	21-inch	0.85%	2.41 sf	5.5 ft	0.4 ft	6.3 ft/sec		----	----	15.1 cfs	OK			29.61
E3-E4	7.1 cfs	20.6 cfs	6.0 cfs	14.6 cfs	N/A	0.013	1.00%	20-inch	21-inch	0.85%	2.41 sf	5.5 ft	0.4 ft	6.6 ft/sec		----	----	15.9 cfs	OK			189.40
E4-E5	7.1 cfs	20.6 cfs	6.0 cfs	14.6 cfs	N/A	0.013	1.00%	20-inch	21-inch	0.85%	2.41 sf	5.5 ft	0.4 ft	6.6 ft/sec		----	----	15.9 cfs	OK			189.25
E5-E6	7.1 cfs	20.6 cfs	6.0 cfs	14.6 cfs	E1, E2 Bypass	0.013	1.20%	20-inch	21-inch	0.85%	2.41 sf	5.5 ft	0.4 ft	7.2 ft/sec		----	----	17.4 cfs	OK			150.07
E6-E7	10.0 cfs	29.0 cfs	9.9 cfs	25.7 cfs	N/A	0.013	0.80%	26-inch	30-inch	0.39%	4.91 sf	7.9 ft	0.6 ft	7.5 ft/sec		----	----	36.8 cfs	OK	DP75		100.41
F1-F2	2.3 cfs	6.6 cfs	2.3 cfs	6.6 cfs	N/A	0.013	4.00%	12-inch	18-inch	0.39%	1.77 sf	4.7 ft	0.4 ft	11.9 ft/sec		----	----	21.1 cfs	OK	DP77		197.94
F2-F3	2.3 cfs	6.6 cfs	2.3 cfs	6.6 cfs	N/A	0.013	0.50%	17-inch	18-inch	0.39%	1.77 sf	4.7 ft	0.4 ft	4.2 ft/sec		----	----	7.4 cfs	OK	DP77		292.03
E7-F3	10.0 cfs	29.0 cfs	12.2 cfs	32.3 cfs	N/A	0.013	0.80%	29-inch	30-inch	0.62%	4.91 sf	7.9 ft	0.6 ft	7.5 ft/sec		----	----	36.8 cfs	OK			64.32
F3-F4	13.5 cfs	39.0 cfs	12.2 cfs	32.3 cfs	N/A	0.013	0.80%	29-inch	30-inch	0.62%	4.91 sf	7.9 ft	0.6 ft	7.5 ft/sec		----	----	36.8 cfs	OK	DP78		63.47
F4-F5	5.4 cfs	39.0 cfs	12.2 cfs	32.3 cfs	N/A	0.013	0.80%	29-inch	30-inch	0.62%	4.91 sf	7.9 ft	0.6 ft	7.5 ft/sec		----	----	36.8 cfs	OK			250.09
F5-F6	5.4 cfs	39.0 cfs	12.2 cfs	32.3 cfs	N/A	0.013	0.40%	33-inch	36-inch	0.23%	7.07 sf	9.4 ft	0.8 ft	6.0 ft/sec		----	----	42.3 cfs	OK			189.19
F6-F7	5.4 cfs	39.0 cfs	12.2 cfs	32.3 cfs	N/A	0.013	0.40%	33-inch	36-inch	0.23%	7.07 sf	9.4 ft	0.8 ft	6.0 ft/sec		----	----	42.3 cfs	OK			75.03
F7-H2	5.4 cfs	15.5 cfs	12.2 cfs	32.3 cfs	N/A	0.013	0.40%	33-inch	36-inch	0.23%	7.07 sf	9.4 ft	0.8 ft	6.0 ft/sec		----	----	42.3 cfs	OK	DP 79		106.99
G1-G2	0.3 cfs	0.7 cfs	15.7 cfs	16.3 cfs	G-2, G3, H2 Bypass	0.013	0.60%	23-inch	24-inch	0.52%	3.14 sf	6.3 ft	0.5 ft	5.6 ft/sec		----	----	17.6 cfs	OK	DP 89		36.18
G2-H1	6.2 cfs	18.1 cfs	21.9 cfs	29.9 cfs	N/A	0.013	1.00%	27-inch	30-inch	0.53%	4.91 sf	7.9 ft	0.6 ft	8.4 ft/sec		----	----	41.1 cfs	OK	DP 88		29.60
G3-G4	3.8 cfs	12.8 cfs	5.7 cfs	16.4 cfs	N/A	0.013	1.10%	21-inch	24-inch	0.53%	3.14 sf	6.3 ft	0.5 ft	7.6 ft/sec		----	----	23.8 cfs	OK	DP 83		10.28
G4-H1	5.7 cfs	16.4 cfs	9.5 cfs	23.5 cfs	N/A	0.013	1.10%	24-inch	24-inch	1.08%	3.14 sf	6.3 ft	0.5 ft	7.6 ft/sec		----	----	23.8 cfs	OK	DP 81		37.88
H2-H3	45.8 cfs	94.5 cfs	64.3 cfs	99.7 cfs	E6 Bypass	0.013	0.60%	46-inch	48-inch	0.48%	12.57 sf	12.6 ft	1.0 ft	8.9 ft/sec		----	----	111.6 cfs	OK			45.54
Pair at Inflow 'J'																						
J2-J1	1.0 cfs	2.6 cfs	1.0 cfs	3.7 cfs	G-2, G3, H2 Bypass	0.013	0.50%	14-inch	24-inch	0.03%	3.14 sf	6.3 ft	0.5 ft	5.1 ft/sec		----	----	16.0 cfs	OK			35.87
J1-End	1.8 cfs	4.1 cfs	2.8 cfs	8.7 cfs	G-2, G3, H2 Bypass	0.013	0.60%	18-inch	24-inch	0.15%	3.14 sf	6.3 ft	0.5 ft	5.6 ft/sec		----	----	17.6 cfs	OK			76.59

Box Culvert Poa Annua Street																						
PA1-PA2		102.1 cfs	N/A	102.1 cfs	OS-2	0.013	0.50%	48-inch	50-inch	0.50%	13.64 sf	13.1 ft	1.0 ft	8.3 ft/sec		----	----	113.6 cfs	OK			97.06

revise title. these are inlet calcs.

The Glen at Widefield
Developed Condition
Runoff Coeficient and Percent Impervious Calculation

Inlet ID	Design Flow (Basin or DP)	Flow to Inlet			Upstream Inlet(s)	Carry Over Flow		Flow to Inlet including Carry Over		Street Flow Depth		Street Section Capacity		Inlet Type	Inlet Condition	Inlet Capacity		Flow Not Captured by Inlet		to
		2yr	5yr	100yr		5yr	100yr	5yr	100yr	5yr	100yr	5yr	100yr			5yr	100yr	5yr	100yr	
A-1	DP 84		3.0cfs	8.6cfs	None	0.0cfs	0.9cfs	3.0cfs	9.5cfs	6.0in	6.2in	8.2cfs	11.3cfs	10' Type R	On Grade	3.0 cfs	6.9 cfs	0.0cfs	2.6cfs	to B-1
A-4	'A-4' (Ultimate)		4.4cfs	12.7cfs	A-1	0.0cfs	2.6cfs	4.4cfs	15.3cfs	6.0in	12.0in	10.0cfs	24.0cfs	MANHOLE	IN PIPE	10.0 cfs	24.0 cfs	0.0cfs	0.0cfs	N/A
B-1	D-16		2.5cfs	7.3cfs	A-1	0.0cfs	2.6cfs	2.5cfs	9.9cfs	6.0in	6.2in	8.2cfs	11.3cfs	10' Type R	On Grade	5.0 cfs	9.6 cfs	0.0cfs	0.3cfs	to C-1
C-1	DP 85		2.4cfs	6.9cfs	A-1, B-1	0.0cfs	0.3cfs	2.4cfs	7.2cfs	6.0in	6.2in	8.2cfs	11.3cfs	10' Type R	On Grade	2.4 cfs	5.8 cfs	0.0cfs	1.4cfs	to D-1
D-1	DP 86		4.4cfs	12.7cfs	A-1, B-1, C-1	0.0cfs	1.4cfs	4.4cfs	14.1cfs	6.0in	6.2in	10.3cfs	14.2cfs	10' Type R	On Grade	4.3 cfs	8.1 cfs	0.1cfs	6.0cfs	to G-2
D-4	DP 82		3.8cfs	11.1cfs	A-1, B-1, C-1	0.0cfs	0.0cfs	3.8cfs	11.1cfs	6.0in	6.2in	8.2cfs	11.3cfs	15' Type R	On Grade	3.8 cfs	9.9 cfs	0.0cfs	1.2cfs	to G-4
G-1	DP 89		0.3cfs	0.7cfs	None	0.0cfs	15.8cfs	0.3cfs	16.6cfs	6.0in	6.2in	11.1cfs	11.1cfs	20' Type R	In Sump	10.8 cfs	19.9 cfs	0.0cfs	0.0cfs	N/A
G-2	DP 88		6.2cfs	18.1cfs	A-1 thru D-1	0.1cfs	6.0cfs	6.3cfs	24.0cfs	6.0in	6.2in	7.7cfs	10.6cfs	15' Type R	On Grade	6.3 cfs	13.6 cfs	0.0cfs	10.4cfs	to G-1
G-3	DP 81		5.7cfs	16.4cfs	None	0.0cfs	0.0cfs	5.7cfs	16.4cfs	6.0in	6.2in	11.1cfs	11.1cfs	20' Type R	In Sump	10.8 cfs	19.9 cfs	0.0cfs	0.0cfs	N/A
G-4	DP 83		3.8cfs	11.0cfs	D-4	0.0cfs	1.2cfs	3.8cfs	12.2cfs	6.0in	6.2in	9.1cfs	12.8cfs	15' Type R	On Grade	3.8 cfs	7.1 cfs	0.0cfs	5.1cfs	J-1
E-1	DP 71		3.4cfs	9.9cfs	None	0.0cfs	0.0cfs	3.4cfs	9.9cfs	6.0in	6.2in	10.2cfs	14.1cfs	10' Type R	On Grade	3.4 cfs	8.5 cfs	0.0cfs	1.4cfs	to E-6
E-2	DP 69		2.6cfs	7.5cfs	None	0.0cfs	0.0cfs	2.6cfs	7.5cfs	6.0in	6.2in	10.2cfs	14.1cfs	10' Type R	On Grade	2.6 cfs	6.1 cfs	0.0cfs	1.4cfs	to E-6
E-6	DP 75		3.7cfs	10.8cfs	E-1, E-2	0.0cfs	2.9cfs	3.8cfs	13.7cfs	6.0in	6.2in	11.6cfs	16.0cfs	15' Type R	On Grade	3.9 cfs	11.1 cfs	0.0cfs	2.6cfs	to H-2
F-1	DP 77		2.3cfs	6.6cfs	None	0.0cfs	0.0cfs	2.3cfs	6.6cfs	6.0in	6.2in	11.1cfs	11.1cfs	10' Type R	In Sump	8.7 cfs	11.2 cfs	0.0cfs	0.0cfs	to H-2
H-2	DP 79		5.4cfs	15.5cfs	A thru H	0.0cfs	5.5cfs	5.4cfs	21.0cfs	6.0in	6.2in	11.1cfs	11.1cfs	20' Type R	In Sump	18.2 cfs	19.9 cfs	0.0cfs	1.1cfs	to J-2
J-1	DP 92a		1.0cfs	2.6cfs	DP 20 Only + Overtopping	0.0cfs	5.1cfs	1.0cfs	7.7cfs	6.0in	6.2in	11.1cfs	11.1cfs	10' Type R	In Sump	8.7 cfs	8.7 cfs	0.0cfs	0.0cfs	to J-1
J-2	DP 92b		0.8cfs	1.5cfs	DP 23 Only + Overtopping	0.0cfs	1.1cfs	0.8cfs	2.6cfs	6.0in	6.2in	11.1cfs	11.1cfs	10' Type R	In Sump	8.7 cfs	8.7 cfs	0.0cfs	0.0cfs	G-1

G-2	BYPASSES	0.0cfs	10.4cfs	Note: Street Capacity Exceeded at Inlets G-2, G-4, and H-2
G-3	BYPASSES	0.0cfs	0.0cfs	Per Design, Flow Depth in excess of five inches (5")
G-4	BYPASSES	0.0cfs	5.1cfs	will overtop to surrounding inlets:
H-2	BYPASSES	0.0cfs	1.1cfs	G-1, J-1 & J-2 to accomplish 100% inlet capture (as Backflow).
	SUB TOTAL:	0.0cfs	16.6cfs	
G-1	RECEIVES	0.0cfs	10.4cfs	
J-1	RECEIVES	0.0cfs	5.1cfs	
J-2	RECEIVES	0.0cfs	1.1cfs	

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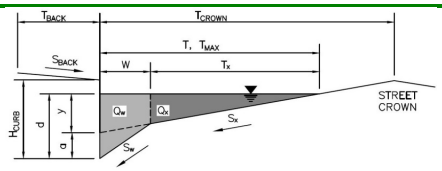
ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

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

Project: The Glen at Widefield Filing No 11

Inlet ID: A-1



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} =	0.017	
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 =	**0.006**	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	6.2	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 Depth Criterion	Q_{allow} =	**8.2**	**11.3**	**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

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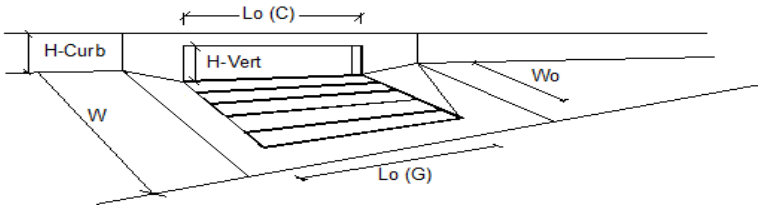


Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a')	a_{LOCAL} =	3.0	3.0	inches
Total Number of Units in the Inlet (Grate or Curb Opening)	No =	2	2	
Length of a Single Unit Inlet (Grate or Curb Opening)	L_o =	5.00	5.00	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 =**	**3.0**	**6.9**	**cfs**
Total Inlet Carry-Over Flow (flow bypassing inlet)	**Q_b =**	**0.0**	**2.6**	**cfs**
Capture Percentage = Q_a/Q_o =	**C% =**	**100**	**73**	**%**

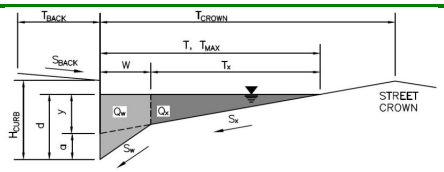
Version 4.05 Released March 2017

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

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

Project: The Glen at Widefield Filing No 11

Inlet ID: F-1



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} =	0.017	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	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	6.2	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

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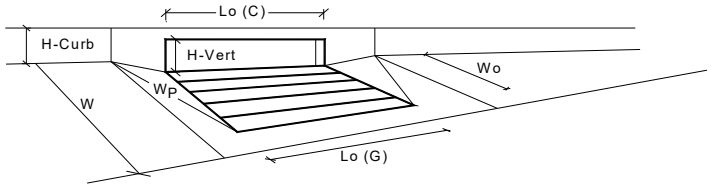

Design Information (Input)		MINOR	MAJOR	
Type of Inlet	CDOT Type R Curb Opening	Type =	CDOT Type R Curb Opening	
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00 inches
Number of Unit Inlets (Grate or Curb Opening)		No =	2	2
Water Depth at Flowline (outside of local depression)		Ponding Depth =	5.6	6.2 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) =	5.00	5.00 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	0.35 ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.53	0.58
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	0.91	0.94
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 =**	**8.7**	**11.2** **cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	2.3	6.6 cfs

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INLET MANAGEMENT

Worksheet Protected

INLET NAME	B-1	C-1	D-1	D-4
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	On Grade	On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	5.5	2.4	4.4	3.8
Major Q_{Known} (cfs)	15.9	6.9	12.7	11.1

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	A-1	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	2.6	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type	C	C	C	C

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**5.5**	**2.4**	**4.4**	**3.8**
Major Total Design Peak Flow, Q (cfs)	**18.5**	**6.9**	**12.7**	**11.1**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.5	0.0	0.1	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	8.9	1.1	4.6	1.2

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	G-1	G-2		E-1	E-2
Site Type (Urban or Rural)	URBAN	URBAN		URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET		STREET	STREET
Hydraulic Condition	In Sump	On Grade		On Grade	On Grade
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening		CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.3	6.2	3.4	2.6
Major Q_{Known} (cfs)	0.7	14.5	9.9	7.5

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	D-1	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.1	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	4.6	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type	C	C	C	C

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**0.3**	**6.3**	**3.4**	**2.6**
Major Total Design Peak Flow, Q (cfs)	**0.7**	**19.1**	**9.9**	**7.5**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0	0.0	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	5.6	2.8	1.4

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	E-6	H-2	J-1	J-2
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET	STREET
Hydraulic Condition	On Grade	In Sump	In Sump	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.9	15.1	1.0	0.8
Major Q_{Known} (cfs)	11.3	43.8	2.6	1.5

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	User-Defined	E-6	User-Defined	User-Defined
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0		
Major Bypass Flow Received, Q_b (cfs)	1.8	2.0	8.2	9.5

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type	C	C	C	C

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.9**	**15.1**	**1.0**	**0.8**
Major Total Design Peak Flow, Q (cfs)	**13.1**	**45.8**	**10.8**	**11.0**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	2.0	N/A	N/A	N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	F-1	A-1	A-4	G-3
Site Type (Urban or Rural)	URBAN	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	AREA	STREET
Hydraulic Condition	In Sump	On Grade	Swale	In Sump
Inlet Type	CDOT Type R Curb Opening	CDOT Type R Curb Opening		CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	2.3	3.0	5.0	5.7
Major Q_{Known} (cfs)	6.6	8.6	10.0	16.4

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	User-Defined	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0		
Major Bypass Flow Received, Q_b (cfs)	0.0	0.9		

Watershed Characteristics

Subcatchment Area (acres)				
Percent Impervious				
NRCS Soil Type	C	C	C	C

Watershed Profile

Overland Slope (ft/ft)				
Overland Length (ft)				
Channel Slope (ft/ft)				
Channel Length (ft)				

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)				
One-Hour Precipitation, P_1 (inches)				
C_1				
C_2				
C_3				
User-defined C				
User-defined 5-yr C_5				
User-defined T_c				

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**2.3**	**3.0**	**5.0**	**5.7**
Major Total Design Peak Flow, Q (cfs)	**6.6**	**9.5**	**10.0**	**16.4**
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	0.0		N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	2.6		N/A

Version 4.05 Released March 2017

INLET MANAGEMENT

Worksheet Protected

INLET NAME	G-4 ON GRADE
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	On Grade
Inlet Type	CDOT Type R Curb Opening

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	3.8
Major Q_{Known} (cfs)	12.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	C

Watershed Profile

Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	
C_1	
C_2	
C_3	
User-defined C	
User-defined 5-yr C_5	
User-defined T_c	

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	
C_1	
C_2	
C_3	
User-defined C	
User-defined 5-yr C_5	
User-defined T_c	

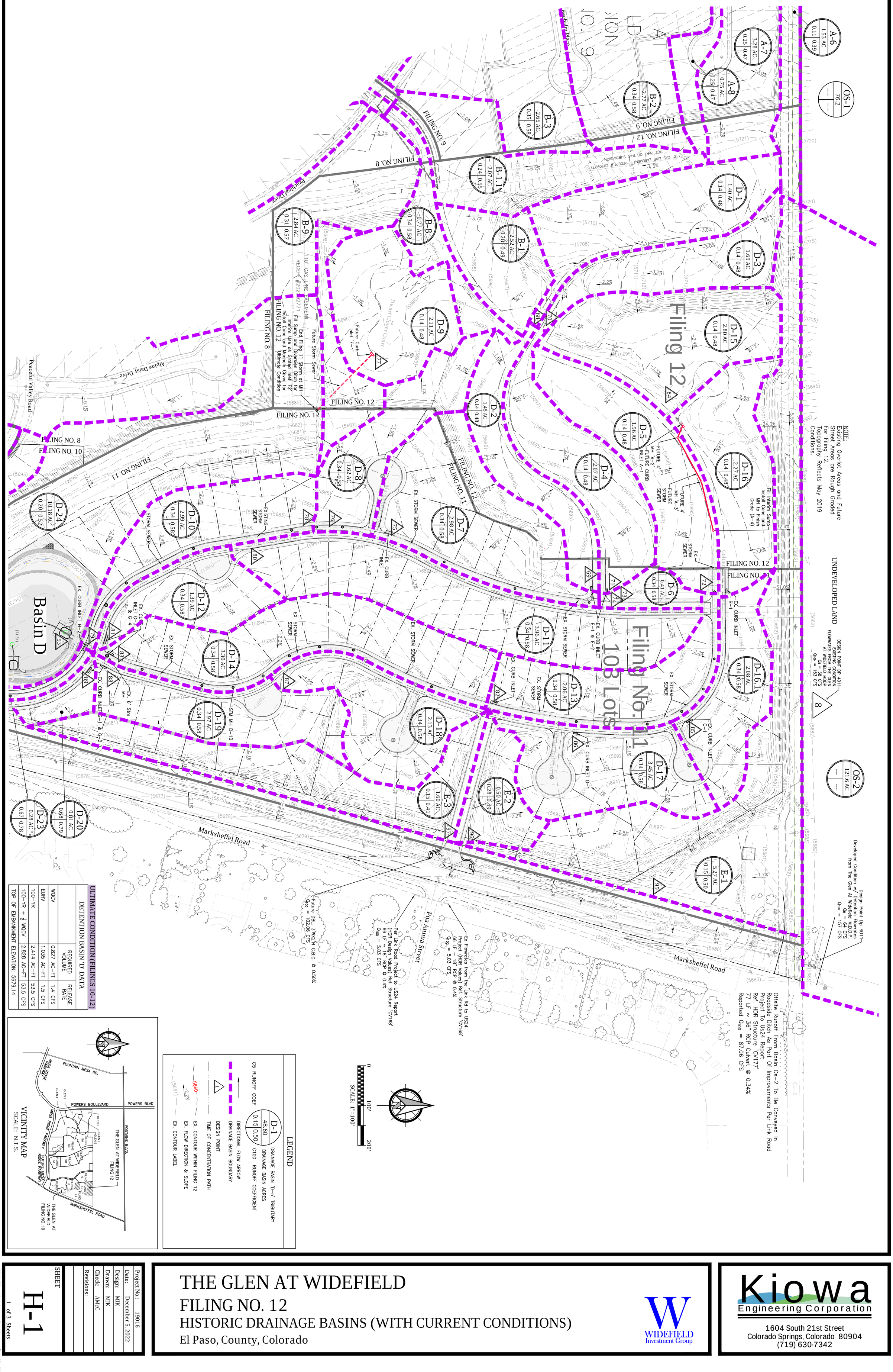
CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	**3.8**
Major Total Design Peak Flow, Q (cfs)	**12.2**
Minor Flow Bypassed Downstream, Q_b (cfs)	0.0
Major Flow Bypassed Downstream, Q_b (cfs)	1.7

APPENDIX D

Existing and Proposed Drainage Plans

H-1 – Historic Conditions (Overall)
D-1 - Developed Conditions Onsite (South)
D-2 – Developed Conditions Onsite (North)



NOTE:
Existing Overlot Areas and Future Street Areas are Rough Graded For Filing 12. Topography Reflects May 2019 Conditions.

UNDEVELOPED LAND

ULTIMATE CONDITION (FILINGS 10-12)

DETENTION BASIN 'D' DATA		
	REQUIRED VOLUME	RELEASE RATE
WQCV	0.827 AC-FT	1.4 CFS
EURV	1.035 AC-FT	1.5 CFS
100-YR	2.414 AC-FT	53.5 CFS
100-YR + ½ WQCV	2.828 AC-FT	53.5 CFS
TOP OF EMBANKMENT ELEVATION: 5679.14		

THE GLEN AT WIDEFIELD
FILING NO. 12
HISTORIC DRAINAGE BASINS (WITH CURRENT CONDITIONS)
El Paso, County, Colorado

WIDEFIELD Investment Group

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

Project No.: 19016
Date: December 5, 2022
Design: MJK
Drawn: MJK
Check: AMcC
Revisions:

SHEET H-1
1 of 3 Sheets

19016 Filing 12 -- Historic Conditions.dwg/Dec 05, 2022

INLET IDENTIFIER B-1

Inlet ID	Design Flow (Basin or DP)	Flow to Inlet			Inlet Type	Inlet Condition	Inlet Capacity		Flow Not Captured by Inlet		to
		2yr	5yr	100yr			5yr	100yr	5yr	100yr	
A-1	DP 84	3.0cfs	8.6cfs	18.7cfs	10' Type R	On Grade	10.0 cfs	24.0 cfs	0.0cfs	1.7cfs	to B-1
A-4	'A-4' (Temp)	4.4cfs	12.7cfs	Temp. Grate at MH	Temp. Grate at MH	In Sump	10.0 cfs	24.0 cfs	0.0cfs	0.0cfs	to C-1
B-1	D-16	2.5cfs	7.3cfs	15.9cfs	10' Type R	On Grade	5.0 cfs	9.6 cfs	0.0cfs	0.0cfs	to C-1
C-1	DP 85	2.4cfs	6.9cfs	15.0cfs	10' Type R	On Grade	2.4 cfs	5.8 cfs	0.0cfs	1.1cfs	to D-1
D-1	DP 86	4.4cfs	12.7cfs	27.6cfs	10' Type R	On Grade	4.3 cfs	8.1 cfs	0.1cfs	5.7cfs	to G-2
D-4	DP 82	3.8cfs	11.1cfs	24.1cfs	15' Type R	On Grade	3.8 cfs	9.9 cfs	0.0cfs	1.2cfs	to G-4
G-1	DP 89	0.3cfs	0.7cfs	1.5cfs	20' Type R	In Sump	10.8 cfs	19.9 cfs	0.0cfs	0.0cfs	N/A
G-2	DP 88	6.2cfs	18.1cfs	39.3cfs	15' Type R	On Grade	6.3 cfs	13.6 cfs	0.0cfs	10.1cfs	to G-1
G-3	DP 81	5.7cfs	16.4cfs	35.6cfs	20' Type R	In Sump	10.0 cfs	19.9 cfs	0.0cfs	0.0cfs	N/A
G-4	DP 83	3.8cfs	11.0cfs	23.9cfs	15' Type R	On Grade	3.8 cfs	7.1 cfs	0.0cfs	5.1cfs	J-1
E-1	DP 71	3.4cfs	9.9cfs	21.5cfs	10' Type R	On Grade	3.4 cfs	8.5 cfs	0.0cfs	1.4cfs	to E-6
E-2	DP 69	2.6cfs	7.5cfs	16.3cfs	10' Type R	On Grade	2.6 cfs	6.1 cfs	0.0cfs	1.4cfs	to E-6
E-6	DP 75	3.7cfs	10.8cfs	23.4cfs	15' Type R	On Grade	3.9 cfs	11.1 cfs	0.0cfs	2.6cfs	to H-2
F-1	DP 77	2.3cfs	6.6cfs	14.3cfs	10' Type R	In Sump	8.7 cfs	11.2 cfs	0.0cfs	0.0cfs	to H-2
H-2	DP 79	5.4cfs	15.5cfs	33.6cfs	20' Type R	In Sump	18.2 cfs	19.9 cfs	0.0cfs	1.1cfs	to J-2
J-1	DP 92a	1.0cfs	2.6cfs	5.6cfs	10' Type R	In Sump	8.7 cfs	8.7 cfs	0.0cfs	0.0cfs	to J-1
J-2	DP 92b	0.8cfs	1.5cfs	3.2cfs	10' Type R	In Sump	8.7 cfs	8.7 cfs	0.0cfs	0.0cfs	to J-1

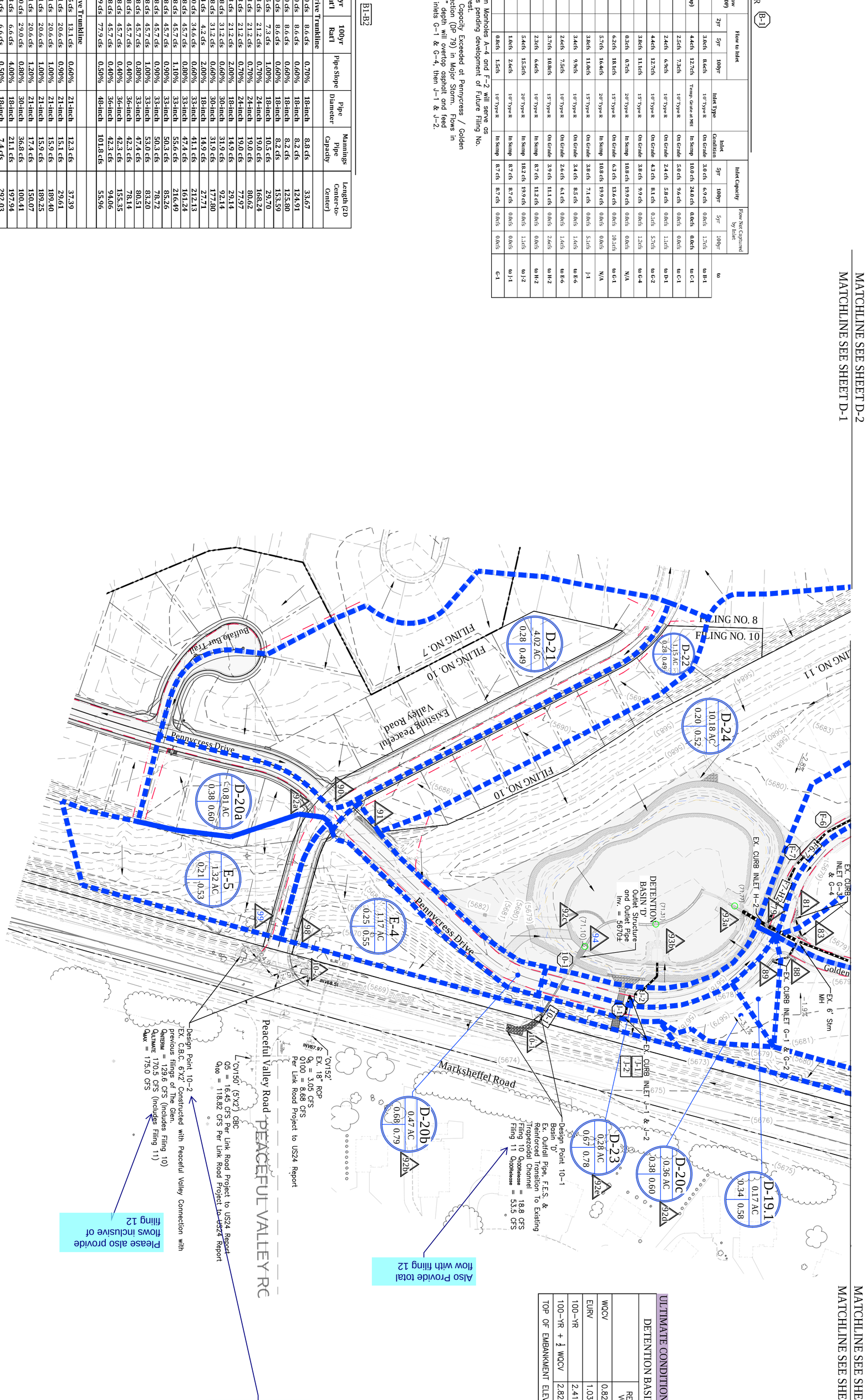
Note: Storm Manholes A-4 and F-2 will serve as interim inlets pending development of Future Filing No. 12 to the west.
Note: Street Capacity Exceeded at Pennycress / Golden Buffs Intersection (DP 79) in Major Storm. Flows in excess of 5" depth will overtop asphalt and feed surrounding inlets G-1 & G-4, then J-1 & J-2.

PIPE IDENTIFIER B1-B2

Pipe #	5yr Rat'l	100yr Rat'l	Pipe Slope	Pipe Diameter	Mannings Pipe Capacity	Length (CD Center-to-Center)
Golden Buffs Drive Trunkline						
A1-A2	3.0 cfs	8.6 cfs	0.70%	18-inch	8.8 cfs	33.67
A2-A3	3.0 cfs	8.6 cfs	0.60%	18-inch	8.2 cfs	124.91
A3-A4	3.0 cfs	8.6 cfs	0.60%	18-inch	8.2 cfs	125.80
A4-B2	3.0 cfs	8.6 cfs	0.60%	18-inch	8.2 cfs	153.59
B1-B2	2.5 cfs	7.3 cfs	1.00%	18-inch	10.5 cfs	29.70
B2-B3	7.3 cfs	21.2 cfs	0.70%	24-inch	19.0 cfs	168.24
B3-B4	7.3 cfs	21.2 cfs	0.70%	24-inch	19.0 cfs	80.62
B4-C2	7.3 cfs	21.2 cfs	0.70%	24-inch	19.0 cfs	77.97
C1-C2	7.3 cfs	21.2 cfs	2.00%	18-inch	14.9 cfs	29.14
C2-C3	10.8 cfs	31.2 cfs	0.60%	30-inch	31.9 cfs	92.14
C3-D2	10.8 cfs	31.2 cfs	0.60%	30-inch	31.9 cfs	177.80
D1-D2	1.4 cfs	4.2 cfs	2.00%	18-inch	14.9 cfs	27.71
D2-D4	12.0 cfs	34.6 cfs	0.60%	33-inch	41.1 cfs	212.13
D4-D5	15.8 cfs	45.7 cfs	0.80%	33-inch	47.4 cfs	161.24
D5-D6	15.8 cfs	45.7 cfs	1.10%	33-inch	55.6 cfs	216.49
D6-D7	15.8 cfs	45.7 cfs	0.90%	33-inch	50.3 cfs	85.26
D7-D8	15.8 cfs	45.7 cfs	0.90%	33-inch	50.3 cfs	78.72
D8-D9	15.8 cfs	45.7 cfs	1.00%	33-inch	53.0 cfs	83.20
D9-D10	15.8 cfs	45.7 cfs	0.80%	33-inch	47.4 cfs	80.51
D10-D11	15.8 cfs	45.7 cfs	0.40%	36-inch	42.3 cfs	78.14
D11-D12	15.8 cfs	45.7 cfs	0.40%	36-inch	42.3 cfs	155.35
D12-H1	15.8 cfs	45.7 cfs	0.40%	36-inch	42.3 cfs	94.06
H1-H2	32.9 cfs	77.9 cfs	0.50%	48-inch	101.8 cfs	55.96
PennyCress Drive Trunkline						
E1-E2	4.5 cfs	13.1 cfs	0.60%	21-inch	12.3 cfs	37.39
E2-E3	7.1 cfs	20.6 cfs	0.90%	21-inch	15.1 cfs	29.61
E3-E4	7.1 cfs	20.6 cfs	1.00%	21-inch	15.9 cfs	189.40
E4-E5	7.1 cfs	20.6 cfs	1.00%	21-inch	15.9 cfs	189.25
E5-E6	7.1 cfs	20.6 cfs	1.20%	21-inch	17.4 cfs	150.07
E6-E7	10.0 cfs	29.0 cfs	0.80%	30-inch	36.8 cfs	100.41
F1-F2	2.3 cfs	6.6 cfs	4.00%	18-inch	21.1 cfs	197.94
F2-F3	2.3 cfs	6.6 cfs	0.50%	18-inch	7.4 cfs	292.03
E7-F3	10.0 cfs	29.0 cfs	0.80%	30-inch	36.8 cfs	64.32
F3-F4	13.5 cfs	39.0 cfs	0.80%	30-inch	36.8 cfs	63.47
F4-F5	5.4 cfs	39.0 cfs	0.80%	30-inch	36.8 cfs	250.09
F5-F6	5.4 cfs	39.0 cfs	0.40%	33-inch	33.5 cfs	189.19
F6-F7	5.4 cfs	39.0 cfs	0.40%	33-inch	33.5 cfs	75.03
F7-H2	5.4 cfs	15.5 cfs	0.40%	33-inch	33.5 cfs	106.99
G1-G2	0.3 cfs	0.7 cfs	0.60%	24-inch	17.6 cfs	36.18
G2-H1	6.2 cfs	18.1 cfs	1.00%	30-inch	41.1 cfs	29.60
G3-G4	3.8 cfs	12.8 cfs	1.10%	24-inch	23.8 cfs	10.28
G4-H1	5.7 cfs	16.4 cfs	1.10%	24-inch	23.8 cfs	37.88
H2-H3	45.8 cfs	94.5 cfs	0.60%	48-inch	111.6 cfs	45.54
Pair at Inflow 'J'						
J2-J1	1.0 cfs	2.6 cfs	0.50%	24-inch	16.0 cfs	35.87
J1-End	1.8 cfs	4.1 cfs	0.60%	24-inch	17.6 cfs	76.59

Box Culvert Poa Annua Street				
PA1-PA2	102.1 cfs	0.50%	50-inch	113.6 cfs	97.06

MATCHLINE SEE SHEET D-2
MATCHLINE SEE SHEET D-1



ULTIMATE CONDITION (FILINGS 10-12)

DETENTION BASIN 'D' DATA		
	REQUIRED VOLUME	RELEASE RATE
WQCV	0.827 AC-FT	1.4 CFS
EURV	1.035 AC-FT	1.5 CFS
100-YR	2.414 AC-FT	53.5 CFS
100-YR + ½ WQCV	2.828 AC-FT	53.5 CFS
TOP OF EMBANKMENT ELEVATION: 5679.14		

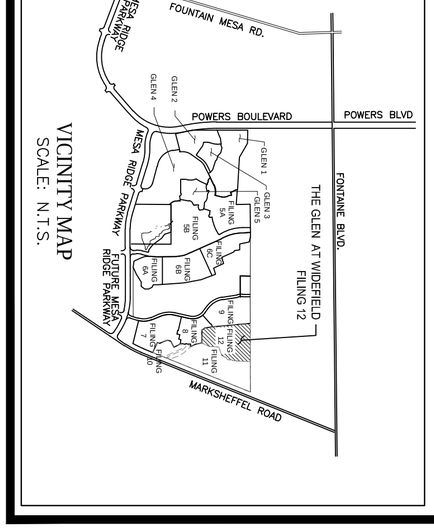
DESIGN POINT FLOWS

	5-YEAR Filings 10-12	100-YEAR Filings 10-12
79	5.4 cfs	15.5 cfs
81	5.7 cfs	16.4 cfs
83	6.4 cfs	18.5 cfs
88	13.5 cfs	39.0 cfs
89	0.3 cfs	0.7 cfs
90	1.3 cfs	3.6 cfs
91	4.4 cfs	12.7 cfs
92a	3.6 cfs	5.9 cfs
92b	6.4 cfs	18.5 cfs
93a	32.7 cfs	94.5 cfs
93b	2.3 cfs	5.9 cfs
94	51.3 cfs	154.8 cfs
10-1	4.0 cfs	41.8 cfs
98	0.9 cfs	3.8 cfs
99	1.1 cfs	4.6 cfs
10-2		146.6 cfs

LEGEND

- D-1 / 48.60 / 0.15 | 0.50 — DRAINAGE BASIN 'D-n' TRIBUTARY; DRAINAGE BASIN ACRES; C5 RUNOFF COEF; C100 RUNOFF COEFFICIENT
- 2.2 cfs / 4.3 cfs — 5-YEAR RUNOFF / 100-YEAR RUNOFF
- 2.05% — DIRECTIONAL FLOW ARROW AND SLOPE
- DRAINAGE BASIN BOUNDARY
- 1 — DESIGN POINT
- TIME OF CONCENTRATION PATH
- (10) S10 — HYDRAULIC STRUCTURE IDENTIFIER
- STORM SEWER IDENTIFIER
- Filing 11 STORM SEWER PIPE
- Filing 11 STORM SEWER MANHOLE
- Filing 11 STORM DRAINAGE CURB INLET
- (6020) — EXISTING CONTOURS
- Filing 11 & 12 SANITARY LINE & STRUCTURE
- Filing 11 & 12 WATER LINE & FITTINGS

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



VICINITY MAP
SCALE: N.T.S.

THE GLEN AT WIDEFIELD
FILING NO. 12
DEVELOPED DRAINAGE BASINS (OFF-SITE AREA)
El Paso, County, Colorado

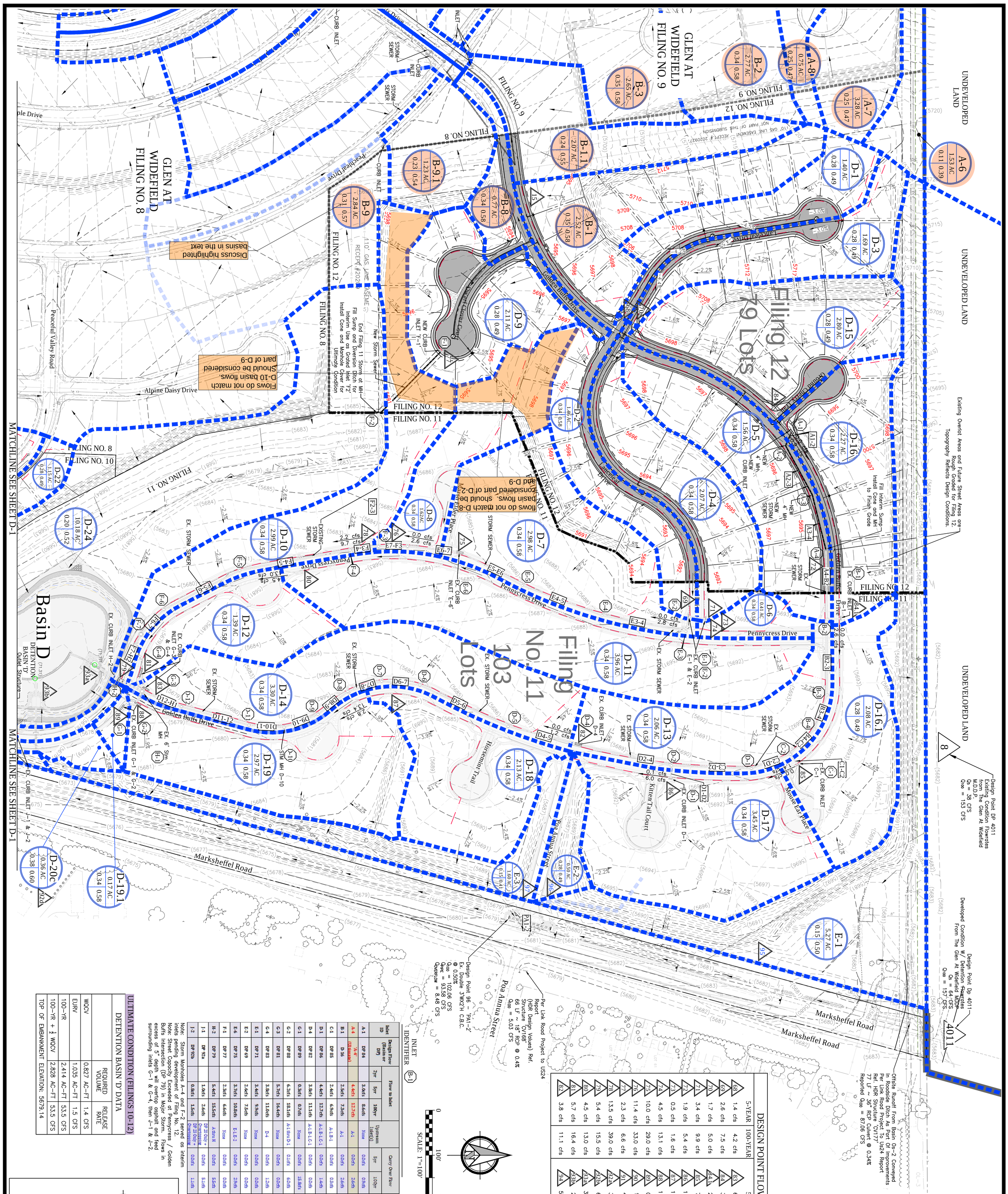
WIDEFIELD Investment Group

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

Project No.:	19016
Date:	Dec 05, 2022
Design:	MJK
Drawn:	MJK
Check:	AMcC
Revisions:	

SHEET D-1
2 of 3 Sheets

19016 Filing 12 – Developed Conditions.dwg/D



ULTIMATE CONDITION (FILINGS 10-12)

DETENTION BASIN 'D' DATA		
	REQUIRED VOLUME	RELEASE RATE
WQCV	0.827 AC-FT	1.4 CFS
EURV	1.035 AC-FT	1.5 CFS
100-YR	2.414 AC-FT	53.5 CFS
100-YR + ½ WQCV	2.828 AC-FT	53.5 CFS
TOP OF EMBANKMENT ELEVATION: 5679.14		

Note: Storm Manholes A-4 and F-2 served as interim inlets pending development of Filing No. 12
Note: Street Capacity Exceeded at Pennycress / Golden Bulls Intersection (DP 79) in Major Storm. Flows in excess of 5" depth will overtop asphalt and feed surrounding inlets G-1 & G-4, then J-1 & J-2.

Inlet ID	Design Flow (Basin or DP)	Flow to Inlet 2yr	5yr	100yr	Upstream Inlet(s)	Carry Over Flow 5yr	100yr	Flow to Inlet including Carry Over 5yr	100yr	Street Flow Depth 5yr	100yr	Street Section Capacity 5yr	100yr	Inlet Type	Inlet Condition	Inlet Capacity 5yr	100yr	Flow Not Captured by Inlet 5yr	100yr	to
A-1	DP 84	3.0cfs	8.6cfs	None		0.0cfs	0.9cfs	3.0cfs	9.5cfs	6.0in	6.2in	8.2cfs	11.3cfs	10' Type R	On Grade	6.9 cfs	0.0cfs	2.6cfs	to B-1	
A-4	'A-4' (Ultimate)	4.4cfs	12.7cfs	A-1		0.0cfs	2.6cfs	4.4cfs	15.3cfs	6.0in	12.0in	8.2cfs	11.3cfs	MANHOLE	IN PIPE	24.0 cfs	0.0cfs	0.0cfs	N/A	
B-1	D-16	2.5cfs	7.3cfs	A-1		0.0cfs	2.6cfs	2.5cfs	9.9cfs	6.0in	6.2in	8.2cfs	11.3cfs	10' Type R	On Grade	5.0 cfs	0.0cfs	0.3cfs	to C-1	
C-1	DP 85	2.4cfs	6.9cfs	A-1,B-1		0.0cfs	0.3cfs	2.4cfs	7.2cfs	6.0in	6.2in	8.2cfs	11.3cfs	10' Type R	On Grade	2.4 cfs	5.8 cfs	0.0cfs	to D-1	
D-1	DP 86	4.4cfs	12.7cfs	A-1,B-1,C-1		0.0cfs	1.4cfs	4.4cfs	14.1cfs	6.0in	6.2in	10.3cfs	14.2cfs	10' Type R	On Grade	4.3 cfs	8.1 cfs	0.1cfs	to G-2	
D-4	DP 82	3.8cfs	11.1cfs	A-1,B-1,C-1		0.0cfs	0.0cfs	3.8cfs	11.1cfs	6.0in	6.2in	8.2cfs	11.3cfs	15' Type R	On Grade	3.8 cfs	9.9 cfs	0.0cfs	to G-4	
G-1	DP 89	0.3cfs	0.7cfs	None		0.0cfs	15.8cfs	0.3cfs	16.6cfs	6.0in	6.2in	11.1cfs	11.1cfs	20' Type R	In Sump	10.0 cfs	199 cfs	0.0cfs	N/A	
G-2	DP 88	6.2cfs	18.1cfs	A-1 thru D-1		0.1cfs	6.0cfs	6.3cfs	24.0cfs	6.0in	6.2in	7.7cfs	10.6cfs	15' Type R	On Grade	6.3 cfs	13.6 cfs	0.0cfs	to G-1	
G-3	DP 81	5.7cfs	16.4cfs	None		0.0cfs	0.0cfs	5.7cfs	16.4cfs	6.0in	6.2in	11.1cfs	11.1cfs	20' Type R	In Sump	10.0 cfs	199 cfs	0.0cfs	to G-1	
G-4	DP 83	3.8cfs	11.0cfs	D-4		0.0cfs	1.2cfs	3.8cfs	12.2cfs	6.0in	6.2in	9.1cfs	12.8cfs	15' Type R	On Grade	3.8 cfs	7.1 cfs	0.0cfs	J-1	
E-1	DP 71	3.4cfs	9.9cfs	None		0.0cfs	0.0cfs	3.4cfs	9.9cfs	6.0in	6.2in	10.2cfs	14.1cfs	10' Type R	On Grade	3.4 cfs	8.5 cfs	0.0cfs	1.4cfs	to E-6
E-2	DP 69	2.6cfs	7.5cfs	None		0.0cfs	0.0cfs	2.6cfs	7.5cfs	6.0in	6.2in	10.2cfs	14.1cfs	10' Type R	On Grade	2.6 cfs	6.1 cfs	0.0cfs	1.4cfs	to E-6
E-6	DP 75	3.7cfs	10.8cfs	E-1,E-2		0.0cfs	2.9cfs	3.8cfs	13.7cfs	6.0in	6.2in	11.6cfs	16.0cfs	15' Type R	On Grade	3.9 cfs	11.1 cfs	0.0cfs	2.6cfs	to H-2
F-1	DP 77	2.3cfs	6.6cfs	None		0.0cfs	0.0cfs	2.3cfs	6.6cfs	6.0in	6.2in	11.1cfs	11.1cfs	10' Type R	In Sump	8.7 cfs	11.2 cfs	0.0cfs	to H-2	
H-2	DP 79	5.4cfs	15.5cfs	A thru H		0.0cfs	5.5cfs	5.4cfs	21.0cfs	6.0in	6.2in	11.1cfs	11.1cfs	20' Type R	In Sump	18.2 cfs	199 cfs	0.0cfs	to J-2	
J-1	DP 92a	1.0cfs	2.6cfs	DP 20 Objr + Overtopping		0.0cfs	0.1cfs	1.0cfs	3.7cfs	6.0in	6.2in	11.1cfs	11.1cfs	10' Type R	In Sump	8.7 cfs	8.7 cfs	0.0cfs	to J-1	
J-2	DP 92b	0.8cfs	1.5cfs	DP 20 Objr + Overtopping		0.0cfs	1.1cfs	0.8cfs	2.6cfs	6.0in	6.2in	11.1cfs	11.1cfs	10' Type R	In Sump	8.7 cfs	8.7 cfs	0.0cfs	to J-2	

Box Culvert Poa Annua Street				
PA1-PA2	102.1 cfs	0.50%	50-inch	113.6 cfs

Pair at Inflow 'J'				
J2-J1	1.0 cfs	0.50%	24-inch	16.0 cfs
J1-End	1.8 cfs	0.60%	24-inch	17.6 cfs

DESIGN POINT FLOWS																					
5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR	5-YEAR	100-YEAR
68 1.4 cfs	4.2 cfs	69 2.6 cfs	7.5 cfs	70 1.7 cfs	5.0 cfs	71 3.4 cfs	9.9 cfs	72 1.9 cfs	5.4 cfs	73 0.5 cfs	1.6 cfs	74 4.5 cfs	13.1 cfs	75 10.0 cfs	29.0 cfs	76 11.4 cfs	33.0 cfs	77 2.3 cfs	6.6 cfs	78 13.5 cfs	39.0 cfs
79 5.4 cfs	15.5 cfs	80 4.5 cfs	13.0 cfs	81 5.7 cfs	16.4 cfs	82 3.8 cfs	11.1 cfs	83 6.4 cfs	18.5 cfs	84 3.0 cfs	8.6 cfs	84A1 2.5 cfs	7.3 cfs	85 7.3 cfs	21.2 cfs	86 10.8 cfs	31.2 cfs	87 12.0 cfs	34.6 cfs	88 13.5 cfs	39.0 cfs
89 0.3 cfs	0.7 cfs	90 1.3 cfs	3.6 cfs	91 4.4 cfs	12.7 cfs	92A 3.6 cfs	5.9 cfs	92B 6.4 cfs	18.5 cfs	93A 32.7 cfs	94.5 cfs	93B 2.3 cfs	5.9 cfs	94 51.3 cfs	154.8 cfs						

PIPE IDENTIFIER B1-B2						
Pipe #	5yr Rat'l	100yr Rat'l	Pipe Slope	Pipe Diameter	Mannings' Pipe Capacity	Length (2D Center-to-Center)
Golden Bulls Drive Trunkline						
A1-A2	3.0 cfs	8.6 cfs	0.70%	18-inch	8.8 cfs	33.67
A2-A3	3.0 cfs	8.6 cfs	0.60%	18-inch	8.2 cfs	124.91
A3-A4	3.0 cfs	8.6 cfs	0.60%	18-inch	8.2 cfs	125.80
A4-B2	3.0 cfs	8.6 cfs	0.60%	18-inch	8.2 cfs	153.59
B1-B2	2.5 cfs	7.3 cfs	1.00%	18-inch	10.5 cfs	29.70
B2-B3	7.3 cfs	21.2 cfs	0.70%	24-inch	19.0 cfs	168.24
B3-B4	7.3 cfs	21.2 cfs	0.70%	24-inch	19.0 cfs	80.62
B4-C2	7.3 cfs	21.2 cfs	0.70%	24-inch	19.0 cfs	77.97
C1-C2	7.3 cfs	21.2 cfs	2.00%	18-inch	14.9 cfs	29.14
C2-C3	10.8 cfs	31.2 cfs	0.60%	30-inch	31.9 cfs	92.14
C3-D2	10.8 cfs	31.2 cfs	0.60%	30-inch	31.9 cfs	177.80
D1-D2	1.4 cfs	4.2 cfs	2.00%	18-inch	14.9 cfs	27.71
D4-D5	15.8 cfs	45.7 cfs	0.80%	33-inch	47.4 cfs	161.24
D5-D6	15.8 cfs	45.7 cfs	1.10%	33-inch	55.6 cfs	216.49
D6-D7	15.8 cfs	45.7 cfs	0.90%	33-inch	50.3 cfs	85.26
D7-D8	15.8 cfs	45.7 cfs	0.90%	33-inch	50.3 cfs	78.72
D8-D9	15.8 cfs	45.7 cfs	1.00%	33-inch	53.0 cfs	83.20
D9-D10	15.8 cfs	45.7 cfs	0.80%	33-inch	47.4 cfs	80.51
D10-D11	15.8 cfs	45.7 cfs	0.40%	36-inch	42.3 cfs	78.14
D11-D12	15.8 cfs	45.7 cfs	0.40%	36-inch	42.3 cfs	155.35
D12-H1	15.8 cfs	45.7 cfs	0.40%	36-inch	42.3 cfs	94.06
H1-H2	32.9 cfs	77.9 cfs	0.50%	48-inch	101.8 cfs	55.96
PennyCress Drive Trunkline						
E1-E2	4.5 cfs	13.1 cfs	0.60%	21-inch	12.3 cfs	37.39
E2-E3	7.1 cfs	20.6 cfs	0.90%	21-inch	15.1 cfs	29.61
E3-E4	7.1 cfs	20.6 cfs	1.00%	21-inch	15.9 cfs	189.40
E4-E5	7.1 cfs	20.6 cfs	1.00%	21-inch	15.9 cfs	189.25
E5-E6	7.1 cfs	20.6 cfs	1.20%	21-inch	17.4 cfs	150.07
E6-E7	10.0 cfs	29.0 cfs	0.80%	30-inch	36.8 cfs	100.41
F1-F2	2.3 cfs	6.6 cfs	4.00%	18-inch	21.1 cfs	197.94
F2-F3	2.3 cfs	6.6 cfs	0.50%	18-inch	7.4 cfs	292.03
E7-F3	10.0 cfs	29.0 cfs	0.80%	30-inch	36.8 cfs	64.32
F3-F4	13.5 cfs	39.0 cfs	0.80%	30-inch	36.8 cfs	63.47
F4-F5	5.4 cfs	39.0 cfs	0.40%	30-inch	36.8 cfs	250.09
F5-F6	5.4 cfs	39.0 cfs	0.40%	33-inch	33.5 cfs	189.19
F6-F7	5.4 cfs	39.0 cfs	0.40%	33-inch	33.5 cfs	75.03
F7-H2	5.4 cfs	15.5 cfs	0.40%	33-inch	33.5 cfs	106.99
G1-G2	0.3 cfs	0.7 cfs	0.60%	24-inch	17.6 cfs	36.18
G2-H1	6.2 cfs	18.1 cfs	1.00%	30-inch	41.1 cfs	29.60
G3-G4	3.8 cfs	12.8 cfs	1.10%	24-inch	23.8 cfs	10.28
G4-H1	5.7 cfs	16.4 cfs	1.10%	24-inch	23.8 cfs	37.88
H2-H3	45.8 cfs	94.5 cfs	0.60%	48-inch	111.6 cfs	45.54
Pair at Inflow 'J'						
J2-J1	1.0 cfs	2.6 cfs	0.50%	24-inch	16.0 cfs	35.87
J1-End	1.8 cfs	4.1 cfs	0.60%	24-inch	17.6 cfs	76.59

LEGEND	
D-1 / 48.60 / 0.15 0.50	DRAINAGE BASIN 'D-n' TRIBUTARY DRAINAGE BASIN ACRES C100 RUNOFF COEFFICIENT
C5 RUNOFF COEF	
2.2 cfs / 4.3 cfs	5-YEAR RUNOFF / 100-YEAR RUNOFF
~2.0%	DIRECTIONAL FLOW ARROW AND SLOPE
	DRAINAGE BASIN BOUNDARY
1	DESIGN POINT
	TIME OF CONCENTRATION PATH
(10) S10	HYDRAULIC STRUCTURE IDENTIFIER
	STORM SEWER IDENTIFIER
	PROPOSED STORM SEWER PIPE
	PROPOSED STORM SEWER MANHOLE
	PROPOSED STORM DRAINAGE CURB INLET
(6020)	EXISTING CONTOURS
	SANITARY LINE & STRUCTURE
	WATER LINE & FITTINGS
	EX. STORM LINE & STRUCTURE

Project No.:	19016
Date:	December 05, 2022
Design:	MJK
Drawn:	MJK
Check:	AMcC
Revisions:	
SHEET	D-2
	3 of 3 Sheets

19016 Filing 12 – Developed Conditions.dwg/Dr

THE GLEN AT WIDEFIELD
FILING NO. 12
DEVELOPED DRAINAGE BASINS (FULL BUILD-OUT)
El Paso, County, Colorado

WIDEFIELD Investment Group

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

APPENDIX E

IRF Reduction Calculations and Exhibits

IRF Analysis Exhibit (Overall)
IRF Zones A & B (UIA/RPA)
IRF UD_BMP Spreadsheet Results

GLEN AT WIDEFIELD NO. 12

IR Exhibit

All On-Site Areas

EL PASO, COUNTY, COLORADO

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

WIDEFIELD Investment Group

Project No.: 19016
Date: December 05, 2022
Design: MK
Drawn: MJK
Check: AWMc
Revisions:

SHEET
IRF-1
1 of 1 Sheets

19016-GW12-IRF.dwg/Dec 06, 2022

IRF REDUCTION AREA SUMMARY

	UIA	RPA	SPA	DCIA	Exempt
A	38539.4814	17719.0123	0	0	0
B	20177.5042	8604.9995	0	0	0
Summ:	58716.9856	26324.0118	0	0	0
Acreage:	1.35	0.60	0.00	0.00	0.00

in accordance with the MHFD, runoff reduction has vegetation requirements that have been overlooked in the past. Going forward the following will be required for runoff reduction:
- All RPA/SPA areas will need to be within a no build/drainage easement (or tract) and discussed in the maintenance agreement and O&M manual.
- RPA/SPA vegetation should be turf grass (from seed [provide appropriate seed mix] or sod).
- Turf grass vegetation should have a uniform density of at least 80%.
- Irrigation (temp or permanent) is necessary to establish sufficient vegetation and not just weeds.
- Show suitability of topsoil of RPA/SPA and steps for proper preparation of topsoil per recommendations in MHFD detail T-0 Table RR-3
- RPA/SPA limits must be shown on GEC Plans (not just FDR) so our SW inspectors and the QSM know that these areas are to remain pervious, vegetated (80%), and irrigated post-construction.

Other requirements that have either been done or do not pertain to this project but I wanted to note for all future projects:
- Provide a figure showing all proposed UIA, RPA and SPA areas to be utilized for runoff reduction.
- Provide a detail for the UIA:RPA interface that shows the recommended vertical drop of 4".

Since adding a Plat note that states there are to be no impervious areas in set backs has not been an option on past projects, consider the orange areas to be UIA and the green areas to be RPA. Note: you only need to achieve 60% WQCV, so the less RPA you have, the less sod, watering and maintenance of the RPA will be required.

You can only use the slope down and any flat bottom of the swale for RPA, you cannot use the sloped area on the far side of the swale.

Basins A-6 and A-7 need to be discussed in the text and will need some type of WQCV treatment

LEGEND

EDB 'D' — Detention Basin Designation

Drainage Basin Boundary

Flow Direction

UIA — UIA (Unconnected Impervious Area)

UIA/RPA interface

RPA — 'B' — RPA (Receiving Pervious Area)

IRF Zone Designation

DCIA — DCIA (Directly-Connected Impervious Area)

Flowline

SCALE: 1" = 60'

0 60' 120'

60' R.O.W. TYPICAL RURAL LOCAL CROSS SECTION

PAVEMENT SECTION DESIGN PER GEOTECH. TO MEET COUNTY STDS.

2' GRAVEL SHOULDER

2% SLOPE

26' PAVEMENT

10.00'

4.00'

60' R.O.W.

5' PUBLIC UEP ESMT

R.O.W.

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.53	inches	
***Minor Storm: 1-Hour Rain Depth	10-Year Event	1.75	inches	
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches	
Optional User Defined Storm	CUHP			
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event			
Max Intensity for Optional User Defined Storm	0			

Designer: M Kahnke
Company: Kiowa Engineering
Date: December 6, 2022
Project: The Glen Filing No. 12 - 'IRF' Reductions
Location: West of Markscheffel Rd 1/2 mile N. of Mesa Ridge Parkway (Poa Annua)

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	A	B
Receiving Pervious Area Soil Type	Silty Clay Loam	Sandy Loam
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	1.350	0.600
Directly Connected Impervious Area (DCIA, acres)	0.000	0.000
Unconnected Impervious Area (UIA, acres)	0.880	0.410
Receiving Pervious Area (RPA, acres)	0.470	0.190
Separate Pervious Area (SPA, acres)	0.000	0.000
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	1.350	0.600
Directly Connected Impervious Area (DCIA, %)	0.0%	0.0%
Unconnected Impervious Area (UIA, %)	65.2%	68.3%
Receiving Pervious Area (RPA, %)	34.8%	31.7%
Separate Pervious Area (SPA, %)	0.0%	0.0%
A_R (RPA / UIA)	0.534	0.463
I_a Check	0.650	0.680
f / I for WQCV Event:	0.5	2.0
f / I for 10-Year Event:	0.3	0.5
f / I for 100-Year Event:	0.2	0.3
f / I for Optional User Defined Storm CUHP:		
IRF for WQCV Event:	0.91	0.71
IRF for 10-Year Event:	0.97	0.93
IRF for 100-Year Event:	0.99	0.96
IRF for Optional User Defined Storm CUHP:		
Total Site Imperviousness: I_{total}	65.2%	68.3%
Effective Imperviousness for WQCV Event:	59.4%	48.7%
Effective Imperviousness for 10-Year Event:	62.9%	63.2%
Effective Imperviousness for 100-Year Event:	64.3%	65.4%
Effective Imperviousness for Optional User Defined Storm CUHP:		

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	8.1%	24.2%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
10-Year Event CREDIT**: Reduce Detention By:	3.6%	7.8%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	1.3%	4.1%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:														

Total Site Imperviousness:	**66.2%**
Total Site Effective Imperviousness for WQCV Event:	**56.1%**
Total Site Effective Imperviousness for 10-Year Event:	**63.0%**
Total Site Effective Imperviousness for 100-Year Event:	**64.7%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.
** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.
*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Runoff Reduction

UD-BMP (Version 3.07, March 2018) **Sheet 1 of 1**

Designer:	**M Kahnke / A McCord**
Company:	**Kiowa Engineering**
Date:	**December 6, 2022**
Project:	**The Glen No 12 - IRF Interfaces A & B**
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)

based on the geotech report soil cross sections, this area is all Soil Type D

Area Type	UIA:RPA	UIA:RPA											
Area ID	A	B											
Downstream Design Point ID	A	B											
Downstream BMP Type	None	None											
DCIA (ft^2)	--	--											
UIA (ft^2)	38539.48	20177.50											
RPA (ft^2)	17719.01	8605.00											
SPA (ft^2)	--	--											
HSG A (%)	0%	0%											
HSG B (%)	50%	80%											
HSG C/D (%)	50%	20%											
Average Slope of RPA (ft/ft)	0.300	0.300											
UIA:RPA Interface Width (ft)	654.00	392.00											

CALCULATED RUNOFF RESULTS

Area ID	A	B										
UIA:RPA Area (ft^2)	56,258	28,783										
L / W Ratio	0.13	0.19										
UIA / Area	0.6850	0.7010										
Runoff (in)	0.08	0.07										
Runoff (ft^3)	375	174										
Runoff Reduction (ft^3)	1230	667										

CALCULATED WQCV RESULTS

Area ID	A	B										
WQCV (ft^3)	1606	841										
WQCV Reduction (ft^3)	1230	667										
WQCV Reduction (%)	77%	79%										
Untreated WQCV (ft^3)	375	174										

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

Downstream Design Point ID	A	B										
DCIA (ft^2)	0	0										
UIA (ft^2)	38,539	20,178										
RPA (ft^2)	17,719	8,605										
SPA (ft^2)	0	0										
Total Area (ft^2)	56,258	28,783										
Total Impervious Area (ft^2)	38,539	20,178										
WQCV (ft^3)	1,606	841										
WQCV Reduction (ft^3)	1,230	667										
WQCV Reduction (%)	77%	79%										
Untreated WQCV (ft^3)	375	174										

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

Total Area (ft^2)	85,041
Total Impervious Area (ft^2)	58,717
WQCV (ft^3)	2,447
WQCV Reduction (ft^3)	1,897
WQCV Reduction (%)	78%
Untreated WQCV (ft^3)	550