ADDENDUM #1 TO
MASTER DEVELOPMENT DRAINAGE PLAN
AND FINAL DRAINAGE REPORT FOR
BARNES AND MEDICAL VIEW APARTMENTS
COLORADO SPRINGS, COLORADO

FEBRUARY 2020

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ADDENDUM #1 TO
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BARNES AND MEDICAL VIEW APARTMENTS

ENGINEER'S STATEMENT:

This report and plan for the final drainage design of "BARNES AND MEDICAL VIEW APARTMENTS" was prepared by me (or under my direct supervision) and is correct to the best of my knowledge and belief. Said report and plan has been prepared in accordance with the City of Colorado Springs Drainage Criteria Manual and is in conformity with the master plan of the drainage basin. I understand that City of Colorado Springs does not and will not assume liability for drainage facilities designed by others. I accept responsibility for any liability caused by any negligent acts, errors or emissions on my part in preparing this report.

L DUCETT 3/24/2020

L DUCETT, P.E. 32339 Seal

DEVELOPER'S STATEMENT:

TIROL HOUSING LLC hereby certifies that the drainage facilities for BARNES AND MEDICAL VIEW APARTMENTS shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and/or certified by my engineer and that are submitted to the City of Colorado Springs pursuant to section 7.7.906 of the City Code; and cannot, on behalf of BARNES AND MEDICAL VIEW APARTMENTS, guarantee that the final drainage design review will absolve TIROL HOUSING LLC and/or their successors and/or assigns of future liability for improper design. I further understand that the approval of final plat does not imply approval of my engineer's drainage design.

TIROL HOUSING LLC

3.2.20

Authorized Signature Date

Derek Mannelin
Printed Name

Manager, Tirol Housing LLC
Title

16037 SW Lower Boones Ferry Road, Suite 150, Tigard, OR 97224
Address

City of Colorado Springs Statement:

Filed in accordance with Section 7-7-906 of the Code of the City of Colorado Springs, 2001, as amended.

03/27/2020

For City Engineer Date

Conditions:

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PURPOSE

The purpose of this Addendum #1 to Master Development Drainage Plan (MDDP) and Final Drainage Report is to update the detention ponds and storm sewer designs, provide storm sewer hydraulic modeling data from UDSEWER, provide offsite basin 5 year drainage calculations, and update the plan sheets.

UPDATED DESIGN CALCULATION

The following design calculation have been updated and are included in the appendix.

- Storm sewer HGL calculations and profiles
- Extended detention basin spillway in detention basin design

UPDATED DESIGN ELEMENTS

The following design elements have been updated and are included on the drainage plans in the appendix.

- Detention basin details
- Storm sewer pipes

UPDATED PROPOSED MAJOR SUBBASIN DESCRIPTION (FOR MDDP)

In the proposed condition offsite and onsite runoff will be directed to one of three Extended Detention Basins (EDB) that provide Water Quality and Full Spectrum Detention. The three ponds are labeled as West, Middle and East. The existing public 60" RCP storm Drain will be re-routed through the site and the outfalls from the three EDBs will tie into this re-routed storm before being transported south offsite. This 60" storm pipe does not appear to be in an existing easement. Title work shows no easement, however it is a public storm sewer and will be rerouted into the center of the drive aisle and reconnected to the main in Barnes Road. There will be a dedicated 30' public storm easement over this main dedicated on the final plat. The following is a description of the

Basins, Design Points, storm drain, and the overall drainage characteristics for the development of Barnes and Medical View Apartments.

Basin A1's 2.13 acres is in the northwest corner of the site and will consist of paved parking, landscaping and open space. Runoff (Q_5 = 3.6 cfs, Q_{100} = 8.7 cfs) sheet flows south over the parking lot and is directed to a private 12' D10-R sump inlet (Design Point 1). Pipe Runs 5A and 5B are private 21" RCPs and will carry the flow into the West EDB (Design Point 2).

Basin A2's 0.05 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 1) directly into the West EDB.

Basin A3's 0.05 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE roof drain (Roof Drain 2) directly into the West EDB.

Basin A4's 0.17 acres consists of roof area. Runoff (Q_5 =0.6 cfs, Q_{100} = 1.2 cfs) is directed by a private 6" HDPE roof drain (Roof Drain 3|4) directly into the West EDB.

Basin A5's 0.11 acres consists of roof area. Runoff (Q_5 =0.4 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE roof drain (Roof Drain 5|6) directly into the West EDB.

Basin A6's 0.06 acres consists of roof area. Runoff (Q_5 =0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE roof drain (Roof Drain 7) directly into the West EDB.

Basin A7's 0.60 acres consists of landscaping and the West EDB. Runoff (Q_5 = 0.3 cfs, Q_{100} = 1.9 cfs) sheet flows into the West EDB (Design Point 2).

At Design Point 2, a 0.243 ac-ft private full spectrum Extended Detention Basin is proposed (West Pond). The EDB was calculated using version 3.07 UD-Detention a spreadsheet supplied by Urban Drainage Control Flood District (see appendix). Based upon the 3.17 acres of area tributary from our site (contributing basins A1 through A7) and consisting of 40.10% impervious area. The bottom of the pond is 6570.50 and the top of pond is set at 6576.00. The pond design has a WQCV storage requirement of 0.048ac-ft. The corresponding water surface elevation is 6571.94. The required

EURV storage volume of 0.088 ac-ft on top of the WQCV gives an elevation of 6572.68. The required 100-year storage volume of 0.107 ac-ft for a total of 0.243 ac-ft gives a 100-year elevation of 6573.40. The proposed forebay is 45 cu-ft in volume and meets the required 2% of the WQCV (see appendix for calculations). A metal plate over the outlet with one column containing three rows of holes (bottom two are 5/8" and top is 1" diameter) spaced 9.6" apart will act as a water quality and EURV outlet. The release of the EURV is 0.00 cfs and will take 73 hours. A 2.0' x 2.0' inlet riser acts as the outlet structure, it is set at a grate elevation of 6572.68 and will route allowable runoff for the 100 year event. The proposed 15" outlet pipe has an orifice plate with a 5.3" x 5.1" orifice giving a release of Q_{100}=2.0 cfs. This is in conformance within 90% of the allowable release rate of 2.2 cfs. A 5' emergency weir set at 6574.50 will also be installed per the DCM with d50 = 12"rip rap and will safely pass the 100-year developed flow downstream. Flow in the emergency overflow situation will flow into the ROW of Barnes Road with a 100 year runoff spillway flow depth of 0.45'. The discharge pipe for the West Pond connects to an existing 60" storm sewer where there is the possibility of a high tailwater conditions being created in the pond. To prevent this, a backflow preventor has been included on the discharge pipe.

Basin B1's 1.14 acres consists of paved parking, landscaping and open space. Runoff (Q_5 = 2.7 cfs, Q_{100} = 5.8 cfs) sheet flows south over the parking lot and is directed to a private 8' D10-R sump inlet (Design Point 3). Pipe Run 8 a private 30" RCP will carry the flow into the Middle EDB (Design Point 8).

There are several offsite basins that are upgradient of the site and drain to the storm sewer network just upgradient of the site. If some or all of this storm sewer network was to fail, some or all of this offsite runoff would surface flow onto the site. To protect against this, an emergency overflow route has been incorporated into the site design, which uses curbs and oversized curb chases to direct the runoff through the parking areas to Medical View. Details of this emergency overflow route are included in the Grading and Erosion Control Plan.

Offsite Basin OS-B1's 0.07 acres consists of undeveloped open space. Runoff (Q_5 =0.0 cfs, Q_{100} = 0.2 cfs) sheet flows south onto Basin B2 and then is directed south to Design Point 3.

Basin B2's 0.46 acres consists of paved parking, landscaping and open space. Runoff (Q_5 = 1.4 cfs,

Q_{100} = 2.8 cfs) sheet flows south over the parking lot and is directed to a private 8' D10-R sump inlet (Design Point 5). Pipe Run 7, a private 12" HDPE, will carry the combined flow to a Manhole Type 2 (Design Point 4).

Basin B3's 0.13 acres consists of paved parking and landscaping. Runoff (Q_5 = 0.5 cfs, Q_{100} = 1.0 cfs) sheet flows south over the parking lot and is directed to a private 8' D10-R sump inlet (Design Point 5). Pipe Run 7 a private 12" HDPE will carry the flow across the driveway entrance to a Manhole Type 2 junction at Design Point 4.

Offsite Basin OS-B2's 0.14 acres consists of undeveloped open space. Runoff (Q_5 =0.1 cfs, Q_{100} = 0.4 cfs) sheet flows south onto Basin B4 and then is directed south to Design Point 6.

Basin B4's 0.78 acres consists of paved parking, landscaping and open space. Runoff (Q_5 = 2.5 cfs, Q_{100} = 4.8 cfs) sheet flows south over the parking lot and is directed to a private 12' D10-R sump inlet (Design Point 6). Pipe Run 10 a private 24" RCP will carry the flow in to a junction at Design Point 3.

Basin B5's 0.47 acres consists of landscaping and the Middle EDB. Runoff (Q_5 = 0.2 cfs, Q_{100} = 1.5 cfs) sheet flows into the Middle EDB (Design Point 8).

Basin B6's 0.06 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 8) directly into the Middle EDB.

Basin B7's 0.13 acres consists of roof area. Runoff (Q_5 = 0.5 cfs, Q_{100} = 0.9 cfs) is directed by a private 8" HDPE (Roof Drains 9|10) directly into the Middle EDB.

Basin B8's 0.10 acres consists of roof area. Runoff (Q_5 = 0.4 cfs, Q_{100} = 0.7 cfs) is directed by a private 6" HDPE (Roof Drains 11) directly into the Middle EDB.

Basin B9's 0.07 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private surface 6" HDPE directly into the Middle EDB.

Basin B10's 0.07 acres consists of roof area. Runoff (Q_5 = 0.3 cfs, Q_{100} = 0.5 cfs) is directed by a private surface 6" HDPE directly into the Middle EDB.

Basin B11's 0.05 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 22) to a junction with Pipe Run 13.

Basin B12's 0.05 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 23) to a junction with Pipe Run 13.

Basin B13's 0.11 acres consists of roof area. Runoff (Q_5 = 0.4 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE (Roof Drain 24|25) to a junction with Pipe Run 13.

Basin B14's 0.12 acres consists of roof area. Runoff (Q_5 = 0.5 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE (Roof Drain 26|27) to a junction with Pipe Run 13.

Basin B15's 0.05 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 28|29) to a junction with Pipe Run 13.

Basin B16's 0.04 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.3 cfs) is directed by a private 6" HDPE (Roof Drain 30) to a junction with Pipe Run 14.

Basin B17's 0.11 acres consists of roof area. Runoff (Q_5 = 0.4 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE (Roof Drain 31|32) to a junction with Pipe Run 14.

Basin B18's 0.11 acres consists of roof area. Runoff (Q_5 = 0.4 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE (Roof Drain 33|34) to a junction with Pipe Run 14.

Basin B19's 0.07 acres consists of roof area. Runoff (Q_5 = 0.3 cfs, Q_{100} = 0.5 cfs) is directed by a private 6" HDPE (Roof Drain 35) to a junction with Pipe Run 14.

Basin B20's 0.07 acres consists of roof area. Runoff (Q_5 = 0.3 cfs, Q_{100} = 0.5 cfs) is directed by a private 6" HDPE (Roof Drain 36) to a junction with Pipe Run 14.

Offsite Basin OS-B3's 0.36 acres consists of undeveloped open space. Runoff (Q_5 =0.2 cfs, Q_{100} = 1.1 cfs) sheet flows south onto Basin B21 and then is directed southwest to Design Point 7.

Basin B21's 0.53 acres consists of landscaping and open space. Runoff (Q_5 = 0.2 cfs, Q_{100} = 1.4 cfs) sheet flows south to a proposed swale along with offsite Basin OS-B3 and is directed to a private Type "C" inlet (Design Point 7). The combined runoff (Q_5 =0.4 cfs, Q_{100} = 2.4 cfs) is routed south via a swale and then Pipe Run 12 a private 12" HDPE to a junction with Pipe Run 13. Pipe Run 11 a private 15" HDPE routes the combined runoff of (Q_5 = 2.9 cfs, Q_{100} = 7.0 cfs) southwest to a junction at Design Point 6. Pipe Run 10 a private 24" RCP routes the combined flow (Q_5 = 3.7 cfs, Q_{100} = 11.9 cfs) west to Pipe Run 9 a private 24" RCP (Q_5 = 5.0 cfs, Q_{100} = 18.2 cfs) then to Design Point 3. Pipe Run 8 a private 30" RCP routes the combined flow (Q_5 = 7.4 cfs, Q_{100} = 23.6 cfs) south to a junction with Pipe Run 7. Pipe Run 6 a private 30" RCP routes the combined flow (Q_5 = 9.2 cfs, Q_{100} = 27.5 cfs) south to the Middle EDB (Design Point 8). The swale along the back side of Building D has been sized to accommodate the combined flow from Basin OS-B3 and B21. If the inlet at the bottom of this swale were to plug, the water would back up to an elevation of 6588' +/- and continue flowing south around the trash enclosure and onto the parking lot.

At Design point 8, a 0.529 ac-ft private full spectrum Extended Detention Basin is proposed (Middle Pond). The EDB was calculated using version 3.07 UD-Detention a spreadsheet supplied by Urban Drainage Control Flood District (see appendix). Based upon the 5.29 acres of area tributary from our site (contributing basins B1 thru B-21 & OS-B1 thru OS-B3) and consisting of 54.60% impervious area. The bottom of the pond is 6563.50 and the top of pond is set at 6571.60. The pond design has a WQCV storage requirement of 0.097 ac-ft. The corresponding water surface elevation is 6566.28. The required EURV storage volume of 0.231 ac-ft on top of the WQCV gives an elevation of 6568.34. The required 100-year storage volume of 0.202 ac-ft for a total of 0.529 ac-ft gives a 100-year elevation of 6569.57. The proposed forebay is 135 cu-ft in volume and meets the required 3% of the WQCV (see appendix for calculations). A metal plate over the outlet with one column containing three rows of holes (bottom 2 are 3/4" and top is 1-1/8" diameter) spaced 19.32" apart will act as a water quality and EURV outlet. The release of the EURV is 0.1 cfs and will take 76 hours. A 2.0' x 2.0' inlet riser acts as the outlet structure, it is set at a grate elevation of 6568.34 and will route allowable runoff for the 100 year event. The proposed 15" outlet pipe has a restrictor plate

with a 7.0" x 7.0" orifice giving a release of Q_{100}=4.0 cfs. This is in conformance within 90% of the allowable release rate of 4.2 cfs. An upper outlet structure and oversized discharge pipe connected to the existing storm sewer network will also be installed per the DCM to safely pass the 100-year developed flow downstream. A 3.0' x 3.0' inlet riser acts as the upper outlet structure, with the grate set at an elevation of 6570.00 and a 30" diameter RCP discharge pipe. If both of the outlet structures fail, the water level will rise in the pond until it overtops the curb and flows into the ROW of Barnes Road. The discharge pipe for the Middle Pond connects to an existing 60" storm sewer where there is the possibility of a high tailwater conditions being created in the pond. To prevent this, a backflow preventor has been included on the discharge pipe.

Basin C1's 1.29 acres consists of paved parking and landscaping. Runoff (Q_5 = 3.2 cfs, Q_{100} = 6.5 cfs) sheet flows south over the parking lot and is directed as surface flow to the East EDB (Design Point 9).

Offsite Basin OS-C's 0.06 acres consists of undeveloped open space. Runoff (Q_5 =0.0 cfs, Q_{100} = 0.2 cfs) sheet flows south onto Basin C2 and then is directed south to Design Point 10.

Basin C2's 0.45 acres consists of paved parking, open space and landscaping. Runoff (Q_5 = 1.3 cfs, Q_{100} = 2.6 cfs) sheet flows south over the parking lot and is directed as surface flow to the East EDB (Design Point 9).

Basin C3's 0.07 acres consists of roof area. Runoff (Q_5 = 0.3 cfs, Q_{100} = 0.5 cfs) is directed by a private 6" HDPE (Roof Drains 11 & 14) directly into East EDB.

Basin C4's 0.05 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 13) directly into the East EDB.

Basin C5's 0.06 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 15) directly into the East EDB.

Basin C6's 0.11 acres consists of roof area. Runoff (Q_5 = 0.4 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE (Roof Drain 16|17) directly into the East EDB.

Basin C7's 0.11 acres consists of roof area. Runoff (Q_5 = 0.4 cfs, Q_{100} = 0.8 cfs) is directed by a private 6" HDPE (Roof Drain 18|19) directly into the East EDB.

Basin C8's 0.06 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 20) directly into the East EDB.

Basin C9's 0.06 acres consists of roof area. Runoff (Q_5 = 0.2 cfs, Q_{100} = 0.4 cfs) is directed by a private 6" HDPE (Roof Drain 21) directly into the East EDB.

Basin C10's 0.44 acres consists of landscaping and the East EDB. Runoff (Q_5 = 0.2 cfs, Q_{100} = 1.4 cfs) sheet flows into the East EDB (Design Point 11).

At Design point 11, a 0.301 ac-ft private full spectrum Extended Detention Basin is proposed (East Pond). The EDB was calculated using version 3.07 UD-Detention a spreadsheet supplied by Urban Drainage Control Flood District (see appendix). Based upon the 2.76 acres of area tributary from our site (contributing basins C1 thru C10) and consisting of 60.10% impervious area. The bottom of the pond is 6571.50 and the top of pond is set at 6578.00. The pond design has a WQCV storage requirement of 0.054 ac-ft. The corresponding water surface elevation is 6573.80 The required EURV storage volume of 0.137 ac-ft on top of the WQCV gives an elevation of 6575.32. The required 100-year storage volume of 0.110 ac-ft for a total of 0.301 ac-ft gives a 100-year elevation of 6576.10. The proposed forebay is 84 cu-ft in volume and meets the required 2% of the WQCV (see appendix for calculations). A metal plate over the outlet with one column containing three rows of holes (bottom two are 9/16" and top is 1" diameter) spaced 14.4" apart will act as a water quality and EURV outlet. The release of the EURV is 0.1 cfs and will take 73 hours. A 2.0' x 2.0' inlet riser acts as the outlet structure, it is set at a grate elevation of 6575.32 and will route allowable runoff for the 100 year event. The proposed 15" outlet pipe has a restrictor plate with a 4.4" x 4.4" orifice giving a release of Q_{100}=2.0 cfs. This is in conformance within 90% of the allowable release rate of 2.2 cfs. A 10' emergency weir set at 6576.40 will also be installed per the DCM with d50 = 12"rip rap and will safely pass the 100-year developed flow downstream. Flow in the emergency overflow situation will flow into the ROW of Barnes Road with a 100 year runoff spillway flow depth of 0.35'.

The runoff (Q_5 =0.0 cfs, Q_{100} = 2.0 cfs) from the West EDB outlet is routed east via Pipe Run 1 a private 15" HDPE to a junction with Pipe Run 2. Pipe Run 2 a private 15" HDPE routes the Middle EDB pond runoff of (Q_5 = 0.1 cfs, Q_{100} = 3.5 cfs) to a junction with Pipe Run 3. Pipe Run 3 a private 18" HDPE routes the combined flow (Q_5 = 0.1 cfs, Q_{100} = 5.5 cfs) of Pipe Runs 1 & 2 west to a junction at with Pipe Run 17. Pipe Run 4 (Q_5 = 0.0 cfs, Q_{100} = 1.8 cfs) routes the outlet flow from the East EDB to a junction with Pipe Run 17. Pipe Run 17 a public 60" RCP routes the existing flow of (Q_{100} = 347.2 cfs) of the upstream development to a junction at with Pipe Run 18. Pipe Run 18 an existing public 60" RCP routes the combined flow (Q_{100} = 355.6 cfs) south offsite.

Basin D's 1.06 acres consists of landscaping and sidewalk along the west, south and east boundary that sheet flows into the adjacent streets. Runoff (Q_5 = 3.1 cfs, Q_{100} = 6.6 cfs) is directed by curb and gutter to the north flowline of Barnes Road at the intersection of Medical View. It is then transported east in the north curb line of Barnes Road. The developed flow is less than the historic flow of Q_5 = 5.0 cfs, Q_{100} = 29.0 cfs.

The West Pond Inflow System, from downstream to upstream, is comprised of a main trunk of Pipe Runs 5B (12' Segment), 5B (33' Segment) 5A (90' Segment), 5A (8' Segment), and 5A (27' Segment). See storm sewer layout, output, and profiles in the Appendix.

The existing public 60" RCP storm sewer crosses most of the site before connecting to dual 6' x 4' concrete box culverts approximately 50 feet from the edge of the Barnes Road ROW (the exact transition location and type of connection is not known). These dual RCB culverts are being connected to at one new manhole. The three proposed laterals, downstream to upstream, are comprised of Pipe Runs 3 and 1, Pipe Run 2, and Pipe Run 4, respectively. See storm sewer layout, output, and profiles in the Appendix. The dual RCB culverts are shown to cross Barnes Road and the flow eventually daylights near Sand Creek. The dual RCB culverts do not extend to the daylight point, which appears to be 66" RCP, but it is not known how far they extend.

Pipe Run 3 has a proposed inline check valve (WaStop NPS 30" inline check valve or similar) just before it connects to the existing dual RCB culverts. This check valve is to prevent backwater conditions in Pipe Run 3 from the dual RCB culverts. Spec sheets for the check valve have been

included with the drainage maps. The check valve will be subject to less than 2' of water of backwater head at the 100 year HGL and the WaStop NPS 30" can support back pressures up to 26.2' of water.

The Middle Pond Inflow System, from downstream to upstream, is comprised of a main trunk of Pipe Runs 6, 8, 9, 10, 11, 13 (24' Segment), 13 (216' Segment), and 14. The two laterals are comprised of Pipe Run 7 and Pipe Run 12, respectively. See storm sewer layout, output, and profiles in the Appendix.

The East Pond Inflow System, from downstream to upstream, is comprised of Pipe Run 17, 16, and 15. Pipe Run 15 and 16 convey runoff from curb inlets to an area inlet, and Pipe Run 17 conveys the combined flow to the East Pond. See storm sewer layout, output, and profiles in the Appendix.

UPDATED HYDROLOGIC & HYDRAULIC CALCULATIONS

Hydrologic and Hydraulic calculations were estimated using the methods described in the City of Colorado Springs Drainage Criteria Manual Volumes 1 & 2 May 2014. The Rational Method was used to estimate storm water runoff anticipated from design storms with 5-year and 100-year recurrence intervals. The pertinent data sheets are included in the appendix of this addendum. The HGL calculations were performed using the software UDSEWER. The pertinent output is included in the appendix of this addendum.

OFFSITE BASIN 5 YEAR DRAINAGE CALCULATIONS FOR STORM SEWER FLOWS

The City requested 5 year flow values for the existing storm sewer network that enters the site with a 60" storm sewer; however, this information was not included in the drainage reports for the previously developed offsite basin. Therefore, drainage calculations have been prepared for this offsite basin to provide the 5 year flow in the storm sewer.

This offsite basin has been labeled OS-1. A map showing the basin boundaries used is included in the appendix. The basin boundaries were developed from the ground surface contours and storm sewer information in the SpringView GIS. The entire area was treated as a single basin with small residential lots that drains to the 60" storm sewer that enters the site.

The drainage calculations are included with the other hydrology calculations and use the same methods. Small changes to the channel flow input values were made to calibrate the calculations so the 100 year flow matched that in the existing drainage report (Stetson Hills Subdivision Filing #24).

Basin OS-1's 87.8+/- acres consists of small lot residential subdivision, and some green space in the northwest corner, that sheet and channel flows into various storm inlets. The runoff (Q_5 = 157.7 cfs, Q_{100} = 347.2 cfs) flows through a storm sewer network to eventually discharge through a single 60" RCP storm sewer that enters the site on the northwest side. The 60" RCP storm sewer crosses the site and Barnes Road, and continues across the adjacent field.

UPDATED FLOODPLAIN STATEMENT

No portion of this site is within a designated F.E.M.A. floodplain, as determined by Flood Insurance Rate Map No. 08041C0539 G dated December 7, 2018.

UPDATED CONSTRUCTION COST OPINION

Private Drainage Facilities Improvements (non-Reimbursable)

	Description	Quantity	Unit Price	Cost
1.	6" HDPE	300 LF	$ 20	$ 6,000
2.	8" HDPE	220 LF	$ 25	$ 5,500
3.	12" HDPE	481 LF	$ 30	$ 14,430
4.	15" HDPE	476 LF	$ 35	$ 16,660
5.	18" HDPE	164 LF	$ 45	$ 7,380
6.	21" HDPE	134 LF	$ 50	$ 6,700
7.	30" HDPE	324 LF	$ 60	$ 19,440
8.	30" RCP	385 LF	$ 65	$ 25,025
9.	Type 2 Manhole	2 EA	$ 4,000	$ 8,000
10.	4' 10-R INLET	3 EA	$ 4,000	$ 12,000
11.	8' 10-R INLET	3 EA	$ 6,000	$ 18,000
12.	12' 10-R INLET	3 EA	$ 8,000	$ 24,000
13.	2'x2' Area Inlet	2 EA	$ 1,500	$ 3,000
14.	Type "C" Inlet	3 EA	$ 2,500	$ 7,500
			Total	**$ 173,635**

Private Permanent BMPs (non-Reimbursable)

	Description	Quantity	Unit Price	Cost
1.	Extended Detention Basins (3)			
	- Earthwork	1,731 CY	$ 12	$ 20,772
	- Forebays	3 EA	$ 1,500	$ 4,500
	- Trickle Channel	564 LF	$ 32	$ 18,048
	- Outlet Structures (2'x2')	3 EA	$ 3,300	$ 9,900
	- Emergency Spillways/Inlets	3 EA	$ 1,500	$ 4,500
	- Access Roads	3 EA	$ 500	$ 1,500
	- Stabilization	3 EA	$ 5,000	$ 15,000
			Subtotal	$ 74,220
			10% Contingency	$ 7,422
			Total	**$ 81,642**

Public Drainage Facilities Improvements (non-Reimbursable)

	Description	Quantity	Unit Price	Cost
1.	Type 1 MH	1 EA	$ 5,000	$ 5,000
			Total	**$ 5,000**

DRAINAGE FEES

This site is not currently platted, is being platted as part of this development, and is located in the Sand Creek Drainage Fee Basin. Fees for this site will be calculated as follows:

Sand Creek Drainage Fee Basin 2020

Drainage	$13,309/acre	x	11.633 acres	=	$ 154,824
Bridge	$791/acre	x	11.633 acres	=	$ 9,202
Pond Land	$1,070/acre	x	11.633 acres	=	$ 12,447
Pond Facility	$3,823/acre	x	11.633 acres	=	$ 44,473
Surcharge	$1,386/acre	x	11.633 acres	=	$ 16,123
				Total	**$ 237,069**

*Fees are due prior to plat recordation

VARIANCE REQUEST

A variance has been requested for the requirement to have crown to crown pipes and to have manholes at all junctions on trunk lines. A copy of the variance request is included in the appendix.

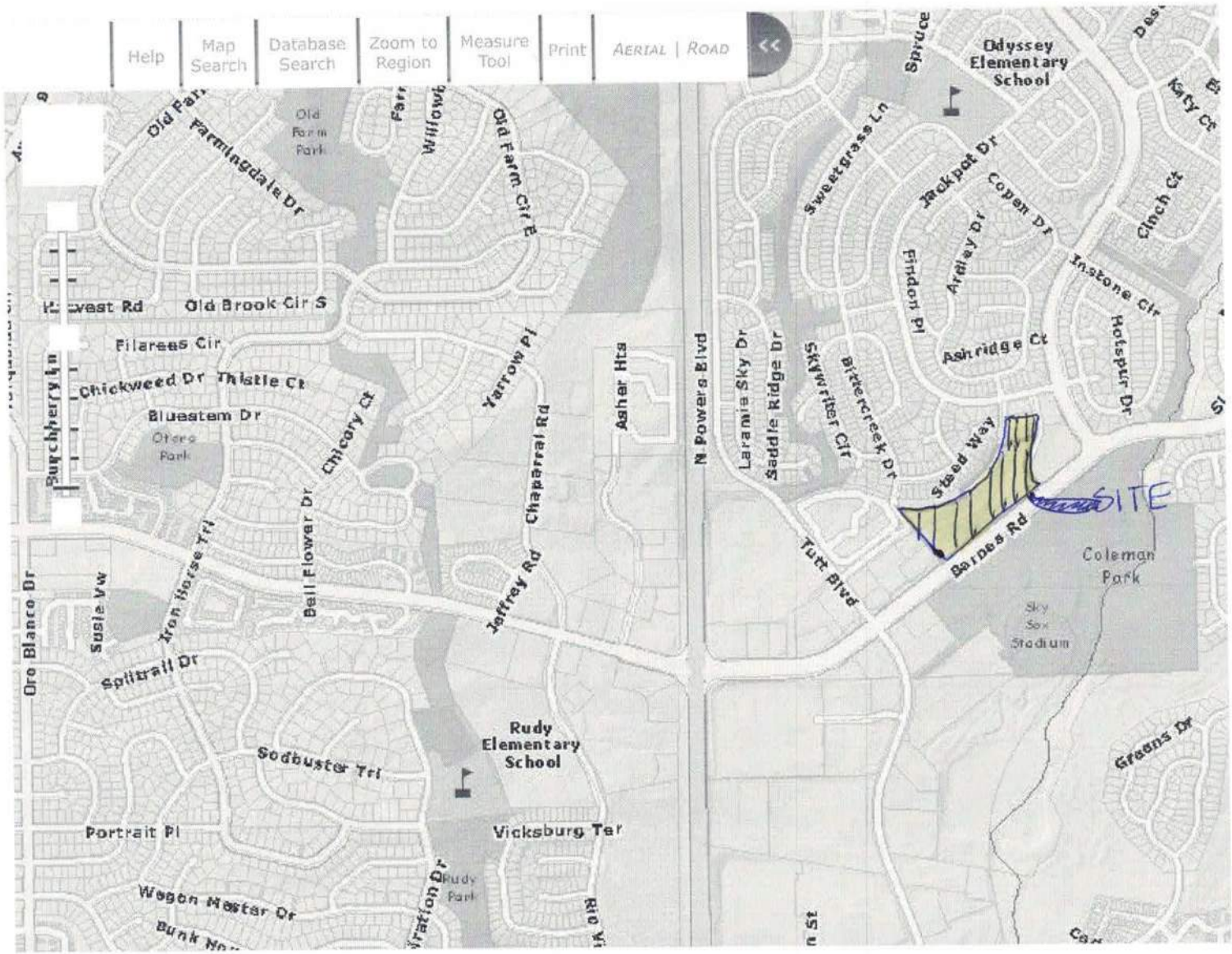
SUMMARY

Development of this site will not adversely affect the surrounding development or increase flows downstream. Site runoff and storm drain appurtenances from Barnes and Medical View Apartments will not adversely affect the downstream and surrounding developments and will be safely routed to the proposed extended detention basins and runoff reduced to the allowable pre-developed rates while slowly treating the water quality capture volume and in turn helping to stabilize the downstream stream and channel banks. This report is in general conformance with all previously approved reports which included this site.

PREPARED BY:
TERRA NOVA ENGINEERING, INC.

L Ducett, P.E.
President

GENERAL LOCATION MAP

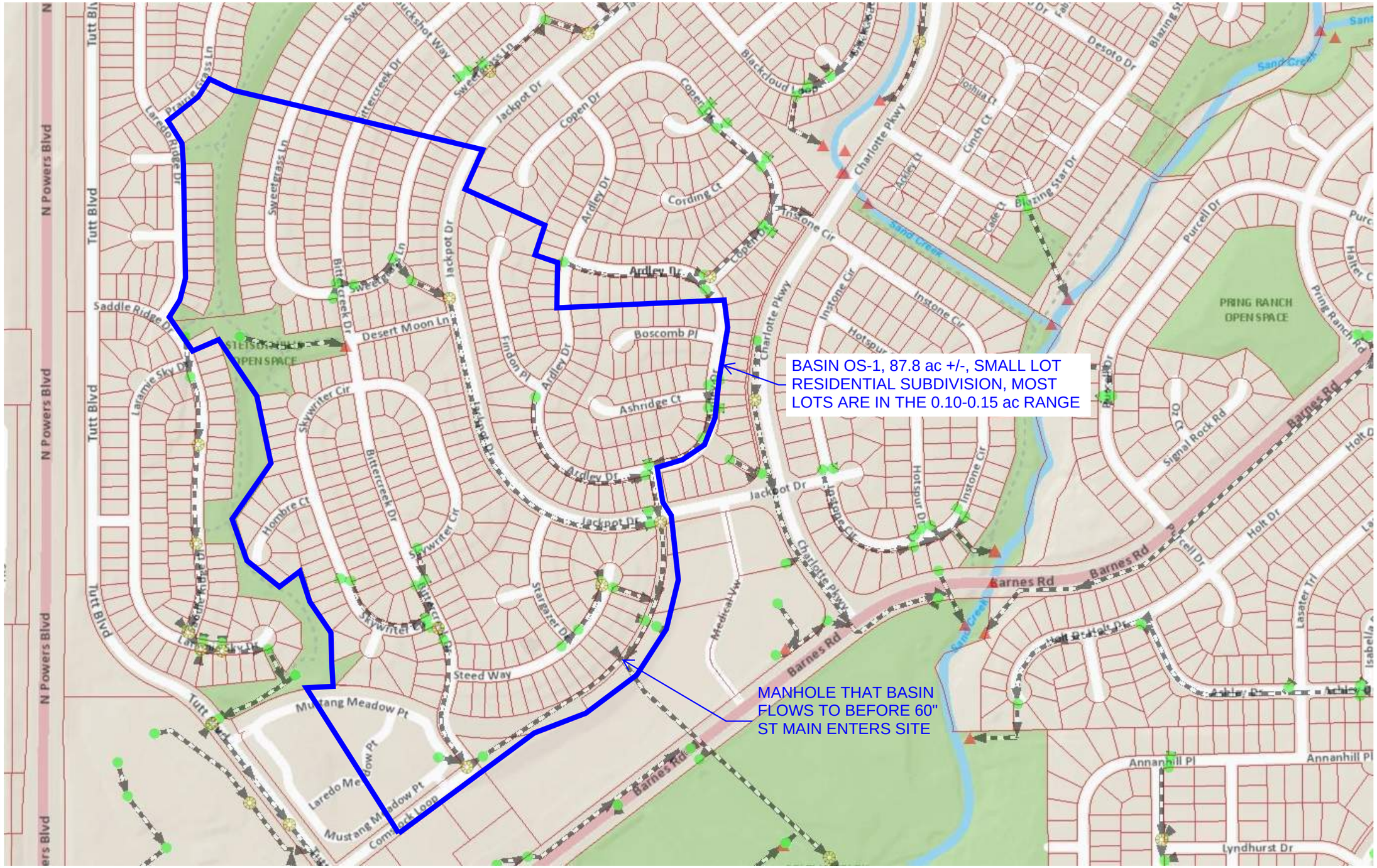


A Vicinity Map
N N.T.S.

0 0.15 0.3mi

OFFSITE BASIN MAP

Barnes & Medical View Apartments - Offsite Storm Flow Basin



Legend

- Parcels
- Storm Manholes
- Storm Inlets
- Storm Outlets
- Storm Lines
  - <all other values>
  - Pipe
- Short-Term Rentals

1: 4,514

0.1 0 0.07 0.1 Miles

NAD_1983_StatePlane_Colorado_Central_FIPS_0502_Feet

Notes

HYDROLOGIC & HYDRAULIC CALCULATIONS

BARNES AND MEDICAL DRIVE APARTMENTS
(Area Runoff Coefficient Summary)

EXISTING CONDITIONS

		STREETS / IMPERVIOUS			*OVERLAND / NONIMPERVIOUS*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
EXA	10.12	0.00	0.90	0.96	10.12	0.09	0.36	0.09	0.36
EXB	0.07	0.06	0.90	0.96	0.01	0.09	0.36	0.79	0.88
EXC	1.52	0.27	0.90	0.96	1.24	0.09	0.36	0.24	0.47
OS-B	0.59	0.00	0.90	0.96	0.59	0.09	0.36	0.09	0.36
OS-C	0.04	0.00	0.90	0.96	0.04	0.09	0.36	0.09	0.36
OS-1	87.80	0.00	0.90	0.96	87.80	0.45	0.59	0.45	0.59

BARNES AND MEDICAL DRIVE APARTMENTS
(Area Runoff Coefficient Summary)

DEVELOPED CONDITIONS

		STREETS / IMPERVIOUS			*OVERLAND / NONIMPERVIOUS*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
A1	2.13	0.89	0.90	0.96	1.24	0.09	0.36	0.43	0.61
A2	0.05	0.05	0.73	0.81	0.00	0.09	0.36	0.73	0.81
A3	0.05	0.05	0.73	0.81	0.00	0.09	0.36	0.73	0.81
A4	0.17	0.17	0.73	0.81	0.00	0.09	0.36	0.73	0.81
A5	0.11	0.11	0.73	0.81	0.00	0.09	0.36	0.73	0.81
A6	0.06	0.06	0.73	0.81	0.00	0.09	0.36	0.73	0.81
A7	0.60	0.00	0.90	0.96	0.60	0.09	0.36	0.09	0.36
OS-B1	0.07	0.00	0.90	0.96	0.07	0.09	0.36	0.09	0.36
OS-B2	0.14	0.00	0.90	0.96	0.14	0.09	0.36	0.09	0.36
OS-B3	0.36	0.00	0.90	0.96	0.36	0.09	0.36	0.09	0.36
B1	1.14	0.66	0.90	0.96	0.48	0.09	0.36	0.56	0.71
B2	0.46	0.30	0.90	0.96	0.16	0.09	0.36	0.62	0.75
B3	0.13	0.11	0.90	0.96	0.02	0.09	0.36	0.78	0.87
B4	0.78	0.59	0.90	0.96	0.19	0.09	0.36	0.64	0.74
B5	0.47	0.00	0.90	0.96	0.47	0.09	0.36	0.09	0.36
B6	0.06	0.06	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B7	0.13	0.13	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B8	0.10	0.10	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B9	0.07	0.07	0.73	0.81	0.00	0.09	0.36	0.64	0.74
B10	0.07	0.07	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B11	0.05	0.05	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B12	0.05	0.05	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B13	0.11	0.11	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B14	0.12	0.12	0.73	0.81	0.00	0.09	0.36	0.73	0.81

BARNES AND MEDICAL DRIVE APARTMENTS
(Area Runoff Coefficient Summary)

		STREETS / IMPERVIOUS			*OVERLAND / NONIMPERVIOUS*			*WEIGHTED*	
BASIN	**TOTAL AREA** *(Acres)*	**AREA** *(Acres)*	**C_5**	**C_{100}**	**AREA** *(Acres)*	**C_5**	**C_{100}**	**C_5**	**C_{100}**
B15	0.05	0.05	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B16	0.04	0.04	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B17	0.11	0.11	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B18	0.11	0.11	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B19	0.07	0.07	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B20	0.07	0.07	0.73	0.81	0.00	0.09	0.36	0.73	0.81
B21	0.53	0.00	0.90	0.96	0.53	0.09	0.36	0.09	0.36
OS-C	0.06	0.00	0.90	0.96	0.06	0.09	0.36	0.09	0.36
C1	1.29	0.90	0.90	0.96	0.39	0.09	0.36	0.66	0.78
C2	0.45	0.28	0.90	0.96	0.17	0.09	0.36	0.59	0.73
C3	0.06	0.06	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C4	0.04	0.04	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C5	0.06	0.06	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C6	0.12	0.12	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C7	0.09	0.09	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C8	0.09	0.09	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C9	0.07	0.07	0.73	0.81	0.00	0.09	0.36	0.73	0.81
C10	0.42	0.00	0.90	0.96	0.42	0.09	0.36	0.09	0.36
D	1.06	0.63	0.90	0.96	0.43	0.09	0.36	0.57	0.72

Calculated by: DLF

Date: 11/4/19

Checked by:

BARNES AND MEDICAL DRIVE APARTMENTS
AREA DRAINAGE SUMMARY

EXISTING CONDITIONS

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		** For Calcs See Runoff Summary*														
EXA	10.12	0.09	0.36	0.09	100	7.0	9.6	640	7.3%	2.9	3.7	13.3	3.7	6.2	3.4	22.6
EXB	0.07	0.79	0.88									5.0	5.2	8.7	0.3	0.5
EXC	1.52	0.24	0.47	0.09	100	7.0	9.6	516	7.6%	3.0	2.9	12.5	3.8	6.4	1.4	4.5
OS-B	0.59	0.09	0.36									5.0	5.2	8.7	0.3	1.8
OS-C	0.04	0.09	0.36									5.0	5.2	8.7	0.0	0.1
OS-1	87.80	0.45	0.59	0.45	100	5.5	6.7	1200	5.5%	4.7	4.3	11.0	4.0	6.7	157.7	347.2

BARNES AND MEDICAL DRIVE APARTMENTS
AREA DRAINAGE SUMMARY

DEVELOPED CONDITIONS

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		** For Calcs See Runoff Summary*														
A1	2.13	0.43	0.61	0.09	100	7.0	9.6	515	7.6%	5.5	1.6	11.2	4.0	6.7	3.6	8.7
A2	0.05	0.73	0.81									5.0	5.2	8.7	0.2	0.4
A3	0.05	0.73	0.81									5.0	5.2	8.7	0.2	0.4
A4	0.17	0.73	0.81									5.0	5.2	8.7	0.6	1.2
A5	0.11	0.73	0.81									5.0	5.2	8.7	0.4	0.8
A6	0.06	0.73	0.81									5.0	5.2	8.7	0.2	0.4
A7	0.60	0.09	0.36									5.0	5.2	8.7	0.3	1.9
OS-B1	0.07	0.09	0.36									5.0	5.2	8.7	0.0	0.2
OS-B2	0.14	0.09	0.36									5.0	5.2	8.7	0.1	0.4
OS-B3	0.36	0.09	0.36									5.0	5.2	8.7	0.2	1.1
B1	1.14	0.56	0.71	0.09	100	13.0	7.8	352	6.8%	5.2	1.1	9.0	4.3	7.2	2.7	5.8
B2	0.46	0.62	0.75	0.09	84	24.0	5.5	275	4.7%	4.4	1.0	6.6	4.8	8.0	1.4	2.8
B3	0.13	0.78	0.87									5.0	5.2	8.7	0.5	1.0
B4	0.78	0.64	0.74	0.09	37	10.0	3.7	363	2.2%	2.9	2.1	5.8	4.9	8.3	2.5	4.8
B5	0.47	0.09	0.36									5.0	5.2	8.7	0.2	1.5
B6	0.06	0.73	0.81									5.0	5.2	8.7	0.2	0.4
B7	0.13	0.73	0.81									5.0	5.2	8.7	0.5	0.9
B8	0.10	0.73	0.81									5.0	5.2	8.7	0.4	0.7
B9	0.07	0.64	0.74									5.0	5.2	8.7	0.2	0.4
B10	0.07	0.73	0.81									5.0	5.2	8.7	0.3	0.5
B11	0.05	0.73	0.81									5.0	5.2	8.7	0.2	0.4
B12	0.05	0.73	0.81									5.0	5.2	8.7	0.2	0.4
B13	0.11	0.73	0.81									5.0	5.2	8.7	0.4	0.8
B14	0.12	0.73	0.81									5.0	5.2	8.7	0.5	0.8
B15	0.05	0.73	0.81									5.0	5.2	8.7	0.2	0.4
B16	0.04	0.73	0.81									5.0	5.2	8.7	0.2	0.3
B17	0.11	0.73	0.81									5.0	5.2	8.7	0.4	0.8

BARNES AND MEDICAL DRIVE APARTMENTS
AREA DRAINAGE SUMMARY

		WEIGHTED		*OVERLAND*				*STREET / CHANNEL FLOW*				T_t	*INTENSITY*		*TOTAL FLOWS*	
BASIN	**AREA TOTAL** *(Acres)*	C_5	C_{100}	C_5	**Length** *(ft)*	**Height** *(ft)*	T_C *(min)*	**Length** *(ft)*	**Slope** *(%)*	**Velocity** *(fps)*	T_t *(min)*	**TOTAL** *(min)*	I_5 *(in/hr)*	I_{100} *(in/hr)*	Q_5 *(c.f.s.)*	Q_{100} *(c.f.s.)*
		** For Calcs See Runoff Summary*														
B18	0.11	0.73	0.81									5.0	5.2	8.7	0.4	0.8
B19	0.07	0.73	0.81									5.0	5.2	8.7	0.3	0.5
B20	0.07	0.73	0.81									5.0	5.2	8.7	0.3	0.5
B21	0.53	0.09	0.36	0.09	40	4.0	5.4	380	2.1%	2.1	3.0	8.4	4.4	7.4	0.2	1.4
OS-C	0.06	0.09	0.36									5.0	5.2	8.7	0.0	0.2
C1	1.29	0.66	0.78	0.09	95	10.0	8.2	505	1.2%	2.1	4.0	12.2	3.8	6.4	3.2	6.5
C2	0.45	0.59	0.73	0.09	60	10.0	5.6	205	2.0%	2.8	1.2	6.8	4.7	7.9	1.3	2.6
C3	0.06	0.73	0.81									5.0	5.2	8.7	0.2	0.4
C4	0.04	0.73	0.81									5.0	5.2	8.7	0.2	0.3
C5	0.06	0.73	0.81									5.0	5.2	8.7	0.2	0.4
C6	0.12	0.73	0.81									5.0	5.2	8.7	0.5	0.8
C7	0.09	0.73	0.81									5.0	5.2	8.7	0.3	0.6
C8	0.09	0.73	0.81									5.0	5.2	8.7	0.3	0.6
C9	0.07	0.73	0.81									5.0	5.2	8.7	0.3	0.5
C10	0.42	0.09	0.36									5.0	5.2	8.7	0.2	1.3
D	1.06	0.57	0.72									5.0	5.2	8.7	3.1	6.6

Calculated by: DLF

Date: 11/4/2019

Checked by: _____

BARNES AND MEDICAL DRIVE APARTMENTS
SURFACE ROUTING SUMMARY

EXISTING CONDITIONS									
Design Point(s)	*Contributing Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*	
						I_5	*I_{100}*	*Q_5*	*Q_{100}*
EX1	EXA THRU OS-C	12.33	1.38	4.64	13.3	3.6	6.2	5.0	29.0

BARNES AND MEDICAL DRIVE APARTMENTS
SURFACE ROUTING SUMMARY

DEVELOPED CONDITIONS									
Design Point(s)	*Contributing Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*	
						I_5	*I_{100}*	*Q_5*	*Q_{100}*
1	A1	0.22	0.91	1.30	11.2	4.0	6.7	3.6	8.7
2	A1-A7	3.17	1.29	1.87	11.2	4.0	6.7	5.1	12.5
3	B1	1.14	0.58	0.81	9.0	4.3	7.2	2.5	5.8
4	B2 & OS-B1	0.53	0.29	0.37	6.6	4.8	8.0	1.4	3.0
5	B3 & OS-B3	0.27	0.11	0.16	5.0	5.2	8.7	0.6	1.4
6	B4	0.78	0.50	1.52	5.8	4.9	8.3	2.5	12.6
7	B21 & OS-B3	0.89	0.08	0.32	8.4	4.4	7.4	0.4	2.4
8	B1-B21	4.72	2.49	3.18	9.0	4.3	7.2	10.7	22.9
9	C1	1.29	0.85	1.00	12.2	3.8	6.4	3.2	6.5
10	C2 & OS-C	0.51	0.27	0.36	6.8	4.7	7.9	1.3	2.8
11	C1-C10	2.69	1.54	2.02	12.2	3.8	6.4	5.9	13.0

Calculated by: DLF
Date: 11/4/19
Checked by:

BARNES AND MEDICAL DRIVE APARTMENTS
PIPE ROUTING SUMMARY

DEVELOPED CONDITIONS

Pipe Run(s)	*Contributing Design Points/Basins*	*Area (Acres)*	*Equivalent CA_5*	*Equivalent CA_{100}*	*Maximum T_C*	*Intensity*		*Flow*		*SIZE & TYPE*	*OWNER*
						I_5	*I_{100}*	*Q_5*	*Q_{100}*		
1	Pond West Outlet	3.17						0.0	2.0	15" HDPE	PRIVATE
2	Pond Middle Outlet	5.29						0.1	3.5	15" HDPE	PRIVATE
3	PR1 & PR2	8.46						0.1	5.5	18" HDPE	PRIVATE
4	Pond East Outlet	2.76						0.0	1.8	15" HDPE	PRIVATE
5A	A1	0.22	0.91	1.30	11.2	4.0	6.7	3.6	8.7	21" RCP	PRIVATE
5B	A1	0.22	0.91	1.30	11.2	4.0	6.7	3.6	8.7	21" RCP	PRIVATE
6	DP4 & PR7 & PR8	4.39	2.13	3.81	9.0	4.3	7.2	9.2	27.5	30" RCP	PRIVATE
7	DP5	0.27	0.11	0.16	5.0	5.2	8.7	0.6	1.4	12" HDPE	PRIVATE
8	DP3 & PR9	3.59	1.73	3.28	9.0	4.3	7.2	7.4	23.6	30" RCP	PRIVATE
9	DP6 & PR11	2.45	1.15	2.47	8.4	4.4	7.4	5.0	18.2	24" RCP	PRIVATE
10	PR11& PARTIAL DP6							3.7	11.9	24 " RCP	PRIVATE
11	PR12 & PR13	1.67	0.65	0.95	8.4	4.4	7.4	2.9	7.0	18" HDPE	PRIVATE
12	DP-7	0.89	0.08	0.32	8.4	4.4	7.4	0.4	2.4	12" HDPE	PRIVATE
13	PR14 & B11-B15	0.78	0.57	0.63	5.0	5.2	8.7	2.9	5.5	15" HDPE	PRIVATE
14	B16-B20	0.40	0.29	0.32	5.0	5.2	8.7	1.5	2.8	12" HDPE	PRIVATE
15	DP10	0.51	0.27	0.36	6.8	4.7	7.9	1.3	2.8	12" HDPE	PRIVATE
16	DP9	1.29	0.85	1.00	12.2	3.8	6.4	3.2	6.5	18" HDPE	PRIVATE
17	DP9 & DP10	1.74						4.5	9.3	21" HDPE	PRIVATE
18	EX 60" + Pond Outfalls							157.9	355.6	6'x4' RCB	PUBLIC
EX 60"								157.7	347.2	60" RCP	PUBLIC

Calculated by: DLF

Date: 11/4/19

Checked by: _____

BARNES AND MEDICAL DRIVE APARTMENTS
PIPE ROUTING SUMMARY

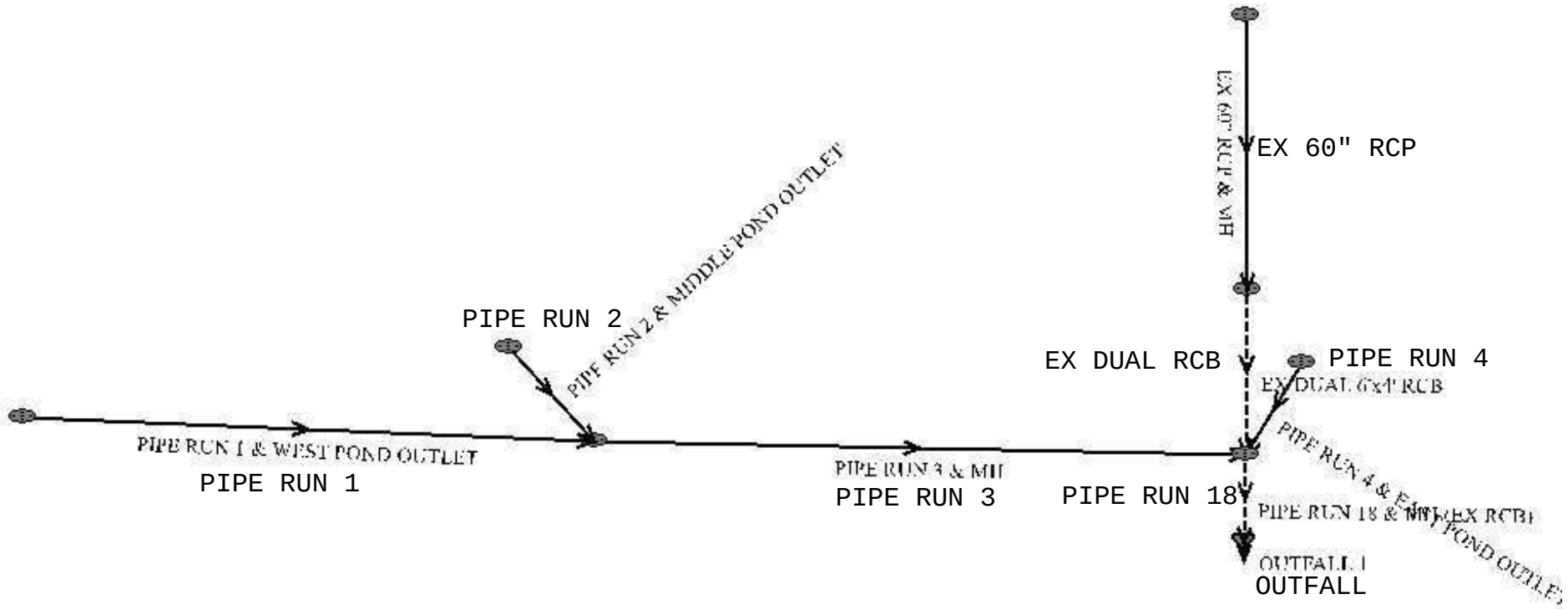
DEVELOPED CONDITIONS

Roof Drains	*Contributing Basins*	*Area (Acres)*	*Flow*		*SIZE & TYPE*	*OWNER*
			Q_5	Q_{100}		
1	A2	0.05	0.2	0.4	6" HDPE	PRIVATE
2	A3	0.05	0.2	0.4	6" HDPE	PRIVATE
3|4	A4	0.17	0.6	1.2	6" HDPE	PRIVATE
5|6	A5	0.11	0.4	0.8	6" HDPE	PRIVATE
7	A6	0.06	0.2	0.4	6" HDPE	PRIVATE
8	B6	0.06	0.2	0.4	6" HDPE	PRIVATE
9|10	B7	0.13	0.5	0.9	6" HDPE	PRIVATE
11	B8	0.10	0.4	0.7	6" HDPE	PRIVATE
12	C3	0.06	0.2	0.4	6" HDPE	PRIVATE
13	C4	0.04	0.2	0.3	6" HDPE	PRIVATE
14	C5	0.06	0.2	0.4	6" HDPE	PRIVATE
15	C6	0.06	0.2	0.4	6" HDPE	PRIVATE
16	C7	0.12	0.5	0.8	6" HDPE	PRIVATE
17	C8	0.09	0.3	0.6	6" HDPE	PRIVATE
18	C9	0.09	0.3	0.6	6" HDPE	PRIVATE
20	C8	0.09	0.3	0.6	6" HDPE	PRIVATE
21	C9	0.07	0.3	0.5	6" HDPE	PRIVATE
19	B11	0.05	0.2	0.4	6" HDPE	PRIVATE
20	B12	0.05	0.2	0.4	6" HDPE	PRIVATE
21|22	B13	0.11	0.4	0.8	6" HDPE	PRIVATE
23|24	B14	0.12	0.5	0.8	6" HDPE	PRIVATE
25	B15	0.05	0.2	0.4	6" HDPE	PRIVATE
26	B15	0.05	0.2	0.4	6" HDPE	PRIVATE
27	B16	0.04	0.2	0.3	6" HDPE	PRIVATE
28|29	B17	0.11	0.4	0.8	6" HDPE	PRIVATE
30	B18	0.11	0.4	0.8	6" HDPE	PRIVATE
31	B18	0.11	0.4	0.8	6" HDPE	PRIVATE
32	B19	0.07	0.3	0.5	6" HDPE	PRIVATE
33	B20	0.07	0.3	0.5	6" HDPE	PRIVATE

Calculated by: DLF

Date: 11/4/19

Checked by: _____



Barnes and Medical Apartments
Existing 60in System Layout

Program: UDSEWER Math Model Interface 2.1.1.4
Run Date: 11/5/2019 9:59:43 AM

UDSewer Results Summary

Project Title: Barnes & Medical Apartments - 60" System - 5 Year
Project Description: Existing 60" System & 3 Ponds Drainage

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 1.50
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6557.20

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6563.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PIPE RUN 18 & MH (EX RCB)	6572.00	157.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX DUAL 6'x4' RCB	6576.00	157.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX 60" RCP & MH	6597.20	157.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 4 & EAST POND OUTLET	6572.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 3 & MH	6570.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 1 & WEST POND OUTLET	6571.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 2 & MIDDLE POND OUTLET	6568.24	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	24.48	6.45	1.09	157.90	
PIPE RUN 18 & MH (EX RCB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	157.90	
EX DUAL 6'x4' RCB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	157.70	
EX 60" RCP & MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	157.70	
PIPE RUN 4 & EAST POND OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	
PIPE RUN 3 & MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	
PIPE RUN 1 & WEST POND OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
PIPE RUN 2 & MIDDLE POND OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**

PIPE RUN 18 & MH (EX RCB)	215.00	6555.70	2.0	6560.00	0.013	0.03	0.00	BOX	4.00 ft	12.00 ft
EX DUAL 6'x4' RCB	50.00	6560.00	2.0	6561.00	0.013	0.05	0.25	BOX	4.00 ft	12.00 ft
EX 60" RCP & MH	326.00	6561.14	5.6	6579.40	0.013	0.05	0.00	CIRCULAR	60.00 in	60.00 in
PIPE RUN 4 & EAST POND OUTLET	31.00	6562.75	12.1	6566.50	0.012	0.17	0.00	CIRCULAR	15.00 in	15.00 in
PIPE RUN 3 & MH	324.00	6561.28	0.5	6562.90	0.012	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 1 & WEST POND OUTLET	299.00	6563.00	1.7	6568.00	0.012	0.05	0.48	CIRCULAR	15.00 in	15.00 in
PIPE RUN 2 & MIDDLE POND OUTLET	27.00	6563.11	0.5	6563.25	0.012	0.35	0.00	CIRCULAR	15.00 in	15.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
PIPE RUN 18 & MH (EX RCB)	1019.51	21.24	21.02	7.51	11.22	14.07	2.56	Supercritical	157.90	0.00	
EX DUAL 6'x4' RCB	1019.51	21.24	21.01	7.51	11.21	14.07	2.56	Supercritical	157.70	0.00	
EX 60" RCP & MH	617.98	31.47	43.20	10.42	20.67	26.31	4.13	Supercritical	157.70	0.00	Velocity is Too High
PIPE RUN 4 & EAST POND OUTLET	24.41	19.89	1.46	1.63	0.70	4.87	4.34	Supercritical	0.10	0.00	
PIPE RUN 3 & MH	31.51	6.42	1.22	1.48	1.24	1.45	0.97	Subcritical	0.10	0.00	Velocity is Too Low
PIPE RUN 1 & WEST POND OUTLET	9.07	7.39	0.46	0.91	0.38	1.21	1.47	Supercritical	0.01	0.00	Velocity is Too Low
PIPE RUN 2 & MIDDLE POND OUTLET	5.06	4.12	1.46	1.63	1.46	1.63	0.99	Subcritical	0.10	0.00	Velocity is Too Low

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PIPE RUN 18 & MH (EX RCB)	157.90	BOX	4.00 ft	12.00 ft	4.50 ft	4.50 ft	4.00 ft	12.00 ft	48.00	Existing height is smaller than the suggested height.
EX DUAL 6'x4' RCB	157.70	BOX	4.00 ft	12.00 ft	4.50 ft	4.50 ft	4.00 ft	12.00 ft	48.00	Existing height is smaller than the suggested height.
EX 60" RCP & MH	157.70	CIRCULAR	60.00 in	60.00 in	36.00 in	36.00 in	60.00 in	60.00 in	19.63	
PIPE RUN 4 & EAST POND OUTLET	0.10	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	
PIPE RUN 3 & MH	0.10	CIRCULAR	30.00 in	30.00 in	12.00 in	12.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 1 & WEST POND OUTLET	0.01	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	
PIPE RUN 2 & MIDDLE POND OUTLET	0.10	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6557.20

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 18 & MH (EX RCB)	6555.70	6560.00	0.00	0.00	6557.20	6561.75	6559.71	2.92	6562.63
EX DUAL 6'x4' RCB	6560.00	6561.00	0.01	0.13	6561.89	6563.61	6564.01	0.00	6564.01
EX 60" RCP & MH	6561.14	6579.40	0.05	0.00	6563.66	6583.00	6573.62	11.07	6584.69
PIPE RUN 4 & EAST POND OUTLET	6562.75	6566.50	0.00	0.00	6562.81	6566.62	6563.18	3.49	6566.66

PIPE RUN 3 & MH	6561.28	6562.90	0.00	0.00	6562.63	6563.02	6562.63	0.41	6563.04
PIPE RUN 1 & WEST POND OUTLET	6563.00	6568.00	0.00	0.00	6563.03	6568.04	6563.05	5.00	6568.05
PIPE RUN 2 & MIDDLE POND OUTLET	6563.11	6563.25	0.00	0.00	6563.23	6563.37	6563.27	0.14	6563.41

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

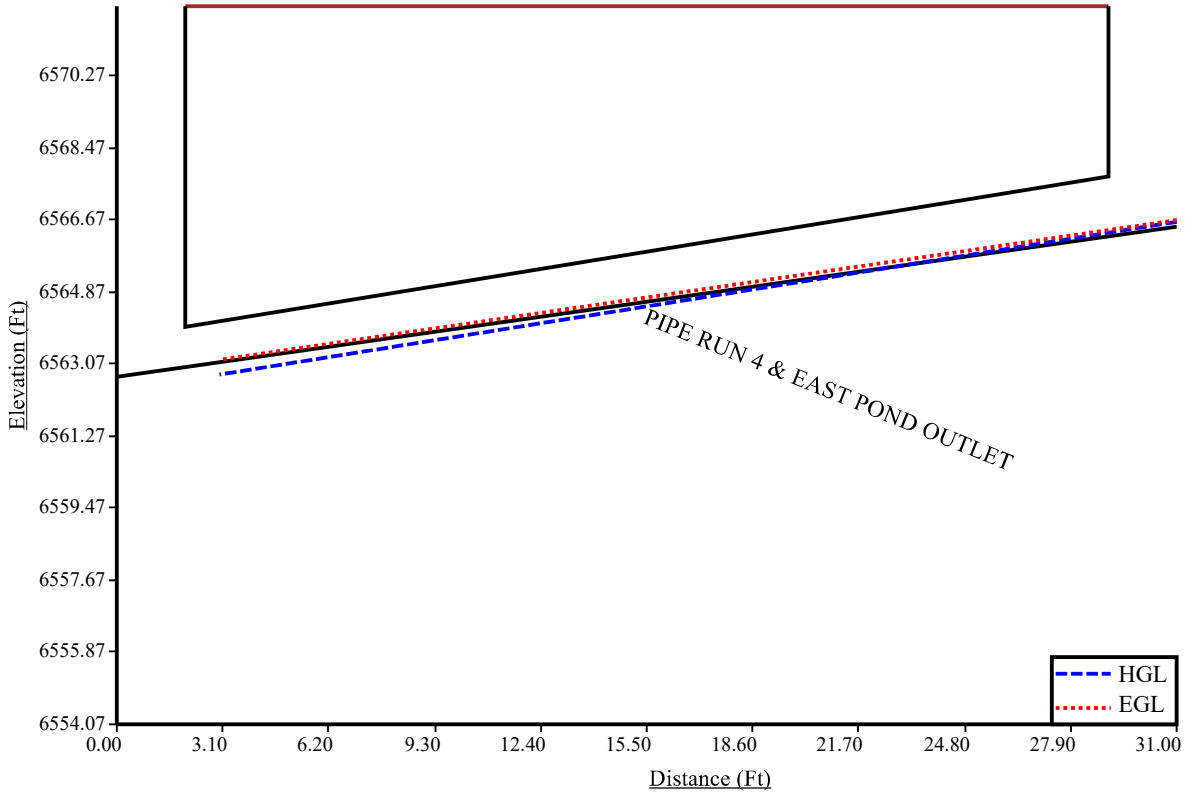
The trench side slope is 0.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE RUN 18 & MH (EX RCB)	215.00	13.00	8.00	17.17	17.17	9.05	2.22	17.17	13.75	6.92	1558.35	
EX DUAL 6'x4' RCB	50.00	13.00	8.00	17.17	17.17	13.75	6.92	17.17	16.75	9.92	484.80	
EX 60" RCP & MH	326.00	6.00	8.00	9.00	9.00	16.02	9.36	9.00	18.97	12.30	1901.09	
PIPE RUN 4 & EAST POND OUTLET	31.00	2.25	4.00	4.63	4.63	9.77	7.81	4.63	6.02	4.06	41.93	
PIPE RUN 3 & MH	324.00	3.50	6.00	6.08	6.08	11.51	7.93	6.08	7.89	4.31	708.23	
PIPE RUN 1 & WEST POND OUTLET	299.00	2.25	4.00	4.63	4.63	7.52	5.56	4.63	3.52	1.56	282.76	
PIPE RUN 2 & MIDDLE POND OUTLET	27.00	2.25	4.00	4.63	4.63	7.41	5.45	4.63	5.51	3.55	29.88	

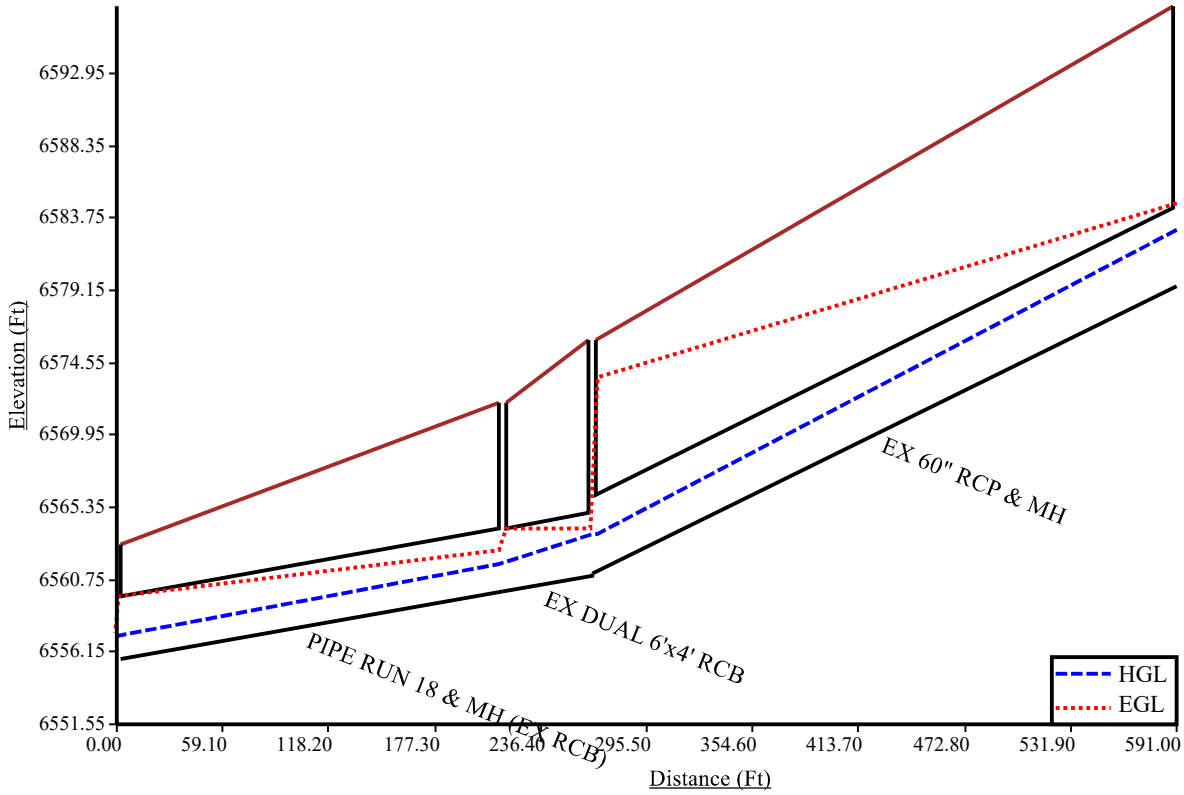
Total earth volume for sewer trenches = 5007 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

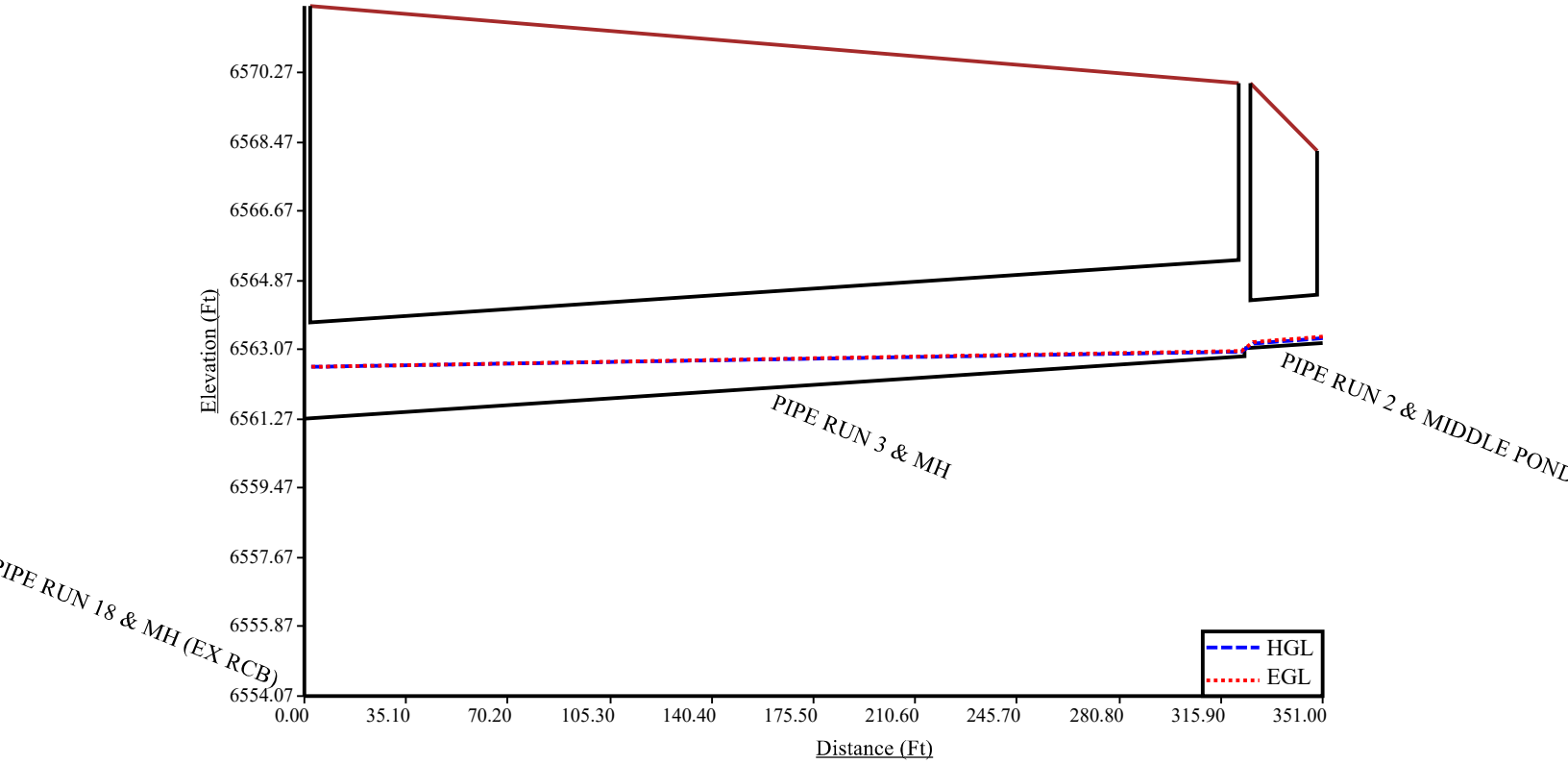
East Pond to RCB



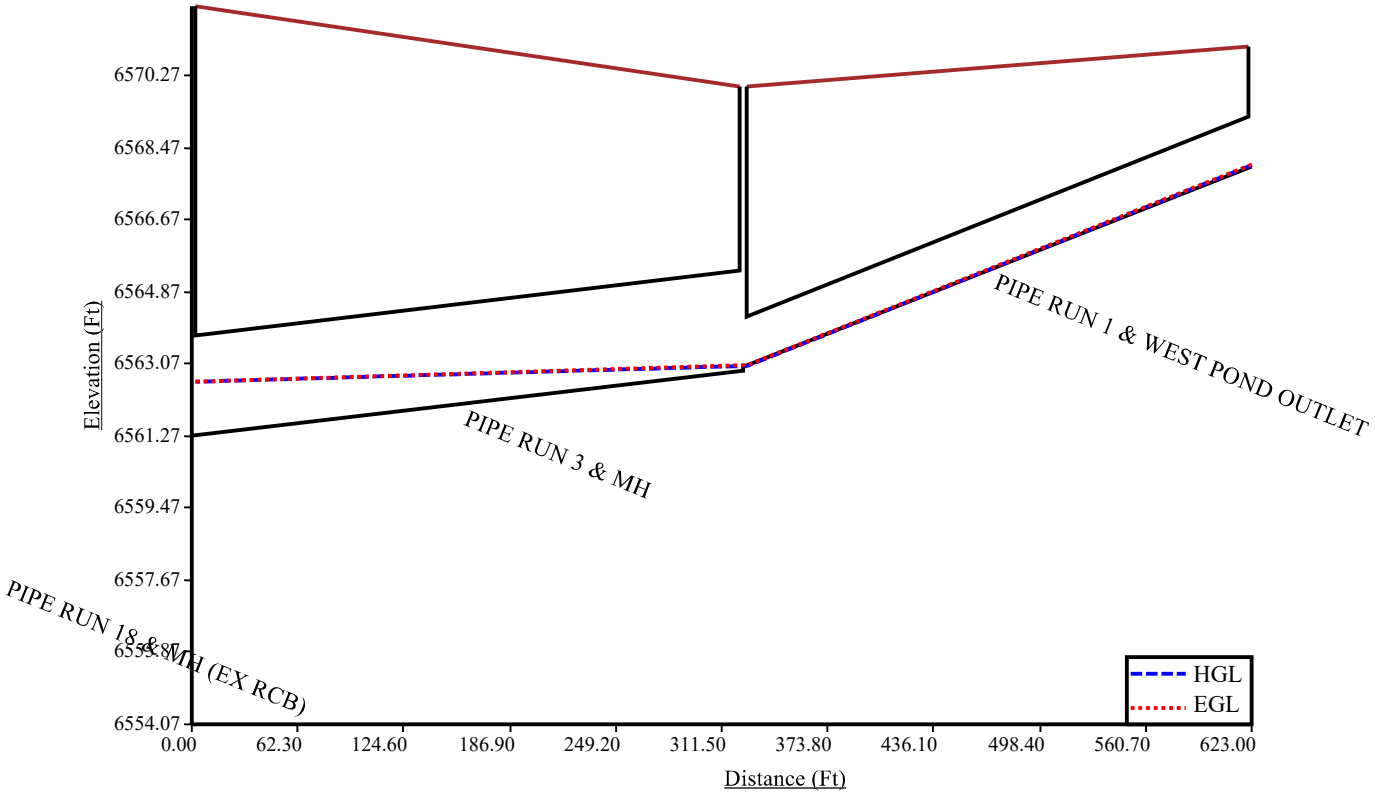
Existing 60" System



Middle Pond to RCB



West Pond to RCB



Program: UDSEWER Math Model Interface 2.1.1.4
Run Date: 11/5/2019 9:45:24 AM

UDSewer Results Summary

Project Title: Barnes & Medical Apartments - 60" System - 100 Year
Project Description: Existing 60" System & 3 Ponds Drainage

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6558.70

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL 1	6563.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PIPE RUN 18 & MH (EX RCB)	6572.00	355.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX DUAL 6'x4' RCB	6576.00	347.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EX 60" RCP & MH	6597.20	347.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 4 & EAST POND OUTLET	6572.00	1.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 3 & MH	6570.00	5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 1 & WEST POND OUTLET	6571.00	2.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 2 & MIDDLE POND OUTLET	6568.24	3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL 1	0.00	0.00	0.00	0.00	0.00	31.39	11.33	0.48	355.60	
PIPE RUN 18 & MH (EX RCB)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	355.60	
EX DUAL 6'x4' RCB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	347.20	
EX 60" RCP & MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	347.20	
PIPE RUN 4 & EAST POND OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	
PIPE RUN 3 & MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	
PIPE RUN 1 & WEST POND OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.00	
PIPE RUN 2 & MIDDLE POND OUTLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**

PIPE RUN 18 & MH (EX RCB)	215.00	6555.70	2.0	6560.00	0.013	0.03	0.00	BOX	4.00 ft	12.00 ft
EX DUAL 6'x4' RCB	50.00	6560.00	2.0	6561.00	0.013	0.05	0.25	BOX	4.00 ft	12.00 ft
EX 60" RCP & MH	326.00	6561.14	5.6	6579.40	0.013	0.05	0.00	CIRCULAR	60.00 in	60.00 in
PIPE RUN 4 & EAST POND OUTLET	31.00	6562.75	12.1	6566.50	0.012	0.17	0.00	CIRCULAR	15.00 in	15.00 in
PIPE RUN 3 & MH	324.00	6561.28	0.5	6562.90	0.012	1.32	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 1 & WEST POND OUTLET	299.00	6563.00	1.7	6568.00	0.012	0.05	0.48	CIRCULAR	15.00 in	15.00 in
PIPE RUN 2 & MIDDLE POND OUTLET	27.00	6563.11	0.5	6563.25	0.012	0.35	0.00	CIRCULAR	15.00 in	15.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
PIPE RUN 18 & MH (EX RCB)	1019.51	21.24	36.12	9.84	18.92	18.79	2.64	Supercritical	355.60	0.00	Velocity is Too High
EX DUAL 6'x4' RCB	1019.51	21.24	35.55	9.77	18.63	18.64	2.64	Supercritical	347.20	0.00	Velocity is Too High
EX 60" RCP & MH	617.98	31.47	57.64	17.92	32.17	32.39	3.89	Supercritical Jump	347.20	6.10	Velocity is Too High
PIPE RUN 4 & EAST POND OUTLET	24.41	19.89	6.58	3.67	2.83	11.82	5.14	Supercritical	1.90	0.00	
PIPE RUN 3 & MH	31.51	6.42	9.29	4.25	8.48	4.82	1.19	Supercritical Jump	5.50	152.92	
PIPE RUN 1 & WEST POND OUTLET	9.07	7.39	6.76	3.73	4.78	5.93	1.94	Supercritical Jump	2.00	17.28	
PIPE RUN 2 & MIDDLE POND OUTLET	5.06	4.12	9.06	4.52	9.18	4.45	0.97	Pressurized	3.50	27.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	Peak Flow (cfs)	Cross Section	Rise	Span	Rise	Span	Rise	Span	Area (ft^2)	Comment
PIPE RUN 18 & MH (EX RCB)	355.60	BOX	4.00 ft	12.00 ft	6.00 ft	6.00 ft	4.00 ft	12.00 ft	48.00	Existing height is smaller than the suggested height.
EX DUAL 6'x4' RCB	347.20	BOX	4.00 ft	12.00 ft	6.00 ft	6.00 ft	4.00 ft	12.00 ft	48.00	Existing height is smaller than the suggested height.
EX 60" RCP & MH	347.20	CIRCULAR	60.00 in	60.00 in	54.00 in	54.00 in	60.00 in	60.00 in	19.63	
PIPE RUN 4 & EAST POND OUTLET	1.90	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	
PIPE RUN 3 & MH	5.50	CIRCULAR	30.00 in	30.00 in	18.00 in	18.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 1 & WEST POND OUTLET	2.00	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	
PIPE RUN 2 & MIDDLE POND OUTLET	3.50	CIRCULAR	15.00 in	15.00 in	15.00 in	15.00 in	15.00 in	15.00 in	1.23	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6558.70

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 18 & MH (EX RCB)	6555.70	6560.00	0.00	0.00	6558.70	6563.01	6562.76	1.75	6564.52
EX DUAL 6'x4' RCB	6560.00	6561.00	0.04	0.65	6563.70	6566.13	6566.95	0.00	6566.95
EX 60" RCP & MH	6561.14	6579.40	0.24	0.00	6566.38	6584.20	6571.00	18.19	6589.19
PIPE RUN 4 & EAST POND OUTLET	6562.75	6566.50	0.01	0.00	6563.02	6567.05	6565.15	2.10	6567.26

PIPE RUN 3 & MH	6561.28	6562.90	0.03	0.00	6564.52	6564.52	6564.54	0.02	6564.56
PIPE RUN 1 & WEST POND OUTLET	6563.00	6568.00	0.00	0.00	6564.52	6568.56	6564.57	4.21	6568.78
PIPE RUN 2 & MIDDLE POND OUTLET	6563.11	6563.25	0.04	0.00	6564.57	6564.63	6564.69	0.07	6564.76

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

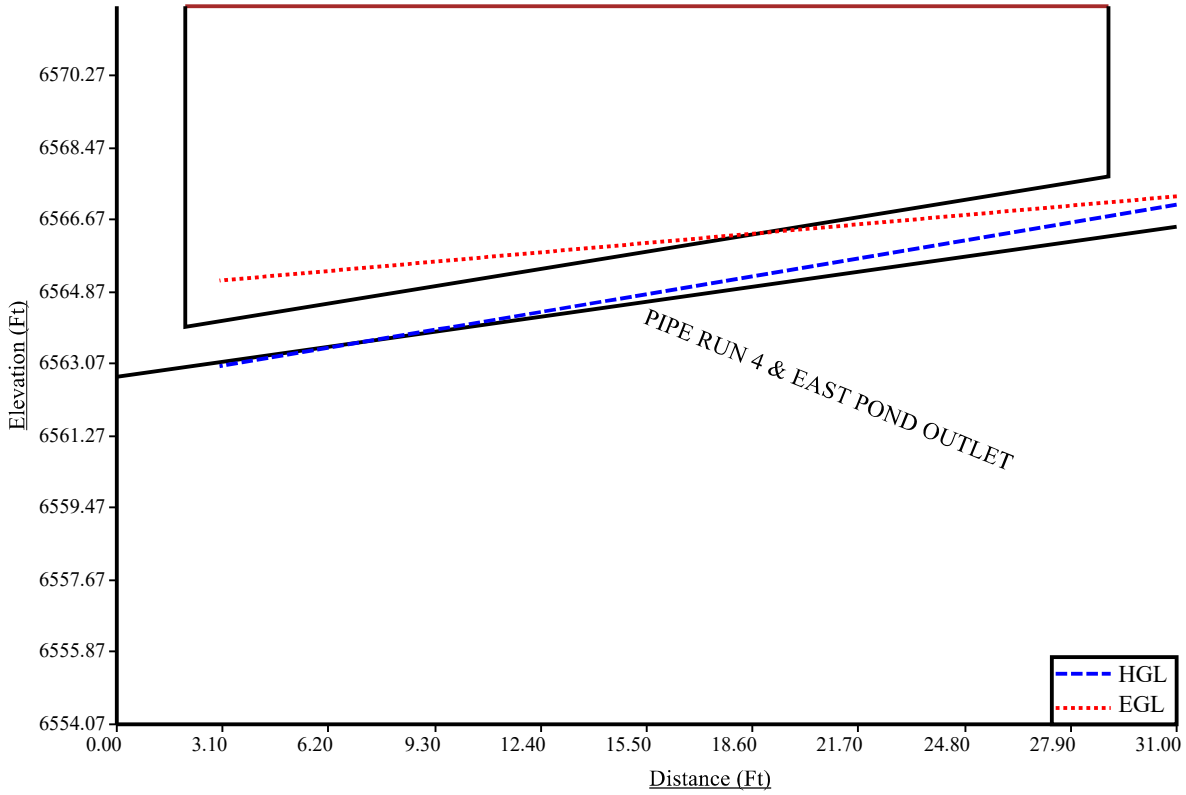
The trench side slope is 0.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	**Length (ft)**	**Wall (in)**	**Bedding (in)**	**Bottom Width (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Top Width (ft)**	**Trench Depth (ft)**	**Cover (ft)**	**Volume (cu. yd)**	**Comment**
PIPE RUN 18 & MH (EX RCB)	215.00	13.00	8.00	17.17	17.17	9.05	2.22	17.17	13.75	6.92	1558.35	
EX DUAL 6'x4' RCB	50.00	13.00	8.00	17.17	17.17	13.75	6.92	17.17	16.75	9.92	484.80	
EX 60" RCP & MH	326.00	6.00	8.00	9.00	9.00	16.02	9.36	9.00	18.97	12.30	1901.09	
PIPE RUN 4 & EAST POND OUTLET	31.00	2.25	4.00	4.63	4.63	9.77	7.81	4.63	6.02	4.06	41.93	
PIPE RUN 3 & MH	324.00	3.50	6.00	6.08	6.08	11.51	7.93	6.08	7.89	4.31	708.23	
PIPE RUN 1 & WEST POND OUTLET	299.00	2.25	4.00	4.63	4.63	7.52	5.56	4.63	3.52	1.56	282.76	
PIPE RUN 2 & MIDDLE POND OUTLET	27.00	2.25	4.00	4.63	4.63	7.41	5.45	4.63	5.51	3.55	29.88	

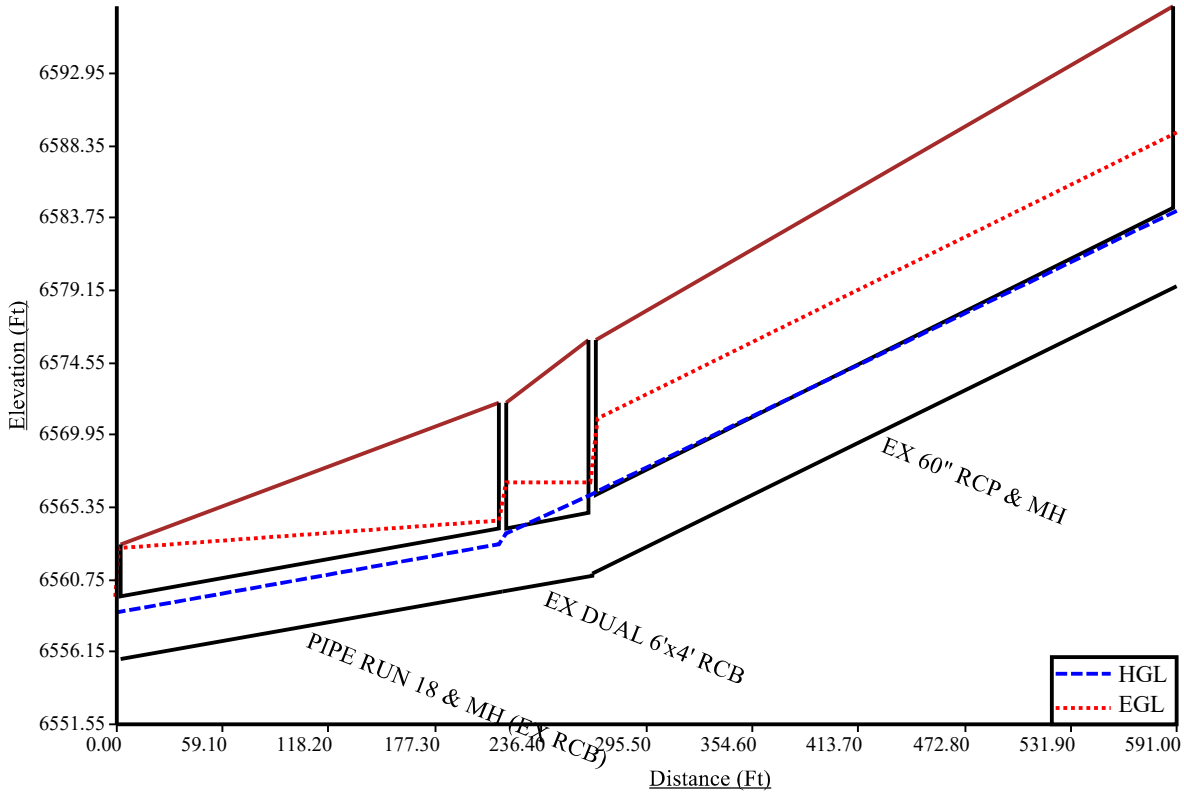
Total earth volume for sewer trenches = 5007 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

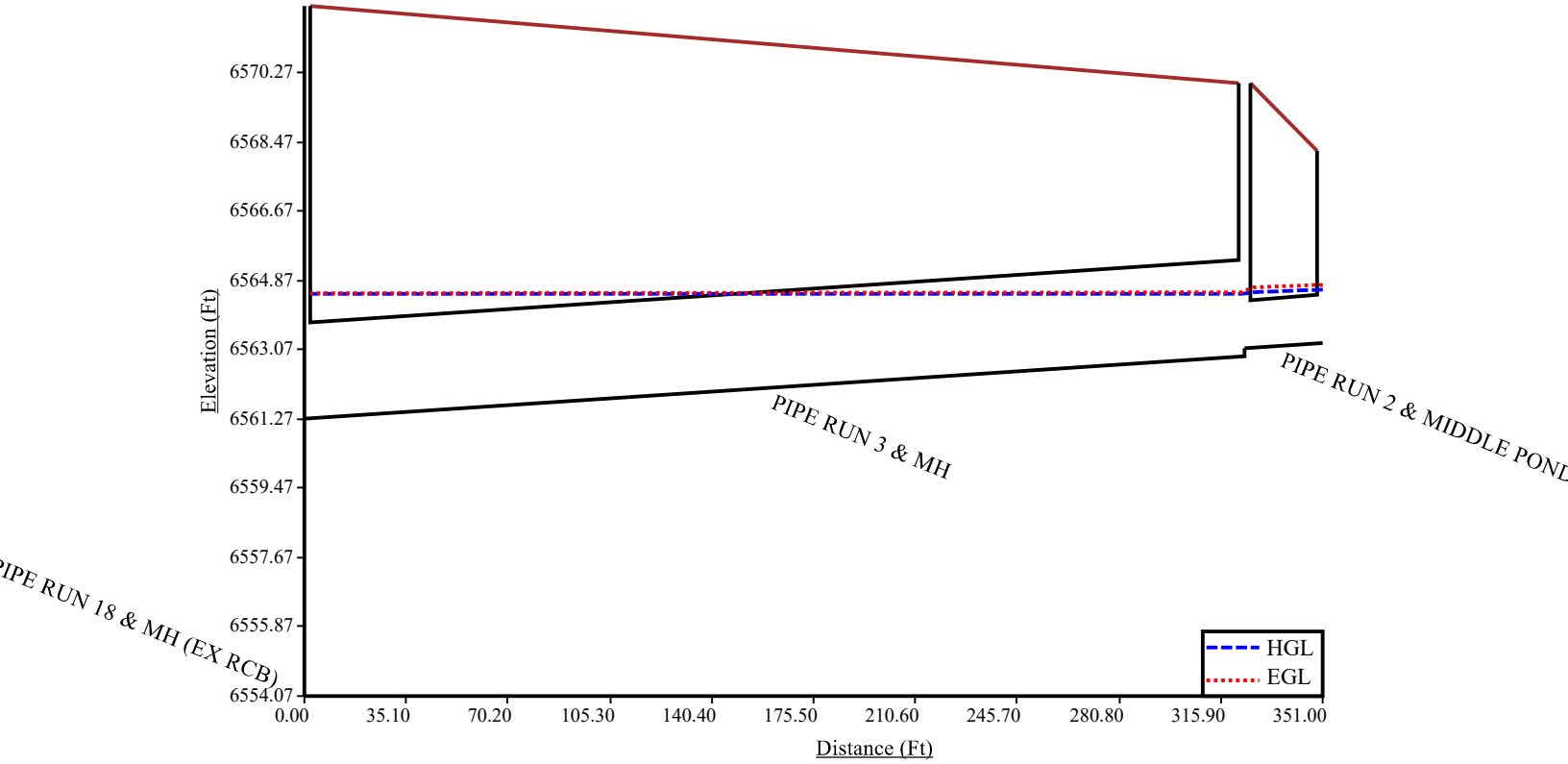
East Pond to RCB



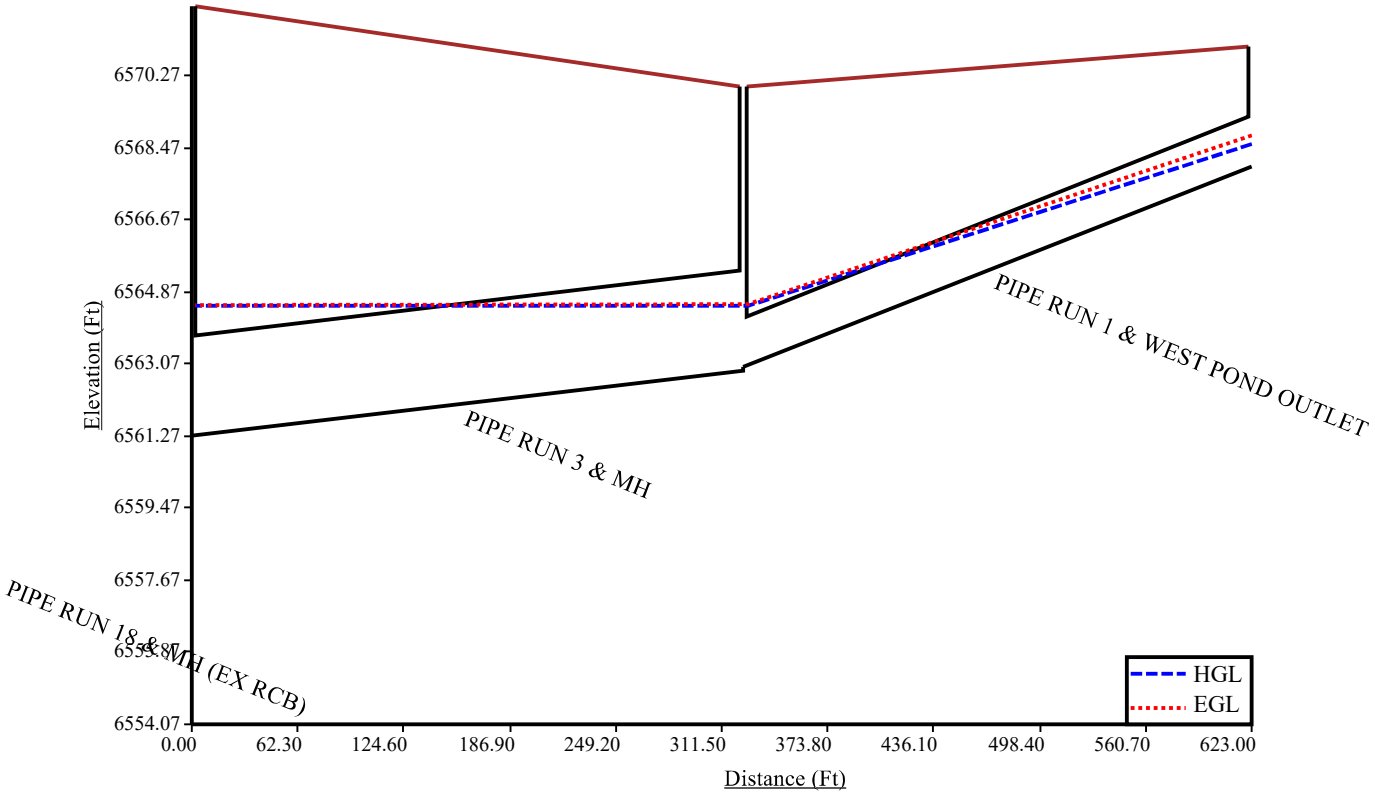
Existing 60" System

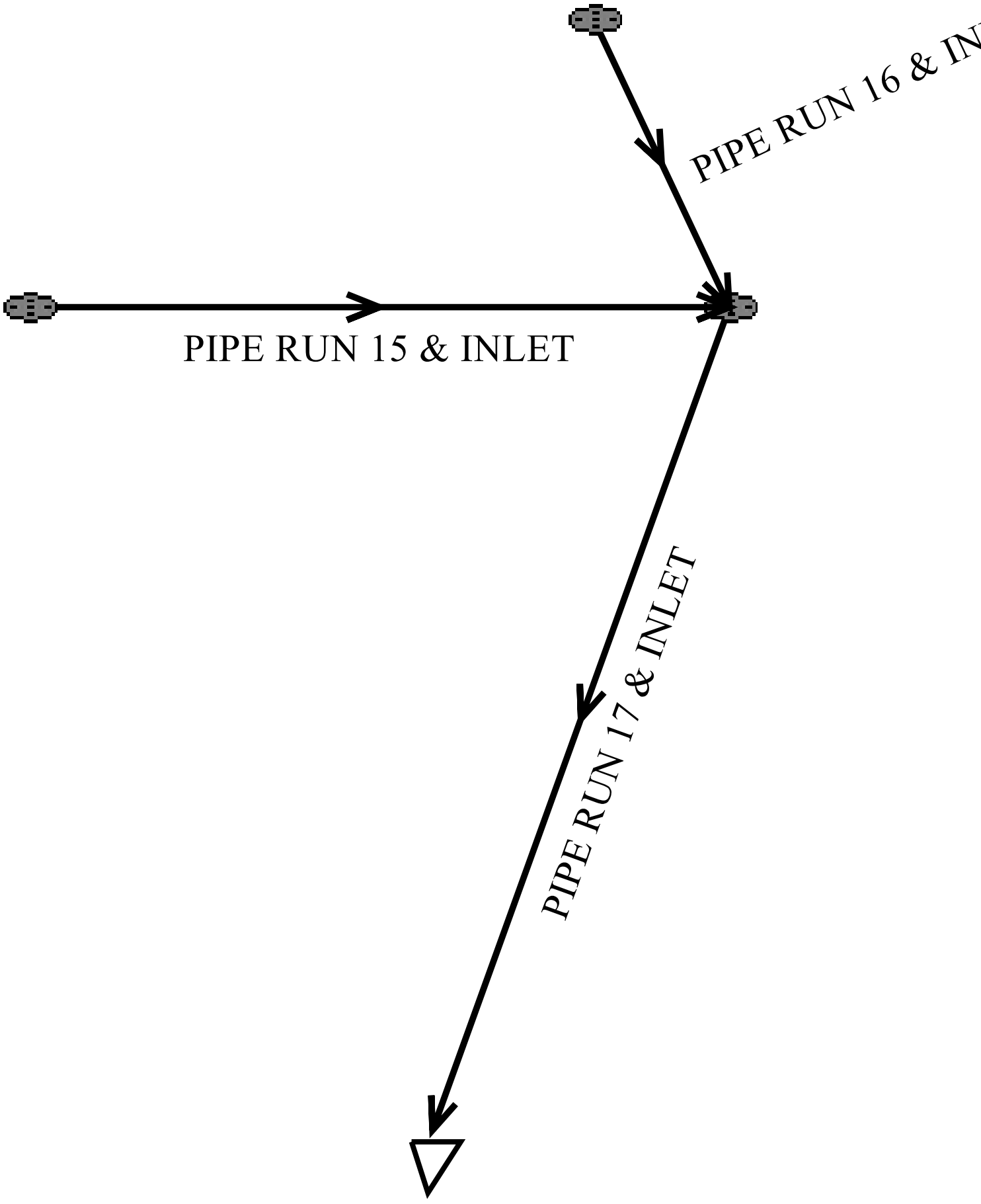


Middle Pond to RCB



West Pond to RCB




PIPE RUN 16 & IN
PIPE RUN 15 & INLET
PIPE RUN 17 & INLET
OUTFALL AT EAST POND

Program: UDSEWER Math Model Interface 2.1.1.4
Run Date: 11/4/2019 11:26:09 AM

UDSewer Results Summary

Project Title: Barnes & Medical - East Pond Inflow System - 5 Yr
Project Description: Storm Sewer on NE Side of Bldg C

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 1.50
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6574.00

Manhole Input Summary:

		Given Flow		Sub Basin Information					
Element Name	Ground Elevation	Total Known	Local Contribution	Drainage Area	Runoff Coefficient	5yr Coefficient	Overland Length	Overland Slope	Gutte Lengt

	(ft)	Flow (cfs)	(cfs)	(Ac.)			(ft)	(%)	(ft)
OUTFALL AT EAST POND	6574.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 17 & INLET	6578.10	4.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 16 & INLET	6578.50	3.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 15 & INLET	6578.39	1.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL AT EAST POND	0.00	0.00	0.00	0.00	0.00	0.70	6.40	1.19	4.50	
PIPE RUN 17 & INLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.50	Surface Water Present (Downstream)
PIPE RUN 16 & INLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.20	
PIPE RUN 15 & INLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.30	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE RUN 17 & INLET	134.00	6574.00	0.5	6574.67	0.012	0.03	0.00	CIRCULAR	21.00 in	21.00 in

PIPE RUN 16 & INLET	24.00	6574.92	2.4	6575.50	0.012	0.07	0.25	CIRCULAR	18.00 in	18.00 in
PIPE RUN 15 & INLET	61.00	6575.43	0.6	6575.80	0.012	1.32	0.00	CIRCULAR	12.00 in	12.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Commer**
PIPE RUN 17 & INLET	12.17	5.06	9.32	4.37	8.84	4.68	1.11	Supercritical	4.50	0.00	
PIPE RUN 16 & INLET	17.68	10.00	8.17	4.10	5.19	7.59	2.40	Supercritical	3.20	0.00	
PIPE RUN 15 & INLET	3.00	3.82	5.78	3.47	5.53	3.68	1.09	Supercritical	1.30	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 17 & INLET	4.50	CIRCULAR	21.00 in	21.00 in	15.00 in	15.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 16 & INLET	3.20	CIRCULAR	18.00 in	18.00 in	12.00 in	12.00 in	18.00 in	18.00 in	1.77	
PIPE RUN 15 & INLET	1.30	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.

- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6574.00

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 17 & INLET	6574.00	6574.67	0.00	0.00	6574.74	6575.45	6575.08	0.67	6575.74
PIPE RUN 16 & INLET	6574.92	6575.50	0.00	0.04	6575.49	6576.18	6576.25	0.19	6576.44
PIPE RUN 15 & INLET	6575.43	6575.80	0.06	0.00	6575.89	6576.28	6576.10	0.36	6576.47

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

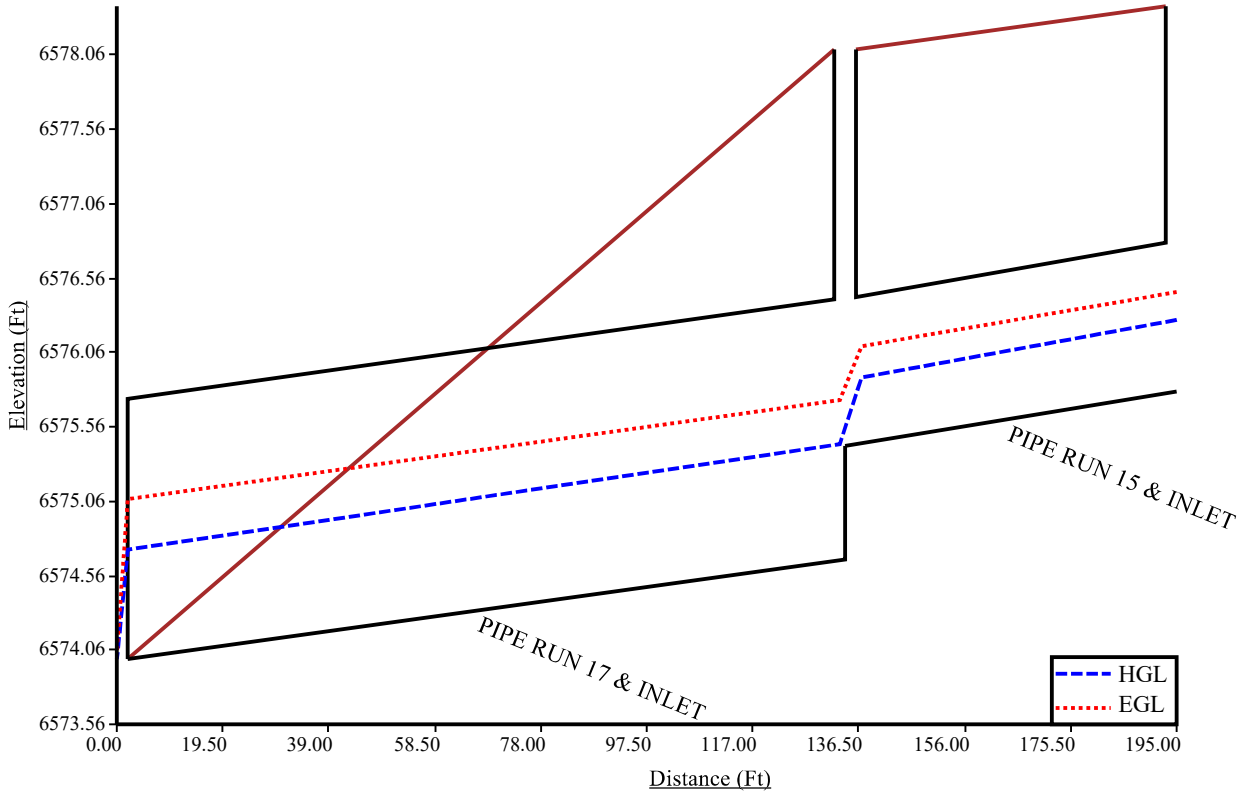
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 17 & INLET	134.00	2.75	4.00	5.21	0.00	0.56	0.00	6.11	3.99	1.45	59.37	Sewer Too Shallow

PIPE RUN 16 & INLET	24.00	2.50	4.00	4.92	5.85	3.72	1.47	5.50	3.54	1.29	16.00	
PIPE RUN 15 & INLET	61.00	2.00	4.00	4.33	5.33	3.17	1.50	5.18	3.09	1.42	31.11	

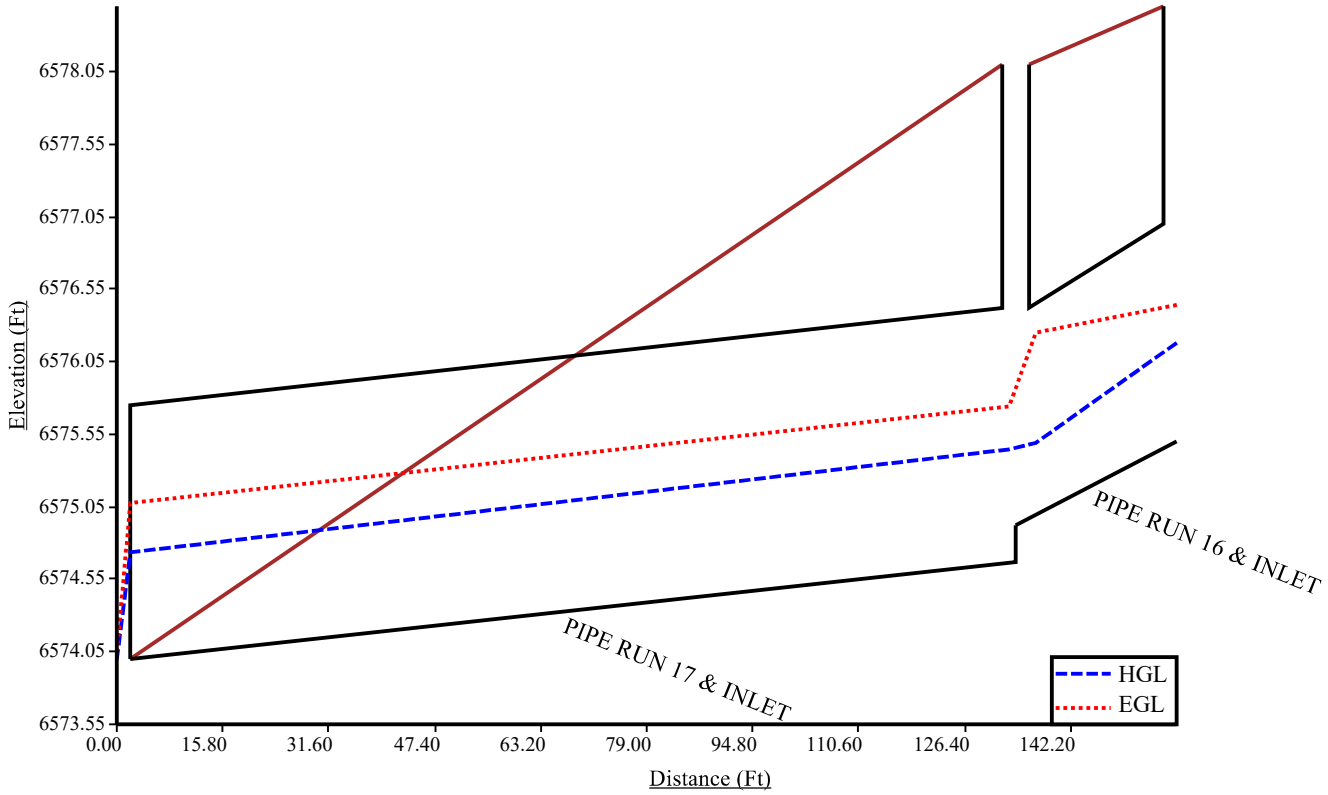
Total earth volume for sewer trenches = 106 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

Pipe Run 15 & 17



Pipe Run 16 & 17



Program: UDSEWER Math Model Interface 2.1.1.4
Run Date: 11/4/2019 11:19:16 AM

UDSewer Results Summary

Project Title: Barnes & Medical - East Pond Inflow System - 100 Yr
Project Description: Storm Sewer on NE Side of Bldg C

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6575.50

Manhole Input Summary:

		Given Flow		Sub Basin Information					
Element Name	Ground Elevation	Total Known	Local Contribution	Drainage Area	Runoff Coefficient	5yr Coefficient	Overland Length	Overland Slope	Gutte Lengt

	(ft)	Flow (cfs)	(cfs)	(Ac.)			(ft)	(%)	(ft)
OUTFALL AT EAST POND	6574.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 17 & INLET	6578.10	9.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 16 & INLET	6578.50	6.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 15 & INLET	6578.39	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	Overland Time (min)	Gutter Time (min)	Basin Tc (min)	Intensity (in/hr)	Local Contrib (cfs)	Coeff. Area	Intensity (in/hr)	Manhole Tc (min)	Peak Flow (cfs)	Comment
OUTFALL AT EAST POND	0.00	0.00	0.00	0.00	0.00	0.83	11.25	0.58	9.30	Surface Water Present (Upstream)
PIPE RUN 17 & INLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.30	Surface Water Present (Downstream)
PIPE RUN 16 & INLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	
PIPE RUN 15 & INLET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.80	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE RUN 17 & INLET	134.00	6574.00	0.5	6574.67	0.012	0.03	0.00	CIRCULAR	21.00 in	21.00 in

PIPE RUN 16 & INLET	24.00	6574.92	2.4	6575.50	0.012	0.07	0.25	CIRCULAR	18.00 in	18.00 in
PIPE RUN 15 & INLET	61.00	6575.43	0.6	6575.80	0.012	1.32	0.00	CIRCULAR	12.00 in	12.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Commer**
PIPE RUN 17 & INLET	12.17	5.06	13.61	5.64	13.75	5.57	0.98	Subcritical	9.30	0.00	
PIPE RUN 16 & INLET	17.68	10.00	11.83	5.28	7.55	9.24	2.36	Supercritical	6.50	0.00	
PIPE RUN 15 & INLET	3.00	3.82	8.61	4.64	9.19	4.34	0.88	Subcritical	2.80	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 17 & INLET	9.30	CIRCULAR	21.00 in	21.00 in	21.00 in	21.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 16 & INLET	6.50	CIRCULAR	18.00 in	18.00 in	15.00 in	15.00 in	18.00 in	18.00 in	1.77	
PIPE RUN 15 & INLET	2.80	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.

- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6575.50

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 17 & INLET	6574.00	6574.67	0.00	0.00	6575.50	6575.81	6575.78	0.52	6576.30
PIPE RUN 16 & INLET	6574.92	6575.50	0.01	0.18	6576.01	6576.49	6576.88	0.04	6576.92
PIPE RUN 15 & INLET	6575.43	6575.80	0.26	0.00	6576.34	6576.60	6576.56	0.31	6576.87

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 1.0 ft/ft
The minimum trench width is 2.00 ft

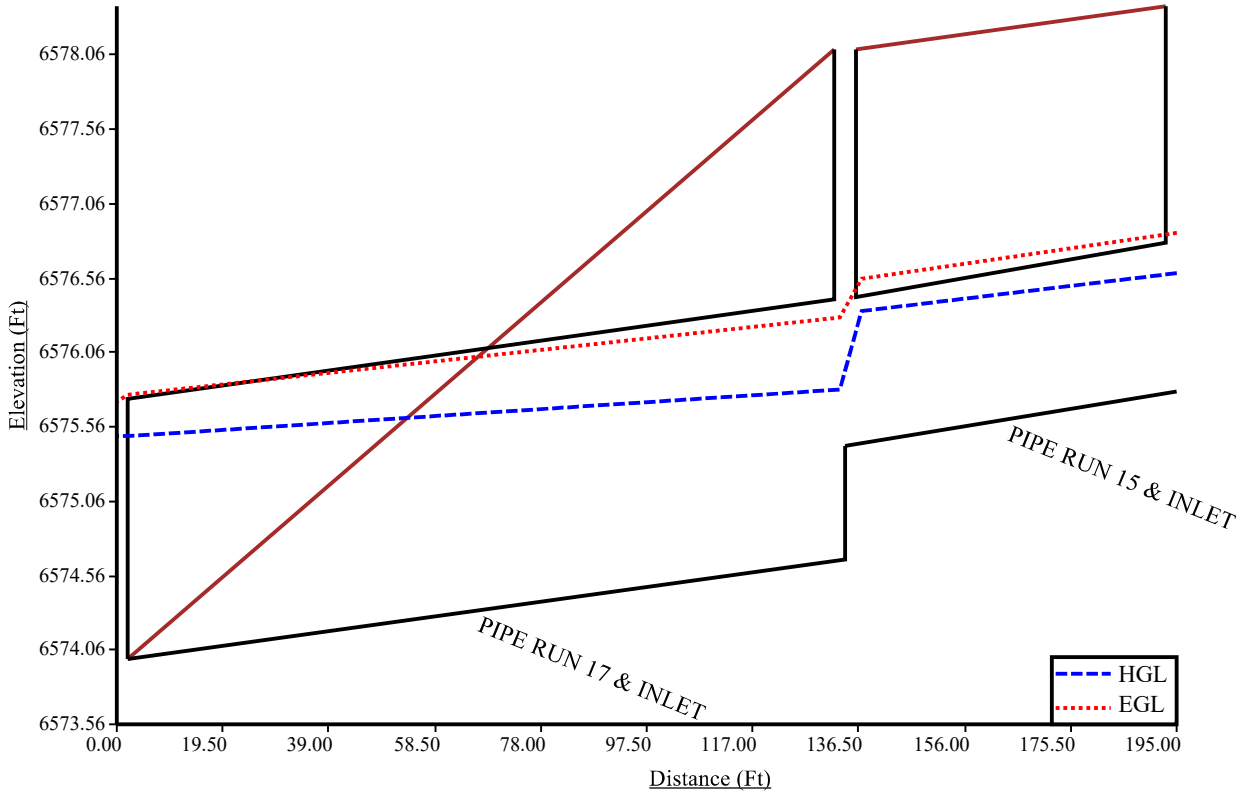
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 17 & INLET	134.00	2.75	4.00	5.21	0.00	0.56	0.00	6.11	3.99	1.45	59.37	Sewer Too Shallow

PIPE RUN 16 & INLET	24.00	2.50	4.00	4.92	5.85	3.72	1.47	5.50	3.54	1.29	16.00	
PIPE RUN 15 & INLET	61.00	2.00	4.00	4.33	5.33	3.17	1.50	5.18	3.09	1.42	31.11	

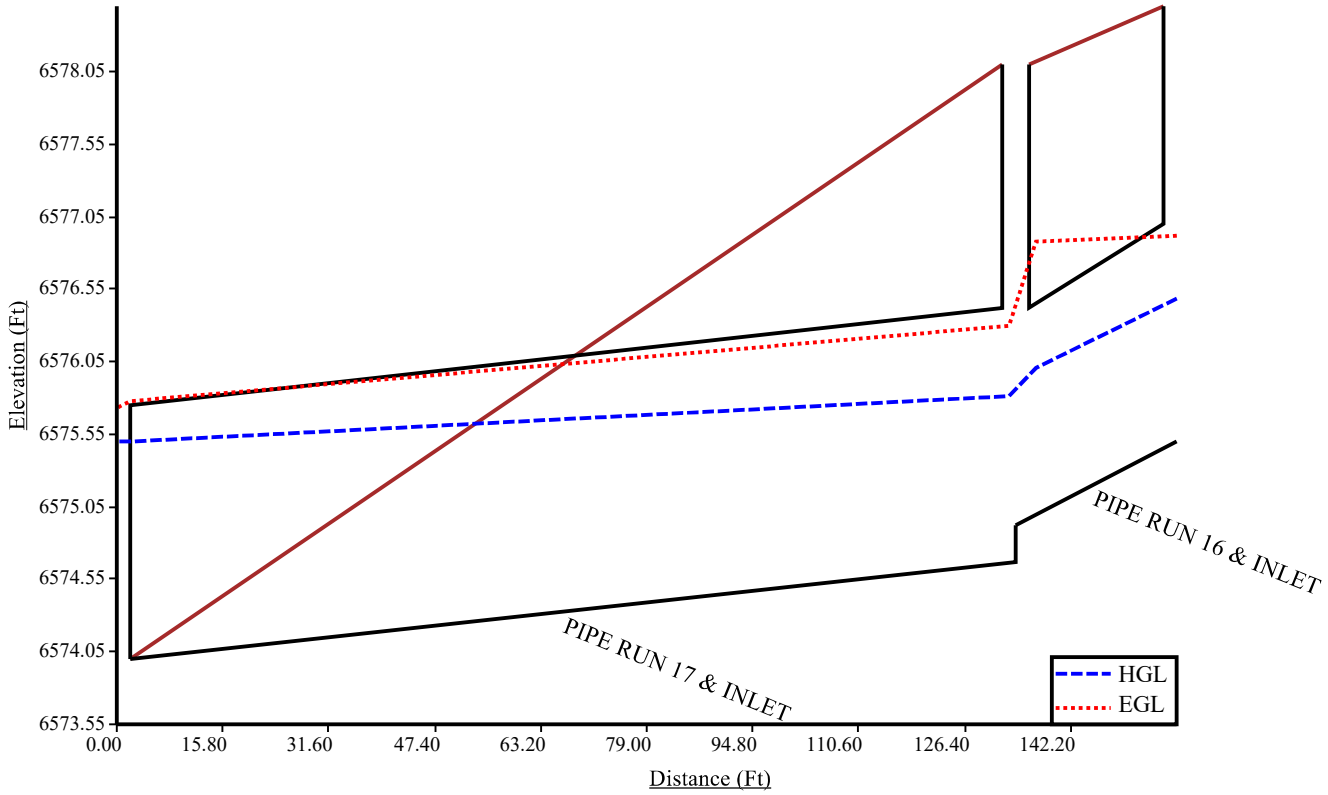
Total earth volume for sewer trenches = 106 cubic yards.

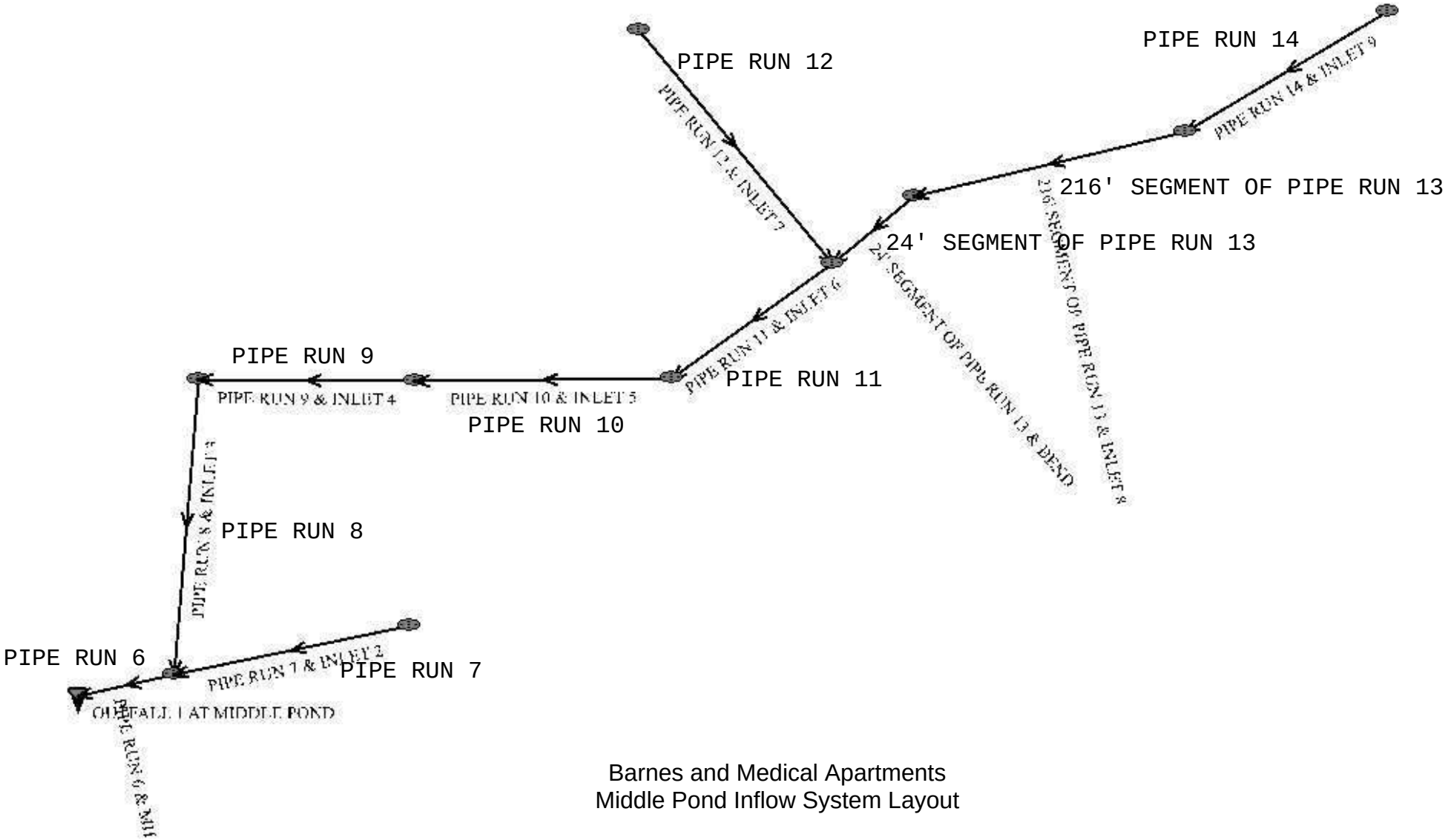
- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

Pipe Run 15 & 17



Pipe Run 16 & 17





Barnes and Medical Apartments
Middle Pond Inflow System Layout

Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 8/26/2019 11:02:01 AM	# UDSewer Results Summary **Project Title:** Barnes & Medical - Middle Pond Inflow System - 5 Yr **Project Description:** Storm Sewer Between BLDGs B & C & Along BLDG D

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 1.50
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6566.50

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1 AT MIDDLE POND	6566.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PIPE RUN 6 & MH	6574.00	9.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 7 & INLET 2	6574.46	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 8 & INLET 3	6578.91	7.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 9 & INLET 4	6578.44	5.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 10 & INLET 5	6578.88	3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 11 & INLET 6	6579.70	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 12 & INLET 7	6586.50	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24' SEGMENT OF PIPE RUN 13 & BEND	6580.50	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
216' SEGMENT OF PIPE RUN 13 & INLET 8	6582.03	2.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 14 & INLET 9	6585.10	1.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL 1 AT MIDDLE POND	0.00	0.00	0.00	0.00	0.00	1.36	6.77	0.43	9.20	
PIPE RUN 6 & MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.20	
PIPE RUN 7 & INLET 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.60	
PIPE RUN 8 & INLET 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.40	
PIPE RUN 9 & INLET 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	
PIPE RUN 10 & INLET 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.70	
PIPE RUN 11 & INLET 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	
PIPE RUN 12 & INLET 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40	
24' SEGMENT OF PIPE RUN 13 & BEND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	
216' SEGMENT OF PIPE RUN 13 & INLET 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.90	
PIPE RUN 14 & INLET 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.50	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE RUN 6 & MH	48.00	6565.00	4.0	6566.92	0.013	0.03	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 7 & INLET 2	79.00	6568.46	3.9	6571.54	0.012	0.05	0.00	CIRCULAR	12.00 in	12.00 in
PIPE RUN 8 & INLET 3	105.00	6567.43	3.8	6571.42	0.013	0.73	0.89	CIRCULAR	30.00 in	30.00 in
PIPE RUN 9 & INLET 4	70.00	6571.75	3.5	6574.20	0.013	1.16	0.00	CIRCULAR	24.00 in	24.00 in
PIPE RUN 10 & INLET 5	150.00	6574.30	0.5	6575.05	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PIPE RUN 11 & INLET 6	94.00	6576.05	0.5	6576.52	0.012	0.24	0.00	CIRCULAR	18.00 in	18.00 in
PIPE RUN 12 & INLET 7	107.00	6577.01	5.6	6583.00	0.012	1.09	0.00	CIRCULAR	12.00 in	12.00 in
24' SEGMENT OF PIPE RUN 13 & BEND	24.00	6576.77	0.8	6576.96	0.012	0.05	0.26	CIRCULAR	15.00 in	15.00 in
216' SEGMENT OF PIPE RUN 13 & INLET 8	216.00	6576.96	0.8	6578.69	0.012	0.06	0.00	CIRCULAR	15.00 in	15.00 in
PIPE RUN 14 & INLET 9	204.00	6578.78	1.4	6581.64	0.012	0.07	0.00	CIRCULAR	12.00 in	12.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE RUN 6 & MH	82.26	16.76	12.14	4.94	6.77	11.07	3.09	Supercritical	9.20	0.00	
PIPE RUN 7 & INLET 2	7.64	9.73	3.87	2.74	2.27	5.80	2.81	Supercritical	0.60	0.00	
PIPE RUN 8 & INLET 3	80.17	16.33	10.84	4.63	6.16	10.20	3.00	Supercritical	7.40	0.00	
PIPE RUN 9 & INLET 4	42.44	13.51	9.45	4.35	5.56	9.06	2.79	Supercritical	5.00	0.00	
PIPE RUN 10 & INLET 5	16.04	5.11	8.08	3.98	7.84	4.15	1.06	Supercritical	3.70	0.00	
PIPE RUN 11 & INLET 6	8.07	4.57	7.76	3.98	7.46	4.19	1.08	Supercritical	2.90	0.00	
PIPE RUN 12 & INLET 7	9.16	11.66	3.14	2.45	1.71	5.84	3.29	Supercritical	0.40	0.00	
24' SEGMENT OF PIPE RUN 13 & BEND	6.28	5.11	8.21	4.22	7.16	5.01	1.30	Supercritical	2.90	0.00	

216' SEGMENT OF PIPE RUN 13 & INLET 8	6.28	5.11	8.21	4.22	7.16	5.01	1.30	Supercritical	2.90	0.00	
PIPE RUN 14 & INLET 9	4.58	5.83	6.23	3.64	4.73	5.22	1.70	Supercritical	1.50	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 6 & MH	9.20	CIRCULAR	30.00 in	30.00 in	15.00 in	15.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 7 & INLET 2	0.60	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	
PIPE RUN 8 & INLET 3	7.40	CIRCULAR	30.00 in	30.00 in	15.00 in	15.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 9 & INLET 4	5.00	CIRCULAR	24.00 in	24.00 in	12.00 in	12.00 in	24.00 in	24.00 in	3.14	
PIPE RUN 10 & INLET 5	3.70	CIRCULAR	24.00 in	24.00 in	15.00 in	15.00 in	24.00 in	24.00 in	3.14	
PIPE RUN 11 & INLET 6	2.90	CIRCULAR	18.00 in	18.00 in	15.00 in	15.00 in	18.00 in	18.00 in	1.77	
PIPE RUN 12 & INLET 7	0.40	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	
24' SEGMENT OF PIPE RUN 13 & BEND	2.90	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	
216' SEGMENT OF PIPE RUN 13 & INLET 8	2.90	CIRCULAR	15.00 in	15.00 in	12.00 in	12.00 in	15.00 in	15.00 in	1.23	
PIPE RUN 14 & INLET 9	1.50	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6566.50

	Invert Elev.	**Downstream Manhole Losses**	**HGL**	**EGL**

Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 6 & MH	6565.00	6566.92	0.00	0.00	6566.50	6567.93	6567.47	0.84	6568.31
PIPE RUN 7 & INLET 2	6568.46	6571.54	0.00	0.00	6568.65	6571.86	6569.17	2.81	6571.98
PIPE RUN 8 & INLET 3	6567.43	6571.42	0.03	0.02	6567.98	6572.32	6569.56	3.10	6572.66
PIPE RUN 9 & INLET 4	6571.75	6574.20	0.05	0.00	6572.37	6574.99	6573.49	1.79	6575.28
PIPE RUN 10 & INLET 5	6574.30	6575.05	0.00	0.00	6575.15	6575.72	6575.28	0.69	6575.97
PIPE RUN 11 & INLET 6	6576.05	6576.52	0.01	0.00	6576.67	6577.17	6576.94	0.47	6577.41
PIPE RUN 12 & INLET 7	6577.01	6583.00	0.00	0.00	6577.17	6583.26	6577.68	5.67	6583.35
24' SEGMENT OF PIPE RUN 13 & BEND	6576.77	6576.96	0.00	0.02	6577.36	6577.64	6577.76	0.17	6577.92
216' SEGMENT OF PIPE RUN 13 & INLET 8	6576.96	6578.69	0.01	0.00	6577.65	6579.37	6577.95	1.70	6579.65
PIPE RUN 14 & INLET 9	6578.78	6581.64	0.00	0.00	6579.58	6582.16	6579.65	2.71	6582.37

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 0.0 ft/ft
The minimum trench width is 2.00 ft

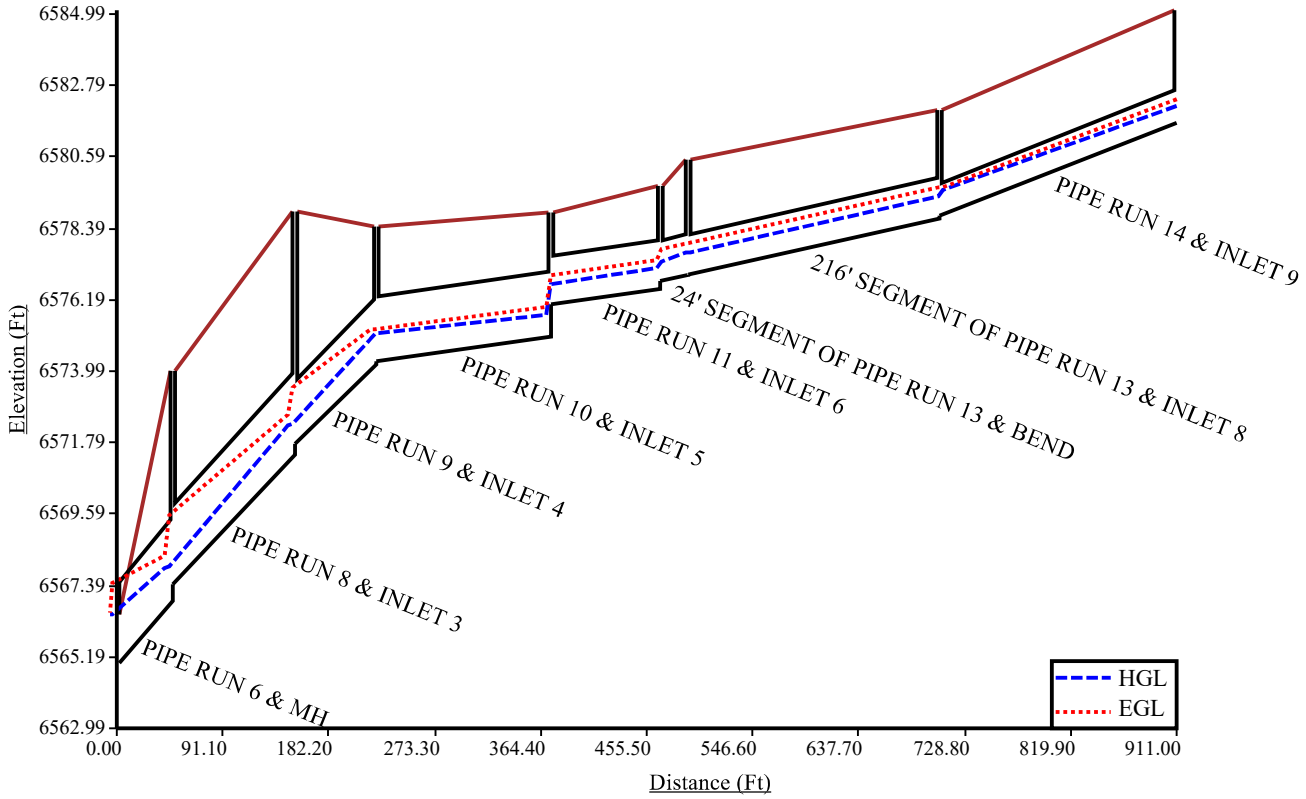
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 6 & MH	48.00	3.50	6.00	6.08	0.00	2.29	0.00	6.08	7.87	4.29	54.96	Sewer Too Shallow
PIPE RUN 7 & INLET 2	79.00	2.00	4.00	4.33	4.33	6.04	4.37	4.33	3.42	1.75	59.98	
PIPE RUN 8 & INLET 3	105.00	3.50	6.00	6.08	6.08	7.36	3.78	6.08	8.28	4.70	185.04	
PIPE RUN 9 & INLET 4	70.00	3.00	4.00	5.50	5.50	7.74	4.91	5.50	4.82	1.99	89.60	
PIPE RUN 10 & INLET 5	150.00	3.00	4.00	5.50	5.50	4.72	1.89	5.50	4.41	1.58	139.59	

PIPE RUN 11 & INLET 6	94.00	2.50	4.00	4.92	4.92	3.37	1.12	4.92	3.72	1.47	60.71	
PIPE RUN 12 & INLET 7	107.00	2.00	4.00	4.33	4.33	3.19	1.53	4.33	4.00	2.33	61.75	
24' SEGMENT OF PIPE RUN 13 & BEND	24.00	2.25	4.00	4.63	4.63	3.45	1.49	4.63	4.06	2.10	15.44	
216' SEGMENT OF PIPE RUN 13 & INLET 8	216.00	2.25	4.00	4.63	4.63	4.06	2.10	4.63	3.86	1.90	146.51	
PIPE RUN 14 & INLET 9	204.00	2.00	4.00	4.33	4.33	3.75	2.08	4.33	3.96	2.29	126.15	

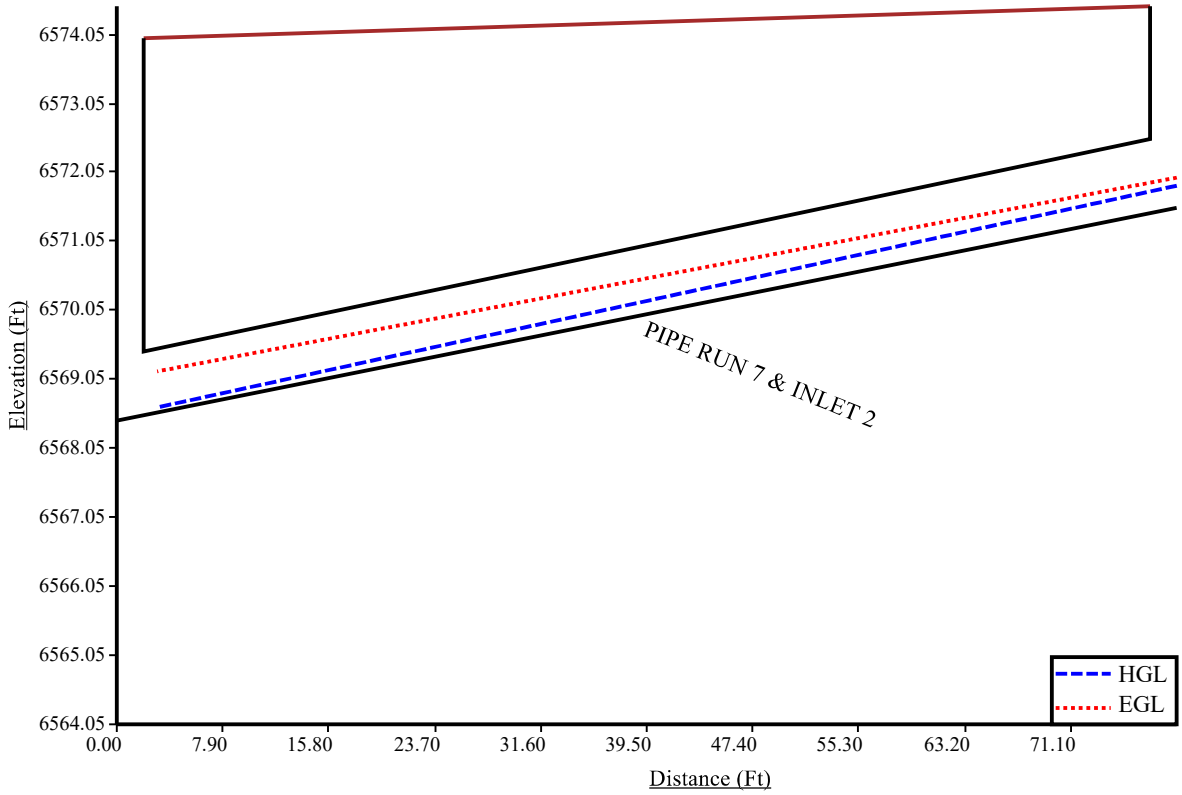
Total earth volume for sewer trenches = 940 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

Main Run

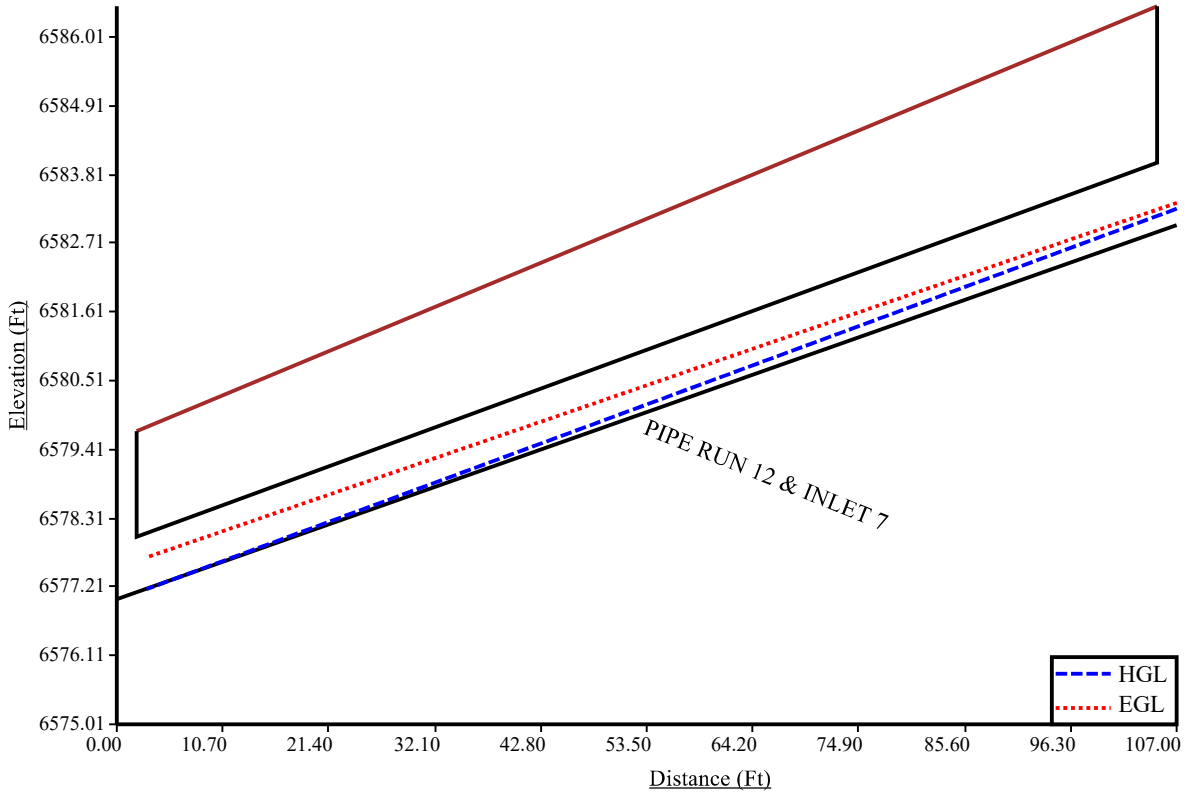

6584.99
6582.79
6580.59
6578.39
6576.19
6573.99
6571.79
6569.59
6567.39
6565.19
6562.99
Elevation (Ft)
0.00
91.10
182.20
273.30
364.40
455.50
546.60
637.70
728.80
819.90
911.00
Distance (Ft)
PIPE RUN 6 & MH
PIPE RUN 8 & INLET 3
PIPE RUN 9 & INLET 4
PIPE RUN 10 & INLET 5
PIPE RUN 11 & INLET 6
24' SEGMENT OF PIPE RUN 13 & BEND
216' SEGMENT OF PIPE RUN 13 & INLET 8
PIPE RUN 14 & INLET 9
HGL
EGL

Pipe Run 7



PIPE RUN 6 & MH

Pipe Run 12



INLET 6

Program: UDSEWER Math Model Interface 2.1.1.4
Run Date: 8/26/2019 10:56:15 AM

UDSewer Results Summary

Project Title: Barnes & Medical - Middle Pond Inflow System - 100 Yr
Project Description: Storm Sewer Between BLDGs B & C & Along BLDG D

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6570.50

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL 1 AT MIDDLE POND	6566.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PIPE RUN 6 & MH	6574.00	27.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 7 & INLET 2	6574.46	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 8 & INLET 3	6578.91	23.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 9 & INLET 4	6578.44	18.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 10 & INLET 5	6578.88	11.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 11 & INLET 6	6579.70	7.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 12 & INLET 7	6586.50	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24' SEGMENT OF PIPE RUN 13 & BEND	6580.50	5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
216' SEGMENT OF PIPE RUN 13 & INLET 8	6582.03	5.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 14 & INLET 9	6585.10	2.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL 1 AT MIDDLE POND	0.00	0.00	0.00	0.00	0.00	2.37	11.63	0.14	27.50	Surface Water Present (Upstream)
PIPE RUN 6 & MH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	27.50	Surface Water Present (Downstream)
PIPE RUN 7 & INLET 2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.40	
PIPE RUN 8 & INLET 3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.60	
PIPE RUN 9 & INLET 4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.20	
PIPE RUN 10 & INLET 5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.90	
PIPE RUN 11 & INLET 6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.00	
PIPE RUN 12 & INLET 7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.40	
24' SEGMENT OF PIPE RUN 13 & BEND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	

216' SEGMENT OF PIPE RUN 13 & INLET 8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.50	
PIPE RUN 14 & INLET 9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.80	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	Sewer Length (ft)	Downstream Invert (ft)	Slope (%)	Upstream Invert (ft)	Mannings n	Bend Loss	Lateral Loss	Cross Section	Rise (ft or in)	Span (ft or in)
PIPE RUN 6 & MH	48.00	6565.00	4.0	6566.92	0.013	0.03	0.00	CIRCULAR	30.00 in	30.00 in
PIPE RUN 7 & INLET 2	79.00	6568.46	3.9	6571.54	0.012	0.05	0.00	CIRCULAR	12.00 in	12.00 in
PIPE RUN 8 & INLET 3	105.00	6567.43	3.8	6571.42	0.013	0.73	0.89	CIRCULAR	30.00 in	30.00 in
PIPE RUN 9 & INLET 4	70.00	6571.72	3.5	6574.20	0.013	1.16	0.00	CIRCULAR	24.00 in	24.00 in
PIPE RUN 10 & INLET 5	150.00	6574.30	0.5	6575.05	0.013	0.05	0.00	CIRCULAR	24.00 in	24.00 in
PIPE RUN 11 & INLET 6	94.00	6576.05	0.5	6576.52	0.012	0.24	0.00	CIRCULAR	18.00 in	18.00 in
PIPE RUN 12 & INLET 7	107.00	6577.01	5.6	6583.00	0.012	1.09	0.00	CIRCULAR	12.00 in	12.00 in
24' SEGMENT OF PIPE RUN 13 & BEND	24.00	6576.77	0.8	6576.96	0.012	0.05	0.26	CIRCULAR	15.00 in	15.00 in
216' SEGMENT OF PIPE RUN 13 & INLET 8	216.00	6576.96	0.8	6578.69	0.012	0.06	0.00	CIRCULAR	15.00 in	15.00 in
PIPE RUN 14 & INLET 9	204.00	6578.78	1.4	6581.64	0.012	0.07	0.00	CIRCULAR	12.00 in	12.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	Flow (cfs)	Velocity (fps)	Depth (in)	Velocity (fps)	Depth (in)	Velocity (fps)	Froude Number	Flow Condition	Flow (cfs)	Surcharged Length (ft)	Comment
PIPE RUN 6 & MH	82.26	16.76	21.45	7.32	11.95	15.09	3.08	Pressurized	27.50	48.00	
PIPE RUN 7 & INLET 2	7.64	9.73	6.01	3.56	3.48	7.41	2.86	Supercritical Jump	1.40	45.00	
PIPE RUN 8 & INLET 3	80.17	16.33	19.85	6.85	11.15	14.20	3.02	Supercritical Jump	23.60	38.69	
PIPE RUN 9 & INLET 4	42.70	13.59	18.44	7.03	10.94	13.05	2.75	Supercritical	18.20	0.00	

PIPE RUN 10 & INLET 5	16.04	5.11	14.87	5.82	15.39	5.59	0.94	Subcritical	11.90	0.00	
PIPE RUN 11 & INLET 6	8.07	4.57	12.29	5.45	12.96	5.14	0.90	Subcritical	7.00	0.00	
PIPE RUN 12 & INLET 7	9.16	11.66	7.96	4.34	4.19	9.82	3.42	Supercritical	2.40	0.00	
24' SEGMENT OF PIPE RUN 13 & BEND	6.28	5.11	11.40	5.49	10.88	5.77	1.10	Supercritical	5.50	0.00	
216' SEGMENT OF PIPE RUN 13 & INLET 8	6.28	5.11	11.40	5.49	10.88	5.77	1.10	Supercritical	5.50	0.00	
PIPE RUN 14 & INLET 9	4.58	5.83	8.61	4.64	6.78	6.12	1.59	Supercritical Jump	2.80	16.14	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 6 & MH	27.50	CIRCULAR	30.00 in	30.00 in	21.00 in	21.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 7 & INLET 2	1.40	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	
PIPE RUN 8 & INLET 3	23.60	CIRCULAR	30.00 in	30.00 in	21.00 in	21.00 in	30.00 in	30.00 in	4.91	
PIPE RUN 9 & INLET 4	18.20	CIRCULAR	24.00 in	24.00 in	18.00 in	18.00 in	24.00 in	24.00 in	3.14	
PIPE RUN 10 & INLET 5	11.90	CIRCULAR	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	24.00 in	3.14	
PIPE RUN 11 & INLET 6	7.00	CIRCULAR	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	18.00 in	1.77	
PIPE RUN 12 & INLET 7	2.40	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	
24' SEGMENT OF PIPE RUN 13 & BEND	5.50	CIRCULAR	15.00 in	15.00 in	15.00 in	15.00 in	15.00 in	15.00 in	1.23	
216' SEGMENT OF PIPE RUN 13 & INLET 8	5.50	CIRCULAR	15.00 in	15.00 in	15.00 in	15.00 in	15.00 in	15.00 in	1.23	
PIPE RUN 14 & INLET 9	2.80	CIRCULAR	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	12.00 in	0.79	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6570.50

	Invert Elev.		Downstream Manhole Losses		HGL		EGL		
Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 6 & MH	6565.00	6566.92	0.00	0.00	6570.50	6570.71	6570.99	0.21	6571.20
PIPE RUN 7 & INLET 2	6568.46	6571.54	0.00	0.00	6571.16	6572.04	6571.20	1.03	6572.24
PIPE RUN 8 & INLET 3	6567.43	6571.42	0.26	0.17	6571.27	6573.07	6571.63	2.17	6573.80
PIPE RUN 9 & INLET 4	6571.72	6574.20	0.60	0.00	6573.68	6575.74	6575.28	1.23	6576.50
PIPE RUN 10 & INLET 5	6574.30	6575.05	0.01	0.00	6576.29	6576.62	6576.51	0.42	6576.93
PIPE RUN 11 & INLET 6	6576.05	6576.52	0.06	0.00	6577.07	6577.64	6577.53	0.49	6578.02
PIPE RUN 12 & INLET 7	6577.01	6583.00	0.16	0.00	6577.80	6583.66	6578.85	5.10	6583.96
24' SEGMENT OF PIPE RUN 13 & BEND	6576.77	6576.96	0.02	0.16	6577.82	6577.91	6578.21	0.17	6578.38
216' SEGMENT OF PIPE RUN 13 & INLET 8	6576.96	6578.69	0.02	0.00	6578.01	6579.64	6578.40	1.71	6580.11
PIPE RUN 14 & INLET 9	6578.78	6581.64	0.01	0.00	6579.93	6582.36	6580.12	2.57	6582.69

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

The trench side slope is 0.0 ft/ft
The minimum trench width is 2.00 ft

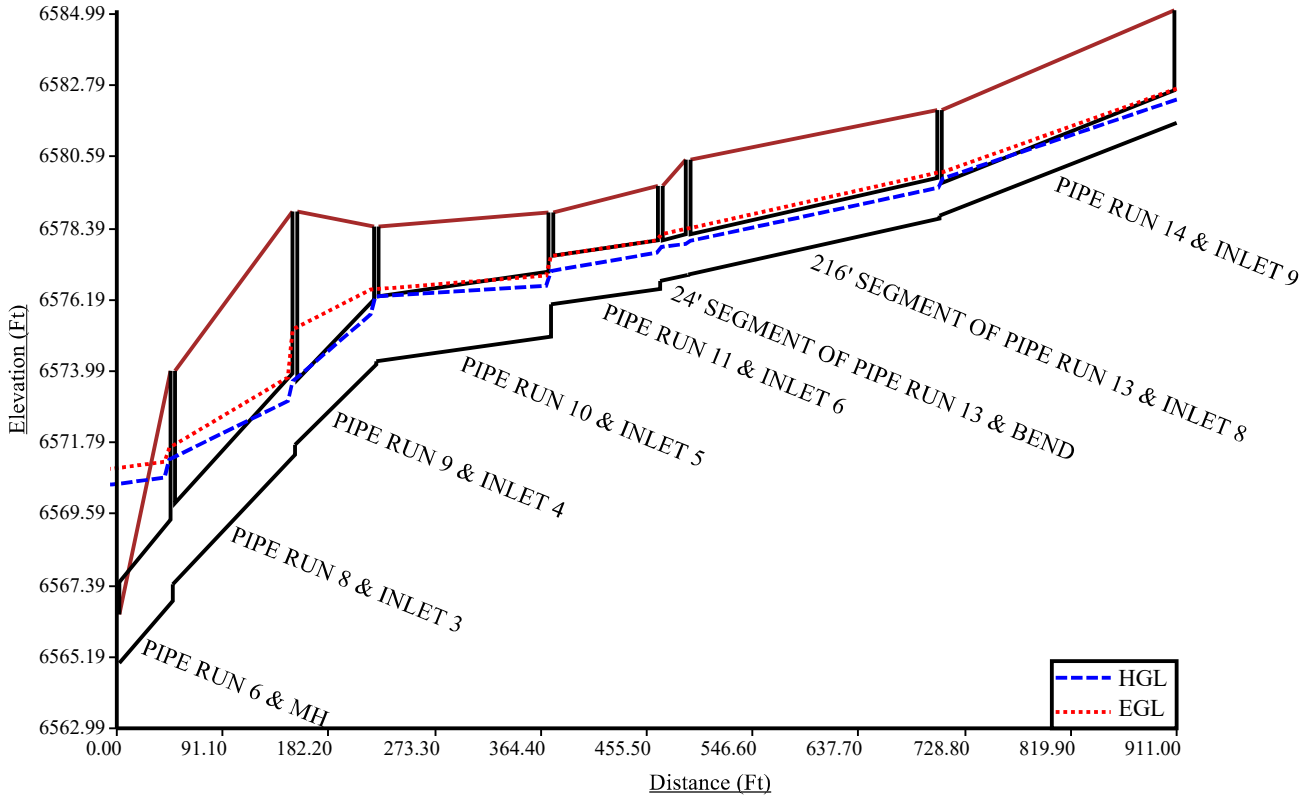
					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 6 & MH	48.00	3.50	6.00	6.08	0.00	2.29	0.00	6.08	7.87	4.29	54.96	Sewer Too Shallow
PIPE RUN 7 & INLET 2	79.00	2.00	4.00	4.33	4.33	6.04	4.37	4.33	3.42	1.75	59.98	

PIPE RUN 8 & INLET 3	105.00	3.50	6.00	6.08	6.08	7.36	3.78	6.08	8.28	4.70	185.04	
PIPE RUN 9 & INLET 4	70.00	3.00	4.00	5.50	5.50	7.77	4.94	5.50	4.82	1.99	89.81	
PIPE RUN 10 & INLET 5	150.00	3.00	4.00	5.50	5.50	4.72	1.89	5.50	4.41	1.58	139.59	
PIPE RUN 11 & INLET 6	94.00	2.50	4.00	4.92	4.92	3.37	1.12	4.92	3.72	1.47	60.71	
PIPE RUN 12 & INLET 7	107.00	2.00	4.00	4.33	4.33	3.19	1.53	4.33	4.00	2.33	61.75	
24' SEGMENT OF PIPE RUN 13 & BEND	24.00	2.25	4.00	4.63	4.63	3.45	1.49	4.63	4.06	2.10	15.44	
216' SEGMENT OF PIPE RUN 13 & INLET 8	216.00	2.25	4.00	4.63	4.63	4.06	2.10	4.63	3.86	1.90	146.51	
PIPE RUN 14 & INLET 9	204.00	2.00	4.00	4.33	4.33	3.75	2.08	4.33	3.96	2.29	126.15	

Total earth volume for sewer trenches = 940 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
    - Four inches for pipes less than 33 inches.
    - Six inches for pipes less than 60 inches.
    - Eight inches for all larger sizes.

Main Run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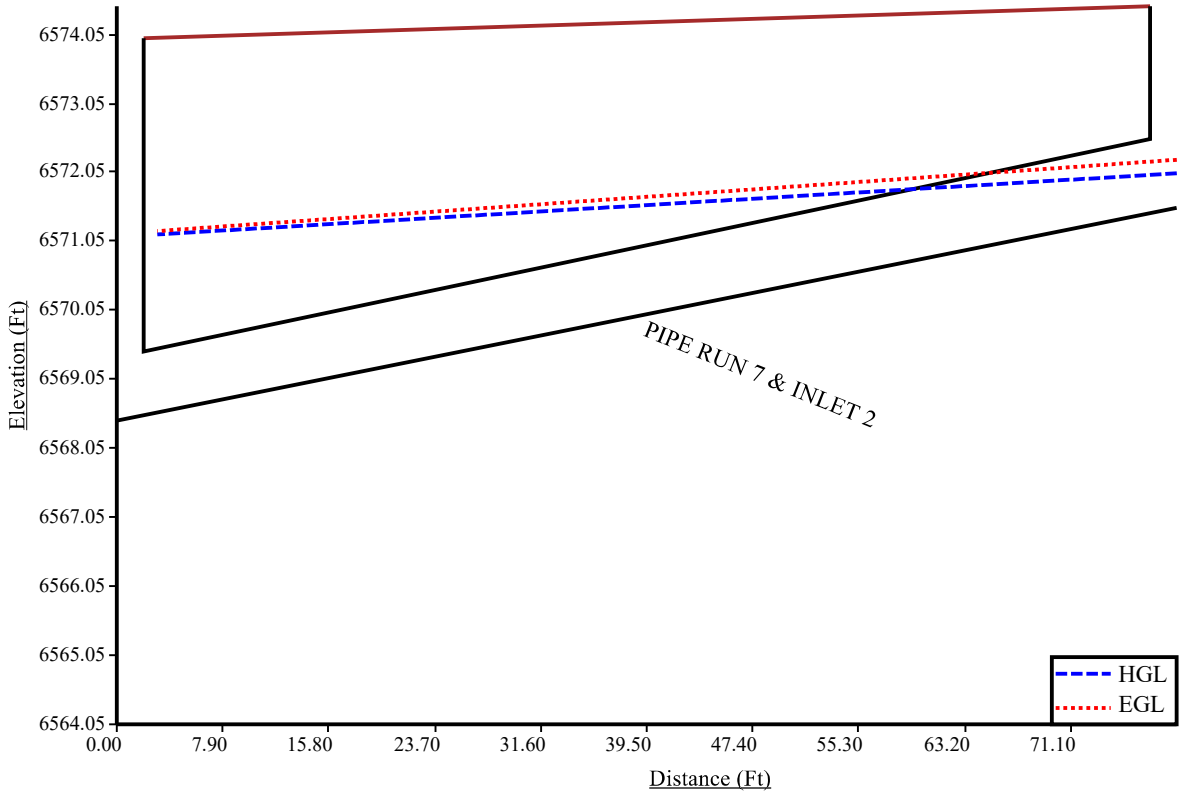
364.40
455.50
546.60
637.70
728.80
819.90
911.00
Distance (Ft)
PIPE RUN 14 & INLET 9
216' SEGMENT OF PIPE RUN 13 & INLET 8
24' SEGMENT OF PIPE RUN 13 & BEND
PIPE RUN 11 & INLET 6
PIPE RUN 10 & INLET 5
PIPE RUN 9 & INLET 4
PIPE RUN 8 & INLET 3
PIPE RUN 6 & MH
HGL
EGL

Pipe Run 7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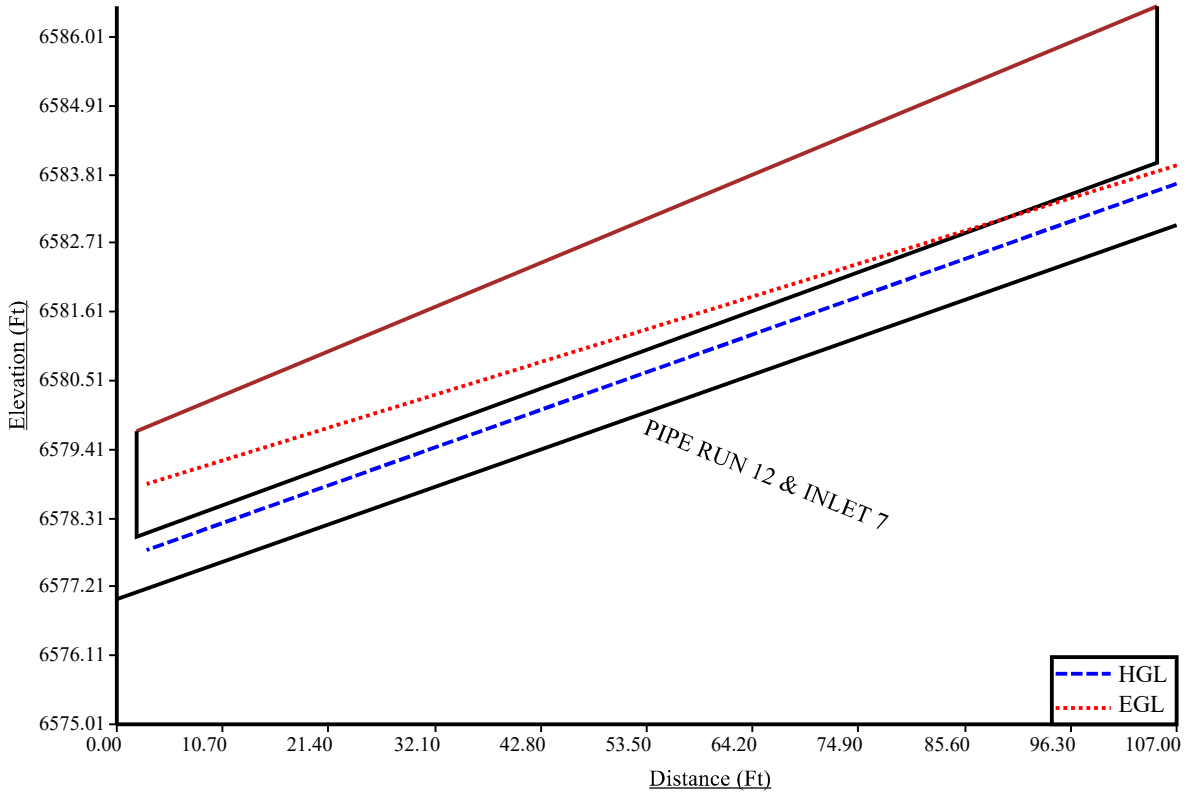
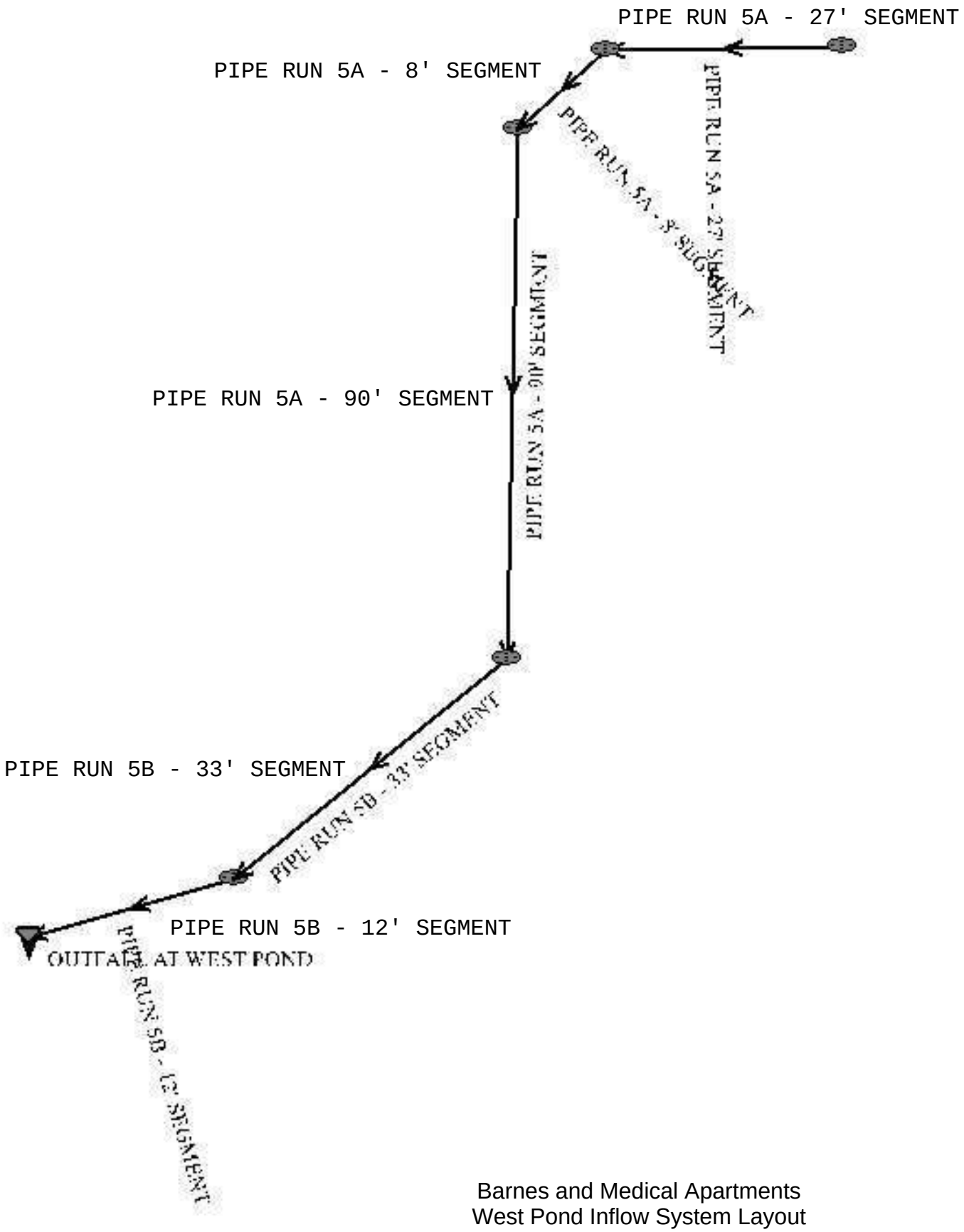
6564.05
Elevation (Ft)
PIPE RUN 7 & INLET 2
PIPE RUN 6 & MH
HGL
EGL
0.00
7.90
15.80
23.70
31.60
39.50
47.40
55.30
63.20
71.10
Distance (Ft)

Pipe Run 12



INLET 6



Barnes and Medical Apartments
West Pond Inflow System Layout

Program: UDSEWER Math Model Interface 2.1.1.4 **Run Date:** 8/20/2019 9:32:23 AM	# UDSewer Results Summary **Project Title:** Barnes & Medical Apartments - West Pond Inflow System - 5 Yr **Project Description:** Storm Sewer Between BLDGs A and B

System Input Summary

Rainfall Parameters

Rainfall Return Period: 5
Rainfall Calculation Method: Formula

One Hour Depth (in): 1.50
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6572.50

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	**Ground Elevation (ft)**	**Total Known Flow (cfs)**	**Local Contribution (cfs)**	**Drainage Area (Ac.)**	**Runoff Coefficient**	**5yr Coefficient**	**Overland Length (ft)**	**Overland Slope (%)**	**Gutter Length (ft)**	**Gutter Velocity (fps)**
OUTFALL AT WEST POND	6573.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PIPE RUN 5B - 12' SEGMENT	6574.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5B - 33' SEGMENT	6575.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5A - 90' SEGMENT	6585.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5A - 8' SEGMENT	6585.00	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5A - 27' SEGMENT	6583.89	3.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL AT WEST POND	0.00	0.00	0.00	0.00	0.00	0.52	6.92	0.13	3.60	
PIPE RUN 5B - 12' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	
PIPE RUN 5B - 33' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	
PIPE RUN 5A - 90' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	
PIPE RUN 5A - 8' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	
PIPE RUN 5A - 27' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.60	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
PIPE RUN 5B - 12' SEGMENT	12.00	6571.75	0.5	6571.81	0.013	0.03	0.00	CIRCULAR	21.00 in	21.00 in
PIPE RUN 5B - 33' SEGMENT	33.00	6571.82	0.5	6571.98	0.013	0.13	0.00	CIRCULAR	21.00 in	21.00 in
PIPE RUN 5A - 90' SEGMENT	90.00	6571.98	4.0	6575.58	0.013	0.38	0.00	CIRCULAR	21.00 in	21.00 in
PIPE RUN 5A - 8' SEGMENT	8.00	6575.58	4.0	6575.90	0.013	0.38	0.00	CIRCULAR	21.00 in	21.00 in

PIPE RUN 5A - 27' SEGMENT	27.00	6575.90	4.0	6576.98	0.013	0.38	0.00	CIRCULAR	21.00 in	21.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
PIPE RUN 5B - 12' SEGMENT	11.23	4.67	8.29	4.08	8.17	4.16	1.03	Supercritical	3.60	0.00	
PIPE RUN 5B - 33' SEGMENT	11.23	4.67	8.29	4.08	8.17	4.16	1.03	Supercritical	3.60	0.00	
PIPE RUN 5A - 90' SEGMENT	31.78	13.21	8.29	4.08	4.77	8.76	2.92	Supercritical	3.60	0.00	
PIPE RUN 5A - 8' SEGMENT	31.78	13.21	8.29	4.08	4.77	8.76	2.92	Supercritical	3.60	0.00	
PIPE RUN 5A - 27' SEGMENT	31.78	13.21	8.29	4.08	4.77	8.76	2.92	Supercritical	3.60	0.00	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 5B - 12' SEGMENT	3.60	CIRCULAR	21.00 in	21.00 in	15.00 in	15.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5B - 33' SEGMENT	3.60	CIRCULAR	21.00 in	21.00 in	15.00 in	15.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5A - 90' SEGMENT	3.60	CIRCULAR	21.00 in	21.00 in	12.00 in	12.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5A - 8' SEGMENT	3.60	CIRCULAR	21.00 in	21.00 in	12.00 in	12.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5A - 27' SEGMENT	3.60	CIRCULAR	21.00 in	21.00 in	12.00 in	12.00 in	21.00 in	21.00 in	2.41	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6572.50

	Invert Elev.	Downstream Manhole Losses	HGL	EGL

Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 5B - 12' SEGMENT	6571.75	6571.81	0.00	0.00	6572.50	6572.50	6572.70	0.06	6572.76
PIPE RUN 5B - 33' SEGMENT	6571.82	6571.98	0.00	0.00	6572.51	6572.67	6572.76	0.16	6572.93
PIPE RUN 5A - 90' SEGMENT	6571.98	6575.58	0.01	0.00	6572.68	6576.27	6573.57	2.96	6576.53
PIPE RUN 5A - 8' SEGMENT	6575.58	6575.90	0.01	0.00	6576.28	6577.10	6577.17	0.00	6577.17
PIPE RUN 5A - 27' SEGMENT	6575.90	6576.98	0.01	0.00	6577.12	6577.67	6577.49	0.44	6577.93

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

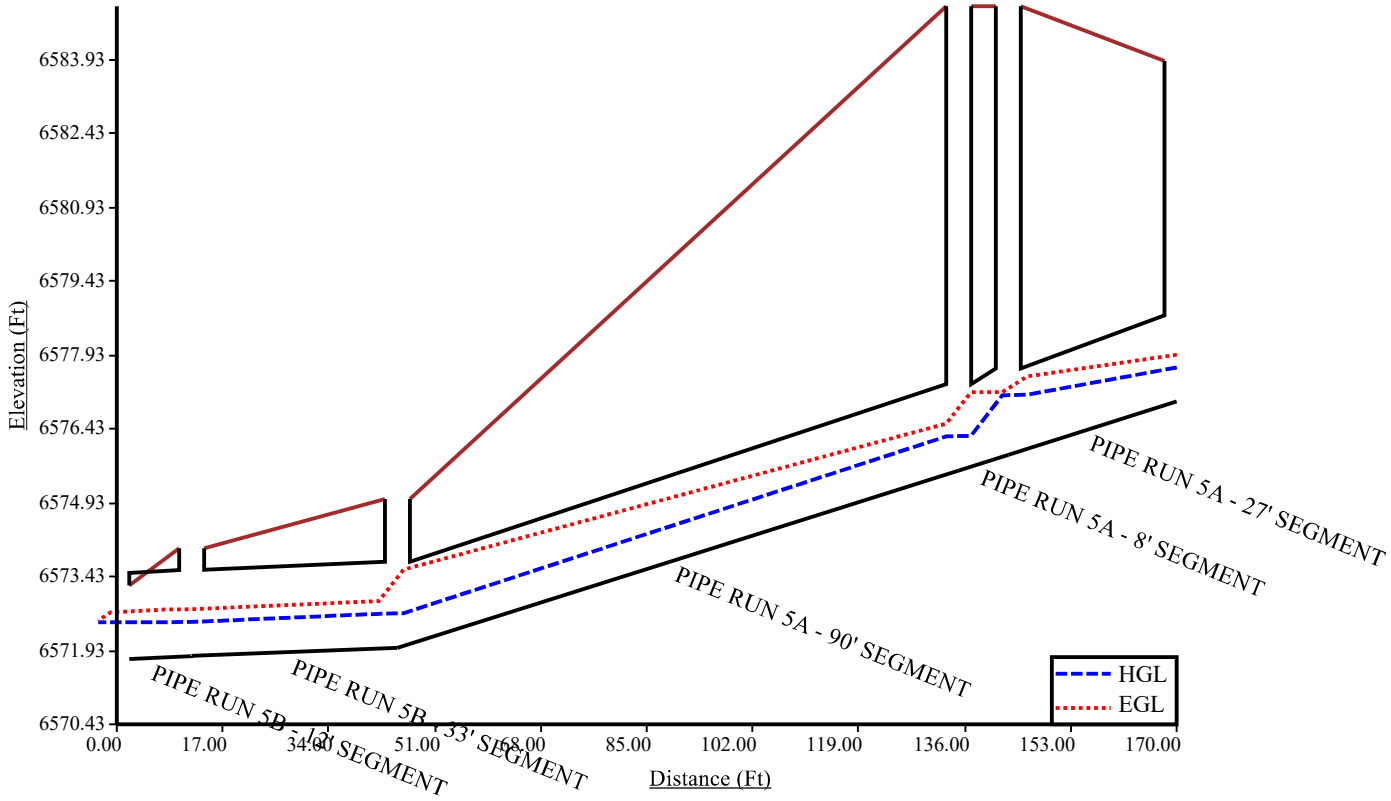
The trench side slope is 0.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 5B - 12' SEGMENT	12.00	2.75	4.00	5.21	0.00	2.06	0.00	5.21	2.75	0.21	5.33	Sewer Too Shallow
PIPE RUN 5B - 33' SEGMENT	33.00	2.75	4.00	5.21	0.00	2.75	0.21	5.21	3.58	1.04	19.49	Sewer Too Shallow
PIPE RUN 5A - 90' SEGMENT	90.00	2.75	4.00	5.21	5.21	3.58	1.04	5.21	9.98	7.44	117.75	
PIPE RUN 5A - 8' SEGMENT	8.00	2.75	4.00	5.21	5.21	9.98	7.44	5.21	9.66	7.12	15.16	
PIPE RUN 5A - 27' SEGMENT	27.00	2.75	4.00	5.21	5.21	9.66	7.12	5.21	7.47	4.93	44.62	

Total earth volume for sewer trenches = 202 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Entire Run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Elevation (Ft)
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34.00
51.00
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102.00
119.00
136.00
153.00
170.00
Distance (Ft)
PIPE RUN 5B - 12' SEGMENT
PIPE RUN 5B - 33' SEGMENT
PIPE RUN 5A - 90' SEGMENT
PIPE RUN 5A - 8' SEGMENT
PIPE RUN 5A - 27' SEGMENT
HGL
EGL

Program: UDSEWER Math Model Interface 2.1.1.4
Run Date: 8/20/2019 9:37:37 AM

UDSewer Results Summary

Project Title: Barnes & Medical - West Pond Inflow System - 100 Yr
Project Description: Storm Sewer Between BLDGs A and B

System Input Summary

Rainfall Parameters

Rainfall Return Period: 100
Rainfall Calculation Method: Formula

One Hour Depth (in): 2.52
Rainfall Constant "A": 28.5
Rainfall Constant "B": 10
Rainfall Constant "C": 0.786

Rational Method Constraints

Minimum Urban Runoff Coeff.: 0.20
Maximum Rural Overland Len. (ft): 500
Maximum Urban Overland Len. (ft): 300
Used UDFCD Tc. Maximum: Yes

Sizer Constraints

Minimum Sewer Size (in): 12.00
Maximum Depth to Rise Ratio: 0.90
Maximum Flow Velocity (fps): 18.0
Minimum Flow Velocity (fps): 2.0

Backwater Calculations:

Tailwater Elevation (ft): 6574.50

Manhole Input Summary:

		Given Flow		Sub Basin Information						
Element Name	Ground Elevation (ft)	Total Known Flow (cfs)	Local Contribution (cfs)	Drainage Area (Ac.)	Runoff Coefficient	5yr Coefficient	Overland Length (ft)	Overland Slope (%)	Gutter Length (ft)	Gutter Velocity (fps)
OUTFALL AT WEST POND	6573.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

PIPE RUN 5B - 12' SEGMENT	6574.00	8.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5B - 33' SEGMENT	6575.00	8.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5A - 90' SEGMENT	6585.00	8.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5A - 8' SEGMENT	6585.00	8.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PIPE RUN 5A - 27' SEGMENT	6583.89	8.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Manhole Output Summary:

	Local Contribution					Total Design Flow				
Element Name	**Overland Time (min)**	**Gutter Time (min)**	**Basin Tc (min)**	**Intensity (in/hr)**	**Local Contrib (cfs)**	**Coeff. Area**	**Intensity (in/hr)**	**Manhole Tc (min)**	**Peak Flow (cfs)**	**Comment**
OUTFALL AT WEST POND	0.00	0.00	0.00	0.00	0.00	0.74	11.70	0.06	8.70	Surface Water Present (Upstream)
PIPE RUN 5B - 12' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	Surface Water Present (Downstream)
PIPE RUN 5B - 33' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	Surface Water Present (Downstream)
PIPE RUN 5A - 90' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	
PIPE RUN 5A - 8' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	
PIPE RUN 5A - 27' SEGMENT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	

Sewer Input Summary:

		Elevation			Loss Coefficients			Given Dimensions		
Element Name	**Sewer Length (ft)**	**Downstream Invert (ft)**	**Slope (%)**	**Upstream Invert (ft)**	**Mannings n**	**Bend Loss**	**Lateral Loss**	**Cross Section**	**Rise (ft or in)**	**Span (ft or in)**
PIPE RUN 5B - 12' SEGMENT	12.00	6571.75	0.5	6571.81	0.013	0.03	0.00	CIRCULAR	21.00 in	21.00 in
PIPE RUN 5B - 33' SEGMENT	33.00	6571.82	0.5	6571.98	0.013	0.13	0.00	CIRCULAR	21.00 in	21.00 in
PIPE RUN 5A - 90' SEGMENT	90.00	6571.98	4.0	6575.58	0.013	0.38	0.00	CIRCULAR	21.00 in	21.00 in
PIPE RUN 5A - 8' SEGMENT	8.00	6575.58	4.0	6575.90	0.013	0.38	0.00	CIRCULAR	21.00 in	21.00 in

PIPE RUN 5A - 27' SEGMENT	27.00	6575.90	4.0	6576.98	0.013	0.38	0.00	CIRCULAR	21.00 in	21.00 in

Sewer Flow Summary:

	Full Flow Capacity		Critical Flow		Normal Flow						
Element Name	**Flow (cfs)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Depth (in)**	**Velocity (fps)**	**Froude Number**	**Flow Condition**	**Flow (cfs)**	**Surcharged Length (ft)**	**Comment**
PIPE RUN 5B - 12' SEGMENT	11.23	4.67	13.15	5.49	13.88	5.16	0.90	Pressurized	8.70	12.00	
PIPE RUN 5B - 33' SEGMENT	11.23	4.67	13.15	5.49	13.88	5.16	0.90	Pressurized	8.70	33.00	
PIPE RUN 5A - 90' SEGMENT	31.78	13.21	13.15	5.49	7.51	11.26	2.92	Supercritical Jump	8.70	27.26	
PIPE RUN 5A - 8' SEGMENT	31.78	13.21	13.15	5.49	7.51	11.26	2.92	Supercritical	8.70	0.00	
PIPE RUN 5A - 27' SEGMENT	31.78	13.21	13.15	5.49	7.51	11.26	2.92	Supercritical Jump	8.70	10.79	

- A Froude number of 0 indicates that pressured flow occurs (adverse slope or undersized pipe).
- If the sewer is not pressurized, full flow represents the maximum gravity flow in the sewer.
- If the sewer is pressurized, full flow represents the pressurized flow conditions.

Sewer Sizing Summary:

			Existing		Calculated		Used			
Element Name	**Peak Flow (cfs)**	**Cross Section**	**Rise**	**Span**	**Rise**	**Span**	**Rise**	**Span**	**Area (ft^2)**	**Comment**
PIPE RUN 5B - 12' SEGMENT	8.70	CIRCULAR	21.00 in	21.00 in	21.00 in	21.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5B - 33' SEGMENT	8.70	CIRCULAR	21.00 in	21.00 in	21.00 in	21.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5A - 90' SEGMENT	8.70	CIRCULAR	21.00 in	21.00 in	15.00 in	15.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5A - 8' SEGMENT	8.70	CIRCULAR	21.00 in	21.00 in	15.00 in	15.00 in	21.00 in	21.00 in	2.41	
PIPE RUN 5A - 27' SEGMENT	8.70	CIRCULAR	21.00 in	21.00 in	15.00 in	15.00 in	21.00 in	21.00 in	2.41	

- Calculated diameter was determined by sewer hydraulic capacity rounded up to the nearest commercially available size.
- Sewer sizes should not decrease downstream.
- All hydraulics where calculated using the 'Used' parameters.

Grade Line Summary:

Tailwater Elevation (ft): 6574.50

	Invert Elev.	Downstream Manhole Losses	HGL	EGL

Element Name	Downstream (ft)	Upstream (ft)	Bend Loss (ft)	Lateral Loss (ft)	Downstream (ft)	Upstream (ft)	Downstream (ft)	Friction Loss (ft)	Upstream (ft)
PIPE RUN 5B - 12' SEGMENT	6571.75	6571.81	0.00	0.00	6574.50	6574.54	6574.70	0.04	6574.74
PIPE RUN 5B - 33' SEGMENT	6571.82	6571.98	0.03	0.00	6574.56	6574.66	6574.77	0.10	6574.86
PIPE RUN 5A - 90' SEGMENT	6571.98	6575.58	0.08	0.00	6574.74	6576.68	6574.94	2.20	6577.14
PIPE RUN 5A - 8' SEGMENT	6575.58	6575.90	0.08	0.00	6576.75	6577.97	6578.18	0.00	6578.18
PIPE RUN 5A - 27' SEGMENT	6575.90	6576.98	0.08	0.00	6578.05	6578.08	6578.25	0.29	6578.54

- Bend and Lateral losses only apply when there is an outgoing sewer. The system outfall, sewer #0, is not considered a sewer.
- Bend loss = Bend K * V_fi ^ 2/(2*g)
- Lateral loss = V_fo ^ 2/(2*g)- Junction Loss K * V_fi ^ 2/(2*g).
- Friction loss is always Upstream EGL - Downstream EGL.

Excavation Estimate:

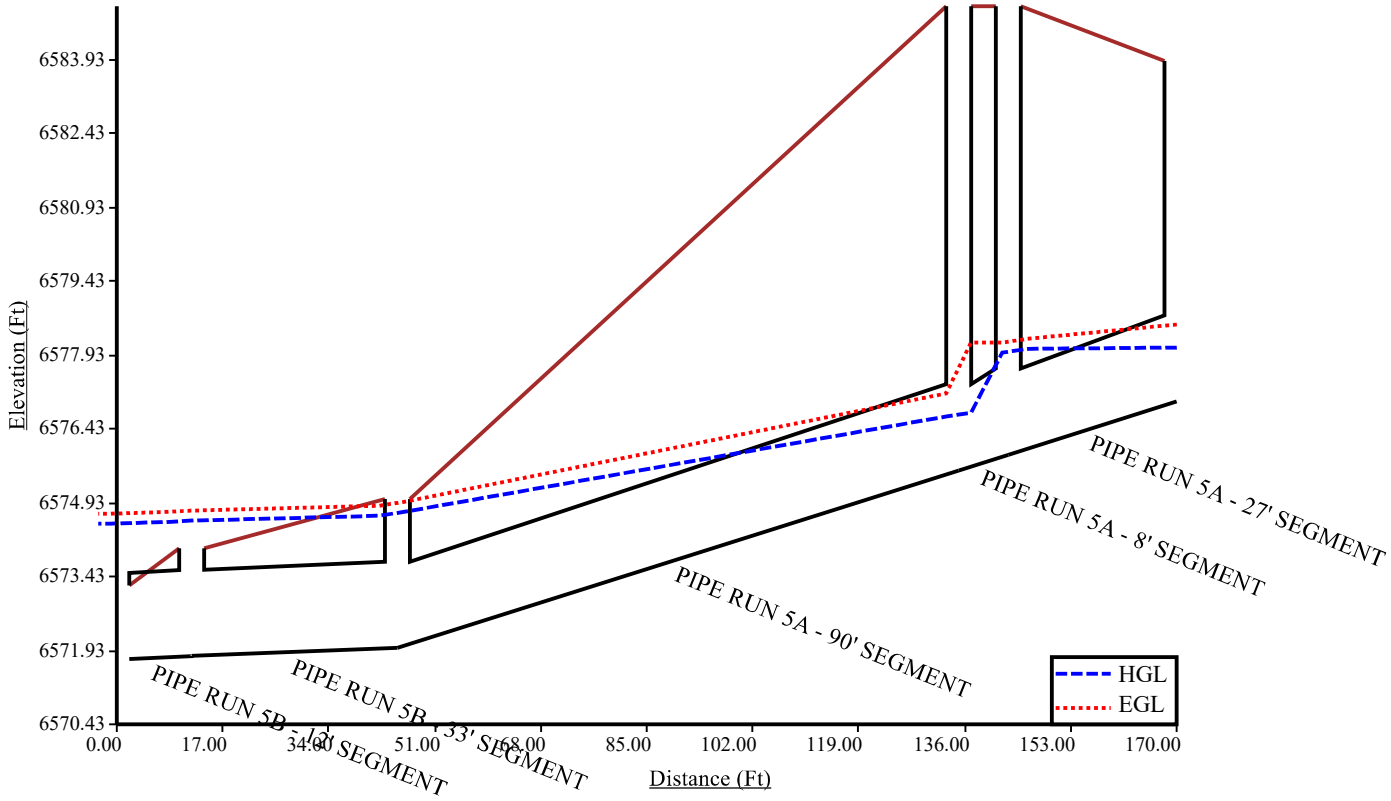
The trench side slope is 0.0 ft/ft
The minimum trench width is 2.00 ft

					Downstream			Upstream				
Element Name	Length (ft)	Wall (in)	Bedding (in)	Bottom Width (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Top Width (ft)	Trench Depth (ft)	Cover (ft)	Volume (cu. yd)	Comment
PIPE RUN 5B - 12' SEGMENT	12.00	2.75	4.00	5.21	0.00	2.06	0.00	5.21	2.75	0.21	5.33	Sewer Too Shallow
PIPE RUN 5B - 33' SEGMENT	33.00	2.75	4.00	5.21	0.00	2.75	0.21	5.21	3.58	1.04	19.49	Sewer Too Shallow
PIPE RUN 5A - 90' SEGMENT	90.00	2.75	4.00	5.21	5.21	3.58	1.04	5.21	9.98	7.44	117.75	
PIPE RUN 5A - 8' SEGMENT	8.00	2.75	4.00	5.21	5.21	9.98	7.44	5.21	9.66	7.12	15.16	
PIPE RUN 5A - 27' SEGMENT	27.00	2.75	4.00	5.21	5.21	9.66	7.12	5.21	7.47	4.93	44.62	

Total earth volume for sewer trenches = 202 cubic yards.

- The trench was estimated to have a bottom width equal to the outer pipe diameter plus 36 inches.
- If the calculated width of the trench bottom is less than the minimum acceptable width, the minimum acceptable width was used.
- The sewer wall thickness is equal to: (equivalent diameter in inches/12)+1 inches
- The sewer bedding thickness is equal to:
  - Four inches for pipes less than 33 inches.
  - Six inches for pipes less than 60 inches.
  - Eight inches for all larger sizes.

Entire Run


6583.93
6582.43
6580.93
6579.43
6577.93
6576.43
6574.93
6573.43
6571.93
6570.43
Elevation (Ft)
0.00
17.00
34.00
51.00
68.00
85.00
102.00
119.00
136.00
153.00
170.00
Distance (Ft)
PIPE RUN 5B - 12' SEGMENT
PIPE RUN 5B - 33' SEGMENT
PIPE RUN 5A - 90' SEGMENT
PIPE RUN 5A - 8' SEGMENT
PIPE RUN 5A - 27' SEGMENT
HGL
EGL

DETENTION CALCULATIONS

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	2-Year Event	1.19	inches	
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	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: Dane Frank
Company: Terra Nova Engineering
Date: December 14, 2018
Project: Barnes and Medical View Apartments
Location:

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	A	B	C	D										
Receiving Pervious Area Soil Type	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam										
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	3.170	5.290	2.760	1.060										
Directly Connected Impervious Area (DCIA, acres)	1.270	2.890	1.660	0.340										
Unconnected Impervious Area (UIA, acres)	0.000	0.000	0.000	0.000										
Receiving Pervious Area (RPA, acres)	1.900	0.640	0.910	0.720										
Separate Pervious Area (SPA, acres)	0.000	1.760	0.190	0.000										
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	V	V	V	C										

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	3.170	5.290	2.760	1.060										
Directly Connected Impervious Area (DCIA, %)	40.1%	54.6%	60.1%	32.1%										
Unconnected Impervious Area (UIA, %)	0.0%	0.0%	0.0%	0.0%										
Receiving Pervious Area (RPA, %)	59.9%	12.1%	33.0%	67.9%										
Separate Pervious Area (SPA, %)	0.0%	33.3%	6.9%	0.0%										
A_R (RPA / UIA)	0.000	0.000	0.000	0.000										
I_a Check	1.000	1.000	1.000	1.000										
f / I for 2-Year Event:	0.9	0.9	0.9	0.9										
f / I for 5-Year Event:	0.5	0.5	0.5	0.5										
f / I for 100-Year Event:	0.3	0.3	0.3	0.3										
f / I for Optional User Defined Storm CUHP:														
IRF for 2-Year Event:	0.00	0.00	0.00	1.00										
IRF for 5-Year Event:	1.00	1.00	1.00	1.00										
IRF for 100-Year Event:	1.00	1.00	1.00	1.00										
IRF for Optional User Defined Storm CUHP:														
Total Site Imperviousness: I_{total}	40.1%	54.6%	60.1%	32.1%										
Effective Imperviousness for 2-Year Event:	40.1%	54.6%	60.1%	32.1%										
Effective Imperviousness for 5-Year Event:	40.1%	54.6%	60.1%	32.1%										
Effective Imperviousness for 100-Year Event:	40.1%	54.6%	60.1%	32.1%										
Effective Imperviousness for Optional User Defined Storm CUHP:														

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

This line only for WQCV Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	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:	0.0%	0.0%	0.0%	0.1%	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:	**50.2%**
Total Site Effective Imperviousness for 2-Year Event:	**50.2%**
Total Site Effective Imperviousness for 5-Year Event:	**50.2%**
Total Site Effective Imperviousness for 100-Year Event:	**50.2%**
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

FORBAY VOLUMES

WEST FORBAY VOLUME

ELEV	*AREA*	*AREA AVG.*	*DELTA ELEV.*	*VOLUME*	*VOLUME TOTAL*
71.75	30				
		30	1.5	45	
73.25	30				45

End Area Method: 45 C.F.
0.001 A.F.

Total East Forebay Volume= 45 C.F.
0.001 A.F.

Required Forbay Volume = 2% of WQCV
WQCV = 0.05 ac-ft
WQCV = 2,072 cu-ft
2% of WQCV = 41.45 cu-ft

MIDDLE FORBAY VOLUME

ELEV	*AREA*	*AREA AVG.*	*DELTA ELEV.*	*VOLUME*	*VOLUME TOTAL*
65.00	90				
		90	1.5	135	
66.50	90				135

End Area Method: 135 C.F.
0.003 A.F.

Total East Forebay Volume= 135 C.F.
0.003 A.F.

Required Forbay Volume = 3% of WQCV
WQCV = 0.10 ac-ft
WQCV = 4,210 cu-ft
3% of WQCV = 126.30 cu-ft

EAST FORBAY VOLUME

ELEV	*AREA*	*AREA AVG.*	*DELTA ELEV.*	*VOLUME*	*VOLUME TOTAL*
74.00	32				
		32	1.5	48	
75.50	32				48

End Area Method: 48 C.F.
0.001 A.F.

Total East Forebay Volume= 48 C.F.
0.001 A.F.

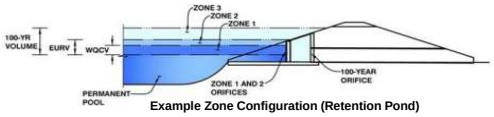
Required Forbay Volume = 2% of WQCV
WQCV = 0.05 ac-ft
WQCV = 2,369 cu-ft
2% of WQCV = 47.39 cu-ft

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Barnes and Powers

Basin ID: West Pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	3.17	acres
Watershed Length =	650	ft
Watershed Slope =	0.022	ft/ft
Watershed Imperviousness =	40.10%	percent
Percentage Hydrologic Soil Group A =	54.0%	percent
Percentage Hydrologic Soil Group B =	46.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.048	acre-feet
Excess Urban Runoff Volume (EURV) =	0.136	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.099	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.134	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.179	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.249	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.313	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.395	acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	0.546	acre-feet
Approximate 2-yr Detention Volume =	0.093	acre-feet
Approximate 5-yr Detention Volume =	0.126	acre-feet
Approximate 10-yr Detention Volume =	0.164	acre-feet
Approximate 25-yr Detention Volume =	0.193	acre-feet
Approximate 50-yr Detention Volume =	0.211	acre-feet
Approximate 100-yr Detention Volume =	0.243	acre-feet

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

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.048	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.088	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.107	acre-feet
Total Detention Basin Volume =	0.243	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

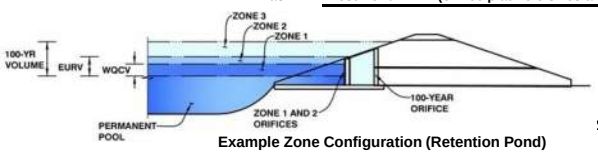
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	25	0.001		
	--	0.25	--	--	--	25	0.001	6	0.000
	--	0.50	--	--	--	25	0.001	13	0.000
	--	0.75	--	--	--	1,187	0.027	154	0.004
	--	1.00	--	--	--	2,349	0.054	584	0.013
	--	1.25	--	--	--	3,511	0.081	1,305	0.030
	--	1.50	--	--	--	4,673	0.107	2,317	0.053
	--	1.75	--	--	--	5,107	0.117	3,535	0.081
	--	2.00	--	--	--	5,541	0.127	4,861	0.112
	--	2.25	--	--	--	5,976	0.137	6,356	0.146
	--	2.50	--	--	--	6,410	0.147	7,904	0.181
	--	2.75	--	--	--	6,844	0.157	9,561	0.219
	--	3.00	--	--	--	7,279	0.167	11,327	0.260
	--	3.25	--	--	--	7,713	0.177	13,201	0.303
	--	3.50	--	--	--	8,148	0.187	15,183	0.349
	--	3.75	--	--	--	8,644	0.198	17,282	0.397
	--	4.00	--	--	--	9,141	0.210	19,505	0.448
	--	4.25	--	--	--	9,638	0.221	21,853	0.502
	--	4.50	--	--	--	10,135	0.233	24,324	0.558
	--	4.75	--	--	--	10,632	0.244	26,920	0.618
	--	5.00	--	--	--	11,128	0.255	29,640	0.680
	--	5.25	--	--	--	11,625	0.267	32,484	0.746
	--	5.50	--	--	--	12,122	0.278	35,453	0.814

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Barnes Apartments

Basin ID: West Pond (orifice plat hole sizes are 5/8" and 1")



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.44	0.048	Orifice Plate
Zone 2 (EURV)	2.18	0.088	Orifice Plate
Zone 3 (100-year)	2.90	0.107	Weir&Pipe (Rect.)
		0.243	Total

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

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

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

			Calculated Parameters for Plate		
Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	2.18	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	9.60	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	0.29	0.29	0.79					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected		**Calculated Parameters for Vertical Orifice**	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

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

	Zone 3 Weir	Not Selected		**Calculated Parameters for Overflow Weir**	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.18	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	2.18	N/A	feet
Overflow Weir Front Edge Length =	2.00	N/A	feet	Over Flow Weir Slope Length =	2.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	14.92	N/A	should be ≥ 4
Horiz. Length of Weir Sides =	2.00	N/A	feet	Overflow Grate Open Area w/o Debris =	2.80	N/A	ft^2
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	1.40	N/A	ft^2
Debris Clogging % =	50%	N/A	%				

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

	Zone 3 Rectangular	Not Selected		**Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate**	Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.19	N/A	ft^2
Rectangular Orifice Width =	5.30	N/A	inches	Outlet Orifice Centroid =	0.21	N/A	feet
Rectangular Orifice Height =	5.10		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

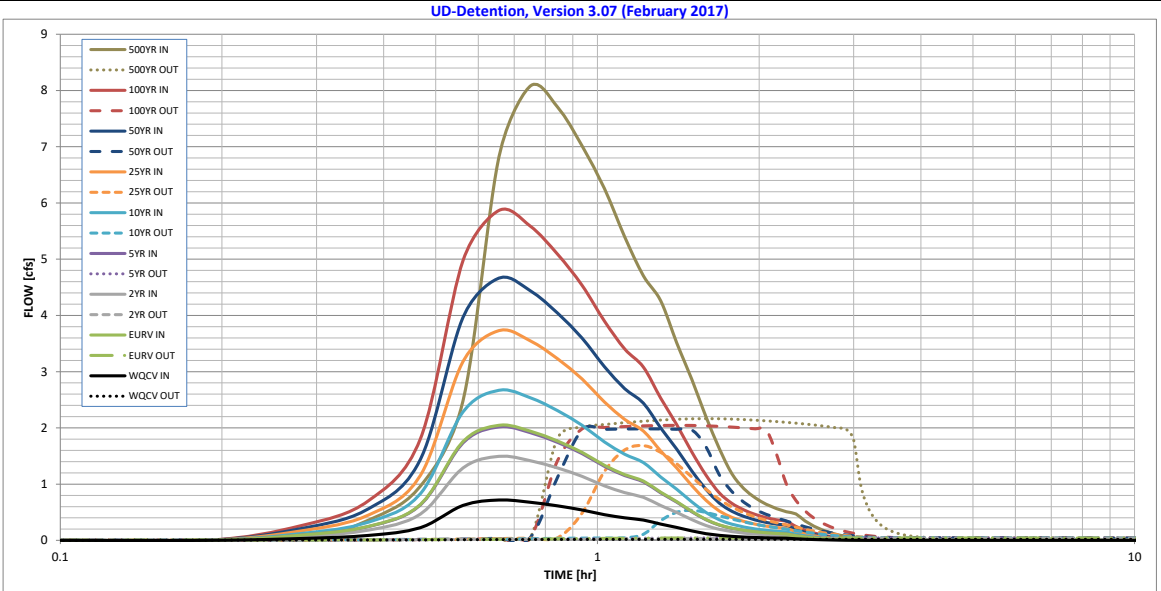
			Calculated Parameters for Spillway		
Spillway Invert Stage=	4.00	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.45	feet
Spillway Crest Length =	5.00	feet	Stage at Top of Freeboard =	5.45	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.28	acres
Freeboard above Max Water Surface =	1.00	feet			

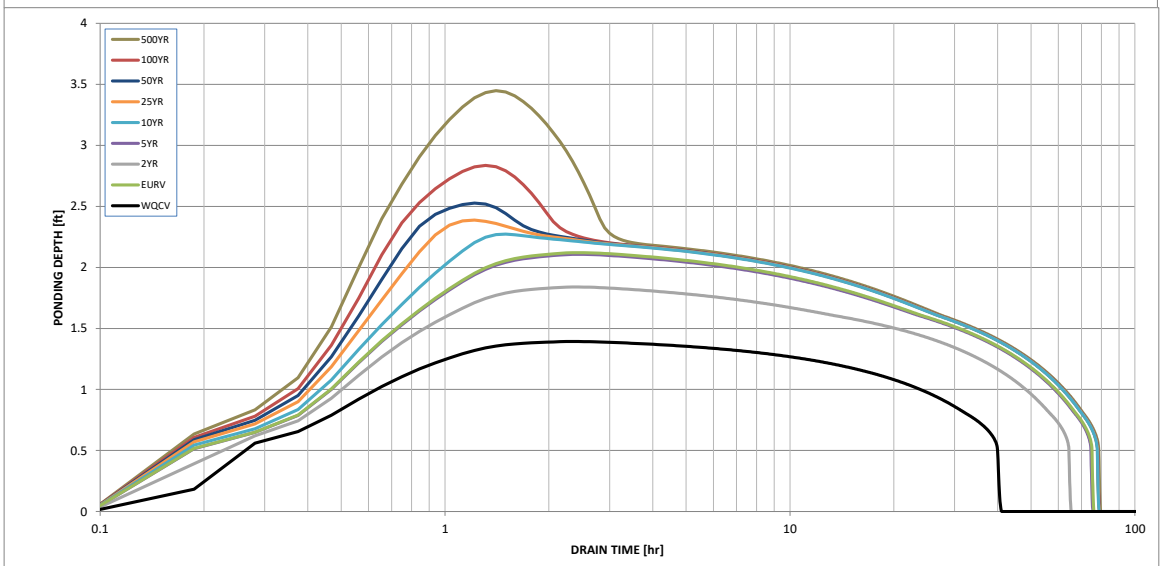
Routed Hydrograph Results

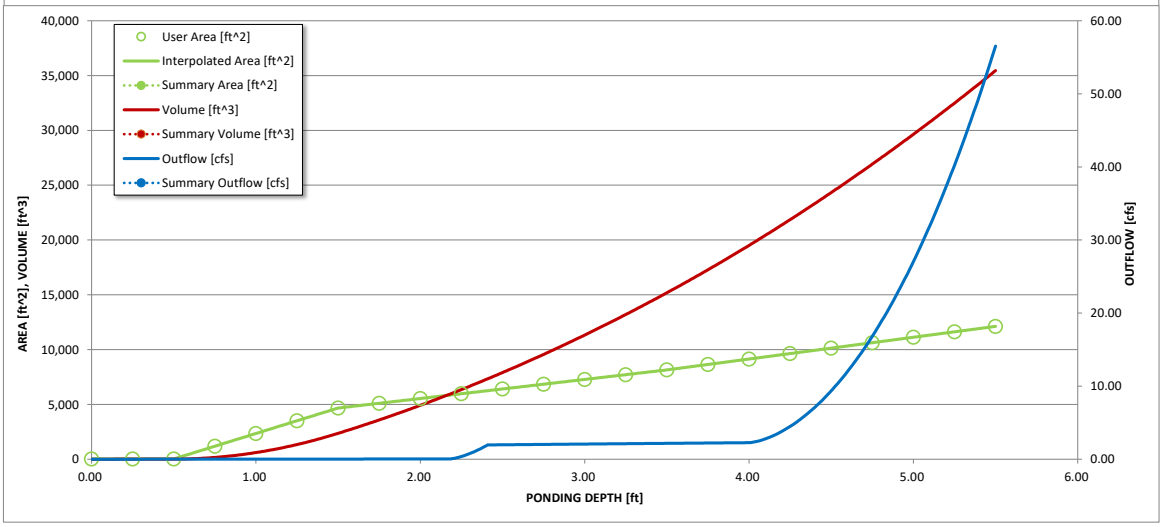
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.048	0.136	0.099	0.134	0.179	0.249	0.313	0.395	0.546
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.047	0.136	0.099	0.134	0.178	0.250	0.313	0.395	0.546
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.08	0.28	0.46	0.72	1.18
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.3	0.9	1.4	2.3	3.8
Peak Inflow Q (cfs) =	0.7	2.0	1.5	2.0	2.7	3.7	4.7	5.9	8.1
Peak Outflow Q (cfs) =	0.0	0.0	0.0	0.0	0.5	1.7	2.0	2.0	2.2
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.3	2.0	1.9	1.4	0.9	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	0.7	0.7	0.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	69	60	69	70	68	66	64	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	63	73	76	75	74	73	71
Maximum Ponding Depth (ft) =	1.39	2.12	1.84	2.11	2.27	2.39	2.53	2.84	3.45
Area at Maximum Ponding Depth (acres) =	0.10	0.13	0.12	0.13	0.14	0.14	0.15	0.16	0.18
Maximum Volume Stored (acre-ft) =	0.043	0.128	0.092	0.126	0.149	0.164	0.184	0.232	0.337

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

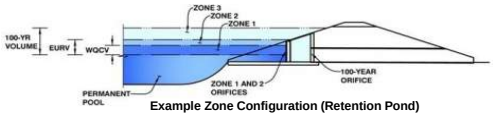
Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.62 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:11:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:16:52	0.03	0.09	0.07	0.09	0.12	0.17	0.21	0.26	0.36
0.890	0:22:29	0.09	0.25	0.18	0.25	0.32	0.45	0.56	0.70	0.97
	0:28:06	0.23	0.64	0.47	0.63	0.83	1.16	1.44	1.81	2.48
	0:33:43	0.62	1.76	1.29	1.73	2.28	3.18	3.97	4.97	6.82
	0:39:20	0.72	2.05	1.49	2.02	2.67	3.73	4.66	5.87	8.08
	0:44:58	0.68	1.94	1.42	1.92	2.54	3.55	4.44	5.59	7.70
	0:50:35	0.61	1.77	1.29	1.74	2.31	3.23	4.04	5.09	7.01
	0:56:12	0.54	1.56	1.14	1.54	2.05	2.87	3.60	4.53	6.26
	1:01:49	0.46	1.34	0.97	1.32	1.75	2.46	3.09	3.90	5.40
	1:07:26	0.40	1.17	0.85	1.15	1.53	2.15	2.70	3.40	4.71
	1:13:04	0.36	1.06	0.77	1.04	1.38	1.95	2.44	3.08	4.26
	1:18:41	0.29	0.86	0.62	0.84	1.13	1.59	2.00	2.53	3.51
	1:24:18	0.23	0.69	0.50	0.68	0.91	1.29	1.62	2.06	2.86
	1:29:55	0.17	0.52	0.37	0.51	0.68	0.97	1.23	1.57	2.20
	1:35:32	0.12	0.37	0.26	0.37	0.50	0.71	0.91	1.16	1.63
	1:41:10	0.09	0.28	0.20	0.27	0.37	0.52	0.66	0.85	1.18
	1:46:47	0.07	0.22	0.16	0.21	0.29	0.41	0.52	0.66	0.92
	1:52:24	0.06	0.18	0.13	0.18	0.24	0.34	0.43	0.54	0.76
	1:58:01	0.05	0.15	0.11	0.15	0.20	0.29	0.36	0.46	0.64
	2:03:38	0.05	0.14	0.10	0.13	0.18	0.25	0.32	0.41	0.56
	2:09:16	0.04	0.12	0.09	0.12	0.16	0.23	0.29	0.37	0.51
	2:14:53	0.04	0.11	0.08	0.11	0.15	0.21	0.27	0.34	0.47
	2:20:30	0.03	0.08	0.06	0.08	0.11	0.16	0.20	0.25	0.34
	2:26:07	0.02	0.06	0.04	0.06	0.08	0.11	0.14	0.18	0.25
	2:31:44	0.01	0.04	0.03	0.04	0.06	0.08	0.10	0.13	0.19
	2:37:22	0.01	0.03	0.02	0.03	0.04	0.06	0.08	0.10	0.14
	2:42:59	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.07	0.10
	2:48:36	0.01	0.02	0.01	0.02	0.02	0.03	0.04	0.05	0.07
	2:54:13	0.00	0.01	0.01	0.01	0.01	0.02	0.03	0.03	0.05
	2:59:50	0.00	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.03
	3:05:28	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.02
	3:11:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	3:16:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:22:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:33:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:39:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:44:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:07:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:12:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:18:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:35:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:03:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:09:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:14:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:37:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:42:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:48:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:54:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:59:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:05:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:10:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:16:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:22:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:27:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:33:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:39:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:44:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Barnes and Powers

Basin ID: Middle Pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	5.29	acres
Watershed Length =	620	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	54.60%	percent
Percentage Hydrologic Soil Group A =	54.0%	percent
Percentage Hydrologic Soil Group B =	46.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.097	acre-feet
Excess Urban Runoff Volume (EURV) =	0.327	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.242	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.323	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.413	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.535	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.644	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.780	acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	1.028	acre-feet
Approximate 2-yr Detention Volume =	0.228	acre-feet
Approximate 5-yr Detention Volume =	0.304	acre-feet
Approximate 10-yr Detention Volume =	0.384	acre-feet
Approximate 25-yr Detention Volume =	0.442	acre-feet
Approximate 50-yr Detention Volume =	0.477	acre-feet
Approximate 100-yr Detention Volume =	0.529	acre-feet

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

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.097	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.231	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.202	acre-feet
Total Detention Basin Volume =	0.529	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	user	acre-feet

Depth Increment = ft

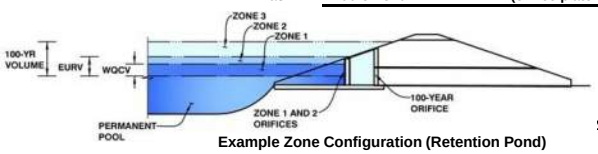
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	25	0.001		
	--	0.25	--	--	--	25	0.001	6	0.000
	--	0.50	--	--	--	25	0.001	12	0.000
	--	0.75	--	--	--	427	0.010	65	0.001
	--	1.00	--	--	--	830	0.019	218	0.005
	--	1.25	--	--	--	1,232	0.028	472	0.011
	--	1.50	--	--	--	1,635	0.038	826	0.019
	--	1.75	--	--	--	2,037	0.047	1,281	0.029
	--	2.00	--	--	--	2,439	0.056	1,836	0.042
	--	2.25	--	--	--	2,842	0.065	2,521	0.058
	--	2.50	--	--	--	3,244	0.074	3,282	0.075
	--	2.75	--	--	--	3,558	0.082	4,132	0.095
	--	3.00	--	--	--	3,871	0.089	5,060	0.116
	--	3.25	--	--	--	4,185	0.096	6,067	0.139
	--	3.50	--	--	--	4,498	0.103	7,153	0.164
	--	3.75	--	--	--	4,812	0.110	8,317	0.191
	--	4.00	--	--	--	5,125	0.118	9,559	0.219
	--	4.25	--	--	--	5,439	0.125	10,879	0.250
	--	4.50	--	--	--	5,752	0.132	12,278	0.282
	--	4.75	--	--	--	6,108	0.140	13,761	0.316
	--	5.00	--	--	--	6,464	0.148	15,332	0.352
	--	5.25	--	--	--	6,819	0.157	16,992	0.390
	--	5.50	--	--	--	7,175	0.165	18,742	0.430
	--	5.75	--	--	--	7,531	0.173	20,580	0.472
	--	6.00	--	--	--	7,887	0.181	22,507	0.517
	--	6.25	--	--	--	8,242	0.189	24,523	0.563
	--	6.50	--	--	--	8,598	0.197	26,628	0.611
	--	6.75	--	--	--	9,135	0.210	28,845	0.662
	--	7.00	--	--	--	9,673	0.222	31,196	0.716
	--	7.25	--	--	--	10,210	0.234	33,681	0.773
	--	7.50	--	--	--	10,748	0.247	36,301	0.833
	--	7.75	--	--	--	11,285	0.259	39,055	0.897
	--	8.00	--	--	--	11,822	0.271	41,943	0.963
	--	8.25	--	--	--	12,360	0.284	44,966	1.032
	--	8.50	--	--	--	12,897	0.296	48,123	1.105

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Barnes and Powers

Basin ID: Middle Pond (orifice plate holes are 3/4" and 1-1/8" - orifice vertical spacing = 19.32")



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.78	0.097	Orifice Plate
Zone 2 (EURV)	4.84	0.231	Orifice Plate
Zone 3 (100-year)	6.07	0.202	Weir&Pipe (Rect.)
		0.529	Total

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	4.84	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.61	3.23					
Orifice Area (sq. inches)	0.49	0.49	0.99					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected			Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	N/A	N/A	ft^2
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	N/A	N/A	feet
Vertical Orifice Diameter =	N/A	N/A	inches				

Calculated Parameters for Vertical Orifice

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

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.84	6.50	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	4.84	6.50	feet
Overflow Weir Front Edge Length =	2.00	3.00	feet	Over Flow Weir Slope Length =	2.00	3.00	feet
Overflow Weir Slope =	0.00	0.00	H:V (enter zero for flat grate)	Grate Open Area / 100-yr Orifice Area =	8.23		should be ≥ 4
Horiz. Length of Weir Sides =	2.00	3.00	feet	Overflow Grate Open Area w/o Debris =	2.80	6.30	ft^2
Overflow Grate Open Area % =	70%	70%	%, grate open area/total area	Overflow Grate Open Area w/ Debris =	1.40	3.15	ft^2
Debris Clogging % =	50%	50%	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Rectangular	Not Selected			Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	0.50	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	0.34		ft^2
Rectangular Orifice Width =	7.00	30.00	inches	Outlet Orifice Centroid =	0.29		feet
Rectangular Orifice Height =	7.00		inches	Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=		ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=		feet
Spillway Crest Length =		feet	Stage at Top of Freeboard =		feet
Spillway End Slopes =		H:V	Basin Area at Top of Freeboard =		acres
Freeboard above Max Water Surface =		feet			

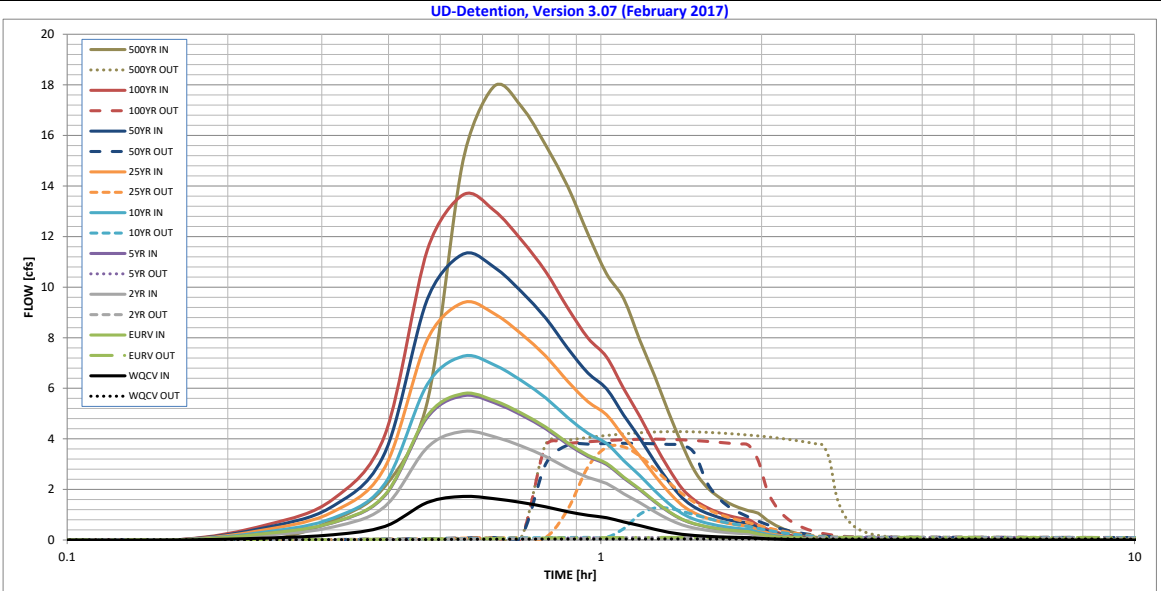
Calculated Parameters for Spillway

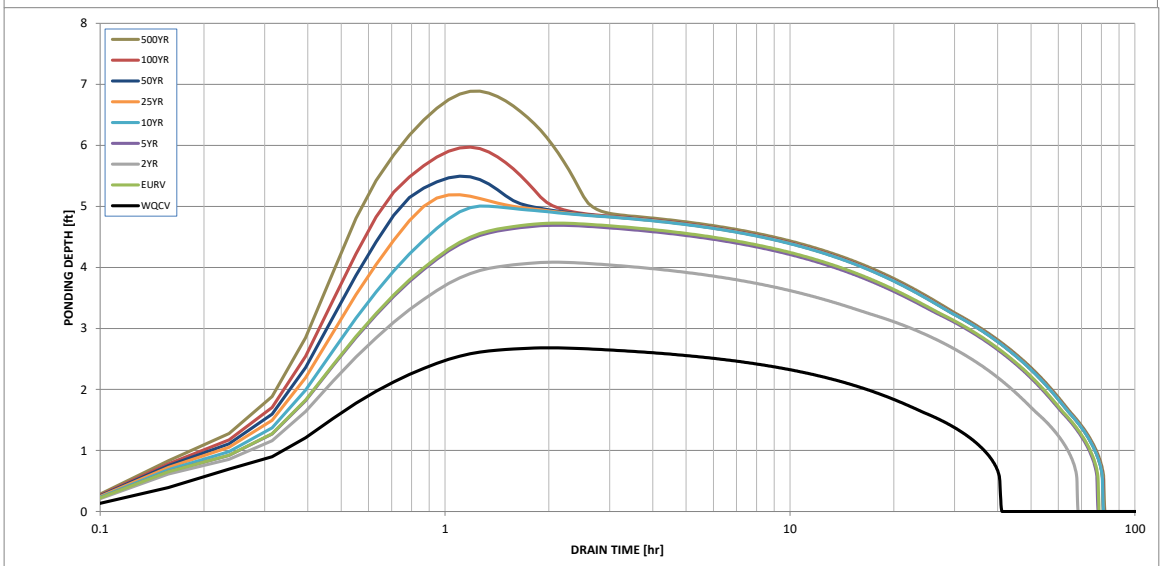
Routed Hydrograph Results

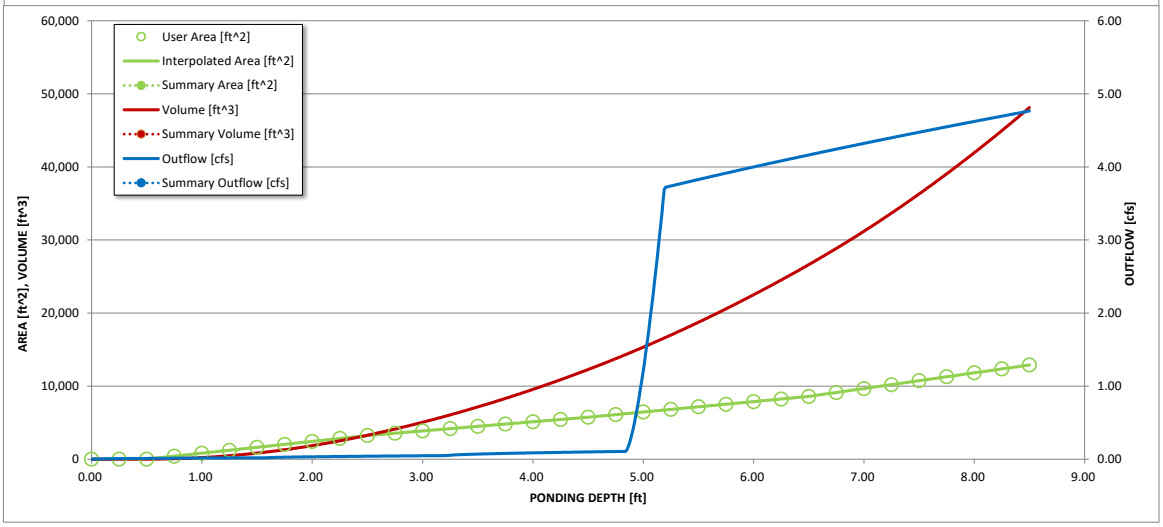
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.097	0.327	0.242	0.323	0.413	0.535	0.644	0.780	1.028
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.096	0.327	0.242	0.322	0.412	0.534	0.644	0.779	1.028
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.11	0.34	0.57	0.89	1.45
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.6	1.8	3.0	4.7	7.7
Peak Inflow Q (cfs) =	1.7	5.8	4.3	5.7	7.3	9.4	11.3	13.7	17.9
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	1.3	3.7	3.8	4.0	4.3
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.5	2.2	2.0	1.3	0.9	0.6
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.4	1.3	1.3	1.4	1.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	-0.7
Time to Drain 97% of Inflow Volume (hours) =	38	71	63	71	72	70	67	65	62
Time to Drain 99% of Inflow Volume (hours) =	**40**	76	66	75	77	77	76	75	74
Maximum Ponding Depth (ft) =	2.68	4.72	4.08	4.69	5.00	5.19	5.49	5.97	6.89
Area at Maximum Ponding Depth (acres) =	0.08	0.14	0.12	0.14	0.15	0.15	0.16	0.18	0.22
Maximum Volume Stored (acre-ft) =	0.089	0.312	0.229	0.308	0.352	0.379	0.429	0.511	0.690

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

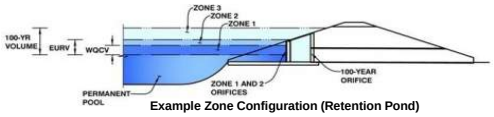
Time Interval	SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
4.73 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:04:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph Constant	0:09:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:14:11	0.08	0.26	0.19	0.26	0.33	0.42	0.50	0.60	0.79
1.057	0:18:55	0.21	0.70	0.52	0.69	0.87	1.12	1.35	1.63	2.13
	0:23:39	0.54	1.79	1.33	1.76	2.24	2.89	3.47	4.18	5.47
	0:28:23	1.49	4.92	3.66	4.85	6.16	7.93	9.53	11.47	15.02
	0:33:07	1.72	5.79	4.30	5.71	7.27	9.39	11.31	13.65	17.94
	0:37:50	1.64	5.52	4.09	5.43	6.93	8.96	10.79	13.04	17.14
	0:42:34	1.49	5.02	3.72	4.95	6.31	8.15	9.83	11.87	15.61
	0:47:18	1.31	4.47	3.30	4.40	5.62	7.27	8.78	10.61	13.97
	0:52:02	1.12	3.84	2.83	3.78	4.84	6.27	7.58	9.17	12.10
	0:56:46	0.98	3.35	2.47	3.30	4.22	5.47	6.60	7.99	10.53
	1:01:29	0.88	3.03	2.24	2.99	3.82	4.95	5.98	7.24	9.54
	1:06:13	0.71	2.49	1.83	2.45	3.14	4.08	4.94	5.98	7.91
	1:10:57	0.57	2.02	1.48	1.99	2.55	3.33	4.03	4.89	6.49
	1:15:41	0.43	1.54	1.12	1.51	1.95	2.55	3.10	3.78	5.03
	1:20:25	0.30	1.13	0.82	1.11	1.44	1.90	2.31	2.82	3.78
	1:25:08	0.23	0.82	0.60	0.81	1.05	1.38	1.67	2.04	2.74
	1:29:52	0.18	0.64	0.47	0.63	0.82	1.07	1.30	1.58	2.11
	1:34:36	0.15	0.53	0.39	0.52	0.67	0.88	1.07	1.30	1.73
	1:39:20	0.13	0.45	0.33	0.44	0.57	0.75	0.91	1.10	1.47
	1:44:04	0.11	0.40	0.29	0.39	0.50	0.66	0.80	0.97	1.28
	1:48:47	0.10	0.36	0.26	0.35	0.45	0.59	0.72	0.87	1.16
	1:53:31	0.10	0.33	0.24	0.33	0.42	0.55	0.66	0.80	1.06
	1:58:15	0.07	0.24	0.18	0.24	0.31	0.40	0.48	0.59	0.78
	2:02:59	0.05	0.18	0.13	0.18	0.23	0.29	0.36	0.43	0.57
	2:07:43	0.04	0.13	0.10	0.13	0.17	0.22	0.26	0.32	0.42
	2:12:26	0.03	0.10	0.07	0.09	0.12	0.16	0.19	0.23	0.31
	2:17:10	0.02	0.07	0.05	0.07	0.09	0.11	0.14	0.17	0.22
	2:21:54	0.01	0.05	0.03	0.05	0.06	0.08	0.10	0.12	0.16
	2:26:38	0.01	0.03	0.02	0.03	0.04	0.06	0.07	0.08	0.11
	2:31:22	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.08
	2:36:05	0.00	0.01	0.01	0.01	0.02	0.02	0.03	0.03	0.05
	2:40:49	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.02	0.02
	2:45:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	2:50:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:55:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2:59:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:04:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:09:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:13:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:18:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:23:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:28:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:42:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:47:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:51:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:56:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:01:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:24:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:29:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:34:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:39:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:43:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:48:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:53:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:12:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:16:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:21:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:26:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:31:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Barnes and Powers

Basin ID: East Pond



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	EDB	
Watershed Area =	2.76	acres
Watershed Length =	515	ft
Watershed Slope =	0.021	ft/ft
Watershed Imperviousness =	60.10%	percent
Percentage Hydrologic Soil Group A =	54.0%	percent
Percentage Hydrologic Soil Group B =	46.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.054	acre-feet
Excess Urban Runoff Volume (EURV) =	0.192	acre-feet
2-yr Runoff Volume (P1 = 1.19 in.) =	0.143	acre-feet
5-yr Runoff Volume (P1 = 1.5 in.) =	0.189	acre-feet
10-yr Runoff Volume (P1 = 1.75 in.) =	0.239	acre-feet
25-yr Runoff Volume (P1 = 2 in.) =	0.303	acre-feet
50-yr Runoff Volume (P1 = 2.25 in.) =	0.360	acre-feet
100-yr Runoff Volume (P1 = 2.52 in.) =	0.431	acre-feet
500-yr Runoff Volume (P1 = 3 in.) =	0.560	acre-feet
Approximate 2-yr Detention Volume =	0.134	acre-feet
Approximate 5-yr Detention Volume =	0.178	acre-feet
Approximate 10-yr Detention Volume =	0.222	acre-feet
Approximate 25-yr Detention Volume =	0.255	acre-feet
Approximate 50-yr Detention Volume =	0.274	acre-feet
Approximate 100-yr Detention Volume =	0.301	acre-feet

Optional User Override 1-hr Precipitation

1.19	inches
1.50	inches
1.75	inches
2.00	inches
2.25	inches
2.52	inches
3.00	inches

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.054	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.137	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.110	acre-feet
Total Detention Basin Volume =	0.301	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

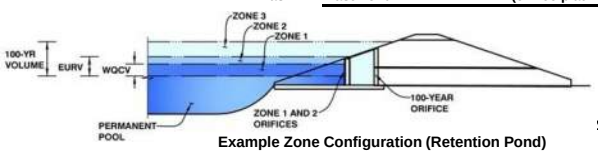
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	25	0.001		
	--	0.25	--	--	--	25	0.001	6	0.000
	--	0.50	--	--	--	25	0.001	12	0.000
	--	0.75	--	--	--	383	0.009	60	0.001
	--	1.00	--	--	--	741	0.017	197	0.005
	--	1.25	--	--	--	1,099	0.025	423	0.010
	--	1.50	--	--	--	1,457	0.033	739	0.017
	--	1.75	--	--	--	1,815	0.042	1,144	0.026
	--	2.00	--	--	--	2,173	0.050	1,639	0.038
	--	2.25	--	--	--	2,531	0.058	2,249	0.052
	--	2.50	--	--	--	2,889	0.066	2,927	0.067
	--	2.75	--	--	--	3,360	0.077	3,708	0.085
	--	3.00	--	--	--	3,832	0.088	4,607	0.106
	--	3.25	--	--	--	4,303	0.099	5,624	0.129
	--	3.50	--	--	--	4,775	0.110	6,758	0.155
	--	3.75	--	--	--	5,246	0.120	8,011	0.184
	--	4.00	--	--	--	5,717	0.131	9,381	0.215
	--	4.25	--	--	--	6,189	0.142	10,870	0.250
	--	4.50	--	--	--	6,660	0.153	12,476	0.286
	--	4.75	--	--	--	7,182	0.165	14,206	0.326
	--	5.00	--	--	--	7,703	0.177	16,067	0.369
	--	5.25	--	--	--	8,225	0.189	18,058	0.415
	--	5.50	--	--	--	8,747	0.201	20,179	0.463
	--	5.75	--	--	--	9,268	0.213	22,431	0.515
	--	6.00	--	--	--	9,790	0.225	24,813	0.570
	--	6.25	--	--	--	10,311	0.237	27,326	0.627
	--	6.50	--	--	--	10,833	0.249	29,969	0.688

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Barnes and Powers

Basin ID: East Pond (orifice plat holes are 9/16" and 1" - orifice vertical spacing = 14.4")



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	2.30	0.054	Orifice Plate
Zone 2 (EURV)	3.82	0.137	Orifice Plate
Zone 3 (100-year)	4.60	0.110	Weir&Pipe (Rect.)
		0.301	Total

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

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

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	N/A	ft^2
Depth at top of Zone using Orifice Plate =	3.82	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	N/A	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	N/A	inches	Elliptical Slot Area =	N/A	ft^2

Calculated Parameters for Plate

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.20	2.40					
Orifice Area (sq. inches)	0.28	0.28	0.79					

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

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	3.82	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	2.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.82	N/A	feet
Over Flow Weir Slope Length =	2.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	20.83	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	2.80	N/A	ft^2
Overflow Grate Open Area w/ Debris =	1.40	N/A	ft^2

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

	Zone 3 Rectangular	Not Selected	
Depth to Invert of Outlet Pipe =	5.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Rectangular Orifice Width =	4.40	N/A	inches
Rectangular Orifice Height =	4.40		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Rectangular	Not Selected	
Outlet Orifice Area =	0.13	N/A	ft^2
Outlet Orifice Centroid =	0.18	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	4.90	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.35	feet
Spillway Crest Length =	10.00	feet	Stage at Top of Freeboard =	6.25	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	0.24	acres
Freeboard above Max Water Surface =	1.00	feet			

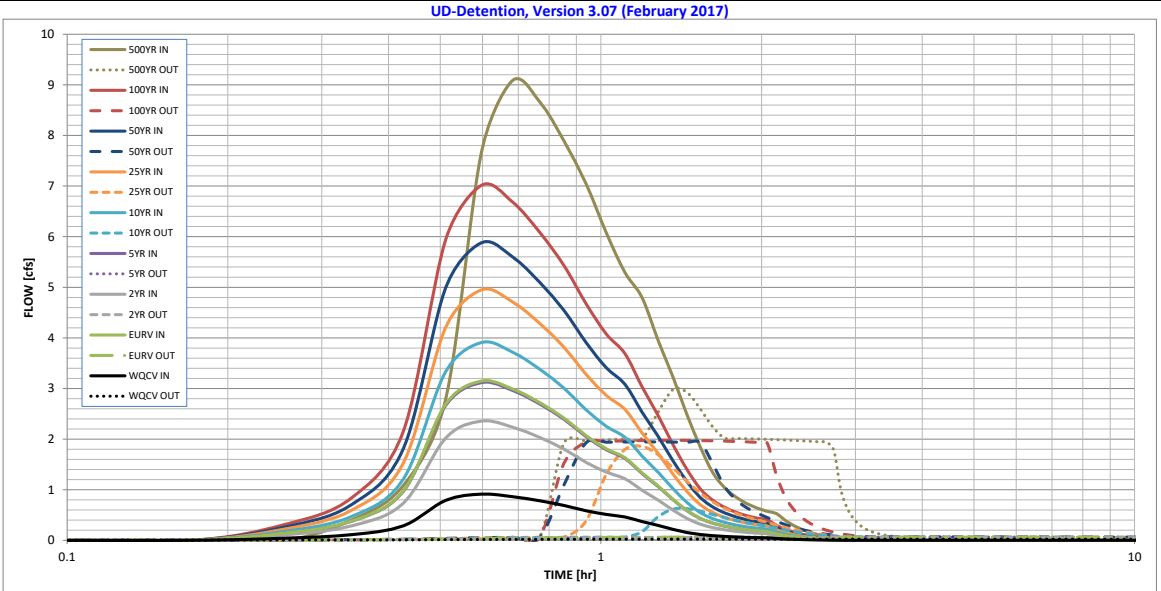
Calculated Parameters for Spillway

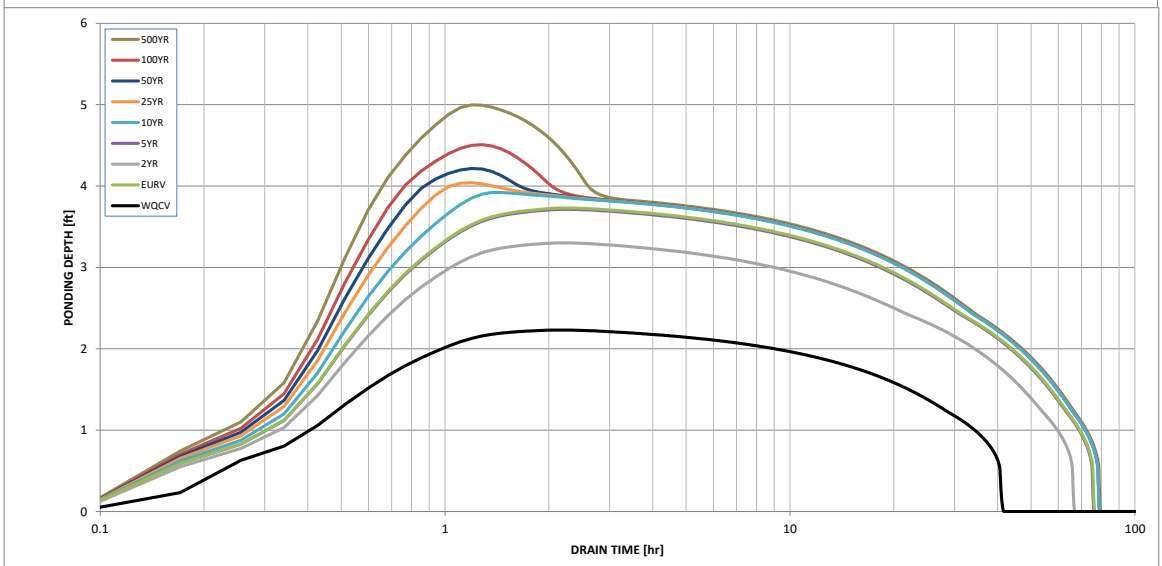
Routed Hydrograph Results

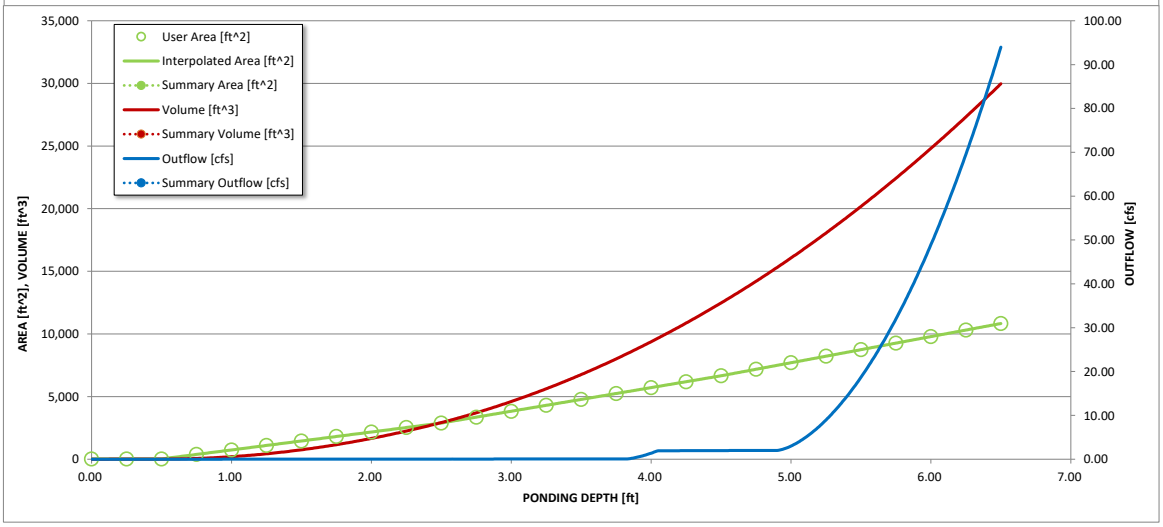
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.00
Calculated Runoff Volume (acre-ft) =	0.054	0.192	0.143	0.189	0.239	0.303	0.360	0.431	0.560
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.054	0.191	0.142	0.189	0.238	0.302	0.360	0.431	0.559
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.01	0.10	0.31	0.51	0.80	1.32
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.0	0.3	0.9	1.4	2.2	3.7
Peak Inflow Q (cfs) =	0.9	3.1	2.4	3.1	3.9	4.9	5.9	7.0	9.1
Peak Outflow Q (cfs) =	0.0	0.1	0.1	0.1	0.6	1.9	1.9	2.0	3.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	1.9	2.4	2.2	1.4	0.9	0.8
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	0.6	0.7	0.7	0.7
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	39	68	60	68	69	67	65	63	61
Time to Drain 99% of Inflow Volume (hours) =	**40**	73	64	73	75	74	73	73	71
Maximum Ponding Depth (ft) =	2.23	3.73	3.30	3.71	3.92	4.04	4.22	4.51	5.00
Area at Maximum Ponding Depth (acres) =	0.06	0.12	0.10	0.12	0.13	0.13	0.14	0.15	0.18
Maximum Volume Stored (acre-ft) =	0.050	0.180	0.134	0.179	0.205	0.221	0.244	0.286	0.367

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

VARIANCE REQUEST

December 16, 2019

City Water Resources Engineering Division
30 S. Nevada Avenue
Colorado Springs, CO 80903
Attention: TJ Gajda

RE: Barnes and Medical View Apartments

Dear TJ:

This letter is submitted as the official submittal of a request for a variance per the DCM Volume 1, Chapter 1 Section 10.0 for Barnes and Medical View Apartment. This request is to allow for a variance to multiple items in the Drainage Criteria Manual. The different sections of the Drainage Criteria Manual for which a variance is being required are discussed separately below.

Location

The 11.63 acres property is located in Section 19, Township 13 South, Range 65 West of the Sixth Principal Meridian, City of Colorado Springs, CO, on the northwest corner of Barnes Road and Medical View. The site is being platted as Barnes and Medical View Apartments.

Background

The site is currently undeveloped and is proposed to be developed as apartment buildings. There is an existing public 60" RCP / dual 4'x6' RCB storm sewer that cuts roughly across the center of the site. Onsite runoff is channeled/piped to three onsite detention basins, before being piped to the existing dual 4'x6' RCB storm sewer and flowing offsite.

Crown to Crown Storm Pipe Requirement

This request is to allow for a variance from Volume 1 Chapter 9 Section 6.5 which states:

> *"The elevation of the downstream pipe crown shall be no higher than the upstream pipe crown(s). This will minimize the backwater effects on the upstream pipe."*

This request is to allow certain downstream pipe crowns to be higher than the upstream pipe crown. Specifically, this occurs at the junction of the West Pond and Middle Pond outlet pipes, and where the combined drainage from these ponds enters the dual 4'x6' RCB.

721 S. 23rd Street • Colorado Springs, CO 80904-3713
Phone: 719-635-6422 • Fax: 719.635.6426

Site Design Constraints

The design constraints include the required volumes of the ponds, being unable to raise the Middle Pond further due to topographic and building foundation limitations, the relative elevation change between the two ponds, the use of an oversized pipe to provide extra capacity for an emergency outlet, and the elevation of the existing dual 4'x6' RCB.

The pond volumes are determined per the DCM and can't be reduced, while raising the elevation of the Middle Pond would create a conflict with the existing Barnes Road and the proposed Building B.

There is 5' of elevation change between the bottoms of the West Pond and Middle Pond, so having water from the West Pond outlet pipe backflow into the Middle Pond is a possible issue. As such, keeping the minor storm event HGL below the Middle Pond outlet pipe at the junction is considered more important than having crown to crown pipes.

The pipe carrying the flow from the two ponds to the existing dual 4'x6' RCB has been oversized to provide extra capacity for the Middle Pond emergency outlet. This makes this pipe twice as tall as the two pond outlet pipes. Having extra capacity in this pipe in the event of an emergency flow is considered more important than having crown to crown pipes. Additionally, lowering this pipe would move it further from the crown of the RCB, and would increase the frequency of the backwater condition at the RCB junction.

With the Middle Pond being as high as it can go and the existing RCB elevation, it isn't possible to get crown to crown at the RCB without upsizing the proposed pipe solely to allow for crown to crown. The Middle Pond outlet has been raised as high on the outlet structure as the code allows, the pipe slopes have been set to the minimum 0.5%, and the discharge pipe is already oversized for the design flows.

Proposed Design

Pipe Run 1 - The proposed design for the junction of the outlet pipes from the West Pond and Middle Pond has the upstream pipe (West Pond outlet) lower than the downstream pipe so the minor event HGL stays below the Middle Pond outlet pipe. The upstream crown is 1.15' lower than the downstream crown.

Pipe Run 2 - The proposed design for the junction of the outlet pipes from the West Pond and Middle Pond has the upstream pipe (Middle Pond outlet) lower than the downstream pipe because the DCM and hydraulics don't allow the upstream pipe to be raised any further. The upstream crown is 1.04' lower than the downstream crown.

Pipe Run 3 - The proposed design for the junction of the pipe carrying the flow from the two ponds and the existing 4'x6' RCB has the upstream pipe lower than the downstream pipe because it isn't possible to raise the upstream pipe any further and still drain the Middle Pond. The upstream crown is 0.22' lower than the downstream crown.

This design allows the HGLs to function properly and avoids the water backflowing into the Middle Pond during minor storm events. As the stated purpose of the crown to crown requirement is to avoid backwater effects, this design appears reasonable.

Alternative Options Considered

Draining the Middle Pond into the Barnes Road ROW was considered. The City stated they wouldn't allow it.

Draining the Middle Pond onto the City Parks land across Barnes Road was considered. The City stated they wouldn't allow it, and the cost was likely to be prohibitively high.

Connecting to the existing RCB further downstream, in the Barnes Road ROW, was considered. Causing major disruption to Barnes Road is considered undesirable by all involved, and the cost is prohibitively high.

Consideration of Long-Term Maintenance Costs

Having stormwater pipes that are not crown to crown is not expected to significantly affect maintenance costs.

Request

Terra Nova Engineering, Inc., on behalf of Fields Land and Cattle, LTD, is requesting a variance to the requirement that downstream pipe crowns be no higher than the upstream pipe crowns. There are pond requirements and existing conditions that limit the available elevation change across these pipe runs. No design alternative has been found that meets all of the City criteria, and this requirement is considered a lower priority than other requirements that could be violated to allow this one to be met.

If granted, this request will not increase peak flows or worsen water quality in downstream Sand Creek.

Crown to Crown Storm Pipe Requirement

This request is to allow for a variance from Volume 1 Chapter 9 Sections 6.1 and 6.2 which state:

> *"Manholes are required whenever there is a change in size, direction, material type, or grade of a storm sewer pipe to provide a hydraulic transition and maintenance and*

inspection access, except in special conditions as noted above with the use of prefabricated fittings or bends. A manhole shall also be constructed when there is a junction of two or more sewer pipes."

and

"Inlets may be used as junction structures in place of manholes to connect adjacent inlets if the interconnecting pipe can be fit within the standard inlet dimensions without modification to the inlet and if the additional flow can be passed through the structure in accordance with standard hydraulic criteria. Inlets may not be used as junctions along trunk lines."

This request is to allow the use of inlets as junctions along specific trunk lines.

Site Design Constraints

There is a private storm sewer trunk line proposed that doesn't meet this requirement, which has diameters ranging from 12" to 30". This trunk line collects runoff and carries it to the Middle Pond. The trunk line goes from inlet to inlet, with only two lateral lines along the route, one of which connects at a manhole. The other lateral connects at a junction with a 12" pipe in, a 15" pipe in, and a 18" pipe out.

No design constraints have been identified that would prevent the use of manholes at junctions. Doing so would simply result in an inferior design.

Proposed Design

The proposed design has Inlet #3, Inlet #4, Inlet #5, and Inlet #6 serving as junctions on a trunk line. At the first three inlets, the trunk line either passes straight through or changes direction at the inlet. Inlet #6 serves as the junction of three pipes, a 12" pipe in, a 15" pipe in, and a 18" pipe out.

Routing this trunk line around these storm inlets, installing manholes adjacent to the inlets, and connecting the inlets to the trunk line with laterals does not appear to provide any technical or economic benefit; while it would substantially increase the cost of this storm sewer system, substantially increase the maintenance cost, and worsen the system hydraulics. All of these inlets and pipe runs will be privately owned.

Alternative Options Considered

Routing this trunk line around these storm inlets, installing manholes adjacent to the inlets, and connecting the inlets to the trunk line with laterals to meet the requirements was considered. No benefits to doing this were identified, while substantial costs were identified.

Consideration of Long-Term Maintenance Costs

Using the proposed design will results in maintenance costs substantially below what the costs would be if this requirement was met.

Request

Terra Nova Engineering, Inc., on behalf of Fields Land and Cattle, LTD, is requesting a variance to the requirement that inlets cannot be used as junctions on trunk lines. No benefit to meeting this requirement has been identified and a significant cost would be incurred to meet this requirement.

If granted, this request will not increase peak flows or worsen water quality in downstream Sand Creek.

This variance request is submitted for your review and approval. If you have any questions, please contact me at 719.635.6422.

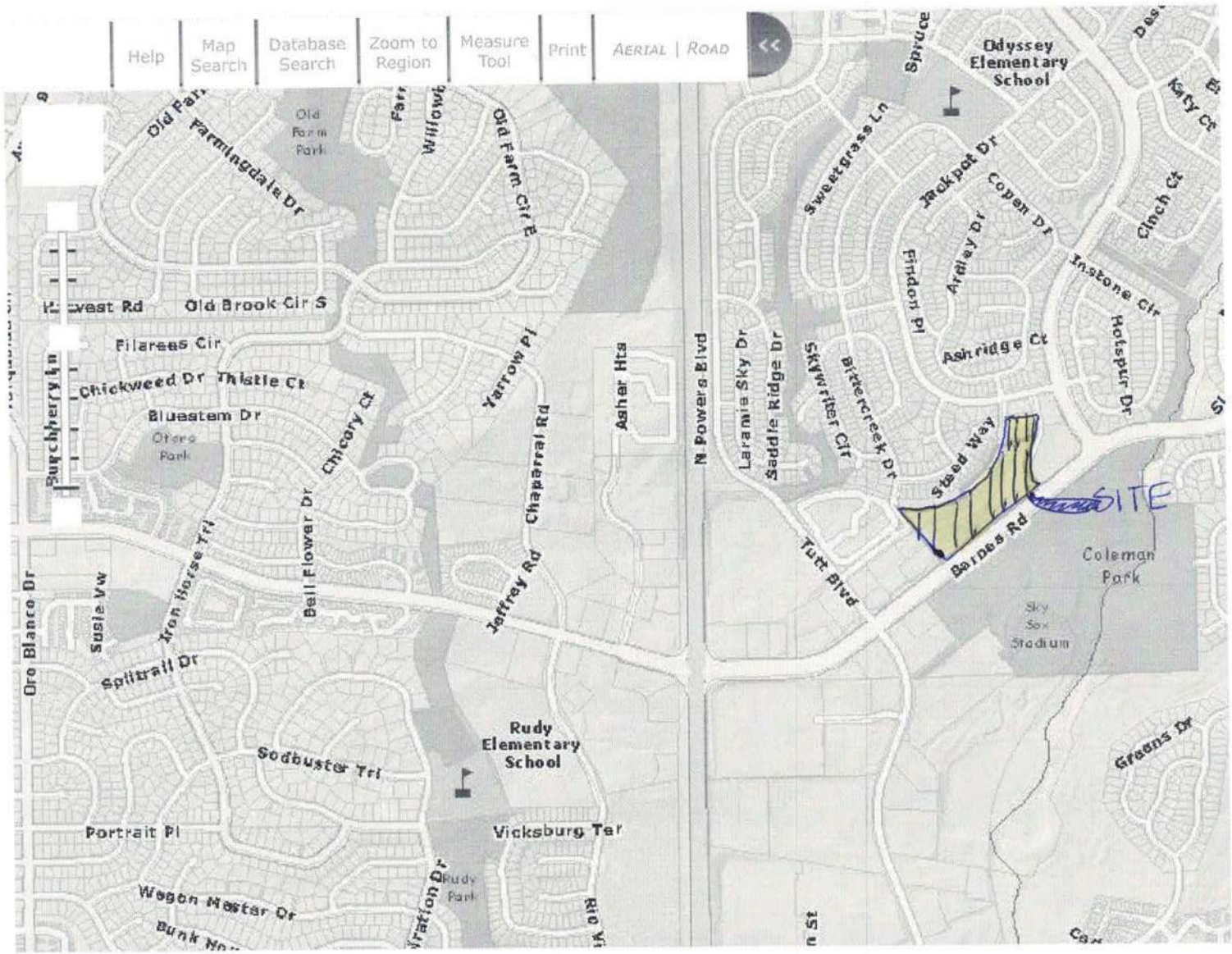
Sincerely,

Dane Frank

Dane Frank, PE
Terra Nova Engineering, Inc.

Attachments:

Vicinity Map
Storm Sewer Plan & Profile, Storm Sewer Overview and Profile Sheets (sheets 2, 5, & 6)



A Vicinity Map
N N.T.S.

0 0.15 0.3mi

LEGEND

PROPOSED	PR
EXISTING	EX
FINISHED SURFACE	FS
FINISHED GROUND	FG
TOP OF CURB	TC
FLOWLINE	FL
TOP OF WALL	TW
BOTTOM OF WALL	BW
LOW POINT	LP
HIGH POINT	HP
EXISTING ELEVATION	(12.00)
PROPOSED ELEVATION	12.00
GRADE & DIRECTION	2.2%

EXISTING CONTOURS – MINOR
EXISTING CONTOURS – MAJOR
PROPOSED CONTOURS – 2'
PROPOSED DOWNSPOUT LOCATION
EXISTING PROPERTY LINE
PROPOSED WALL
PROPOSED RIPRAP
WATER LINE
SANITARY SEWER LINE
GAS LINE
UNDERGROUND ELECTRICAL LINE
TELEPHONE LINE
FIBER OPTIC LINE
STORM WATER LINE

PIPE RUN SUMMARY

PIPE RUN	Q5 CFS	Q100 CFS	SLOPE	SIZE	MATERIAL	PUB./PVT.
1	0.0	2.0	1.7%	15"	HDPE	PVT.
2	0.1	3.5	0.5%	15"	HDPE	PVT.
3	0.1	5.5	0.5%	18"	HDPE	PVT.
4	0.1	1.9	12.1%	15"	HDPE	PVT.
5A	3.6	8.7	4.0%	21"	RCP	PVT.
5B	3.6	8.7	0.5%	21"	RCP	PVT.
6	9.2	27.5	4.0%	30"	RCP	PVT.
7	0.6	1.4	3.9%	12"	HDPE	PVT.
8	7.4	23.6	3.8%	30"	RCP	PVT.
9	5.0	18.2	3.5%	24"	RCP	PVT.
10	3.7	11.9	0.5%	24"	RCP	PVT.
11	2.9	7.0	0.5%	18"	HDPE	PVT.
12	0.4	2.4	5.6%	12"	HDPE	PVT.
13	2.9	5.5	0.8%	15"	HDPE	PVT.
14	1.5	2.8	1.3%	12"	HDPE	PVT.
15	1.3	2.8	0.6%	12"	HDPE	PVT.
16	3.2	6.5	2.4%	18"	HDPE	PVT.
17	4.5	9.3	0.5%	21"	HDPE	PVT.
18	157.9	355.6	2.0%	6'x4'	RCB	PUB.
EX60"	157.7	347.2	4.9%	60"	RCP	PUB.

COLORADO 811 — KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

STORM SEWER NOTES

1. ALL PRIVATE TO PUBLIC STORM SEWER CONNECTIONS MUST BE INSPECTED BY AN ENGINEERING DEVELOPMENT REVIEW INSPECTOR.

2. PLAN REVIEW BY THE CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSION, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

3. ALL HDPE STORM SEWER MUST BE SMOOTH INTERIOR PIPE.

4. IT IS RECOMMENDED THAT THE TRANSITIONS FROM THE EXISTING 60" RCP TO DUAL RCB BE EXPOSED AND INSPECTED DURING STORM SEWER INSTALLATION. HOW THIS TRANSITION WAS MADE IS NOT KNOWN.

5. IT IS RECOMMENDED THAT THE CONTRACTOR CONTACT THE BACK FLOW PREVENTOR MANUFACTURER TO DISCUSS INSTALLATION, MATERIALS, ETC. BEFORE ORDERING MATERIALS.

REVIEW:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

STREET DESIGN FOR CITY ENGINEERING:

UTILITY GRADE REVIEW _____ DATE _____

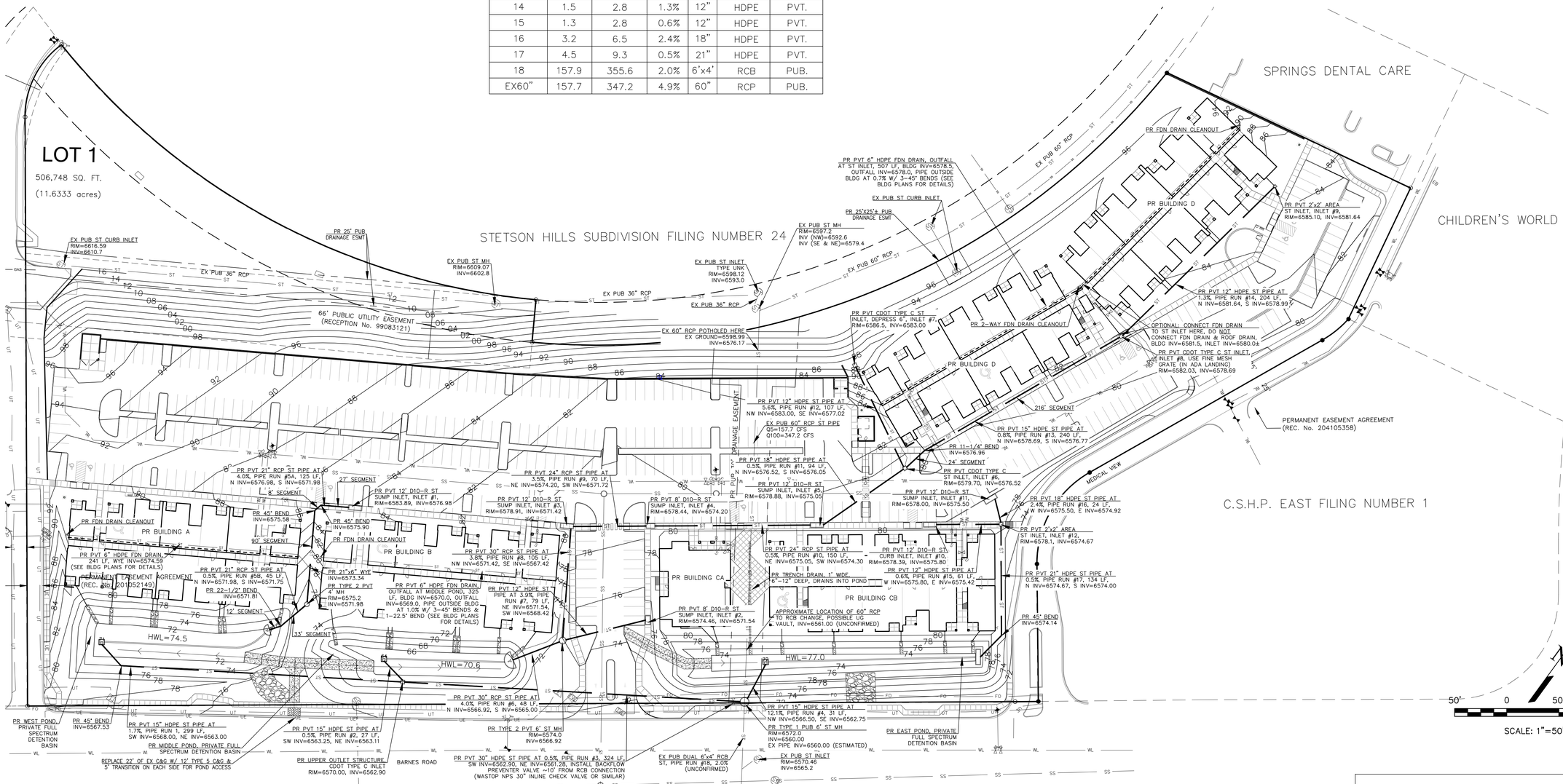
CURB & GUTTER REVIEW _____ DATE _____

TRAFFIC REVIEW _____ DATE _____

FINAL REVIEW _____ DATE _____

DRAINAGE DESIGN _____ DATE _____

THIS IS FILED IN ACCORDANCE WITH SECTION 7-7-906 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS, 2001 AS AMENDED.



PREPARED FOR:
PAVILION CONSTRUCTION
ATTN: PETER MILLER
15455 SW HALLMARK DR. #200
LAKE OSWEGO, OR 97035
(503) 290-5005

NO.	REVISIONS	DESCRIPTION	DATE

UNTIL SUCH TIME AS THESE DRAWINGS ARE APPROVED BY THE APPROPRIATE REVIEWING AGENCIES, TERRA NOVA ENGINEERING, INC. APPROVES THEIR USE ONLY FOR THE PURPOSES DESIGNATED BY WRITTEN AUTHORIZATION.

Terra Nova Engineering, Inc. "Creative Civil Engineering Solutions"
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tnespc.com

BARNES & MEDICAL VIEW APARTMENTS

STORM SEWER PLANS
OVERVIEW

THIS DESIGN WAS PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF TERRA NOVA ENGINEERING, INC.

DANE FRANK, COLORADO P.E. #50207

DESIGNED BY	DLF
DRAWN BY	DLF
CHECKED BY	LD
H-SCALE	1"=50'
V-SCALE	N/A
JOB NO.	1859.00
DATE ISSUED	01/27/20
SHEET NO.	2 OF 10

N:\jobs\1859.00\drawings\CDs\185900 STORM.dwg, 2/18/2020 8:14:51 AM

THIS DESIGN WAS PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF TERRA NOVA ENGINEERING, INC.

DANE FRANK, COLORADO P.E. #50207

REVIEW:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

STREET DESIGN FOR CITY ENGINEERING:

UTILITY GRADE REVIEW _____ DATE_____

CURB & GUTTER REVIEW _____ DATE_____

TRAFFIC REVIEW _____ DATE_____

FINAL REVIEW _____ DATE_____

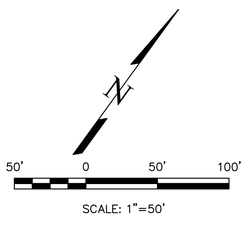
DRAINAGE DESIGN _____ DATE_____

THIS IS FILED IN ACCORDANCE WITH SECTION 7-7-906 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS, 2001 AS AMENDED.

PROPOSED	PR
EXISTING	EX
FINISHED SURFACE	FS
FINISHED GROUND	FG
TOP OF CURB	TC
FLOWLINE	FL
TOP OF WALL	TW
BOTTOM OF WALL	BW
LOW POINT	LP
HIGH POINT	HP
EXISTING ELEVATION	(12.00)
PROPOSED ELEVATION	12.00
GRADE & DIRECTION	2.2%

LEGEND

EXISTING CONTOURS – MINOR	31
EXISTING CONTOURS – MAJOR	30
PROPOSED CONTOURS – 2'	31
PROPOSED DOWNSPOUT LOCATION	
EXISTING PROPERTY LINE	
PROPOSED WALL	
PROPOSED RIPRAP	
WATER LINE	WL
SANITARY SEWER LINE	SS
GAS LINE	GAS
UNDERGROUND ELECTRICAL LINE	UE
TELEPHONE LINE	UT
FIBER OPTIC LINE	FO
STORM WATER LINE	ST



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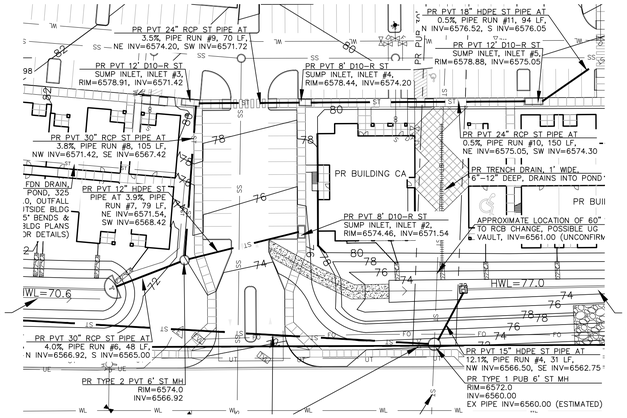

PIPE RUN 6, 8, 9, & 10 DETAIL

SCALE: 1"=50'

STORM SEWER NOTES

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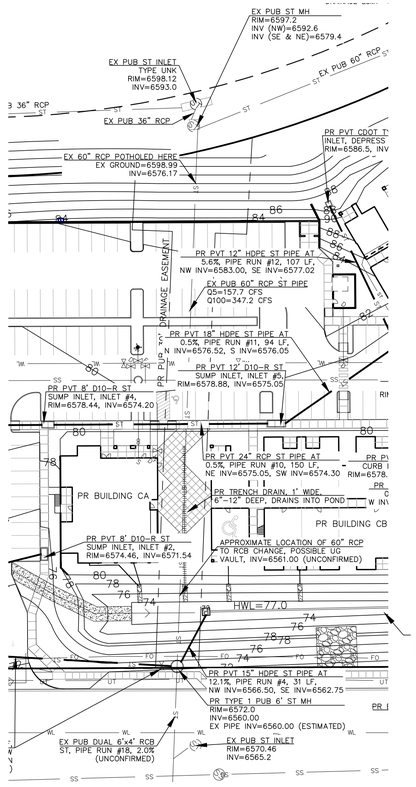
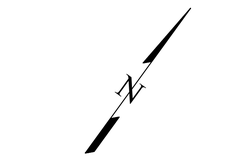
3. ALL HDPE STORM SEWER MUST BE SMOOTH INTERIOR PIPE.

4. ON MANHOLES THAT TIE INTO EXISTING 60" STORM MAIN, CREATE 0.3'± DROP ACROSS THE MANHOLE BOTTOM.

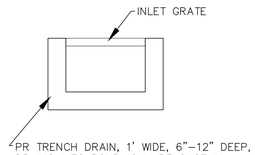


EX 60" RCP & PIPE RUN 18 DETAIL

SCALE: 1"=50'

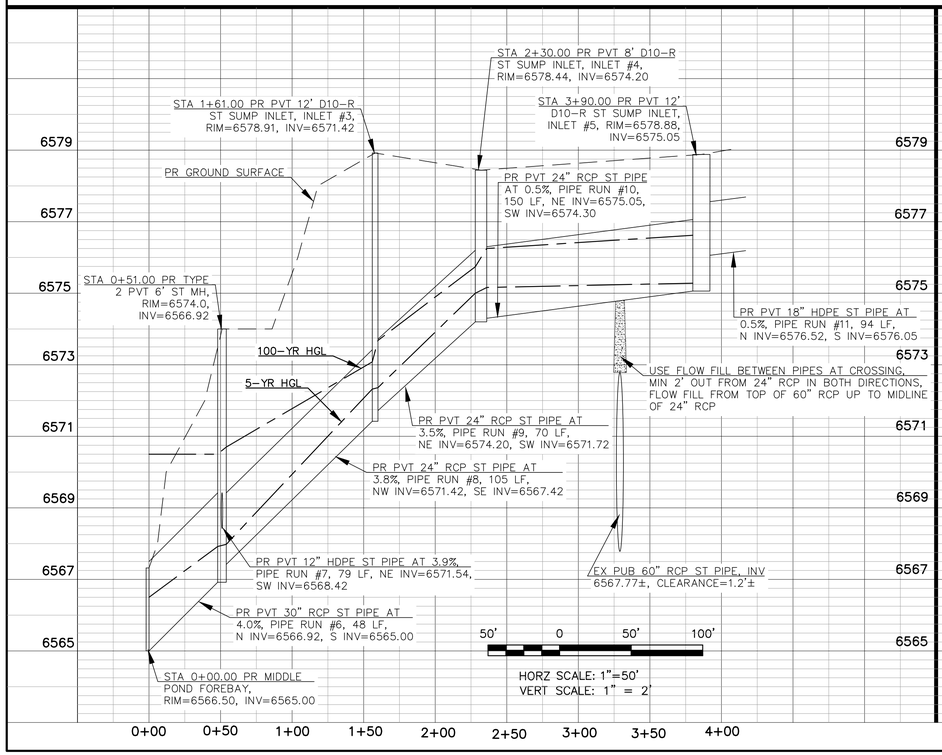


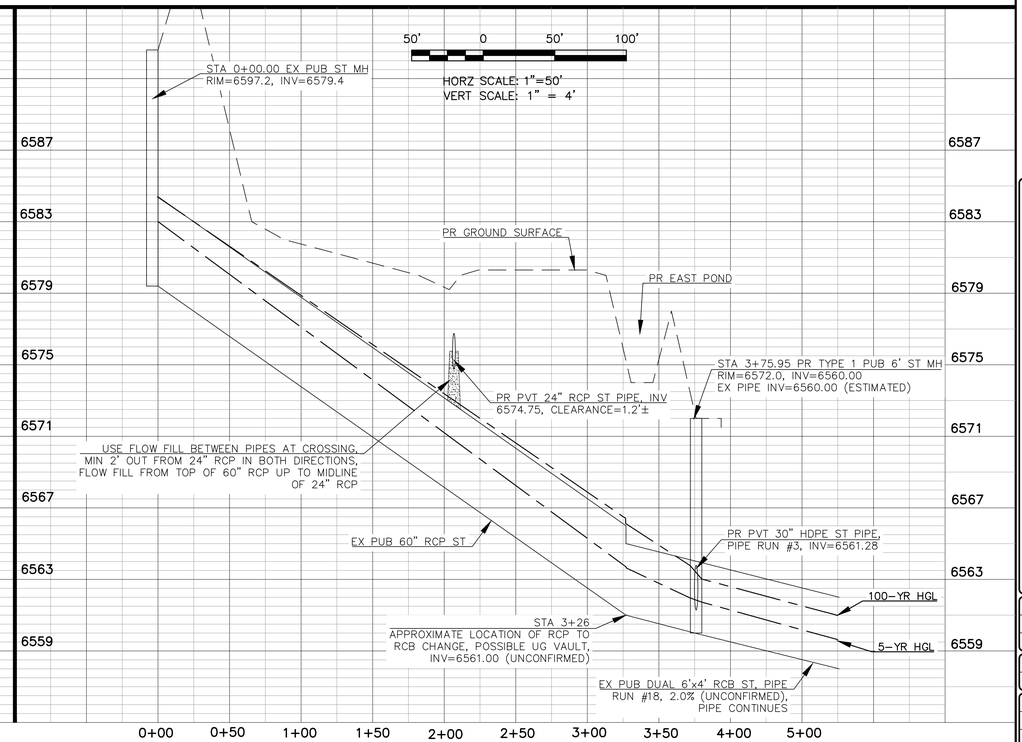
SCALE: 1"=50'



TRENCH DRAIN DETAIL – BLDG C

NOT TO SCALE





REVISIONS

NO.	DESCRIPTION	DATE

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PREPARED FOR:
PAVILION CONSTRUCTION
ATTN: PETER MILLER
15455 SW HALLMARK DR. #200
LAKE OSWEGO, OR 97035
(503) 290-5005

Terra Nova Engineering, Inc. Creative Civil Engineering Solutions
721 S. 23RD STREET
COLORADO SPRINGS, CO 80904
OFFICE: 719-635-6422
FAX: 719-635-6426
www.tneiinc.com

BARNES & MEDICAL VIEW APARTMENTS

STORM SEWER PLANS
PIPE RUN 6, 8-10, & 15-17 PLAN AND PROFILES

DESIGNED BY DLF
DRAWN BY DLF
CHECKED BY LD
H-SCALE 1"=50'
V-SCALE AS SHOWN
JOB NO. 1859.00
DATE ISSUED 01/27/20
SHEET NO. 5 OF 10

N:\jobs\1859.00\drawings\CDs\185900 STORM.dwg, 2/18/2020 8:14:54 AM

THIS DESIGN WAS PREPARED UNDER MY DIRECT SUPERVISION FOR AND ON BEHALF OF TERRA NOVA ENGINEERING, INC.

DANE FRANK, COLORADO P.E. #50207

COLORADO 811 KNOW WHAT'S BELOW. CALL BEFORE YOU DIG.

REVIEW:

THE CITY OF COLORADO SPRINGS RECOGNIZES THE DESIGN ENGINEER AS HAVING RESPONSIBILITY FOR THE DESIGN. THE CITY HAS LIMITED ITS SCOPE OF REVIEW ACCORDINGLY. RESUBMITTAL REQUIRED IF CONSTRUCTION HAS NOT COMMENCED WITHIN 180 DAYS AFTER REVIEW DATE.

STREET DESIGN FOR CITY ENGINEERING:

UTILITY GRADE REVIEW _____ DATE _____

CURB & GUTTER REVIEW _____ DATE _____

TRAFFIC REVIEW _____ DATE _____

FINAL REVIEW _____ DATE _____

DRAINAGE DESIGN _____ DATE _____

THIS IS FILED IN ACCORDANCE WITH SECTION 7-7-906 (DRAINAGE ORDINANCE) OF THE CODE OF THE CITY OF COLORADO SPRINGS, 2001 AS AMENDED.

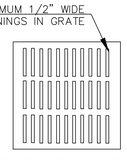
LEGEND

PROPOSED	PR
EXISTING	EX
FINISHED SURFACE	FS
FINISHED GROUND	FG
TOP OF CURB	TC
FLOWLINE	FL
TOP OF WALL	TW
BOTTOM OF WALL	BW
LOW POINT	LP
HIGH POINT	HP
EXISTING ELEVATION	(12.00)
PROPOSED ELEVATION	12.00
GRADE & DIRECTION	2.2%

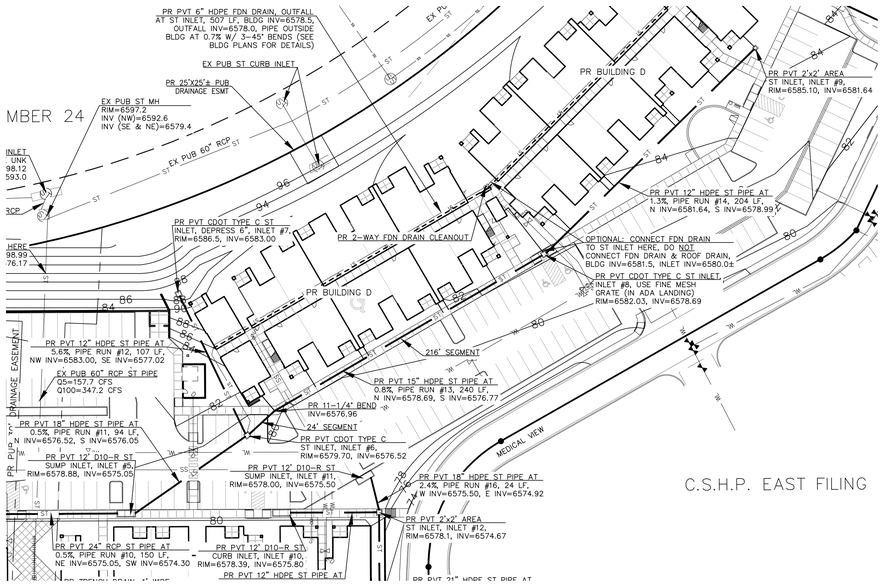
EXISTING CONTOURS – MINOR
EXISTING CONTOURS – MAJOR
PROPOSED CONTOURS – 2'
PROPOSED DOWNSPOUT LOCATION
EXISTING PROPERTY LINE
PROPOSED WALL
PROPOSED RIPRAP
WATER LINE — WL
SANITARY SEWER LINE — SS
GAS LINE — GAS
UNDERGROUND ELECTRICAL LINE — UE
TELEPHONE LINE — UT
FIBER OPTIC LINE — FO
STORM WATER LINE — ST

STORM SEWER NOTES

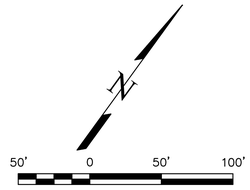
1. ALL PRIVATE TO PUBLIC STORM SEWER CONNECTIONS MUST BE INSPECTED BY AN ENGINEERING DEVELOPMENT REVIEW INSPECTOR.
2. PLAN REVIEW BY THE CITY OF COLORADO SPRINGS IS PROVIDED ONLY FOR GENERAL CONFORMANCE WITH DESIGN CRITERIA. THE CITY OF COLORADO SPRINGS IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, DIMENSION, AND/OR ELEVATIONS WHICH SHALL BE CONFIRMED AT THE JOB SITE. THE CITY OF COLORADO SPRINGS, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.
3. ALL HDPE STORM SEWER MUST BE SMOOTH INTERIOR PIPE.



FINE MESH GRATE (ADA) DETAIL
NTS



PIPE RUN 11, 13, & 14 DETAIL
SCALE: 1"=50'



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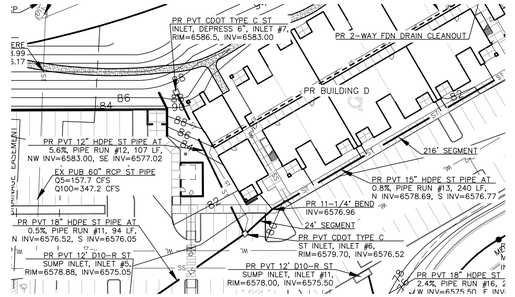
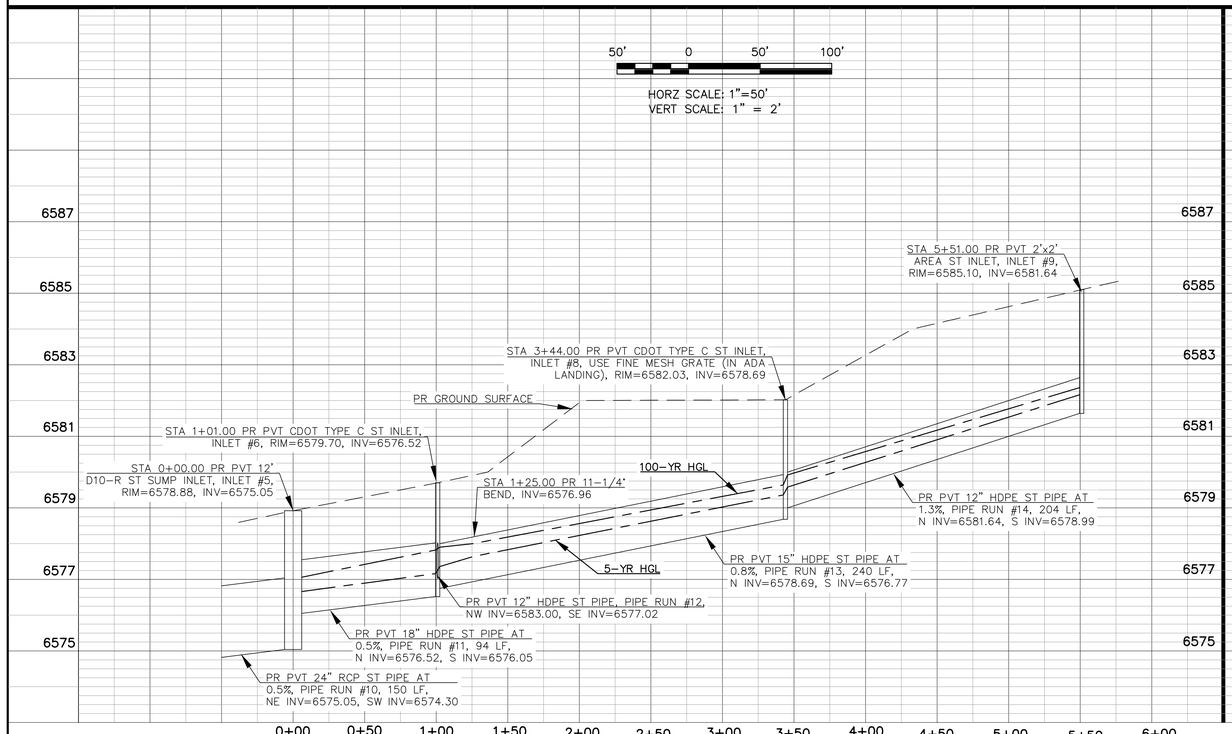
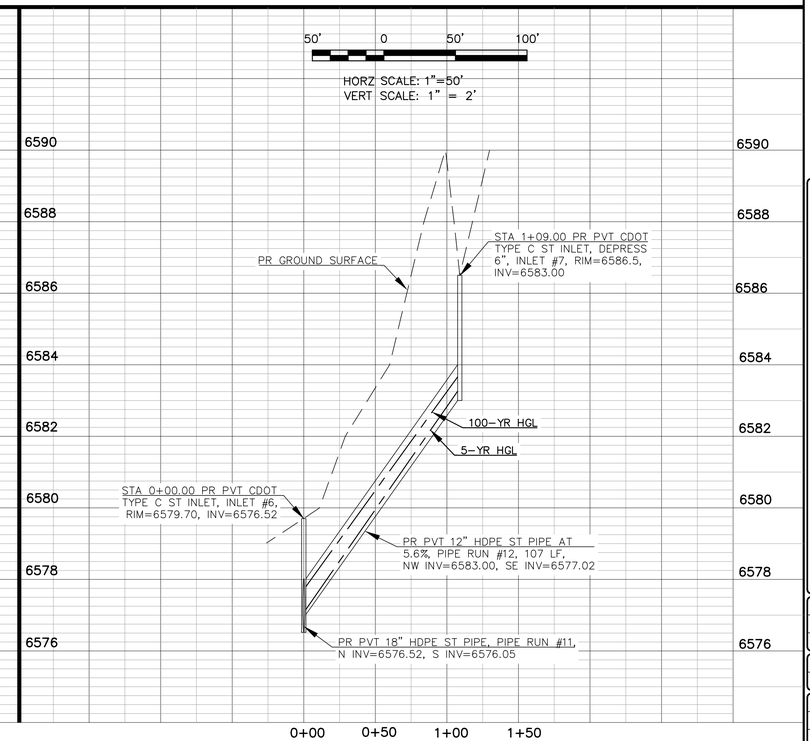


PIPE RUN 12 DETAIL
SCALE: 1"=50'





REVISIONS

NO.	DESCRIPTION	DATE

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PREPARED FOR:
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www.tneinc.com

BARNES & MEDICAL VIEW APARTMENTS

STORM SEWER PLANS
PIPE RUN 7, 11, 13, & 14 PLAN AND PROFILES

DESIGNED BY	DLF
DRAWN BY	DLF
CHECKED BY	LD
H-SCALE	1"=50'
V-SCALE	AS SHOWN
JOB NO.	1859.00
DATE ISSUED	01/27/20
SHEET NO.	6 OF 10

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DRAINAGE MAPS

BARNES AND MEDICAL VIEW APARTMENTS

COLORADO SPRINGS, CO

EXISTING DRAINAGE MAP

JANUARY 2020

LEGEND

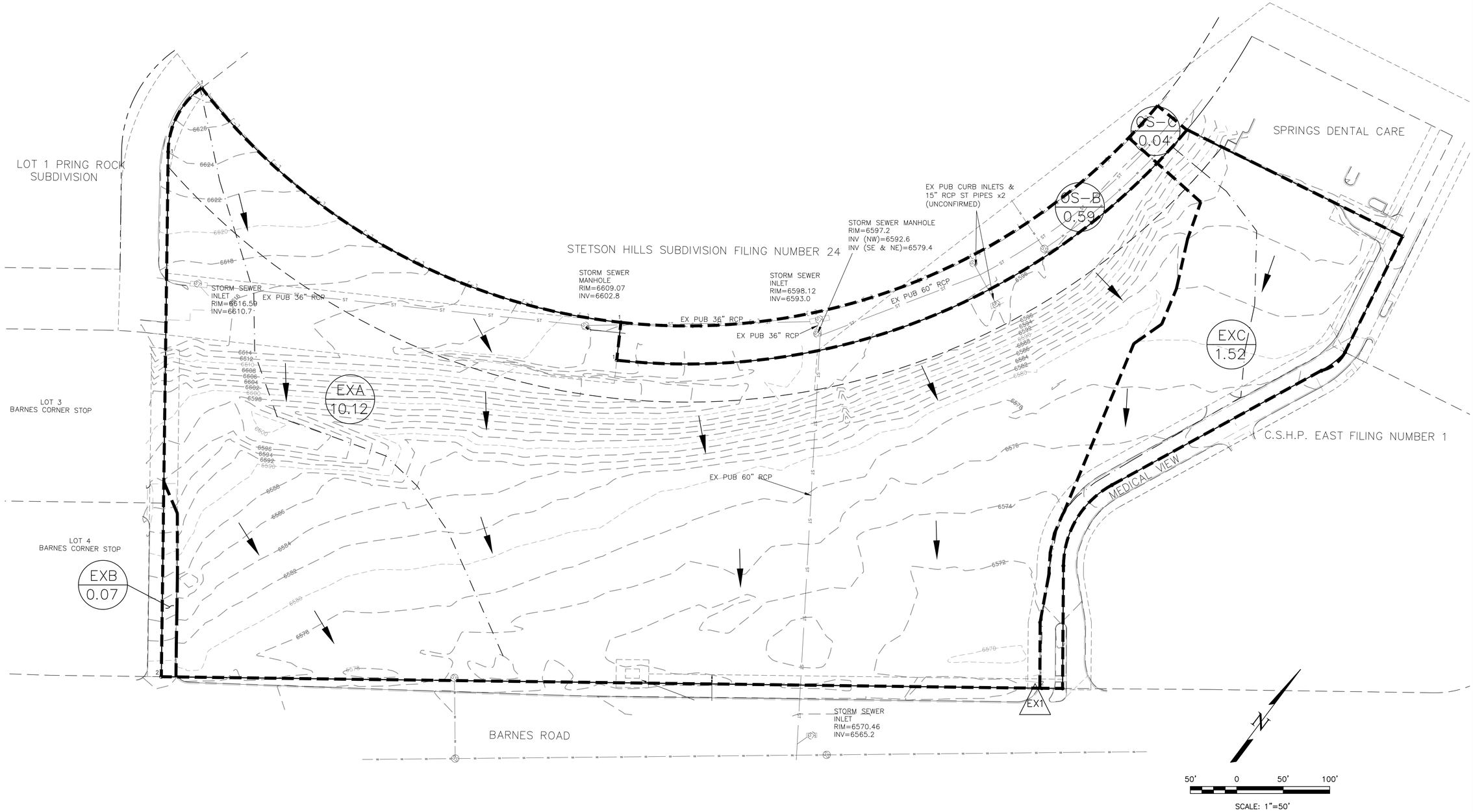
- 10' EX CONTOUR — 6810
- 2' EX CONTOUR — 6802
- PROPOSED FLOW DIRECTION
- BASIN BOUNDARY
- TIME OF CONCENTRATION
- BASIN ID → A
- ACREAGE → 0.37
- DESIGN POINT → 3

EXISTING CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
EXA	10.12	3.4	22.6
EXB	0.07	0.3	0.5
EXC	1.52	1.4	4.5
OS-B	0.59	0.3	1.8
OS-C	0.04	0.0	0.1

DESIGN POINT SUMMARY

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS
EX1	EXA, EXB, EXC, OS-B & OS-C	12.33	5.0	29.0



REVISIONS

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PREPARED FOR:
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16037 SW BOONESFERRY RD
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503-332-6582

Terra Nova Engineering, Inc.
Traffic Civil Engineering Surveying
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FAX: 719-635-6426
www.tneinc.com

BARNES AND MEDICAL VIEW APARTMENTS

EXISTING DRAINAGE MAP

DESIGNED BY	LD
DRAWN BY	JF
CHECKED BY	LD
H-SCALE	AS NOTED
V-SCALE	N/A
JOB NO.	1859.00
DATE ISSUED	01/27/20
SHEET NO.	1 OF 4

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BARNES & MEDICAL VIEW APARTMENTS

COLORADO SPRINGS, CO

PROPOSED DRAINAGE MAP

JANUARY 2020

PROPOSED CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
A1	2.13	3.6	8.7
A2	0.05	0.2	0.4
A3	0.05	0.4	0.4
A4	0.17	0.6	1.2
A5	0.11	0.4	0.8
A6	0.06	0.2	0.4
A7	0.60	0.3	1.9
OS–B1	0.07	0.0	0.2
OS–B2	0.14	0.1	0.4
OS–B3	0.36	0.2	1.1
B1	1.14	2.7	5.8
B2	0.46	1.4	2.8
B3	0.13	0.5	1.0
B4	0.78	2.5	4.8
B5	0.47	0.2	1.5
B6	0.06	0.2	0.4
B7	0.13	0.5	0.9

PROPOSED CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
B8	0.10	0.4	0.7
B9	0.07	0.2	0.4
B10	0.07	0.3	0.5
B11	0.05	0.2	0.4
B12	0.05	0.2	0.4
B13	0.11	0.4	0.8
B14	0.12	0.5	0.8
B15	0.05	0.2	0.4
B16	0.04	0.2	0.3
B17	0.11	0.4	0.8
B18	0.11	0.4	0.8
B19	0.07	0.3	0.5
B20	0.07	0.3	0.5
B21	0.53	0.2	1.4
OS–C	0.06	0.0	0.2
C1	1.29	3.2	6.5
C2	0.45	1.3	2.6

PROPOSED CONDITIONS

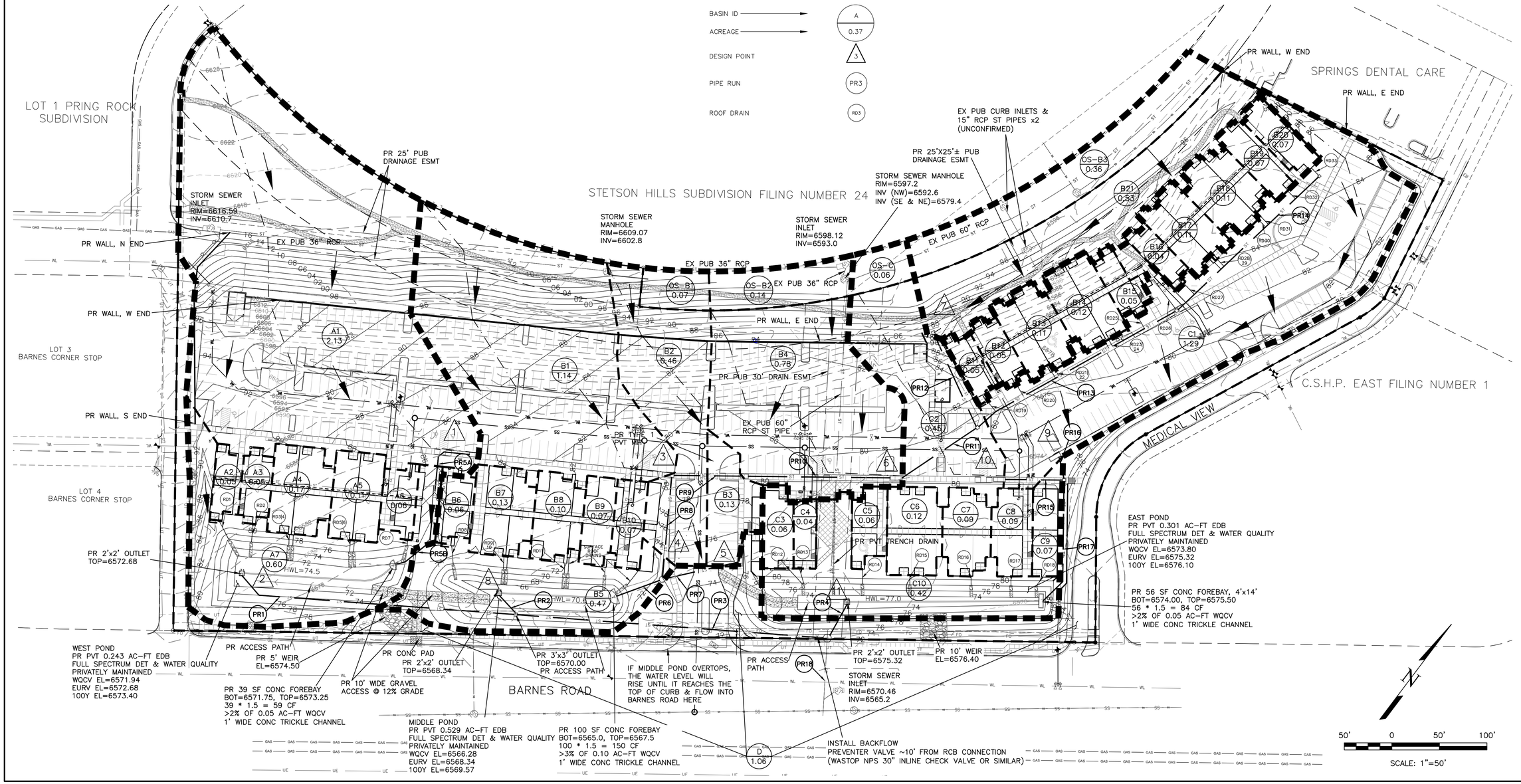
BASIN	ACRES	Q5 CFS	Q100 CFS
C3	0.06	0.2	0.4
C4	0.04	0.2	0.3
C5	0.06	0.2	0.4
C6	0.12	0.5	0.8
C7	0.09	0.3	0.6
C8	0.09	0.3	0.6
C9	0.07	0.3	0.5
C10	0.42	0.2	1.3
D	1.06	3.1	6.6

LEGEND

10' EX CONTOUR 6810
2' EX CONTOUR 6802
10' PROP. CONTOUR 6810
2' PROP. CONTOUR 6802
PROPOSED FLOW DIRECTION
BASIN BOUNDARY
TIME OF CONCENTRATION
BASIN ID — A
ACREAGE — 0.37
DESIGN POINT 3
PIPE RUN PR3
ROOF DRAIN RD3

DESIGN POINT SUMMARY

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS	INLET SIZE/TYPE	OWNER
1	A1	0.22	3.6	8.7	8' D10–R SUMP	PRIVATE
2	A1–A7	3.17	5.1	12.5	WEST POND	PRIVATE
3	B1	1.14	2.5	5.8	8' D10–R SUMP	PRIVATE
4	B2 & OS–B1	0.53	1.4	3.0	4' D10–R SUMP	PRIVATE
5	B3 & OS–B3	0.27	0.6	1.4	4' D10–R SUMP	PRIVATE
6	B4	0.78	2.5	12.6	12' D10–R SUMP	PRIVATE
7	B21 & OS–B3	0.89	0.4	2.4	TYPE "C" INLET	PRIVATE
8	B1–B21	4.72	10.7	22.9	MIDDLE POND	PRIVATE
9	C1	1.29	3.2	6.5	12' D10–R SUMP	PRIVATE
10	C2 & OS–C	0.51	1.3	2.8	12' D10–R SUMP	PRIVATE
11	C1–C10	2.69	5.9	13.0	EAST POND	PRIVATE



REVISIONS

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www.tnesinc.com

BARNES & MEDICAL VIEW APARTMENTS

PROPOSED DRAINAGE MAP

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H–SCALE AS NOTED
V–SCALE N/A
JOB NO. 1859.00
DATE ISSUED 01/27/20
SHEET NO. 2 OF 4

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BARNES & MEDICAL VIEW APARTMENTS

COLORADO SPRINGS, CO

PROPOSED DRAINAGE MAP

JANUARY 2020

PROPOSED CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
A1	2.13	3.6	8.7
A2	0.05	0.2	0.4
A3	0.05	0.4	0.4
A4	0.17	0.6	1.2
A5	0.11	0.4	0.8
A6	0.06	0.2	0.4
A7	0.60	0.3	1.9
OS–B1	0.07	0.0	0.2
OS–B2	0.14	0.1	0.4
OS–B3	0.36	0.2	1.1
B1	1.14	2.7	5.8
B2	0.46	1.4	2.8
B3	0.13	0.5	1.0
B4	0.78	2.5	4.8
B5	0.47	0.2	1.5
B6	0.06	0.2	0.4
B7	0.13	0.5	0.9

PROPOSED CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
B8	0.10	0.4	0.7
B9	0.07	0.2	0.4
B10	0.07	0.3	0.5
B11	0.05	0.2	0.4
B12	0.05	0.2	0.4
B13	0.11	0.4	0.8
B14	0.12	0.5	0.8
B15	0.05	0.2	0.4
B16	0.04	0.2	0.3
B17	0.11	0.4	0.8
B18	0.11	0.4	0.8
B19	0.07	0.3	0.5
B20	0.07	0.3	0.5
B21	0.53	0.2	1.4
OS–C	0.06	0.0	0.2
C1	1.29	3.2	6.5
C2	0.45	1.3	2.6

PROPOSED CONDITIONS

BASIN	ACRES	Q5 CFS	Q100 CFS
C3	0.06	0.2	0.4
C4	0.04	0.2	0.3
C5	0.06	0.2	0.4
C6	0.12	0.5	0.8
C7	0.09	0.3	0.6
C8	0.09	0.3	0.6
C9	0.07	0.3	0.5
C10	0.42	0.2	1.3
D	1.06	3.1	6.6

LEGEND

10' EX CONTOUR 6810

2' EX CONTOUR 6802

10' PROP. CONTOUR 6810

2' PROP. CONTOUR 6802

PROPOSED FLOW DIRECTION

BASIN BOUNDARY

TIME OF CONCENTRATION

BASIN ID A

ACREAGE 0.37

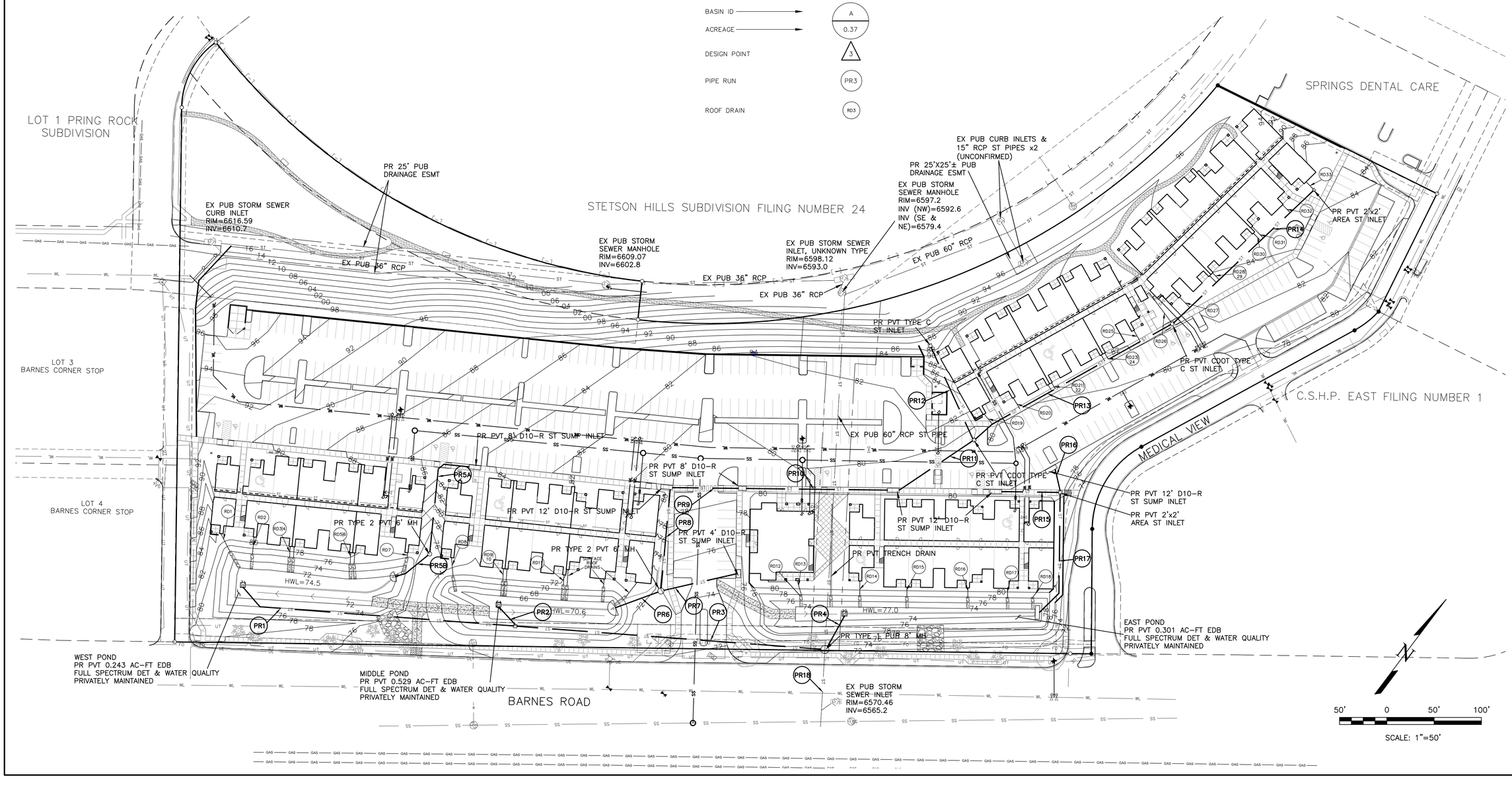
DESIGN POINT 3

PIPE RUN PR3

ROOF DRAIN RD3

DESIGN POINT SUMMARY

DP	CONTRIBUTING BASINS	AREA AC.	Q5 CFS	Q100 CFS	INLET SIZE/TYPE	OWNER
1	A1	0.22	3.6	8.7	8' D10–R SUMP	PRIVATE
2	A1–A7	3.17	5.1	12.5	WEST POND	PRIVATE
3	B1	1.14	2.5	5.8	8' D10–R SUMP	PRIVATE
4	B2 & OS–B1	0.53	1.4	3.0	4' D10–R SUMP	PRIVATE
5	B3 & OS–B3	0.27	0.6	1.4	4' D10–R SUMP	PRIVATE
6	B4	0.78	2.5	12.6	12' D10–R SUMP	PRIVATE
7	B21 & OS–B3	0.89	0.4	2.4	TYPE "C" INLET	PRIVATE
8	B1–B21	4.72	10.7	22.9	MIDDLE POND	PRIVATE
9	C1	1.29	3.2	6.5	12' D10–R SUMP	PRIVATE
10	C2 & OS–C	0.51	1.3	2.8	12' D10–R SUMP	PRIVATE
11	C1–C10	2.69	5.9	13.0	EAST POND	PRIVATE



REVISIONS

NO.	DESCRIPTION	DATE

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Civil Engineering, Surveying, Water Resources
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FAX: 719–635–6426
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BARNES & MEDICAL VIEW APARTMENTS

STORM SEWER LAYOUT

DESIGNED BY QNA
DRAWN BY QNA
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H–SCALE AS NOTED
V–SCALE N/A
JOB NO. 1859.00
DATE ISSUED 01/27/20
SHEET NO. 3 OF 4

BARNES & MEDICAL VIEW APARTMENTS

COLORADO SPRINGS, CO

PIPERUN SUMMARY

JANUARY 2020

WAPRO

WaStop® Inline Check Valve Technical Specification
Stainless Steel AISI 304/316

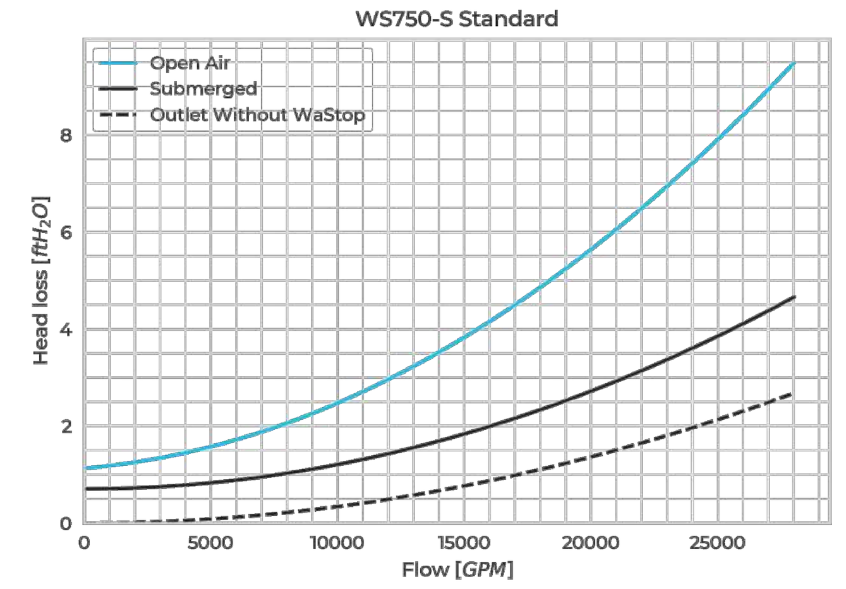
Model no.:	WS750-S2-304/316	WS750-S3-304/316	WS750-S4-304/316
Nominal Size:	30		
Pipe:	Stainless Steel AISI 304/316		
Membrane:	Polyurethane		
Fasteners:	Marine grade stainless steel (AISI 316)		

Technical data:	Soft (S2)	Standard (S3)	Hard (S4)
Max. back pressure*:	9,8 ft H_2O	16,4 ft H_2O	26,2 ft H_2O
Horizontal opening pressure*:	12,6 in H_2O	13,6** in H_2O	17,7** in H_2O
Horizontal closing pressure*:	8,3 in H_2O	8,9** in H_2O	10,6** in H_2O
Submerged opening pressure*:	7,3** in H_2O	8,5** in H_2O	9,6** in H_2O
Submerged closing pressure*:	2,4** in H_2O	2,8** in H_2O	3,5** in H_2O
Vertical opening pressure*:	16,7** in H_2O	18,5** in H_2O	20,4** in H_2O
Vertical closing pressure*:	7,1** in H_2O	7,9** in H_2O	7,9** in H_2O

*) +/- 15% **) Modeled value
- Values measured from bottom of pipe.
- Tests performed at room temperature (61-68˚F).

Max Flow	f/s	GPM
	13	28025

- Higher flows requires custom valve, contact Wapro
- Flange installation is highly recommended at flows above 6.5 f/s



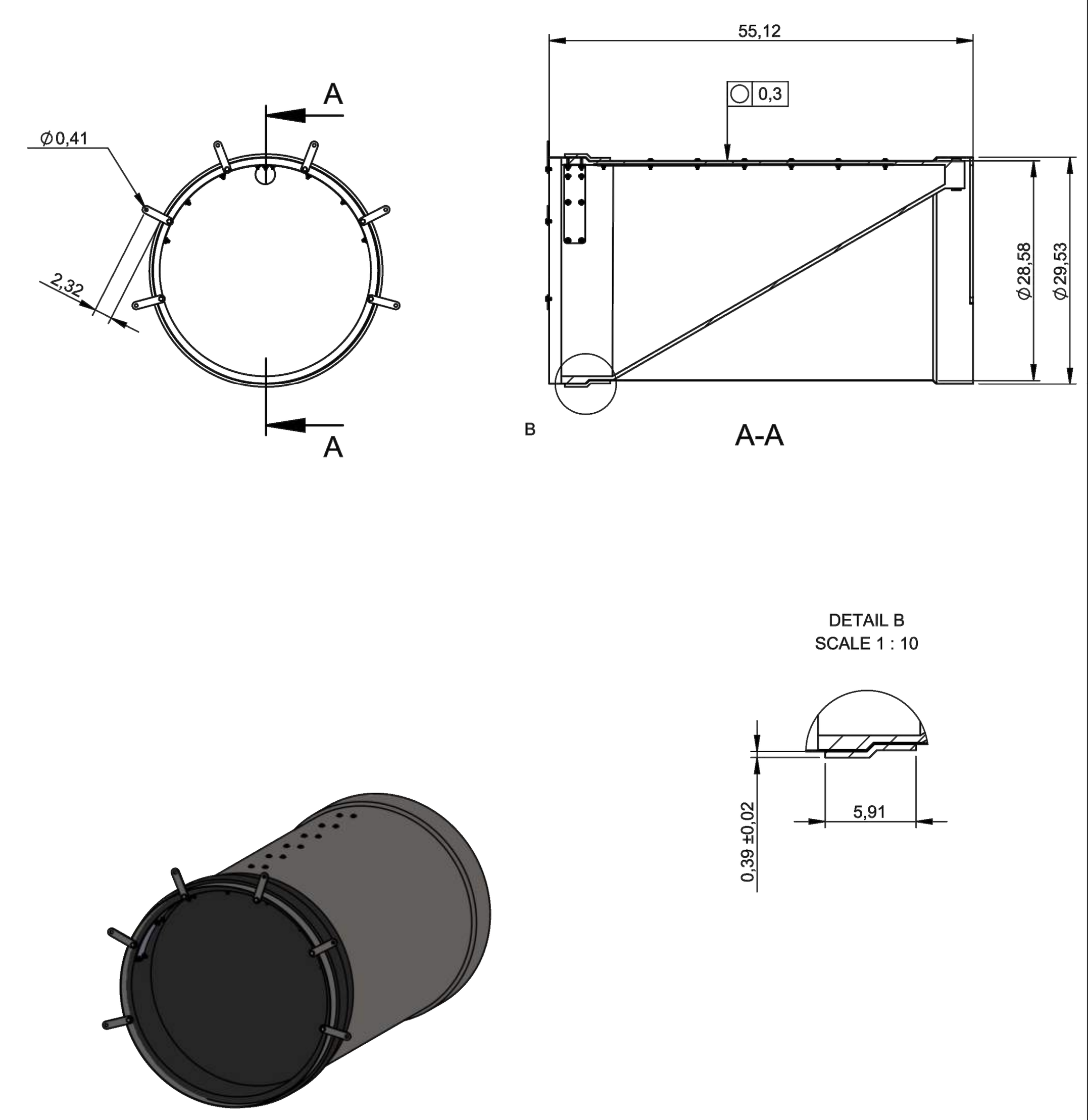
In the submerged case opening pressure [mmH2O /inH2O] is the difference between the water level upstream and the water level downstream and in the open-air case to the invert of the pipe. In vertical applications, the vertical opening pressure is measured from the outlet of the WaStop.

Postal address
Wapro AB
Munkahusvägen 103
SE-374 31 Karlshamn
SWEDEN

Tel: +46 454 185 10
Fax: +46 454 123 38
email: wapro@wapro.se
Website: www.wapro.se

Reg.nr: 556352-1466
Registered office:
Karlshamn, Sweden
VAT nr: SE 556 352 146604

HOLDING BACK THE FLOOD



Designed By	Approved By	Created Date	Units	General Tolerance	Scale
RB	RB	2017-09-20	[inch]	SS-ISO 2768-1 m	1:20
Material: AISI 304 / AISI 316			Comments		Project Number
Weight [Lbs]: 194	Box Volume [ft³]: 28		Description: WaStop NPS 30"		
WAPRO www.wapro.com			Article Number: ws750-S	Rev: 2017-09-12	Sheet: 1 (1)

BARNES AND MEDICAL DRIVE APARTMENTS
PIPE ROUTING SUMMARY

DEVELOPED CONDITIONS

Roof Drains	Contributing Basins	Area (Acres)	Flow Q_5	Flow Q_{100}	SIZE & TYPE	OWNER
1	A2	0.05	0.2	0.4	6" HDPE	PRIVATE
2	A3	0.05	0.2	0.4	6" HDPE	PRIVATE
3|4	A4	0.17	0.6	1.2	6" HDPE	PRIVATE
5|6	A5	0.11	0.4	0.8	6" HDPE	PRIVATE
7	A6	0.06	0.2	0.4	6" HDPE	PRIVATE
8	B6	0.06	0.2	0.4	6" HDPE	PRIVATE
9|10	B7	0.13	0.5	0.9	6" HDPE	PRIVATE
11	B8	0.10	0.4	0.7	6" HDPE	PRIVATE
12	C3	0.06	0.2	0.4	6" HDPE	PRIVATE
13	C4	0.04	0.2	0.3	6" HDPE	PRIVATE
14	C5	0.06	0.2	0.4	6" HDPE	PRIVATE
15	C6	0.06	0.2	0.4	6" HDPE	PRIVATE
16	C7	0.12	0.5	0.8	6" HDPE	PRIVATE
17	C8	0.09	0.3	0.6	6" HDPE	PRIVATE
18	C9	0.09	0.3	0.6	6" HDPE	PRIVATE
20	C8	0.09	0.3	0.6	6" HDPE	PRIVATE
21	C9	0.07	0.3	0.5	6" HDPE	PRIVATE
19	B11	0.05	0.2	0.4	6" HDPE	PRIVATE
20	B12	0.05	0.2	0.4	6" HDPE	PRIVATE
21|22	B13	0.11	0.4	0.8	6" HDPE	PRIVATE
23|24	B14	0.12	0.5	0.8	6" HDPE	PRIVATE
25	B15	0.05	0.2	0.4	6" HDPE	PRIVATE
26	B15	0.05	0.2	0.4	6" HDPE	PRIVATE
27	B16	0.04	0.2	0.3	6" HDPE	PRIVATE
28|29	B17	0.11	0.4	0.8	6" HDPE	PRIVATE
30	B18	0.11	0.4	0.8	6" HDPE	PRIVATE
31	B18	0.11	0.4	0.8	6" HDPE	PRIVATE
32	B19	0.07	0.3	0.5	6" HDPE	PRIVATE
33	B20	0.07	0.3	0.5	6" HDPE	PRIVATE

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BARNES AND MEDICAL DRIVE APARTMENTS
PIPE ROUTING SUMMARY

DEVELOPED CONDITIONS

Pipe Run(s)	Contributing Design Points/Basins	Area (Acres)	Equivalent CA_5	Equivalent CA_{100}	Maximum T_C	Intensity I_5	Intensity I_{100}	Flow Q_5	Flow Q_{100}	SIZE & TYPE	OWNER
1	Pond West Outlet	3.17						0.0	2.0	15" HDPE	PRIVATE
2	Pond Middle Outlet	5.29						0.1	3.5	15" HDPE	PRIVATE
3	PR1 & PR2	8.46						0.1	5.5	18" HDPE	PRIVATE
4	Pond East Outlet	2.76						0.0	1.8	15" HDPE	PRIVATE
5A	A1	0.22	0.91	1.30	11.2	4.0	6.7	3.6	8.7	21" RCP	PRIVATE
5B	A1	0.22	0.91	1.30	11.2	4.0	6.7	3.6	8.7	21" RCP	PRIVATE
6	DP4 & PR7 & PR8	4.39	2.13	3.81	9.0	4.3	7.2	9.2	27.5	30" RCP	PRIVATE
7	DP5	0.27	0.11	0.16	5.0	5.2	8.7	0.6	1.4	12" HDPE	PRIVATE
8	DP3 & PR9	3.59	1.73	3.28	9.0	4.3	7.2	7.4	23.6	30" RCP	PRIVATE
9	DP6 & PR11	2.45	1.15	2.47	8.4	4.4	7.4	5.0	18.2	24" RCP	PRIVATE
10	PR11& PARTIAL DP6							3.7	11.9	24 " RCP	PRIVATE
11	PR12 & PR13	1.67	0.65	0.95	8.4	4.4	7.4	2.9	7.0	18" HDPE	PRIVATE
12	DP-7	0.89	0.08	0.32	8.4	4.4	7.4	0.4	2.4	12" HDPE	PRIVATE
13	PR14 & B11-B15	0.78	0.57	0.63	5.0	5.2	8.7	2.9	5.5	15" HDPE	PRIVATE
14	B16-B20	0.40	0.29	0.32	5.0	5.2	8.7	1.5	2.8	12" HDPE	PRIVATE
15	DP10	0.51	0.27	0.36	6.8	4.7	7.9	1.3	2.8	12" HDPE	PRIVATE
16	DP9	1.29	0.85	1.00	12.2	3.8	6.4	3.2	6.5	18" HDPE	PRIVATE
17	DP9 & DP10	1.74						4.5	9.3	21" HDPE	PRIVATE
18	EX 60" + Pond Outfalls							157.9	355.6	6'x4' RCB	PUBLIC
EX 60"								157.7	347.2	60" RCP	PUBLIC

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REVISIONS		
NO.	DESCRIPTION	DATE

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BARNES & MEDICAL VIEW APARTMENTS
PIPERUN SUMMARY

DESIGNED BY QNA
DRAWN BY QNA
CHECKED BY
H-SCALE AS NOTED
V-SCALE N/A
JOB NO. 1859.00
DATE ISSUED 01/27/20
SHEET NO. 4 OF 4