PHASE I DRAINAGE REPORT
FOR
STREETS AT SOUTHGLENN
6851 SOUTH VINE STREET, #200
CENTENNIAL, COLORADO

Prepared By:

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SEMSWA Case No. DPR21-00046

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INTRODUCTION

The Streets at SouthGlenn is a mixed-use center, located at the southwest corner of the intersection of East Arapahoe Road and South University Boulevard. The project was approved under a Master Development Plan (MDP) in 2007 and originally opened in the fall of 2009. This mixed-use center is extremely successful and vibrant, providing a regional community destination. The department store industry continues to face extreme pressures and the Owners' desire is to put in place a framework that encourages the market-based redevelopment of the property to further enhance the overall viability of the center.

The Sears assemblage identified as the "South Redevelopment Area" comprises 10.4 acres with the ground lease office building at the southwest corner of the property comprising 1.29 acres, for a total of 11.69 acres. The Macy's assemblage identified as the "North Redevelopment Area" comprises 8.66 acres. These two Redevelopment Areas will comprise the anticipated disturbed area under the scope of this Amendment and will be developed independent of each other and in phases as markets dictate.

The Owners of the two Redevelopment Areas desire to amend the Master Development Plan ("MDP") to accommodate and encourage the re-positioning of the existing department store boxes that have ceased to operate or that are likely to cease operating in the near future. The requested modifications to the MDP will change the number of residential units allowed, revise the minimum retail square footage requirements and modify the allowable height on the Redevelopment Areas.

- The MDP Amendment requests 550 additional residential units on the South Redevelopment Area and 575 residential units on the remainder of the property. Considering that 350 residential units were entitled on the overall site in the original MDP, this request adds a net 225 residential units to the approved entitlements stated in the original MDP in addition to the South Redevelopment Parcel request.
- The MDP Amendment also requests a modification to the minimum retail square feet required to 645,000 square feet.
- The MDP Amendment also requests a change in the allowable height to seventy-five feet for the North Redevelopment Area and the South Redevelopment Area.

I. GENERAL LOCATION AND DESCRIPTION

A. Site Location

1. This Phase I Drainage Report is being prepared for Streets at SouthGlenn, located at the southwest corner of East Arapahoe Road and South University Boulevard. See Appendix for the vicinity map.
2. A parcel of land located in the northeast one-quarter of Section 26, Township 5 South, Range 68 West of the 6th principal meridian.
3. The project is within the City of Centennial and Arapahoe County at the southwest

corner of the intersection of University Boulevard (100' ROW) and Arapahoe Road (100' ROW). Race Street (60' ROW) and Easter Ave (80' ROW) boarder the site on the west and south sides, respectively.

4. Developments surrounding the project include the Cherry Knolls Shopping Center commercial development and the Knolls Townhouse Association residential development to the east; the Glenn Oaks Homeowner's Association and other residential development to the south; a church, and residential development including apartments to the west; residential development to the northwest; and commercial development to the northeast.

B. Description of Property

1. The Streets at SouthGlenn is a total of 72.148-acres. This includes the entire block between East Arapahoe Road, East Easter Avenue, South Race Street and South University Boulevard, excluding the existing southeast parcel with an existing office building. This MDP Amendment is for the inclusion of the southwest parcel, Lot 2, Block 2 Filing 2 into the Master Plan and to create north and south redevelopment areas. The south redevelopment area is 11.69-acres and the north redevelopment area is 8.66-acres. The current zoning is Mixed Use – Planned Unit Development and will remain as is.
2. The existing ground cover is mostly impervious, consisting mainly of roof areas, asphalt and concrete parking and sidewalk areas. There is existing landscape scattered throughout the development with a park in the middle and tree lawns along the perimeter streets.
3. See Appendix for NRSC Soil Map and Survey. The site is mainly comprised of two soils: FdB, which is a fondis silt loam belonging to soil group C, FdC, which is a fondis silt loam belonging to hydrologic soil group C.
4. Runoff from the project site is tributary to two major drainageways. The west side of the site is tributary to Upper Slaughterhouse Gulch. The east side of the site is tributary to Big Dry Creek.
5. There are no floodplains that affect this site. See Appendix for the FEMA FIRM Panels.
6. There are no irrigation canals or ditches on site.
7. There are no significant geologic features on this site.
8. The site is an existing mixed-use development that is pedestrian oriented and includes retail, office, entertainment and multi-family. This MDP Amendment No. 8 creates two redevelopment areas: north and south. The south redevelopment area includes the old Sears building, parking area south of the Sears building and existing office building in the southwest corner of the site and is a total of 11.69-acres. The north redevelopment area includes the Macy's building and the parking area

between the building and East Arapahoe Road and is a total of 8.66-acres. See Appendix for MDP site plan. The maximum residential units have been increased, the minimum retail square footage has been reduced, setbacks along East Easter Avenue and South Race Street have been revised, building heights for south and north redevelopment areas have been revised and an open space commitment has been added for the south redevelopment area. The south redevelopment area is has agreed to provide a minimum of 25,000 square feet of contiguous public open space, passive recreation, common public squares or green areas on Lot 2, Block 1, Filing No. 3.

9. A Geotechnical Investigation was completed by GROUND Engineering Consultants, Inc, on November 21, 2005. Groundwater was not encountered during the subsurface exploration. Since then there were final Geotechnical Investigations completed for each block/building completed in 2007 and again, groundwater was not encountered during subsurface exploration. There has not been a more recent groundwater investigation completed.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins

1. The westerly side of the Streets at SouthGlenn drains north and west and is tributary to Upper Slaughterhouse Gulch. The "Phase B Report (Major Drainageway Planning)," dated March 1983, as prepared by WRC Engineering (Phase B Report) describes historic drainage concerns for this drainageway and includes recommendations for proposed improvements. The upper limit of the Phase B Report extends to the intersection of Downing Street and Arapahoe Road, approximately 400 feet to the west of the Streets at SouthGlenn. The report indicates that the area downstream of the Streets at SouthGlenn, along Downing Street to the Highline Canal, experiences flooding because the existing storm sewer system is inadequate for 2-year storm events. Reportedly the 15-inch storm sewer in Downing Street is connected upstream to a 24-inch and 48-inch storm sewer in Arapahoe Road. The study recommends construction of a 60-inch storm sewer system in Downing Street to convey the 5-year storm. The storm sewer is intended to discharge into a proposed regional detention pond downstream of the Highline Canal.

   In 1998 storm sewer improvements were made to the reach from Downing Street downstream to the Highline Canal. The project, "Drainage and Flood Control Improvements Upper Slaughterhouse Gulch Phase VI", consisted of installation of 54-inch diameter storm sewer consistent with the design intent of the Phase B

Report. At this time Mile High Flood District (MHFD) shows that the remaining improvements are still proposed.

2. The easterly side of the Streets at SouthGlenn property drains north and east and is tributary to Big Dry Creek. The "Phase A Report Major Drainageway Planning Alternatives for Big Dry Creek," dated June 1996, as prepared by WRC Engineering (Phase A Report) describes historic drainage concerns for this drainageway and includes recommendations for proposed improvements. The highly urbanized basin described in the Phase A Report has problems with inadequate drainage capacity of bridge structures along Big Dry Creek at the University Boulevard and Arapahoe Road crossings. The City of Centennial will be reconstructing the bridge on Arapahoe Road over Big Dry Creek in the near future and will improve the capacity concerns at the bridge crossing. According to MHFD there were improvements completed on Big Dry Creek just north of the East Arapahoe Road crossing in 2004 and maintenance for Cherry Knolls Park completed in 2013.

B. Minor Drainage Basins

1. Historically the site drains into the two major drainageways as described above. Currently, there are six basins on the site that each convey stormwater to underground facilities for both water quality and detention. The stormwater flows overland to curb and gutter and into storm sewer inlets throughout the site. The underground storm sewer infrastructure then conveys the stormwater to the one of the six underground facilities.
2. The existing land use includes retail, office, entertainment and multi-family. The south redevelopment area land use will change from retail, office and parking area to multi-family and open space with associated parking for tenants. The south redevelopment area has agreed to include a minimum of 25,000 square feet (0.57-acres) of park and/or open space that will reduce the imperviousness of the overall site. The existing percent impervious for the south redevelopment area is 80.72% and the anticipated percent impervious is 75.0%, which is for apartment development. The actual percent impervious will be determined during the design of the redevelopment area. At this time, it is anticipated that the open space will be located within Basin C. There is a portion of the site, 0.52-acres, in the southwest corner that was not previously included within the Streets at SouthGlenn, Basin G, and now will be incorporated into the infrastructure of Basin C. Currently, the area designated for the open space is mostly pervious therefore including the stormwater for Basin G into Basin C's underground infrastructure could be a trade-off. This will be further analyzed in the Phase III Drainage Reports required as the redevelopment is designed.

   The north redevelopment area land use will change from retail and parking area to

additional mixed-use development. As the north redevelopment area is designed, the existing storm sewer infrastructure will be analyzed. The existing percent impervious for this area is 82.28% and the anticipated percent impervious is 90%, which is for anticipated commercial development. The actual percent impervious will be determined during the design of the redevelopment area. There is a small portion of Basin F within this redevelopment area and instead of disrupting the parking area within basin F to modify the underground detention facility, the additional volume could be added to Basin E. This will be further analyzed in the Phase III Drainage Reports required as the redevelopment is designed.

3. Seven Basins: A, B, C, D, E, F and G.
    i. Basins A and B are 10.49-acres and 16.65-acres, respectively. Each basin is tributary to Big Dry Creek and the underground detention systems located at design points A and B. A total 10-year release of 7.48 cfs is being released from Basins A and B to the existing 18-inch storm drain at the northeast corner of the site. The existing detention outlet pipe connection is to an existing curb inlet located approximately 650-feet south of Arapahoe Road in University Boulevard. The existing 18-inch pipe has a full flow capacity of 9.10 cfs. Runoff in excess capacity of the existing pipe in University are released through inlets and manholes and discharge onto University Boulevard. In the event of a runoff event exceeding the 10-year storm, runoff is conveyed overland via the private internal street system to University Boulevard and Arapahoe Road. At the low point of Basin B in the corner of the parking lot, south of the first entrance off of University Boulevard, the 100-year overflow for Basins A and B is located. The storm water flows over the retaining wall along University Boulevard and into the street section. At this location, the retaining wall has been constructed to convey the stormwater over the wall.
        a. The portion of Basin A within the south redevelopment area is 4.06 acres. The runoff coefficients are 0.68 and 0.79 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 75%.
        b. The portion of Basin B within the north redevelopment area is 2.50 acres. The runoff coefficients are 0.79 and 0.85 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 90%.
    ii. Basin E is 1.53 acres and consists of an existing parking lot for the Macy's building and a portion of South York Street. The stormwater is captured by storm sewer inlets and conveyed to the underground water quality and detention facility. Basin E has a 10-year release of 1.00 cfs to Arapahoe Road though a curb inlet. In the event of a runoff event exceeding the 10-year

storm, runoff is conveyed overland to Arapahoe Road. At the low point for Basin E, the 100-year storm event overtops the curb and is conveyed through the screen wall onto Arapahoe Road. The screen wall was constructed to accommodate this flow through it with a weir configuration.

a. The portion of Basin E within the north redevelopment area is 1.53 acres. The runoff coefficients are 0.79 and 0.85 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 90%.

iii. Basins C and D are 34.23 and 3.65 acres, respectively. Each basin is tributary to Slaughterhouse Gulch and the underground detention systems located at design points C and D. The 10-year release is 11.35 cfs to the existing 18-inch storm drain at the northwest corner of the site. The existing 18-inch pipe has a full flow capacity of 8.64 cfs. Runoff in excess capacity of the existing pipe in Race Street and Arapahoe Road is released through inlets and manholes and discharged onto Arapahoe Road. In the event of a runoff event exceeding the 10-year storm, runoff is conveyed overland via the private internal street system to Race Street and Arapahoe Road. The 100-year storm event for half of Basin C overtops the curb along Arapahoe Road inline with the two inlets for the underground detention system. This flow overtops the retaining wall at this location. The 100-year flow for the upper half of Basin C and all of Basin D is located at the low point for Basin D along Race Street. The storm water overtops the curb and is conveyed through the screen wall and over the retaining wall. The screen was constructed with a weir configuration to accommodate the flow.

a. The portion of Basin C within the south redevelopment area is 7.11 acres. The runoff coefficients are 0.68 and 0.79 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 75%.

b. The portion of Basin C within the north redevelopment area is 4.64 acres. The runoff coefficients are 0.79 and 0.85 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 90%.

iv. Basin F is 3.53 acres. The area is tributary to the existing underground detention system located at design point F. The basin has a total 10-year release of 1.06 cfs. The 10-year release from the detention facility is conveyed to the east side of the site in University Boulevard, into the existing storm system. When a runoff event exceeds the 10-year storm runoff is conveyed overland via the private internal street system to University Boulevard and Arapahoe Road.

a. The portion of Basin F within the north redevelopment area is 0.11 acres. The runoff coefficients are 0.79 and 0.85 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 90%.

v. Basin G is 0.52 acres and consists of an existing office building, landscape area and some parking area. Based on the south redevelopment concept this basin has a 75% impervious value per MHFD Table 6-3. Currently, this basin conveys stormwater to Race Street and Easter Avenue. In the proposed condition the stormwater from this basin will be captured on-site and conveyed to Basin C underground infrastructure. The approximate 10-year detention volume for Basin G is 0.042 acre-feet, see detention basin spreadsheet in the appendix. The required 10-year detention volume for Basin C is 2.68 acre-feet and based on the pond volume certification the existing volume of Basin C is 2.72 acre-feet. Therefore, adding Basin G will bring the required 10-year detention volume of Basin C to 2.72 acre-feet. Based on this preliminary analysis, Basin C will be able to accept the proposed flow from Basin G in the existing configuration. The additional volume for the 100-year storm event is discussed in the storage facilities section below.

a. The portion of Basin G within the south redevelopment area is 0.52 acres. The runoff coefficients are 0.68 and 0.79 for the minor 10-year and major 100-year storm events, respectively. The overall percent impervious is 75%.

III. EXISTING STORMWATER CONVEYANCE OR STORAGE FACILITIES

A. Existing Stormwater Conveyance Facilities

1. The north and south redevelopment areas are located within six basins: A, B, C, E, F and G. The south redevelopment area will impact basins A and C conveyance systems and include Basin G. The north redevelopment area will impact basins B, C, E and F conveyance systems. The storm sewer infrastructure will be modified as necessary to provide proper drainage from the developed site to the nearest storm sewer inlet. When the redevelopment areas are designed, all modifications will be shown and designed to convey the 100-year storm event.
2. As the redevelopment areas are designed, the existing conveyance systems that will be utilized will be evaluated to ensure capacity of the anticipated flow. The existing systems will be modified as needed to accommodate the stormwater.
3. Pending full design of the redevelopment areas, will determine which of the conveyance systems will be reconstructed, shifted and/or abandoned.

B. Existing Stormwater Storage Facilities

1. The north and south redevelopment areas are located within six basins: A, B, C, E, F and G. The south redevelopment area will utilize the underground storage facilities A and C. The north redevelopment area will utilize underground storage facilities B, C, E and F. The stormwater from each area shall be routed to the same basin it is currently conveyed to for water quality and detention volume purposes. The ADS water quality units intercept and treat a first flush of runoff pollutants. These units have shown to remove concentrations of contaminated particles and hydrocarbons for storm water runoff. Laboratory tests have shown an 80% TSS removal rate. Floatable debris such as oils and greases are also intercepted prior to discharging into the underground detention facilities. The existing StormTech detention systems provide storm water detention and a secondary line of defense for TSS removal. Each system utilizes an isolator rows within the system which basically creates an extended detention basin that allows water to egress through surrounding fabric while sediment is trapped within.
2. The underground detention facilities within the basins of the redevelopment areas will be modified due to providing the 100-year detention volumes. It is anticipated that the underground detention facilities within basins A, B, C and E will be expanded to account for the 100-year detention volume that is attributed to the redeveloped areas.
3. It is not anticipated to modify the existing water quality units for this site. However, it is anticipated to potentially modify four of the underground detention facilities; A, B, C and E. These facilities may be expanded as necessary to accommodate the 100-year volume from the redevelopment areas.

IV. PROPOSED STORMWATER CONVEYANCE OR STORAGE FACILITIES

A. Proposed Stormwater Conveyance Facilities

1. As the redevelopment areas are designed and analyzed for grading and drainage, additional conveyance systems are likely to be required. The proposed systems will be analyzed for capacity and designed with the intent of conveying the stormwater towards the existing underground facilities within each basin.
2. There is no off-site runoff that is conveyed through this site.
3. A Drainage Map (DM) can be found in the Appendix. The DM shows the entire Streets at SouthGlenn, with the six basins and associated underground facilities. The north and south redevelopment areas are shaded to show the limits. The basin information is based on the existing conditions of the site today. A Soils Report is

located in the Appendix. The site is located within two FEMA FIRM Panels, which can both be found in the Appendix.

4. Based on discussions with SEMSWA, there are known minor flooding concerns within East Arapahoe Road and South University Boulevard during storm events. As the redeveloped areas are designed, attention will be given to the minor flooding concerns. The south redevelopment area will decrease the percent imperviousness of the area and therefore decreasing the runoff coming from the site which will improve the situation.
5. There are no anticipated improvements to the major drainageways that this site conveys stormwater to.
6. There is an existing Operations and Maintenance Manual (O&M) for the on-site underground water quality units and detention facilities. The O&M requires continued inspections and maintenance of all underground facilities. Refer to the O&M for procedures for inspection and maintenance.

B. Proposed Stormwater Storage Facilities

1. The north and south redevelopment areas are required to provide the 100-year detention volume. Currently, the 10-year detention volume is provided on-site within the existing underground StormTech detention facilities. Therefore, the difference between the 10-year and 100-year detention volumes will be required to be detained on-site prior to releasing to the major drainage basins. This shall be achieved by either above ground detention facilities meeting SEMSWA standards and regulations or by modifying the existing underground StormTech facilities. There are four existing underground facilities that will potentially be affected if it is chosen to modify them during the specific designs of the redevelopment areas; A, B, C and D. Based on the anticipated percent impervious of 75% and 90% for the south and north redevelopment areas, respectively, additional detention volumes were calculated. The anticipated additional volumes required to meet the 100-year detention requirement for the redevelopment areas are Basin A (south): 0.127 acre-feet, Basin C (south): 0.222 acre-feet, Basin G (south): 0.016 acre-feet, Basin B (north): 0.082 acre-feet, Basin C (north): 0.151 acre-feet, Basin E (north): 0.05 acre-feet and Basin F (north): 0.003 acre-feet. In the Appendix are the UD-Detention Basin sheets for reference.
2. The Streets at SouthGlenn's existing underground StormTech facilities provide water quality capture volume and detention volume for the 10-year storm event. Currently, the 100-year storm is conveyed overland to the outlet points for each basin. For each of the redevelopment areas, the 100-year detention volume will be required to be captured on-site. This shall be achieved by either above ground detention facilities meeting SEMSWA standards and regulations or by modifying the

existing underground StormTech facilities. During specific design of the redevelopment areas will determine the method for achieving this detention volume on-site.

3. If above ground detention facilities are incorporated into the design of the redevelopment areas then the maintenance and access shall be standard per SEMSWA's regulations. However, if the underground StormTech facilities are expanded to account for the additional volume then they will be required to be maintained similarly to the existing systems. The isolator rows shall be inspected and cleaned as necessary.

V. WATER QUALITY ENHANCEMENT BEST MANAMGEMENT PRACTICES

A. Non-Structural BMPs

1. Within the south redevelopment area, there is a stipulation on the MDP Amendment for a minimum of 25,000 square feet to be provided as contiguous public open space, passive recreation, common public squares or green areas. This stipulation was included in this MDP Amendment at the direction of the developer to increase common open space for the community. Currently, there is very little pervious area within the south redevelopment, this will provide reduced runoff within the existing basin C. Where possible, within the redevelopment areas, there will be measures put in place that will minimized directly connected impervious areas (MDCIA).

B. Structural BMPs

1. The existing water quality units intercept and treat a first flush of runoff pollutants. These units have shown to remove concentrations of contaminated particles and hydrocarbons for stormwater runoff. Laboratory tests have shown an 80% TSS removal rate. Floatable debris such as oils and greases are also intercepted prior to discharging into underground detention facilities. The proposed detention systems provide stormwater detention and a secondary line of defense for TSS removal. Each system utilizes an Isolator Row within the system which basically creates an extended detention basin that allows water to egress through surrounding fabric while sediment is trapped within. The existing systems are sized to accommodate the north and south redevelopment areas for water quality capture volume (WQCV) if the stormwater is conveyed to these existing systems. If, during the specific designs of the redevelopment areas, a different conveyance path or detention facility is chosen then the WQCV will be required to be analyzed and included in the proposed design.

During the first 3 quarters of 2021, all of the existing water quality units and isolator rows were inspected and cleaned by the SouthGlenn Metropolitan District. This included videoing the systems, jet vacuuming the debris and sediment out and finally videoing again to assure the systems were in fact cleaned. All of this information is currently being processed and will be submitted to SEMSWA. All of the systems have recently been inspected and cleaned.

2. The SouthGlenn Metropolitan District monitors the performance of each drainage facility and performs facility maintenance based on an inspection schedule and detailed product maintenance procedures provided in the O&M Manual.

C. Source Controls

1. Site operations that could potentially impact stormwater quality include oil leaking from vehicles, grass clippings clogging the inlets and removal of vegetation, use of fertilizer and vehicle maintenance are a few.
2. Site activities that can prevent or manage source controls include covering outdoor storage and handling areas, storm sewer system cleaning, landscape management to control clippings and fertilizer and street sweeping.

VI. FLOODPLAIN

A. Major Drainageway – Undesignated Floodplain

1. This site lies within Flood Zone X as seen in FEMA FIRM Maps No. 08005C0452K dated December 17, 2010 and No. 08005C0454K dated December 17, 2010.

VII. POTENTIAL PERMITTING REQUIREMENTS

Permits required for this site include a site construction, building permit, GESC permit, Stormwater Public Improvement Permit and State stormwater permit. No Section 404 permit is required. No endangered species are located within the site limits. A floodplain development permit is not required as no development near the floodplain is anticipated.

VIII. REFERENCES

Soil Survey of Arapahoe County, Colorado, United States Department of Agriculture, Washington, DC, 2006.

Mile High Flood District, Denver, Colorado, *Urban Storm Drainage Criteria Manual, Volumes 1(updated 2018), 2 (updated 2017) & 3 (updated November 2019).*

FEMA Flood Maps, msc.fema.gov

SEMSWA Stormwater Management Manual, Updated January 2017, Chapter 14 (updated 2019)

"Phase B Report (Major Drainageway Planning)," prepared by WRC Engineering, dated March 1983.

"Phase A Report Major Drainageway Planning Alternatives for Big Dry Creek," dated June 1996, as prepared by WRC Engineering

APPENDIX

VICINITY MAP

1" = 2,000'

NORTH

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO

LEGAL DESCRIPTION:

LOTS 5, 6, 8 & 13, BLOCK 1, STREETS AT SOUTHGLENN FILING NO. 1 RECORDED AT RECEPTION NO. B7076397;

LOTS 2 & 3, BLOCK 1 & TRACT C, STREETS AT SOUTHGLENN FILING NO. 2 RECORDED AT RECEPTION NO. B7126582;

LOT 1, BLOCK 1, STREETS AT SOUTHGLENN FILING NO. 3 RECORDED AT RECEPTION NO. B7126585;

LOTS 2, 6 & 8, BLOCK 1, STREETS AT SOUTHGLENN FILING NO. 4 RECORDED AT RECEPTION NO. B7126586;

LOTS 1, 2, 3, 4, 5, BLOCK 1 & TRACT A, STREETS AT SOUTHGLENN FILING NO. 5 RECORDED AT RECEPTION NO. B7126589;

LOTS 1 & 2, BLOCK 1 & TRACT C, STREETS AT SOUTHGLENN FILING NO. 6 RECORDED AT RECEPTION NO. B8049432;

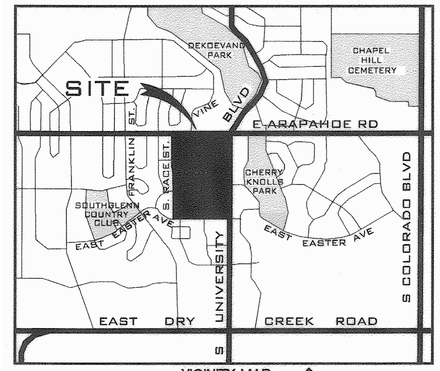
LOTS 1 & 2, BLOCK 1, STREETS AT SOUTHGLENN FILING NO. 7 RECORDED AT RECEPTION NO. D1091834;

COUNTY OF ARAPAHOE,

STATE OF COLORADO.

3,142,762 SQUARE FEET OR 72.148 ACRES ±

SHEET INDEX:



VICINITY MAP
1" = 2000'
NORTH

CERTIFICATE OF OWNERSHIP

SOUTHGLENN PROPERTY HOLDINGS, LLC,
A DELAWARE LIMITED LIABILITY COMPANY

BY: AW SOUTHGLENN SENIOR MEZZ, LLC,
A DELAWARE LIMITED LIABILITY COMPANY,
ITS MANAGER

BY: PCCP CS II SG COLORADO FUNDING, LLC,
A DELAWARE LIMITED LIABILITY COMPANY,
ITS MANAGING MEMBER

BY: PACIFICCAL II, LLC,
A DELAWARE LIMITED LIABILITY COMPANY,
ITS SOLE MEMBER

BY: PCCP CS HOLDINGS II, LLC,
A DELAWARE LIMITED LIABILITY COMPANY,
ITS MANAGER

BY: _____
NAME: _____
TITLE: _____

A NOTARY PUBLIC OR OTHER OFFICER COMPLETING THIS CERTIFICATE VERIFIES ONLY THE IDENTITY OF THE INDIVIDUAL WHO SIGNED THE DOCUMENT TO WHICH THIS CERTIFICATE IS ATTACHED, AND NOT THE TRUTHFULNESS, ACCURACY, OR VALIDITY OF THAT DOCUMENT.

STATE OF CALIFORNIA)
COUNTY OF_____)

ON _____, 20___, BEFORE ME, _____,
NOTARY PUBLIC, PERSONALLY APPEARED _____,
WHO PROVED TO ME ON THE BASIS OF SATISFACTORY EVIDENCE TO BE THE PERSON WHOSE NAME IS SUBSCRIBED TO THE WITHIN INSTRUMENT AND ACKNOWLEDGED TO ME THAT HE/SHE EXECUTED THE SAME IN HIS/HER AUTHORIZED CAPACITY, AND THAT BY HIS/HER SIGNATURE ON THE INSTRUMENT THE PERSON, OR THE ENTITY UPON BEHALF OF WHICH THE PERSON ACTED, EXECUTED THE INSTRUMENT.

I CERTIFY UNDER PENALTY OF PERJURY UNDER THE LAWS OF THE STATE OF CALIFORNIA THAT THE FOREGOING PARAGRAPH IS TRUE AND CORRECT.

WITNESS MY HAND AND OFFICIAL SEAL.

SIGNATURE _____

NOTARY SEAL

CERTIFICATE OF OWNERSHIP

SOUTHGLENN AFFILIATED HOLDINGS, LLC,
A DELAWARE LIMITED LIABILITY COMPANY

BY: _____
NAME: _____
TITLE: _____

A NOTARY PUBLIC OR OTHER OFFICER COMPLETING THIS CERTIFICATE VERIFIES ONLY THE IDENTITY OF THE INDIVIDUAL WHO SIGNED THE DOCUMENT TO WHICH THIS CERTIFICATE IS ATTACHED, AND NOT THE TRUTHFULNESS, ACCURACY, OR VALIDITY OF THAT DOCUMENT.

STATE OF CALIFORNIA)
COUNTY OF_____)

ON _____, 20___, BEFORE ME, _____,
NOTARY PUBLIC, PERSONALLY APPEARED _____,
WHO PROVED TO ME ON THE BASIS OF SATISFACTORY EVIDENCE TO BE THE PERSON WHOSE NAME IS SUBSCRIBED TO THE WITHIN INSTRUMENT AND ACKNOWLEDGED TO ME THAT HE/SHE EXECUTED THE SAME IN HIS/HER AUTHORIZED CAPACITY, AND THAT BY HIS/HER SIGNATURE ON THE INSTRUMENT THE PERSON, OR THE ENTITY UPON BEHALF OF WHICH THE PERSON ACTED, EXECUTED THE INSTRUMENT.

I CERTIFY UNDER PENALTY OF PERJURY UNDER THE LAWS OF THE STATE OF CALIFORNIA THAT THE FOREGOING PARAGRAPH IS TRUE AND CORRECT.

WITNESS MY HAND AND OFFICIAL SEAL.

SIGNATURE _____

NOTARY SEAL

CERTIFICATE OF OWNERSHIP

_____
OWNER OF RECORD OR AUTHORIZED AGENT
NW CENTENNIAL LLC

STATE OF _____

COUNTY OF _____

THE FOREGOING INSTRUCMENT WAS ACKNOWLEDGED BEFORE ME
THIS __ DAY OF_____, 2019 BY_____ AS _____
AUTHORIZED SIGNATORY

BY _____
NOTARY PUBLIC

MY COMMISSION EXPIRES _____

_____
ADDRESS

_____
CITY STATE ZIP

_____
CITY STATE ZIP

CERTIFICATE OF OWNERSHIP

I _____, AS _____OF NW CENTENNIAL LLC, A DELAWARE LIMITED LIABILITY COMPANY, HEREBY AFFIRM THAT NW CENTENNIAL LLC, A DELAWARE LIMITED LIABILITY COMPANY, IS THE OWNER OF REAL PROPERTY LEGALLY DESCRIBED AS LOT 2, BLOCK 1, STREETS AT SOUTHGLENN FILING NO. 2, AND LOT 1, BLOCK 1, STREETS AT SOUTHGLENN FILING NO. 3, COUNTY OF ARAPAHOE, STATE OF COLORADO.

NW CENTENNIAL LLC,
A DELAWARE LIMITED LIABILITY COMPANY

BY:_____
NAME:_____
TITLE:_____

THIS STREETS AT SOUTHGLENN MASTER DEVELOPMENT PLAN AMENDMENT NO. 8 WAS ACKNOWLEDGED BEFORE ME THIS ___ DAY OF _____, 2020, BY _____, AS _____ OF NW CENTENNIAL LLC, A DELAWARE LIMITED LIABILITY COMPANY.

RECORDER'S CERTIFICATE

THIS PLAN WAS FILED FOR RECORD IN THE OFFICE OF THE COUNTY CLERK AND RECORDER OF ARAPAHOE COUNTY AT___ (AM/PM) ON THE ____ DAY OF _____ A.D., 2019.

BOOK _____ PAGES_____ MAP _____ RECEPTION NO. _____

ARAPAHOE COUNTY CLERK AND RECORDER

_____

BY: _____
DEPUTY

PLANNING AND ZONING COMMISSION RECOMMENDATION

RECOMMENDED BY THE CITY OF CENTENNIAL PLANNING AND ZONING COMMISSION ON THIS ___ DAY OF _____ A.D., 20___.
CHAIRPERSON: _____
ATTEST: _____

CITY COUNCIL APPROVAL

APPROVED BY THE CITY OF CENTENNIAL CITY COUNCIL ON THIS ___ DAY OF _____ A.D., 2019.

MAYOR: _____

ATTEST: _____

DEVELOPMENT TEAM:

DEVELOPER
ALBERTA DEVELOPMENT PARTNERS, LLC
5460 S. QUEBEC ST. STE 100
GREENWOOD VILLAGE, CO 80111
303.771.4004
CONTACT: DON PROVOST

DEVELOPER
NORTHWOOD RAVIN
3015 CARRINGTON MILL BLVD
MORRISVILLE, NC 27560
919.354.3692
CONTACT: KYLE WHITAKER

ARCHITECT
FARNSWORTH GROUP, INC
5613 DTC PKWY SUITE 1100
GREENWOOD VILLAGE, CO 80111
303.692.8838
CONTACT: BRUCE MCLENNAN

ARCHITECT
DAVIS PARTNERSHIP ARCHITECTS
2901 BLAKE ST #100
DENVER, CO 80205
303.861.8555

CIVIL ENGINEER
POINT CONSULTING, LLC
8460 W. KEN CARYL AVE, #101
LITTLETON, CO 80128
720.258.6836
CONTACT: TIFFANY WATSON

AMENDMENT NO. 1
- REVISED TENANT SIGNAGE CRITERIA. CURRENT CRITERIA DATE IS MAY 1, 2007. (SEPARATE DOCUMENT)

AMENDMENT NO. 2 (LU-0708-004)
- REVISED STRUCTURE DATA TABLE
- MOVED BANK FROM S. UNIVERSITY BLVD. TO E. ARAPAHOE RD.
- ELIMINATED BUILDING AT NORTHEAST CORNER OF S. YORK ST. AND E. ARAPAHOE RD,
- ELIMINATED BUILDINGS AT NORTHEAST CORNER OF S. YORK ST. AT E. COMMONS DR.

AMENDMENT NO. 3 (LU-0710-001)
- REVISED BUILDING SETBACK ALONG RACE ST. FROM 25 FEET TO 20 FEET ALONG RACE ST. FOR THE PARKING STRUCTURE TO ACCOMMODATE THE WIDTH OF PARKING GARAGE AND MAINTAIN WIDTH OF LANDSCAPING ON EAST SIDE OF STRUCTURE
- CORRECTED MDP OVERALL SITE AREA

AMENDMENT NO. 4 (LU-0710-002)
INCLUSION TO THE MASTER DEVELOPMENT PLAN FOR THE STREETS AT SOUTHGLENN OF LOTS 1 AND 2, TRACTS A, B, AND C STREETS AT SOUTHGLENN FILINGNO. 6, LOCATED AT THE SOUTHWEST CORNER OF THE INTERSECTION OF S. UNIVERSITY BOULEVARD AND E. ARAPAHOE ROAD, WITH DEVELOPMENT AS DEPICTED ON SHEET 3. SAID LOT BEING CONCURRENTLY REPLATTED AS STREETS AT SOUTHGLENN FILING NO. 6
- REZONING OF THE INCLUDED LOT FROM "B-3" AND "O" TO MU-PUD IN ACCORDANCE WITH TERMS AND CONDITIONS OF THE SOUTHGLENN MASTER DEVELOPMENT PLAN (LU-0512-001)

REVISIONS TO SHEET 2:
1. REVISED ALLOWABLE USES FOR 24 HOUR FITNESS CLUB
2. REVISED TOTAL SITE AREA UNDER GROSS FLOOR HEADING FOR INCLUDED LOT
3. ADDED SETBACKS FROM S. UNIVERSITY BOULEVARD AND E. ARAPAHOE ROAD FOR BUILDINGS F, W1,W2, AND W3.
4. ADDED BUILDING HEIGHT LIMITATIONS FOR INCLUDED LOT
5. DELETED DRAINAGE MASTER PLAN NOTE
6. REVISED BUILDING HEIGHT TO REFLECT CURRENT PLATTED LOTTING AND INCLUDED LOT.

REVISIONS TO SHEETS 3, 4, AND 6
1. ADDED SITE PLAN FOR INCLUDED WELLS FARGO LOT

REVISION TO SHEET 7
1. REVISED LOTTING TO REFLECT PLATTING SUBSEQUENT TO INITIAL STREETS AT SOUTHGLENN FILING NO. 1 PLAT

AMENDMENT NO. 5 (LU-0812-007)
- REVISION TO SHEET 3
  - REVISED SITE LIGHTING CRITERIA TO ALLOW LIGHT LEVELS TO EXCEED 0.5 FOOT-CANDLES AT SITE PERIMETER ALONG EAST ARAPAHOE ROAD AND SOUTH UNIVERSITY BOULEVARD

REVISION TO SHEET 3
REVISED SITE LIGHTING PLAN PER CURRENT FICTURES AND ADDED PHOTOMETRIC VALUES

REVISION TO SHEET 4 AND 5
REVISED LIGHTING DETAILS PER CURRENT FIXTURES

AMENDMENT NO. 6 (LU-0908-001)
- GENERAL: CHANGE DATES ON ALL PAGES INCLUDING COVER. PAGE RENUMBERING.
- PAGE A,B: REVISE AMENDMENT HISTORY
- PAGE 0.1: REVISE TABLE OF CONTENTS
- PAGE 0.4: REVISE MAP
- PAGE 0.5: REVISE LANDLORD ADDRESS AND CONTACT INFORMATION
- PAGE 1.1: REMOVE REFERENCES TO SECONDARY MONUMENTS
- PAGE 2.1, 2.2, 3.1, 4.1, 5.1: ADD THE "ILLUMINATED GRAPHIC DISPLAY PANEL" TYPE TO THE SIGN MATRIX
- PAGE 2.9, 2.10, 4.8: RECOMMENDED SIGN TYPES, REVISE BLADE SIGN LANGUAGE TO REMOVE LIGHTING REQUIREMENT.
- PAGE 2.12, 3.8, 4.10, 5.9: PROHIBITED SIGN TYPES, REVISE ITEM 13 TO READ "SIGNS WITH ANIMATED COMPONENTS OR FLASHING LIGHTS EXCEPT THOSE THAT ARE NOT VISIBLE FROM THE PUBLIC ROW."
- PAGE 6.1: REVISE QUANTITY OF POSTERS ALLOWED FROM 8 TO 12
- PAGE 8.0, 8.1, 8.2: NEW PAGES CONTAINING KIOSK CRITERIA
- PAGE 9.0, 9.1: NEW PAGES CONTAINING ILLUMINATED GRAPHIC PANEL CRITERIA

AMENDMENT NO. 7 (LU-10-00106)
- GENERAL: CHANGE DATES ON ALL PAGES INCLUDING COVER
- PAGE A, B: REVISE AMENDMENT HISTORY; ADD NEW PAGE C
- PAGE 4.1: ADD ILLUMINATED IDENTIFICATION DISPLAY IN HIGH VISIBILITY SIGN CRITERIA CHART UNDER AUXILIARY SIGNS
- PAGE 4.5: ADD ILLUMINATED IDENTIFICATION DISPLAY DESCRIPTION UNDER AUXILIARY SIGNS

AMENDMENT NO. 8
INCLUSION AND REZONING FROM AC OF LOT 2 BLOCK 1, STREETS AT SOUTHGLENN SUBDIVISION FILING 2 INTO THE MASTER DEVELOPMENT PLAN CREATED NORTH AND SOUTH REDEVELOPMENT AREAS
REVISIONS TO SHEET 2

- ACCESS SPACING CHANGE/VARIANCE
- REVISED MAXIMUM RESIDENTIAL UNITS ALLOWED
- REVISED MINIMUM RETAIL SF THRESHOLD
- REVISED HEIGHTS ON NORTH AND SOUTH REDEVELOPMENT AREAS
- CREATED OPEN SPACE COMMITMENT ON SOUTH REDEVELOPMENT AREA
- COMMERCIAL RADIO SERVICE FACILITIES REGULATED BY CMRS STANDARDS

Case Number (PUD-21-00004)

Farnsworth
GROUP
5613 DTC PARKWAY, SUITE 1100
GREENWOOD VILLAGE, COLORADO 80111
(303) 692-8838 / info@f-w.com
www.f-w.com
Engineers | Architects | Surveyors | Scientists

ISSUE:

#	DATE:	DESCRIPTION:

PROJECT:
Alberta Development Partners, LLC

Southglenn MDP

DATE:	09/17/2021
DESIGNED:	BM
DRAWN:	SM
REVIEWED:	BN
FIELD BOOK NO.:	

SHEET TITLE:
COVER SHEET

SHEET NUMBER:
1 OF 16

PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO

VESTING

APPROVAL OF THIS MASTER DEVELOPMENT PLAN (MDP) CREATES A VESTED PROPERTY RIGHT SUBJECT TO ALL CONDITIONS OF APPROVAL PURSUANT TO COLORADO REVISED STATUTES §24-68-103. THE EFFECTIVE DATE IS JUNE 15, 2006.

STATEMENT OF INTENT

THE INTENT OF THIS MASTER DEVELOPMENT PLAN (MDP) IS TO ESTABLISH THE GENERAL GUIDELINES FOR THE REDEVELOPMENT OF SOUTHGLENN MALL INTO A MIXED USE PROJECT CONSISTING OF COMMERCIAL, RETAIL, OFFICE, AND RESIDENTIAL USES. THE MDP WILL PROVIDE THE FRAMEWORK AND CONDITIONS FOR APPROVAL OF SUBSEQUENT ADMINISTRATIVE SITE PLANS (ASP) DEPICTING SPECIFIC BUILDING ARCHITECTURE, LANDSCAPING, LIGHTING, AND SITE DESIGN DETAILS.

THE STREETS OF SOUTHGLENN IS ENVISIONED AS A REDEVELOPMENT THAT IS AN UPSCALE URBAN MIXED-USE LIFESTYLE VILLAGE DESIGNED FOR THE PEDESTRIAN. THE CHARACTER OF THE STREETS THROUGH WHICH THE VILLAGE IS EXPERIENCED IS TO BE DESIGNED WITH INTENTION TO CREATE A UNIQUE AND SOPHISTICATED ENVIRONMENT THAT IS APPEALING TO THE RESIDENTS WHO LIVE THERE AND TO ALL WHO WORK, SHOP AND ENJOY THE AMENITIES OF THE PROJECT.

IN ADDITION TO THE 35 PLAN SHEETS CONTAINED HEREIN, THE ARCHITECTURAL DESIGN GUIDELINES, DATED APRIL 12, 2006, AND THE TENANT SIGN CRITERIA, DATED MAY 1, 2007 PREPARED FOR THE STREETS AT SOUTHGLENN OR LATEST AMENDMENT THEREOF ARE CONSIDERED TO BE INTEGRAL TO AND A PART OF THE MASTER DEVELOPMENT PLAN.

PROPOSED USE:

MIXED USE - PLANNED UNIT DEVELOPMENT

USE STANDARDS

ALLOWED USES

GENERAL OFFICE USES:

GENERAL OFFICE USES INCLUDE GENERAL OFFICE SPACE THAT IS USED FOR A VARIETY OF SERVICES, INCLUDING, BUT NOT LIMITED TO:

- ADMINISTRATIVE AND EXECUTIVE OFFICES
- BANKS OR FINANCIAL INSTITUTIONS WITH OR WITHOUT DRIVE-THROUGH FACILITIES
- COLLEGES OR UNIVERSITIES
- COMMUNITY MEETING FACILITY
- CONSULTING SERVICES OFFICES (BUSINESS AND PROFESSIONAL)
- DESIGN PROFESSIONALS
- INSURANCE AND INVESTMENT OFFICES
- MEDICAL/HEALTH CARE, AND DENTAL
- NURSERY SCHOOL OR DAYCARE CENTER

COMMUNITY BUSINESS USES:

COMMUNITY BUSINESS USES INCLUDE RETAIL SALES AND SERVICES THAT MEET THE NEED OF THE COMMUNITY, INCLUDING, BUT NOT LIMITED TO THE FOLLOWING:

- APPLIANCE STORE
- AUTOMOBILE REPAIR (RESTRICTED TO EXISTING SEARS AUTOMOTIVE)
- AUTOMOBILE PARKING LOT
- BEAUTY SALON OR BARBER SHOP
- BILLIARD PARLOR OR POOL HALL
- BOOKSELLER
- BAKERIES, CATERING SERVICES, CONFECTION SHOPS ETC.
- BOWLING ALLEY, TENNIS CLUB, SKATING RINK, HEALTH CLUB, SWIM CLUB OR SIMILAR RECREATIONAL
- CONVENIENCE STORE WITH OR WITHOUT GAS PUMPS
- DEPARTMENT STORE
- DRY GOOD STORE
- ENTERTAINMENT CENTER OR AMUSEMENT ARCADE
- FITNESS CLUB
- FLOWER SHOP OR PLANT STORE
- FURNITURE STORE
- GROCERY OR MARKET
- HARDWARE SALES
- HOME OR CONSUMER ELECTRONICS STORE
- HOME FURNISHINGS OR ACCESSORIES
- KIOSK RELATED RETAIL SALES
- LAUNDRY AND DRY-CLEANING PICK-UP SERVICES (NO DRY-CLEANING PLANT)
- LIQUOR AND WINE SALES
- NIGHT CLUB, PUBS, BARS OR TAVERNS WITH OR WITHOUT LIVE ENTERTAINMENT/DANCING
- OFFICE SUPPLY STORE
- PARKING STRUCTURES OR FACILITIES
- PET STORE AND ASSOCIATED SERVICES
- PHARMACY AND DRUG STORES
- QUASI-PUBLIC AGENCIES
- REPAIR OR RENTAL SERVICES (SHOE REPAIR, BICYCLE OR SKI EQUIPMENT RENTALS, ETC)
- RESTAURANTS CAFES OR BISTROS WITH OR WITHOUT DRIVE THROUGH FACILITIES OR WITH OR WITHOUT SIDEWALK SEATING AREAS AND WITH OR WITHOUT LIQUOR SALES
- RETAIL SALES
- SCHOOLS, PRIVATE OR PUBLIC
- SECURITY, POLICE OR MANAGEMENT OFFICES
- SPORTING GOODS STORE
- STUDIOS (PHOTOGRAPHIC, DANCE, ART, RADIO/TV, ETC)
- THEATER/CINEMA
- THERAPEUTIC MASSAGE, DAY SPA OR SIMILAR HEALTH-RELATED USES
- TRANSIT STOP FACILITY
- WOMEN'S OR MEN'S APPAREL, CLOTHING, SHOE AND ACCESSORY STORES

HOTEL (LUXURY OR BUSINESS CLASS)

A LUXURY OR BUSINESS CLASS HOTEL IS A HOTEL ORIENTED TO BUSINESS TRAVELERS THAT OFFERS GUEST SERVICES AND FACILITIES, WHICH INCLUDE ANY COMBINATION OF, BUT ARE NOT LIMITED TO, CONCIERGE, VALET, SHUTTLE, RESTAURANT (OPERATED BY OR INTEGRATED WITH THE HOTEL), DRY CLEANING AND LAUNDRY, AND WHERE GUEST ROOMS ARE APPOINTED WITH UPSCALE FURNISHINGS AND AMENITIES.

Case Number (PUD-21-00004)

WIRELESS COMMUNITCATION FACILITIES

WIRELESS COMMUNICATION FACILITIES (WCFs) WITHIN THE STREETS OF SOUTHGLENN MASTER DEVELOPMENT PLAN SHALL FOLLOW THE REQUIREMENTS OF THE LAND DEVELOPMENT CODE (LDC) SECTIONS 12-2-305, 12-2-425, AND 12-14-601 AS APPLICABLE TO PLANNED UNIT DEVELOPMENTS.

PERMITTED ACCESSORY USE:

CAR WASH/AUTO DETAILING FACILITIES WILL BE ALLOWED ONLY WITHIN A PARKING STRUCTURE (ABOVE OR BELOW-GROUND) AS A SECONDARY AND INCIDENTAL USE TO THE PARKING STRUCTURE FOR THE USE OF RESIDENTIAL OWNERS OR THE SHOPPING PUBLIC. NO SUCH CAR WASH/AUTO DETAILING FACILITY, INCLUDING SIGNAGE, SHALL BE VISIBLE FROM THE PUBLIC RIGHTS-OF-WAY.

CIVIC USES:

- COMMUNITY MEETING ROOM
- LIBRARY
- POLICE SUBSTATION

RESIDENTIAL USES:

- SINGLE FAMILY ATTACHED DWELLING UNIT, APARTMENT OR CONDOMINIUM
- MULTI-FAMILY DWELLING UNIT, APARTMENT OR CONDOMINIUM
- MOTHER IN-LAW APARTMENT/DWELLING UNIT
- RESIDENCE REQUIRED FOR CARETAKER OR NIGHT WATCHMAN
- HOME OCCUPATION

TEMPORARY USES:

- SIDEWALK OR TENT SALES
- FAIR, FESTIVAL OR CARNIVAL
- FRUIT STANDS OR FARMER'S MARKET, FOOD SALES AND LIQUOR SALES
- RESIDENTIAL SALES OFFICES*
- PHARMACY SALES*
- CONSTRUCTION OFFICES*

ALL OTHER USES NOT SPECIFICALLY LISTED ABOVE SHALL BE CONSIDER AS AN ALLOWED USE IF, IN THE OPINION OF THE ZONING ADMINISTRATOR, THEY ARE SIMILAR IN CHARACTER TO PERMITTED USES IN THIS DISTRICT, AND ARE IN CONFORMANCE WITH THE INTENT OF THIS DISTRICT.

* TEMPORARY USES ASSOCIATED WITH CONSTRUCTION OF THE PROJECT SHALL BE PERMITTED IN ACCORDANCE WITH ORDINANCE NO. 2006-0-03 AND PURSUANT TO THE TERMS OF MASTER DEVELOPMENT AGREEMENT WITH THE CITY OF CENTENNIAL.

PROHIBITED USES:

- ANIMAL HOSPITAL/KENNEL
- AUTOMOBILE SERVICE STATION AND REPAIR EXCLUSIVE OF EXISTING AUTOMOTIVE SERVICE ON SEARS PROPERTY (LOT 1 AS SHOWN ON SHEET 7)
- AUTOMOBILE, TRUCK, TRAILER OR BOAT STORAGE
- AUTOMOBILE SALES AND AUTO BODY REPAIRS
- BUILDING MATERIAL SALES
- MANUFACTURING FACILITIES OR SHOPS
- MINI-STORAGE OR SELF STORAGE FACILITIES (INDOOR OR OUTDOOR)
- OUTDOOR STORAGE FACILITIES
- SEXUALLY ORIENTED BUSINESS
- SPECIAL TRADE CONTRACTORS

GROSS FLOOR AREA

TOTAL SITE AREA	72.148 AC
MAXIMUM PERMITTED NON-RESIDENTIAL DEVELOPMENT	2,000,000 SF
MAXIMUM RESIDENTIAL UNITS	1,125 UNITS (1)
MINIMUM RETAIL AREA	621,000 SF

(1) A MAXIMUM OF 550 RESIDENTIAL UNITS ARE PERMITTED ACROSS LOTS 2, BLOCK 1, FILING NO.2, LOT 3, BLOCK 1, FILING NO.3 AND LOT 4, BLOCK 1, FILING NO.3, AND A MAXIMUM OF 575 RESIDENTIAL UNITS ARE PERMITTED ACROSS ALL REMAINING LOTS INCLUDING THE 350 AUTHORIZED IN THE ORIGINAL MDP 342-33 (lu-0512-001) OF JUNE 14, 2007.

A MDP AMENDMENT WILL BE REQUIRED IF THE PROJECT CHANGES IN TERMS OF AN INCREASE IN RESIDENTIAL UNITS OR A DECREASE IN RETAIL SQUARE FOOTAGE.

ALTHOUGH RETAIL SQUARE FOOTAGE DEVELOPED ON THE SOUTH DEVELOPMENT AREA, IF ANY, COUNTS TOWARDS THE MINIMUM RETAIL AREA, THE OWNER OF THE SOUTH DEVELOPMENT AREA IS NOT OBLIGATED BY THIS MDP TO CONSTRUCT ANY RETAIL SQUARE FOOTAGE; PROVIDED, HOWEVER, THAT ANY FAILURE TO MEET THE REQUIREMENT FOR THE MINIMUM RETAIL AREA SHALL NOT REDUCE OR IN ANY WAY LIMIT THE NUMBER OF RESIDENTIAL UNITS PERMITTED WITHIN SOUTH DEVELOPMENT AREA.

SETBACKS

	OPEN PARKING SETBACK /BUTTING PUBLIC ROW	BUILDING SETBACK
A) EAST EASTER AVENUE(1)	10'	25'
B) UNIVERSITY BOULEVARD(4)	10'	25'
C) ARAPAHOE ROAD(5)	8'	25'
D) RACE STREET(2)(3)	10'	25
E) WITHIN PROPERTY	0'	0'

(1) THE BUILDING SETBACK FOR LOT 2, BLOCK 1, FILING NO.2, AND LOT 3, BLOCK 1, FILING NO.3 SHALL BE 35' ADJACENT TO E EASTER AVENUE AND FIFTEEN PERCENT (15%) OF BUILDING FRONTAGE SHALL HAVE A MINIMUM SETBACK OF 75' ADJACENT TO E EASTER AVENUE.

(2) THE BUILDING SETBACK FOR LOT 2, BLOCK 1, FILING NO.2 SHALL BE 35' ADJACENT TO S RACE STREET AND FIFTEEN PERCENT (15%) OF BUILDING FRONTAGE SHALL HAVE A MINIMUM SETBACK OF 75' ADJACENT TO S RACE STREET.

(3) THE BUILDING SETBACK FOR THE PARKING GARAGE SHALL BE 20'

(4) THE PARKING SETBACK FOR BUILDING F SHALL BE 7' ADJACENT TO S. UNIVERSITY BOULEVARD EXCEPT FOR THAT PORTION ADJACENT TO THE ROW FOR BUS SHELTER WHICH SHALL BE 0'. THE PARKING SETBACK FOR BUILDING W3 SHALL BE 7' ADJACENT TO S UNIVERSITY BOULEVARD.

(5) THE BUILDING SETBACK FOR BUILDINGS W1 AND W2 SHALL BE 15' ADJACENT TO E ARAPAHOE ROAD

BUILDING HEIGHT

NO BUILDING HEIGHTS SHALL EXCEED 100 FEET AND SHALL BE RESTRICTED TO SPECIFIC LOTS AS SHOWN ON SHEET 7 OF THE ORIGINAL MDP, CASE NO. LU-0512-001 AS FOLLOWS:

LOT 3, BLOCK 1, FILING 2 LOT 13, BLOCK 1, FILING 1 LOT 8, BLOCK 1, FILING 4 LOT 1, BLOCK 1, FILING 6 LOT 2, BLOCK 1, FILING 6 LOT 2, BLOCK 1, FILING 3 LOT 2, BLOCK 1, FILING 3	MAXIMUM BUILDING HEIGHT = 50 FEET
LOT 1, BLOCK 1, FILING 5 LOT 2, BLOCK 1, FILING 5 LOT 6, BLOCK 1, FILING 4 LOT 2, BLOCK 1, FILING 2 (1) LOT 3, BLOCK 1, FILING 3 (1) LOT 4, BLOCK 1, FILING 3	MAXIMUM BUILDING HEIGHT = 75 FEET
LOT 5, BLOCK 1, FILING 1 LOT 6, BLOCK 1, FILING 1 LOT 4, BLOCK 1, FILING 5 LOT 8, BLOCK 1, FILING 5 LOT 5, BLOCK 1, FILING 5 LOT 3, BLOCK 1, FILING 5 LOT 2, BLOCK 1, FILING 4	MAXIMUM BUILDING HEIGHT = 100 FEET

*THE PARKING STRUCTURE AND THE SIGN MARQUEE FOR THE THEATER WITHIN LOT 3 SHALL BE PERMITTED TO HAVE A MXIMUM HEIGHT OF 75 FEET

(1) ANY PORTION OF A BUILDING WITHIN 55' OF THE PUBLIC ROW ON E EASTER AVENUE AND S RACE STREET SHALL HAVE A MAXIMUM BUILDING HEIGHT OF 50'.

PARKING REQUIREMENTS

PARKING SPACES SHALL BE PROVIDED ON SITE IN ACCORDANCE WITH THE FOLLOWING MINIMUM STANDARDS:

RETAIL:	4 SPACES PER 1000 GFA (4/1000)
RESIDENTIAL:	1 SPACE PER BEDROOM
OFFICE:	3 SPACES PER 1000 GFA (3/1000)
SIT DOWN RESTAURANT:	10 SPACES PER 1000 GFA (10/1000)
ALL OTHER USES:	2 SPACES PER 1000 GFA (2/1000)

A. PARKING LOTS SHOULD BE DESIGNED TO PROVIDE FOR DROP-OFF AREAS AND CONVENIENCE LOADING AREAS, IF REQUIRED, OUTSIDE OF DRIVE LANES AND AISLES WHERE APPROPRIATE.
B. SHARED PARKING BETWEEN COMPATIBLE USES IS ENCOURAGED. A MITIGATION PLAN IS REQUIRED TO ILLUSTRATE HOW ADDITIONAL PARKING CAN BE ACCOMODATED IN THE EVENT A USE CHANGES AND THEY BECOME INCOMPATIBLE.
C. PARKING STALL SIZE SHALL BE A MINIMUM OF 8'-6" WIDE BE 18'-0" LONG. THE STALL LENGTH MAY BE REDUCED TO 16'-0" FOR THOSE STALLS OVERHANGING PERIMETER LANDSCAPE AREAS.

OPEN SPACE

OPEN SPACE WITHIN THIS MDP SHALL BE A MINIMUM OF TEN PERCENT (10%) OF THE NET LAND AREA (EXCLUDING R.O.W.). OPEN SPACE SHALL INCLUDE ALL LANDSCAPE AREAS AND HARDSCAPE AREAS FOR PEDESTRIAN USE SUCH AS SIDEWALKS, PLAZAS, COURTYARDS AND AREAS OF DECORATIVE PAVING. OPEN SPACE DOES NOT INCLUDE PARKING AREAS AND OTHER VEHICLE ORIENTED SPACE.

PRIOR TO ISSUANCE OF THE CERTIFICATE OF OCCUPANCY FOR THE 1ST RESIDENTIAL BUILDING LOCATED ON LOT 2, BLOCK 1, FILING NO.2, LOT 3, BLOCK 1, FILING NO.3 AND LOT 4, BLOCK 1, FILING NO.3, THE PROJECT SHALL PROVIDE A MINIMUM OF 25,000SF OF CONTIGUOUS PUBLIC OPEN SPACE, PASSIVE RECREATION, COMMON PUBLIC SQUARES OR GREEN AREAS ON LOT 2, BLOCK 1, FILING NO. 3.

NUMBER, SIZE AND LOCATIONS OF BUILDINGS

ADMINISTRATIVE SITE PLANS SHALL SUBSTANTIALLY CONFORM, IN TERMS OF LAYOUT, TO THE SITE AND UTILITY PLAN DEPICTED ON SHEET 3 OF THIS MDP. FOR PURPOSES OF INTERPRETING THE VESTED RIGHT GRANTED WITH THIS MDP, MINOR VARIATIONS IN SITE LAYOUT WHICH DO NOT SUBSTANTIALLY DEVIATE IN TERMS OF BUILDING FOOTPRINT OR STREET LOCATION WILL BE CONSIDERED TO BE IN SUBSTANTIAL CONFORMANCE.

SIDEWALKS

SIDEWALKS SHALL BE PROVIDED ALONG ALL PUBLIC RIGHTS OF WAY AND ALONG ALL SOUTHGLENN METROPOLITAN DISTRICT OWNED AND MAINTAINED RIGHTS OF WAY ACCORDING TO CITY STANDARDS AND SHALL BE CONNECTED TO THE PRIMARY ENTRANCE OF EACH BUILDING IN A MANNER COMPLIANT WITH THE AMERICAN'S WITH DISABILITIES ACT (ADA) STANDARDS.

WINTER SOLAR SHADING

ASP SUBMITTALS SHALL COMPLY WITH THE CITY REGULATIONS REGARDING WINTER SOLAR SHADING IN EFFECT AT THE TIME OF ASP APPLICATION. BUILDINGS SHALL BE DESIGNED OF A HEIGHT AND PLACED ON THE SITE IN A MANNER WHICH MINIMIZES THE PERMANENT FULL DAY SHADING ON TO PAVED SURFACES WITHIN ADJACENT RIGHT-OF-WAY A DISTANCE EQUAL TO ITS HEIGHT (1:1 RATIO OF HEIGHT TO SETBACK)

SCREENING OF MECHANICAL EQUIPMENT, TRASH FACILITES AND OFF-STREET LOADING

ROOF MOUNTED MECHANICAL EQUIPMENT SHALL BE SCREENED FROM VIEW AT GROUND LEVEL AND GROUND MOUNTED MECHANICAL EQUIPMENT SHALL BE SCREENED WITH FENCING OR LANDSCAPING. TRASH FACILITIES SHALL BE SCREENED AND SHALL BE PLACED IN SUCH A MANNER TO MINIMIZE THE AESTHETIC IMPACT ON ADJACENT PUBLIC AREAS. SCREENING OF OFF-STREET LOADING SHALL BE PROVIDED THROUGH USE OF WALLS FINISHED WITH MATERIAL AND COLORS COMPATIBLE WITH THE BUILDING AND SHALL BE SUBJECT TO STAFF APPROVAL IN THE ASP PROCESS.

DISCREPANCIES

IF THERE ARE DIFFERENCES OR DISCREPANCIES IN THE DEVELOPMENT CRITERIA AMONG THE TERMS OF THIS PLAN OR AN EXECUTED DEVELOPMENT AGREEMENT IT SHALL BE RESOLVED BY ADHERING TO THE STRICTER STANDARD.

OWNER/DEVELOPER AUTHORIZATION OF AMENDMENTS

APPLICATION FOR AMENDMENTS TO THIS MDP SHALL BE ACCEPTED FOR PROCESSING BY THE CITY, AND SHALL BE TREATED AS AUTHORIZATION BY THE OWNERS AND DEVELOPERS OF THIS MDP SO LONG AS THE APPLICATIONS ARE SIGNED BY THE RECORD OWNERSHIP OF THE SITE UPON WHICH THE AMENDMENT WILL APPLY, WITHOUT REGARD TO WHETHER THE AMENDMENT HAS BEEN AUTHORIZED OR APPROVED BY THE OWNERS ASSOCIATION (IF ANY), TENANTS, MORTGAGEES, OR ADJACENT OWNERS WITHIN THE MDP.

EMERGENCY ACCESS

EXCEPTING PARKING STRUCTURES, DRIVE AISLES FOR EMERGENCY VEHICLE ACCESS SHALL BE A MINIMUM OF 24 FEET (24') WIDE WITH INSIDE TURNING DIMENSION OF TWENTY-ONE FEET INSIDE RADIUS (21'IR) AND FORTY-FIVE FEET OUTSIDE RADIUS (45'OR).

STREET NAMING

STREET NAMES, EXCLUDING ALL PUBLIC RIGHTS OF WAY OWNED AND MAINTAINED BY THE CITY, SHALL BE AS SHOWN ON THE MASTER DEVELOPMENT PLAN.

INFRASTRUCTURE AND COLLATERAL

COLLATERAL SHALL BE AS PROVIDED IN A MASTER DEVELOPMENT AGREEMENT EXECUTED IN CONNECTION WITH THIS MDP, AND AS MAY BE FURTHER DETAILED IN AMENDMENTS THERETO AT THE TIME OF ASP SUBMITTAL.

REQUIRED UPDATES TO TRAFFIC AND DRAINAGE PROJECTION

ALL ASP APPLICATIONS MUST COMPLY WITH THE ASSUMPTIONS AND LIMITATIONS OF THE MASTER DRAINAGE PLANS AND THE MASTER TRAFFIC STUDY, AND THE PERIODIC UPDATES TO SUCH DOCUMENTS IN THE CASE OF THE PROJECT MDP. THE CITY MAY DENY ANY ASP APPLICATION THAT DOES NOT COMPLY WITH SUCH REQUIREMENTS. EXCEPT TO THE EXTENT SUCH REQUIREMENTS ARE SUSPENDED IN WRITING BY THE CITY'S ENGINEERING DIVISION THE UPDATES SHALL CONTAIN THE FOLLOWING INFORMATION . FAILURE TO INCLUDE THE REQUIRED DOCUMENTATION WITH CONTENT CONFORMING TO THIS REQUIREMENT WILL RESULT IN THE REJECTION OF THE APPLICATION.

(A) MASTER TRAFFIC STUDY UPDATES AND ASP TRAFFIC SUBMITTAL REQUIREMENTS

WITH EACH ASP APPLICATION THE APPLICANT SHALL SUBMIT A LETTER OF COMPLIANCE DOCUMENTING THAT THE CONDITIONS WITHIN THE ASP HAVE DEVELOPED IN A PATTERN CONSISTENT WITH THE MASTER TIA , AND THAT THE TRAFFIC IMPACTS OF THE ASP WILL CONFORM TO THE ASSUMPTIONS AND LIMITATIONS OF THE MASTER TIA. IF THE CODE REQUIREMENTS RELATING TO TRAFFIC STUDIES ARE AMENDED AFTER THE APPROVAL OF THE MASTER TIA, THE UPDATES MUST ANALYZE THE INFRASTRUCTURE REQUIREMENTS AND RESTRICTIONS REQUIRED BY THE CODE AND PROVIDE A MEANS ACCEPTABLE TO THE CITY FOR COMPLYING WITH SUCH NEW REQUIREMENTS.

(B) DRAINAGE PLAN ASP SUBMITTAL REQUIREMENT

WITH EACH ASP APPLICATION, THE APPLICANT MUST SUBMIT A DRAINAGE REPORT UPDATE COMPLYING WITH THE CITY'S CONTENT AND CERTIFICATION REQUIREMENTS FOR PHASE III DRAINAGE REPORTS THAT DEMONSTRATE THAT THE SITE PLAN DRAINAGE, AND INFRASTRUCTURE WILL COMPLY WITH THE MASTER DRAINAGE PLAN.

STANDARD NOTES

THE OWNER(S) DEVELOPER(S) AND/OR SUBDIVIDERS(S) OF THE MASTER DEVELOPMENT PLAN KNOWN AS THE STREETS AT SOUTHGLENN THEIR RESPECTIVE SUCCESSORS, HEIRS AND/OR ASSIGNS, AGREE TO THE FOLLOWING NOTES.

PRIVATE STREET MAINTENANCE
IT IS MUTUALLY UNDERSTOOD AND AGREED THAT THE PRIVATE ROADWAYS SHOWN ON THIS PLAN ARE NOT IN CONFORMANCE WITH CITY OF CENTENNIAL ROADWAY DESIGN AND CONSTRUCTION STANDARDS AND WILL NOT BE MAINTAINED BY THE CITY. THE OWNERS, DEVELOPERS, AND OR SUBDIVIDERS, THEIR SUCCESSORS AND/OR ASSIGNS IN INTEREST SHALL BE RESPONSIBLE FOR STREET MAINTENANCE.

DRAINAGE MAINTENANCE
THE SOUTHGLENN METROPOLITAN DISTRICT SHALL BE RESPONSIBLE FOR MAINTENANCE OF ALL DRAINAGE FACILITIES INSTALLED PURSUANT TO THE SUBDIVISION AGREEMENTS. REQUIREMENTS INCLUDE, BUT ARE NOT LIMITED TO, MAINTAINING THE SPECIFIED STORM WATER DETENTION/RETENTION VOLUMES, MAINTAINING OUTLET STRUCTURES, FLOW RESTRICTION DEVICES AND FACILITIES NEEDED TO CONVEY FLOW TO SAID BASINS. THE SOUTHGLENN METROPOLITAN DISTRICT SHALL BE RESPONSIBLE FOR MAINTAINING AND INSPECTING BOTH DETENTION VOLUMES AND WATER QUALITY FACILITIES. THE CITY OF CENTENNIAL SHALL HAVE THE RIGHT TO ENTER PROPERTIES TO INSPECT SAID FACILITIES AT ANY TIME. IF THESE FACILITIES ARE NOT PROPERLY MAINTAINED THE CITY MAY PROVIDE NECESSARY MAINTENANCE AND ASSESS THE MAINTENANCE COST TO THE OWNER OF THE PROPERTY.

EMERGENCY ACCESS
EMERGENCY ACCESS IS GRANTED HEREWITH OVER AND ACROSS ALL PAVED AREAS FOR POLICE, FIRE AND EMERGENCY VEHICLES.

DRIVES, PARKING AREAS, AND UTILITY EASMENTS MAINTENANCE
THE OWNERS OF THIS PLAN, THEIR SUCCESSORS, AND/OR ASSIGNS IN INTEREST, THE ADJACENT PROPERTY OWNERS(S), HOMEOWNERS ASSOCIATION OR OTHER ENTITY OTHER THAN THE CITY OF CENTENNIAL IS RESPONSIBLE FOR MAINTENANCE AND UPKEEP OF ANY AN ALL DRIVES, PARKING AREAS, AND EASEMENTS, I.E. CROSS ACCESS EASEMENTS, DRAINAGE EASEMENTS, ETC.

DRAINAGE LIABILITY
IT IS THE POLICY OF THE CITY OF CENTENNIAL THAT IT DOES NOT AND WILL NOT ASSUME LIABILITY FOR THE DRAINAGE FACILITIES DESIGNED AND/OR CERTIFIED BY CLC ASSOCIATES. THE CITY OF CENTENNIAL REVIEWS DRAINAGE PLANS PURSUANT TO COLORADO REVISED STATUES TITLE 31, ARTICLE 23 BUT CANNOT, ON BEHALF OF THE OWNERS WITHIN THE MDP AREA, GUARANTEE THAT FINAL DRAINAGE DESIGN REVIEW WILL ABSOLVE THE OWNERS, AND/OR THEIR SUCCESSORS AND/OR ASSIGNS OF FUTURE LIABILITY FOR IMPROPER DESIGN. IT IS THE POLICY OF THE CITY THAT APPROVAL OF THE MASTER DEVELOPMENT PLAN DOES NOT IMPLY APPROVAL OF THE DRAINAGE DESIGN OF CLC ASSOCIATES.

LANDSCAPE MAINTENANCE
THE SOUTHGLENN METROPOLITAN DISTRICT IS RESPONSIBLE FOR MAINTENANCE AND UPKEEP OF PERIMETER FENCING, LANDSCAPED AREAS AND SIDEWALKS BETWEEN THE FENCELINE/PROPERTY LINE AND ANY PAVED ROADWAYS.

THE SOUTHGLENN METROPOLITAN DISTRICT IS RESPONSIBLE FOR MAINTAINING ALL OTHER OPEN SPACE AREAS ASSOCIATED WITH THIS DEVELOPMENT.

SIGHT TRIANGLE MAINTENANCE
THE OWNERS OF PRIVATE PROPERTY CONTAINING A TRAFFIC SIGHT TRIANGLE ARE PROHIBITED FROM ERECTING OR GROWING ANY OBSTRUCTIONS OVER THREE FEET IN HEIGHT ABOVE THE ELEVATION OF THE LOWEST POINT ON THE CROWN OF THE ADJACENT ROADWAY WITHIN SAID TRIANGLE.

PUBLIC IMPROVEMENTS NOTE
AFTER ADMINISTRATIVE SITE PLAN APPROVAL, ISSUANCE OF INDIVIDUAL BUILDING PERMITS WILL BE SUBJECT TO THE FOLLOWING STIPULATION AND/OR CONDITIONS PRECEDENT, WHICH OWNER AGREES TO IN CONJUNCTION WITH APPROVAL OF THE ADMINISTRATIVE SITE PLAN. SUCH BUILDING PERMITS WILL BE ISSUED ONLY AFTER THE OWNERS GUARANTEE THE CONSTRUCTION OF THE PUBLIC IMPROVEMENTS IN A FORM ACCEPTABLE TO THE CITY COUNCIL PURSUANT TO THE MASTER DEVELOPMENT AGREEMENT

MAINTENANCE EASEMENT
A MAINTENANCE EASEMENT IS REQUIRED FOR DEVELOPMENTS WITH ZERO SIDE SETBACKS IF ONE STRUCTURE IS BUILT ON THE LOT LINE. IN ORDER TO MAINTAIN STRUCTURE WITH THE ZERO SIDE SETBACK, A MAINTENANCE EASEMENT MAY BE REQUIRED ON THE ADJACENT LOT TO ENABLE MAINTENANCE TO BE PERFORMED ON SAID STRUCTURE FROM THE ADJOINING PROPERTY. EACH LOT OWNER AGREES TO ALLOW ADJACENT LOT OWNERS ACCESS ACROSS THEIR LOT, WITHIN FIVE FEET OF THE COMMON LOT LINE, AS MAY BE NEEDED TO MAINTAIN AND REPAIR THE ADJACENT OWNER'S PRINCIPAL STRUCTURE. EACH ADJACENT OWNER AGREES TO REPAIR ANY DAMAGE WHICH MAY BE CAUSED TO THE LOT OWNER'S PROPERTY FROM THE ADJACENT OWNERS USE OF THIS MAINTENANCE EASEMENT, AND TO TAKE ALL NECESSARY STEPS TO AVOID CAUSING SUCH DAMAGE

DRAINAGE MASTER PLAN NOTE
THE POLICY OF THE CITY REQUIRES THAT ALL NEW DEVELOPMENT AND REDEVELOPMENT SHALL PARTICIPATE IN THE REQUIRED DRAINAGE IMPROVEMENTS AS SET FORTH BELOW.

1. DESIGN AND CONSTRUCT THE LOCAL DRAINAGE SYSTEM AS DEFINED BY THE PHASE I DRAINAGE REPORT FOR THE STREETS AT SOUTHGLENN.
2. DESIGN AND CONSTRUCT THE CONNECTION OF THE SUBDIVISION DRAINAGE SYSTEM TO A DRAINAGEWAY OF ESTABLISHED CONVEYANCE CAPACITY SUCH AS A MASTER PLANNED OUTFALL STORM SEWER OR MASTER PLANNED MAJOR DRAINAGEWAY. THE CITY WILL REQUIRE THAT THE CONNECTION OF THE MINOR AND MAJOR SYSTEMS PROVIDE CAPACITY TO CONVEY ONLY THOSE FLOWS (INCLUDING OFF SITE FLOWS) LEAVING THE SPECIFIC DEVELOPMENT SITE. TO MINIMIZE OVERALL CAPITAL COSTS THE CITY ENCOURAGES ADJACENT DEVELOPMENTS TO JOIN IN DESIGNING AND CONSTRUCTING CONNECTION SYSTEMS. ALSO, THE CITY MAY CHOOSE TO PARTICIPATE WITH A DEVELOPER IN THE DESIGN AND CONSTRUCTION OF THE CONNECTION SYSTEM.
3. EQUITABLE PARTICIPATION IN THE DESIGN AND CONSTRUCTION OF THE MAJOR DRAINAGEWAY SYSTEM THAT SERVES THE DEVELOPMENT AS DEFINED BY ADOPTED MASTER DRAINAGEWAY PANS (SECTION 3.3.2 OF ARAPAHOE COUNTY STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA MANUAL) OR AS REQUIRED BY THE CITY AND DESIGNATED IN THE PHASE I DRAINAGE REPORT.

METROPOLITAN DISTRICT OBLIGATIONS AND MAINTENANCE RESPONSIBILITIES

WITHIN THE PROPERTY BOUNDARY OF THE STREETS OF SOUTHGLENN, THE SOUTHGLENN METROPOLITAN DISTRICT SHALL BE RESPONSIBLE FOR THE DESIGN, INSTALLATION, CONSTRUCTION, OPERATION, AND MAINTENANCE OF: PRIVATE ROADWAYS; COMMON AREA LANDSCAPING; PUBLIC PLAZAS; PUBLIC PARK AREAS; PUBLIC PARKING STRUCTURES; OUTDOOR PEDESTRIAN LIGHTING; PARKING LOT LIGHTING; GROUND SIGNAGE; ONSITE STORM SEWER LINES AND APPURTENANCES; UNDERGROUND DETENTION STRUCTURES; WATER QUALITY STRUCTURES; WATERLINES AND APPURTENANCES; AND SANITARY SEWER LINES AND APPURTENANCES.

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ISSUE:

#	DATE:	DESCRIPTION:

PROJECT:
Alberta Development Partners, LLC

Southglenn MDP

DATE:	09/17/2021
DESIGNED:	BM
DRAWN:	SM
REVIEWED:	BN
FIELD BOOK NO.:	

SHEET TITLE:
DEVELOPMENT STANDARDS AND STANDARD NOTES

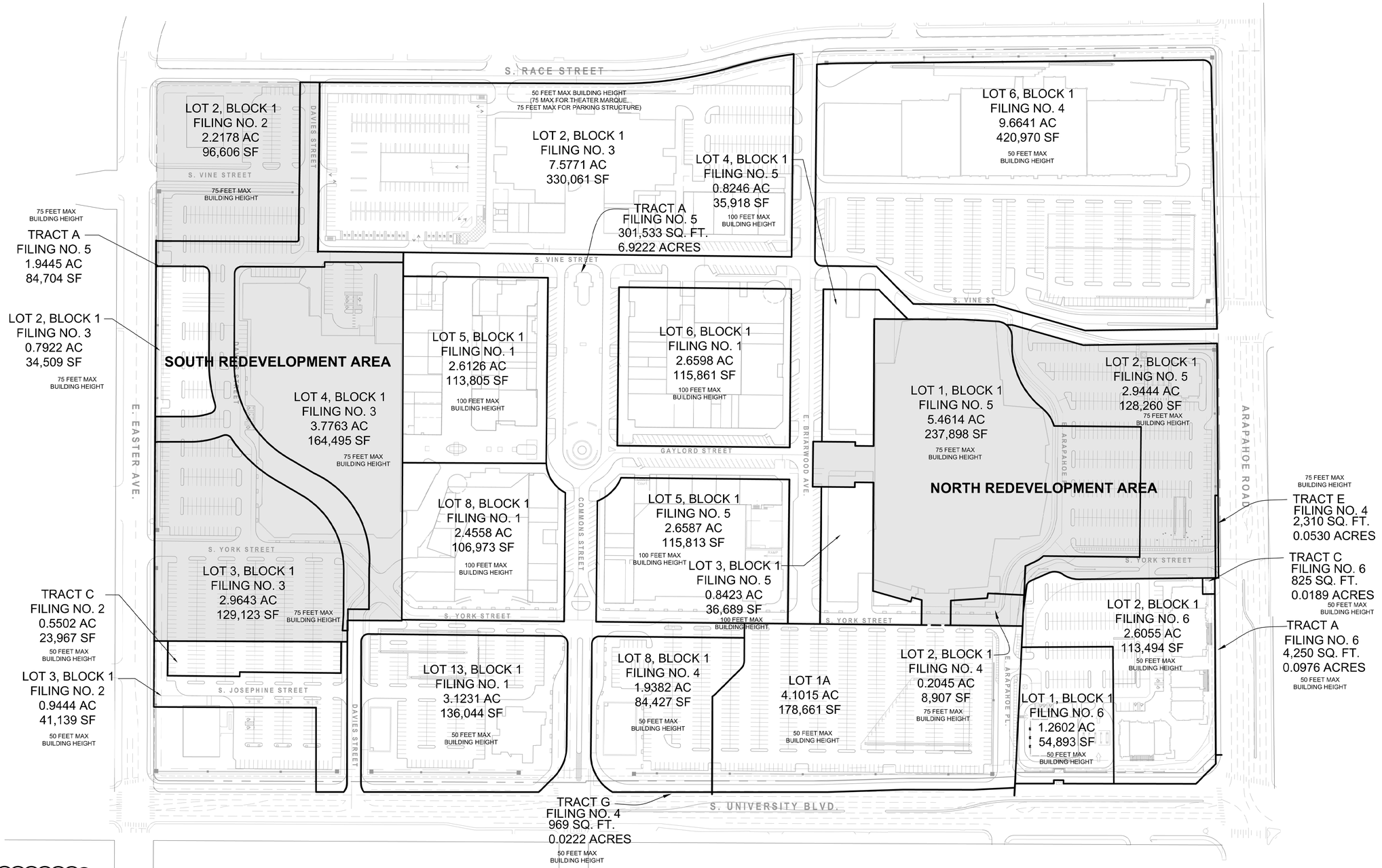
SHEET NUMBER:
2 OF 16

PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO



Case Number (PUD-21-00004)

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FIELD BOOK NO.:	

SHEET TITLE:
REDEVELOPMENT
BLOCKING PLAN

SHEET NUMBER:
3 OF 16

PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
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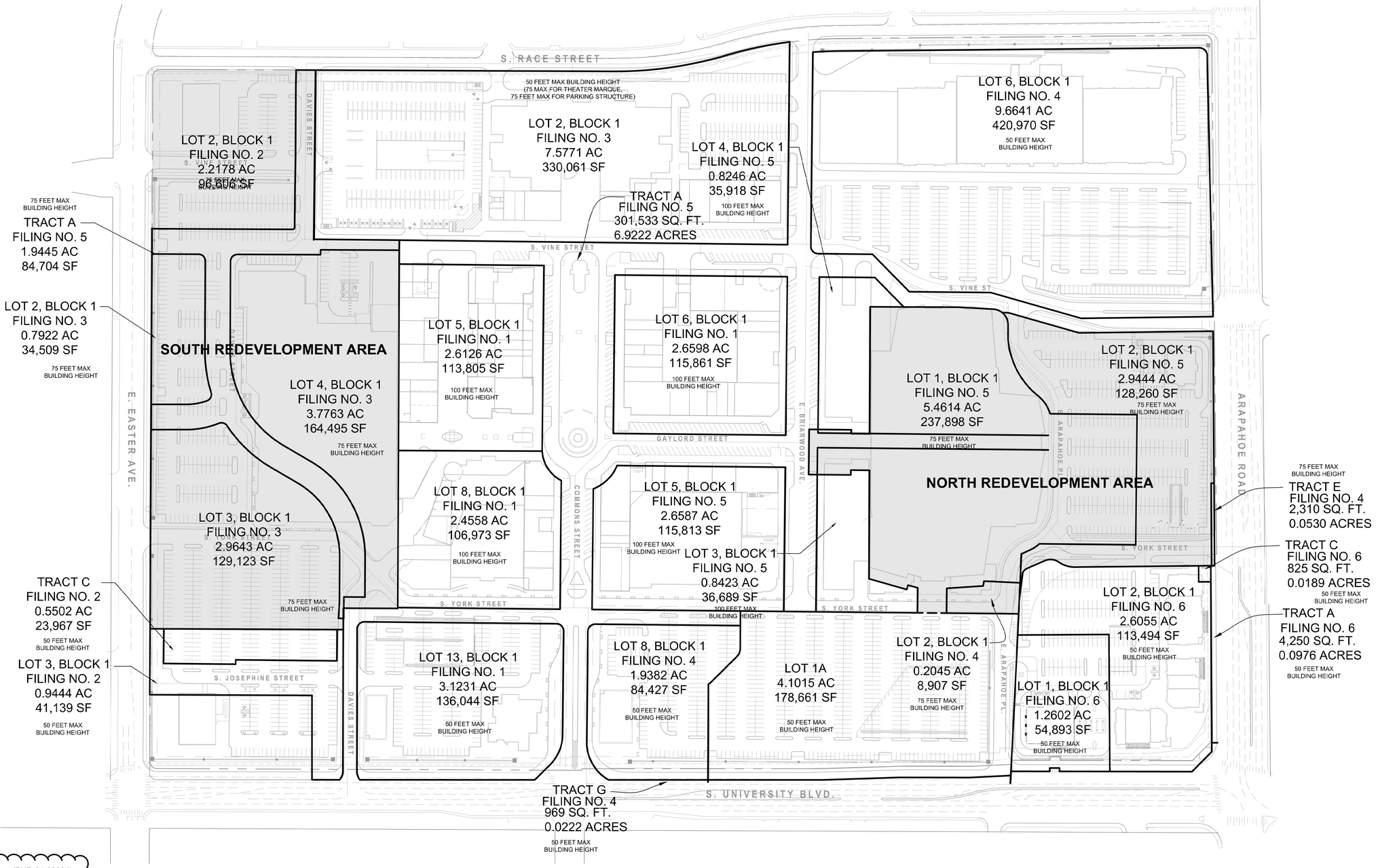

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Alberta Development Partners, LLC

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DATE:	09/17/2021
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SHEET TITLE:
PROPOSED FUTURE REDEVELOPMENT BLOCKING PLAN

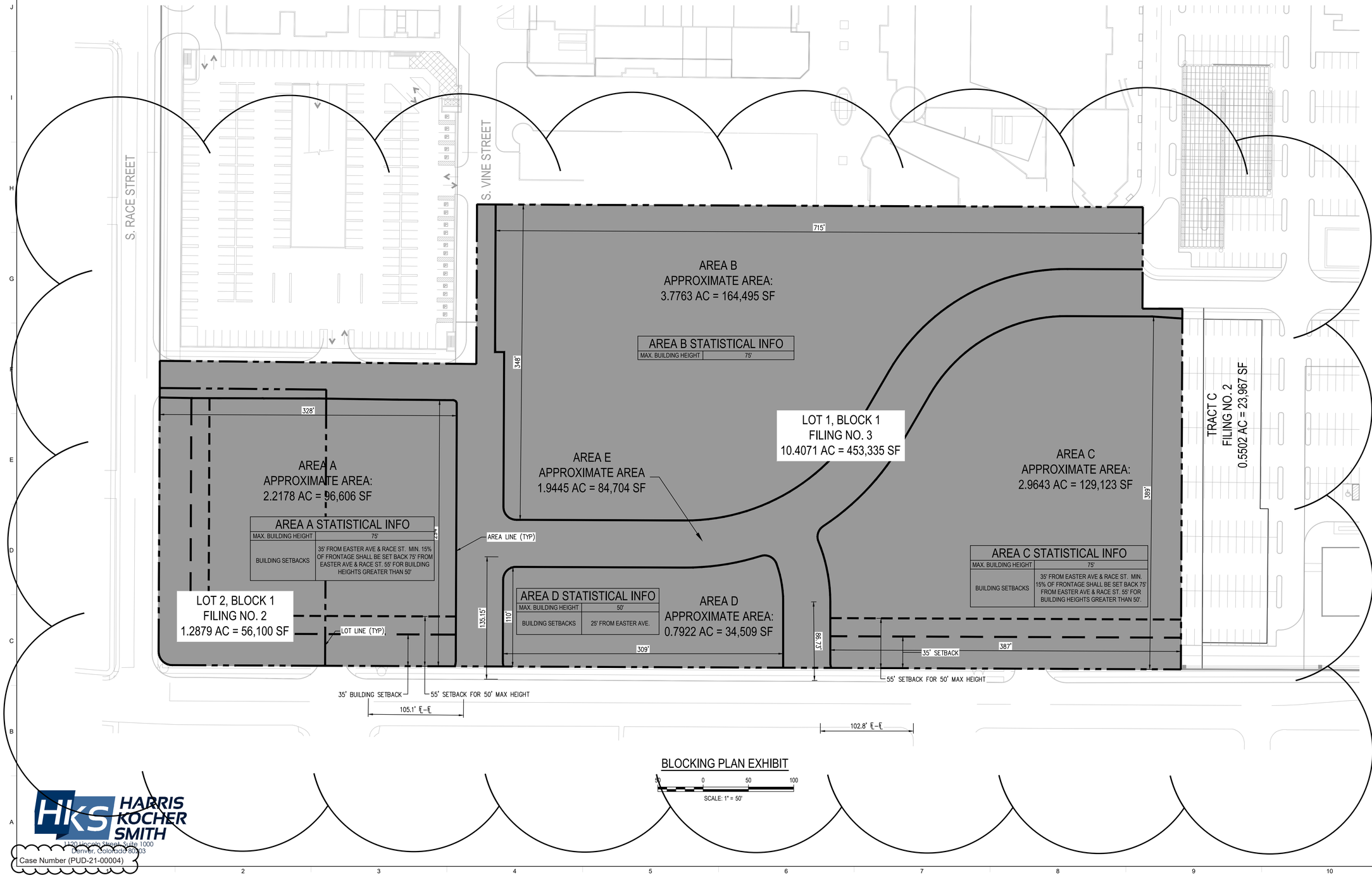
SHEET NUMBER:
4 OF 16

PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO



BLOCKING PLAN EXHIBIT

-50 0 50 100
SCALE: 1" = 50'

HARRIS KOCHER SMITH
1120 Lincoln Street, Suite 1000
Denver, Colorado 80203

Case Number (PUD-21-00004)

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Southglenn MDP

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FIELD BOOK NO.:	

SHEET TITLE:
SOUTH REDEVELOPMENT AREA BLOCKING PLAN

SHEET NUMBER:
5 OF 16

PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
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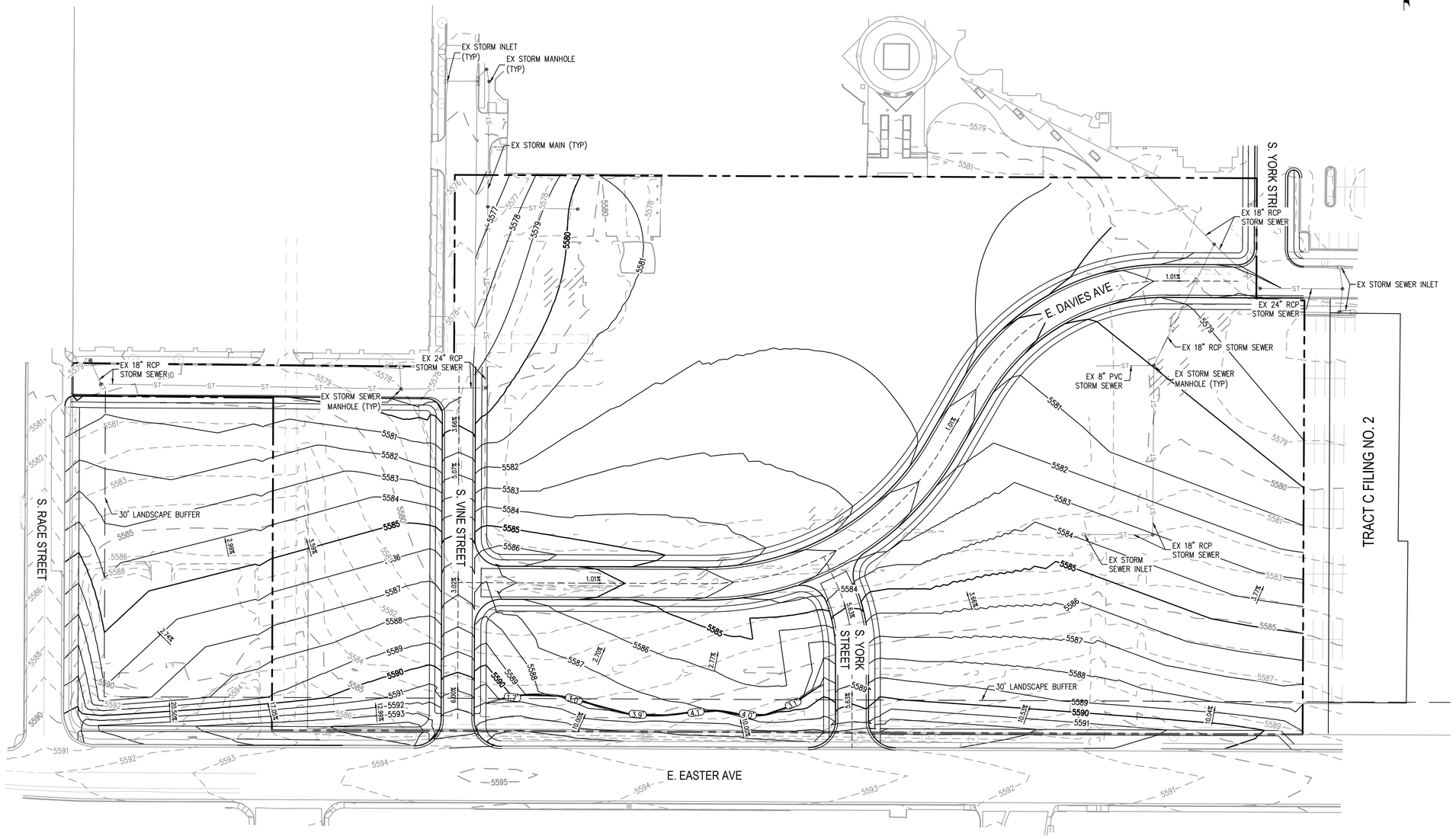

PRELIMINARY GRADING & DRAINAGE EXHIBIT

50 0 50 100
SCALE: 1" = 50'

NOTES:
EXISTING STORM SEWER INFRASTRUCTURE SHALL BE MODIFIED WITH THE PROPOSED GRADING

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SHEET TITLE:
SOUTH REDEVELOPMENT AREA CONCEPTUAL GRADING PLAN

SHEET NUMBER:
6 OF 16

PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO

LANDSCAPING

LANDSCAPE DESIGN PRINCIPLES
THE LANDSCAPE FRAMEWORK FOR THE STREETS AT SOUTHGLENN SUPPORTS THE CONCEPT OF A TRADITIONAL URBAN NEIGHBORHOOD WITH MODERN DETAILS. LANDSCAPE IS APPROACHED AT SEVERAL DIFFERENT LEVELS PRIMARILY CONSISTING OF:

A. STREETSCAPE: PEDESTRIAN FRIENDLY TREE-LINED CONNECTORS, UTILIZING TRADITIONAL TREE LAWNS AND SITE AMENITIES TO DEFINE AN URBAN NEIGHBORHOOD. THIS APPROACH IS REFLECTED IN THE DEVELOPMENT OF INTERNAL AS WELL AS PERIMETER STREETS.
B. GARDEN: THE LANDSCAPE DESIGN APPROACH GENERALLY USES TRADITIONAL LANDSCAPE PROTOTYPES TO INFORM THE DESIGN OF PUBLIC PLACES AT SOUTHGLENN. THE LANDSCAPE MATERIALS USED TO ESTABLISH THESE FORMS ARE UNIQUE TO COLORADO.
C. URBAN PARK: PARKING AREAS AND DRIVE LANES ARE DELINEATED BY THE USE OF ISLANDS AND MEDIANS THAT UTILIZE POSSIBLE COMBINATIONS OF ARCHITECTURAL ELEMENTS, LIGHTING AND SPECIAL PAVING AND/OR LANDSCAPING TO ADD COLOR AND INTEREST SPECIFIC TO THE DESIGN VOCABULARY OF THE PROJECT.
D. PLAZA: PEOPLE PLACES COMPLEMENT AND CONTRAST ADJACENT BUILDING ARCHITECTURE TO CREATE COMFORTABLE PLACES THAT ARE INTERESTING AND MEMORABLE.

GENERAL LANDSCAPE REQUIREMENTS
THE LANDSCAPE FRAMEWORK FOR THE STREETS AT SOUTHGLENN SUGGESTS AN URBAN NETWORK OF INTERCONNECTED STREETS. THERE ARE PRIMARILY TWO TYPES OF STREETSCAPES INDICATED: THOSE LINKING THE PERIMETER AND CORE AREAS - MOSTLY WITHOUT BUILDING EDGES, AND THE INTERNAL STREETS BOUNDED BY BUILDINGS. WHERE APPROPRIATE THE STREETS ARE LINED WITH SIDEWALKS AND STREET TREES FORMING A PEDESTRIAN STREETSCAPE. CAREFUL COORDINATION OF TRAFFIC, PARKING, LIGHTING, EMERGENCY ACCESS AND EGRESS AND UTILITY REQUIREMENTS WILL RESULT IN STREETS THAT ARE ATTRACTIVE AND ACCESSIBLE FOR BOTH PEDESTRIAN AND VEHICULAR USERS.

LANDSCAPE REQUIREMENTS SHALL CONFORM TO THE CITY OF CENTENNIAL'S LAND DEVELOPMENT CODE EXCEPT AS OTHERWISE SPECIFIED. TREES, SHRUBS AND OTHER PLANT MATERIALS SHALL BE SELECTED FROM AN APPROVED LIST. THE CITY'S LIST OF RECOMMENDED PLANT MATERIALS IS REFERENCED, BUT NOT CONSIDERED ALL INCLUSIVE. THE PROJECT MAY USE ANY LANDSCAPE PLANT MATERIAL THAT IS NOT PROHIBITED BY STATE OR LOCAL LAW. ALL LANDSCAPE AREAS SHALL BE IRRIGATED WITH AN AUTOMATIC IRRIGATION SYSTEM EQUIPPED WITH A CENTRAL CONTROL MECHANISM. ONLY TURFGRASS, GROUNDCOVER AND ANNUAL PLANTING AREAS SHOULD BE SPRAY IRRIGATED. ALL OTHER AREAS SHOULD BE PROVIDED WITH DRIP OR SUBSURFACE IRRIGATION.
ALL PLANT BED AREAS SHALL RECEIVE MULCH COVERING INCLUDING, BUT NOT LIMITED TO, GRAVEL, COBBLE, WOOD AND BARK MULCH. HARDSCAPES MAY INCLUDE ROCKS, BOULDERS, NATURAL AND CULTURED STONE, CEMENT CONCRETE, UNIT PAVERS, SITE AMENITIES SUCH AS BENCHES TRASH, TRASH RECEPTACLES, BOLLARDS, BIKE RACKS AND OTHER ELEMENTS DEEMED APPROPRIATE.

ALL LANDSCAPE AREAS SHALL BE MAINTAINED IN A HEALTHY AND NEAT CONDITION - INCLUDING WEEKLY MOWING AND TRASH REMOVAL, PERIODIC FERTILIZING AND MULCHING AND ANNUAL PRUNING AND REPLACEMENT OF DEAD MATERIALS.

STREETSCAPES
THERE ARE THREE GENERAL TYPES OF STREETS AT THE STREETS AT SOUTHGLENN. AS EACH HAS A DISTINCT URBAN CHARACTER, EACH SHOULD HAVE A DISTINCT LANDSCAPE CHARACTER.

URBAN STREETS ARE STREETS THAT ARE CHARACTERIZED BY BUILDINGS ON BOTH SIDES PROVIDING SPATIAL CONTAINMENT. THE STREETSCAPES ARE PRIMARILY DEFINED BY THE ARCHITECTURAL CHARACTER OF THE ADJACENT BUILDINGS. LANDSCAPING ON THESE STREETS REINFORCES THE ARCHITECTURAL CHARACTER AND PROVIDES SEPARATION OF THE PEDESTRIAN FROM VEHICULAR TRAFFIC AS WELL AS SHADE, VISUAL INTEREST AND DEFINITION FOR AREAS OF ACTIVITY AND USE. URBAN STREETS SIDEWALKS SHALL HAVE EVENLY SPACED STREET TREES AT THE BACK OF THE CURB IN TREE GRATES OR PLANT PITS. ORNAMENTAL TREES, SHRUBS, GROUNDCOVERS, PERENNIALS AND ANNUALS PLANTING SHOULD BE IN POTS, PLANTERS OR CONTAINED PLANTING AREAS.

PERIMETER STREETS ARE CHARACTERIZED BY BUILDINGS ON ONE SIDE ONLY AND WITH CIRCULATION AND/OR LANDSCAPE BUFFERS ON THE OPPOSITE SIDE. LANDSCAPING OF THESE AREAS VARIES WITH PROXIMITY TO ADJACENT USE. PROVIDE LANDSCAPING IN PERIMETER STREETS SUBJECT TO THE REQUIREMENTS OF PARKING AREA AND BUILDING AREA LANDSCAPING AS DEFINED BELOW.

APPROACH STREETS ARE NOT DEFINED ON EITHER SIDE BY A BUILDING. THEY ARE DEFINED IN MOST CASES BY LANDSCAPED AREAS, ISLANDS OR MEDIANS. PROVIDE LANDSCAPING IN APPROACH STREETS SUBJECT TO THE REQUIREMENTS OF PARKING AREA LANDSCAPING AS DEFINED BELOW.

PERIMETER AREA LANDSCAPING
LANDSCAPING SHOULD HELP PROVIDE COMPATIBILITY WITH ADJACENT LAND USES BY PROVIDING AN EDGE CONDITION THAT RESPECTS THOSE USES. COMPATIBLE USES SHOULD BE OPEN AND VISIBLE. INCOMPATIBLE USES SHOULD BE SCREENED. LANDSCAPING SHOULD PROVIDE VISUAL CUES TO THE LOCATION OF SITE ENTRIES AND PEDESTRIAN CONNECTIONS.

A. PERIMETER LANDSCAPE BUFFERS, WHERE REQUIRED, SHALL BE A MINIMUM OF FIVE (5) FEET WIDE.
B. PROVIDE SOD TREE LAWNS BETWEEN CURB AND SIDEWALK WHERE POSSIBLE. AVOID TREE LAWNS THAT ARE LESS THAN SIX (6) FEET IN WIDTH. SAVE EXISTING TREES WHERE PRACTICAL. EXISTING TREES SHALL NOT BE REQUIRED TO BE SAVED OR MAINTAINED ON THE PROPERTY GIVEN THE REQUIREMENTS OF THE PROPOSED PLAN.
C. PROVIDE STREET TREES FROM APPROVED LIST AT A MINIMUM OF 40 FT ON CENTER.
D. WHERE PARKING IS ADJACENT TO PUBLIC STREET RIGHT OF WAY PROVIDE A CONTINUOUS SHRUB HEDGE OR LOW DECORATIVE SCREEN WALL AVERAGING 30 INCHES IN HEIGHT.
E. WHERE SERVICE AND LOADING OPERATIONS ARE ADJACENT TO A PUBLIC RIGHT OF WAY PROVIDE A MINIMUM EIGHT (8) FEET HIGH DECORATIVE SCREEN WALL SET BACK A MINIMUM OF 5 FEET FROM THE RIGHT OF WAY WITH HEDGE OR EVERGREEN SHRUB LANDSCAPE SCREEN PLANTED AT A MAXIMUM OF 10 FEET ON CENTER.

PARKING AREA LANDSCAPING

LANDSCAPING IS AN IMPORTANT ENHANCEMENT FOR THE LARGE PARKING AREAS REQUIRED AT A MIXED USE DEVELOPMENT. LANDSCAPED MEDIANS AND ISLANDS PROVIDE A MEANS OF ORGANIZING PARKING MODULES, ASSISTING WITH VEHICULAR AND PEDESTRIAN MOVEMENT, PROVIDING VISUAL SCREENING WHERE APPROPRIATE, ADDING ENVIRONMENTAL PROTECTIONS SUCH AS SHADE AND WINDBREAK AND REDUCING THE SIZE OF CONTIGUOUS IMPERVIOUS SURFACES.

A. PARKING LOT LANDSCAPING SHALL BE PROVIDED AT THE PERIMETER OF THE PARKING AREAS. INTERNAL LANDSCAPED ISLANDS SHALL NOT BE REQUIRED.
B. PROVIDE LANDSCAPE AREAS IN PARKING LOTS THAT ARE EQUIVALENT TO FIVE (5) SQUARE FEET PER PARKING STALL. ISLANDS SHALL NOT BE LESS THAN 200 SQ FT. IN SIZE FOR A DOUBLE LOADED ROW OF PARKING.
C. PROVIDE AT LEAST ONE TREE AND FIVE (5) SHRUBS IN EACH LANDSCAPED ISLAND EXCEPT WHERE RESTRICTED BY UTILITY EASEMENTS. AVOID PLACING UTILITY EASEMENTS IN LANDSCAPED ISLANDS.
D. WHERE LINE OF SIGHT IS REQUIRED, SHRUBS SHALL BE A MAXIMUM OF 36" MATURE HEIGHT.
E. LANDSCAPING OF ISLANDS MAY INCLUDE DECORATIVE PAVERS, LIGHTING AND SITE AMENITIES SUCH AS RAISED PLANTERS OR BOLLARDS.

BUILDING AREA LANDSCAPING
WHERE LANDSCAPING IS PROVIDED ADJACENT TO BUILDINGS IT SHALL ACCENT BUILDING ENTRANCES AND COMPLEMENT BUILDING ARCHITECTURE. LANDSCAPING MAY INCLUDE DECORATIVE PAVEMENTS, PLANTERS AND SITE FURNISHINGS AS APPROPRIATE.

A. IRRIGATED PLANT MATERIAL SHALL NOT BE PLACED WITHIN FIVE (5) FT OF BUILDING FOUNDATIONS.
B. SODDED AREAS ARE DISCOURAGED WHERE THEY ARE LESS THAN SIX FT IN WIDTH AND/OR LESS THAN 200 SQ FT IN TOTAL SIZE.
C. PLANTING AREAS LARGER THAN 200 SQ FT IN SIZE SHOULD BE LOCATED IN AREAS THAT DO NOT ATTRACT PEDESTRIAN TRAFFIC OR SHOULD BE BERMED TO DISCOURAGE CROSS-CUTTING.
D. PROVIDE ONE TREE AND 6 SHRUBS MINIMUM PER EACH 1000 SQ FEET OF SHRUB BED AREA.

RESIDENTIAL LANDSCAPE
RESIDENTIAL AREAS SHALL MEET THE REQUIREMENTS OF THE MDP FOR URBAN STREETS.

COMMERCIAL LANDSCAPE
MOST OF THE COMMERCIAL PROPERTIES AT THE STREETS AT SOUTHGLENN ARE LOCATED ON URBAN STREETS OR PLAZAS. OTHERS ARE LOCATED ON PERIMETER OR APPROACH STREETS.

COMMERCIAL AREAS SHALL MEET THE REQUIREMENTS OF THE MDP FOR THE TYPE OF STREET (AS DEFINED ABOVE) THAT THEY ARE ADJACENT TO.

SURFACE PARKING LOTS
PARKING LOTS SHOULD BE DESIGNED TO BE SAFE, EFFICIENT, CONVENIENT AND ATTRACTIVE. THEY SHALL TAKE INTO CONSIDERATION ALL TYPES OF TRANSPORTATION MODES WHICH THEY WILL ACCOMMODATE, SUCH AS AUTOMOBILES, TRUCKS, EMERGENCY VEHICLES, BICYCLES, AND PEDESTRIANS.

LANDSCAPED ISLANDS ARE REQUIRED IN PARKING AREAS AS IDENTIFIED HEREIN. ISLANDS WHICH ARE SURFACED WITH DECORATIVE PAVING AND WHICH INCLUDE TREES, BOLLARDS OR OTHER URBAN ELEMENTS MAY BE CONSIDERED LANDSCAPED.

LANDSCAPE PLANT MATERIAL
REFER TO SHEET 9 OF 35 FOR THE GENERAL PALLETTE OF PLANT MATERIAL.

RUSSIAN OLIVE OR COTTONWOOD TREES SHALL NOT BE ALLOWED TO BE PLANTED WITHIN THE PROJECT.

1 THE STREETS AT SOUTHLGENN LANDSCAPING DESIGN STANDARDS SHALL ALSO APPLY TO THE NORTH AND SOUTH REDEVELOPMENT AREAS, AND SHALL BE CONSISTENT WITH THE EXISTING SOUTHGLENN DEVELOPMENT

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Southglenn MDP

DATE:	09/17/2021
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DRAWN:	SM
REVIEWED:	BN
FIELD BOOK NO.:	

SHEET TITLE:
LANDSCAPE GUIDELINES

SHEET NUMBER:
7 OF 16

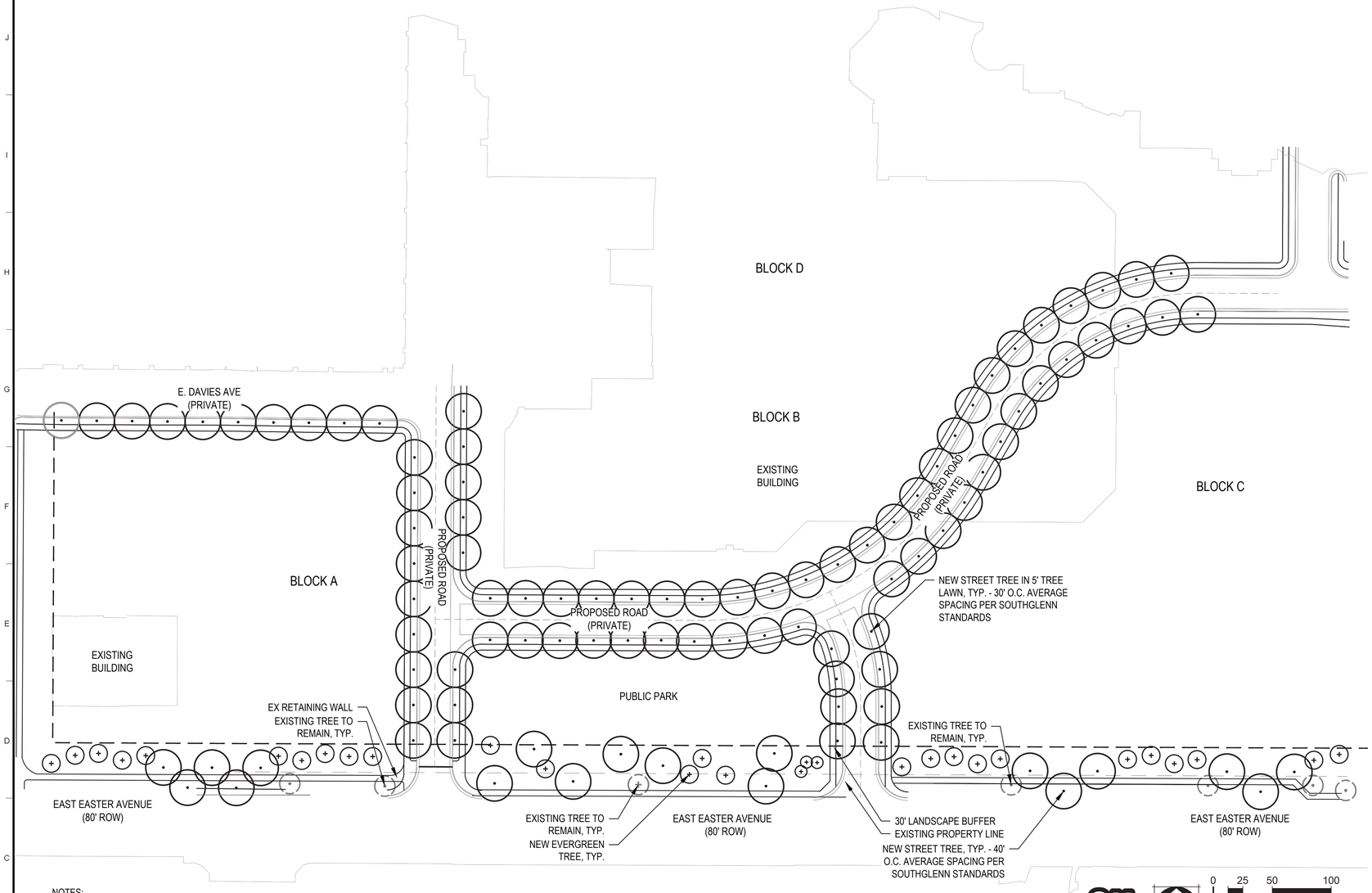
PROJECT NO.: 0190862.00

STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN

AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO



NOTES:
1) THESE PLANT MATERIALS REPRESENT THE GENERAL PALETTE INTENDED FOR THE STREETS AT SOUTHGLENN PROJECT. DUE TO THE WIDE VARIETY OF SHRUBS, GROUNDCOVERS, PERENNIALS AND ANNUALS AVAILABLE FOR USE, THIS IS NOT INTENDED TO BE A COMPLETE LIST OF MATERIALS THAT WILL BE USED AT THIS SITE.

2) LANDSCAPE SHOWN FOR OVERALL DESIGN INTENT ONLY. FINAL DESIGN LAYOUT AND PROGRAM ELEMENTS MAY BE UPDATED DURING THE CITY SITE PLAN APPROVAL PROCESS.

Case Number (PUD-21-00004)

LANDSCAPE PLANT SCHEDULE

BOTANICAL NAME	COMMON NAME
DECIDUOUS TREES	
ACER x FREEMANII 'AUTUMN BLAZE'	AUTUMN BLAZE MAPLE
CARPINUS BETULIS	PYRAIDAL HORNBEAM
CELTIS OCCIDENTALIS	WESTERN HACKBERRY
QUERCUS BICOLOR	SWAMP WHITE OAK
QUERCUS MACROCARPA	BUR OAK
QUERCUS RUBRA	NORTHERN RED OAK
QUERCUS ROBUR SPP	ENGLISH OAK
ROBINA PSEUDOACACIA	PURPLE ROBE LOCUST
SOPHORA JAPONICA	JAPANESE PAGODATREE
TILIA AMERICANA	AMERICAN LINDEN
TILIA CORDATA	LITTLELEAF LINDEN
EVERGREEN TREES	
PICEA PUNGENS	COLORADO SPRUCE
PINUS CEMBRA	SWISS STONE PINE
PINUS NIGRA	AUSTRIAN PINE
PINUS PONDEROSA	PONDEROSA PINE
PSEUTOTSUGA MENZIESII	DOUGLAS FIR
ORNAMENTAL TREES	
ACER GINNALA 'FLAME'	FLAME AMUR MAPLE
AMELANCHIER CANADENSIS	SERVICEBERRY
CRATAEGUS CRUS-GALLI 'INERMIS'	THORNLESS COCKSPUR HAWTHORN
KOEIREUTERIA PANICULATA	GOLDENRAIN TREE
MALUS SP	CRABAPPLE (VARIETY)
PYRUS CALLERYANA 'AUTUMN BLAZE'	AUTUMN BLAZE PEAR
SYRINGA RETICULATA	JAPANESE TREE LILAC
DECIDUOUS SHRUBS	
ALNUS TENUIFOLIA	THINLEAF ALDER
BERBERIS THUNBERGII	JAPANESE BARBERRY
BUDDLEJA DAVIDII NANHOENSIS	COMPACT LAVENDER BUTTERFLY BUSH
CARYOPTERIS X CLANDOENSIS 'BLUE MIST'	BLUE MIST SPIREA
CERCOCARPUS MONTANUS	MOUNTAIN MOHOGANY
CORNUS SERICEA	RED TWIG DOGWOOD
COTONEASTER DAMMERI 'CORAL BEAUTY'	CORAL BEAUTY COTONEASTER
CYTISUS PURGANS 'SPANISH GOLD'	SPANISH GOLD BROOM
CYTISUS X 'LENA'	LENA BROOM
DAPHNE X BURKWOODI 'CAROL MACKIE'	CAROL MACKIE DAPHNE
HESPERALOE PARVIFLORA	RED YUCCA
ILEX GLABRA 'COMPACTA'	COMPACT INKBERRY HOLLY
LIGUSTRUM VULGARE 'LODENSE'	LODENSE PRIVET
MAHONIA AQUIFOLIUM COMPACTA	COMPACT OREGON GRAPE HOLLY
PEROVSKIA ATRIPLICIFOLIA	RUSSIAN SAGE
PHILADELPHUS SP	MOCKORANGE
POTENTILLIA FRUTICOSA 'GOLD DROP'	GOLD DROP POTENTILLA
PRUNUS BESSEYI	WESTERN SAND CHERRY
PRUNUS X CISTENA	PURPLE LEAF PLUM
RHUS AROMATICA 'GRO-LOW'	DWARF FRAGRANT SUMAC
RIBES ALPINUM	ALPINE CURRANT
ROSA X SPP	SHRUB ROSE
SALIX PURPUREA NANA	DWARF ARCTIC WILLOW
SPIRAEA JAPONICA 'ANTHONY WATERER'	ANTHONY WATERER SPIREA
SYMPHORICARPOS ALBUS	WHITE SNOWBERRY
SYMPHORICARPOS X CHENAULT 'HANCOCK'	HANCOCK CORALBERRY
SYRINGA PATULA 'MISS KIM'	MISS KIM DWARF LILAC
SYRINGA MANZANA	DWARF LILAC
VIBURNUM LANTANA	NANNYBERRY
EVERGREEN SHRUBS	
BUXUS MICROPHYLLA 'WINTER GEM'	WINTER GEM BOXWOOD
PICEA ABIES	NORWAY SPRUCE
PICEA GLAUCA	DWARF ALBERTA SPRUCE
PINUS MUGO	MUGHO PINE
TAXUS MEDIA	YEW
THUJA OCCIDENTALIS EMERALD	EMERALD ARBORVITAE
GROUNDCOVER - PERENNIALS - ORNAMENTAL GRASSES	
ARCTOSTAPHYLOS UVA-URSI	KINNIKINNICK
ASTER SPP	ASTER
CALAMAGROSTIS ACUT. SP	FEATHER REED GRASS
CERASTIUM TOMENTOSUM	SNOW-IN-SUMMER
DIANTHUS SPP	PINKS
ERIANTHUS RAVENNAE	HARDY PAMPAS GRASS
EUONYMUS FORTUNEI	PURPLELEAF WINTERCREEPER
FESTUCA GLAUCA	FESCUE GRASS
GAZANIA	HARDY GAZANIA
HEMEROCALLIS SPP	DAYLILY
IIMPERATA CYLINDRICA 'RED BARON'	JAPANESE BLOOD GRASS
IRIS SPP	IRIS
LEUCANTHEMUM SPP	DAISY
MAHONIA REPENS	CREEPING OREGON GRAPE HOLLY
MISCANTHUS SINENSIS SP	MAIDEN GRASS
PARTHENOCISSUS QUINQUEFOLIA ENGELMANNII	VIRGINIA CREEPER
PENNISETUM SP	FOUNTAIN GRASS
PHALARIS	RIBBON GRASS
PHLOX SUBULATA	CREEPING PHLOX
RUDBECKIA	BLACK EYED SUSAN
SALVIA MAY NIGHT	MAY NIGHT SALVIA
SEDUM SPP	SEDUM
VINCA MINOR 'BOWLES'	PERIWINKLE

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Southglenn MDP

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SHEET TITLE:
SOUTH REDEVELOPMENT AREA CONCEPTUAL LANDSCAPE PLAN

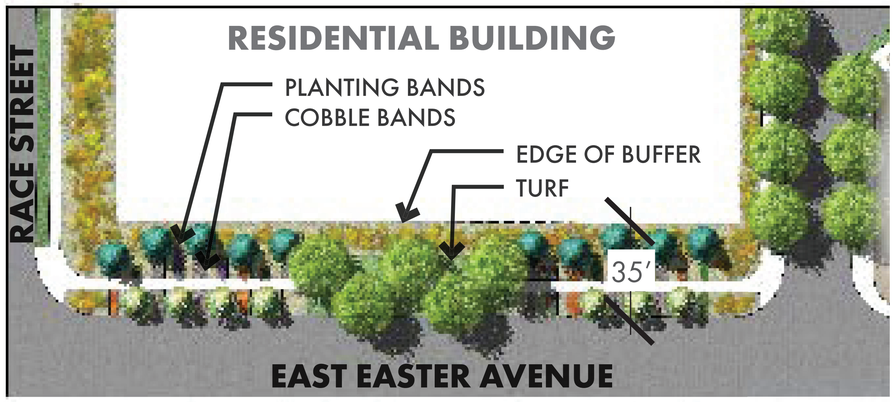
SHEET NUMBER:
8 OF 16

PROJECT NO.: 0190862.00

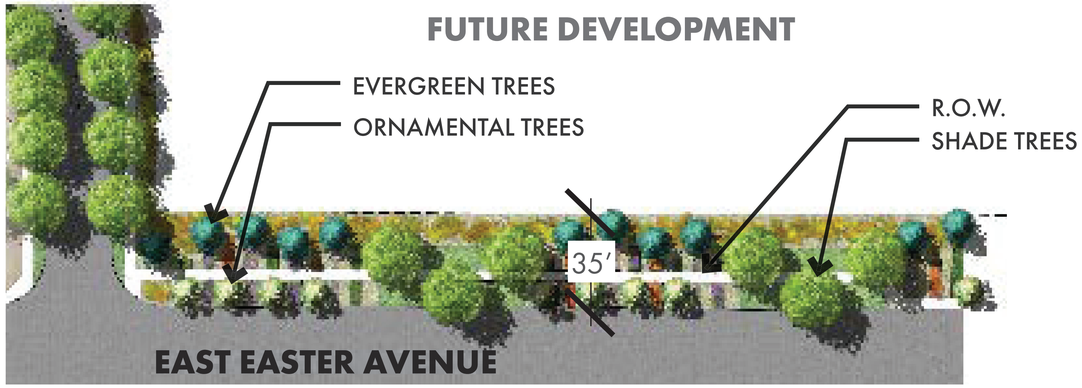
STREETS AT SOUTHGLENN

MASTER DEVELOPMENT PLAN
AMENDMENT NO. 8

PART OF THE NE 1/4 OF SECTION 26, TOWNSHIP 5 SOUTH, RANGE 68 WEST
OF THE SIXTH PRINCIPAL MERIDIAN,
CITY OF CENTENNIAL, ARAPAHOE COUNTY, STATE OF COLORADO



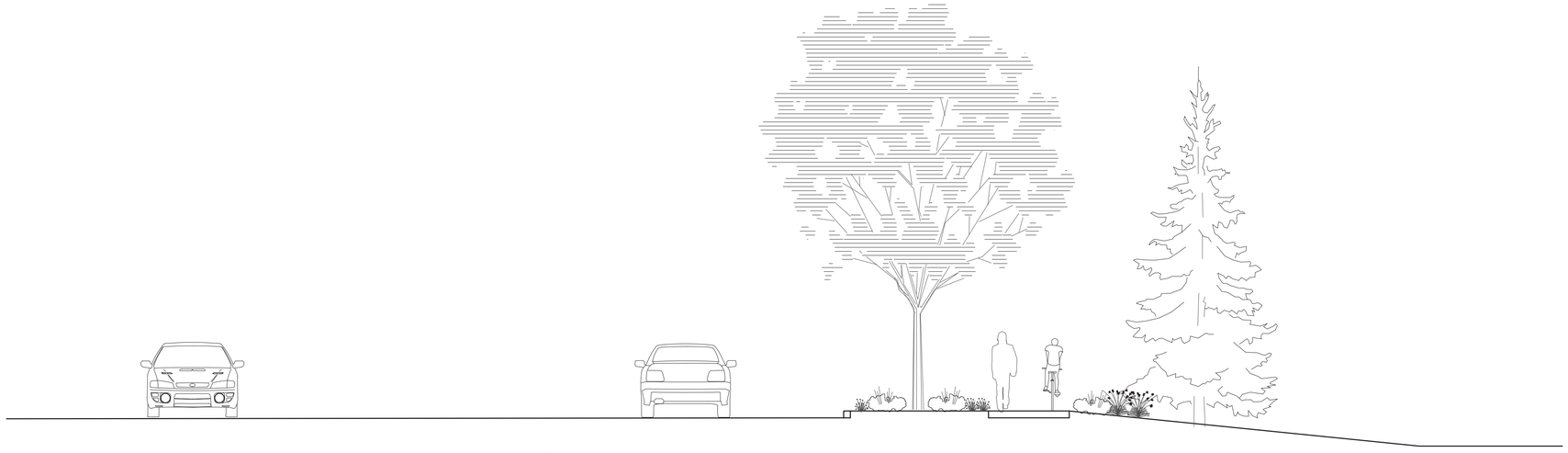
EAST STREETSCAPE



WEST STREETSCAPE

NORTH

0 15 30 60
1"=30'-0" SCALE



EASTER AVENUE TYPICAL SECTION
(FACING WEST)
NTS

PROPOSAL FOR
STREETS OF SOUTHGLENN APTS

Case Number (PUD-21-00004)

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NOTE: THE REQUREMENTS FOR THE SCALE/SIZE OF THIS AREA ARE NOTED ON SHEET 2.

STREETS AT SOUTHGLENN

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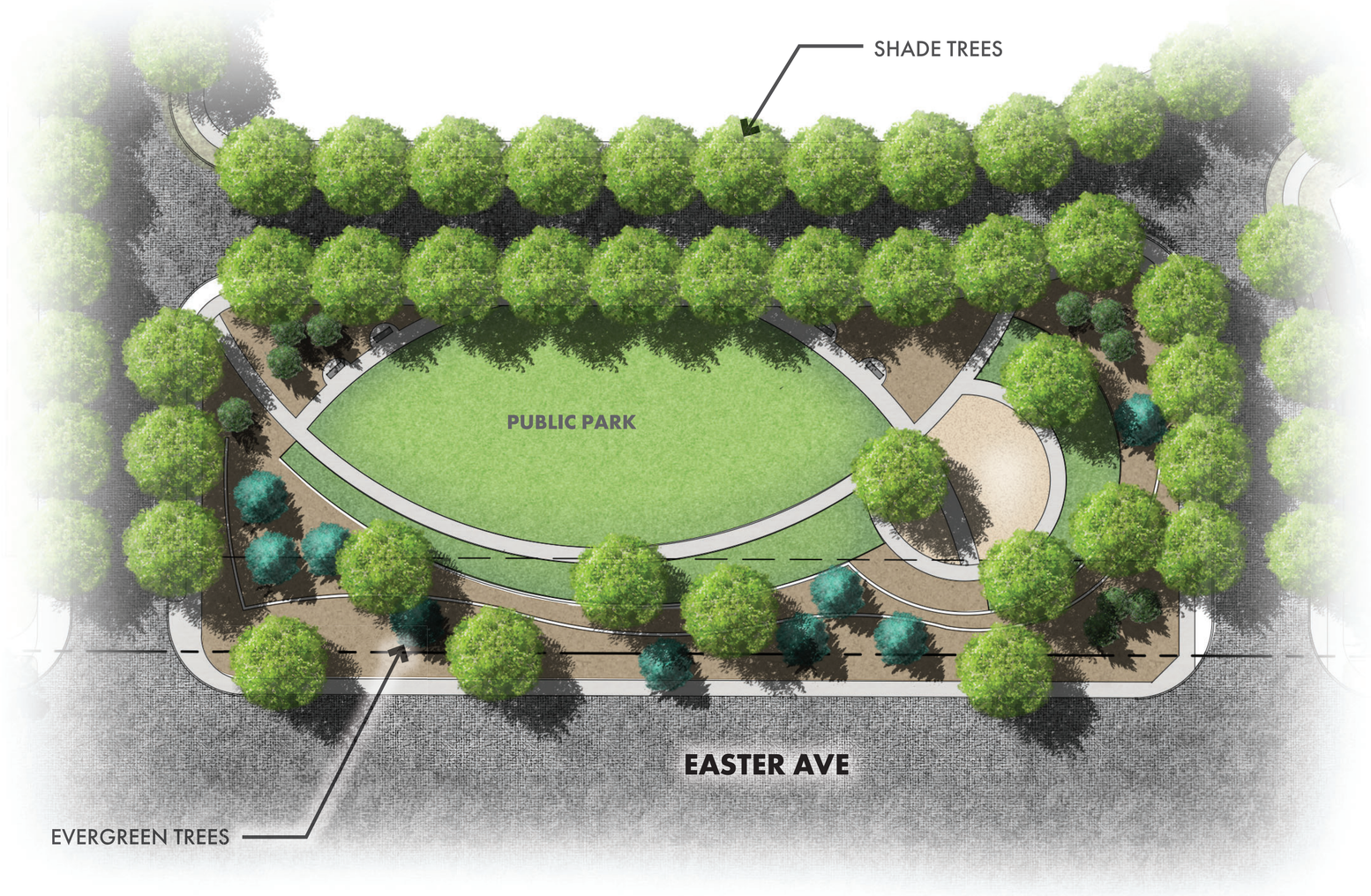


NOTE:
REQUIREMENTS FOR THE SCALE/SIZE OF THIS AREA ARE PROVIDED ON SHEET 2.

NORTH

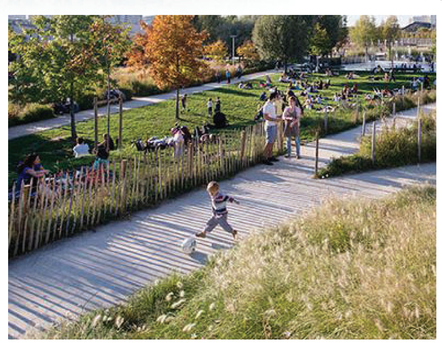
0 10 20 40

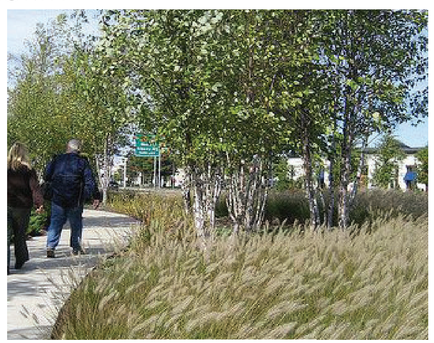
1"=20'-0" SCALE


STREETSCAPE CHARACTER


NATURALIZED BIOSWALE CHARACTER


NATURE PLAY CHARACTER


LANDSCAPE CHARACTER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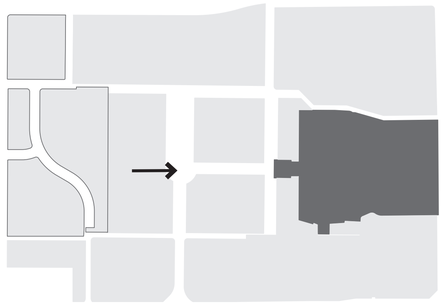

NOTE: RENDERINGS AND IMAGES TO COMMUNICATE THE GENERAL OVERALL DESIGN CHARACTER FOR THE PROJECT, AND ARE SUBJET TO REVISIONS BASED UPON CONSTRUCTION, BUDGET, AND TENANT INFLUENCES.

NOTE: ALL BUILDING AND SITE DESIGN WILL NEED TO COMPLY WITH THE STREETS AT SOUTHGLENN ARCHITECTURAL DESIGN GUIDELINES

Case Number (PUD-21-00004)

GAYLORD ST VIEW FROM COMMONS PARK LOOKING NORTH

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STREETS AT SOUTHGLENN

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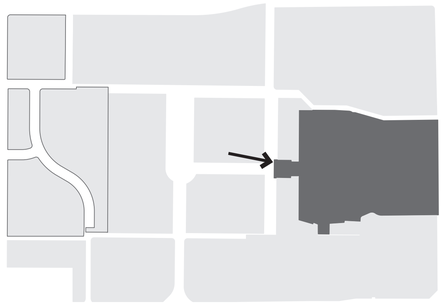

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Case Number (PUD-21-00004)

NORTH PARCEL RETAIL OPTION AT GAYLORD STREET EXTENSION

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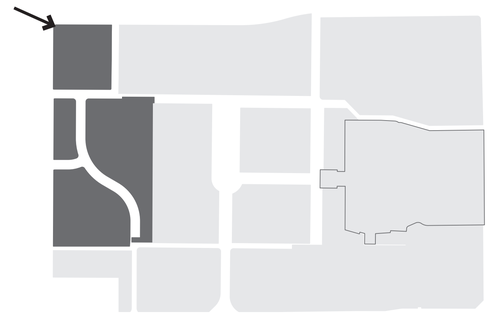

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Case Number (PUD-21-00004)

VIEW FROM THE CORNER OF RACE ST AND EASTER AVE

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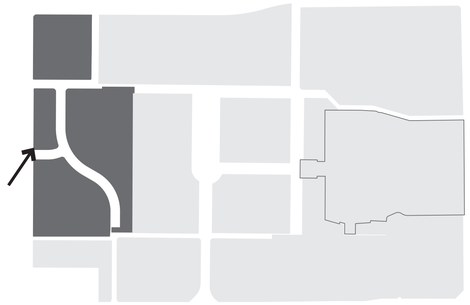

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Case Number (PUD-21-00004)

VIEW OVER PARK FROM EASTER AVE

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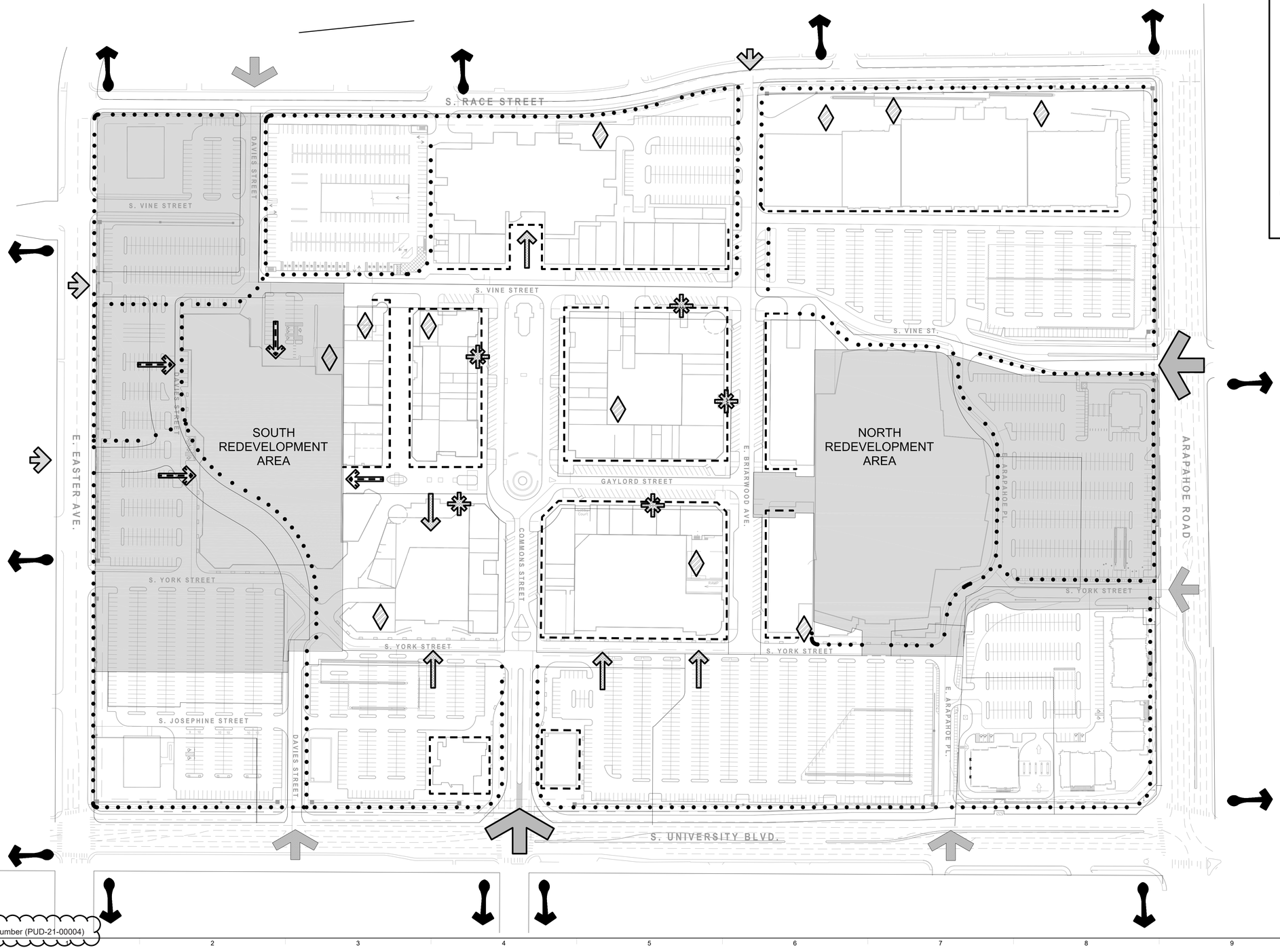

LEGEND

- PRIMARY EXISTING SITE ACCESS TO REMAIN
- SECONDARY EXISTING SITE ACCESS TO REMAIN
- PROPOSED SITE ACCESS
- PROPOSED ENTRY TO LOWER LEVEL PARKING
- PROPOSED PEDESTRIAN CONNECTION
- EXISTING PEDESTRIAN CONNECTION TO ADJACENT NEIGHBORHOOD
- PROPOSED RETAIL ENTRANCES
- ENTRANCE OF EXISTING RETAIL ANCHOR
- PROPOSED ENTRANCE OF NEW ANCHOR
- RESIDENTIAL ENTRY
- SERVICE AREA

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CONNECTIVITY PLAN

SHEET NUMBER:
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STREETS AT SOUTHGLENN

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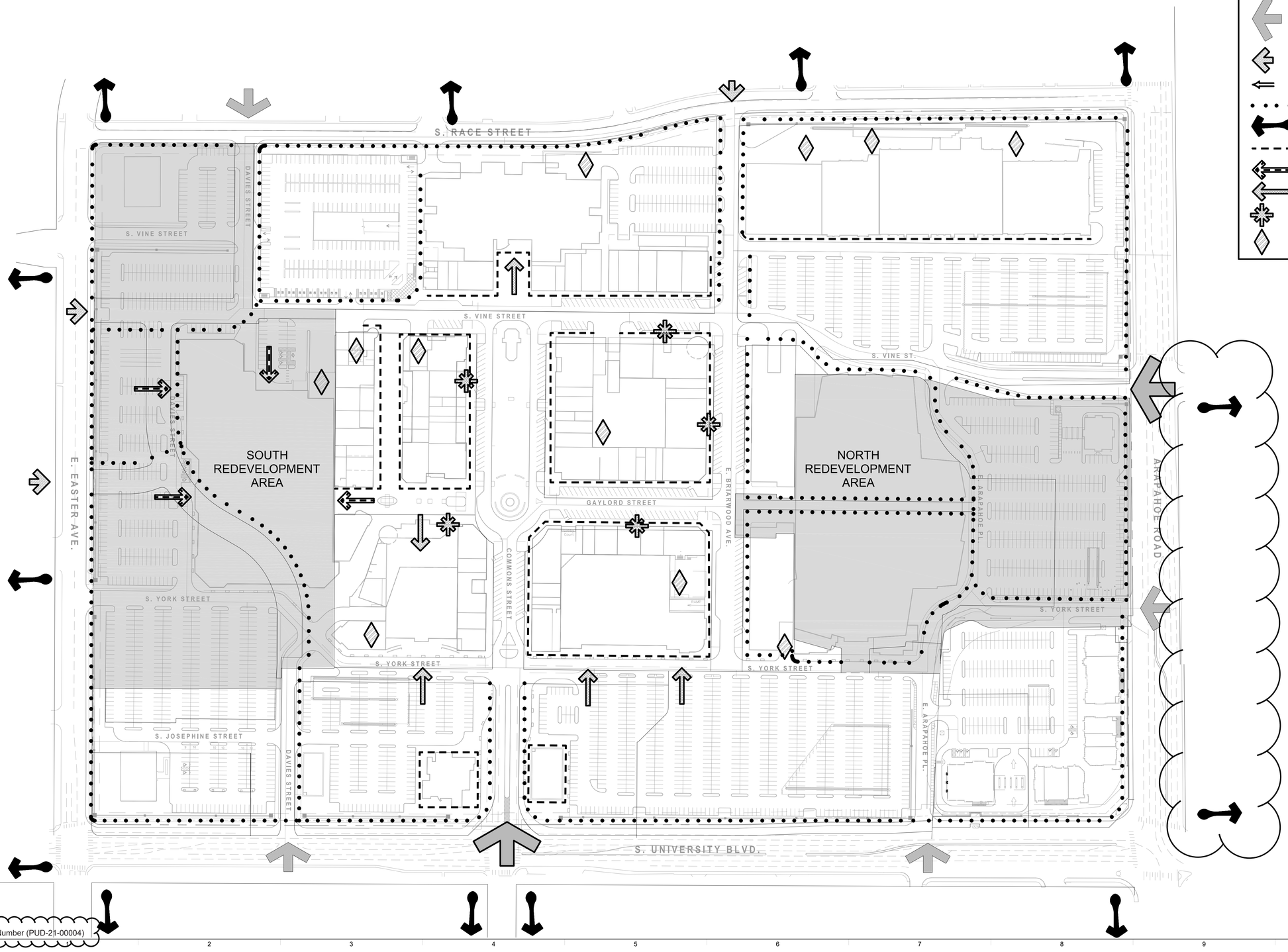

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- PROPOSED ENTRY TO LOWER LEVEL PARKING
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PROPOSED FUTURE REDEVELOPMENT AREA CONNECTIVITY PLAN

SHEET NUMBER:
16 OF 16

PROJECT NO.: 0190862.00

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0° North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

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

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

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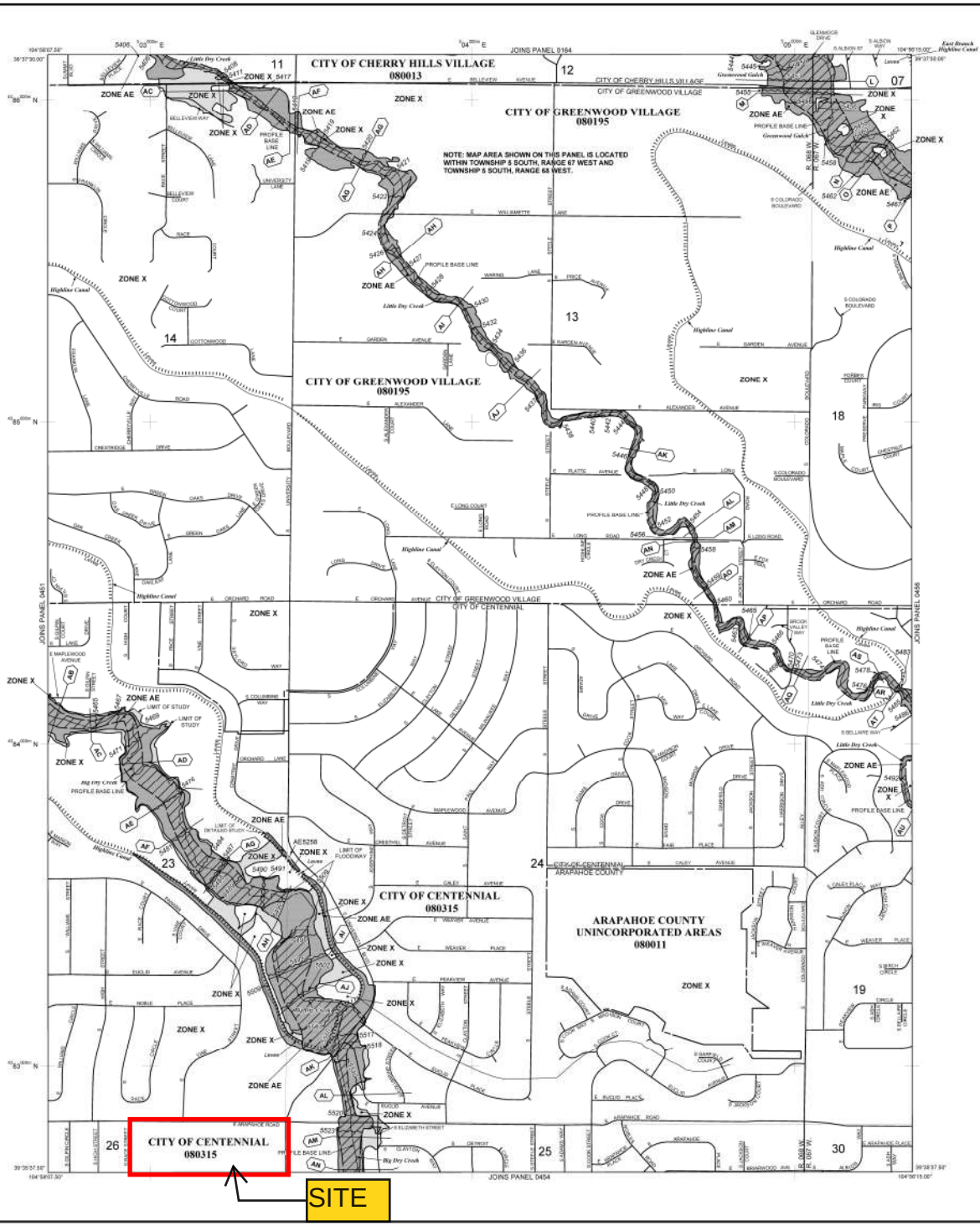

LEGEND

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

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

ZONE A — No Base Flood Elevations determined.

ZONE AE — Base Flood Elevations determined.

ZONE AH — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.

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ZONE A99 — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.

ZONE V — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.

ZONE VE — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

ZONE X — Areas determined to be outside the 0.2% annual chance floodplain.

ZONE D — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

Floodplain boundary

Floodway boundary

Zone D boundary

CBRS and OPA boundary

Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513 — Base Flood Elevation line and value; elevation in feet*

(EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

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

A — A — Cross section line

23 — 23 — Transect line

97°07'30", 32°22'30" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)

4275000mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13

6000000 M — 5000-foot grid ticks: New York State Plane coordinate system, east zone (FIPSZONE 3101), Transverse Mercator

DX5510 — Bench mark (see explanation in Notes to Users section of this panel)

M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
April 17, 1989

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
March 4, 1991 - December 3, 1993 - August 16, 1995
December 17, 2010 - to update map format, to change Special Flood Hazard Areas, and to change Base Flood Elevations

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MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0452K

FIRM
FLOOD INSURANCE RATE MAP
ARAPAHOE COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 452 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ARAPAHOE COUNTY	080011	0452	K
CENTENNIAL, CITY OF	080315	0452	K
CHERRY HILLS VILLAGE, CITY OF	080013	0452	K
GREENWOOD VILLAGE, CITY OF	080195	0452	K

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

MAP NUMBER
08005C0452K

MAP REVISED
DECEMBER 17, 2010

Federal Emergency Management Agency

NOTES TO USERS

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

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

Coastal Base Flood Elevations shown on this map apply only landward of 0.0° North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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

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

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

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

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

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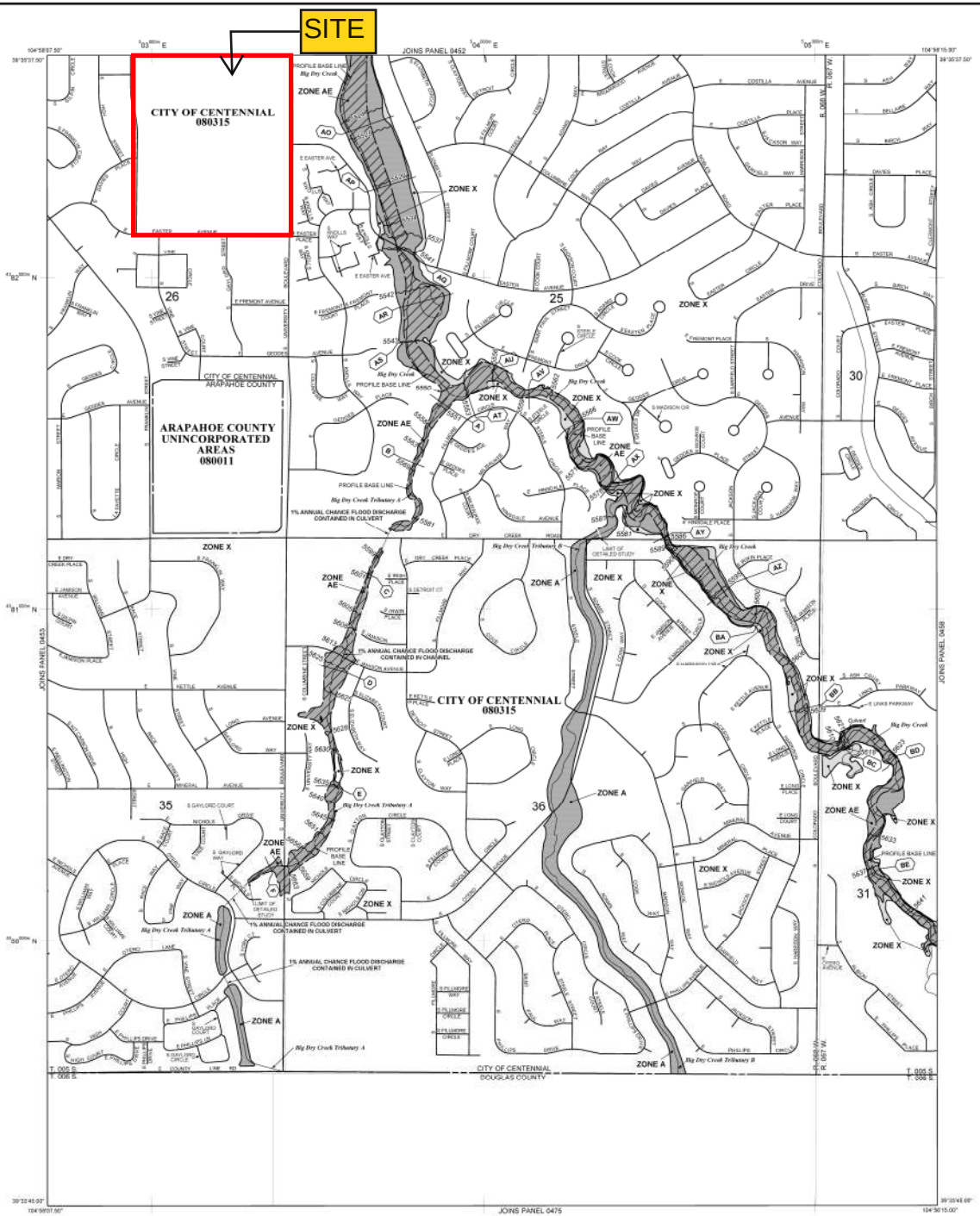

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NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0454K

FIRM
FLOOD INSURANCE RATE MAP
ARAPAHOE COUNTY, COLORADO
AND INCORPORATED AREAS

PANEL 454 OF 725
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ARAPAHOE COUNTY	080011	0454	K
CENTENNIAL, CITY OF	080315	0454	K

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MAP NUMBER
08005C0454K

MAP REVISED
DECEMBER 17, 2010

Federal Emergency Management Agency

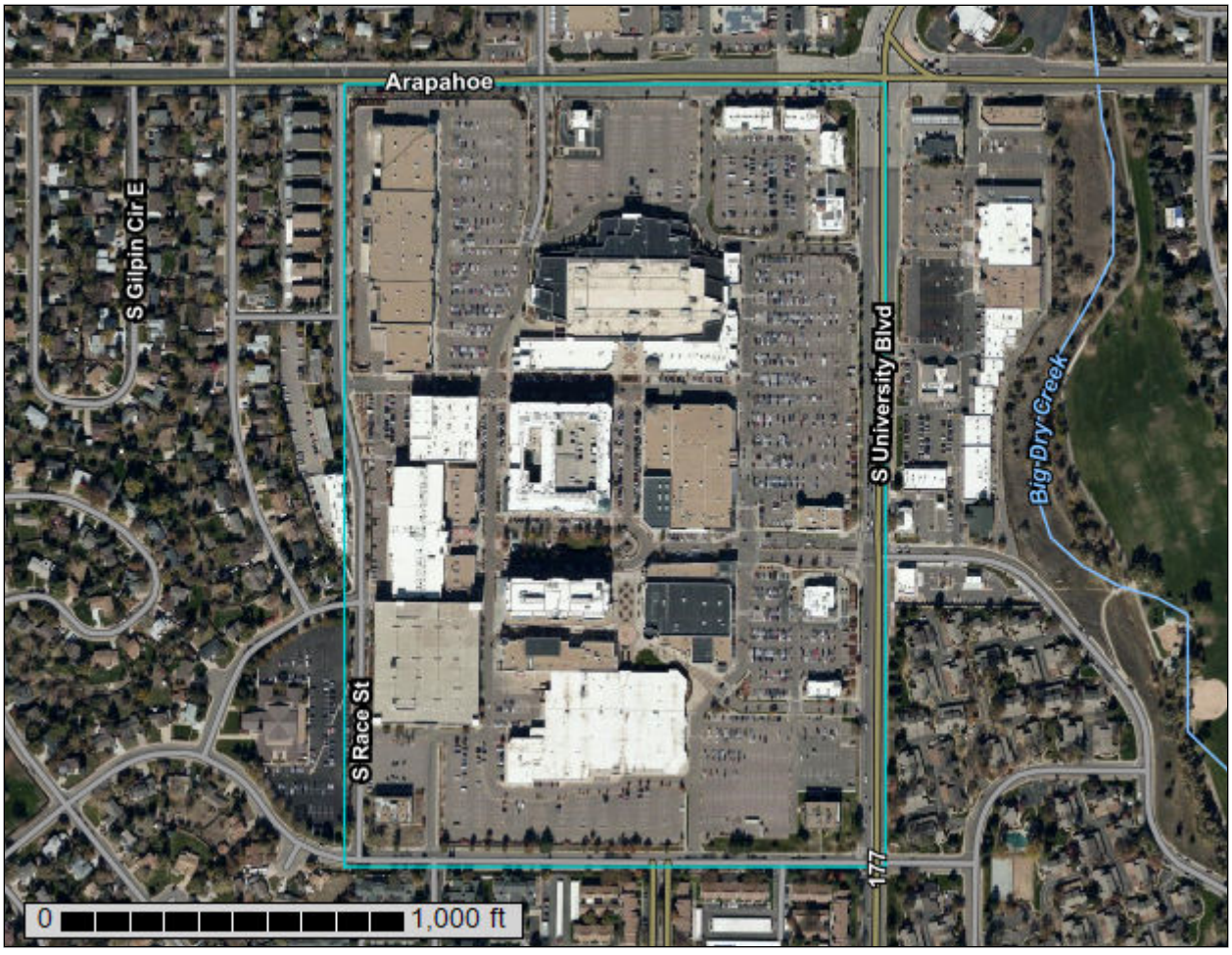
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Arapahoe County, Colorado



April 27, 2021

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,070 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Arapahoe County, Colorado
Survey Area Data: Version 16, Jun 4, 2020

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

Date(s) aerial images were photographed: Oct 20, 2018—Oct 26, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FdB	Fondis silt loam, 1 to 3 percent slopes	54.6	65.8%
FdC	Fondis silt loam, 3 to 5 percent slopes	28.4	34.2%
Totals for Area of Interest		**83.0**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Arapahoe County, Colorado

FdB—Fondis silt loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 34yh
Elevation: 4,700 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fondis and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fondis

Setting

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty and/or loamy

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 27 inches: clay
H3 - 27 to 60 inches: clay loam

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: High (about 10.5 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R049XY202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Weld

Percent of map unit: 10 percent
Hydric soil rating: No

Buick

Percent of map unit: 5 percent
Hydric soil rating: No

FdC—Fondis silt loam, 3 to 5 percent slopes

Map Unit Setting

National map unit symbol: 34yj
Elevation: 4,700 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 150 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Fondis and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fondis

Setting

Landform: Drainageways
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy and/or silty

Typical profile

H1 - 0 to 6 inches: silt loam
H2 - 6 to 24 inches: clay
H3 - 24 to 32 inches: silty clay loam
H4 - 32 to 46 inches: loam, silt loam
H4 - 32 to 46 inches: clay loam
H5 - 46 to 84 inches:

Properties and qualities

Slope: 3 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Available water capacity: Very high (about 12.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Ecological site: R049XY202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Weld

Percent of map unit: 8 percent
Hydric soil rating: No

Buick

Percent of map unit: 7 percent
Hydric soil rating: No

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential lots (lot area only)**:**	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Undeveloped Areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

PROJECT: Streets at SouthGlenn
DATE: 9/13/2021

Proposed/Existing	Land Use	%Imp
	Apartments	75
	Parks	10
	Drive and Walk	90
	Landscape	2
	Commercial/Roofs	90

Soil Types: FdB - Fondis silt loam, 1 to 3 percent slopes
FdC - Fondis silt loam, 3 to 5 percent slopes

Hydrologic Grouping: Type C

Runoff Coefficients: $C_{C/D}$(2year) = 0.83i^1.122
$C_{C/D}$(5year) = 0.82i+.035
$C_{C/D}$(10year) = 0.74i+.132
$C_{C/D}$(100year) = 0.41i+.484

NORTH REDEVELOPMENT AREA
Proposed Basins (proposed conditions) **Land Use (Acres)** **Weighted Runoff Coefficient**

Basin	Total Area	Apartments	Parks	Drive and Walk	Landscape	Commercial	C2	C5	C10	C100	%Imp
B - NORTH	2.50	0.00	0.00	0.00	0.00	2.50	0.74	0.77	0.80	0.85	90.0
C - NORTH	4.64	0.00	0.00	0.00	0.00	4.64	0.74	0.77	0.80	0.85	90.0
E - NORTH	1.53	0.00	0.00	0.00	0.00	1.53	0.74	0.77	0.80	0.85	90.0
F - NORTH	0.11	0.00	0.00	0.00	0.00	0.11	0.74	0.77	0.80	0.85	90.0

TOTAL AREA (ACRES): **8.79**
TOTAL IMPERVIOUSNESS (%): **90.00**

SOUTH REDEVELOPMENT AREA
Proposed Basins (proposed conditions) **Land Use (Acres)** **Weighted Runoff Coefficient**

Basin	Total Area	Apartments	Parks	Drive and Walk	Landscape	Commercial	C2	C5	C10	C100	%Imp
A - SOUTH	4.06	4.06	0.00	0.00	0.00	0.00	0.60	0.65	0.69	0.79	75.0
C - SOUTH	7.11	7.11	0.00	0.00	0.00	0.00	0.60	0.65	0.69	0.79	75.0
G - SOUTH	0.52	0.52	0.00	0.00	0.00	0.00	0.60	0.65	0.69	0.79	75.0

TOTAL AREA (ACRES): **11.69**
TOTAL IMPERVIOUSNESS (%): **75.00**

NORTH REDEVELOPMENT AREA
Historic Basins (existing conditions) **Land Use (Acres)** **Weighted Runoff Coefficient**

Basin	Total Area	Apartments	Parks	Drive and Walk	Landscape	Roof	C2	C5	C10	C100	%Imp
B - NORTH	2.50	0.00	0.00	0.39	0.05	2.06	0.72	0.76	0.78	0.85	88.1
C - NORTH	4.64	0.00	0.00	2.23	0.55	1.86	0.64	0.69	0.72	0.81	79.5
E - NORTH	1.53	0.00	0.00	1.37	0.17	0.00	0.65	0.69	0.73	0.81	80.5
F - NORTH	0.11	0.00	0.00	0.11	0.00	0.00	0.74	0.77	0.80	0.85	90.0

TOTAL AREA (ACRES): **8.79**
TOTAL IMPERVIOUSNESS (%): **82.28**

SOUTH REDEVELOPMENT AREA
Historic Basins (existing conditions) **Land Use (Acres)** **Weighted Runoff Coefficient**

Basin	Total Area	Apartments	Parks	Drive and Walk	Landscape	Roof	C2	C5	C10	C100	%Imp
A - SOUTH	4.06	0.00	0.00	2.32	0.31	1.43	0.68	0.72	0.75	0.83	83.3
C - SOUTH	7.11	0.00	0.00	4.76	0.66	1.69	0.66	0.71	0.74	0.82	81.9
G - SOUTH	0.52	0.00	0.00	0.07	0.27	0.19	0.34	0.40	0.46	0.67	44.7

TOTAL AREA (ACRES): **11.69**
TOTAL IMPERVIOUSNESS (%): **80.72**

Calculation of Peak Runoff using Rational Method

Designer: Tiffany D. Watson
Company: Point Consulting
Date: 9/17/2021
Project: Streets at SouthGlenn
Location: University Blvd and Arapahoe Road

Version 2.00 released May 2017

Cells of this color are for required user-input
Cells of this color are for optional override values
Cells of this color are for calculated results based on overrides

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L_i}}{S_i^{0.33}}$$

$$t_t = \frac{L_t}{60K\sqrt{S_t}} = \frac{L_t}{60V_t}$$

$$\text{Computed } t_c = t_i + t_t$$

$$\text{Regional } t_c = (26 - 17i) + \frac{L_t}{60(14i + 9)\sqrt{S_t}}$$

$t_{minimum}$ = 5 (urban)
$t_{minimum}$ = 10 (non-urban)

$$\text{Selected } t_c = \max\{t_{minimum}, \min(\text{Computed } t_c, \text{Regional } t_c)\}$$

Select UDFCD location for NOAA Atlas 14 Rainfall Depths from the pulldown list OR enter your own depths obtained from the NOAA website (click this link)

	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
1-hour rainfall depth, P1 (in) =	0.85	1.11	1.35	1.70	2.00	2.32	3.15
	a	b	c				
Rainfall Intensity Equation Coefficients =	28.50	10.00	0.786				

$$I(in/hr) = \frac{a * P_1}{(b + t_c)^c}$$

$$Q(cfs) = CIA$$

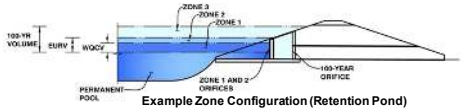
Subcatchment Name	Area (ac)	NRCS Hydrologic Soil Group	Percent Imperviousness	Runoff Coefficient, C							Overland (Initial) Flow Time					Channelized (Travel) Flow Time							Time of Concentration			Rainfall Intensity, I (in/hr)							Peak Flow, Q (cfs)						
				2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	Overland Flow Length L_i (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Overland Flow Slope S_i (ft/ft)	Overland Flow Time t_i (min)	Channelized Flow Length L_t (ft)	U/S Elevation (ft) (Optional)	D/S Elevation (ft) (Optional)	Channelized Flow Slope S_t (ft/ft)	NRCS Conveyance Factor K	Channelized Flow Velocity V_t (ft/sec)	Channelized Flow Time t_t (min)	Computed t_c (min)	Regional t_c (min)	Selected t_c (min)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	500-yr
B - NORTH	2.50	C	90.0	0.74	0.77	0.79	0.82	0.84	0.85	0.87	20.00			0.020	2.13	385.00			0.020	20	2.83	2.27	4.40	12.80	5.00	2.89	3.76	4.58	5.77	6.78	7.87	10.68	5.35	7.23	9.08	11.86	14.21	16.76	23.28
C - NORTH	4.64	C	90.0	0.74	0.77	0.79	0.82	0.84	0.85	0.87	20.00			0.020	2.13	540.00			0.020	20	2.83	3.18	5.31	13.65	5.31	2.84	3.70	4.51	5.67	6.68	7.74	10.51	9.78	13.21	16.59	21.67	25.94	30.61	42.51
E - NORTH	1.53	C	90.0	0.74	0.77	0.79	0.82	0.84	0.85	0.87	20.00			0.020	2.13	420.00			0.020	20	2.83	2.47	4.60	12.99	5.00	2.89	3.76	4.58	5.77	6.78	7.87	10.68	3.28	4.43	5.56	7.26	8.69	10.26	14.25
F - NORTH	0.11	C	90.0	0.74	0.77	0.79	0.82	0.84	0.85	0.87	10.00			0.020	1.51	225.00			0.020	20	2.83	1.33	2.83	11.93	5.00	2.89	3.76	4.58	5.77	6.78	7.87	10.68	0.24	0.32	0.40	0.52	0.63	0.74	1.02
A - SOUTH	4.06	C	75.0	0.60	0.65	0.68	0.74	0.76	0.79	0.82	20.00			0.020	2.91	510.00			0.020	20	2.83	3.01	5.92	16.33	5.92	2.76	3.59	4.37	5.50	6.47	7.51	10.20	6.76	9.43	12.12	16.51	20.07	24.11	34.12
C - SOUTH	7.11	C	75.0	0.60	0.65	0.68	0.74	0.76	0.79	0.82	20.00			0.020	2.91	680.00			0.020	20	2.83	4.01	6.92	17.36	6.92	2.63	3.42	4.17	5.24	6.17	7.16	9.72	11.29	15.74	20.23	27.56	33.50	40.24	56.95
G - SOUTH	0.52	C	75.0	0.60	0.65	0.68	0.74	0.76	0.79	0.82	10.00			0.020	2.06	160.00			0.020	20	2.83	0.94	3.00	14.22	5.00	2.89	3.76	4.58	5.77	6.78	7.87	10.68	0.91	1.27	1.63	2.22	2.69	3.24	4.58

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN A - SOUTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	4.06	acres
Watershed Length =	500	ft
Watershed Length to Centroid =	250	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	75.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.101	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.298	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.193	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.268	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.344	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.467	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.568	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	0.681	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	0.965	acre-feet	inches
Approximate 2-yr Detention Volume =	0.192	acre-feet	
Approximate 5-yr Detention Volume =	0.274	acre-feet	
Approximate 10-yr Detention Volume =	0.328	acre-feet	
Approximate 25-yr Detention Volume =	0.383	acre-feet	
Approximate 50-yr Detention Volume =	0.411	acre-feet	
Approximate 100-yr Detention Volume =	0.455	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	13	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

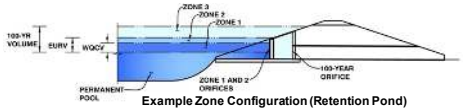
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN B - NORTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	2.50	acres
Watershed Length =	345	ft
Watershed Length to Centroid =	172	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.084	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.223	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.140	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.190	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.238	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.310	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.371	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	0.438	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	0.608	acre-feet	inches
Approximate 2-yr Detention Volume =	0.146	acre-feet	
Approximate 5-yr Detention Volume =	0.201	acre-feet	
Approximate 10-yr Detention Volume =	0.242	acre-feet	
Approximate 25-yr Detention Volume =	0.282	acre-feet	
Approximate 50-yr Detention Volume =	0.302	acre-feet	
Approximate 100-yr Detention Volume =	0.324	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	11	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

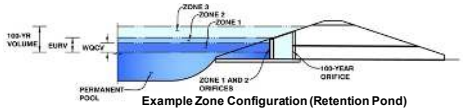
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN C - NORTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	4.64	acres
Watershed Length =	700	ft
Watershed Length to Centroid =	350	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.155	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.414	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.271	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.369	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.462	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.602	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.721	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	0.850	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	1.181	acre-feet	inches
Approximate 2-yr Detention Volume =	0.270	acre-feet	
Approximate 5-yr Detention Volume =	0.372	acre-feet	
Approximate 10-yr Detention Volume =	0.450	acre-feet	
Approximate 25-yr Detention Volume =	0.524	acre-feet	
Approximate 50-yr Detention Volume =	0.560	acre-feet	
Approximate 100-yr Detention Volume =	0.601	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	20	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

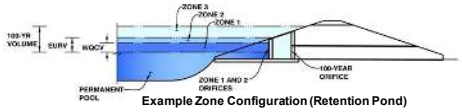
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN C - SOUTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	7.11	acres
Watershed Length =	800	ft
Watershed Length to Centroid =	400	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	75.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.177	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.521	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.343	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.477	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.612	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.830	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	1.009	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	1.211	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	1.715	acre-feet	inches
Approximate 2-yr Detention Volume =	0.337	acre-feet	
Approximate 5-yr Detention Volume =	0.479	acre-feet	
Approximate 10-yr Detention Volume =	0.574	acre-feet	
Approximate 25-yr Detention Volume =	0.671	acre-feet	
Approximate 50-yr Detention Volume =	0.720	acre-feet	
Approximate 100-yr Detention Volume =	0.796	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	23	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

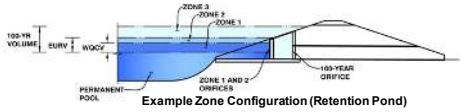
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN E - NORTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	1.53	acres
Watershed Length =	345	ft
Watershed Length to Centroid =	172	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.051	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.137	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.088	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.119	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.149	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.194	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.233	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	0.275	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	0.381	acre-feet	inches
Approximate 2-yr Detention Volume =	0.089	acre-feet	
Approximate 5-yr Detention Volume =	0.123	acre-feet	
Approximate 10-yr Detention Volume =	0.148	acre-feet	
Approximate 25-yr Detention Volume =	0.173	acre-feet	
Approximate 50-yr Detention Volume =	0.185	acre-feet	
Approximate 100-yr Detention Volume =	0.198	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	7	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

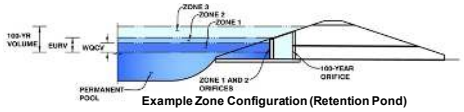
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN F - NORTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	0.11	acres
Watershed Length =	150	ft
Watershed Length to Centroid =	75	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	90.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.004	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.010	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.006	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.009	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.011	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.014	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.017	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	0.020	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	0.028	acre-feet	inches
Approximate 2-yr Detention Volume =	0.006	acre-feet	
Approximate 5-yr Detention Volume =	0.009	acre-feet	
Approximate 10-yr Detention Volume =	0.011	acre-feet	
Approximate 25-yr Detention Volume =	0.012	acre-feet	
Approximate 50-yr Detention Volume =	0.013	acre-feet	
Approximate 100-yr Detention Volume =	0.014	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	0	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		acre-feet

Depth Increment = ft

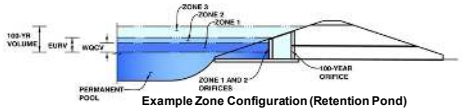
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool									

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Streets at SouthGlenn

Basin ID: BASIN G - SOUTH REDEVELOPMENT AREA



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	EDB	
Watershed Area =	0.52	acres
Watershed Length =	160	ft
Watershed Length to Centroid =	80	ft
Watershed Slope =	0.020	ft/ft
Watershed Imperviousness =	75.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	0.0%	percent
Percentage Hydrologic Soil Groups C/D =	100.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	Centennial - Municipal Court	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides
Water Quality Capture Volume (WQCV) =	0.013	acre-feet	acre-feet
Excess Urban Runoff Volume (EURV) =	0.038	acre-feet	acre-feet
2-yr Runoff Volume (P1 = 0.85 in.) =	0.024	acre-feet	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	0.033	acre-feet	inches
10-yr Runoff Volume (P1 = 1.35 in.) =	0.042	acre-feet	inches
25-yr Runoff Volume (P1 = 1.7 in.) =	0.057	acre-feet	inches
50-yr Runoff Volume (P1 = 2 in.) =	0.069	acre-feet	inches
100-yr Runoff Volume (P1 = 2.32 in.) =	0.083	acre-feet	inches
500-yr Runoff Volume (P1 = 3.15 in.) =	0.118	acre-feet	inches
Approximate 2-yr Detention Volume =	0.025	acre-feet	
Approximate 5-yr Detention Volume =	0.035	acre-feet	
Approximate 10-yr Detention Volume =	0.042	acre-feet	
Approximate 25-yr Detention Volume =	0.049	acre-feet	
Approximate 50-yr Detention Volume =	0.053	acre-feet	
Approximate 100-yr Detention Volume =	0.058	acre-feet	

Define Zones and Basin Geometry

Select Zone 1 Storage Volume (Required) =		acre-feet
Select Zone 2 Storage Volume (Optional) =		acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =		acre-feet
Initial Surcharge Volume (ISV) =	2	ft^3
Initial Surcharge Depth (ISD) =		ft
Total Available Detention Depth (H_{total}) =		ft
Depth of Trickle Channel (H_{TC}) =		ft
Slope of Trickle Channel (S_{TC}) =		ft/ft
Slopes of Main Basin Sides (S_{main}) =		H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =		

Initial Surcharge Area (A_{ISV}) =		ft^2
Surcharge Volume Length (L_{ISV}) =		ft
Surcharge Volume Width (W_{ISV}) =		ft
Depth of Basin Floor (H_{FLOOR}) =		ft
Length of Basin Floor (L_{FLOOR}) =		ft
Width of Basin Floor (W_{FLOOR}) =		ft
Area of Basin Floor (A_{FLOOR}) =		ft^2
Volume of Basin Floor (V_{FLOOR}) =		ft^3
Depth of Main Basin (H_{MAIN}) =		ft
Length of Main Basin (L_{MAIN}) =		ft
Width of Main Basin (W_{MAIN}) =		ft
Area of Main Basin (A_{MAIN}) =		ft^2
Volume of Main Basin (V_{MAIN}) =		ft^3
Calculated Total Basin Volume (V_{total}) =		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									

PHASE III DRAINAGE STUDY
for
THE STREETS AT SOUTHGLENN
Centennial, Colorado

PHASE III DRAINAGE STUDY
for
THE STREETS AT SOUTHGLENN
Centennial, Colorado

Prepared for

Alberta Development Partners, LLC.
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Prepared by

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Colorado Registration No. 40360
For and on Behalf of
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Phone: (303) 770-5600
Fax: (303) 770-2349

CLC Job #05.0199

July 18, 2006
Revised: July 2007
Revised: August 2007
Revised: September 2007

PHASE III DRAINAGE STUDY
for
THE STREETS AT SOUTHGLENN
Centennial, Colorado

ENGINEERS CERTIFICATION

"I hereby affirm that this report (plan) for the Phase III drainage report for the "The Streets at SouthGlenn" was prepared by me (or under my direct supervision) for the owners thereof in accordance with the provisions of Arapahoe County Drainage Design and Technical Criteria, the City of Centennial Stormwater Quality Requirements, and the Urban Drainage and Flood Control District Criteria and approved variances and exceptions thereto. I understand that it is the policy of City of Centennial that the City of Centennial does not and will not assume liability for drainage facilities designed by others."

_____
Registered Professional Engineer
State of Colorado No. 40360

DEVELOPERS CERTIFICATION

"Alberta Development Partners, LLC hereby certifies that the drainage facilities for the "The Streets at SouthGlenn" shall be constructed according to the design presented in this report. I understand the City of Centennial does not and will not assume liability for the drainage facilities designed and/or certified by my engineer. I understand the City of Centennial reviews drainage plans pursuant to Colorado Revised Statutes Title 31, Article 23; but cannot, on behalf of "The Streets at SouthGlenn", guarantee that final drainage design review will absolve Alberta Development Partners, LLC and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the Final Plat and/or Master Development Plan does not imply approval of my engineer's drainage design."

Alberta Development Partners, LLC.

_____
Authorized Signature

PHASE III DRAINAGE STUDY
for
THE STREETS AT SOUTHGLENN
Centennial, Colorado

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PHASE III DRAINAGE STUDY
for
THE STREETS AT SOUTHGLENN
Centennial, Colorado

I. GENERAL LOCATION AND DESCRIPTION

A. Location

(1.) The project is within the northeast one-quarter of Section 26, Township 5 South, Range 68 West of the 6th principal meridian. The project's location is shown on the vicinity map included in the Appendix.

(2.) The project is within the City of Centennial and Arapahoe County at the southwest corner of the intersection of University Boulevard (100' ROW) and Arapahoe Road (100' ROW). Race Street (60' ROW) and Easter Ave (80' ROW) boarder the site on the west and south sides respectively.

(3.) The site is located within two major drainageway basins. The west side of the site is tributary to Upper Slaughterhouse Gulch. The east side of the site is tributary to Big Dry Creek. Facilities downstream of the project site are described in section II.A below.

(4.) Developments surrounding the project include the Cherry Knolls Shopping Center commercial development and the Knolls Townhouse Association residential development to the east; the Glenn Oaks Home Owner's Association and other residential development to the south; a church, and residential development including apartments to the west; residential development to the northwest; and commercial development to the northeast.

B. Description of Property

(1.) The total mall site with all outlying buildings within the bounding streets is approximately 74 acres. The proposed redevelopment will consist of all property excluding the Wells Fargo building located at the University and Arapahoe intersection, the Sears building located to the south of the mall, the Macy's building located to the north of the mall, and the two small office buildings fronting Easter Avenue to the south. All other site buildings and structures will be demolished.

(2.) The existing groundcover is highly impervious, consisting mainly of the roof areas of the existing mall and surrounding buildings; and the asphalt and concrete parking and sidewalk areas associated with the existing development. There is landscaping at some of the building entrances, as well as around the perimeter of the site.

(3.) Runoff from the project site is tributary to two major drainageways. The west side of the site is tributary to Upper Slaughterhouse Gulch. The east side of the site is tributary to Big Dry Creek.

(4.) The site is a redevelopment project consisting of the entire property excluding the Wells Fargo building located at the University and Arapahoe intersection, the Sears building

located to the south of the mall, the Macy's building located to the north of the mall, and the two small office buildings fronting Easter Avenue to the south.

(5) There are no major irrigation facilities on the project site.

(6) The proposed development will be a pedestrian oriented mixed use development including retail, commercial, and residential uses.

II. DRAINAGE BASINS AND SUB-BASINS

A. Major Basin Description

(1.) The westerly side of the existing mall property drains north and west and is tributary to Upper Slaughterhouse Gulch. The "Phase B Report (Major Drainageway Planning)," dated March 1983, as prepared by WRC Engineering (Phase B Report) describes historic drainage concerns for this drainageway and includes recommendations for proposed improvements. The upper limit of the Phase B Report extends to the intersection of Downing Street and Arapahoe Road, approximately 400 feet to the west of the mall property. The report indicates that the area downstream of the mall, along Downing Street to the Highline Canal, experiences flooding because the existing storm sewer system is inadequate for 2-year storm events. Reportedly the 15-inch storm sewer in Downing Street is connected upstream to a 24-inch and 48-inch storm sewer in Arapahoe Road. The study recommends construction of a 60-inch storm sewer system in Downing Street to convey the 5-year storm. The storm sewer is intended to discharge into a proposed regional detention pond downstream of the Highline Canal.

In 1998 storm sewer improvements were made to the reach from Downing Street downstream to the Highline Canal. The project, "Drainage and Flood Control Improvements Upper Slaughterhouse Gulch Phase VI", consisted of installation of 54-inch diameter storm sewer consistent with the design intent of the Phase B Report.

(2.) The easterly side of the existing mall property drains north and east and is tributary to Big Dry Creek. The "Phase A Report Major Drainageway Planning Alternatives for Big Dry Creek," dated June 1996, as prepared by WRC Engineering (Phase A Report) describes historic drainage concerns for this drainageway and includes recommendations for proposed improvements. The highly urbanized basin described in the Phase A Report has problems with inadequate drainage capacity of bridge structures along Big Dry Creek at the University Boulevard and Arapahoe Road crossings.

(3.) There are no nearby irrigation facilities that will influence, or be influenced by the local drainage described in this study.

B. Sub-Basin Description

(1.) Historically the site drains into the two drainageways described above. Currently the west side of the site surface drains from the south to the north. Runoff flows across the parking lots and discharges directly to Race Street and Arapahoe Road, or is collected in one of a few on-site inlets located along the west edge of the property. Runoff collected in the inlets is conveyed in storm sewer to an existing storm sewer system at the intersection of Race Street and Arapahoe Road. The east side of the site surface drains from the south to the north. Runoff flows across the parking lots and discharges directly to University Boulevard and Arapahoe Road, or is collected in one of a few on-site inlets located east of the existing mall. Runoff collected in the inlets is conveyed in storm sewer along the easterly property line and discharges into a storm sewer system in University Boulevard. Currently there is no on-site detention or water quality associated with the SouthGlenn Mall site.

(2.) Representatives of the City of Centennial have reported that there is minor local street flooding due to the inadequate local drainage system within the surrounding streets. Adjacent street grades are such that runoff is conveyed around the site. No other off site drainage flow patterns impact the development under existing, or proposed conditions.

III. DRAINAGE DESIGN CRITERIA

A. Regulations

The redevelopment of the SouthGlenn mall presents challenges which require adaptations from jurisdictional criteria. There are five existing tenants who plan to remain on-site: two anchor retailers including Sears and Macy's, two office buildings and a bank, Wells Fargo. The existing site drainage system currently provides no storm water quality or storm water detention relief. Due to site constraints, including grading and space requirements, an innovative approach was incorporated into the drainage design to provided storm water quality and detention for the site. As approved in the Phase I drainage report, the proposed drainage system provides water quality and a 10-year detention volume for developed runoff at outfall locations. The detention system and water quality bmps presented are proprietary structures with an established history in construction and operational stability.

B. Development Criteria Reference and Constraints

(1.) Previous drainage studies prepared include discussion on the existing site conditions and downstream impacts on drainage facilities. These reports include: "Phase B Report (Major Drainageway Planning)," dated March 1983, as prepared by WRC Engineering

(Phase B Report) and "Phase A Report Major Drainageway Planning Alternatives for Big Dry Creek," dated June 1996, as prepared by WRC Engineering (Phase A Report). The current condition of the on-site drainage facilities provide minimal conveyance and no storage relief for minor and major storm events. The proposed drainage system shall alleviate flooding up to the 10-year storm event and provide water quality for the minor rainfall events.

(2.) No negative drainage impacts are expected to affect adjacent properties. The historic drainage pattern remains intact with the proposed drainage facility design and construction. The site will continue to drain east and west to respective drainage outfalls. Underground detention facilities release at historic locations to the existing drainage systems in Arapahoe Road and University Boulevard. Storm water release rates to existing drainage facilities has been designed to discharge at 10-year historic release rates. Runoff levels exceeding the capacity of the off-site drainage system will be conveyed in the off-site street system.

(3.) The drainage impact on the site required various considerations. The main impact of drainage was the streets and parking lots within the existing development. Internal streets and parking areas were designed to maintain historic drainage patters across the site. In addition to maintaining historic drainage patterns, parking lots were re-graded to provide adequate cover on the proposed underground detention systems though out the site.

C. Hydrological Criteria

(1.) The site drainage characteristics are evaluated for the 10-year and 100-year storm events. Rainfall intensities were derived from Figure 501 – Time –Frequency Curves as published in the "Arapahoe County Storm Drainage Design and Technical Criteria Manual".

(2.) Runoff rates were calculated by the Rational Method using the intensities discussed above. These calculations are found in the appendix of the report.

(3.) Detention volumes and discharge rates were determined from the empirical method as published in the "Arapahoe County Storm Drainage Design and Technical Criteria Manual".

(4.) Peak runoff rates were calculated for the 10 and 100 year rainfall events.

(5.) No alternate criteria or calculation method is presented in the report.

D. Hydraulic Criteria

(1.) Storm runoff from on-site detention facilities discharge at three distinct locations. Release rates for each detention system are based on a historic 10-year release rate of 0.30 cfs/acre. Detention Systems A and B discharge at the northeast corner of the site into an existing storm sewer in University Boulevard. Detention System E discharges at the north to Arapahoe Road through a curb cut. Detention Systems C and D discharge at the northwest

corner of the site into an existing storm sewer in Arapahoe Road. By detaining and effectively reducing runoff rates, the current flooding condition shall be controlled up to the 10-year storm event. Detailed pipe capacities of the existing storm sewer in Arapahoe Road and University is show on the Historic Drainage Map and the calculations section of the report.

(2.) No other drainage facility design criteria are presented in the report.

E. Variances from Criteria

(1.) Section #14.3.1 – Volume and Release Rate: A variance is requested to waive the 100-year detention requirement for the site.

Section #14.6.1 – Materials: A variance is requested to change the underground detention material from CAP or RCP to a product know as "StormTech". The product consists of chambers injected molded from polypropylene. Reference the appendix for detailed product information.

Section #14.6.4 – Maintenance Access: A variance is requested to eliminate the number and type of access to underground detention systems.

(2.) Section #14.3.1 – 100-year detention volume: Currently there are no detention facilities located on-site. The SouthGlenn Mall is a redevelopment site with site and grading restraints. A detention volume up to the 10-years storm event was negotiated with the City of Centennial with the Phase I drainage report.

Section #14.6.1 – Materials: Due to site and grading constraints, the "StormTech" detention system with added water quality provides a high quality conveyance and treatment for urban areas. Reference the appendix for detailed product information. Due to the size and amount of underground pipe required to detain the 10-year storm event, the economics of constructing such facilities becomes uneconomical. The detention system material was negotiated with the City of Centennial with the Phase I drainage report.

Section #14.6.4 – Maintenance Access: The "StormTech" detention system isolates pollutants into isolator rows which are easily inspected and jet vacuumed without physically entering the system. Reference the appendix for detailed product information.

IV. DRAINAGE FACILITY DESIGN

A. General Concept

(1.) The general drainage concept for the development of this site is to maintain the two existing, overall basins and drainage patterns. The west side of the site will remain tributary

to the Upper Slaughterhouse Gulch drainageway system, and the east side of the site will remain tributary to the Big Dry Creek drainageway system. Currently, the existing drainage facilities on-site do not provide storm water detention or water quality. Storm water runoff is currently conveyed overland across the parking lots to the existing street sections and public drain lines located within Arapahoe Road and University Boulevard. Above ground detention and water quality is not an economical approach for the redevelopment of the existing mall. In order to meet Colorado's requirement for NPDES compliance, requiring storm water to be treated to the maximum extent practicable, an innovative approach to provide storm water quality and detention is presented. On-site inlets and storm drains collect surface runoff from parking, rooftop, and landscape areas and convey surface runoff to water quality units and underground detention systems throughout the site. The water quality units intercept and treat a first flush of runoff pollutants. These units have shown to remove concentrations of contaminated particles and hydrocarbons for storm water runoff. Laboratory tests have shown an 80% TSS removal rate. Floatable debris such as oils and greases are also intercepted prior to discharging into underground detention facilities. The proposed detention systems provide storm water detention and a secondary line of defense for TSS removal. Each system utilizes an isolator rows within the system which basically creates an extended detention basin that allows water to egress through surrounding fabric while sediment is trapped within. The SouthGlenn Metropolitan District will monitor the performance of each drainage facility and perform facility maintenance based on an inspection schedule and detailed product maintenance procedures.

In addition to water quality, the detention systems mitigate excessive runoff up to the 10-year rainfall event. Outlet pipes from each system will be discharged into existing storm sewer drains in Arapahoe Road at the northwest corner of the site, and in University Boulevard at the northeast corner of the site. The design of each drainage facility is such that outlet pipes will connect to existing storm drains by gravity at each corner of the site.

(2.) The general drainage concept proposes an on-site 10-year detention volume within an underground system. On-site detention consists of five underground systems located in parking fields throughout the proposed site. These facilities will reduce the on-site peak flows for minor storms and alleviate potential for local flooding due to the inadequate local drainage system by detaining runoff up to the 10-year storm event. Currently, storm water runoff on the existing site discharges directly to the adjacent streets. The proposed site and grading will reduce the area directly tributary to the adjacent streets. The frequency of minor local flooding will be reduced as well. Runoff from the 100-year storm event will continue to surface flow across the site to the local street system at the northwest and northeast ends of the site. Adjacent street grades will remain such that runoff is conveyed around the site. Other than the reduced local flooding due to inadequate downstream facilities as described above, no other off site drainage flow patterns impact the development of this site.

(3.) Two (2) drainage maps are presented in the report: an existing and proposed drainage conditions map. Basin areas, composite runoff coefficients, time of concentration, maximum

runoff rates for the 10 and 100-year storms, and detention requirements are presented for each drainage basin.

The Historic Drainage Map (HDP) delineates two (2) drainage basins: W and E. The W and E drainage basins represent the areas tributary to the Upper Slaughterhouse Gulch and the Big Dry Creek drainageways. Basin W and E are 39.69 and 34.37 acres respectively. A ridge along the middle of the existing mall generally splits the rooftop drainage evenly to the east and west. The existing drainage facilities are shown in and around the site. The existing storm drain located around the perimeter of the building conveys nuisance flows from the building rooftop areas and truck wells while major flows overtop and spill into parking areas. A few inlets located within the parking fields intercept and convey additional runoff up to their capacity to storm drains located in Arapahoe Road and University Boulevard. Runoff in excess of on-site existing drainage facilities are conveyed overland to the local streets.

The Proposed Drainage Map (DP) delineates five (5) major drainage basins: A, B, C, D and E. Drainage basins A, B and E represent the areas tributary to the Big Dry Creek drainageway. Basins C and D represent the areas tributary to the Upper Slaughterhouse Gulch drainageway. Underground detention systems and water quality units are located at the downstream end of each basin. Proposed storm drains within the site collect and convey runoff up to the 10-year storm to the proposed detention facilities.

Basins A, B and E are 10.49, 16.65 and 1.53 acres respectively. Each basin is tributary to Big Dry Creek and the underground detention systems located at design points A, B and E. A total 10-year release of 7.48 cfs is planned for release from Basins A and B to the existing 18-inch storm drain at the northeast corner of the site. The detention outlet pipe connection is to an existing curb inlet located approximately 650-feet south of Arapahoe Road in University Boulevard. The existing 18-inch pipe has a full flow capacity of 9.10 cfs. Runoff in excess capacity of the existing pipe in University will release through inlets and manholes and discharge onto University Boulevard. A storm sewer upgrade in University Boulevard is planned to extend to the proposed outfall location. This extension to Big Dry Creek will be coordinated by others and will not be the responsibility of the SouthGlenn developers. In the event of a runoff event exceeding the 10-year storm, runoff will be conveyed overland via the private internal street system to University Boulevard and Arapahoe Road. At the low point of Basin B in the corner of the parking lot, south of the first entrance off of University Boulevard, the 100-year overflow for Basins A and B will be located. The storm water will flow over the retaining wall along University Boulevard and into the street section. At this location, the retaining wall will be constructed to convey the storm water over the wall.

Basin E is 1.53 acres. It consists of an existing parking lot for the Macy's building. The parking lot currently drains to the north and directly onto Arapahoe Road though an existing curb cut. The parking lot is planned to be re-graded to allow for the construction of an underground water quality unit and detention facility. A 10-year release of 1.00 cfs is

planned for release from Basin E to Arapahoe Road though a concrete curb cut. In the event of a runoff event exceeding the 10-year storm, runoff will be conveyed overland to Arapahoe Road. At the low point for Basin E, the 100-year storm event will overtop the curb and be conveyed through the screen wall onto Arapahoe Road. The screen wall will be constructed to accommodate this flow through it with a weir configuration.

Basins C and D are 34.23 and 3.65 acres respectively. Each basin is tributary to Slaughterhouse Gulch and the underground detention systems located at design points C and D. A total 10-year release of 11.35 cfs is planned for release to the existing 18-inch storm drain at the northwest corner of the site. The existing 18-inch pipe has a full flow capacity of 8.64 cfs. Runoff in excess capacity of the existing pipe in Race Street and Arapahoe Road will release through inlets and manholes and discharge onto Arapahoe Road. In the event of a runoff event exceeding the 10-year storm, runoff will be conveyed overland via the private internal street system to Race Street and Arapahoe Road. The 100 year storm event for half of Basin C will overtop the curb along Arapahoe Road inline with the two inlets for the underground detention system. This flow will overtop the retaining wall at this location. The 100-year flow for the upper half of Basin C and all of Basin D will be located at the low point for Basin D along Race Street. The storm water will overtop the curb and be conveyed through the screen wall and over the retaining wall. The screen wall will be constructed with a weir configuration to accommodate the flow.

A table showing the 100-year peak flows and weir lengths at the above stated locations is included in the appendix.

(4.) Drainage patterns for the developed site will generally flow east or west away from the ridge running north and south down the center of the site. Runoff will then generally flow from the south to the north.

B. Specific Details

(1.) Due to the capacity of offsite downstream facilities, the proposed drainage system is designed to alleviate stress on the downstream drainage system. Five detention facilities are located on-site to detain and minimize the affects of developed runoff from the site.

The onsite inlets, storm pipes, and underground detention systems are designed to capture and convey the 10-year storm event, therefore the spread width and depth within the street sections is negligible. However, the 100-year storm event will be conveyed within the onsite street sections to the nearest offsite discharges as stated above. The full width street section, including the street parking, is 64 feet flowline to flowline. In a plugged condition during the 100-year storm event the water level will be at the flowline of the street. At the intersections the street sections neck down to 30 feet flowline to flowline. In a plugged condition during the 100-year storm event the water level will be 0.66 feet above the flowline and therefore above the top of curb by approximately 2 inches. At these locations the

sidewalks have been sloped up toward the buildings at 2 percent and therefore the water will not reach the buildings. FlowMaster worksheets are included in the appendix for the two above scenarios.

Onsite sump inlets are designed to pond up to 18 inches in depth at the most and typically approximately 12 inches deep before spilling over to the next inlet. During the 100-year storm event the storm water will spill over each inlet until the discharge point to the site for that particular basin. At which time it will be discharged from the site as specified above.

(2.) On-site detention and water quality does not currently exist. Due to site and grading constraints, the proposed on-site detention will be separated into five underground facilities, each sized to detain runoff from the 10-year storm event. The provided detention volume will reduce the peak flows from the site which historically has contributed to minor local flooding due to the inadequate local drainage system. The frequency of minor local flooding will be reduced as well. Runoff from the 100-year storm event will continue to surface flow across the site to the local street system at the northwest and northeast ends of the site. Discharge from the underground detention systems will be released at the allowable 10-year rate before being discharged into the storm sewer systems in Arapahoe Road at the northwest corner of the site, and in University Boulevard at the northeast corner of the site. Each underground detention facility will require an impermeable liner, engineered sub grade with granular bedding and an under drain system to protect the integrity of the pavement and other facilities within their vicinity.

The water quality system design approach being provided utilizes two systems in series. The first is an in-line ADS® Water Quality Unit which uses a controlled outlet to reduce velocities to allow for removal of a high percentage of sediments and oils associate with the "first flush" of a storm event. The size of the unit is based upon the treated flow rate of 25% of the 10-year runoff intended to treat the "first flush" of runoff. Flows in excess of this rate are designed to bypass preventing re-suspension of the captured pollutants.

Immediately downstream of the Water Quality Unit, runoff is directed into the "isolator row" of the Stormtech® chamber system. This chamber is wrapped in fabric and allows for both settling and filtration of sediments. Sediments captured in this chamber protect the storage areas of adjacent stone and chambers from sediment accumulation. An upstream manhole provides maintenance access to the isolator chamber but provides a high flow weir such that when flowrates or volumes exceed the capacity of the water quality chamber the flows are discharged through a manifold to the other chambers. The manufacturer's information is included in the appendix of this report.

Conventional water quality within the Denver Metro Area, as defined in the UDFCD, is accomplished with above ground detention with an additional volume component known as WQCV, water quality capture volume. The WQCV allows for the physical settling of suspended sediments and associated absorbed pollutants prior to discharge. This volume

is equivalent to runoff from an 80th percentile storm. In comparison, the WQCV and below ground water quality units accomplish treatment of pollutants in different manners. The WQCV provides a volume for runoff to slowly discharge and settle out pollutants while the water quality units capture and contain pollutants within the system without compromising the downstream source.

(3.) The on-site storm sewer, detention, and water quality facilities are private and will be maintained by the SouthGlenn Metropolitan District. An operation, inspection and maintenance agreement for underground detention and water quality facilities will require the SouthGlenn Metropolitan District to perform routine inspection and maintenance on all such facilities within the development. Access to the facilities is accommodated by locating them in, or immediately adjacent to parking and drive areas.

(4.) Drainage easements have been dedicated for each underground water quality and detention facility located on-site. Easements will allow the SouthGlenn Metropolitan District to observe, access and maintain each structure located on-site.

(5.) The Phase B Report for Slaughterhouse Gulch recommends construction of a 60-inch storm sewer system in Downing Street to convey the 5-year storm for tributary basins. The storm sewer is intended to discharge into a proposed regional detention pond downstream of the Highline Canal. These recommended improvements were constructed. This study, for the redevelopment of the mall site, does not anticipate any other future upgrades to the Upper Slaughterhouse Gulch drainageway system.

As part of the proposed improvements for the Arapahoe and University intersection the local storm sewer system will be upgraded to provide a connection for the 10-year discharge from the proposed detention facilities on the east side of the project site.

V. CONCLUSIONS

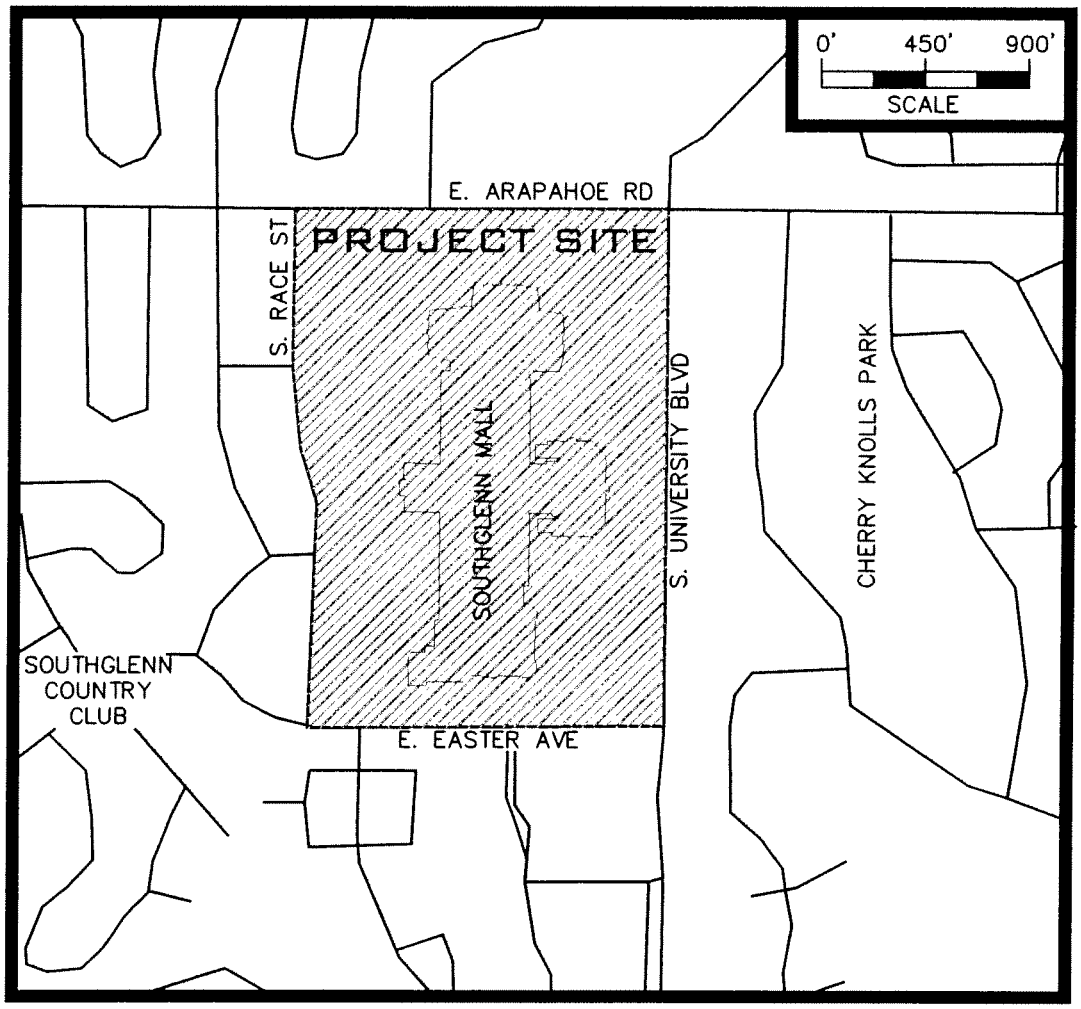
A. Compliance with Standards

The design and construction of all drainage facilities as noted shall be in compliance with the standards and provisions set within this document. Adaptations to criteria defined in the "Arapahoe County Storm Drainage Design and Technical Criteria Manual" are approved by the City of Centennial with the Phase I drainage report.

B. Drainage Concept

(1.) Proposed on-site inlets and storm drains will intercept and convey runoff up to the 10-year storm event to underground detention systems located on-site. Runoff depths will not

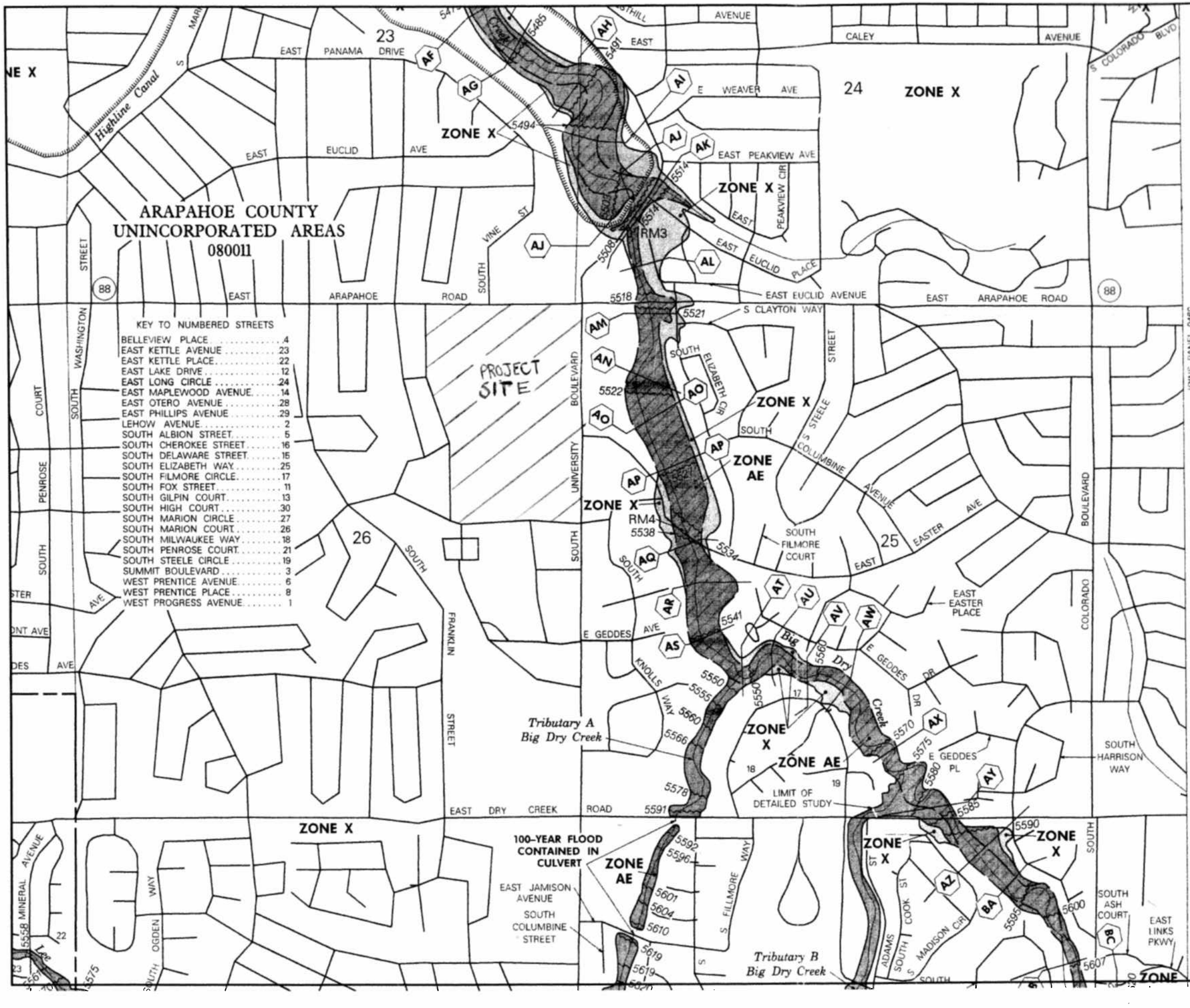
Appendix



VICINITY MAP

NORTH

Figures



KEY TO NUMBERED STREETS

BELLEVIEW PLACE	4
EAST KETTLE AVENUE	23
EAST KETTLE PLACE	22
EAST LAKE DRIVE	12
EAST LONG CIRCLE	24
EAST MAPLEWOOD AVENUE	14
EAST OTERO AVENUE	28
EAST PHILLIPS AVENUE	29
LEHOW AVENUE	2
SOUTH ALBION STREET	5
SOUTH CHEROKEE STREET	16
SOUTH DELAWARE STREET	15
SOUTH ELIZABETH WAY	25
SOUTH FILMORE CIRCLE	17
SOUTH FOX STREET	11
SOUTH GILPIN COURT	13
SOUTH HIGH COURT	30
SOUTH MARION CIRCLE	27
SOUTH MARION COURT	26
SOUTH MILWAUKEE WAY	18
SOUTH PENROSE COURT	21
SOUTH STEELE CIRCLE	19
SUMMIT BOULEVARD	3
WEST PRENTICE AVENUE	6
WEST PRENTICE PLACE	8
WEST PROGRESS AVENUE	1

APPROXIMATE SCALE IN FEET
1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

ARAPAHOE COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 455 OF 725
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ARAPAHOE COUNTY, UNINCORPORATED AREAS	080011	0455	J
CHERRY HILLS VILLAGE, CITY OF	080013	0455	J
ENGLEWOOD, CITY OF	085074	0455	J
GREENWOOD VILLAGE, CITY OF	080195	0455	J

MAP NUMBER
08005C0455 J

MAP REVISED:
AUGUST 16, 1995

Federal Emergency Management Agency

A

B

1

2

39°37'3

ELEVATION REFERENCE MARKS

REFERENCE MARK	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
RM1	5427.7	Bridge flow line invert at Big DryRM Creek and Orchard Road.
RM2	5444.6	Bridge flow line invert at Big Dry Creek and South Franklin Street.
RM3	5500.6	South West corner of intersection of South University Boulevard and Orchard Road.
RM4	5535.5	Bridge upstream flow line invert at Big Dry Creek and Easter Avenue.
RM71	5453.76	Top of fire hydrant at northeast corner of South Albion Street and Belleview Avenue.
RM80	5541.77	A U.S. Geological Survey Square on south side of first step leading to main entrance of Curtis School. At intersection of South University Boulevard and Orchard Road.

APPROXIMATE SCALE IN FEET

1000 0 1000

LEGEND

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

ZONE A No base flood elevations determined.

ZONE AE Base flood elevations determined.

ZONE AH Flood depths of 1 to 3 feet (usually areas of ponding); base flood elevations determined.

ZONE AO Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.

ZONE A99 To be protected from 100-year flood by Federal flood protection system under construction; no base elevations determined.

ZONE V Coastal flood with velocity hazard (wave action); no base flood elevations determined.

ZONE VE Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X Areas of 500-year flood; areas of 100-year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100-year flood.

OTHER AREAS

ZONE X Areas determined to be outside 500-year floodplain.

ZONE D Areas in which flood hazards are undetermined.

UNDEVELOPED COASTAL BARRIERS

Identified 1983 | Identified 1990 | Otherwise Protected Areas

Coastal barrier areas are normally located within or adjacent to Special Flood Hazard Areas.

Flood Boundary

Floodway Boundary

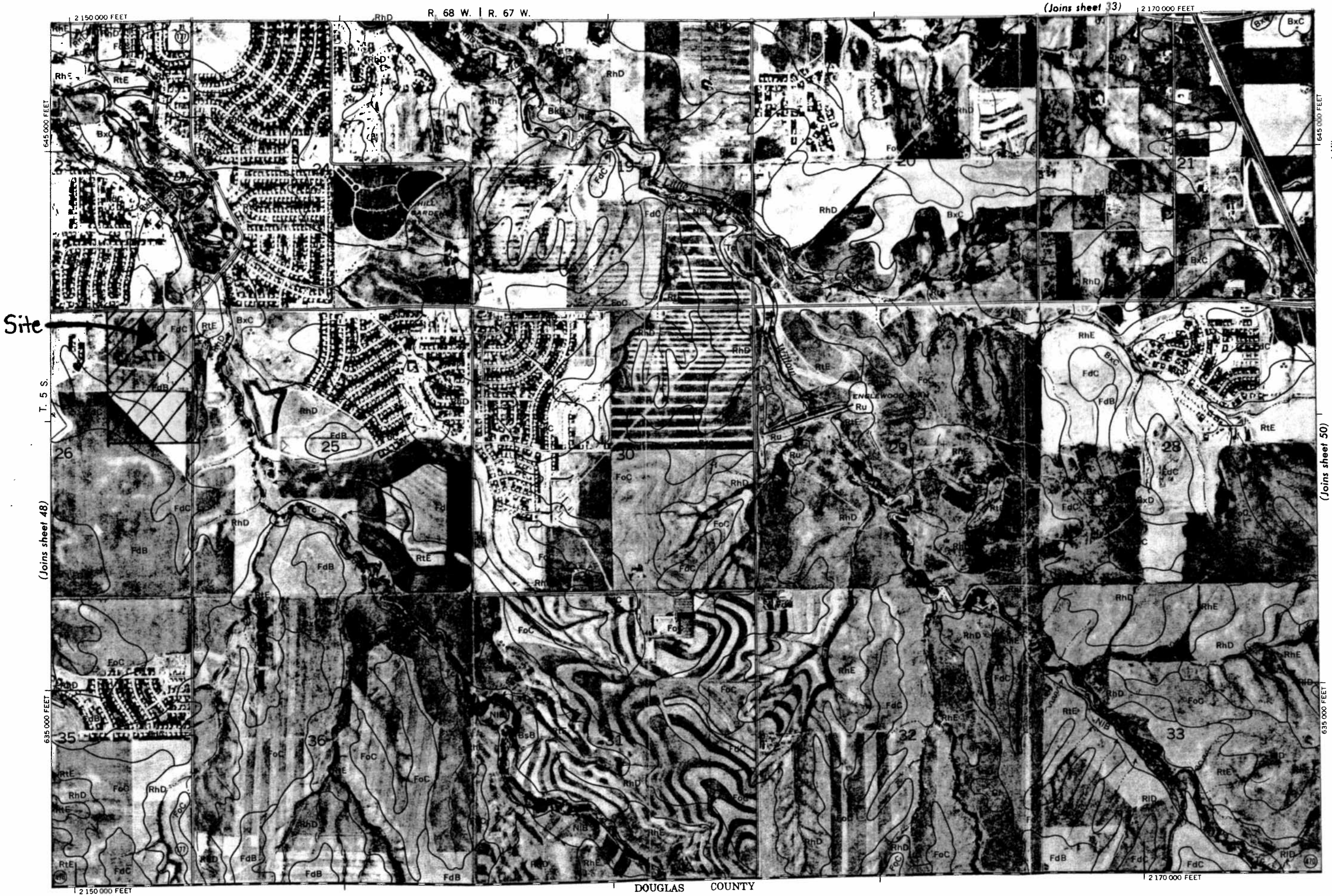
Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones

513 — Base Flood Elevation Line; Elevation in Feet See Map Index for Elevation Datum

D — D — Cross Section Line

(EL 987) — Base Flood Elevation in Feet Where Uniform Within Zone



Mosaic constructed from 1963 aerial photographs.
5,000-foot grid ticks based on Colorado coordinate

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those of soils or land types that have a considerable range of slope but some are for land types that are nearly level. The number, 2, in a symbol indicates that the soil is eroded.

SYMBOL	NAME
AcC	Adena-Colby fine sandy loams, 1 to 5 percent slopes
AcD	Adena-Colby fine sandy loams, 5 to 9 percent slopes
AdC	Adena-Colby silt loams, 1 to 5 percent slopes
AdD	Adena-Colby silt loams, 5 to 9 percent slopes
AsD	Ascalon sandy loam, 5 to 9 percent slopes
BcC	Baca loam, 3 to 5 percent slopes
BcD	Baca loam, 5 to 9 percent slopes
BhD	Baca-Thedalund loams, 3 to 9 percent slopes
BkB	Beckton loam, 0 to 3 percent slopes
BlB	Bijou sandy loam, 0 to 3 percent slopes
BmB	Bijou sandy loam, wet, 0 to 3 percent slopes
BoD2	Blakeland loamy sand, 1 to 9 percent slopes, eroded
BoE	Blakeland loamy sand, 1 to 20 percent slopes
BrB	Bresser loamy sand, terrace, 0 to 3 percent slopes
BsB	Bresser sandy loam, terrace, 0 to 3 percent slopes
BtB	Bresser loam, gravelly subsoil variant, 1 to 3 percent slopes
BuD	Bresser-Stapleton sandy loams, 3 to 9 percent slopes
BuE	Bresser-Stapleton sandy loams, 9 to 20 percent slopes
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes
BvE	Bresser-Truckton sandy loams, 5 to 20 percent slopes
BwD2	Bresser and Truckton soils, 3 to 9 percent slopes, eroded
BxC	Buick loam, 3 to 5 percent slopes
BxD	Buick loam, 5 to 9 percent slopes
Ca	Clayey alluvial land
CoC	Colby silt loam, 1 to 5 percent slopes
CoE	Colby silt loam, 5 to 20 percent slopes
CyD2	Colby and Adena soils, 1 to 9 percent slopes, eroded
EdB	Edgewater loam, 0 to 3 percent slopes
FdB	Fondis silt loam, 1 to 3 percent slopes
FdC	Fondis silt loam, 3 to 5 percent slopes
FgD	Fondis-Ascalon, gravelly subsoil variant, complex, 1 to 9 percent slopes
FoC	Fondis-Colby silt loams, 3 to 5 percent slopes
FrB	Fort Collins loam, 0 to 3 percent slopes
Gr	Gravelly land
HlB	Heldt clay, 0 to 3 percent slopes
HsB	Heldt clay, saline, 0 to 3 percent slopes
LcD	Litle silty clay loam, 1 to 9 percent slopes
LsD	Litle-Samsil, gypsum, silty clay loams, 3 to 9 percent slopes
Lv	Loamy alluvial land
NlB	Nunn loam, 0 to 3 percent slopes
NrB	Nunn-Bresser-Ascalon complex, 0 to 3 percent slopes
OnD	Olney fine sandy loam, 5 to 9 percent slopes

SYMBOL	NAME
RdD	Renohill loam, 3 to 9 percent slopes
ReE	Renohill loam, reddish variant, 5 to 20 percent slopes
RhD	Renohill-Buick loams, 3 to 9 percent slopes
RhE	Renohill-Buick loams, 9 to 20 percent slopes
RkE2	Renohill-Buick complex, 5 to 20 percent slopes, eroded
RlD	Renohill-Litle clay loams, 3 to 9 percent slopes
RtE	Renohill-Litle-Thedalund complex, 9 to 30 percent slopes
Ru	Rock outcrop
SaE	Samsil clay, gypsum, 5 to 20 percent slopes
SlF	Samsil-Litle stony clays, 20 to 50 percent slopes
SrE	Samsil-Renohill clay loams, 3 to 20 percent slopes
Ss	Samsil-Shale outcrop complex
St	Sand pits
Su	Sandy alluvial land
Sv	Shale outcrop
SwE	Stapleton sandy loam, 9 to 30 percent slopes
Ta	Tassel-Rock outcrop complex
Tc	Terrace escarpments
TdE	Terry fine sandy loam, 5 to 20 percent slopes
TeE	Terry-Olney-Thedalund sandy loams, 5 to 20 percent slopes
ThE	Thedalund clay loam, 9 to 20 percent slopes
ThE2	Thedalund clay loam, 9 to 20 percent slopes, eroded
TrC	Truckton loamy sand, 1 to 5 percent slopes
TrE	Truckton loamy sand, 5 to 20 percent slopes
WdC	Weld fine sandy loam, 1 to 5 percent slopes
WeB	Weld silt loam, 0 to 3 percent slopes
WeC	Weld silt loam, 3 to 5 percent slopes
WrB	Weld-Deertrail silt loams, 0 to 3 percent slopes
Wt	Wet alluvial land

WO

Highways and ro
Dual .....
Good motor
Poor motor ..
Trail .....
Highway markers
National Inter
U. S. .....
State or coun
Railroads
Single track
Multiple track
Abandoned
Bridges and cros
Road .....
Trail .....
Railroad ....
Ferry .....
Ford .....
Grade .....
R. R. over ...
R. R. under
Tunnel .....
Buildings .....
School .....
Church .....
Mine and quarry
Gravel pit .....
Power line .....
Pipeline .....
Cemetery .....
Dams .....
Levee .....
Tanks .....
Well, oil or gas
Forest fire or loc
Windmill .....

SOIL SERIES OF COLORADO (continued)

SERIES	DEPTH (INS)	USDA TEXTURE	K	T	WEG	H
FISHERS	0-12	STL	.15	5	8	B
	12-30	STL STCL	.15			
	30-60	STL STCL	.15			
FLATIRONS	0-13	CBVSL	.05	5	8	C
	0-13	STVSL	.10	5	8	
	13-47	GRVC GRVSC GRVCL	.15			
	47-60	GRVSCL	.05			
FLEER	0-30	L FSL			-	A/D
	30-60	GRVLS GRVS				
FLORISSANT	0- 4	L	.24	2	5	C
	4-22	CL C	.32			
	22-31	GRSL	.17			
	31-40	WB				
FLORITA	0- 4	SL	.24	5	3	B
	0- 4	LCOS	.15	5	2	
	4-43	SL COSL	.20			
	43-60	COS COSL SL	.20			
FLUETSCH	0-10	SL	.32	5	-	B
	10-30	SCL	.37			
	30-60	SL	.20			
FOLA	0- 6	CBSL STSL	.15	3	8	B
	6-16	CBVSL STVSL	.10			
	16-60	CBVSL STVSL STX*	.10			
FONDIS	0- 7	SIL L	.28	5	6	C
	0- 7	CL	.28	5	4	
	7-23	SIC C SICL	.32			
	23-60	CL SICL SCL	.32			
FORELLE	0- 4	FSL	.20	5	3	B
	0- 4	L SCL	.28	5	5	
	4-20	CL L SCL	.32			
	20-60	L	.28			
FORSEY	0- 7	CBL	.17	5	8	B
	0- 7	CBVL	.10	5	8	
	7-17	CBVL CBVCL	.10			
	17-60	CBVSL CBVL CBVS*	.10			

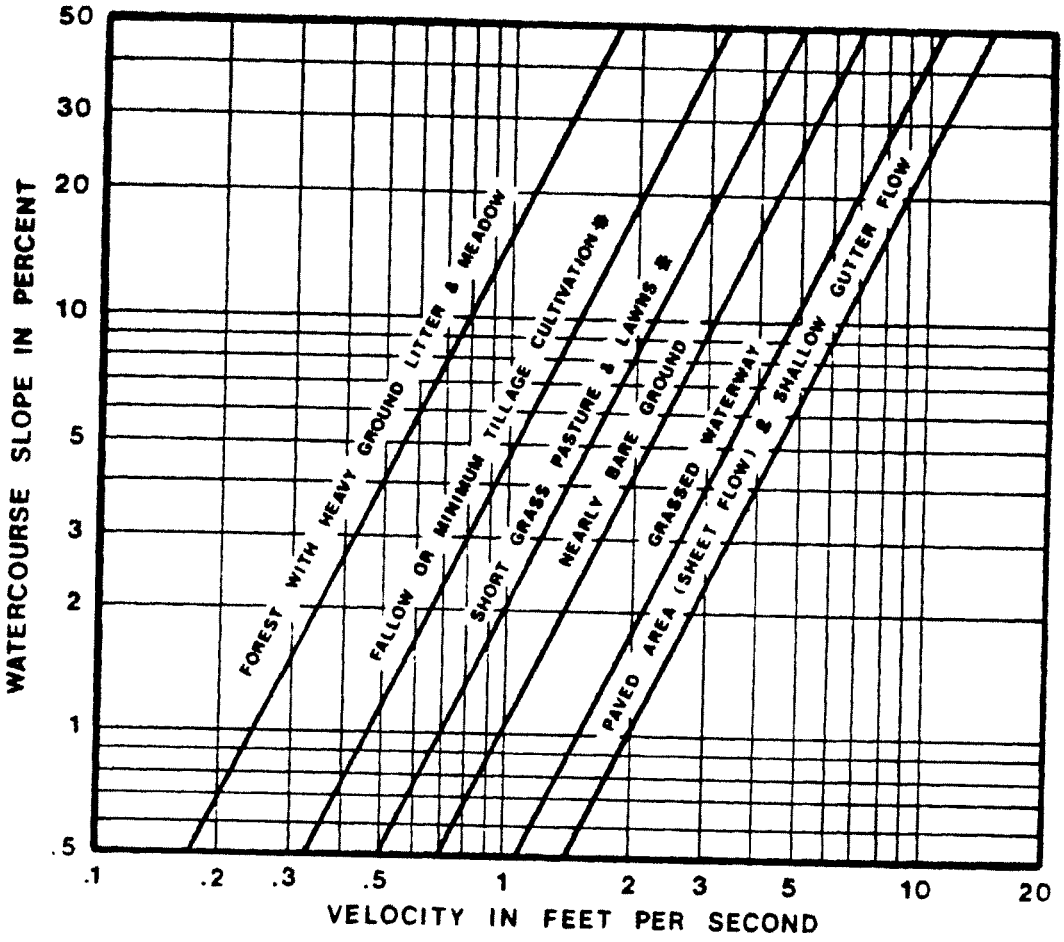
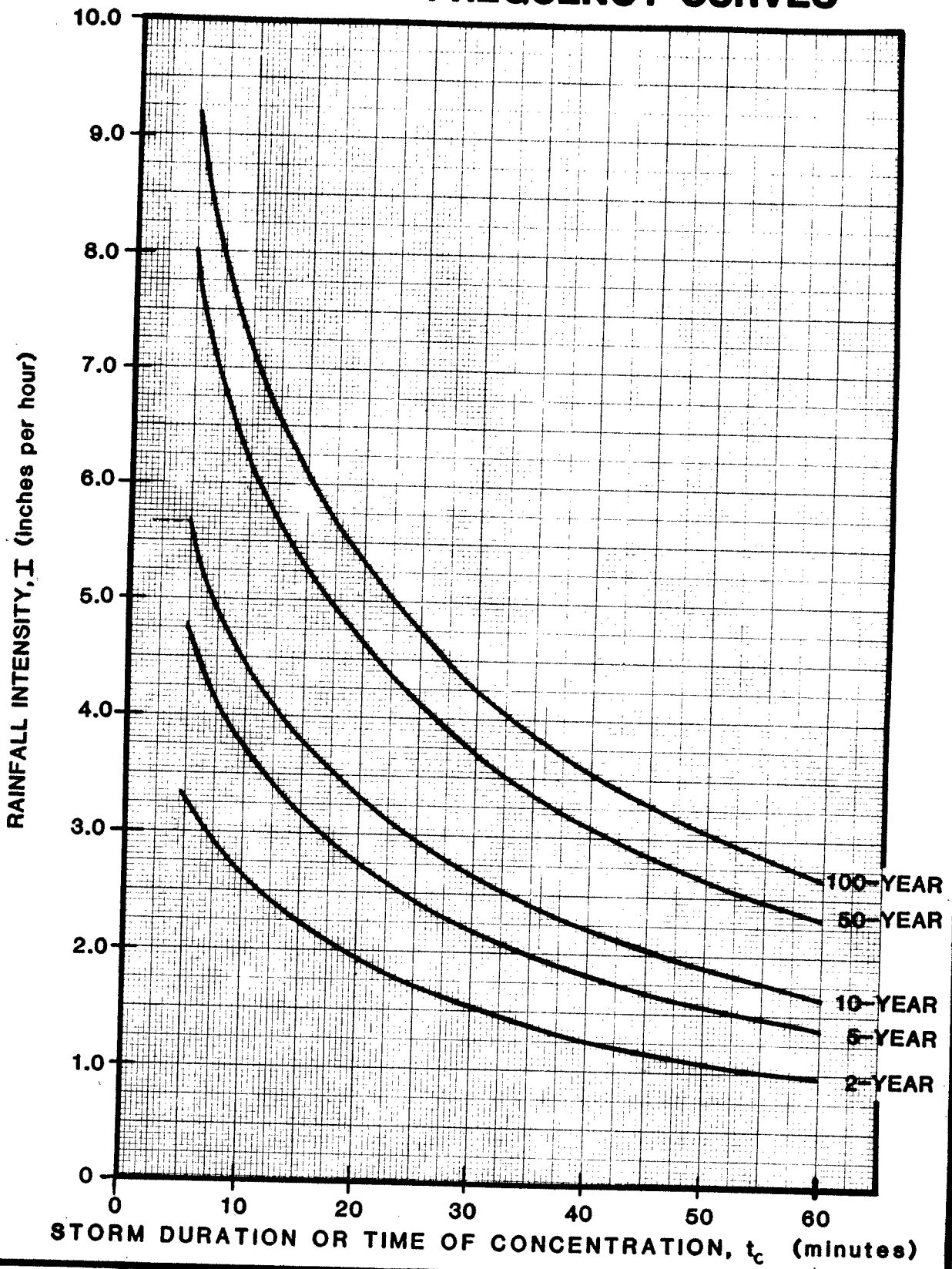


FIGURE RO-1

Estimate of Average Overland Flow Velocity for Use With the Rational Formula

TIME - INTENSITY - FREQUENCY CURVES



Date: NOV 1984
Rev:

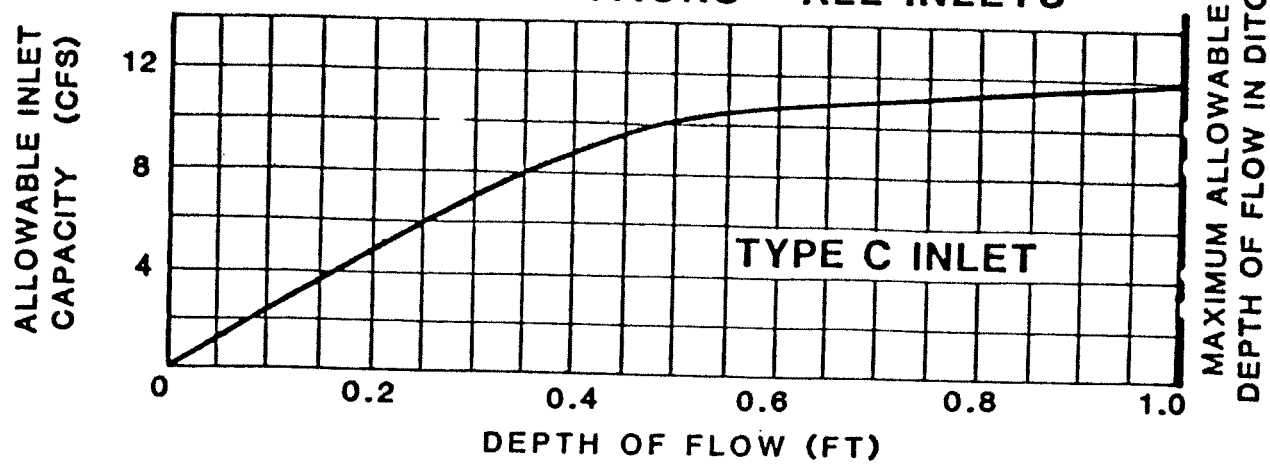
REFERENCE:

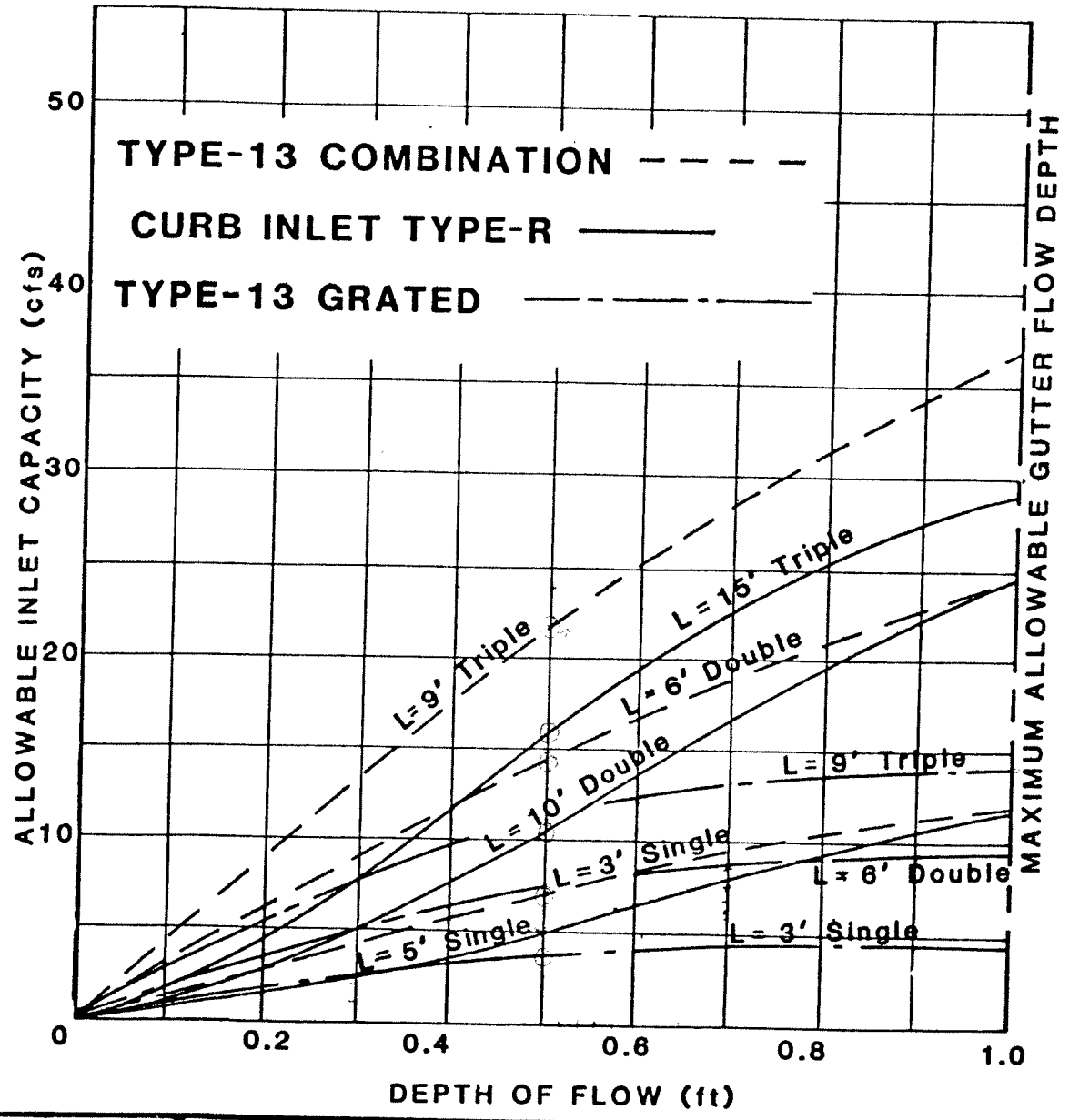
TIME - INTENSITY - FREQUENCY TABULATION

DURATION DURATION FACTORS	5 MIN 0.29		10 MIN 0.45		15 MIN 0.57		30 MIN 0.79		60 MIN 1.00	
FREQ.	DEPTH (IN)	INTEN. (IN/HR)	DEPTH (IN)	INTEN. (IN/HR)	DEPTH (IN)	INTEN. (IN/HR)	DEPTH (IN)	INTEN. (IN/HR)	DEPTH (IN)	INTEN. (IN/HR)
2-YR	0.28	3.36	0.44	2.64	0.55	2.20	0.77	1.54	0.97	0.97
5-YR	0.40	4.80	0.62	3.72	0.79	3.16	1.09	2.18	1.38	1.38
10-YR	0.48	5.76	0.74	4.44	0.94	3.76	1.30	2.60	1.65	1.65
50-YR	0.67	8.04	1.04	6.24	1.32	5.28	1.83	3.66	2.32	2.32
100-YR	0.77	9.24	1.20	7.20	1.52	6.08	2.11	4.22	2.67	2.67

NOTE: Depth at each duration = one hour rainfall depth x respective duration factor

ALLOWABLE INLET CAPACITY
SUMP CONDITIONS - ALL INLETS



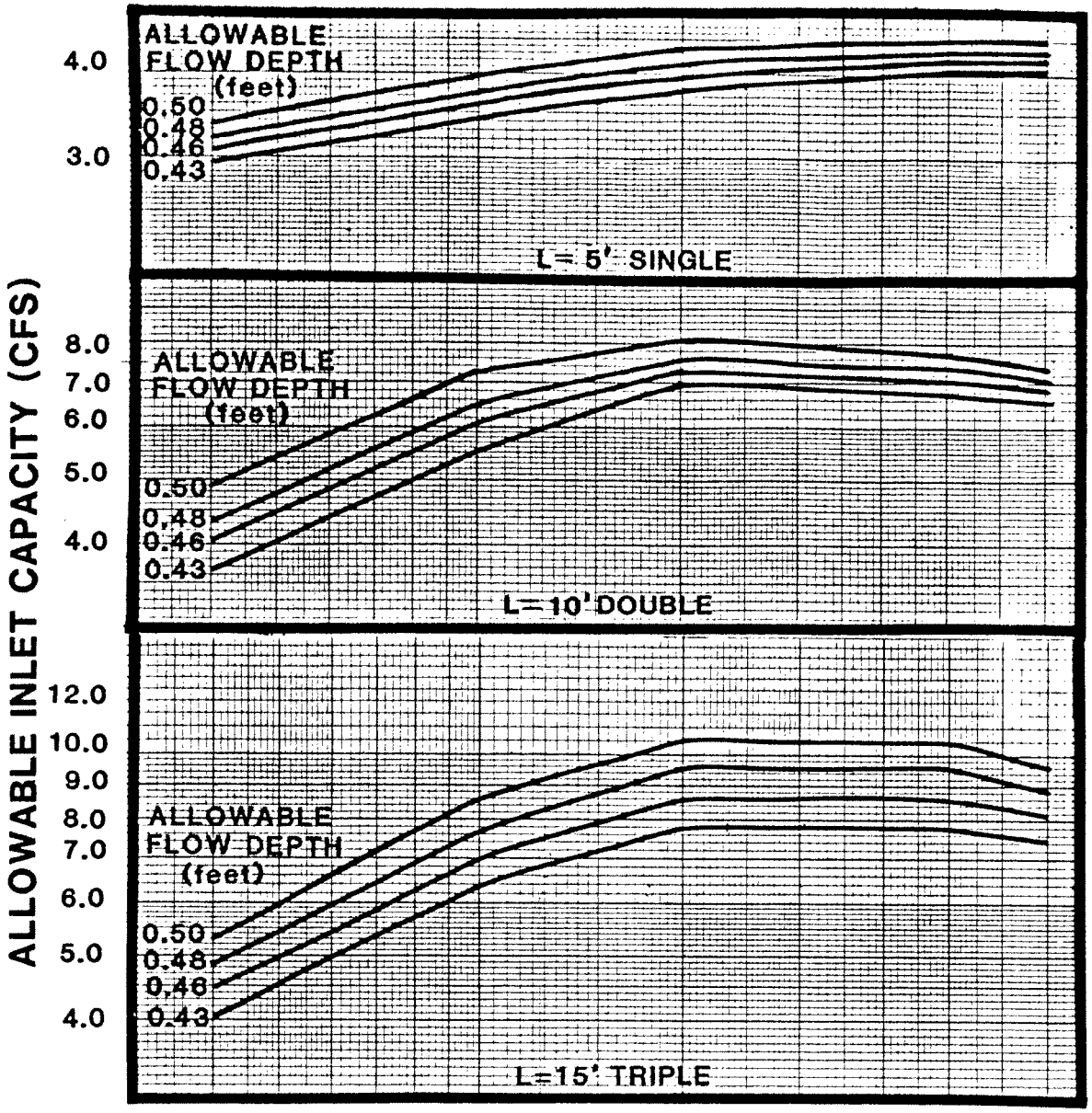


Date: NOV 1984
Rev: JULY 1985

REFERENCE: WRC ENGINEERING, INC., TM-2 AUG. 1984

ALLOWABLE INLET CAPACITY

TYPE - R CURB OPENING ON A CONTINUOUS GRADE

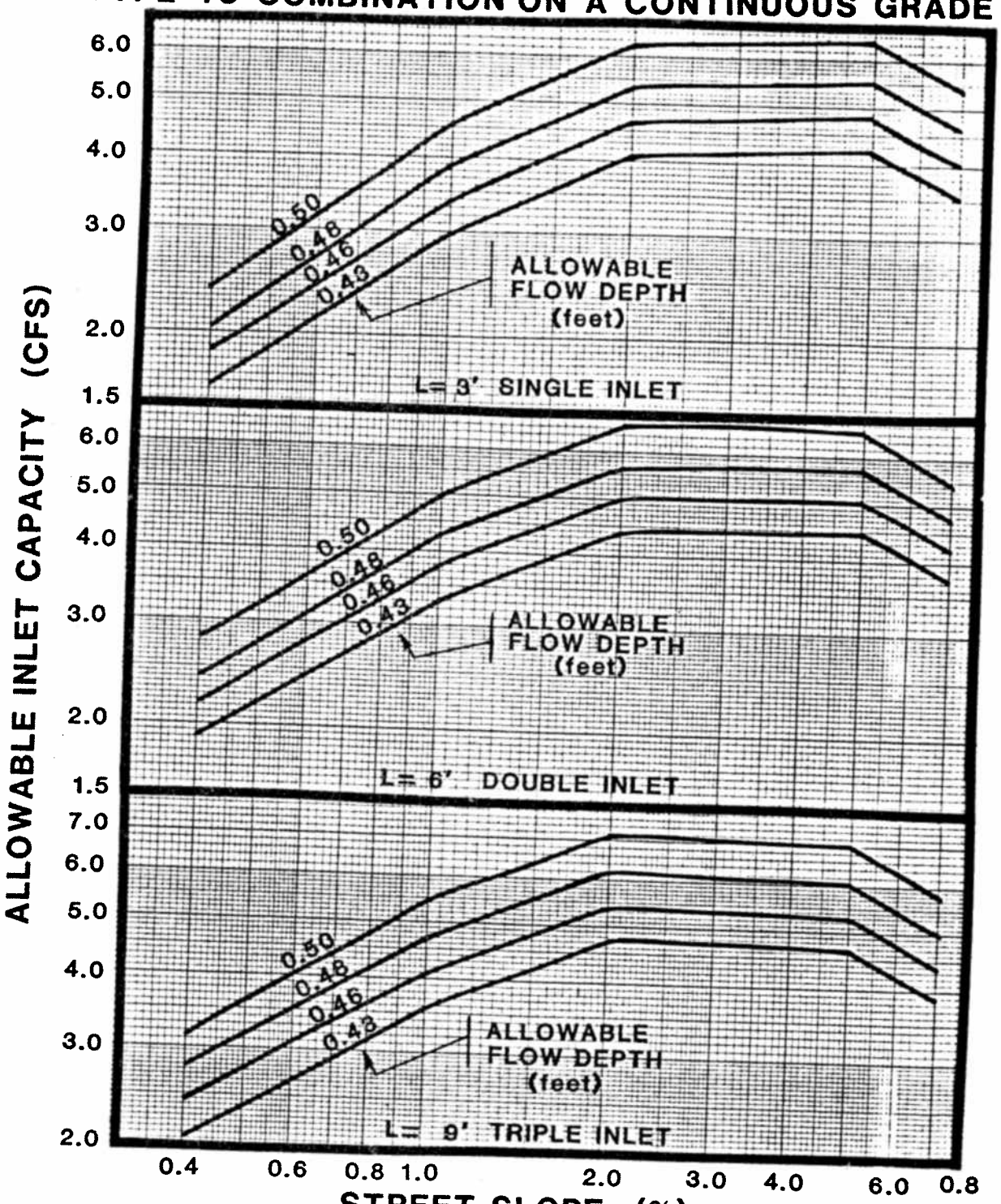


NOTES:

1. Maximum inlet capacity at maximum allowable flow depth. Proportionally reduce for other depths.
2. Allowable Capacity =
   88% (L = 5')
   92% (L = 10')
   95% (L = 15')
   } of Theoretical Capacity
3. Interpolate for other inlet lengths.

ALLOWABLE INLET CAPACITY

TYPE 13 COMBINATION ON A CONTINUOUS GRADE



NOTES:

1. Allowable capacity = 66% theoretical capacity
2. Maximum inlet capacity at maximum allowable flow depth. Proportionally reduce for other depths.

Date: NOV 1984
Rev:

REFERENCE: WRC ENGINEERING, INC., TM-2 AUG. 1984

Hydrologic Computations

Basin Summary
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 9/12/2007

Historic Basins (existing conditions.)

Basin Designation	Design Pt Designation	Area (SF)	Area (Acres)	Tc (Min)	Composite C(10Yr)	i - 10Yr (in/hr)	Q - 10Yr (CFS)	Composite C (100 Yr)	i - 100 Yr (in/hr)	Q- 100Yr (CFS)
W	W	1728820	39.69	21.1	0.81	3.2	104.6	0.87	5.2	180.4
E	E	1497362	34.37	19.8	0.73	3.3	84.4	0.80	5.4	148.9

Proposed Basins (proposed conditions.)

Basin Designation	Design Pt Designation	Area (SF)	Area (Acres)	Tc (Min)	Composite C(10Yr)	i - 10Yr (in/hr)	Q - 10Yr (CFS)	Composite C (100 Yr)	i - 100 Yr (in/hr)	Q- 100Yr (CFS)
A1	A1	25713	0.59	7.20	0.70	5.0	2.1	0.78	8.1	3.7
A2	A2	62193	1.43	8.45	0.77	4.7	5.2	0.83	7.7	9.1
A3	A3	26178	0.60	5.00	0.77	5.6	2.6	0.83	9.0	4.5
A4	A4	9524	0.22	5.00	0.82	5.6	1.0	0.87	9.0	1.7
A5	A5	21313	0.49	9.54	0.56	4.5	1.2	0.67	7.3	2.4
A6	A6	160393	3.68	8.73	0.75	4.7	12.9	0.81	7.6	22.7
A7	A7	5445	0.13	6.55	0.55	5.2	0.4	0.66	8.3	0.7
A8	A8	13713	0.31	7.33	0.76	5.0	1.2	0.82	8.0	2.1
A9	A9/10	8971	0.21	5.90	0.77	5.3	0.8	0.83	8.6	1.5
A10	-	-	-	-	-	-	-	-	-	-
A11	A11	43727	1.00	14.38	0.58	3.9	2.2	0.68	6.3	4.3
A12	A12	26830	0.62	10.45	0.74	4.4	2.0	0.80	7.1	3.5
A13	A13	22035	0.51	9.19	0.75	4.6	1.7	0.81	7.4	3.1
A14	A14	30773	0.71	11.33	0.58	4.3	1.8	0.68	6.9	3.3
A		456808	10.49							

Proposed Basins (proposed conditions.)

Basin Designation	Design Pt Designation	Area (SF)	Area (Acres)	Tc (Min)	Composite C(10Yr)	I - 10Yr (In/hr)	Q - 10Yr (CFS)	Composite C (100 Yr)	I - 100 Yr (in/hr)	Q- 100Yr (CFS)
B1	B1	22071	0.51	5.00	0.77	5.6	2.2	0.83	9.0	3.8
B2	B1/B4	54863	1.26	5.88	0.77	5.3	5.2	0.83	8.6	9.1
B3	B3	11188	0.26	5.00	0.87	5.6	1.2	0.91	9.0	2.1
B4	B4	12502	0.29	5.00	0.79	5.6	1.3	0.85	9.0	2.2
B5	B5	27744	0.64	8.24	0.69	4.8	2.1	0.77	7.7	3.8
B6	B6	14321	0.33	7.31	0.75	5.0	1.2	0.81	8.0	2.1
B7	B7	17472	0.40	5.19	0.79	5.5	1.7	0.84	8.9	3.0
B8	B3/B9	94260	2.16	8.53	0.77	4.7	7.9	0.83	7.6	13.8
B9	B9	24600	0.56	6.98	0.74	5.1	2.1	0.81	8.2	3.7
B10	B10	6559	0.15	5.39	0.54	5.5	0.4	0.65	8.8	0.9
B11	B12	23132	0.53	5.00	0.77	5.6	2.3	0.83	9.0	4.0
B12	B12	27557	0.63	8.80	0.53	4.7	1.6	0.65	7.5	3.1
B13	-	-	-	-	-	-	-	-	-	-
B14	-	-	-	-	-	-	-	-	-	-
B15	B15	92906	2.13	8.93	0.77	4.7	7.7	0.83	7.5	13.4
B16	B16	11511	0.26	5.00	0.85	5.6	1.3	0.90	9.0	2.1
B17	B6	7480	0.17	5.00	0.74	5.6	0.7	0.81	9.0	1.3
B18	B18	121153	2.78	11.78	0.64	4.2	7.5	0.72	6.8	13.7
B19	B19	78308	1.80	6.76	0.83	5.1	7.7	0.88	8.2	13.1
B20	B20	77776	1.79	7.37	0.82	5.0	7.3	0.87	8.0	12.5
B		725402	16.65							

Proposed Basins (proposed conditions.)

Basin Designation	Design Pt Designation	Area (SF)	Area (Acres)	Tc (Min)	Composite C(10Yr)	i - 10Yr (in/hr)	Q - 10Yr (CFS)	Composite C (100 Yr)	i - 100 Yr (in/hr)	Q- 100Yr (CFS)
C1	C1	12237	0.28	7.27	0.70	5.0	1.0	0.78	8.1	1.8
C2	C2	194932	4.48	14.08	0.71	3.9	12.5	0.79	6.3	22.2
C3	C3	77384	1.78	8.50	0.77	4.7	6.5	0.83	7.6	11.3
C4	C4	99372	2.28	9.07	0.77	4.6	8.2	0.83	7.5	14.2
C5	C5	8623	0.20	5.93	0.46	5.3	0.5	0.61	8.6	1.0
C6	C5	25001	0.57	7.53	0.77	4.9	2.2	0.83	8.0	3.8
C7	C7	87603	2.01	6.63	0.77	5.1	8.0	0.83	8.3	13.9
C8	C8	35423	0.81	8.03	0.78	4.8	3.0	0.84	7.8	5.3
C9	C9	50420	1.16	7.43	0.71	5.0	4.1	0.78	8.0	7.3
C10	C10	34438	0.79	6.78	0.77	5.1	3.1	0.83	8.2	5.4
C11	C11	95684	2.20	8.99	0.77	4.6	7.9	0.83	7.5	13.7
C12	C12	25184	0.58	5.76	0.77	5.4	2.4	0.83	8.7	4.2
C13	C13	38007	0.87	11.94	0.62	4.2	2.3	0.71	6.7	4.2
C14	C14	17921	0.41	5.45	0.80	5.5	1.8	0.86	8.8	3.1
C15	C15	16240	0.37	5.00	0.84	5.6	1.8	0.89	9.0	3.0
C16	C18.1	25602	0.59	5.00	0.77	5.6	2.6	0.83	9.0	4.4
C17	C17	16972	0.39	9.25	0.68	4.6	1.2	0.76	7.4	2.2
C18	C18	19872	0.46	10.93	0.54	4.3	1.1	0.65	7.0	2.1
C19	C20	20119	0.46	5.98	0.77	5.3	1.9	0.83	8.6	3.3
C20	C20	51334	1.18	6.60	0.79	5.2	4.8	0.85	8.3	8.3
C21	C21	75876	1.74	8.73	0.77	4.7	6.3	0.83	7.6	11.0
C22	C23.1	20123	0.46	6.97	0.77	5.1	1.8	0.83	8.2	3.1
C23	C23	24950	0.57	5.02	0.85	5.6	2.7	0.90	9.0	4.7
C24	C24	34749	0.80	5.00	0.87	5.6	3.9	0.91	9.0	6.6
C25	C25	18128	0.42	5.89	0.77	5.3	1.7	0.83	8.6	3.0
C26	C27	49720	1.14	7.41	0.77	5.0	4.4	0.83	8.0	7.6
C27	C27	30411	0.70	7.04	0.78	5.0	2.7	0.84	8.1	4.8
C28	C28	64669	1.48	5.89	0.80	5.3	6.4	0.86	8.6	11.0
C29	C29	36584	0.84	7.64	0.72	4.9	3.0	0.79	7.9	5.2
C30	C30	49962	1.15	9.48	0.75	4.6	3.9	0.81	7.4	6.9
C31	C31	64906	1.49	9.81	0.66	4.5	4.4	0.74	7.3	8.0
C32	C32	8826	0.20	9.19	0.65	4.6	0.6	0.74	7.4	1.1
C33	C33	7881	0.18	9.24	0.42	4.6	0.4	0.59	7.4	0.8
C		1439152	33.04							

Proposed Basins (proposed conditions.)

Basin Designation	Design Pt Designation	Area (SF)	Area (Acres)	Tc (Min)	Composite C(10Yr)	I - 10Yr (in/hr)	Q - 10Yr (CFS)	Composite C (100 Yr)	I - 100 Yr (In/hr)	Q- 100Yr (CFS)
D1	D1	3992	0.09	5.00	0.75	5.6	0.4	0.82	9.0	0.7
D2	D2	7084	0.16	5.00	0.86	5.6	0.8	0.91	9.0	1.3
D3	D2	27596	0.63	5.33	0.77	5.5	2.7	0.83	8.9	4.7
D4	D4	15699	0.36	5.00	0.59	5.6	1.2	0.69	9.0	2.2
D5	D5	21958	0.50	9.53	0.71	4.6	1.6	0.78	7.3	2.9
D6	D6	31240	0.72	9.66	0.63	4.5	2.1	0.72	7.3	3.8
D7	D7	29553	0.68	9.63	0.74	4.5	2.3	0.80	7.3	4.0
D8	D8	17805	0.41	8.50	0.46	4.7	0.9	0.61	7.6	1.9
D9	D9	31268	0.72	7.31	0.75	5.0	2.7	0.81	8.0	4.7
D		186195	4.27							

Proposed Basins (proposed conditions.)

Basin Designation	Design Pt Designation	Area (SF)	Area (Acres)	Tc (Min)	Composite C(10Yr)	I - 10Yr (in/hr)	Q - 10Yr (CFS)	Composite C (100 Yr)	I - 100 Yr (In/hr)	Q- 100Yr (CFS)
E1	E1	10663	0.24	9.78	0.60	4.5	0.7	0.70	7.3	1.2
E2	E2	45876	1.05	7.45	0.81	5.0	4.2	0.87	8.0	7.3
E(TOTAL)		56539	1.30							

Time Of Concentration
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 9/12/2007

Basin Designation	Sub-Basin Data C5	Sub-Basin Area (Acres)	Initial/ Overland Time Time (Ti) Length (Ft)	Slope (%)	Ti (Min)	Travel Time (Sh. Conc./Gutter) Time (Tt) Length (Ft)	Slope (%)	Vel (FPS)	Tt (Min)	Tc Check Urbanized Basin Comp. Tc	Tot Len (Ft)	Tc (Max)	Final Tc (Min)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
W	0.79	39.69	300	4.0	6.26	2500	2.0	2.8	14.88	21.1	2800	25.6	21.1
E	0.70	34.37	300	4.0	7.94	2000	2.0	2.8	11.90	19.8	2300	22.8	19.8
A1	0.67	0.59	185	5.0	6.25	85	0.5	1.5	0.94	7.2	270	11.5	7.2
A2	0.75	1.43	269	2.0	8.45	0	0.0	1.0	0.00	8.5	269	11.5	8.5
A3	0.75	0.60	25	0.5	4.09	257	NA	8.0	0.54	4.6	282	11.6	5.0
A4	0.79	0.22	97	2.4	4.18	23	2.0	2.8	0.14	4.3	120	10.7	5.0
A5	0.51	0.49	155	3.2	9.08	76	1.8	2.7	0.47	9.5	231	11.3	9.5
A6	0.72	3.68	300	3.6	7.92	117	1.5	2.4	0.81	8.7	417	12.3	8.7
A7	0.51	0.13	60	2.7	6.03	100	2.5	3.2	0.52	6.6	160	10.9	6.6
A8	0.73	0.31	180	2.2	6.98	60	2.0	2.8	0.36	7.3	240	11.3	7.3
A9	0.74	0.21	129	2.0	5.90	0	0.0	1.0	0.00	5.9	129	10.7	5.9
A10	-	-	-	-	-	-	-	-	-	-	-	-	-
A11	0.53	1.00	252	1.5	14.38	0	0.0	1.0	0.00	14.4	252	11.4	14.4
A12	0.71	0.62	262	1.4	10.45	0	0.0	1.0	0.00	10.5	262	11.5	10.5
A13	0.72	0.51	267	1.9	9.19	0	0.0	1.0	0.00	9.2	267	11.5	9.2
A14	0.54	0.71	252	3.0	11.33	0	0.0	1.0	0.00	11.3	252	11.4	11.3

Basin Designation	Sub-Basin		Initial/ Overland Time Time (Ti)			Travel Time (Sh. Conc./Gutter) Time (Tt)				Tc Check Urbanized Basin			Final Tc
	Data C5	Area (Acres)	Length (Ft)	Slope (%)	Ti (Min)	Length (Ft)	Slope (%)	Vel (FPS)	Tt (Min)	Comp. Tc	Tot Len (Ft)	Tc (Max)	(Min)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
B1	0.75	0.51	25	2.0	2.58	255	0.0	8.0	0.53	3.1	280	11.6	5.0
B2	0.75	1.26	130	2.0	5.88	0	0.0	1.0	0.00	5.9	130	10.7	5.9
B3	0.84	0.26	67	1.8	3.16	95	1.3	1.7	0.93	4.1	162	10.9	5.0
B4	0.76	0.29	27	2.0	2.57	136	2.4	3.0	0.76	3.3	163	10.9	5.0
B5	0.66	0.64	93	1.5	6.84	202	1.4	2.4	1.40	8.2	295	11.6	8.2
B6	0.72	0.33	93	1.5	5.90	202	1.4	2.4	1.40	7.3	295	11.6	7.3
B7	0.76	0.40	35	1.0	3.70	250	1.4	2.8	1.49	5.2	285	11.6	5.2
B8	0.75	2.16	274	2.0	8.53	0	0.0	1.0	0.00	8.5	274	11.5	8.5
B9	0.71	0.56	71	3.0	4.17	337	1.0	2.0	2.81	7.0	408	12.3	7.0
B10	0.49	0.15	48	3.5	5.10	35	1.0	2.0	0.29	5.4	83	10.5	5.4
B11	0.75	0.53	92	2.0	4.94	0	0.0	1.0	0.00	4.9	92	10.5	5.0
B12	0.48	0.63	40	1.1	6.97	220	1.0	2.0	1.83	8.8	260	11.4	8.8
B13	-	-	-	-	-	-	-	-	-	-	-	-	-
B14	-	-	-	-	-	-	-	-	-	-	-	-	-
B15	0.75	2.13	300	2.0	8.93	0	0.0	1.5	0.00	8.9	300	11.7	8.9
B16	0.82	0.26	56	11.6	1.67	181	4.4	4.5	0.67	2.3	237	11.3	5.0
B17	0.71	0.17	66	2.0	4.59	0	0.0	1.0	0.00	4.6	66	10.4	5.0
B18	0.60	2.78	300	2.8	11.26	86	2.2	2.8	0.51	11.8	386	12.1	11.8
B19	0.81	1.80	300	2.8	6.58	28	1.9	2.7	0.17	6.8	328	11.8	6.8
B20	0.79	1.79	300	3.0	6.71	138	3.0	3.5	0.66	7.4	438	12.4	7.4

Basin Designation	Sub-Basin		Initial/ Overland Time Time (Ti)			Travel Time (Sh. Conc./Gutter) Time (Tt)				Tc Check Urbanized Basin			Final Tc
	Data C5	Area (Acres)	Length (Ft)	Slope (%)	Ti (Min)	Length (Ft)	Slope (%)	Vel (FPS)	Tt (Min)	Comp. Tc	Tot Len (Ft)	Tc (Max)	(Min)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
C1	0.67	0.28	202	3.6	7.27	0	0.0	1.0	0.00	7.3	202	11.1	7.3
C2	0.68	4.48	195	4.0	6.74	661	0.5	1.5	7.34	14.1	856	14.8	14.1
C3	0.75	1.78	272	2.0	8.50	0	0.0	1.0	0.00	8.5	272	11.5	8.5
C4	0.75	2.28	300	2.0	8.93	24	2.0	2.7	0.15	9.1	324	11.8	9.1
C5	0.40	0.20	15	2.0	3.91	290	1.4	2.4	2.01	5.9	305	11.7	5.9
C6	0.74	0.57	204	2.0	7.53	0	0.0	1.0	0.00	7.5	204	11.1	7.5
C7	0.75	2.01	100	1.2	6.11	250	1.2	8.0	0.52	6.6	350	11.9	6.6
C8	0.75	0.81	174	2.4	6.35	242	1.4	2.4	1.68	8.0	416	12.3	8.0
C9	0.68	1.16	65	2.7	4.46	321	0.9	1.8	2.97	7.4	386	12.1	7.4
C10	0.74	0.79	65	2.7	3.81	321	0.9	1.8	2.97	6.8	386	12.1	6.8
C11	0.75	2.20	300	2.0	8.93	10	2.0	2.7	0.06	9.0	310	11.7	9.0
C12	0.75	0.58	125	2.0	5.76	0	0.0	1.0	0.00	5.8	125	10.7	5.8
C13	0.58	0.87	133	2.0	8.74	384	1.0	2.0	3.20	11.9	517	12.9	11.9
C14	0.78	0.41	50	2.9	2.94	301	1.0	2.0	2.51	5.4	351	12.0	5.4
C15	0.81	0.37	26	2.5	1.96	302	1.0	2.0	2.52	4.5	328	11.8	5.0
C16	0.75	0.59	94	2.0	5.00	0	0.0	1.0	0.00	5.0	94	10.5	5.0
C17	0.65	0.39	75	1.1	6.92	280	1.0	2.0	2.33	9.3	355	12.0	9.3
C18	0.49	0.46	125	3.0	8.59	280	1.0	2.0	2.33	10.9	405	12.3	10.9
C19	0.74	0.46	131	2.0	5.98	0	0.0	1.0	0.00	6.0	131	10.7	6.0
C20	0.77	1.18	258	3.3	6.60	0	0.0	1.0	0.00	6.6	258	11.4	6.6
C21	0.75	1.74	287	2.0	8.73	0	0.0	1.0	0.00	8.7	287	11.6	8.7
C22	0.74	0.46	178	2.0	6.97	0	0.0	1.0	0.00	7.0	178	11.0	7.0
C23	0.83	0.57	234	3.5	5.02	0	0.0	1.0	0.00	5.0	234	11.3	5.0
C24	0.85	0.80	255	3.6	4.86	0	0.0	1.0	0.00	4.9	255	11.4	5.0
C25	0.74	0.42	154	2.9	5.73	35	2.9	3.5	0.17	5.9	189	11.1	5.9
C26	0.74	1.14	205	2.0	7.41	0	0.0	1.0	0.00	7.4	205	11.1	7.4
C27	0.75	0.70	190	2.0	7.04	0	0.0	1.0	0.00	7.0	190	11.1	7.0
C28	0.78	1.48	221	3.3	5.89	0	0.0	1.0	0.00	5.9	221	11.2	5.9
C29	0.69	0.84	145	1.7	7.64	0	0.0	1.0	0.00	7.6	145	10.8	7.6
C30	0.72	1.15	268	4.5	6.95	243	0.6	1.6	2.53	9.5	511	12.8	9.5
C31	0.62	1.49	254	4.5	8.45	131	0.7	1.6	1.36	9.8	385	12.1	9.8
C32	0.61	0.20	57	0.5	8.46	158	3.3	3.7	0.72	9.2	215	11.2	9.2
C33	0.36	0.18	103	4.5	8.38	191	3.3	3.7	0.86	9.2	294	11.6	9.2

Basin Designation	Sub-Basin		Initial/ Overland Time Time (Ti)			Travel Time (Sh. Conc./Gutter) Time (Tt)				Tc Check Urbanized Basin			Final Tc
	Data C5	Area (Acres)	Length (Ft)	Slope (%)	Ti (Min)	Length (Ft)	Slope (%)	Vel (FPS)	Tt (Min)	Comp. Tc	Tot Len (Ft)	Tc (Max)	(Min)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(11)
D1	0.72	0.09	25	0.6	4.08	40	4.0	4.0	0.17	4.2	65	10.4	5.0
D2	0.84	0.16	75	3.5	2.71	0	0.0	1.0	0.00	2.7	75	10.4	5.0
D3	0.74	0.63	103	2.0	5.33	0	0.0	1.0	0.00	5.3	103	10.6	5.3
D4	0.55	0.36	20	5.0	2.64	114	3.1	3.5	0.54	3.2	134	10.7	5.0
D5	0.68	0.50	244	2.3	9.10	86	2.5	3.3	0.43	9.5	330	11.8	9.5
D6	0.60	0.72	115	2.2	7.60	247	1.1	2.0	2.06	9.7	362	12.0	9.7
D7	0.71	0.68	279	2.6	8.76	104	1.0	2.0	0.87	9.6	383	12.1	9.6
D8	0.41	0.41	43	1.5	7.29	116	0.7	1.6	1.21	8.5	159	10.9	8.5
D9	0.72	0.72	80	2.0	4.99	278	1.0	2.0	2.32	7.3	358	12.0	7.3

Basin Designation	Sub-Basin		Initial/ Overland Time Time (Ti)			Travel Time (Sh. Conc./Gutter) Time (Tt)				Tc Check Urbanized Basin			Final Tc
	Data C5	Area (Acres)	Length (Ft)	Slope (%)	Ti (Min)	Length (Ft)	Slope (%)	Vel (FPS)	Tt (Min)	Comp. Tc	Tot Len (Ft)	Tc (Max)	(Min)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(11)
E1	0.56	0.24	188	3.0	9.37	88	3.3	3.6	0.41	9.8	276	11.5	9.8
E2	0.79	1.05	300	2.7	7.13	65	2.7	3.4	0.32	7.4	365	12.0	7.4

Weighted Runoff Coefficients
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 9/12/2007

Proposed/ Existing	IMP%
Roof	90
Concrete Drive/Walk	90
Landscaping	0
Paved Street	100
Multi-family (attached)	75
Commercial	95

Soil Types: FdB - Fondis Silt Loam, 1-3 %
FdC - Fondis Silt Loam, 3-5 %

Hydrologic Grouping: Type C

Runoff Coefficients: C = Kc + (.858i^3-.786i^2+.774i+.04)
Kc(2year) = 0
Kc(5year) = -.10i+.11
Kc(10year) = -.18i+.21
Kc(100year) = -.39i+.46

Historic Basins (existing conditions.)

		Land Use (Acres)						Weighted Runoff Coefficient				
Basin	Total Area	Roof	Concrete Drive/Walk	Landscape	Paved Street	Multi-family	Commercial	C2	C5	C10	C100	%Imp
W	39.69	10.33	0.06	1.75	27.55	0.00	0.00	0.77	0.79	0.81	0.87	93.0
E	34.37	10.40	0.06	3.53	20.39	0.00	0.00	0.68	0.70	0.73	0.80	86.7

Proposed Basins (proposed conditions.)

		Land Use (Acres)						Weighted Runoff Coefficient				
Basin	Total Area	Roof	Concrete Drive/Walk	Landscape	Paved Street	Multi-family	Commercial	C2	C5	C10	C100	%Imp
A1	0.59	0.00	0.06	0.09	0.44	0.00	0.00	0.64	0.67	0.70	0.78	84.1
A2	1.43	1.43	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
A3	0.60	0.46	0.14	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
A4	0.22	0.00	0.15	0.00	0.07	0.00	0.00	0.77	0.79	0.82	0.87	93.2
A5	0.49	0.00	0.18	0.14	0.17	0.00	0.00	0.47	0.51	0.56	0.67	67.8
A6	3.68	0.18	0.04	0.42	3.03	0.00	0.00	0.70	0.72	0.75	0.81	87.9
A7	0.13	0.00	0.00	0.04	0.08	0.00	0.00	0.47	0.51	0.55	0.66	67.1
A8	0.31	0.00	0.01	0.03	0.27	0.00	0.00	0.71	0.73	0.76	0.82	88.9
A9	0.21	0.21	0.00	0.00	0.00	0.00	0.00	0.72	0.74	0.77	0.83	89.8
A10	-	-	-	-	-	-	-	-	-	-	-	-
A11	1.00	0.00	0.08	0.29	0.63	0.00	0.00	0.49	0.53	0.58	0.68	70.3
A12	0.62	0.00	0.02	0.08	0.52	0.00	0.00	0.68	0.71	0.74	0.80	86.9
A13	0.51	0.00	0.01	0.06	0.44	0.00	0.00	0.70	0.72	0.75	0.81	88.0
A14	0.71	0.00	0.03	0.20	0.47	0.00	0.00	0.50	0.54	0.58	0.68	70.8
A	10.49	2.28	0.73	1.36	6.12	0.00	0.00	0.65	0.67	0.70	0.78	84.2

Proposed Basins (proposed conditions.)

Basin	Total Area	Land Use (Acres)						Weighted Runoff Coefficient				
		Roof	Concrete Drive/Walk	Landscape	Paved Street	Multi-family	Commercial	C2	C5	C10	C100	%imp
B1	0.51	0.00	0.51	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
B2	1.26	1.26	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
B3	0.26	0.00	0.08	0.00	0.17	0.00	0.00	0.83	0.84	0.87	0.91	96.7
B4	0.29	0.00	0.10	0.02	0.17	0.00	0.00	0.74	0.76	0.79	0.85	91.0
B5	0.64	0.00	0.22	0.09	0.33	0.00	0.00	0.63	0.66	0.69	0.77	82.8
B6	0.33	0.00	0.00	0.04	0.29	0.00	0.00	0.70	0.72	0.75	0.81	87.9
B7	0.40	0.00	0.20	0.02	0.19	0.00	0.00	0.74	0.76	0.79	0.84	91.0
B8	2.16	2.16	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
B9	0.56	0.00	0.17	0.06	0.34	0.00	0.00	0.69	0.71	0.74	0.81	87.3
B10	0.15	0.00	0.04	0.05	0.06	0.00	0.00	0.45	0.49	0.54	0.65	64.8
B11	0.53	0.53	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
B12	0.63	0.00	0.10	0.23	0.31	0.00	0.00	0.43	0.48	0.53	0.65	63.2
B13	-	-	-	-	-	-	-	-	-	-	-	-
B14	-	-	-	-	-	-	-	-	-	-	-	-
B15	2.13	2.13	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
B16	0.26	0.00	0.12	0.00	0.15	0.00	0.00	0.81	0.82	0.85	0.90	95.5
B17	0.17	0.17	0.00	0.00	0.00	0.00	0.00	0.69	0.71	0.74	0.81	87.4
B18	2.78	0.00	0.06	0.62	2.10	0.00	0.00	0.57	0.60	0.64	0.72	77.5
B19	1.80	0.00	0.06	0.10	1.65	0.00	0.00	0.79	0.81	0.83	0.88	94.4
B20	1.79	0.00	0.13	0.10	1.55	0.00	0.00	0.78	0.79	0.82	0.87	93.5
B	16.65	6.25	1.78	1.31	7.31	0.00	0.00	0.69	0.71	0.74	0.81	87.3

Proposed Basins (proposed conditions.)

		Land Use (Acres)						Weighted Runoff Coefficient				
Basin	Total Area	Roof	Concrete Drive/Walk	Landscape	Paved Street	Multi-family	Commercial	C2	C5	C10	C100	%Imp
C1	0.28	0.00	0.00	0.04	0.24	0.00	0.00	0.65	0.67	0.70	0.78	84.2
C2	4.48	0.00	0.19	0.65	3.63	0.00	0.00	0.66	0.68	0.71	0.79	85.0
C3	1.78	1.78	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C4	2.28	0.00	2.28	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C5	0.20	0.00	0.00	0.10	0.10	0.00	0.00	0.35	0.40	0.46	0.61	51.3
C6	0.57	0.57	0.00	0.00	0.00	0.00	0.00	0.72	0.74	0.77	0.83	89.4
C7	2.01	1.55	0.46	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C8	0.81	0.00	0.18	0.06	0.57	0.00	0.00	0.73	0.75	0.78	0.84	90.2
C9	1.16	0.00	0.61	0.11	0.43	0.00	0.00	0.65	0.68	0.71	0.78	84.8
C10	0.79	0.00	0.52	0.03	0.24	0.00	0.00	0.72	0.74	0.77	0.83	89.6
C11	2.20	2.20	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C12	0.58	0.58	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C13	0.87	0.00	0.36	0.18	0.33	0.00	0.00	0.54	0.58	0.62	0.71	75.4
C14	0.41	0.00	0.14	0.02	0.25	0.00	0.00	0.76	0.78	0.80	0.86	92.3
C15	0.37	0.00	0.13	0.01	0.24	0.00	0.00	0.80	0.81	0.84	0.89	94.9
C16	0.59	0.59	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C17	0.39	0.00	0.10	0.06	0.23	0.00	0.00	0.62	0.65	0.68	0.76	82.2
C18	0.46	0.00	0.07	0.15	0.23	0.00	0.00	0.45	0.49	0.54	0.65	65.4
C19	0.46	0.46	0.00	0.00	0.00	0.00	0.00	0.72	0.74	0.77	0.83	89.6
C20	1.18	0.00	0.21	0.08	0.89	0.00	0.00	0.75	0.77	0.79	0.85	91.5
C21	1.74	1.74	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.77	0.83	90.0
C22	0.46	0.46	0.00	0.00	0.00	0.00	0.00	0.72	0.74	0.77	0.83	89.6
C23	0.57	0.00	0.08	0.02	0.47	0.00	0.00	0.81	0.83	0.85	0.90	95.8
C24	0.80	0.00	0.08	0.02	0.70	0.00	0.00	0.83	0.85	0.87	0.91	96.9
C25	0.42	0.00	0.06	0.04	0.32	0.00	0.00	0.72	0.74	0.77	0.83	89.6
C26	1.14	1.14	0.00	0.00	0.00	0.00	0.00	0.72	0.74	0.77	0.83	89.9
C27	0.70	0.70	0.00	0.00	0.00	0.00	0.00	0.73	0.75	0.78	0.84	90.2
C28	1.48	0.00	0.07	0.11	1.31	0.00	0.00	0.76	0.78	0.80	0.86	92.4
C29	0.84	0.00	0.00	0.12	0.72	0.00	0.00	0.66	0.69	0.72	0.79	85.4
C30	1.15	0.00	0.18	0.12	0.85	0.00	0.00	0.70	0.72	0.75	0.81	87.9
C31	1.49	0.00	0.00	0.30	1.19	0.00	0.00	0.59	0.62	0.66	0.74	79.7
C32	0.20	0.00	0.02	0.04	0.14	0.00	0.00	0.58	0.61	0.65	0.74	78.9
C33	0.18	0.00	0.04	0.10	0.04	0.00	0.00	0.29	0.36	0.42	0.59	41.5
C	33.04	11.76	5.79	2.36	13.12	0.00	0.00	0.69	0.71	0.74	0.81	87.5

Proposed Basins (proposed conditions.)

	Land Use (Acres)							Weighted Runoff Coefficient				
Basin	Total Area	Roof	Concrete Drive/Walk	Landscape	Paved Street	Multi-family	Commercial	C2	C5	C10	C100	%Imp
D1	0.09	0.00	0.09	0.00	0.00	0.00	0.00	0.70	0.72	0.75	0.82	88.4
D2	0.16	0.00	0.03	0.00	0.13	0.00	0.00	0.83	0.84	0.86	0.91	96.5
D3	0.63	0.63	0.00	0.00	0.00	0.00	0.00	0.72	0.74	0.77	0.83	89.5
D4	0.36	0.00	0.00	0.10	0.26	0.00	0.00	0.51	0.55	0.59	0.69	72.1
D5	0.50	0.00	0.11	0.06	0.33	0.00	0.00	0.66	0.68	0.71	0.78	84.9
D6	0.72	0.00	0.11	0.15	0.45	0.00	0.00	0.56	0.60	0.63	0.72	77.2
D7	0.68	0.00	0.00	0.09	0.59	0.00	0.00	0.68	0.71	0.74	0.80	87.0
D8	0.41	0.00	0.00	0.03	0.21	0.00	0.00	0.35	0.41	0.46	0.61	51.4
D9	0.72	0.00	0.00	0.09	0.63	0.00	0.00	0.69	0.72	0.75	0.81	87.8
D	4.27	0.63	0.34	0.53	2.60	0.00	0.00	0.61	0.64	0.67	0.75	81.3

Proposed Basins (proposed conditions.)

	Land Use (Acres)							Weighted Runoff Coefficient				
Basin	Total Area	Roof	Concrete Drive/Walk	Landscape	Paved Street	Multi-family	Commercial	C2	C5	C10	C100	%Imp
E1	0.24	0.00	0.03	0.06	0.15	0.00	0.00	0.53	0.56	0.60	0.70	73.5
E2	1.05	0.00	0.04	0.07	0.94	0.00	0.00	0.77	0.79	0.81	0.87	93.0
E(TOTAL)	1.30	0.00	0.07	0.13	1.10	0.00	0.00	0.72	0.74	0.76	0.83	89.3

10yr Storm Accumulations
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 9/12/2007

Line A1 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
A1	A1	0.59	0.70	7.20	0.42	5.0	2.1					2.1	2.2	18	62	4.9	0.21	Inlet
A1.1	A1							7.41	0.42	4.96	2.1	2.1	2.0	18	155	2.4	1.07	Mh
A2	1/2A2	0.71	0.77	8.45	0.55	4.7	2.6	8.48	0.97	4.74	4.6	4.6	0.5	18	119	2.7	0.75	DS
A3	A3	0.60	0.77	5.00	0.46	5.6	2.6					2.6						Inlet
A4	A4	0.22	0.82	5.00	0.18	5.6	1.0					1.0	0.5	18	18	0.6	0.59	Inlet
A4.1	1/2A2; A3-A4							9.20	1.20	4.61	5.5	5.5	0.5	18	109	3.8	0.47	Mh
A4.2	A1-A4							9.22	2.16	4.61	10.0	10.0	0.5	24	80	3.2	0.41	Mh
A5	A5	0.49	0.56	9.54	0.27	4.5	1.2					1.2	2.0	18	22	0.7	0.52	Inlet
A6	A6	3.68	0.75	8.73	2.75	4.7	12.9					12.9	2.0	18	23	7.5	0.05	Inlet
A6.1	A1-A6							9.64	5.19	4.53	23.5	23.5	0.5	30	26	4.7	0.09	Mh
A7	A7	0.13	0.55	6.55	0.07	5.2	0.4					0.4	2.9	18	36	1.6	0.37	Inlet
A8	A8	0.31	0.76	7.33	0.24	5.0	1.2					1.2	0.5	18	27	7.6	0.06	Inlet
A8.1	A7-A8							6.92	0.31	5.08	1.6	1.6	2.9	18	72	2.1	0.57	Mh
A8.2	A1-A8							9.73	5.50	4.52	24.8	24.8	0.5	30	40	5.0	0.13	Mh
WQA1	A1-A8							9.86	5.50	4.50	24.7	24.7	0.5	30	45	5.0	0.15	Detention
A9	A9	0.21	0.77	5.90	0.16	5.3	0.8											DS
A10	A10	NOT	USED	-	-	-	-											
A11	A11	1.00	0.58	14.38	0.58	3.9	2.2											Inlet
A12	A12	0.62	0.74	10.45	0.45	4.4	2.0											Inlet
A13	A13	0.51	0.75	9.19	0.38	4.6	1.7											Inlet
A14	A14	0.71	0.58	11.33	0.41	4.3	1.8											Inlet
A OUT	A					10 Release Rate =	3.1											Outlet

Line B1 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
B1	B1	0.51	0.77	5.00	0.39	5.6	2.2					2.2						Inlet
B2	B1, 1/2B2	0.63	0.77	5.88	0.49	5.3	2.6	5.88	0.88	5.35	4.7	4.7	0.5	18	69	4.5	0.26	DS
B2.1	B1, 1/2B2							6.13	0.88	5.28	4.6	4.6	0.5	18	25	4.1	0.10	Mh
B3	B3	0.26	0.87	5.00	0.22	5.6	1.2					1.2	3.0	18	9	4.6	0.03	Inlet
B8	1/2B8	1.08	0.77	8.53	0.84	4.7	4.0					4.0						Inlet
B3.1	B1;1/2B2; B3;1/2B8							8.53	1.94	4.73	9.2	9.2	0.5	24	266	4.9	0.90	Mh
B4	B4	0.29	0.79	5.00	0.23	5.6	1.3					1.3						Inlet
	1/2B2	0.63	0.77	5.88	0.49	5.3	2.6	5.88	0.71	5.35	3.8	3.8	1.5	18	91	1.9	0.80	DS
B4.1	B1-B4							9.43	2.65	4.57	12.1	12.1	0.5	24	51	4.1	0.21	Mh
B5	B5	0.64	0.69	8.24	0.44	4.8	2.1					2.1	1.3	18	72	2.9	0.41	Inlet
B6	B6	0.33	0.75	7.31	0.25	5.0	1.2					1.2						DS
	B17	0.17	0.74	5.00	0.13	5.6	0.7					0.7						
	B5-B6;B17							7.31	0.81	4.99	4.1	4.1	1.3	18	35	3.9	0.15	Inlet
B6.1	B1-B6;B17							9.64	3.46	4.53	15.7	15.7	0.9	24	165	5.7	0.48	Mh
B6.2	B1-B6;B17							10.12	3.46	4.45	15.4	15.4	1.0	24	21	5.1	0.07	Mh
B7	B7	0.40	0.79	5.19	0.32	5.5	1.7					1.7	0.5	18	22	3.5	0.11	Inlet
B7.1	B1-B7;B17							10.19	3.78	4.44	16.8	16.8	1.0	24	243	5.8	0.70	Mh
B8	1/2B8	1.08	0.77	8.53	0.84	4.7	4.0					4.0						Inlet
B9	B9;1/2B8	0.56	0.74	6.98	0.42	5.1	2.1	8.53	1.25	4.73	5.9	5.9	0.5	18	54	4.2	0.22	Inlet
B10	B9-B10;1/2B8	0.15	0.54	5.39	0.08	5.5	0.4	8.75	1.34	4.69	6.3	6.3	0.5	18	21	5.0	0.07	Inlet
B12	B12	0.63	0.53	8.80	0.33	4.7	1.6					1.6	6.3	18	11	1.4	0.13	Inlet
B11	B9-B12;1/2B8	0.53	0.77	5.00	0.41	5.6	2.3	8.82	2.08	4.68	9.7	9.7	0.5	24	102	4.6	0.37	Mh
B14.1	B1-B12;B17							10.89	5.86	4.33	25.4	25.4	1.0	30	178	6.0	0.49	Mh
B15	B1-1/2B15;B17	1.07	0.77	8.93	0.82	4.7	3.8	11.38	6.68	4.26	28.5	28.5	0.5	30	163	6.9	0.39	Mh
B16	B16	0.26	0.85	5.00	0.22	5.6	1.3					1.3	0.8	18	96	3.7	0.44	Inlet
B16.1	B1-B17							11.77	6.91	4.21	29.1	29.1	0.5	30	10	6.9	0.02	Mh
WQB1	B1-B17							11.80	6.91	4.20	29.0	29.0	0.5	30	47	6.9	0.11	Detention

Line B2 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
B18	B18	2.78	0.64	11.78	1.77	4.2	7.5					7.5	2.5	18	168	4.9	0.57	Inlet
B19	B18-B19	1.80	0.83	6.76	1.50	5.1	7.7	12.35	3.27	4.13	13.5	13.5	0.8	18	10	5.3	0.03	Inlet
B19.1	B18-B19							12.38	3.27	4.12	13.5	13.5	0.5	24	29	4.7	0.10	Mh
WQB2	B18-B19							12.48	3.27	4.11	13.4	13.4	0.5	24	43	4.7	0.15	Detention

Line B3 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
B20	B20	1.79	0.82	7.37	1.46	5.0	7.3					7.3	3.6	18	66	4.3	0.26	Inlet
B OUT	B	10 Release Rate =					5.0											Outlet

Line C1 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
C1	C1	0.28	0.70	7.27	0.20	5.0	1.0					1.0	0.7	18	23	3.3	0.12	Inlet
C1.1	C1							7.39	0.20	4.97	1.0	1.0	0.7	18	276	1.8	2.57	Mh
C2	C2	4.48	0.71	14.08	3.19	3.9	12.5					12.5	6.0	18	20	9.5	0.04	Inlet
C2.1	C1-C2							14.12	3.39	3.91	13.3	13.3	0.5	24	78	5.5	0.23	Mh
C2.2	C1-C2							14.35	3.39	3.88	13.2	13.2	1.7	24	166	5.1	0.54	Mh
C3	C3	1.78	0.77	8.50	1.37	4.7	6.5					6.5						DS
C4	C1-C4	2.28	0.77	9.07	1.76	4.6	8.2	14.89	6.53	3.82	24.9	24.9	0.7	30	171	5.0	0.57	Mh
C6	C6	0.57	0.77	7.53	0.44	4.9	2.2					2.2						DS
C5	C5-C6	0.20	0.46	5.93	0.09	5.3	0.5	7.53	0.53	4.94	2.6	2.6	0.5	18	29	3.4	0.14	Inlet
C8	C5-C8	0.81	0.78	8.03	0.63	4.8	3.0	8.03	1.16	4.83	5.6	5.6	7.3	18	8	5.3	0.02	Inlet
C7	C1-C8	2.01	0.77	6.63	1.56	5.1	8.0	15.46	9.25	3.76	34.8	34.8	0.7	30	173	7.4	0.39	Mh
C9	C9	1.16	0.71	7.43	0.82	5.0	4.1					4.1	11.1	18	18	3.5	0.09	Inlet
C9.1	C1-C9							15.85	10.07	3.72	37.4	37.4	1.0	30	114	8.6	0.22	Mh
C10	C10	0.79	0.77	6.78	0.61	5.1	3.1					3.1	4.9	18	19	3.1	0.10	Inlet
C10.1	C1-C10							16.07	10.68	3.70	39.5	39.5	1.0	36	136	6.8	0.33	Mh
C11	C11	2.20	0.77	8.99	1.70	4.6	7.9					7.9						Mh
C12	C1-C12	0.58	0.77	5.76	0.45	5.4	2.4	16.40	12.83	3.66	47.0	47.0	1.0	36	211	7.7	0.46	Mh
C13	C13	0.87	0.62	11.94	0.54	4.2	2.3					2.3	6.2	18	31	3.0	0.17	Inlet
C14	C13-C14	0.41	0.80	5.45	0.33	5.5	1.8	12.11	0.87	4.16	3.6	3.6	6.0	18	2	2.8	0.01	Inlet
C14.1	C1-C14							16.86	13.70	3.62	49.5	49.5	1.0	36	84	8.1	0.17	Mh
C15	C15	0.37	0.84	5.00	0.31	5.6	1.8					1.8	1.5	18	81	2.8	0.48	Inlet
C16	C15-C16	0.59	0.77	5.00	0.45	5.6	2.6	5.48	0.77	5.46	4.2	4.2	1.5	18	324	4.0	1.34	Mh
C17	C17	0.39	0.68	9.25	0.27	4.6	1.2					1.2	0.5	18	31	2.5	0.20	Inlet
C18	C17-C18	0.46	0.54	10.93	0.25	4.3	1.1	9.46	0.51	4.56	2.3	2.3	0.5	18	8	3.7	0.04	Inlet
C18.1	C15-C18							9.49	1.28	4.56	5.8	5.8	0.8	18	33	4.2	0.13	Mh
C18.2	C1-C18							17.03	14.98	3.60	53.9	53.9	1.0	42	73	6.6	0.19	Mh
C19	C19	0.46	0.77	5.98	0.36	5.3	1.9					1.9						DS
C20	C19-C20	1.18	0.79	6.60	0.93	5.2	4.8	6.60	1.29	5.15	6.6	6.6	0.9	18	106	4.0	0.44	Inlet
C20.1	C1-C20							17.21	16.27	3.58	58.3	58.3	0.8	42	102	10.0	0.17	Mh
C21	C1-C21	1.74	0.77	8.73	1.35	4.7	6.3	17.38	17.61	3.57	62.8	62.8	1.0	42	18	11.0	0.03	DS
C22	C22	0.46	0.77	6.97	0.36	5.1	1.8											DS
C23	C23	0.57	0.85	5.02	0.49	5.6	2.7					2.7	1.4	18	132	5.6	0.39	Inlet
C23.1	C1-C23							17.80	18.46	3.53	65.1	65.1	0.8	42	125	10.2	0.20	Mh
C24	C24	0.80	0.87	5.00	0.69	5.6	3.9					3.9	1.3	18	7	6.1	0.02	Inlet
C25	C24-C25	0.42	0.77	5.89	0.32	5.3	1.7	5.89	1.01	5.34	5.4	5.4	1.5	18	14	7.0	0.03	Inlet
C26	C26	1.14	0.77	7.41	0.88	5.0	4.4											DS
C27	C27	0.70	0.78	7.04	0.54	5.0	2.7											
C27.2	C24-C27							7.41	2.44	4.96	12.1	12.1	1.0	24	88	7.3	0.20	Mh
C27.1	C1-C27							17.61	20.89	3.54	74.1	74.1						Mh
WQC1	C1-C27							17.61	20.89	3.54	74.1	74.1	0.5	42	81	8.4	0.16	Detention
C28	C26	1.48	0.80	5.89	1.19	5.3	6.4											Inlet
C29	C24-C27	0.84	0.72	7.64	0.60	4.9	3.0											Inlet

Line C2 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
C30	C30	1.15	0.75	9.48	0.86	4.6	3.9					3.9	0.5	18	118	4.0	0.49	Inlet
C31	C30-C31	1.49	0.66	9.81	0.98	4.5	4.4	9.98	1.84	4.48	8.2	8.2	0.5	24	9	2.6	0.06	Inlet
C31.1	C30-C31							10.03	1.84	4.47	8.2	8.2	0.5	24	28	2.6	0.18	Mh
C32	C30-C32	0.20	0.65	9.19	0.13	4.6	0.6	10.21	1.97	4.44	8.7	8.7	0.5	24	18	2.8	0.11	Inlet
C33	C33	0.18	0.42	9.24	0.08	4.6	0.4					0.4	0.5	18	30	0.2	2.50	Mh
C33.1	C30-C33							10.32	2.05	4.42	9.0	9.0	0.5	24	42	2.8	0.25	Mh
WQC2	C30-C33							10.58	2.05	4.38	9.0	9.0	0.5	24	102	2.7	0.62	Detention
C OUT	C	10 Release Rate =					9.9											Outlet

Line D1 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
D1	D1	0.09	0.75	5.00	0.07	5.6	0.4					0.4	1.0	18	25	0.8	0.55	Inlet
D3	D3	0.63	0.77	5.33	0.49	5.5	2.7											DS
D2	D1-D3	0.16	0.86	5.00	0.14	5.6	0.8	5.55	0.70	5.44	3.8	3.8	1.0	18	234	4.9	0.80	Inlet
D3.1	D1-D3							6.35	0.70	5.22	3.6	3.6	0.8	18	143	4.0	0.59	Mh
D4	D4	0.36	0.59	5.00	0.21	5.6	1.2					1.2	0.5	18	11	0.9	0.20	Inlet
D4.1	D1-D4							6.94	0.91	5.07	4.6	4.6	1.9	18	206	3.8	0.90	Mh
D5	D5	0.50	0.71	9.53	0.36	4.6	1.6					1.6	0.8	18	29	2.1	0.23	Inlet
D5.1	D1-D5							7.84	1.27	4.87	6.2	6.2	1.9	18	73	6.4	0.19	Mh
D6	D6	0.72	0.63	9.66	0.46	4.5	2.1					2.1	2.2	18	51	2.9	0.29	Inlet
D6.1	D1-D6							8.03	1.72	4.83	8.3	8.3	0.8	24	94	4.1	0.38	Mh
D7	D7	0.68	0.74	9.63	0.50	4.5	2.3					2.3	0.5	18	14	1.7	0.14	Inlet
D7.1	D1-D7							8.41	2.22	4.76	10.6	10.6	0.5	24	227	3.9	0.97	Mh
D8	D8	0.41	0.46	8.50	0.19	4.7	0.9					0.9	0.6	18	15	1.0	0.25	Inlet
D8.1	D1-D8							9.38	2.41	4.58	11.0	11.0	0.5	24	24	3.3	0.12	Mh
WQD1	D1-D8							9.50	2.41	4.56	11.0	11.0	1.5	24	77	3.3	0.39	Detention

Line D2 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
D9	D9	0.72	0.75	7.31	0.54	5.0	2.7											
WQD2	D9							7.38	0.54	4.97	2.7	2.7	0.5	15	11	2.5	0.07	Inlet
D OUT	D	10 Release Rate =					1.3					2.7	0.5	15	52	2.5	0.35	Detention
																		Outlet

Line E1 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
E1	E1	0.24	0.60	9.78	0.15	4.5	0.7											
WQE1	E1							12.98	0.15	4.05	0.6	0.7	0.5	18	71	0.4	3.20	Inlet
												0.6	0.5	18	41	0.3	2.10	Detention

Line E2 (10 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
E2	E2	1.05	0.81	7.45	0.86	5.0	4.2											
WQE2	E2							7.51	0.86	4.94	4.2	4.2	0.5	18	9	2.5	0.06	Inlet
E OUT	E	10 Release Rate =					0.4					4.2	0.5	18	35	2.5	0.24	Detention
																		Outlet

100yr Storm Accumulations
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 9/12/2007

Line A1 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
A1	A1	0.59	0.78	7.20	0.46	8.1	3.7					3.7	2.2	18	62	2.2	0.46	Inlet
A1.1	A1							7.66	0.46	7.91	3.6	3.6	2.0	18	155	2.1	1.21	Mh
A2	1/2A2	0.71	0.83	8.45	0.60	7.7	4.6	8.87	1.05	7.53	7.9	7.9	0.5	18	119	4.6	0.43	DS
A3	A3	0.60	0.83	5.00	0.50	9.0	4.5					4.5						Inlet
A4	A4	0.22	0.87	5.00	0.19	9.0	1.7					1.7	0.5	18	18	1.0	0.59	Inlet
A4.1	1/2A2; A3-A4							8.88	1.29	7.52	9.7	9.7	0.5	18	109	6.7	0.27	Mh
A4.2	A1-A4							9.30	2.34	7.40	17.3	17.3	0.5	24	80	5.6	0.24	Mh
A5	A5	0.49	0.67	9.54	0.33	7.3	2.4					2.4	2.0	18	22	1.4	0.27	Inlet
A6	A6	3.68	0.81	8.73	2.99	7.6	22.7					22.7	2.0	18	23	13.1	0.03	Inlet
A6.1	A1-A6							9.54	5.66	7.34	41.5	41.5	0.5	30	26	8.5	0.05	Mh
A7	A7	0.13	0.66	6.55	0.08	8.3	0.7					0.7	2.9	18	36	0.7	0.90	Inlet
A8	A8	0.31	0.82	7.33	0.26	8.0	2.1					2.1	0.5	18	27	1.2	0.38	Inlet
A8.1	A7-A8							7.45	0.34	7.99	2.7	2.7	2.9	18	72	1.6	0.76	Mh
A8.2	A1-A8							9.59	6.00	7.32	44.0	44.0	0.5	30	40	8.9	0.07	Mh
WQA1	A1-A8							9.66	6.00	7.30	43.8	43.8	0.5	30	45	8.9	0.08	Detention
A9	A9	0.21	0.83	5.90	0.17	8.6	1.5											DS
A10	A10	NOT	USED	-	-	-	-											
A11	A11	1.00	0.68	14.38	0.68	6.3	4.3											Inlet
A12	A12	0.62	0.80	10.45	0.49	7.1	3.5											Inlet
A13	A13	0.51	0.81	9.19	0.41	7.4	3.1											Inlet
A14	A14	0.71	0.68	11.33	0.48	6.9	3.3											Inlet
A OUT	A					10 Release Rate =	3.1											Outlet

Line B1 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
B1	B1	0.51	0.83	5.00	0.42	9.0	3.8					3.8						Inlet
B2	B1, 1/2B2	0.63	0.83	5.88	0.53	8.6	4.5	5.88	0.95	8.61	8.2	8.2	0.5	18	69	4.5	0.26	DS
B2.1	B1, 1/2B2							6.13	0.95	8.50	8.1	8.1	0.5	18	25	4.9	0.08	Mh
B3	B3	0.26	0.91	5.00	0.23	9.0	2.1					2.1	3.0	18	9	4.5	0.03	Inlet
B8	1/2B8	1.08	0.83	8.53	0.90	7.6	6.9					6.9						Inlet
B3.1	B1;1/2B2; B3;1/2B8							8.53	2.09	7.63	15.9	15.9	0.5	24	266	5.2	0.86	Mh
B4	B4	0.29	0.85	5.00	0.24	9.0	2.2					2.2						Inlet
	1/2B2	0.63	0.83	5.88	0.53	8.6	4.5	5.88	0.77	8.61	6.6	6.6	1.5	18	91	3.8	0.40	DS
B4.1	B1-B4							9.39	2.85	7.38	21.1	21.1	0.5	24	51	6.6	0.13	Mh
B5	B5	0.64	0.77	8.24	0.49	7.7	3.8					3.8	1.3	18	72	2.9	0.41	Inlet
B6	B6	0.33	0.81	7.31	0.27	8.0	2.1					2.1						DS
	B17	0.17	0.81	5.00	0.14	9.0	1.3											
	B5-B6;B17							7.31	0.89	8.04	7.2	7.2	1.3	18	35	4.2	0.14	Inlet
B6.1	B1-B6;B17							9.52	3.75	7.34	27.5	27.5	0.9	24	165	8.7	0.32	Mh
B6.2	B1-B6;B17							9.84	3.75	7.26	27.2	27.2	1.0	24	21	8.5	0.04	Mh
B7	B7	0.40	0.84	5.19	0.34	8.9	3.0					3.0	0.5	18	22	1.8	0.21	Inlet
B7.1	B1-B7;B17							9.88	4.09	7.25	29.6	29.6	1.0	24	243	9.3	0.44	Mh
B8	1/2B8	1.08	0.83	8.53	0.90	7.6	6.9					6.9						Inlet
B9	B9;1/2B8	0.56	0.81	6.98	0.46	8.2	3.7	8.53	1.36	7.63	10.4	10.4	0.5	18	54	6.1	0.15	Inlet
B10	B9-B10;1/2B8	0.15	0.65	5.39	0.10	8.8	0.9	8.68	1.46	7.59	11.1	11.1	0.5	18	21	6.4	0.05	Inlet
B12	B12	0.63	0.65	8.80	0.41	7.5	3.1					3.1	6.3	18	11	0.6	0.32	Inlet
B11	B9-B12;1/2B8	0.53	0.83	5.00	0.44	9.0	4.0	8.73	2.31	7.57	17.5	17.5	0.5	24	102	5.0	0.34	Mh
B14.1	B1-B12;B17							10.31	6.39	7.13	45.6	45.6	1.0	30	178	9.3	0.32	Mh
B15	B1-1/2B15;B17	1.07	0.83	8.93	0.89	7.5	6.7	10.63	7.28	7.05	51.4	51.4	0.5	30	163	6.6	0.41	Mh
B16	B16	0.26	0.90	5.00	0.24	9.0	2.1					2.1	0.8	18	96	4.3	0.37	Inlet
B16.1	B1-B17							11.04	7.52	6.95	52.3	52.3	0.5	30	10	6.6	0.03	Mh
WQB1	B1-B17							11.07	7.52	6.95	52.2	52.2	0.5	30	47	6.6	0.12	Detention

Line B2 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
B18	B18	2.78	0.72	11.78	2.02	6.8	13.7					13.7	2.5	18	168	5.5	0.51	Inlet
B19	B18-B19	1.80	0.88	6.76	1.59	8.2	13.1	12.29	3.60	6.67	24.0	24.0	0.8	18	10	11.3	0.01	Inlet
B19.1	B18-B19							12.30	3.60	6.67	24.0	24.0	0.5	24	29	8.1	0.06	Mh
WQB2	B18-B19							12.36	3.60	6.65	24.0	24.0	0.5	24	43	8.1	0.09	Detention

Line B3 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
B20	B20	1.79	0.87	7.37	1.56	8.0	12.5					12.5	3.6	18	66	7.3	0.15	Inlet
B OUT	B					10 Release Rate =	5.0											Outlet

Line C1 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
C1	C1	0.28	0.78	7.27	0.22	8.1	1.8					1.8	0.7	18	23	1.0	0.37	Inlet
C1.1	C1							7.64	0.22	7.92	1.7	1.7	0.7	18	276	1.0	4.51	Mh
C2	C2	4.48	0.79	14.08	3.51	6.3	22.2					22.2	6.0	18	20	13.7	0.02	Inlet
C2.1	C1-C2							14.11	3.73	6.31	23.5	23.5	0.5	24	78	7.6	0.17	Mh
C2.2	C1-C2							14.28	3.73	6.27	23.4	23.4	1.7	24	166	7.5	0.37	Mh
C3	C3	1.78	0.83	8.50	1.48	7.6	11.3					11.3						DS
C4	C1-C4	2.28	0.83	9.07	1.90	7.5	14.2	14.64	7.12	6.21	44.2	44.2	0.7	30	171	9.0	0.32	Mh
C6	C6	0.57	0.83	7.53	0.48	8.0	3.8					3.8						DS
C5	C5-C6	0.20	0.61	5.93	0.12	8.6	1.0	7.53	0.60	7.96	4.7	4.7	0.5	18	29	5.8	0.08	Inlet
C8	C5-C8	0.81	0.84	8.03	0.68	7.8	5.3	8.03	1.28	7.79	9.9	9.9	7.3	18	8	8.4	0.02	Inlet
C7	C1-C8	2.01	0.83	6.63	1.68	8.3	13.9	14.96	10.07	6.15	62.0	62.0	0.7	30	173	13.3	0.22	Mh
C9	C9	1.16	0.78	7.43	0.91	8.0	7.3					7.3	11.1	18	18	4.3	0.07	Inlet
C9.1	C1-C9							15.18	10.98	6.11	67.1	67.1	1.0	30	114	14.3	0.13	Mh
C10	C10	0.79	0.83	6.78	0.66	8.2	5.4					5.4	4.9	18	19	3.2	0.10	Inlet
C10.1	C1-C10							15.31	11.64	6.09	70.9	70.9	1.0	36	136	10.5	0.22	Mh
C11	C11	2.20	0.83	8.99	1.83	7.5	13.7					13.7						Mh
C12	C1-C12	0.58	0.83	5.76	0.48	8.7	4.2	15.53	13.95	6.05	84.5	84.5	1.0	36	211	12.4	0.28	Mh
C13	C13	0.87	0.71	11.94	0.62	6.7	4.2					4.2	6.2	18	31	2.4	0.22	Inlet
C14	C13-C14	0.41	0.86	5.45	0.35	8.8	3.1	12.15	0.97	6.70	6.5	6.5	6.0	18	2	3.7	0.01	Inlet
C14.1	C1-C14							15.81	14.92	6.01	89.6	89.6	1.0	36	84	13.1	0.11	Mh
C15	C15	0.37	0.89	5.00	0.33	9.0	3.0					3.0	1.5	18	81	1.7	0.78	Inlet
C16	C15-C16	0.59	0.83	5.00	0.49	9.0	4.4	5.78	0.82	8.66	7.1	7.1	1.5	18	324	4.2	1.29	Mh
C17	C17	0.39	0.76	9.25	0.30	7.4	2.2					2.2	0.5	18	31	1.3	0.41	Inlet
C18	C17-C18	0.46	0.65	10.93	0.30	7.0	2.1	9.66	0.60	7.30	4.3	4.3	0.5	18	8	2.4	0.06	Inlet
C18.1	C15-C18							9.72	1.42	7.29	10.3	10.3	0.8	18	33	5.6	0.10	Mh
C18.2	C1-C18							15.92	16.34	5.99	97.9	97.9	1.0	42	73	10.5	0.12	Mh
C19	C19	0.46	0.83	5.98	0.38	8.6	3.3					3.3						DS
C20	C19-C20	1.18	0.85	6.60	1.00	8.3	8.3	6.60	1.39	8.31	11.5	11.5	0.9	18	106	6.8	0.26	Inlet
C20.1	C1-C20							16.03	17.73	5.97	105.8	105.8	0.8	42	102	10.5	0.16	Mh
C21	C1-C21	1.74	0.83	8.73	1.45	7.6	11.0	16.20	19.18	5.94	114.0	62.7	1.0	42	18	11.0	0.03	DS
C22	C22	0.46	0.83	6.97	0.38	8.2	3.1											DS
C23	C23	0.57	0.90	5.02	0.52	9.0	4.7					4.7	1.4	18	132	6.5	0.34	Inlet
C23.1	C1-C23							16.56	20.08	5.88	118.2	118.2	0.8	42	125	10.5	0.20	Mh
C24	C24	0.80	0.91	5.00	0.73	9.0	6.6					6.6	1.3	18	7	6.9	0.02	Inlet
C25	C24-C25	0.42	0.83	5.89	0.35	8.6	3.0	5.89	1.08	8.60	9.3	9.3	1.5	18	14	7.9	0.03	Inlet
C26	C26	1.14	0.83	7.41	0.95	8.0	7.6											DS
C27	C27	0.70	0.84	7.04	0.58	8.1	4.8											
C27.2	C24-C27							7.41	2.61	8.00	20.9	20.9	1.0	24	88	8.2	0.18	Mh
C27.1	C1-C27							16.94	22.69	5.82	132.2	132.2						Mh
WQC1	C1-C27							16.94	22.69	5.82	132.2	132.2	0.5	42	81	8.2	0.16	Detention
C28	C26	1.48	0.86	5.89	1.28	8.6	11.0											Inlet
C29	C24-C27	0.84	0.79	7.64	0.66	7.9	5.2											Inlet

Line C2 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
C30	C30	1.15	0.81	9.48	0.93	7.4	6.9					6.9	0.5	18	118	3.9	0.50	Inlet
C31	C30-C31	1.49	0.74	9.81	1.10	7.3	8.0	9.98	2.04	7.22	14.7	14.7	0.5	24	9	4.7	0.03	Inlet
C31.1	C30-C31							10.01	2.04	7.21	14.7	14.7	0.5	24	28	4.7	0.10	Mh
C32	C30-C32	0.20	0.74	9.19	0.15	7.4	1.1	10.11	2.18	7.18	15.7	15.7	0.5	24	18	5.0	0.06	Inlet
C33	C33	0.18	0.59	9.24	0.11	7.4	0.8					0.8	0.5	18	30	0.5	1.11	Mh
C33.1	C30-C33							10.17	2.29	7.17	16.4	16.4	0.5	24	42	5.2	0.13	Mh
WQC2	C30-C33							10.31	2.29	7.13	16.3	16.3	0.5	24	102	5.2	0.33	Detention
C OUT	C				10 Release Rate =		9.9											Outlet

Line D1 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
D1	D1	0.09	0.82	5.00	0.07	9.0	0.7					0.7	1.0	18	25	0.8	0.56	Inlet
D3	D3	0.63	0.83	5.33	0.53	8.9	4.7											DS
D2	D1-D3	0.16	0.91	5.00	0.15	9.0	1.3	5.56	0.75	8.76	6.6	6.6	1.0	18	234	5.1	0.77	Inlet
D3.1	D1-D3							6.33	0.75	8.42	6.3	6.3	0.8	18	143	4.7	0.51	Mh
D4	D4	0.36	0.69	5.00	0.25	9.0	2.2					2.2	0.5	18	11	0.9	0.21	Inlet
D4.1	D1-D4							6.83	1.00	8.22	8.2	8.2	1.9	18	206	4.8	0.72	Mh
D5	D5	0.50	0.78	9.53	0.40	7.3	2.9					2.9	0.8	18	29	2.2	0.22	Inlet
D5.1	D1-D5							7.55	1.39	7.95	11.1	11.1	1.9	18	73	5.8	0.21	Mh
D6	D6	0.72	0.72	9.66	0.52	7.3	3.8					3.8	2.2	18	51	2.2	0.39	Inlet
D6.1	D1-D6							7.76	1.91	7.88	15.1	15.1	0.8	24	94	4.3	0.37	Mh
D7	D7	0.68	0.80	9.63	0.55	7.3	4.0					4.0	0.5	18	14	2.6	0.09	Inlet
D7.1	D1-D7							8.13	2.46	7.76	19.1	19.1	0.5	24	227	5.6	0.67	Mh
D8	D8	0.41	0.61	8.50	0.25	7.6	1.9					1.9	0.6	18	15	0.9	0.27	Inlet
D8.1	D1-D8							8.80	2.70	7.55	20.4	20.4	0.5	24	24	5.9	0.07	Mh
WQD1	D1-D8							8.87	2.70	7.53	20.4	20.4	1.5	24	77	5.9	0.22	Detention

Line D2 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
D9	D9	0.72	0.81	7.31	0.58	8.0	4.7					4.7	0.5	15	11	3.1	0.06	Inlet
WQD2	D9							7.37	0.58	8.02	4.7	4.7	0.5	15	52	3.0	0.29	Detention
D OUT	D	10 Release Rate =					1.3											Outlet

Line E1 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
E1	E1	0.24	0.70	9.78	0.17	7.3	1.2					1.2	0.5	18	71	0.7	1.69	Inlet
WQE1	E1							11.47	0.17	6.85	1.2	1.2	0.5	18	41	0.7	0.98	Detention

Line E2 (100 Year Storm)

Design Point	Direct Runoff							Total Runoff				Pipe			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
E2	E2	1.05	0.87	7.45	0.91	8.0	7.3					7.3	0.5	18	9	7.1	0.02	Inlet
WQE2	E2							7.47	0.91	7.98	7.3	7.3	0.5	18	35	7.8	0.07	Detention
E OUT	E	10 Release Rate =					0.4											Outlet

Overflow Conditions - West Basin

Design Point	Direct Runoff							Total Runoff				Street			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
C2	C2	4.48	0.79	14.08	3.51	3.9	13.7					13.7	1.5		273	2.4	1.90	
C8	C8	0.81	0.84	8.03	0.68	4.8	3.3	15.98	4.19	5.98	25.1							
F	C2,C8							15.98	4.19	5.98	25.1	25.1	1.0		200	2.0	1.67	
C7	C7	2.01	0.83	6.63	1.68	5.1	8.6											
G	C2,C7,C8							17.64	5.87	5.72	33.6	33.6	1.0		133	2.0	1.11	
C9	C9	1.16	0.78	7.43	0.91	5.0	4.5											
C3		1.78	0.83	8.50	1.48	4.7	7.0											
C4		2.28	0.83	9.07	1.90	4.6	8.8											
B1		0.51	0.83	5.00	0.42	5.6	2.4											
C6		0.57	0.83	7.53	0.48	4.9	2.3											
C10	C10	0.79	0.83	6.78	0.66	5.1	3.4											
C13	1/2C13	0.44	0.71	11.94	0.31	4.2	1.3											
H	C2,C7-C10,1/2C13							18.75	12.03	5.56	66.8	66.8	1.0		100	2.0	0.83	
C14	1/2C14	0.21	0.86	5.45	0.18	5.5	1.0											
I	2,C7-C10,C13,1/2C14							19.59	12.52	5.44	68.1	68.1	1.0		238	2.0	1.98	
J	C2,C7-C10,C13-C14							21.57	12.69	5.19	65.9	65.9	1.0					

Overflow Conditions - East Basin

Design Point	Direct Runoff							Total Runoff				Street			Travel Time			
	Area Designation	Area (Acres)	Runoff Coeff	Tc (min)	CA (AC)	I (in/hr)	Q (cfs)	Tc (min)	Total CA (AC)	I (in/hr)	Q (cfs)	Design Flow (cfs)	Slope (%)	Pipe Size (in)	Length (ft)	Velocity (fps)	Tt (min)	Remarks
A1	A1	0.59	0.78	7.20	0.46	5.0	2.3						1.0		300	2.0	2.50	
A3	A3	0.60	0.83	5.00	0.50	5.6	2.8											
A5	A1,A3-A8	0.49	0.67	9.54	0.33	4.5	1.5											
A6	A1,A6	3.68	0.81	8.73	2.99	4.7	14.1						1.7		50	2.7	0.31	
A7	A7	0.13	0.66	6.55	0.08	5.2	0.4											
A8	A8	0.31	0.82	7.33	0.26	5.0	1.3											
A4	A3,A4	0.22	0.87	5.00	0.19	5.6	1.1											
A14	A1,A3-A8,A14	0.71	0.68	11.33	0.48	4.3	2.1											
A13	A1,A3-A8,A13-A14	0.51	0.81	9.19	0.41	4.6	1.9											
A12	A1,A3-A8,A11-A14	0.62	0.80	10.45	0.49	4.4	2.2											
A11	A1,A3-A8,A12-A13	1.00	0.68	14.38	0.68	3.9	2.6						1.7		60	2.7	0.37	
B4	A1,A3-A8,A11-A14	0.29	0.85	5.00	0.24	5.6	1.4	10.72	7.12	7.03	50.1	50.1	1.0		41	2.0	0.34	
B5	A3-A8,A11-A14,B4	0.64	0.77	8.24	0.49	4.8	2.3	11.06	7.61	6.95	52.9	52.9	1.0					
B1	B1	0.51	0.83	5.00	0.42	5.6	2.4											
B3	B1,B3	0.26	0.91	5.00	0.23	5.6	1.3						1.0		20	2.0	0.17	
B7	1/2B7	0.40	0.84	5.19	0.34	5.5	1.9											
K	A8,A11-A14,B1,B3-B5,1/2B7							11.23	8.61	6.91	59.5	59.5	2.4					

Rainfall Data
SouthGlenn Mall
Job Number: 05-0199

Calculated By: CMJ
Checked By: CMJ
Date: 01-27-06
Revised: 03-16-06

One-Hour Point Rainfall (In)

Frequency (yr)	(in)
2	0.97
5	1.38
10	1.65
50	2.32
100	2.67

Factors for Durations of Less than One Hour

Duration (min)	Ratio to 1hr depth
5	0.29
10	0.45
15	0.57
30	0.79

Time - Intensity - Frequency Tabulation

Duration	Time (min)																					
Frequency	5	10	15	20	25	30	35	40	45	50	55	60	70	80	90	100	120	130	140	160	170	180
2 yr	3.36	2.64	2.20	1.91	1.69	1.54	1.39	1.28	1.18	1.11	1.04	0.97	0.88	0.80	0.74	0.69	0.60	0.57	0.54	0.49	0.47	0.45
5 yr	4.80	3.72	3.16	2.71	2.40	2.18	1.97	1.82	1.69	1.57	1.48	1.38	1.26	1.14	1.05	0.98	0.86	0.81	0.77	0.69	0.66	0.64
10 yr	5.76	4.44	3.76	3.25	2.88	2.60	2.36	2.17	2.02	1.88	1.77	1.65	1.50	1.37	1.26	1.17	1.03	0.97	0.92	0.83	0.79	0.76
50 yr	8.04	6.24	5.28	4.56	4.04	3.66	3.32	3.05	2.83	2.65	2.49	2.32	2.11	1.92	1.77	1.64	1.44	1.36	1.29	1.17	1.12	1.07
100 yr	9.24	7.20	6.08	5.25	4.65	4.22	3.82	3.52	3.26	3.05	2.86	2.67	2.43	2.21	2.04	1.89	1.66	1.56	1.48	1.34	1.28	1.23

I = 28.5*P1/[(10+Tc)^.786]
I: Rainfall intensity (in/hr)
P1: 1-hour point rainfall depth (inches)
Tc: Time of concentration (minutes)

Detention
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 8/13/2007

Detention Requirements (10-year storm)-Empirical Method:

Release Rates (cfs/acre)

Soil Type:	a	b	c
10-yr release (cfs/acre):	0.13	0.23	0.30
100-yr release (cfs/acre):	0.50	0.85	1.00

Basin A

Basin Area (acres): **10.49**
Percent Imperviousness (%): **84.2**
Release Rate (10-year storm): **3.15 cfs**

Required Detention Volume

V=KA K100=(1.78I-.002I^2-3.56)/900 K10=(0.95I-1.90)/1000	**Basin A**
Area (acres)=	10.49
I(%) =	84.2
K100=	0.132
K10=	0.078
V100 (acre-ft)=	1.39
V10 (acre-ft)=	**0.82**

Basin B

Basin Area (acres): **16.65**
Percent Imperviousness (%): **87.3**
Release Rate (10-year storm): **5.00 cfs**

Required Detention Volume

V=KA K100=(1.78I-.002I^2-3.56)/900 K10=(0.95I-1.90)/1000	**Basin B**
Area (acres)=	16.65
I(%) =	87.3
K100=	0.137
K10=	0.081
V100 (acre-ft)=	2.27
V10 (acre-ft)=	**1.35**

Basin C

Basin Area (acres):	**33.04**
Percent Imperviousness (%):	**87.5**
Release Rate (10-year storm):	**9.91 cfs**

Required Detention Volume

V=KA K100=(1.78I-.002I^2-3.56)/900 K10=(0.95I-1.90)/1000	**Basin C**
Area (acres)=	33.04
I(%) =	87.5
K100=	0.137
K10=	0.081
V100 (acre-ft)=	4.52
V10 (acre-ft)=	**2.68**

Basin D

Basin Area (acres):	**4.27**
Percent Imperviousness (%):	**81.3**
Release Rate (10-year storm):	**1.28 cfs**

Required Detention Volume

V=KA K100=(1.78I-.002I^2-3.56)/900 K10=(0.95I-1.90)/1000	**Basin D**
Area (acres)=	4.27
I(%) =	81.3
K100=	0.128
K10=	0.075
V100 (acre-ft)=	0.55
V10 (acre-ft)=	**0.32**

Basin E

Basin Area (acres):	**1.30**
Percent Imperviousness (%):	**89.3**
Release Rate (10-year storm):	**0.39 cfs**

Required Detention Volume

V=KA K100=(1.78I-.002I^2-3.56)/900 K10=(0.95I-1.90)/1000	**Basin E(Total)**
Area (acres)=	1.30
I(%) =	89.3
K100=	0.139
K10=	0.083
V100 (acre-ft)=	0.18
V10 (acre-ft)=	**0.11**

Detention Provided
SouthGlenn Mall
Job Number: 05-0199

Calculated By: CMJ
Checked By: CMJ
Date: 8/13/2007

Detention Facility Options

Basin A

Required 10-year volume (acre-ft): 0.82

StormTech Option

Number of chambers	486	
Area system	17,370	sf
Perimeter system	563	ft
Stone above	6	in
Stone below	6	in
Voids in stone	40	%
Length of Isolator Row	100	ft

Volume in chambers	22307	cf (45.9 cf per chamber)
Volume of excavation	60795	cf (system only - not total excavation)
Amount of stone	38488	cf
Volume in stone	15395	cf
Total Storage Volume	**37702**	**cf (Volume of chambers + Volume of stone)**
Total Storage Volume	**0.87**	**acre-ft (Volume of chambers + Volume of stone)**
Amount of Filter Fabric	36711	sf (not including Isolator Row)

Basin B

Required 10-year volume (acre-ft): 1.35

StormTech Option

Number of chambers	672	
Area system	24,303	sf
Perimeter system	698	ft
Stone above	6	in
Stone below	18	in
Voids in stone	40	%
Length of Isolator Row	210	ft

Volume in chambers	30845	cf (45.9 cf per chamber)
Volume of excavation	109364	cf (system only - not total excavation)
Amount of stone	78519	cf
Volume in stone	31407	cf
Total Storage Volume	**62252**	**cf (Volume of chambers + Volume of stone)**
Total Storage Volume	**1.43**	**acre-ft (Volume of chambers + Volume of stone)**
Amount of Filter Fabric	51747	sf (not including Isolator Row)

Basin C

Required 10-year volume (acre-ft): 2.68

StormTech Option		
Number of chambers	1,356	
Area system	47,270	sf
Perimeter system	954	ft
Stone above	6	in
Stone below	18	in
Voids in stone	40	%
Length of Isolator Row	570	ft

Volume in chambers	62240	cf (45.9 cf per chamber)
Volume of excavation	212715	cf (system only - not total excavation)
Amount of stone	150475	cf
Volume in stone	60190	cf
Total Storage Volume	**122430**	**cf (Volume of chambers + Volume of stone)**
Total Storage Volume	**2.81**	**acre-ft (Volume of chambers + Volume of stone)**
Amount of Filter Fabric	98833	sf (not including Isolator Row)

Basin D

Required 10-year volume (acre-ft): 0.32

StormTech Option		
Number of chambers	178	
Area system	6,504	sf
Perimeter system	460	ft
Stone above	6	in
Stone below	18	in
Voids in stone	40	%
Length of Isolator Row	185	ft

Volume in chambers	8170	cf (45.9 cf per chamber)
Volume of excavation	29268	cf (system only - not total excavation)
Amount of stone	21098	cf
Volume in stone	8439	cf
Total Storage Volume	**16609**	**cf (Volume of chambers + Volume of stone)**
Total Storage Volume	**0.38**	**acre-ft (Volume of chambers + Volume of stone)**
Amount of Filter Fabric	15078	sf (not including Isolator Row)

Basin E

Required 10-year volume (acre-ft): 0.11

StormTech Option		
Number of chambers	60	
Area system	2,455	sf
Perimeter system	245	ft
Stone above	6	in
Stone below	12	in
Voids in stone	40	%
Length of Isolator Row	21	ft

Volume in chambers	2754	cf (45.9 cf per chamber)
Volume of excavation	9820	cf (system only - not total excavation)
Amount of stone	7066	cf
Volume in stone	2826	cf
Total Storage Volume	**5580**	**cf (Volume of chambers + Volume of stone)**
Total Storage Volume	**0.13**	**acre-ft (Volume of chambers + Volume of stone)**
Amount of Filter Fabric	5890	sf (not including Isolator Row)

EMERGENCY OVERFLOW
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 8/13/2007

BASINS A and B
Weir Equation: Q=CLH^3/2

100-yr inflow (cfs) =	132.6	Basin 100-Year Peak Flow
2*100-yr inflow (cfs) =	265.2	
C (Trapezoidal Section) =	3.4	(Weir flow coefficient)
Total Head H (ft) =	1.5	
Required Length of Weir L (ft) =	42	

BASIN C
Weir Equation: Q=CLH^3/2

100-yr inflow (cfs) =	148.6	Basin 100-Year Peak Flow
2*100-yr inflow (cfs) =	297.2	
C (Trapezoidal Section) =	3.4	(Weir flow coefficient)
Total Head H (ft) =	1.5	
Required Length of Weir L (ft) =	48	

BASIN 1/2C and D
Weir Equation: Q=CLH^3/2

100-yr inflow (cfs) =	114.7	Basin 100-Year Peak Flow
2*100-yr inflow (cfs) =	229.4	
C (Trapezoidal Section) =	3.4	(Weir flow coefficient)
Total Head H (ft) =	1.0	
Required Length of Weir L (ft) =	67	

BASIN E
Weir Equation: Q=CLH^3/2

100-yr inflow (cfs) =	8.5	Basin 100-Year Peak Flow
2*100-yr inflow (cfs) =	17.0	
C (Trapezoidal Section) =	3.4	(Weir flow coefficient)
Total Head H (ft) =	1.0	
Required Length of Weir L (ft) =	5	

Street Capacity - W/Parking
Worksheet for Irregular Channel

Project Description	
Project File	f:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\100 yr s.fm2
Worksheet	Street Capacity
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Input Data		
Channel Slope	0.010000	ft/ft
Elevation range: 0.00 ft to 0.96 ft.		

Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
0.00	0.96	0.00	63.00	0.012
0.00	0.46			
1.00	0.38			
15.00	0.08			
16.00	0.00			
17.00	0.08			
31.00	0.36			
45.00	0.08			
46.00	0.00			
47.00	0.08			
62.00	0.38			
63.00	0.46			
63.00	0.96			

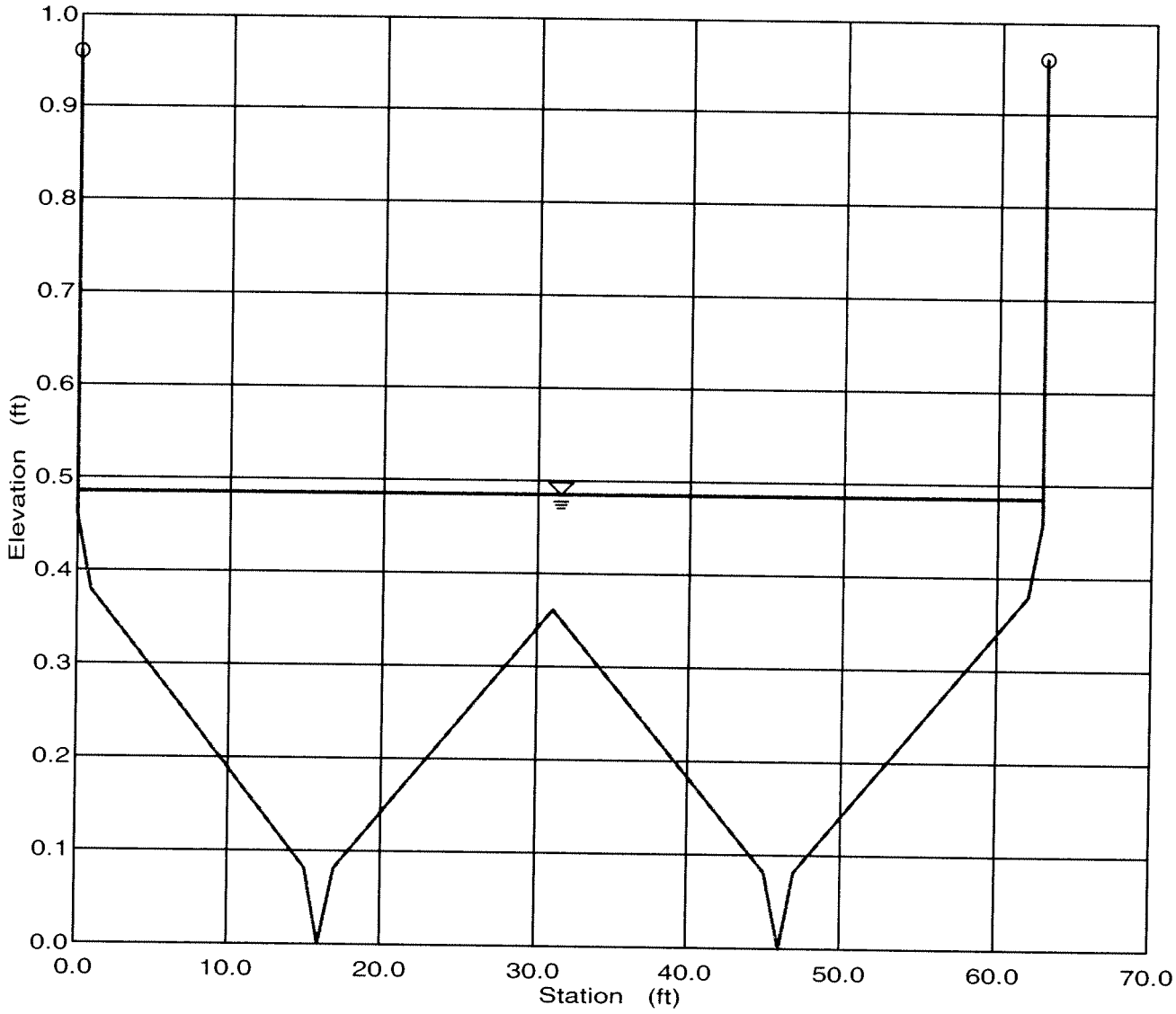
Discharge	85.40	cfs

Results		
Wtd. Mannings Coefficient	0.012	
Water Surface Elevation	0.48	ft
Flow Area	16.72	ft^2
Wetted Perimeter	63.08	ft
Top Width	63.00	ft
Height	0.48	ft
Critical Depth	0.60	ft
Critical Slope	0.002904	ft/ft
Velocity	5.11	ft/s
Velocity Head	0.41	ft
Specific Energy	0.89	ft
Froude Number	1.75	
Flow is supercritical.		

Cross Section - W/Parking
Cross Section for Irregular Channel

Project Description	
Project File	f:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\100 yr s.fm2
Worksheet	Street Capacity
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.012	
Channel Slope	0.010000	ft/ft
Water Surface Elevation	0.48	ft
Discharge	85.40	cfs



Street Capacity - 30 ft
Worksheet for Irregular Channel

Project Description	
Project File	f:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\100 yr s.fm2
Worksheet	Street Capacity - 30 ft
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

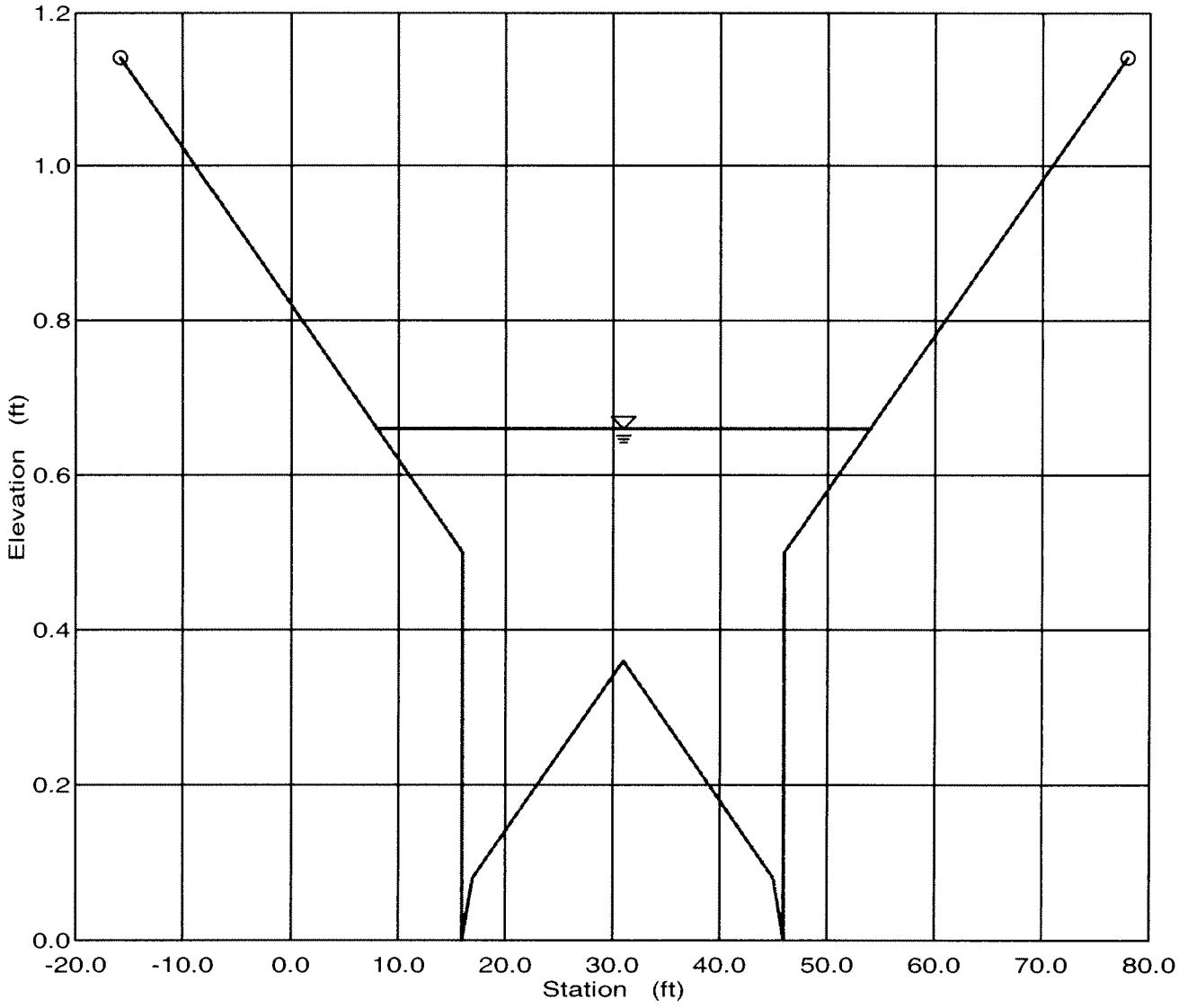
Input Data				
Channel Slope	0.010000 ft/ft			
Elevation range: 0.00 ft to 1.14 ft.				
Station (ft)	Elevation (ft)	Start Station	End Station	Roughness
-15.80	1.14	-15.80	77.80	0.012
16.00	0.50			
16.00	0.00			
17.00	0.08			
31.00	0.36			
45.00	0.08			
46.00	0.00			
46.00	0.50			
77.80	1.14			
Discharge	85.40 cfs			

Results		
Wtd. Mannings Coefficient	0.012	
Water Surface Elevation	0.66	ft
Flow Area	14.86	ft^2
Wetted Perimeter	46.97	ft
Top Width	45.95	ft
Height	0.66	ft
Critical Depth	0.83	ft
Critical Slope	0.002948	ft/ft
Velocity	5.75	ft/s
Velocity Head	0.51	ft
Specific Energy	1.17	ft
Froude Number	1.78	
Flow is supercritical.		

Cross Section - 30 ft
Cross Section for Irregular Channel

Project Description	
Project File	f:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\100 yr s.fm2
Worksheet	Street Capacity - 30 ft
Flow Element	Irregular Channel
Method	Manning's Formula
Solve For	Water Elevation

Section Data		
Wtd. Mannings Coefficient	0.012	
Channel Slope	0.010000	ft/ft
Water Surface Elevation	0.66	ft
Discharge	85.40	cfs



Hydraulic Computations

Existing Pipe Capacity
Worksheet for Circular Channel

Project Description	
Project File	j:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\05-0199.fm2
Worksheet	Pipe Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.015000	ft/ft
Diameter	24.00	in

Results		
Depth	2.00	ft
Discharge	24.01	cfs
Flow Area	3.14	ft²
Wetted Perimeter	6.28	ft
Top Width	0.00	ft
Critical Depth	1.74	ft
Percent Full	100.00	
Critical Slope	0.013726	ft/ft
Velocity	7.64	ft/s
Velocity Head	0.91	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	25.83	cfs
Full Flow Capacity	24.01	cfs
Full Flow Slope	0.015000	ft/ft

Existing Pipe Capacity
Worksheet for Circular Channel

Project Description	
Project File	j:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\05-0199.fm2
Worksheet	Pipe Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.009000	ft/ft
Diameter	18.00	in

Results		
Depth	1.50	ft
Discharge	8.64	cfs
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.14	ft
Percent Full	100.00	
Critical Slope	0.010543	ft/ft
Velocity	4.89	ft/s
Velocity Head	0.37	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	9.29	cfs
Full Flow Capacity	8.64	cfs
Full Flow Slope	0.009000	ft/ft

Existing Pipe Capacity
Worksheet for Circular Channel

Project Description	
Project File	j:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\05-0199.fm2
Worksheet	Pipe Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.001000	ft/ft
Diameter	15.00	in

Results		
Depth	1.25	ft
Discharge	1.77	cfs
Flow Area	1.23	ft^2
Wetted Perimeter	3.93	ft
Top Width	0.00	ft
Critical Depth	0.53	ft
Percent Full	100.00	
Critical Slope	0.007192	ft/ft
Velocity	1.44	ft/s
Velocity Head	0.03	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	1.90	cfs
Full Flow Capacity	1.77	cfs
Full Flow Slope	0.001000	ft/ft

Existing Pipe Capacity
Worksheet for Circular Channel

Project Description	
Project File	j:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\05-0199.fm2
Worksheet	Pipe Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.007500	ft/ft
Diameter	21.00	in

Results		
Depth	1.75	ft
Discharge	11.89	cfs
Flow Area	2.41	ft²
Wetted Perimeter	5.50	ft
Top Width	0.00	ft
Critical Depth	1.29	ft
Percent Full	100.00	
Critical Slope	0.009474	ft/ft
Velocity	4.94	ft/s
Velocity Head	0.38	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	12.79	cfs
Full Flow Capacity	11.89	cfs
Full Flow Slope	0.007500	ft/ft

Existing Pipe Capacity
Worksheet for Circular Channel

Project Description	
Project File	j:\2005\05-0199 streets at southglenn\civil\drainage\flowmaster\05-0199.fm2
Worksheet	Pipe Capacity
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Full Flow Capacity

Input Data		
Mannings Coefficient	0.015	
Channel Slope	0.010000	ft/ft
Diameter	18.00	in

Results		
Depth	1.50	ft
Discharge	9.10	cfs
Flow Area	1.77	ft^2
Wetted Perimeter	4.71	ft
Top Width	0.00	ft
Critical Depth	1.17	ft
Percent Full	100.00	
Critical Slope	0.011080	ft/ft
Velocity	5.15	ft/s
Velocity Head	0.41	ft
Specific Energy	FULL	ft
Froude Number	FULL	
Maximum Discharge	9.79	cfs
Full Flow Capacity	9.10	cfs
Full Flow Slope	0.010000	ft/ft

INLET SUMMARY
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 9/12/2007

TYPE R INLET DESIGN:

1. MAX PONDING DEPTH =1.0' UNLESS OTHERWISE INDICATED.
2. DESIGN CAPACITY FOR 10-YR STORM EVENT.
3. ALL INLETS LOCATED IN SUMP CONDITION UNLESS OTHERWISE INDICATED.
4. STREET SECTION: CROSS SLOPE 2%, 1-FOOT PAN
5. ALLOWABLE INLET CAPACITY FROM ARAPAHOE COUNTY FIGURES 902 & 903

TYPE 13 COMBINATION AND TYPE 13 GRATED

1. MAX PONDING DEPTH =1.0' UNLESS OTHERWISE INDICATED.
2. DESIGN CAPACITY FOR 10-YR STORM EVENT.
3. ALL INLETS LOCATED IN SUMP CONDITION UNLESS OTHERWISE INDICATED.
4. STREET SECTION: CROSS SLOPE 2%, 1-FOOT PAN
5. ALLOWABLE INLET CAPACITY FROM ARAPAHOE COUNTY FIGURES 902 & 903

Design Point	10 YEAR DESIGN FLOW	Location	Depth of Flow (Ft)	Inlet Type	Condition
A1	2.1	6"VC	0.5	3' - Type 13 Combo	Sump
A4	1.0	6"VC	0.5	3' - Type 13 Combo	Sump
A5	1.2	6"VC	0.5	5' - Type R	Sump
A6	12.9	6"VC	0.7	10' - Type R	Sump
A7	0.4	6"VC	NA	5' - Type R	On-Grade(2.6%)
A8	1.2	6"VC	0.5	3' - Type 13 Combo	Sump
A11	2.2	Sump	0.5	3' - Type 13 Grated	Sump
A12	2.0	Sump	0.5	3' - Type 13 Grated	Sump
A13	1.7	Sump	0.5	3' - Type 13 Grated	Sump
A14	1.8	Sump	0.5	3' - Type 13 Grated	Sump
B3	1.2	6"VC	NA	5' - Type R	On-Grade(1.0%)
B4	1.3	6"VC	0.2	5' - Type R	Sump
B5	2.1	6"VC	0.5	5' - Type R	Sump
B6	1.2	6"VC	0.5	5' - Type R	Sump
B7	1.7	6"VC	NA	5' - Type R	On-Grade(0.5%)
B9	2.1	6"VC	NA	5' - Type R	On-Grade(1.0%)
B10	0.4	6"VC	0.2	5' - Type R	Sump
B12	1.6	6"VC	0.2	5' - Type R	Sump
B16	1.3	6"VC	NA	5' - Type R	On-Grade(4.5%)
B18	7.5	6"VC	0.5	6' - Type 13 Combo	Sump
B19	7.7	6"VC	0.5	6' - Type 13 Combo	Sump
B20	7.3	6"VC	0.5	6' - Type 13 Combo	Sump

Design Point	10 YEAR DESIGN FLOW	Location	Depth of Flow (Ft)	Inlet Type	Condition
C1	1.0	6"VC	NA	5' - Type R	On-Grade(1.6%)
C2	12.5	6"VC	0.5	15' - Type R	Sump
C5	0.5	6"VC	NA	5' - Type R	On-Grade(1.0%)
C8	3.0	Sump	NA	6' - Type 13 Combo	On-Grade(1.0%)
C9	4.1	6"VC	0.3	10' - Type R	Sump
C10	3.1	6"VC	NA	5' - Type R	On-Grade(1.0%)
C13	2.3	6"VC	0.4	5' - Type R	Sump
C14	1.8	6"VC	0.4	5' - Type R	Sump
C15	1.8	6"VC	NA	5' - Type R	On-Grade(1.0%)
C17	1.2	6"VC	0.3	5' - Type R	Sump
C18	1.1	6"VC	0.5	5' - Type R	Sump
C20	4.8	Sump	0.5	6' - Type 13 Grated	Sump
C23	2.7	Sump	0.5	6' - Type 13 Grated	Sump
C24	3.9	6"VC	0.5	3' - Type 13 Combo	Sump
C25	1.7	6"VC	0.5	5' - Type R	Sump
C28	6.4	Sump	0.5	6' - Type 13 Grated	Sump
C29	3.0	Sump	0.5	6' - Type 13 Grated	Sump
C30	3.9	6"VC	0.5	10' - Type R	Sump
C31	4.4	6"VC	0.5	6' - Type 13 Combo	Sump
C32	0.6	6"VC	NA	5' - Type R	On-Grade(1.0%)
C33	0.4	6"VC	NA	5' - Type R	On-Grade(1.0%)
D1	0.4	6"VC	NA	5' - Type R	On-Grade(2.5%)
D2	0.8	6"VC	NA	5' - Type R	On-Grade(2.5%)
D4	1.2	6"VC	NA	5' - Type R	On-Grade(1.5%)
D5	1.6	6"VC	0.5	5' - Type R	Sump
D6	2.1	6"VC	NA	5' - Type R	On-Grade(1.1%)
D7	2.3	6"VC	0.5	3' - Type 13 Combo	Sump
D8	0.9	6"VC	0.5	3' - Type 13 Combo	Sump
D9	2.7	6"VC	0.5	3' - Type 13 Combo	Sump
E1	0.7	6"VC	NA	5' - Type R	On-Grade(3.3%)
E2	4.2	6"VC	0.5	6' - Type 13 Combo	Sump

Interception of Storm Runoff
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 8/13/2007

Design Point	Q10 (cfs)	Allowable Depth (ft)	Inlet Type/Size	Inlet Capacity (cfs)	Street Capacity (cfs)	Interception Ratio R	10yr Qi (cfs)	10yr Qc (cfs)	Downstream Sump Qn (cfs)	Downstream Sump Qt (cfs)
A7	0.4	0.46	5' - Type R	4.0	12.0	0.33	0.1	0.2		
							Flow bypassed to sump inlet at DP: A14		1.8	2.0
B3	1.2	0.46	5' - Type R	3.6	8.4	0.43	0.5	0.7		
							Carryover flow from B3 is bypassed first to B9 and ultimately to the sump inlet at B10			
B9	2.8	0.46	5' - Type R	3.6	8.4	0.43	1.2	1.6		
							Flow bypassed to sump inlet at DP: B10		0.4	2.1
B7	1.7	0.46	5' - Type R	3.2	5.2	0.62	1.1	0.7		
							Flow bypassed to sump inlet at DP: B18		7.5	8.1
B16	1.3	0.46	5' - Type R	4.4	12.0	0.37	0.5	0.8		
							Flow bypassed offsite			
C1	1.0	0.46	5' - Type R	3.8	10.5	0.36	0.4	0.6		
							Flow bypassed offsite			
C5	0.5	0.46	5' - Type R	3.6	8.4	0.43	0.2	0.3		
							Flow bypassed to sump inlet at DP: C13		2.3	2.5
C8	3.0	0.46	6' - Type 13 Combo	3.6	8.4	0.43	1.3	1.7		
							Flow bypassed to sump inlet at DP: C9		4.1	5.8
C10	3.1	0.46	5' - Type R	3.6	8.4	0.43	1.3	1.8		
							Flow bypassed to sump inlet at DP: C14		1.8	3.6
C15	1.8	0.46	5' - Type R	3.6	8.4	0.43	0.8	1.0		
							Flow bypassed to sump inlet at DP: C17		1.2	2.2
C32	0.6	0.46	5' - Type R	3.6	8.4	0.43	0.3	0.3		
C33	0.4	0.46	5' - Type R	3.6	8.4	0.43	0.2	0.2		
							Flow bypassed offsite			
D1	0.4	0.46	5' - Type R	4.0	12.0	0.33	0.1	0.3		
D2	0.8	0.46	5' - Type R	4.0	12.0	0.33	0.3	0.5		
							Flow bypassed offsite			
D4	1.2	0.46	5' - Type R	3.8	10.3	0.37	0.4	0.8		
							Flow bypassed to sump inlet at DP: D5		1.6	2.4
D6	2.1	0.46	5' - Type R	3.6	8.4	0.43	0.9	1.2		
							Flow bypassed to sump inlet at DP: D7		2.3	3.4
E1	0.7	0.46	5' - Type R	4.1	12.0	0.34	0.2	0.4		
							Flow bypassed offsite			

Note: The downstream sump flow, Qn, is the nominal flow before carryover is taken into account.
Qt refers to the total accumulated surface flow at that inlet.

Interception of Storm Runoff
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 8/13/2007

Design Point	Q100 (cfs)	Allowable Depth (ft)	Inlet Type/Size	Inlet Capacity (cfs)	Street Capacity (cfs)	Interception Ratio R	100yr Qi (cfs)	100yr Qc (cfs)	Downstream Sump Qn (cfs)	Downstream Sump Qt (cfs)
A7	0.7	0.46	5' - Type R	4.0	12.0	0.33	0.2	0.5		
							Flow bypassed to sump inlet at DP: A14		3.3	3.8
B3	2.1	0.46	5' - Type R	3.6	8.4	0.43	0.9	1.2		
							Carryover flow from B3 is bypassed first to B9 and ultimately to the sump inlet at B10			
B9	4.9	0.46	5' - Type R	3.6	8.4	0.43	2.1	2.8		
							Flow bypassed to sump inlet at DP: B10		0.9	3.7
B7	3.0	0.46	5' - Type R	3.2	5.2	0.62	1.9	1.2		
							Flow bypassed to sump inlet at DP: B18		13.7	14.8
B16	2.1	0.46	5' - Type R	4.4	12.0	0.37	0.8	1.4		
							Flow bypassed offsite			
C1	1.8	0.46	5' - Type R	3.8	10.5	0.36	0.6	1.1		
							Flow bypassed offsite			
C5	1.0	0.46	5' - Type R	3.6	8.4	0.43	0.4	0.6		
							Flow bypassed to sump inlet at DP: C13		4.2	4.8
C8	5.3	0.46	6' - Type 13 Combo	3.6	8.4	0.43	2.3	3.0		
							Flow bypassed to sump inlet at DP: C9		7.3	10.3
C10	5.4	0.46	5' - Type R	3.6	8.4	0.43	2.3	3.1		
							Flow bypassed to sump inlet at DP: C14		3.1	6.2
C15	3.0	0.46	5' - Type R	3.6	8.4	0.43	1.3	1.7		
							Flow bypassed to sump inlet at DP: C17		2.2	3.9
C32	1.1	0.46	5' - Type R	3.6	8.4	0.43	0.5	0.6		
C33	0.8	0.46	5' - Type R	3.6	8.4	0.43	0.3	0.4		
							Flow bypassed offsite			
D1	0.7	0.46	5' - Type R	4.0	12.0	0.33	0.2	0.5		
D2	1.3	0.46	5' - Type R	4.0	12.0	0.33	0.4	0.9		
							Flow bypassed offsite			
D4	2.2	0.46	5' - Type R	3.8	10.3	0.37	0.8	1.4		
							Flow bypassed to sump inlet at DP: D5		2.9	4.3
D6	3.8	0.46	5' - Type R	3.6	8.4	0.43	1.6	2.2		
							Flow bypassed to sump inlet at DP: D7		4.0	6.1
E1	1.2	0.46	5' - Type R	4.1	12.0	0.34	0.4	0.8		
							Flow bypassed offsite			

Note: The downstream sump flow, Qn, is the nominal flow before carryover is taken into account. Qt refers to the total accumulated surface flow at that inlet.

Orifice Sizing

Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 8/13/2007

Detention Basin	10yr Required Volume (acre-ft)	Volume Provided (acre-ft)	10yr Water Surface (ft)	10yr Allowable Release (cfs)
A	0.82	0.87	5568.75	3.15
B	1.35	1.43	5558.00	5.00
C	2.68	2.81	5555.00	9.91
D	0.32	0.38	5554.70	1.28
E	0.11	0.13	5559.70	0.39

Detention Basin	h (ft)
A	3.75
B	5.00
C	4.50
D	4.50
E	4.00

Major Basin	Minor Basins Included	Max Pipe Flow (cfs)
East	A,B	8.14
West	C,D	11.19

Orifice Sizing		
Basin	A	
Allowable Discharge (cfs)	3.15	
Cd:	0.65	
h (ft):	3.47	
Orifice Area Required (sf):	0.32	
Orifice Opening Height (ft)	0.57	
Orifice Opening Height (in)	6.821	6-11/16" SQUARE

Orifice Sizing		
Basin	B	
Allowable Discharge (cfs)	5.00	
Cd:	0.65	
h (ft):	4.67	
Orifice Area Required (sf):	0.44	
Orifice Opening Height (ft)	0.67	
Orifice Opening Height (in)	8.042	7-15/16" SQUARE

Orifice Sizing		
Basin	C	
Allowable Discharge (cfs)	9.91	
Cd:	0.65	
h (ft):	4.01	
Orifice Area Required (sf):	0.95	
Orifice Opening Height (ft)	0.97	
Orifice Opening Height (in)	11.619	12" SQUARE

Orifice Sizing		
Basin	D	
Allowable Discharge (cfs)	1.28	
Cd:	0.65	
h (ft):	4.33	
Orifice Area Required (sf):	0.12	
Orifice Opening Height (ft)	0.35	
Orifice Opening Height (in)	4.170	4" SQUARE

Orifice Sizing		
Basin	E(TOTAL)	
Allowable Discharge (cfs)	0.39	
Cd:	0.65	
h (ft):	3.90	
Orifice Area Required (sf):	0.04	
Orifice Opening Height (ft)	0.19	
Orifice Opening Height (in)	2.268	2-1/4" SQUARE

WATER QUALITY SUMMARY
SouthGlenn Mall
Job Number: 05-0199

Calculated By: BEP
Checked By: CMJ
Date: 8/13/2007

WQ UNIT	10 YEAR DESIGN FLOW	25% OF 10yr	MODEL NUMBER*	VOLUME (ac-ft)
WQA1	24.7	6.2	6040WQA	0.018
WQB1	29.1	7.3	4840WQA x2	0.023
WQB2	13.4	3.4	3640WQA	0.006
WQC1	74.1	18.5	6040WQA x3	0.054
WQC2	9.0	2.2	3640WQA	0.006
WQD1	11.0	2.7	3640WQA	0.006
WQD2	2.7	0.7	3620WQB	0.003
WQE1	0.6	0.1	3620WQB	0.003
WQE2	4.2	1.1	3620WQA	0.003

* Refer to "StormTech" data in appendix for the manufacturer's model number.

WQVC Requirements (above ground detention facilities) for information only:

Basin A
Basin Area (acres): 10.49
Percent Imperviousness (%): 84.19

	Basin A
Area [A] (acres) =	10.49
% Impervious [I](%) =	84.2
Req. Storage-40hr drain T (in) =	0.36
WQVC=(Req.Storage/12)A (ac-ft) =	0.31
WQVCdesign=1.2WQVC (ac-ft) =	0.37
WQVC/Acre (ac-ft) =	0.04

Basin B
Basin Area (acres): 16.65
Percent Imperviousness (%): 87.29

	Basin B
Area [A] (acres) =	16.65
% Impervious [I](%) =	87.3
Req. Storage-40hr drain T (in) =	0.38
WQVC=(Req.Storage/12)A (ac-ft) =	0.53
WQVCdesign=1.2WQVC (ac-ft) =	0.63
WQVC/Acre (ac-ft) =	0.04

Basin C
Basin Area (acres): 33.04
Percent Imperviousness (%): 87.53

	Basin C
Area [A] (acres) =	33.04
% Impervious [I](%) =	87.5
Req. Storage-40hr drain T (in) =	0.38
WQVC=(Req.Storage/12)A (ac-ft) =	1.05
WQVCdesign=1.2WQVC (ac-ft) =	1.26
WQVC/Acre (ac-ft) =	0.04

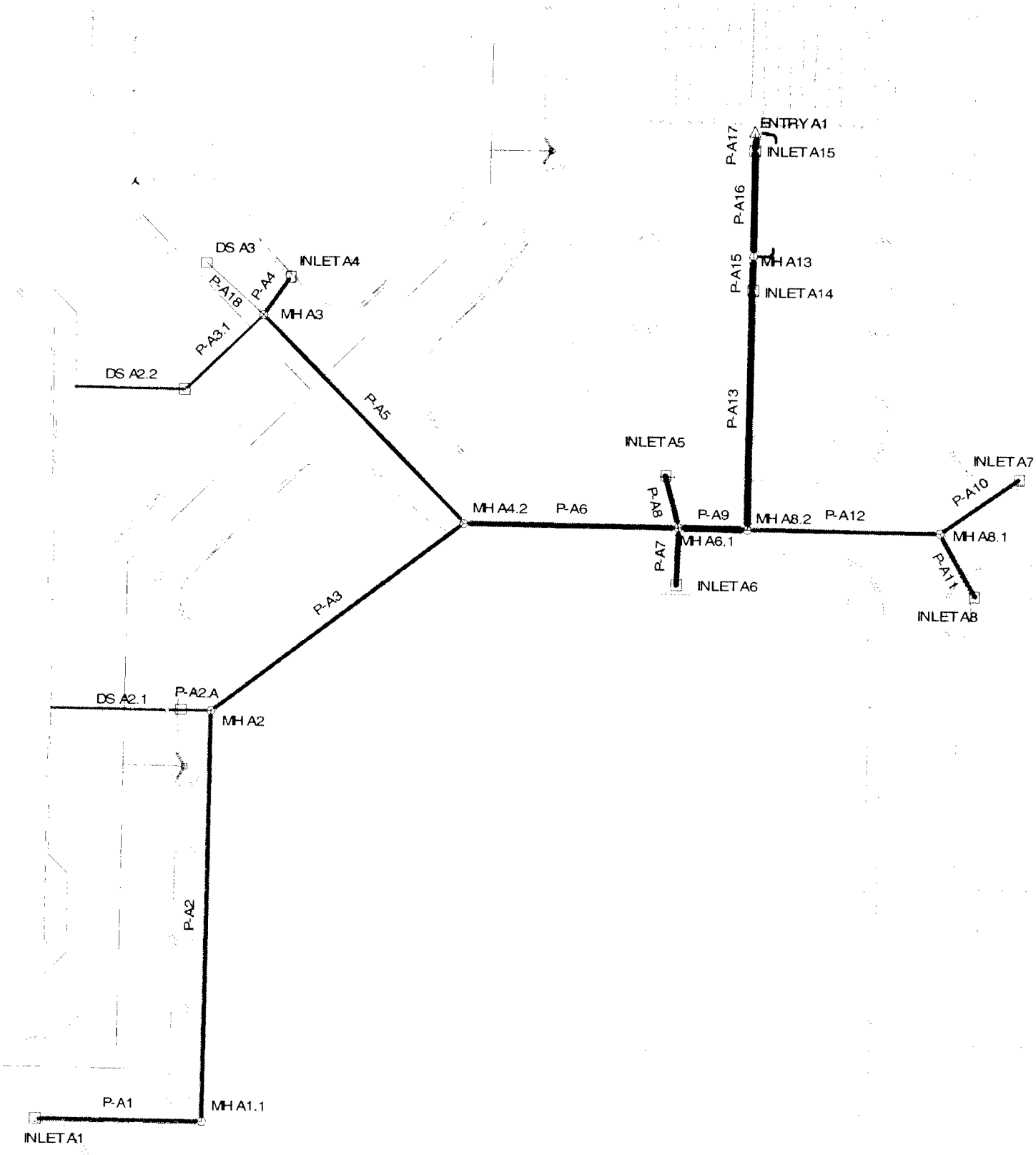
Basin D
Basin Area (acres): 4.27
Percent Imperviousness (%): 81.32

	Basin D
Area [A] (acres) =	4.27
% Impervious [I](%) =	81.3
Req. Storage-40hr drain T (in) =	0.34
WQVC=(Req.Storage/12)A (ac-ft) =	0.12
WQVCdesign=1.2WQVC (ac-ft) =	0.14
WQVC/Acre (ac-ft) =	0.03

Basin E(TOTAL)
Basin Area (acres): 1.30
Percent Imperviousness (%): 89.32

	Basin E(TOTAL)
Area [A] (acres) =	1.30
% Impervious [I](%) =	89.3
Req. Storage-40hr drain T (in) =	0.40
WQVC=(Req.Storage/12)A (ac-ft) =	0.04
WQVCdesign=1.2WQVC (ac-ft) =	0.05
WQVC/Acre (ac-ft) =	0.04

Scenario: LINE A - 100-YR



Scenario: LINE A - 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-A1	18 inch	61.00	INLET A1	MH A1.1	5,573.50	5,572.89	0.010000	4.15	10.50	2.16	5,578.34	5,579.80	5,574.05	5,573.35	5,574.26	5,573.69
P-A2	18 inch	155.00	MH A1.1	MH A2	5,572.59	5,568.81	0.024387	3.04	16.40	2.13	5,579.80	5,578.05	5,573.14	5,569.55	5,573.34	5,569.64
P-A2.A	12 inch	11.00	DS A2.1	MH A2	5,269.00	5,268.84	0.014545	3.45	4.30	2.71	5,278.00	5,578.05	5,569.61	5,569.55	5,569.80	5,569.73
P-A3	18 inch	119.00	MH A2	MH A4.2	5,568.51	5,567.32	0.010000	3.85	10.50	4.71	5,578.05	5,575.32	5,569.34	5,568.55	5,569.68	5,568.69
P-A3.1	18 inch	41.00	DS A2.2	MH A3	5,571.16	5,570.34	0.020000	5.11	14.85	2.71	5,577.00	5,576.19	5,571.78	5,570.78	5,572.02	5,571.40
P-A4	18 inch	18.00	INLET A4	MH A3	5,570.34	5,569.26	0.060000	1.90	25.73	1.05	5,575.75	5,576.19	5,570.72	5,570.25	5,570.86	5,570.26
P-A5	18 inch	109.00	MH A3	MH A4.2	5,568.96	5,567.32	0.015046	4.39	12.88	5.81	5,576.19	5,575.32	5,569.89	5,568.55	5,570.29	5,568.77
P-A6	24 inch	80.00	MH A4.2	MH A6.1	5,566.82	5,566.34	0.006000	3.63	17.52	10.25	5,575.32	5,574.72	5,568.36	5,568.27	5,568.60	5,568.44
P-A7	18 inch	20.00	INLET A6	MH A6.1	5,568.04	5,566.84	0.060000	7.76	25.73	13.29	5,575.10	5,574.72	5,569.40	5,568.27	5,570.37	5,569.18
P-A8	18 inch	22.00	INLET A5	MH A6.1	5,568.16	5,566.84	0.060000	1.92	25.73	1.26	5,574.00	5,574.72	5,568.58	5,568.27	5,568.73	5,568.28
P-A9	30 inch	26.00	MH A6.1	MH A8.2	5,565.84	5,565.69	0.005769	5.51	31.15	23.64	5,574.72	5,574.87	5,567.83	5,567.79	5,568.32	5,568.24
P-A10	18 inch	36.00	INLET A7	MH A8.1	5,570.50	5,569.24	0.035000	1.86	19.65	0.39	5,575.64	5,575.50	5,570.73	5,569.55	5,570.81	5,569.58
P-A11	18 inch	27.00	INLET A8	MH A8.1	5,571.00	5,569.24	0.065185	5.39	26.82	1.22	5,576.24	5,575.50	5,571.41	5,569.46	5,571.56	5,570.38
P-A12	18 inch	73.00	MH A8.1	MH A8.2	5,568.94	5,566.39	0.034932	2.12	19.63	1.59	5,575.50	5,574.87	5,569.41	5,567.79	5,569.58	5,567.80
P-A13	30 inch	90.00	MH A8.2	INLET A14	5,565.39	5,564.89	0.005556	6.22	30.57	24.92	5,574.87	5,572.90	5,567.16	5,566.97	5,567.86	5,567.47
P-A15	30 inch	13.00	INLET A14	MH A13	5,564.69	5,564.62	0.005385	6.01	30.10	25.40	5,572.90	5,573.10	5,566.68	5,566.65	5,567.25	5,567.20
P-A16	30 inch	40.00	MH A13	INLET A15	5,564.42	5,564.22	0.005000	6.14	29.00	25.38	5,573.10	5,573.00	5,566.34	5,566.22	5,566.95	5,566.79
P-A17	30 inch	4.00	INLET A15	ENTRY A1	5,564.02	5,564.00	0.005000	7.14	29.00	26.92	5,573.00	5,573.00	5,565.84	5,565.77	5,566.61	5,566.59
P-A18	12 inch	29.00	DS A3	MH A3	5,566.60	5,566.17	0.014828	3.42	4.34	2.68	5,576.50	5,576.19	5,570.41	5,570.25	5,570.59	5,570.43

CLC Associates, Inc.
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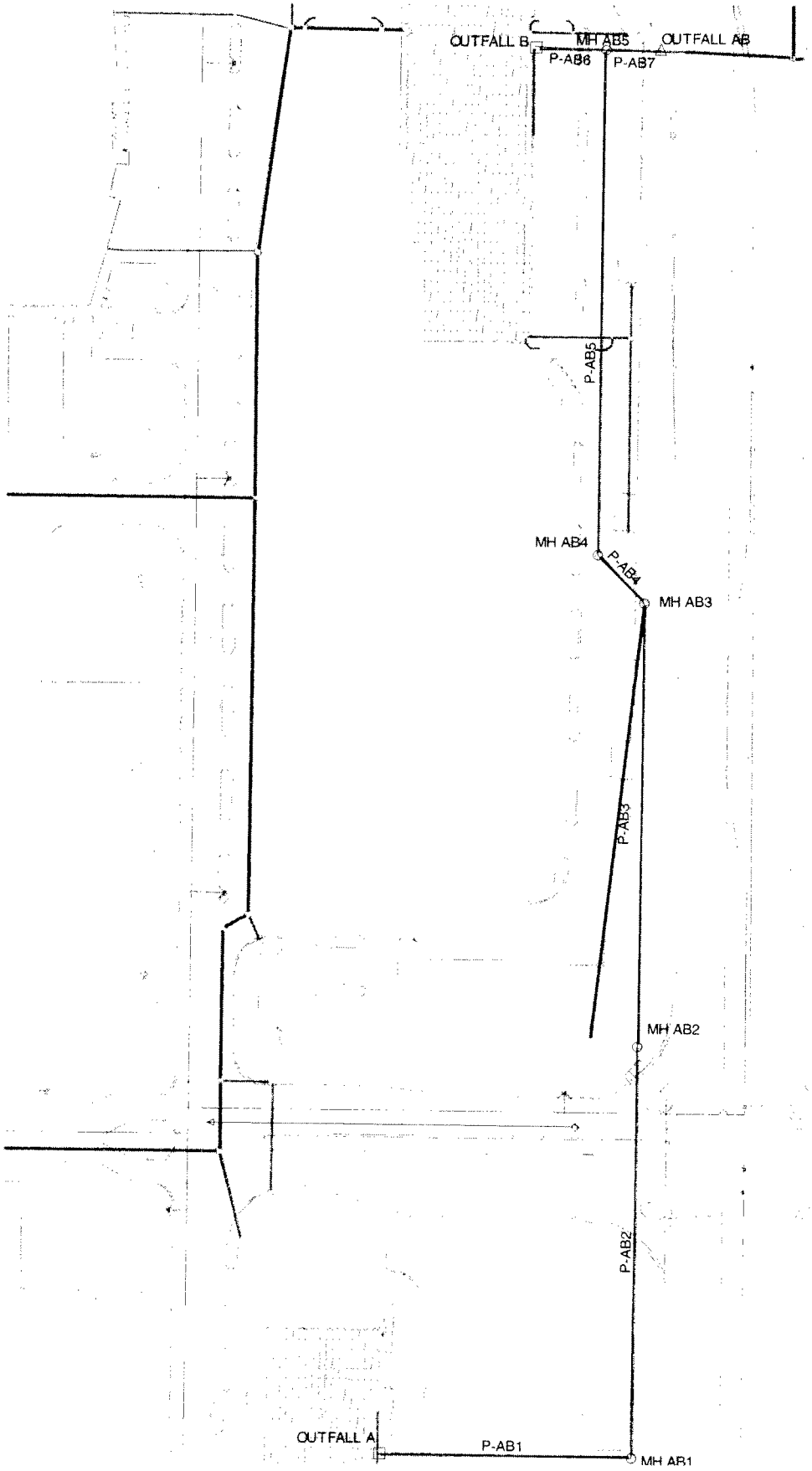
Scenario: LINE A - 100-YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-A1	18 inch	61.00	INLET A1	MH A1.1	5,573.50	5,572.89	0.010000	2.42	10.50	3.87	5,578.34	5,579.80	5,574.66	5,574.61	5,574.76	5,574.68
P-A2	18 inch	155.00	MH A1.1	MH A2	5,572.59	5,568.81	0.024387	2.14	16.40	3.79	5,579.80	5,578.05	5,574.55	5,574.35	5,574.62	5,574.42
P-A2.A	12 inch	11.00	DS A2.1	MH A2	5,269.00	5,268.84	0.014545	6.01	4.30	4.72	5,278.00	5,578.05	5,574.54	5,574.35	5,575.10	5,574.91
P-A3	18 inch	119.00	MH A2	MH A4.2	5,568.51	5,567.32	0.010000	4.63	10.50	8.19	5,578.05	5,575.32	5,574.15	5,573.43	5,574.48	5,573.76
P-A3.1	18 inch	41.00	DS A2.2	MH A3	5,571.16	5,570.34	0.020000	2.67	14.85	4.72	5,577.00	5,576.19	5,574.95	5,574.87	5,575.06	5,574.98
P-A4	18 inch	18.00	INLET A4	MH A3	5,570.34	5,569.26	0.060000	1.01	25.73	1.78	5,575.75	5,576.19	5,574.87	5,574.87	5,574.89	5,574.89
P-A5	18 inch	109.00	MH A3	MH A4.2	5,568.96	5,567.32	0.015046	5.67	12.88	10.03	5,576.19	5,575.32	5,574.42	5,573.43	5,574.92	5,573.93
P-A6	24 inch	80.00	MH A4.2	MH A6.1	5,566.82	5,566.34	0.006000	5.65	17.52	17.74	5,575.32	5,574.72	5,573.03	5,572.54	5,573.53	5,573.03
P-A7	18 inch	20.00	INLET A6	MH A6.1	5,568.04	5,566.84	0.060000	13.12	25.73	23.19	5,575.10	5,574.72	5,573.51	5,572.54	5,576.19	5,575.21
P-A8	18 inch	22.00	INLET A5	MH A6.1	5,568.16	5,566.84	0.060000	1.38	25.73	2.44	5,574.00	5,574.72	5,572.55	5,572.54	5,572.58	5,572.57
P-A9	30 inch	26.00	MH A6.1	MH A8.2	5,565.84	5,565.69	0.005769	8.45	31.15	41.49	5,574.72	5,574.87	5,571.54	5,571.27	5,572.65	5,572.38
P-A10	18 inch	36.00	INLET A7	MH A8.1	5,570.50	5,569.24	0.035000	0.57	19.65	0.74	5,575.64	5,575.50	5,571.35	5,571.36	5,571.36	5,571.36
P-A11	18 inch	27.00	INLET A8	MH A8.1	5,571.00	5,569.24	0.065185	2.41	26.82	2.12	5,576.24	5,575.50	5,571.55	5,571.36	5,571.75	5,571.38
P-A12	18 inch	73.00	MH A8.1	MH A8.2	5,568.94	5,566.39	0.034932	1.59	19.63	2.80	5,575.50	5,574.87	5,571.33	5,571.27	5,571.36	5,571.31
P-A13	30 inch	90.00	MH A8.2	INLET A14	5,565.39	5,564.89	0.005556	8.93	30.57	43.86	5,574.87	5,572.90	5,570.16	5,569.13	5,571.40	5,570.37
P-A15	30 inch	13.00	INLET A14	MH A13	5,564.69	5,564.62	0.005385	9.18	30.10	45.06	5,572.90	5,573.10	5,568.47	5,568.32	5,569.78	5,569.63
P-A16	30 inch	40.00	MH A13	INLET A15	5,564.42	5,564.22	0.005000	9.17	29.00	45.03	5,573.10	5,573.00	5,567.66	5,567.18	5,568.97	5,568.49
P-A17	30 inch	4.00	INLET A15	ENTRY A1	5,564.02	5,564.00	0.005000	10.03	29.00	47.78	5,573.00	5,573.00	5,566.43	5,566.27	5,567.94	5,567.89
P-A18	12 inch	29.00	DS A3	MH A3	5,566.60	5,566.17	0.014828	5.91	4.34	4.64	5,576.50	5,576.19	5,575.36	5,574.87	5,575.90	5,575.41

Scenario: LINE AB OUT 10 YR

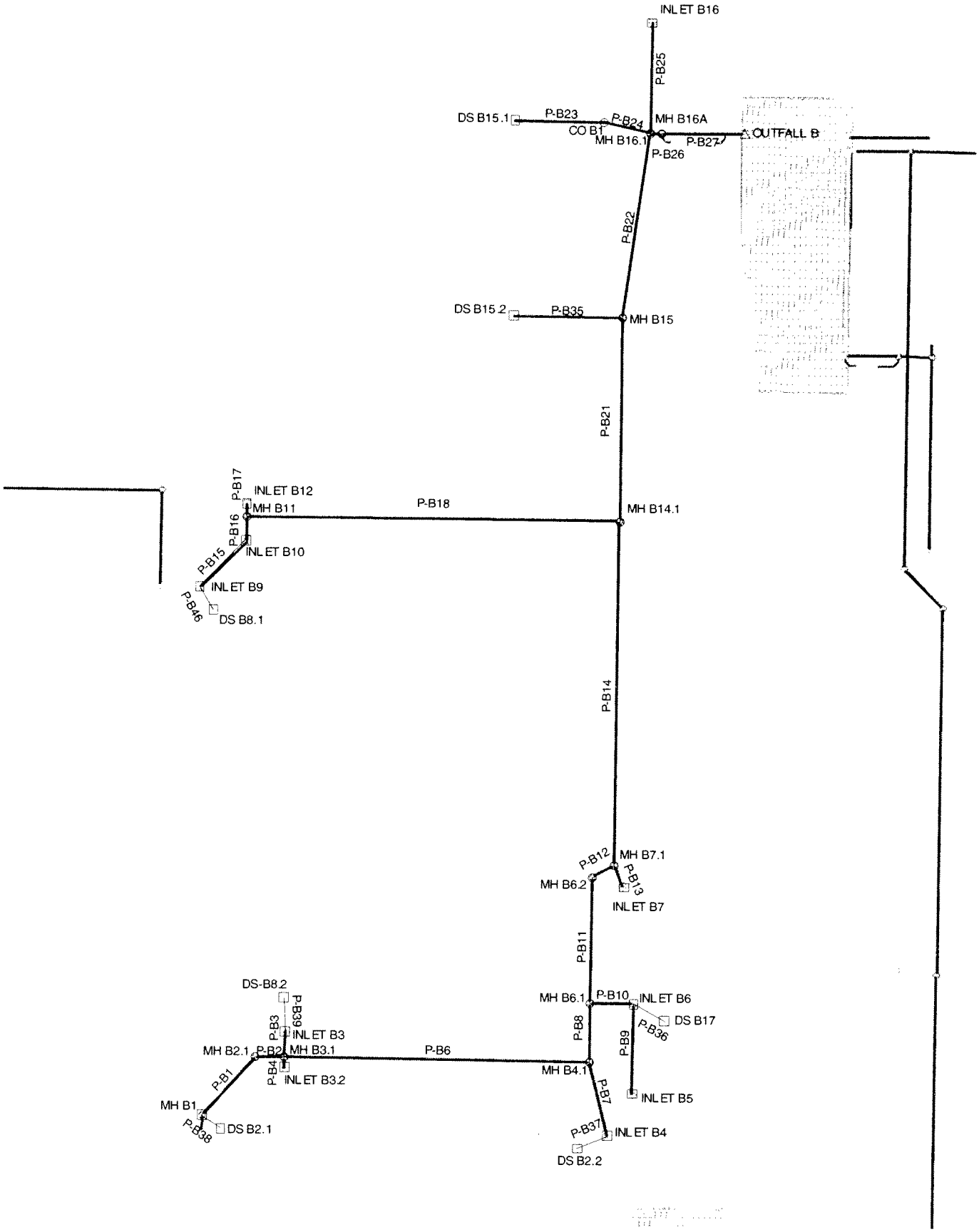


Scenario: LINE AB OUT 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-AB1	18 inch	180.00	OUTFALL A	MH AB1	5,562.50	5,561.60	0.005000	4.04	7.43	3.10	5,573.70	5,577.00	5,563.18	5,562.27	5,563.43	5,562.53
P-AB2	18 inch	297.00	MH AB1	MH AB2	5,561.30	5,559.82	0.004983	4.03	7.41	3.10	5,577.00	5,575.10	5,561.98	5,560.49	5,562.23	5,560.75
P-AB3	18 inch	321.00	MH AB2	MH AB3	5,559.62	5,556.60	0.009408	4.56	10.19	3.10	5,575.10	5,566.07	5,560.29	5,557.17	5,560.55	5,557.57
P-AB4	18 inch	48.00	MH AB3	MH AB4	5,556.30	5,553.66	0.055000	6.79	24.63	3.10	5,566.07	5,565.39	5,556.97	5,554.02	5,557.23	5,555.43
P-AB5	18 inch	365.00	MH AB4	MH AB5	5,553.36	5,547.59	0.015808	3.08	13.21	3.10	5,565.39	5,558.94	5,554.03	5,548.76	5,554.29	5,548.83
P-AB6	18 inch	48.00	OUTFALL B	MH AB5	5,552.50	5,547.49	0.104375	3.95	33.93	5.00	5,560.80	5,558.94	5,553.36	5,548.76	5,553.71	5,548.91
P-AB7	18 inch	39.00	MH AB5	OUTFALL A	5,547.29	5,546.90	0.010000	6.17	10.50	8.10	5,558.94	5,551.00	5,548.39	5,547.89	5,548.92	5,548.55

Scenario: LINE B1 100 YR



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Scenario: LINE B1 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-B1	18 inch	69.00	MH B1	MH B2.1	5,569.42	5,569.07	0.005130	4.63	7.52	4.87	5,573.40	5,573.96	5,570.30	5,569.91	5,570.62	5,570.26
P-B2	18 inch	25.00	MH B2.1	MH B3.1	5,568.86	5,568.73	0.005033	3.90	7.45	4.81	5,573.96	5,574.05	5,569.80	5,569.76	5,570.06	5,569.98
P-B3	18 inch	9.00	INLET B3.2	MH B3.1	5,568.32	5,568.73	-0.045556	0.44	-22.42	0.66	5,574.68	5,574.05	5,569.76	5,569.76	5,569.76	5,569.76
P-B4	18 inch	23.00	INLET B3	MH B3.1	5,568.45	5,568.73	-0.012174	3.08	-11.59	4.58	5,573.60	5,574.05	5,569.89	5,569.76	5,570.00	5,569.95
P-B6	24 inch	266.00	MH B3.1	MH B4.1	5,568.23	5,566.80	0.005376	4.40	16.59	9.31	5,574.05	5,574.08	5,569.32	5,568.39	5,569.76	5,568.57
P-B7	18 inch	91.00	INLET B4	MH B4.1	5,567.56	5,567.10	0.005055	3.02	7.47	3.96	5,573.70	5,574.08	5,568.46	5,568.39	5,568.66	5,568.48
P-B8	24 inch	51.00	MH B4.1	MH B6.1	5,566.60	5,566.35	0.004968	4.39	15.94	12.04	5,574.08	5,573.41	5,568.16	5,568.06	5,568.48	5,568.34
P-B9	18 inch	78.00	INLET B5	INLET B6	5,568.11	5,567.33	0.010000	3.11	10.50	2.18	5,572.90	5,572.90	5,568.67	5,568.06	5,568.87	5,568.16
P-B10	18 inch	38.00	INLET B6	MH B6.1	5,567.03	5,566.65	0.010000	2.67	10.50	3.94	5,572.90	5,573.41	5,568.06	5,568.06	5,568.20	5,568.14
P-B11	24 inch	110.00	MH B6.1	MH B6.2	5,566.15	5,565.53	0.005606	6.12	16.94	15.57	5,573.41	5,571.80	5,567.66	5,567.04	5,568.24	5,567.62
P-B12	24 inch	22.00	MH B6.2	MH B7.1	5,565.23	5,565.01	0.010000	6.94	22.62	15.40	5,571.80	5,571.60	5,566.64	5,566.27	5,567.30	5,567.12
P-B13	18 inch	20.00	INLET B7	MH B7.1	5,565.63	5,565.21	0.021000	2.47	15.22	1.82	5,572.00	5,571.60	5,566.14	5,566.19	5,566.32	5,566.22
P-B14	24 inch	301.00	MH B7.1	MH B14.1	5,564.71	5,561.70	0.010000	6.48	22.62	16.77	5,571.60	5,568.60	5,566.19	5,563.30	5,566.89	5,563.90
P-B15	18 inch	54.00	INLET B9	INLET B10	5,564.30	5,564.53	-0.004259	3.91	-6.86	6.04	5,569.32	5,568.62	5,565.91	5,565.62	5,566.09	5,565.92
P-B16	18 inch	24.00	INLET B10	MH B11	5,563.83	5,564.21	-0.015833	4.41	-13.22	6.35	5,568.62	5,568.92	5,565.50	5,565.18	5,565.70	5,565.61
P-B17	18 inch	11.00	INLET B12	MH B11	5,564.40	5,564.21	0.017273	0.65	13.80	0.45	5,568.70	5,568.92	5,564.94	5,564.95	5,564.95	5,564.95
P-B18	24 inch	324.00	MH B11	MH B14.1	5,563.71	5,561.70	0.006204	3.63	17.82	6.73	5,568.92	5,568.60	5,564.63	5,563.30	5,564.98	5,563.40
P-B21	30 inch	178.00	MH B14.1	MH B15	5,561.20	5,556.92	0.024045	6.14	63.60	22.49	5,568.60	5,568.46	5,562.81	5,558.84	5,563.51	5,559.32
P-B22	30 inch	163.81	MH B15	MH B16.1	5,556.72	5,555.24	0.009035	6.17	38.99	25.66	5,568.46	5,566.01	5,558.45	5,557.71	5,559.23	5,558.14
P-B23	12 inch	77.00	DS B15.1	CO B1	5,559.66	5,557.80	0.024156	5.48	5.54	3.92	5,569.80	5,566.84	5,560.50	5,558.67	5,560.98	5,559.12
P-B24	12 inch	41.00	CO B1	MH B16.1	5,557.60	5,555.75	0.045122	5.22	7.57	3.87	5,566.84	5,566.01	5,558.44	5,557.71	5,558.91	5,558.09
P-B25	18 inch	96.00	INLET B16	MH B16.1	5,556.79	5,556.06	0.007604	0.92	9.16	1.28	5,561.80	5,566.01	5,557.72	5,557.71	5,557.74	5,557.72
P-B26	30 inch	10.00	MH B16.1	MH B16A	5,554.94	5,554.85	0.009000	6.90	38.91	29.68	5,566.01	5,565.72	5,556.93	5,556.95	5,557.71	5,557.66
P-B27	30 inch	72.00	MH B16A	OUTFALL B	5,554.65	5,554.00	0.009028	8.12	38.97	29.66	5,565.72	5,563.95	5,556.51	5,555.65	5,557.40	5,556.81
P-B35	12 inch	95.00	DS B15.2	MH B15	5,558.67	5,557.72	0.010000	4.99	3.56	3.92	5,569.00	5,568.46	5,559.99	5,558.84	5,560.38	5,559.23
P-B36	12 inch	31.00	DS B17	INLET B6	5,568.22	5,567.60	0.020000	2.50	5.04	0.73	5,573.00	5,572.90	5,568.58	5,568.06	5,568.71	5,568.12
P-B37	12 inch	29.00	DS B2.2	INLET B4	5,568.50	5,568.00	0.017241	5.31	4.68	2.70	5,574.50	5,573.70	5,569.20	5,568.55	5,569.53	5,569.12
P-B38	12 inch	20.00	DS B2.1	MH B1	5,570.00	5,569.40	0.030000	4.10	6.17	2.70	5,574.00	5,573.40	5,570.70	5,570.30	5,571.03	5,570.50
P-B39	12 inch	30.00	DS-B8.2	INLET B3	5,570.00	5,569.45	0.018333	6.22	4.82	4.05	5,574.30	5,573.60	5,570.85	5,570.16	5,571.35	5,570.87
P-B46	12 inch	24.00	DS B8.1	INLET B9	5,565.50	5,565.00	0.020833	5.53	5.14	4.05	5,569.50	5,569.32	5,566.35	5,565.91	5,566.85	5,566.36

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Scenario: LINE B1 100 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-B1	18 inch	69.00	MH B1	MH B2.1	5,569.42	5,569.07	0.005130	4.78	7.52	8.45	5,573.40	5,573.96	5,574.40	5,573.96	5,574.76	5,574.31
P-B2	18 inch	25.00	MH B2.1	MH B3.1	5,568.86	5,568.73	0.005033	4.73	7.45	8.36	5,573.96	5,574.05	5,574.21	5,574.05	5,574.56	5,574.40
P-B3	18 inch	9.00	INLET B3.2	MH B3.1	5,568.32	5,568.73	-0.045556	0.62	-22.42	1.10	5,574.68	5,574.05	5,574.05	5,574.05	5,574.06	5,574.06
P-B4	18 inch	23.00	INLET B3	MH B3.1	5,568.45	5,568.73	-0.012174	4.50	-11.59	7.95	5,573.60	5,574.05	5,574.18	5,574.05	5,574.50	5,574.37
P-B6	24 inch	266.00	MH B3.1	MH B4.1	5,568.23	5,566.80	0.005376	5.17	16.59	16.23	5,574.05	5,574.08	5,575.45	5,574.08	5,575.87	5,574.50
P-B7	18 inch	91.00	INLET B4	MH B4.1	5,567.56	5,567.10	0.005055	3.88	7.47	6.86	5,573.70	5,574.08	5,574.47	5,574.08	5,574.71	5,574.32
P-B8	24 inch	51.00	MH B4.1	MH B6.1	5,566.60	5,566.35	0.004968	6.76	15.94	21.23	5,574.08	5,573.41	5,573.86	5,573.41	5,574.57	5,574.12
P-B9	18 inch	78.00	INLET B5	INLET B6	5,568.11	5,567.33	0.010000	2.23	10.50	3.93	5,572.90	5,572.90	5,573.01	5,572.90	5,573.09	5,572.98
P-B10	18 inch	38.00	INLET B6	MH B6.1	5,567.03	5,566.65	0.010000	3.93	10.50	6.95	5,572.90	5,573.41	5,573.58	5,573.41	5,573.82	5,573.65
P-B11	24 inch	110.00	MH B6.1	MH B6.2	5,566.15	5,565.53	0.005606	8.82	16.94	27.72	5,573.41	5,571.80	5,573.45	5,571.80	5,574.66	5,573.01
P-B12	24 inch	22.00	MH B6.2	MH B7.1	5,565.23	5,565.01	0.010000	8.72	22.62	27.40	5,571.80	5,571.60	5,571.42	5,571.10	5,572.61	5,572.28
P-B13	18 inch	20.00	INLET B7	MH B7.1	5,565.63	5,565.21	0.021000	1.76	15.22	3.10	5,572.00	5,571.60	5,571.12	5,571.10	5,571.17	5,571.15
P-B14	24 inch	301.00	MH B7.1	MH B14.1	5,564.71	5,561.70	0.010000	9.48	22.62	29.79	5,571.60	5,568.60	5,571.10	5,565.88	5,572.50	5,567.28
P-B15	18 inch	54.00	INLET B9	INLET B10	5,564.30	5,564.53	-0.004259	5.99	-6.86	10.59	5,569.32	5,568.62	5,568.23	5,567.68	5,568.79	5,568.24
P-B16	18 inch	24.00	INLET B10	MH B11	5,563.83	5,564.21	-0.015833	6.37	-13.22	11.26	5,568.62	5,568.92	5,567.30	5,567.03	5,567.94	5,567.66
P-B17	18 inch	11.00	INLET B12	MH B11	5,564.40	5,564.21	0.017273	0.58	13.80	1.02	5,568.70	5,568.92	5,567.03	5,567.03	5,567.04	5,567.03
P-B18	24 inch	324.00	MH B11	MH B14.1	5,563.71	5,561.70	0.006204	3.87	17.82	12.17	5,568.92	5,568.60	5,566.82	5,565.88	5,567.05	5,566.11
P-B21	30 inch	178.00	MH B14.1	MH B15	5,561.20	5,556.92	0.024045	8.24	63.60	40.46	5,568.60	5,568.46	5,565.14	5,563.41	5,566.20	5,564.47
P-B22	30 inch	163.81	MH B15	MH B16.1	5,556.72	5,555.24	0.009035	9.43	38.99	46.29	5,568.46	5,566.01	5,562.72	5,560.63	5,564.10	5,562.01
P-B23	12 inch	77.00	DS B15.1	CO B1	5,559.66	5,557.80	0.024156	8.70	5.54	6.84	5,569.80	5,566.84	5,565.53	5,562.70	5,566.71	5,563.87
P-B24	12 inch	41.00	CO B1	MH B16.1	5,557.60	5,555.75	0.045122	8.64	7.57	6.78	5,566.84	5,566.01	5,562.12	5,560.63	5,563.28	5,561.79
P-B25	18 inch	96.00	INLET B16	MH B16.1	5,556.79	5,556.06	0.007604	1.23	9.16	2.18	5,561.80	5,566.01	5,560.67	5,560.63	5,560.70	5,560.65
P-B26	30 inch	10.00	MH B16.1	MH B16A	5,554.94	5,554.85	0.009000	10.95	38.91	53.73	5,566.01	5,565.72	5,558.77	5,558.60	5,560.63	5,560.46
P-B27	30 inch	72.00	MH B16A	OUTFALL B	5,554.65	5,554.00	0.009028	11.09	38.97	53.71	5,565.72	5,563.95	5,557.67	5,556.34	5,559.53	5,558.31
P-B35	12 inch	95.00	DS B15.2	MH B15	5,558.67	5,557.72	0.010000	8.70	3.56	6.84	5,569.00	5,568.46	5,566.91	5,563.41	5,568.08	5,564.59
P-B36	12 inch	31.00	DS B17	INLET B6	5,568.22	5,567.60	0.020000	1.63	5.04	1.28	5,573.00	5,572.90	5,572.94	5,572.90	5,572.98	5,572.94
P-B37	12 inch	29.00	DS B2.2	INLET B4	5,568.50	5,568.00	0.017241	5.96	4.68	4.68	5,574.50	5,573.70	5,574.20	5,573.70	5,574.75	5,574.25
P-B38	12 inch	20.00	DS B2.1	MH B1	5,570.00	5,569.40	0.030000	5.96	6.17	4.68	5,574.00	5,573.40	5,573.75	5,573.40	5,574.30	5,573.95
P-B39	12 inch	30.00	DS-B8.2	INLET B3	5,570.00	5,569.45	0.018333	8.97	4.82	7.05	5,574.30	5,573.60	5,574.77	5,573.60	5,576.03	5,574.85
P-B46	12 inch	24.00	DS B8.1	INLET B9	5,565.50	5,565.00	0.020833	8.97	5.14	7.05	5,569.50	5,569.32	5,569.17	5,568.23	5,570.42	5,569.48

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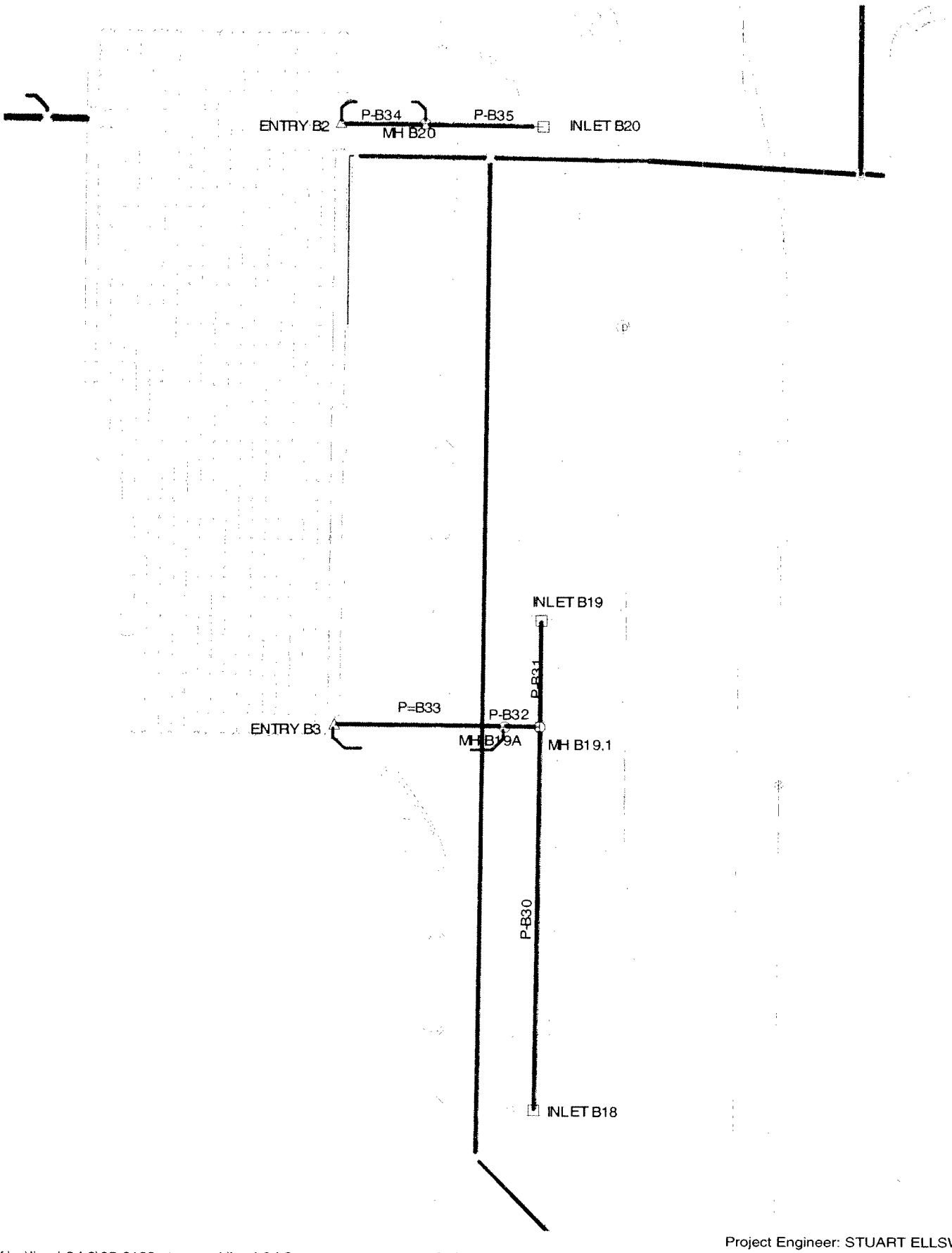
Scenario: LINE B2-B3 100 YR



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Scenario: LINE B2-B3 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-B30	18 inch	140.00	INLET B18	MH B19.1	5,559.90	5,557.09	0.020071	7.03	14.88	7.53	5,564.94	5,561.82	5,560.96	5,557.85	5,561.45	5,558.95
P-B31	18 inch	39.00	INLET B19	MH B19.1	5,557.48	5,557.09	0.010000	6.14	10.50	7.97	5,558.00	5,561.82	5,558.57	5,558.07	5,559.09	5,558.73
P-B32	24 inch	13.00	MH B19.1	MH B19A	5,556.59	5,556.46	0.010000	6.58	22.62	13.70	5,561.82	5,562.34	5,557.92	5,557.66	5,558.51	5,558.42
P-B34	18 inch	31.00	MH B20	ENTRY B2	5,554.16	5,554.00	0.005161	5.33	7.55	7.54	5,559.80	5,559.10	5,555.34	5,555.06	5,555.74	5,555.56
P-B35	18 inch	43.00	INLET B20	MH B20	5,554.57	5,554.36	0.004884	5.29	7.34	7.60	5,560.02	5,559.80	5,555.79	5,555.43	5,556.17	5,555.92
P=B33	24 inch	62.00	MH B19A	ENTRY B3	5,556.26	5,555.00	0.020323	7.77	32.25	13.69	5,562.34	5,563.36	5,557.59	5,555.94	5,558.18	5,557.31

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Scenario: LINE B2-B3 100 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-B30	18 inch	140.00	INLET B18	MH B19.1	5,559.90	5,557.09	0.020071	8.82	14.88	13.72	5,564.94	5,561.82	5,561.27	5,558.23	5,562.29	5,559.65
P-B31	18 inch	39.00	INLET B19	MH B19.1	5,557.48	5,557.09	0.010000	7.87	10.50	13.61	5,558.00	5,561.82	5,559.18	5,558.46	5,560.10	5,559.46
P-B32	24 inch	13.00	MH B19.1	MH B19A	5,556.59	5,556.46	0.010000	8.28	22.62	24.37	5,561.82	5,562.34	5,558.39	5,558.21	5,559.43	5,559.30
P-B34	18 inch	31.00	MH B20	ENTRY B2	5,554.16	5,554.00	0.005161	7.52	7.55	12.92	5,559.80	5,559.10	5,555.90	5,555.35	5,556.73	5,556.28
P-B35	18 inch	43.00	INLET B20	MH B20	5,554.57	5,554.36	0.004884	7.35	7.34	12.99	5,560.02	5,559.80	5,556.56	5,555.90	5,557.40	5,556.74
P=B33	24 inch	62.00	MH B19A	ENTRY B3	5,556.26	5,555.00	0.020323	9.54	32.25	24.35	5,562.34	5,563.36	5,558.00	5,556.36	5,559.09	5,558.14

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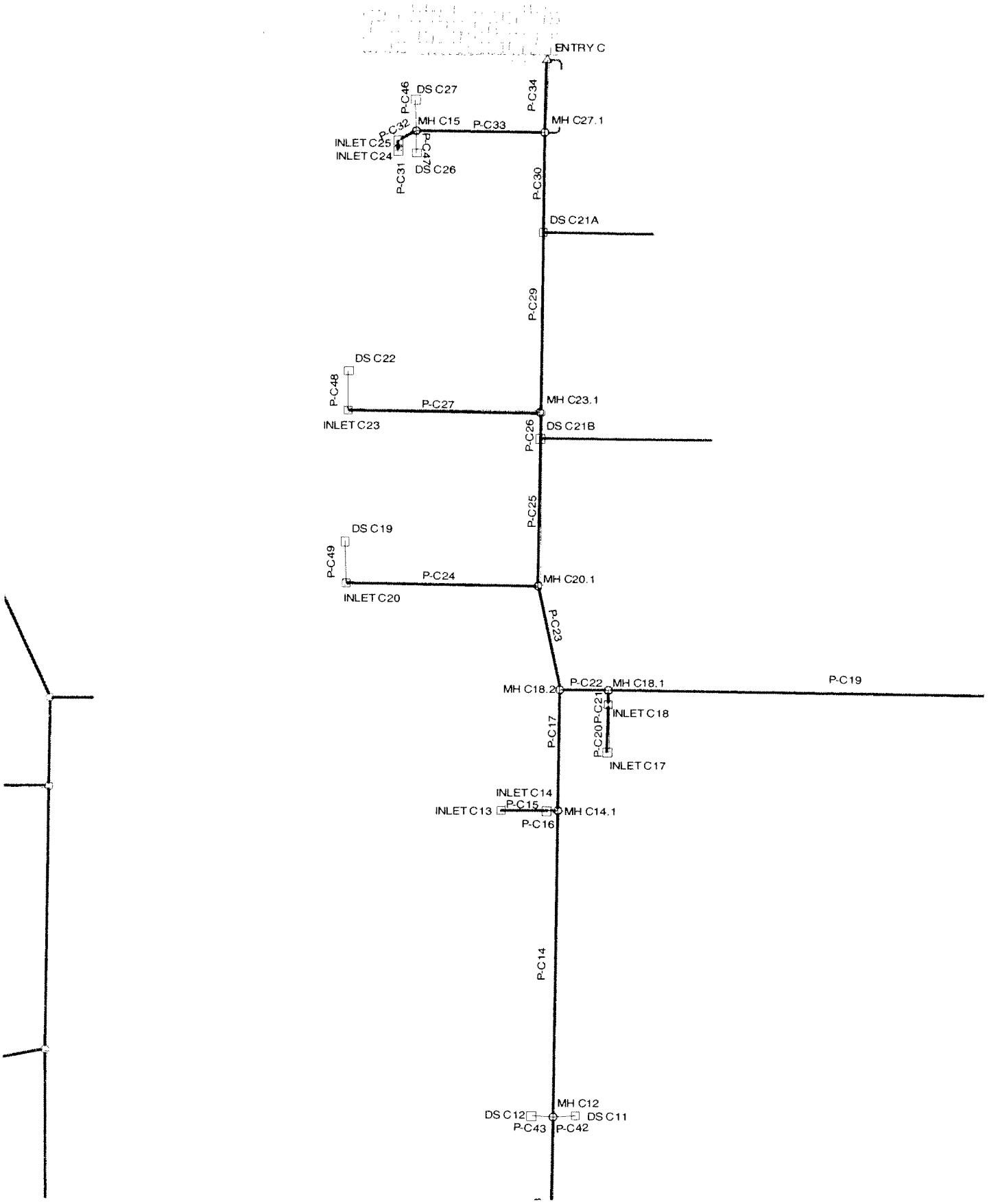
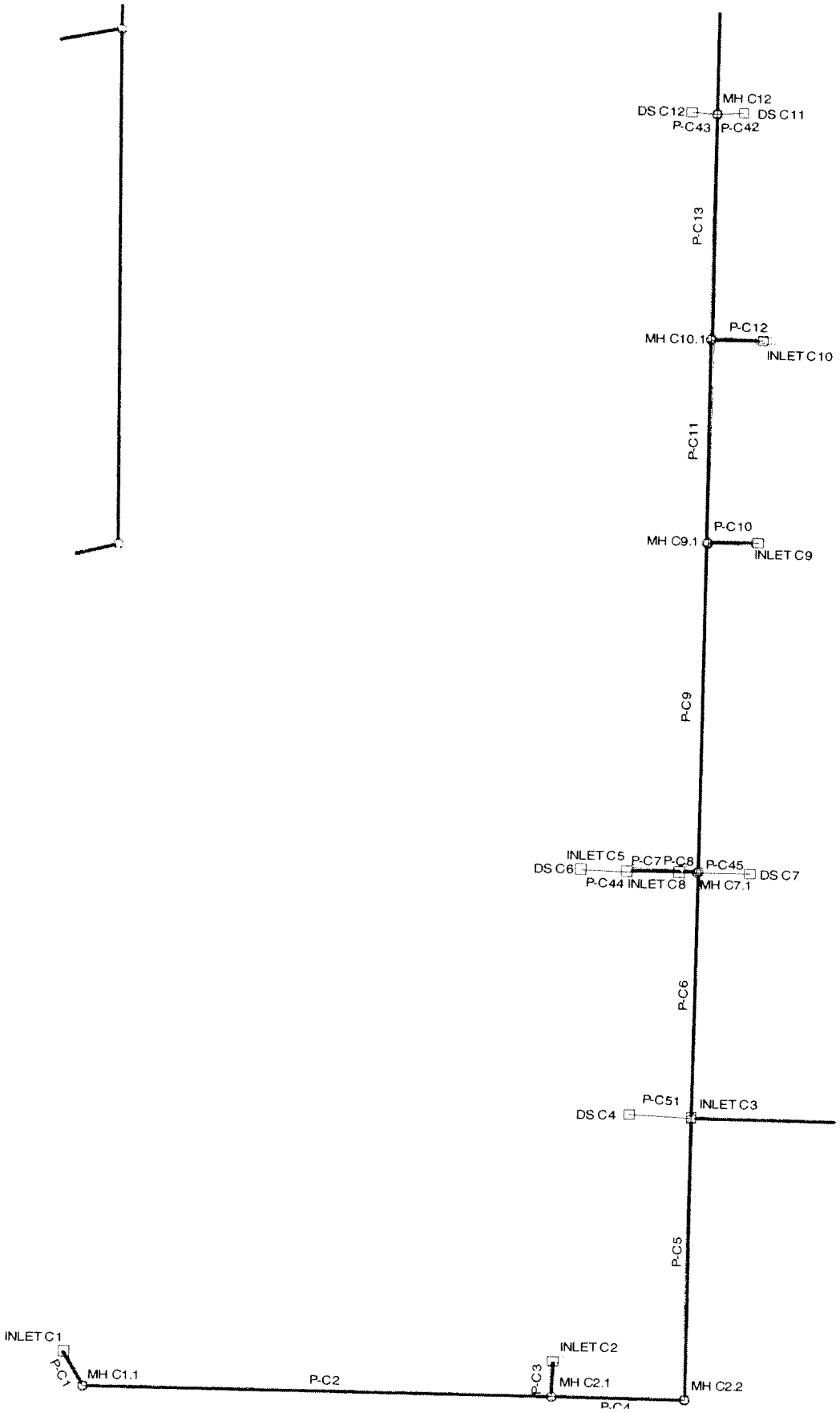
Scenario: LINE C1 - 10 YR



Scenario: LINE C1 - 10 YR



Scenario: LINE C1 - 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-C1	18 inch	23.00	INLET C1	MH C1.1	5,573.55	5,573.32	0.010000	3.35	10.50	1.02	5,577.28	5,577.57	5,573.93	5,573.64	5,574.06	5,573.86
P-C2	18 inch	276.00	MH C1.1	MH C2.1	5,573.02	5,570.26	0.010000	1.80	10.50	1.01	5,577.57	5,575.73	5,573.40	5,571.47	5,573.53	5,571.48
P-C3	18 inch	20.00	INLET C2	MH C2.1	5,571.20	5,570.26	0.047000	9.11	22.77	12.46	5,575.70	5,575.73	5,572.53	5,571.20	5,573.41	5,572.98
P-C4	24 inch	78.00	MH C2.1	MH C2.2	5,569.76	5,568.98	0.010000	6.76	22.62	13.21	5,575.73	5,577.29	5,571.07	5,570.08	5,571.64	5,570.94
P-C5	24 inch	166.00	MH C2.2	INLET C3	5,568.68	5,567.02	0.010000	5.30	22.62	13.12	5,577.29	5,574.20	5,569.98	5,568.75	5,570.55	5,569.07
P-C6	30 inch	146.00	INLET C3	MH C7.1	5,566.52	5,565.59	0.006370	5.56	32.73	24.80	5,574.20	5,572.53	5,568.46	5,568.13	5,569.03	5,568.52
P-C7	18 inch	31.00	INLET C5	INLET C8	5,567.49	5,567.18	0.010000	3.05	10.50	2.71	5,572.30	5,572.30	5,568.11	5,568.17	5,568.35	5,568.24
P-C8	18 inch	9.00	INLET C8	MH C7.1	5,566.98	5,566.39	0.065556	3.89	26.89	5.81	5,572.30	5,572.53	5,568.01	5,568.13	5,568.32	5,568.30
P-C9	30 inch	195.00	MH C7.1	MH C9.1	5,565.39	5,563.93	0.007487	8.24	35.49	34.67	5,572.53	5,570.04	5,567.39	5,565.93	5,568.44	5,566.98
P-C10	18 inch	32.00	INLET C9	MH C9.1	5,565.36	5,564.73	0.019688	3.66	14.74	4.25	5,569.80	5,570.04	5,566.15	5,565.92	5,566.47	5,566.04
P-C11	30 inch	120.00	MH C9.1	MH C10.1	5,563.73	5,562.83	0.007500	8.20	35.52	37.36	5,570.04	5,569.17	5,565.92	5,565.01	5,566.96	5,566.06
P-C12	12 inch	30.00	INLET C10	MH C10.1	5,564.73	5,563.83	0.030000	4.56	6.17	3.24	5,569.80	5,569.17	5,565.50	5,565.01	5,565.89	5,565.28
P-C13	36 inch	133.00	MH C10.1	MH C12	5,562.33	5,561.33	0.007519	6.73	57.83	39.35	5,569.17	5,567.86	5,564.37	5,564.10	5,565.29	5,564.61
P-C14	36 inch	211.00	MH C12	MH C14.1	5,561.33	5,559.02	0.010948	7.52	69.78	46.83	5,567.86	5,566.39	5,563.56	5,561.90	5,564.63	5,562.60
P-C15	18 inch	31.00	INLET C13	INLET C14	5,561.11	5,560.65	0.014839	1.89	12.80	2.27	5,566.14	5,566.14	5,561.91	5,561.94	5,562.00	5,561.97
P-C16	18 inch	9.00	INLET C14	MH C14.1	5,560.45	5,560.32	0.014444	2.06	12.62	3.62	5,566.14	5,566.39	5,561.91	5,561.90	5,561.98	5,561.96
P-C17	36 inch	84.00	MH C14.1	MH C18.2	5,558.82	5,557.98	0.010000	8.06	66.69	49.35	5,566.39	5,566.24	5,561.11	5,560.58	5,562.24	5,561.47
P-C18	18 inch	81.00	INLET C15	MH C16	5,564.37	5,563.56	0.010000	3.95	10.50	1.80	5,569.81	5,569.78	5,564.88	5,563.98	5,565.06	5,564.29
P-C19	18 inch	324.00	MH C16	MH C18.1	5,563.26	5,560.01	0.010031	4.07	10.52	4.37	5,569.78	5,566.33	5,564.06	5,560.99	5,564.38	5,561.19
P-C20	18 inch	33.00	INLET C17	INLET C18	5,561.16	5,560.50	0.020000	2.36	14.85	1.24	5,566.17	5,566.12	5,561.58	5,561.17	5,561.73	5,561.21
P-C21	18 inch	10.00	INLET C18	MH C18.1	5,560.50	5,560.30	0.020000	3.25	14.85	2.23	5,566.12	5,566.33	5,561.06	5,560.99	5,561.27	5,561.11
P-C22	18 inch	33.00	MH C18.1	MH C18.2	5,559.81	5,559.48	0.010000	4.48	10.50	5.55	5,566.33	5,566.24	5,560.72	5,560.58	5,561.10	5,560.83
P-C23	42 inch	73.00	MH C18.2	MH C20.1	5,557.48	5,555.72	0.024110	6.86	156.21	53.71	5,566.24	5,565.12	5,559.77	5,559.06	5,560.78	5,559.56
P-C24	18 inch	132.00	INLET C20	MH C20.1	5,558.83	5,557.52	0.009924	4.67	10.46	6.92	5,562.49	5,565.12	5,559.85	5,559.06	5,560.30	5,559.29
P-C25	42 inch	102.00	MH C20.1	DS C21B	5,555.52	5,555.01	0.005000	6.03	71.14	58.04	5,565.12	5,567.00	5,559.06	5,558.72	5,559.62	5,559.28
P-C26	42 inch	18.00	DS C21B	MH C23.1	5,555.01	5,554.92	0.005000	6.32	71.14	59.95	5,567.00	5,566.90	5,558.34	5,558.29	5,558.97	5,558.91
P-C27	18 inch	131.00	INLET C23	MH C23.1	5,558.03	5,556.72	0.010000	3.52	10.50	4.40	5,562.20	5,566.90	5,558.83	5,558.29	5,559.16	5,558.39
P-C29	42 inch	125.00	MH C23.1	DS C21A	5,554.72	5,553.96	0.006080	6.73	78.45	62.84	5,566.90	5,565.20	5,557.85	5,557.48	5,558.59	5,558.14
P-C30	42 inch	69.00	DS C21A	MH C27.1	5,553.96	5,553.55	0.005942	7.11	77.55	64.63	5,565.20	5,563.80	5,556.98	5,556.82	5,557.81	5,557.56
P-C31	18 inch	6.00	INLET C24	INLET C25	5,556.63	5,556.57	0.010000	4.24	10.50	4.04	5,561.44	5,561.90	5,557.40	5,557.39	5,557.70	5,557.65
P-C32	24 inch	14.00	INLET C25	MH C15	5,556.07	5,555.93	0.010000	2.57	22.62	5.68	5,561.90	5,561.71	5,557.32	5,557.34	5,557.44	5,557.43
P-C33	24 inch	88.00	MH C15	MH C27.1	5,555.73	5,554.85	0.010000	4.98	22.62	12.59	5,561.71	5,563.80	5,557.01	5,556.82	5,557.56	5,557.07
P-C34	42 inch	50.00	MH C27.1	ENTRY C	5,553.35	5,553.00	0.007000	9.51	84.17	72.87	5,563.80	5,563.60	5,556.02	5,555.53	5,557.35	5,557.02
P-C42	12 inch	15.00	DS C11	MH C12	5,561.00	5,560.63	0.024667	10.23	5.60	8.04	5,568.00	5,567.86	5,564.86	5,564.10	5,566.49	5,565.72
P-C43	12 inch	15.00	DS C12	MH C12	5,561.00	5,560.63	0.024667	3.19	5.60	2.50	5,568.00	5,567.86	5,564.17	5,564.10	5,564.33	5,564.25

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Scenario: LINE C1 - 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-C44	12 inch	27.00	DS C6	INLET C5	5,569.00	5,568.49	0.018889	5.09	4.90	2.25	5,572.50	5,572.30	5,569.64	5,568.98	5,569.92	5,569.53
P-C45	12 inch	32.00	DS C7	MH C7.1	5,565.50	5,564.89	0.019062	10.59	4.92	8.31	5,572.50	5,572.53	5,569.87	5,568.13	5,571.61	5,569.87
P-C46	12 inch	22.00	DS C27	MH C15	5,554.25	5,553.95	0.013636	3.66	4.16	2.87	5,561.00	5,561.71	5,557.48	5,557.34	5,557.69	5,557.54
P-C47	12 inch	16.00	DS C26	MH C15	5,554.25	5,553.95	0.018750	5.77	4.88	4.53	5,561.00	5,561.71	5,557.60	5,557.34	5,558.11	5,557.85
P-C48	12 inch	27.00	DS C22	INLET C23	5,558.50	5,557.72	0.028889	3.16	6.06	1.87	5,562.00	5,562.20	5,559.08	5,558.83	5,559.32	5,558.92
P-C49	12 inch	29.00	DS C19	INLET C20	5,560.00	5,559.33	0.023103	5.11	5.42	1.96	5,563.00	5,562.49	5,560.60	5,559.75	5,560.85	5,560.35
P-C50	12 inch	34.00	DS C16	MH C16	5,563.50	5,562.76	0.021765	3.94	5.26	2.64	5,569.00	5,569.78	5,564.20	5,564.06	5,564.51	5,564.24
P-C51	12 inch	37.00	DS C4	INLET C3	5,567.00	5,566.12	0.023784	10.56	5.49	8.29	5,574.00	5,574.20	5,570.75	5,568.75	5,572.48	5,570.48

Scenario: LINE C1 - 100 YR

Combined Pipe\Node Report

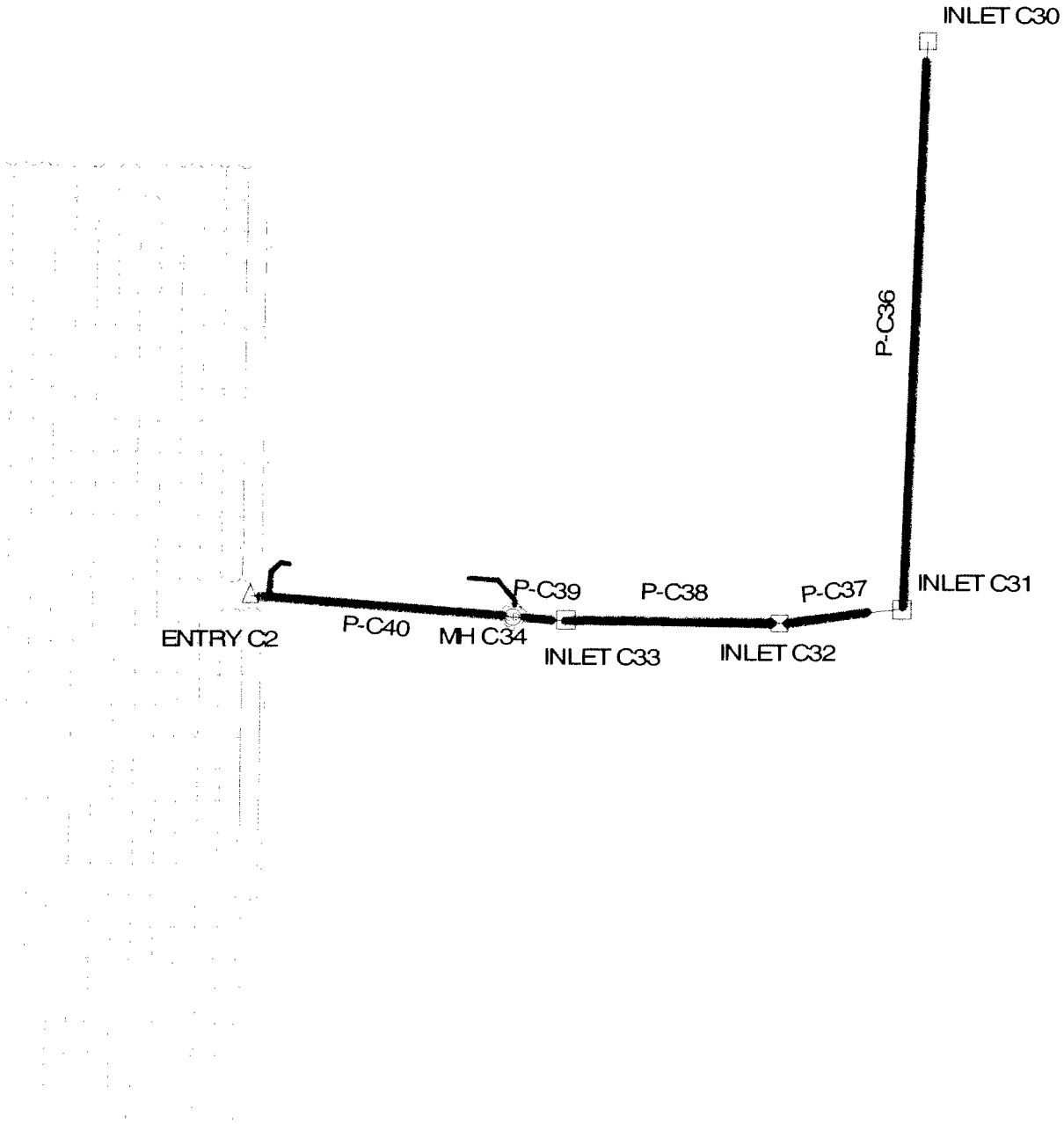
Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-C1	18 inch	23.00	INLET C1	MH C1.1	5,573.55	5,573.32	0.010000	1.04	10.50	1.83	5,577.28	5,577.57	5,575.83	5,575.82	5,575.85	5,575.84
P-C2	18 inch	276.00	MH C1.1	MH C2.1	5,573.02	5,570.26	0.010000	1.02	10.50	1.80	5,577.57	5,575.73	5,575.81	5,575.73	5,575.83	5,575.75
P-C3	18 inch	20.00	INLET C2	MH C2.1	5,571.20	5,570.26	0.047000	12.69	22.77	22.43	5,575.70	5,575.73	5,576.65	5,575.73	5,579.15	5,578.24
P-C4	24 inch	78.00	MH C2.1	MH C2.2	5,569.76	5,568.98	0.010000	7.57	22.62	23.79	5,575.73	5,577.29	5,576.88	5,576.01	5,577.77	5,576.90
P-C5	24 inch	166.00	MH C2.2	INLET C3	5,568.68	5,567.02	0.010000	7.53	22.62	23.64	5,577.29	5,574.20	5,576.01	5,574.20	5,576.89	5,575.08
P-C6	30 inch	146.00	INLET C3	MH C7.1	5,566.52	5,565.59	0.006370	9.01	32.73	44.25	5,574.20	5,572.53	5,574.23	5,572.53	5,575.50	5,573.80
P-C7	18 inch	31.00	INLET C5	INLET C8	5,567.49	5,567.18	0.010000	2.77	10.50	4.90	5,572.30	5,572.30	5,572.37	5,572.30	5,572.49	5,572.42
P-C8	18 inch	9.00	INLET C8	MH C7.1	5,566.98	5,566.39	0.065556	5.82	26.89	10.29	5,572.30	5,572.53	5,572.62	5,572.53	5,573.15	5,573.06
P-C9	30 inch	195.00	MH C7.1	MH C9.1	5,565.39	5,563.93	0.007487	12.61	35.49	61.91	5,572.53	5,570.04	5,574.49	5,570.04	5,576.96	5,572.51
P-C10	18 inch	32.00	INLET C9	MH C9.1	5,565.36	5,564.73	0.019688	4.26	14.74	7.52	5,569.80	5,570.04	5,570.21	5,570.04	5,570.49	5,570.32
P-C11	30 inch	120.00	MH C9.1	MH C10.1	5,563.73	5,562.83	0.007500	13.64	35.52	66.95	5,570.04	5,569.17	5,572.37	5,569.17	5,575.26	5,572.06
P-C12	12 inch	30.00	INLET C10	MH C10.1	5,564.73	5,563.83	0.030000	7.16	6.17	5.63	5,569.80	5,569.17	5,569.92	5,569.17	5,570.72	5,569.97
P-C13	36 inch	133.00	MH C10.1	MH C12	5,562.33	5,561.33	0.007519	10.00	57.83	70.66	5,569.17	5,567.86	5,569.36	5,567.86	5,570.91	5,569.42
P-C14	36 inch	211.00	MH C12	MH C14.1	5,561.33	5,559.02	0.010948	11.91	69.78	84.16	5,567.86	5,566.39	5,569.75	5,566.39	5,571.96	5,568.60
P-C15	18 inch	31.00	INLET C13	INLET C14	5,561.11	5,560.65	0.014839	2.38	12.80	4.21	5,566.14	5,566.14	5,566.19	5,566.14	5,566.28	5,566.23
P-C16	18 inch	9.00	INLET C14	MH C14.1	5,560.45	5,560.32	0.014444	3.72	12.62	6.57	5,566.14	5,566.39	5,566.43	5,566.39	5,566.64	5,566.61
P-C17	36 inch	84.00	MH C14.1	MH C18.2	5,558.82	5,557.98	0.010000	12.63	66.69	89.29	5,566.39	5,566.24	5,567.75	5,566.24	5,570.23	5,568.72
P-C18	18 inch	81.00	INLET C15	MH C16	5,564.37	5,563.56	0.010000	1.74	10.50	3.07	5,569.81	5,569.78	5,567.99	5,567.92	5,568.04	5,567.97
P-C19	18 inch	324.00	MH C16	MH C18.1	5,563.26	5,560.01	0.010031	4.17	10.52	7.37	5,569.78	5,566.33	5,567.92	5,566.33	5,568.19	5,566.60
P-C20	18 inch	33.00	INLET C17	INLET C18	5,561.16	5,560.50	0.020000	1.27	14.85	2.24	5,566.17	5,566.12	5,566.13	5,566.12	5,566.16	5,566.14
P-C21	18 inch	10.00	INLET C18	MH C18.1	5,560.50	5,560.30	0.020000	2.37	14.85	4.20	5,566.12	5,566.33	5,566.35	5,566.33	5,566.43	5,566.42
P-C22	18 inch	33.00	MH C18.1	MH C18.2	5,559.81	5,559.48	0.010000	5.63	10.50	9.95	5,566.33	5,566.24	5,566.54	5,566.24	5,567.03	5,566.74
P-C23	42 inch	73.00	MH C18.2	MH C20.1	5,557.48	5,555.72	0.024110	10.13	156.21	97.45	5,566.24	5,565.12	5,565.81	5,565.12	5,567.40	5,566.72
P-C24	18 inch	132.00	INLET C20	MH C20.1	5,558.83	5,557.52	0.009924	6.78	10.46	11.99	5,562.49	5,565.12	5,566.84	5,565.12	5,567.55	5,565.84
P-C25	42 inch	102.00	MH C20.1	DS C21B	5,555.52	5,555.01	0.005000	10.95	71.14	105.37	5,565.12	5,567.00	5,566.91	5,565.79	5,568.78	5,567.66
P-C26	42 inch	18.00	DS C21B	MH C23.1	5,555.01	5,554.92	0.005000	11.35	71.14	109.18	5,567.00	5,566.90	5,564.59	5,564.38	5,566.59	5,566.38
P-C27	18 inch	131.00	INLET C23	MH C23.1	5,558.03	5,556.72	0.010000	4.28	10.50	7.57	5,562.20	5,566.90	5,565.06	5,564.38	5,565.35	5,564.67
P-C29	42 inch	125.00	MH C23.1	DS C21A	5,554.72	5,553.96	0.006080	11.89	78.45	114.40	5,566.90	5,565.20	5,563.06	5,561.45	5,565.26	5,563.64
P-C30	42 inch	69.00	DS C21A	MH C27.1	5,553.96	5,553.55	0.005942	12.27	77.55	118.09	5,565.20	5,563.80	5,560.04	5,559.09	5,562.38	5,561.43
P-C31	18 inch	6.00	INLET C24	INLET C25	5,556.63	5,556.57	0.010000	3.84	10.50	6.78	5,561.44	5,561.90	5,560.48	5,560.46	5,560.71	5,560.69
P-C32	24 inch	14.00	INLET C25	MH C15	5,556.07	5,555.93	0.010000	3.07	22.62	9.63	5,561.90	5,561.71	5,560.37	5,560.34	5,560.52	5,560.49
P-C33	24 inch	88.00	MH C15	MH C27.1	5,555.73	5,554.85	0.010000	6.91	22.62	21.70	5,561.71	5,563.80	5,559.90	5,559.09	5,560.64	5,559.83
P-C34	42 inch	50.00	MH C27.1	ENTRY C	5,553.35	5,553.00	0.007000	13.97	84.17	133.11	5,563.80	5,563.60	5,557.31	5,556.32	5,560.28	5,559.41
P-C42	12 inch	15.00	DS C11	MH C12	5,561.00	5,560.63	0.024667	17.84	5.60	14.01	5,568.00	5,567.86	5,570.18	5,567.86	5,575.13	5,572.81
P-C43	12 inch	15.00	DS C12	MH C12	5,561.00	5,560.63	0.024667	5.52	5.60	4.33	5,568.00	5,567.86	5,568.08	5,567.86	5,568.56	5,568.34

Scenario: LINE C1 - 100 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-C44	12 inch	27.00	DS C6	INLET C5	5,569.00	5,568.49	0.018889	4.98	4.90	3.91	5,572.50	5,572.30	5,572.63	5,572.30	5,573.01	5,572.69
P-C45	12 inch	32.00	DS C7	MH C7.1	5,565.50	5,564.89	0.019062	18.36	4.92	14.42	5,572.50	5,572.53	5,577.78	5,572.53	5,583.02	5,577.77
P-C46	12 inch	22.00	DS C27	MH C15	5,554.25	5,553.95	0.013636	6.34	4.16	4.98	5,561.00	5,561.71	5,560.78	5,560.34	5,561.40	5,560.97
P-C47	12 inch	16.00	DS C26	MH C15	5,554.25	5,553.95	0.018750	10.03	4.88	7.88	5,561.00	5,561.71	5,561.13	5,560.34	5,562.69	5,561.91
P-C48	12 inch	27.00	DS C22	INLET C23	5,558.50	5,557.72	0.028889	4.13	6.06	3.25	5,562.00	5,562.20	5,562.42	5,562.20	5,562.69	5,562.47
P-C49	12 inch	29.00	DS C19	INLET C20	5,560.00	5,559.33	0.023103	4.33	5.42	3.40	5,563.00	5,562.49	5,562.75	5,562.49	5,563.05	5,562.78
P-C50	12 inch	34.00	DS C16	MH C16	5,563.50	5,562.76	0.021765	5.81	5.26	4.56	5,569.00	5,569.78	5,568.48	5,567.92	5,569.00	5,568.45
P-C51	12 inch	37.00	DS C4	INLET C3	5,567.00	5,566.12	0.023784	18.41	5.49	14.46	5,574.00	5,574.20	5,580.29	5,574.20	5,585.56	5,579.47

Scenario: LINE C2 10 YR



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Scenario: LINE C2 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-C36	18 inch	122.70	INLET C30	INLET C31	5,555.57	5,554.95	0.005053	3.07	7.47	3.98	5,558.20	5,559.50	5,556.43	5,556.32	5,556.65	5,556.41
P-C37	18 inch	28.00	INLET C31	INLET C32	5,554.65	5,554.50	0.005357	4.82	7.69	8.22	5,559.50	5,559.52	5,556.03	5,555.88	5,556.39	5,556.25
P-C38	18 inch	52.00	INLET C32	INLET C33	5,554.30	5,554.04	0.005000	5.61	7.43	8.78	5,559.52	5,559.50	5,555.68	5,555.19	5,556.09	5,555.76
P-C39	18 inch	8.00	INLET C33	MH C34	5,553.54	5,553.50	0.005000	5.74	7.43	9.07	5,559.50	5,559.80	5,554.83	5,554.72	5,555.32	5,555.26
P-C40	18 inch	59.00	MH C34	ENTRY C2	5,553.30	5,553.00	0.005085	5.69	7.49	9.06	5,559.80	5,559.50	5,554.72	5,554.16	5,555.15	5,554.75

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Scenario: LINE C2 - 100 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-C36	18 inch	122.70	INLET C30	INLET C31	5,555.57	5,554.95	0.005053	3.94	7.47	6.96	5,558.20	5,559.50	5,559.89	5,559.35	5,560.13	5,559.59
P-C37	18 inch	28.00	INLET C31	INLET C32	5,554.65	5,554.50	0.005357	8.35	7.69	14.76	5,559.50	5,559.52	5,558.49	5,557.93	5,559.57	5,559.02
P-C38	18 inch	52.00	INLET C32	INLET C33	5,554.30	5,554.04	0.005000	8.95	7.43	15.81	5,559.52	5,559.50	5,557.31	5,556.13	5,558.55	5,557.38
P-C39	18 inch	8.00	INLET C33	MH C34	5,553.54	5,553.50	0.005000	9.35	7.43	16.53	5,559.50	5,559.80	5,556.13	5,555.93	5,557.49	5,557.29
P-C40	18 inch	59.00	MH C34	ENTRY C2	5,553.30	5,553.00	0.005085	9.43	7.49	16.52	5,559.80	5,559.50	5,555.93	5,554.43	5,557.29	5,555.84

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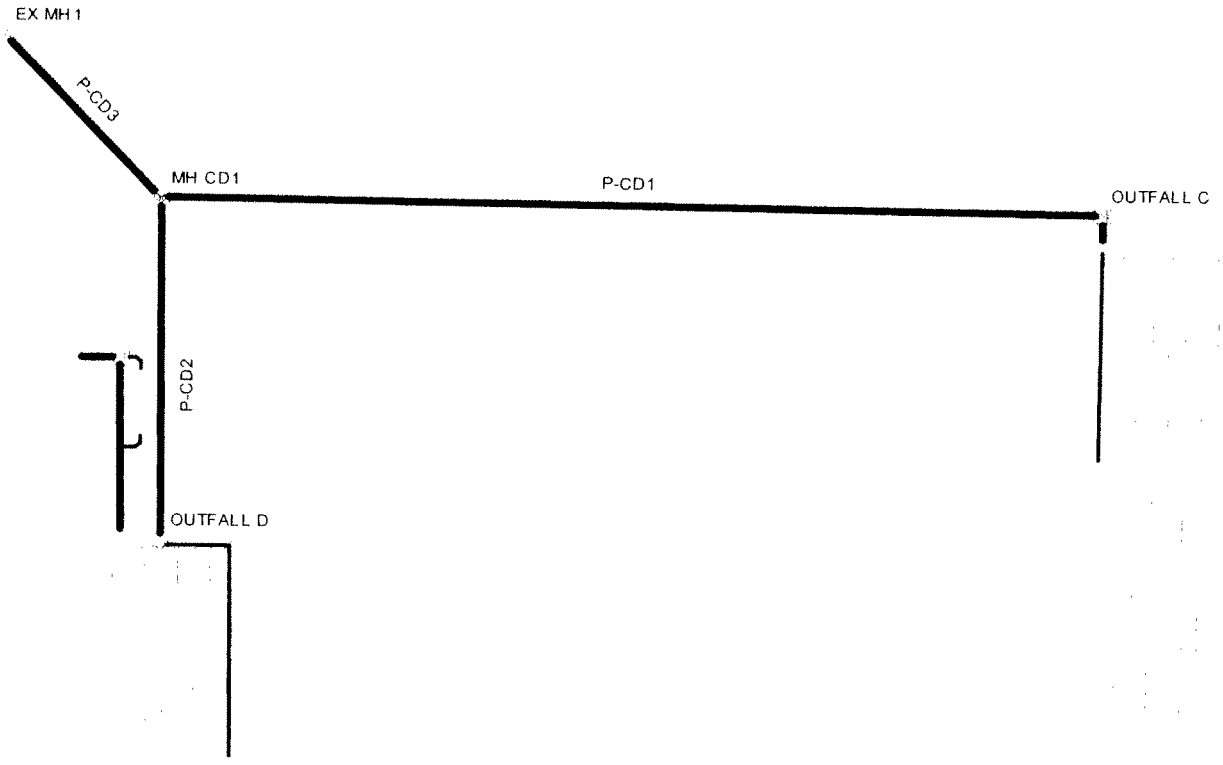
Scenario: LINE CD OUT - 10 YR



Scenario: LINE CD OUT - 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-CD1	18 inch	273.00	OUTFALL (	MH CD1	5,551.17	5,547.13	0.014799	6.03	12.78	9.90	5,557.80	5,554.20	5,552.38	5,549.30	5,553.03	5,549.79
P-CD2	18 inch	100.00	OUTFALL I	MH CD1	5,547.75	5,547.23	0.005200	0.74	7.57	1.30	5,555.10	5,554.20	5,549.32	5,549.30	5,549.33	5,549.31
P-CD3	18 inch	66.00	MH CD1	EX MH1	5,546.93	5,546.60	0.005000	6.66	7.43	11.20	5,554.20	5,549.70	5,548.74	5,547.88	5,549.37	5,548.64

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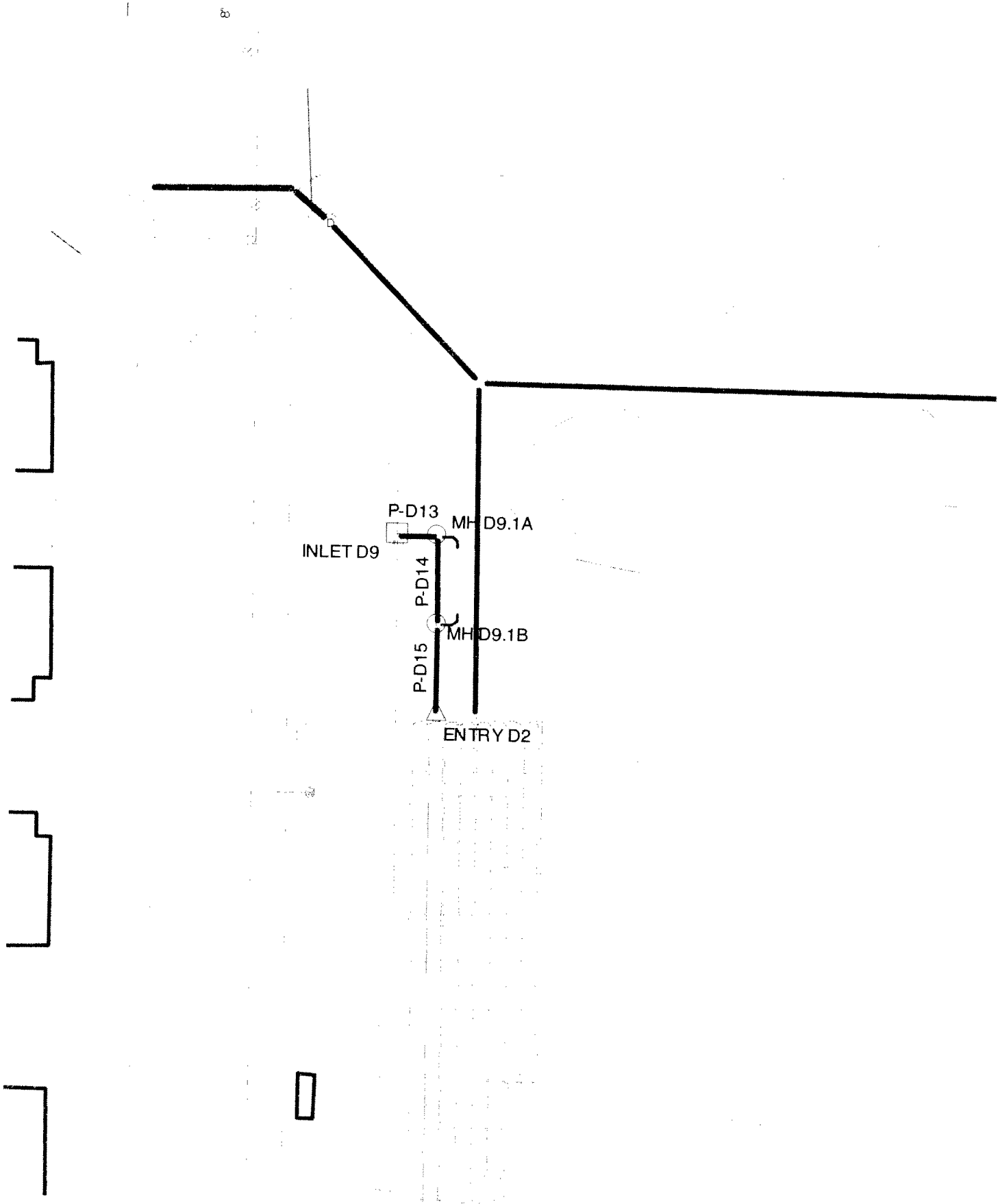
Scenario: LINE D1-D2 - 100 YR



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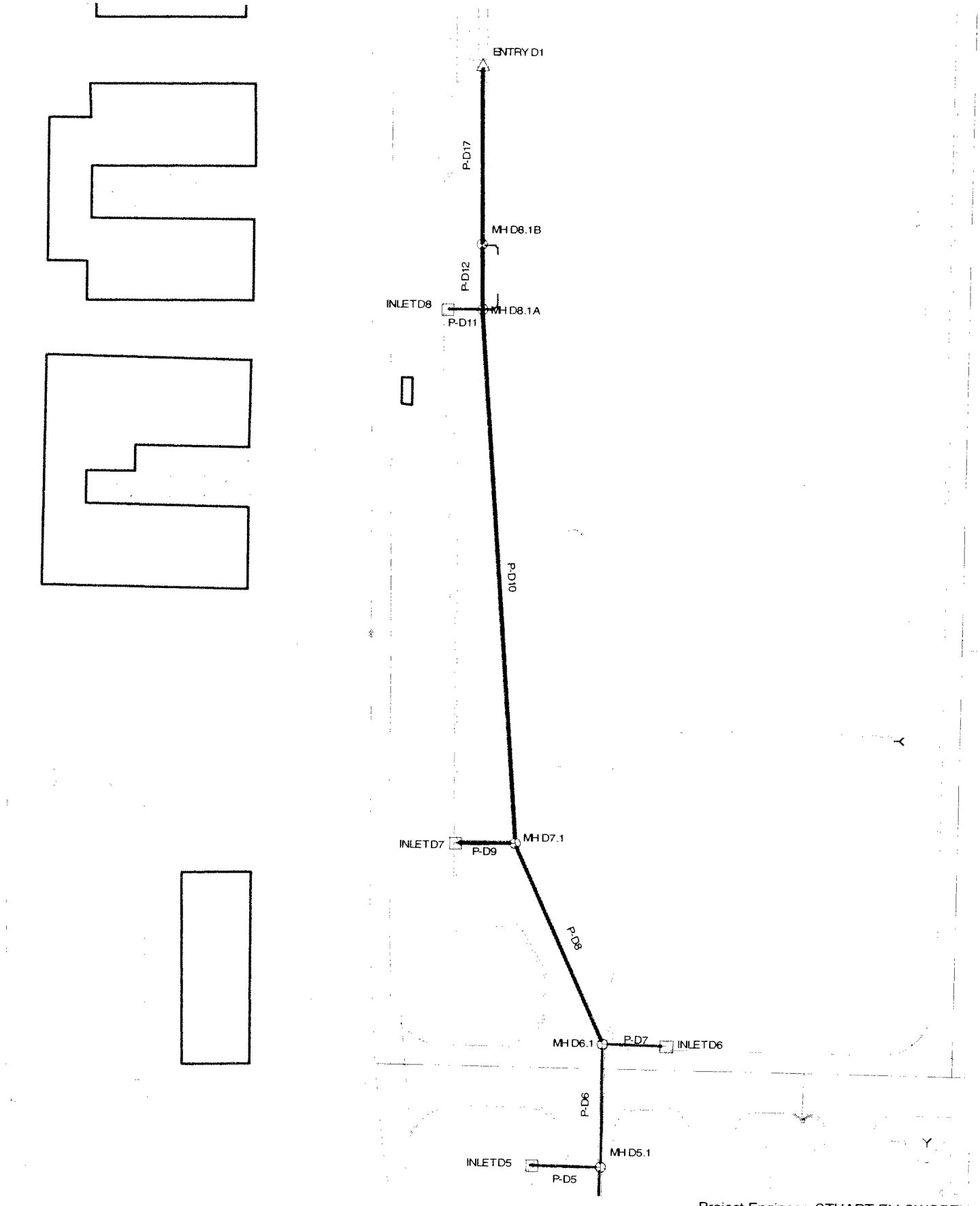
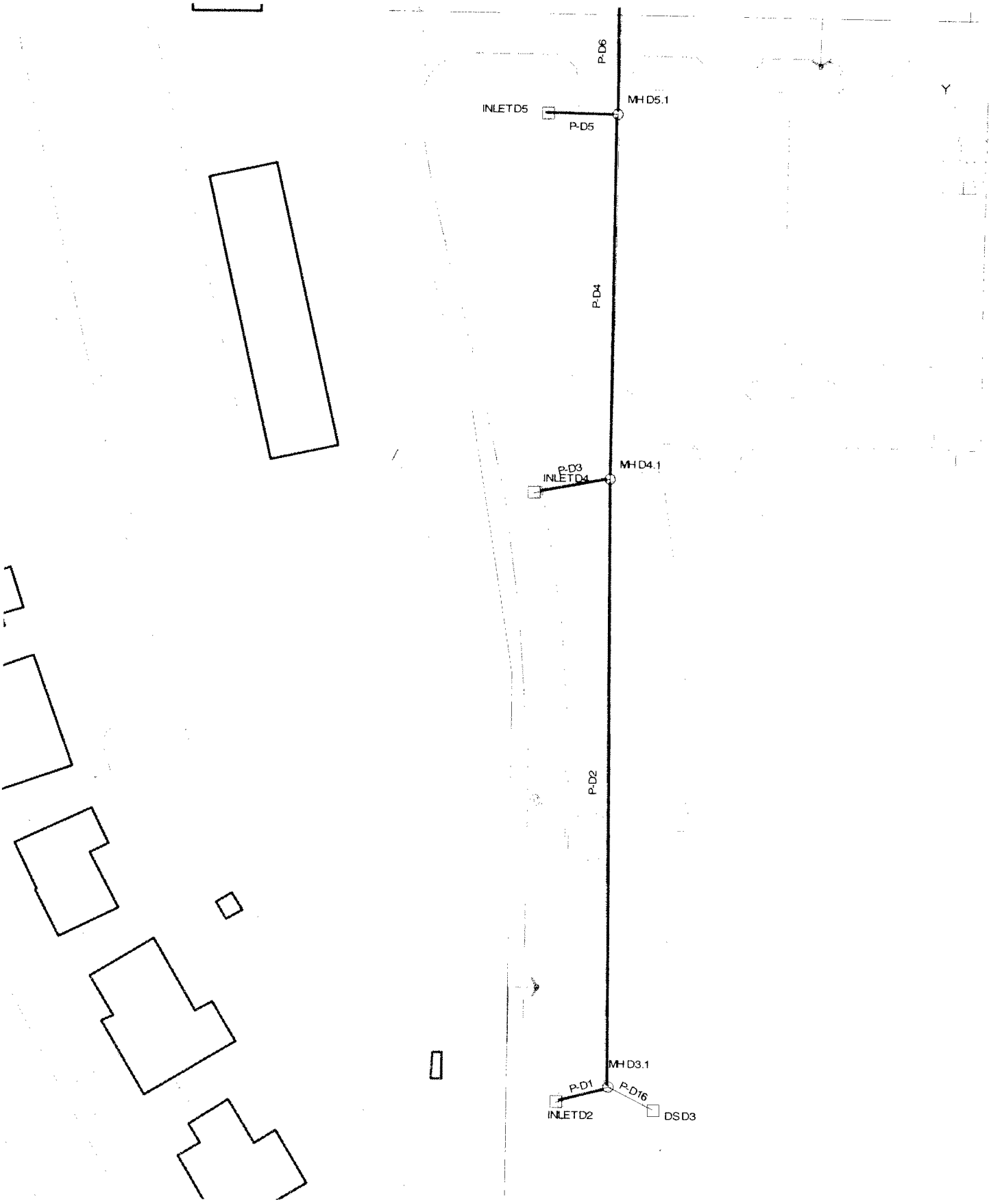
Scenario: LINE D1-D2 - 100 YR



Scenario: LINE D1-D2 - 100 YR



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Scenario: LINE D1-D2 - 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-D1	18 inch	26.00	INLET D2	MH D3.1	5,563.69	5,563.43	0.010000	2.11	10.50	0.80	5,568.90	5,569.80	5,564.02	5,563.95	5,564.14	5,563.98
P-D2	18 inch	303.00	MH D3.1	MH D4.1	5,563.23	5,559.24	0.013168	3.86	12.05	3.55	5,569.80	5,565.60	5,563.95	5,560.08	5,564.23	5,560.27
P-D3	18 inch	38.00	INLET D4	MH D4.1	5,560.06	5,559.34	0.018947	2.26	14.46	1.23	5,565.00	5,565.60	5,560.48	5,560.08	5,560.62	5,560.11
P-D4	18 inch	182.00	MH D4.1	MH D5.1	5,559.04	5,557.23	0.009945	5.14	10.47	4.47	5,565.60	5,563.15	5,559.85	5,557.91	5,560.18	5,558.42
P-D5	18 inch	33.00	INLET D5	MH D5.1	5,557.99	5,557.33	0.020000	2.92	14.85	1.63	5,561.60	5,563.15	5,558.47	5,557.93	5,558.64	5,558.02
P-D6	18 inch	61.00	MH D5.1	MH D6.1	5,557.03	5,556.41	0.010164	5.47	10.59	5.42	5,563.15	5,560.80	5,557.93	5,557.17	5,558.30	5,557.73
P-D7	18 inch	29.00	INLET D6	MH D6.1	5,556.99	5,556.41	0.020000	2.93	14.85	2.07	5,561.15	5,560.80	5,557.53	5,557.18	5,557.73	5,557.26
P-D8	24 inch	110.00	MH D6.1	MH D7.1	5,555.91	5,554.81	0.010000	4.31	22.62	7.40	5,560.80	5,559.60	5,556.88	5,556.02	5,557.25	5,556.24
P-D9	18 inch	28.00	INLET D7	MH D7.1	5,555.67	5,555.11	0.020000	2.87	14.85	2.30	5,558.92	5,559.60	5,556.24	5,556.02	5,556.46	5,556.09
P-D10	24 inch	269.00	MH D7.1	MH D8.1A	5,554.61	5,551.92	0.010000	6.12	22.62	9.51	5,559.60	5,557.30	5,555.71	5,552.82	5,556.16	5,553.56
P-D11	18 inch	17.00	INLET D8	MH D8.1A	5,552.40	5,552.22	0.010588	1.75	10.81	0.92	5,556.64	5,557.30	5,552.83	5,552.86	5,552.90	5,552.88
P-D12	24 inch	32.00	MH D8.1A	MH D8.1B	5,551.72	5,550.99	0.022813	6.98	34.17	10.11	5,557.30	5,557.40	5,552.86	5,551.80	5,553.32	5,552.92
P-D13	18 inch	10.00	INLET D9	MH D9.1A	5,549.57	5,549.51	0.006000	4.05	8.14	2.80	5,552.77	5,553.25	5,550.21	5,550.12	5,550.45	5,550.39
P-D14	18 inch	26.00	MH D9.1A	MH D9.1B	5,549.21	5,549.08	0.005000	3.92	7.43	2.80	5,553.25	5,554.10	5,549.85	5,549.71	5,550.09	5,549.96
P-D15	18 inch	26.00	MH D9.1B	ENTRY D2	5,548.88	5,548.75	0.005000	3.91	7.43	2.78	5,554.10	5,554.70	5,549.52	5,549.38	5,549.75	5,549.62
P-D16	12 inch	25.00	DS D3	MH D3.1	5,564.75	5,564.23	0.020800	5.52	5.14	2.77	5,569.00	5,569.80	5,565.46	5,564.77	5,565.80	5,565.41
P-D17	24 inch	89.00	MH D8.1B	ENTRY D1	5,550.79	5,548.75	0.022921	7.44	34.25	10.09	5,557.40	5,557.90	5,551.93	5,549.50	5,552.39	5,550.88

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Scenario: LINE D1-D2 - 100 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-D1	18 inch	26.00	INLET D2	MH D3.1	5,563.69	5,563.43	0.010000	2.35	10.50	1.36	5,568.90	5,569.80	5,564.13	5,564.19	5,564.28	5,564.22
P-D2	18 inch	303.00	MH D3.1	MH D4.1	5,563.23	5,559.24	0.013168	4.51	12.05	6.12	5,569.80	5,565.60	5,564.19	5,560.50	5,564.60	5,560.73
P-D3	18 inch	38.00	INLET D4	MH D4.1	5,560.06	5,559.34	0.018947	2.65	14.46	2.31	5,565.00	5,565.60	5,560.64	5,560.50	5,560.85	5,560.53
P-D4	18 inch	182.00	MH D4.1	MH D5.1	5,559.04	5,557.23	0.009945	6.15	10.47	7.97	5,565.60	5,563.15	5,560.13	5,558.21	5,560.65	5,558.87
P-D5	18 inch	33.00	INLET D5	MH D5.1	5,557.99	5,557.33	0.020000	3.30	14.85	2.91	5,561.60	5,563.15	5,558.64	5,558.23	5,558.88	5,558.34
P-D6	18 inch	61.00	MH D5.1	MH D6.1	5,557.03	5,556.41	0.010164	6.19	10.59	9.65	5,563.15	5,560.80	5,558.23	5,557.69	5,558.86	5,558.25
P-D7	18 inch	29.00	INLET D6	MH D6.1	5,556.99	5,556.41	0.020000	3.37	14.85	3.83	5,561.15	5,560.80	5,557.74	5,557.69	5,558.03	5,557.78
P-D8	24 inch	110.00	MH D6.1	MH D7.1	5,555.91	5,554.81	0.010000	5.29	22.62	13.35	5,560.80	5,559.60	5,557.23	5,556.60	5,557.80	5,556.92
P-D9	18 inch	28.00	INLET D7	MH D7.1	5,555.67	5,555.11	0.020000	3.35	14.85	4.03	5,558.92	5,559.60	5,556.44	5,556.60	5,556.74	5,556.69
P-D10	24 inch	269.00	MH D7.1	MH D8.1A	5,554.61	5,551.92	0.010000	7.36	22.62	17.08	5,559.60	5,557.30	5,556.10	5,553.22	5,556.82	5,554.19
P-D11	18 inch	17.00	INLET D8	MH D8.1A	5,552.40	5,552.22	0.010588	1.68	10.81	1.97	5,556.64	5,557.30	5,553.26	5,553.27	5,553.32	5,553.30
P-D12	24 inch	32.00	MH D8.1A	MH D8.1B	5,551.72	5,550.99	0.022813	8.42	34.17	18.53	5,557.30	5,557.40	5,553.27	5,552.16	5,554.05	5,553.63
P-D13	18 inch	10.00	INLET D9	MH D9.1A	5,549.57	5,549.51	0.006000	4.67	8.14	4.88	5,552.77	5,553.25	5,550.42	5,550.38	5,550.77	5,550.71
P-D14	18 inch	26.00	MH D9.1A	MH D9.1B	5,549.21	5,549.08	0.005000	4.60	7.43	4.87	5,553.25	5,554.10	5,550.10	5,549.93	5,550.41	5,550.28
P-D15	18 inch	26.00	MH D9.1B	ENTRY D2	5,548.88	5,548.75	0.005000	4.60	7.43	4.85	5,554.10	5,554.70	5,549.76	5,549.60	5,550.07	5,549.94
P-D16	12 inch	25.00	DS D3	MH D3.1	5,564.75	5,564.23	0.020800	6.84	5.14	4.80	5,569.00	5,569.80	5,565.66	5,565.01	5,566.30	5,565.83
P-D17	24 inch	89.00	MH D8.1B	ENTRY D1	5,550.79	5,548.75	0.022921	8.93	34.25	18.49	5,557.40	5,557.90	5,552.34	5,549.82	5,553.12	5,551.63

CLC Associates, Inc.
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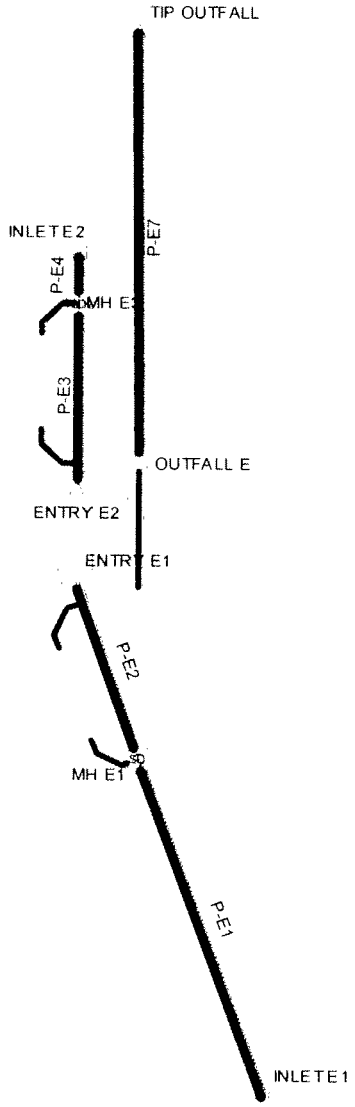
Scenario: LINE E1-E2-EOUT - 10 YR



Scenario: LINE E1-E2-EOUT - 10 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-E1	18 inch	74.00	INLET E1	MH E1	5,556.50	5,554.71	0.024189	N/A	16.34	N/A	5,561.60	5,561.50	N/A	N/A	N/A	N/A
P-E2	18 inch	40.00	MH E1	ENTRY E1	5,554.51	5,553.50	0.025250	N/A	16.69	N/A	5,561.50	5,560.30	N/A	N/A	N/A	N/A
P-E3	18 inch	38.00	MH E3	ENTRY E2	5,553.74	5,553.50	0.006316	N/A	8.35	N/A	5,561.80	5,559.20	N/A	N/A	N/A	N/A
P-E4	18 inch	10.00	INLET E2	MH E3	5,554.00	5,553.94	0.006000	N/A	8.14	N/A	5,561.88	5,561.80	N/A	N/A	N/A	N/A
P-E7	18 inch	89.00	OUTFALL I	TIP OUTFAL	5,552.00	5,551.55	0.005056	N/A	7.47	N/A	5,559.10	5,554.50	N/A	N/A	N/A	N/A

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Scenario: LINE E1-E2-EOUT - 100 YR

Combined Pipe\Node Report

Label	Section Size	Length (ft)	Upstream Node	Downstream Node	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Constructed Slope (ft/ft)	Average Velocity (ft/s)	Full Capacity (cfs)	Total System Flow (cfs)	Upstream Ground Elevation (ft)	Downstream Ground Elevation (ft)	Hydraulic Grade Line In (ft)	Hydraulic Grade Line Out (ft)	Energy Grade Line In (ft)	Energy Grade Line Out (ft)
P-E1	18 inch	71.00	INLET E1	MH E1	5,558.00	5,553.68	0.060845	2.79	25.91	1.23	5,561.60	5,561.50	5,558.42	5,554.17	5,558.56	5,554.26
P-E2	18 inch	20.00	MH E1	MH E2	5,553.68	5,553.08	0.030000	4.37	18.19	1.21	5,561.50	5,560.90	5,554.09	5,553.35	5,554.24	5,553.85
P-E3	18 inch	19.00	MH E2	ENTRY E1	5,552.88	5,552.50	0.020000	3.99	14.85	1.21	5,560.90	5,560.30	5,553.29	5,552.80	5,553.44	5,553.17
P-E4	18 inch	11.00	INLET E2	MH E3	5,553.11	5,553.06	0.004545	5.03	7.08	7.59	5,561.88	5,561.80	5,554.32	5,554.24	5,554.70	5,554.64
P-E5	18 inch	20.00	MH E3	MH E4	5,552.86	5,552.76	0.005000	5.36	7.43	7.57	5,561.80	5,563.80	5,554.04	5,553.83	5,554.44	5,554.32
P-E6	18 inch	12.00	MH E4	ENTRY E2	5,552.56	5,552.50	0.005000	5.39	7.43	7.55	5,563.80	5,559.20	5,553.72	5,553.56	5,554.13	5,554.06
P-E7	18 inch	88.00	OUTFALL I	TIP OUTFAL	5,551.00	5,545.00	0.068182	3.93	27.43	0.40	5,559.10	5,554.50	5,551.23	5,545.13	5,551.31	5,545.61

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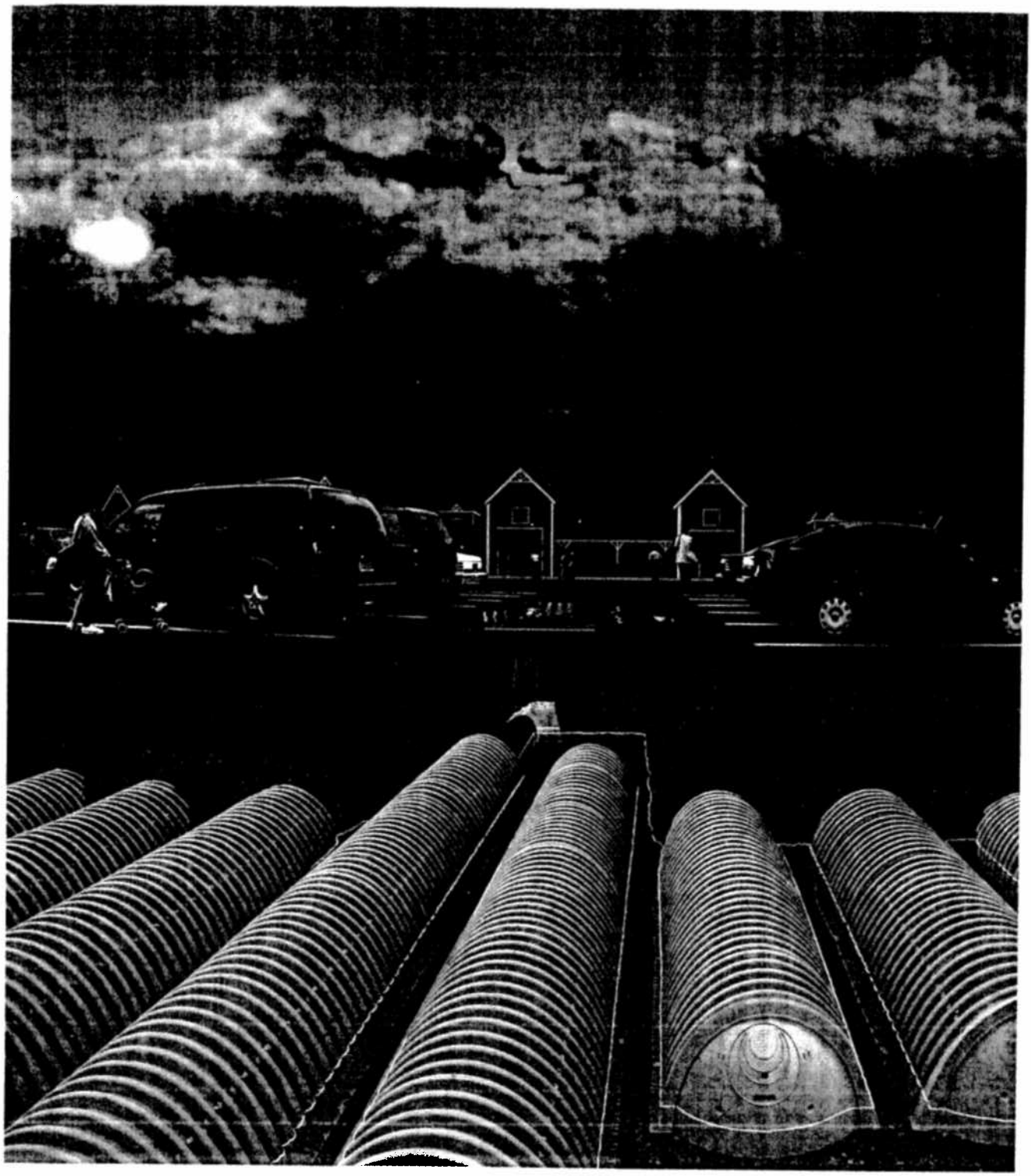
Reference Material

StormTech®

Detention • Retention • Recharge

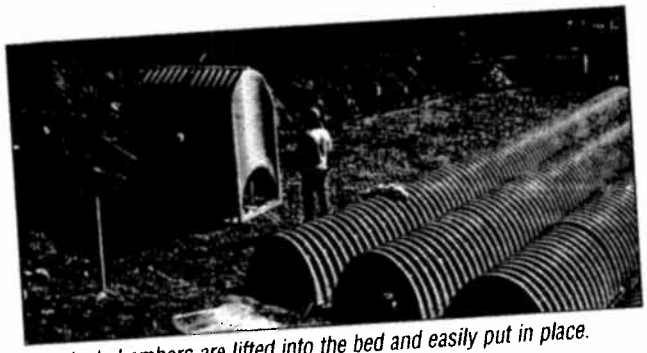
Subsurface Stormwater Management℠



Design Manual

StormTech® Chamber Systems for Stormwater Management

1.0 Introduction



Stacked chambers are lifted into the bed and easily put in place.

1.1 INTRODUCTION

StormTech's stormwater management systems allow stormwater professionals to create more profitable, environmentally sound developments. Compared with other subsurface systems, StormTech systems offer lower overall installed cost, superior design flexibility and enhanced performance. Applications include commercial, residential, agricultural and highway drainage.

StormTech has invested over $7.5 million and four years in the development of StormTech chambers. These innovative products exceed the rigorous requirements of the stormwater industry.

1.2 THE GOLD STANDARD IN STORMWATER MANAGEMENT

The advanced designs of StormTech's chambers were created by implementing an aggressive research, development, design and manufacturing protocol. StormTech chamber products establish the new gold standard in stormwater management through:

- Collaborations with experts in the field of buried plastic structures and polyolefin materials
- The development and utilization of new testing methods and proprietary test fixtures
- The use of thermoformed prototypes to verify engineering models, perform in-ground testing and install observation sites
- The investment in custom-designed, injection molding equipment
- The utilization of polypropylene as a manufacturing material
- The design of molded-in features not possible with traditional thermoformed chambers

Section 3.0 of this design manual, *Structural Capabilities*, provides a detailed description of the research, development and design process.

Many of StormTech's unique chamber features can benefit a site developer, stormwater system designer, and installer. Where applicable, StormTech's Product Specifications are referenced throughout this design manual. If StormTech's unique product benefits are important to a stormwater system's design, consider including the applicable StormTech product specifications on the site plans. This can prevent substitutions with inferior products. Refer to Section 15.0, *StormTech Product Specifications.*

1.3 TECHNICAL SUPPORT FOR PLAN REVIEWS

StormTech's in-house technical support staff is available to review proposed plans that incorporate StormTech chamber systems. They are also available to assist with plan conversions from existing products to StormTech. Not all plan sheets are necessary for StormTech's review. Required sheets include plan view sheet(s) with final elevations, any detail sheets with cross sections of the stormwater system including catch basins and any landscape details.

When specifying StormTech Chambers it is recommended that the following items are included in project plans: StormTech chamber system General Notes, applicable StormTech chamber illustrations and StormTech chamber system Product Specifications. These items are available in various formats and can be obtained by contacting StormTech at **1-888-892-2694** or may be downloaded at **www.stormtech.com.**

StormTech's plan review is limited to the sole purpose of determining whether plans meet StormTech chamber systems' minimum requirements. **It is the ultimate responsibility of the design engineer to assure that the stormwater system's design is in full compliance with all applicable laws and regulations.** StormTech products must be designed and installed in accordance with StormTech's minimum requirements.

SEND PLANS TO:

StormTech LLC, Plan Review, 20 Beaver Road, Suite 104, Wethersfield, CT 06109 E-mail: techinfo@stormtech.com. File size should not exceed 2MB.

2.0 Product Information

StormTech

2.1 PRODUCT APPLICATIONS

StormTech chamber systems may function as stormwater detention, retention, first-flush storage, or some combination of these. The StormTech chambers can be used for commercial, municipal, industrial, recreational, and residential applications including installation under parking lots and commercial roadways.

One of the key advantages of the StormTech chamber system is its design flexibility. Chambers may be configured into beds or trenches of various sizes or shapes. They can be centralized or decentralized, and fit on nearly all sites. Chamber lengths enhance the ability to develop on both existing and pre-developed projects. The systems can be designed easily and efficiently around utilities, natural or man-made structures and any other limiting boundaries.

2.2 CHAMBERS FOR STORMWATER DETENTION

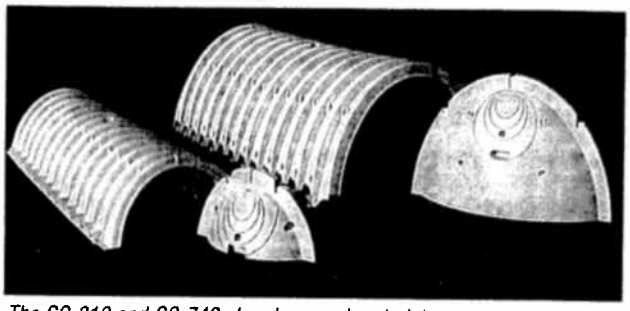
Chamber systems have been used effectively for stormwater detention for over 15 years. A detention system temporarily holds water while it is released at a defined rate through an outlet. While some infiltration may occur in a detention system, it is often considered an environmental benefit and a storage safety factor. Over 70% of StormTech's installations are non-watertight detention systems. There are only a few uncommon situations where a detention system might need to be watertight: The subgrade soil's bearing capacity is significantly affected by saturation such as with expansive clays or karst soils, and; in sensitive aquifer areas where the depth to groundwater does not meet EPA's guidelines of 2 – 4 feet. Adequate pretreatment could eliminate concerns for the latter case. An impermeable liner may be considered for both situations to create a watertight chamber system. Contact StormTech's Technical service department for more information on using Stormtech chambers in your application.

2.3 STONE POROSITY ASSUMPTION

A StormTech chamber system requires the application of washed angular stone below, between and above the chambers. This stone serves as a structural component while allowing conveyance and storage of stormwater. Storage volume examples throughout this Design Manual are calculated with an assumption that the angular stone has a porosity of 40%. Actual stone porosity may vary. Contact StormTech for information on calculating stormwater volumes with varying stone porosity assumptions.

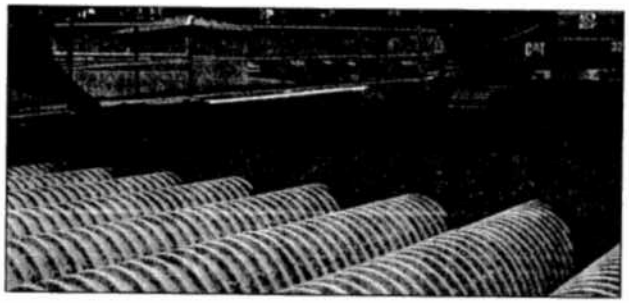
2.4 CHAMBER SELECTION

StormTech currently offers two chamber sizes for stormwater management. These chambers have been designed to optimize and balance storage volumes with respect to depth and area constraints.



The SC-310 and SC-740 chambers and end plates.

StormTech systems can be integrated into retrofit and new construction projects.



StormTech chambers may be configured into beds or trenches.

Primary considerations when selecting between the SC-740™ and SC-310™ chambers are the depth to groundwater, available area for subsurface storage and outfall restrictions.

The StormTech SC-740 chamber shown in **Figure 1** on page 4 optimizes storage volumes in relatively small footprints. By providing 2.2 ft^3/ft^2 (minimum) of storage, the SC-740 chambers can minimize excavation, backfill and associated costs.

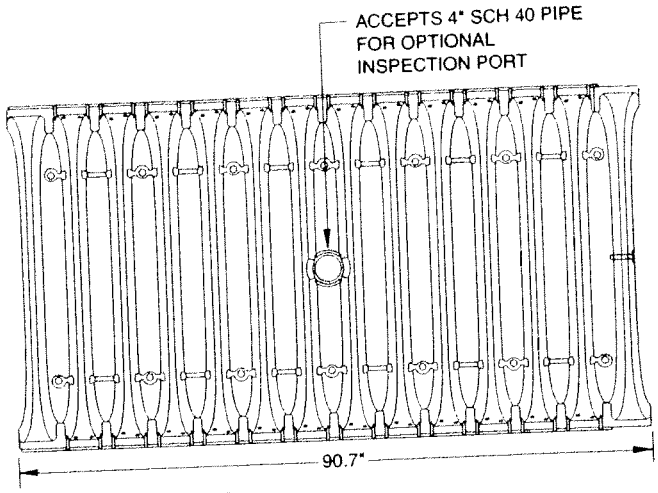
The StormTech SC-310 chamber shown in **Figure 2** on page 4 is ideal for systems requiring low-rise and wide-span solutions. This low profile chamber allows the storage of large volumes, 1.3 ft^3/ft^2 (minimum), at minimum depths. *Product Specifications: 2.2 and 2.5*

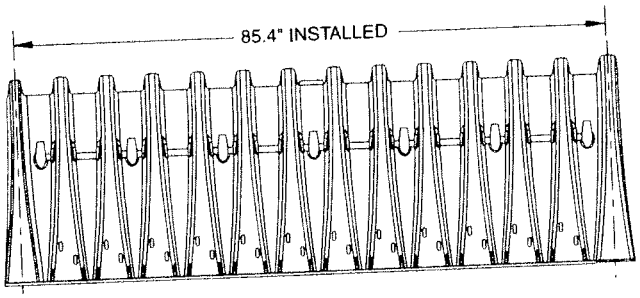
2.0 Product Information

Figure 1
StormTech SC-740 Chamber (not to scale)

Nominal Chamber Specifications

Size (W x H x Installed L)	51.0" x 30.0" x 85.4"
Chamber Storage	45.9 ft³
Minimum Installed Storage*	74.9 ft³
Weight	74 lbs





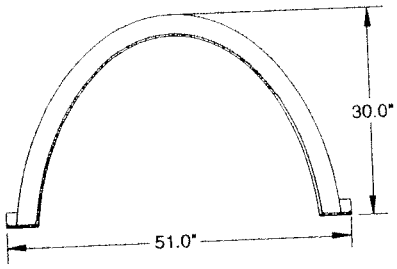
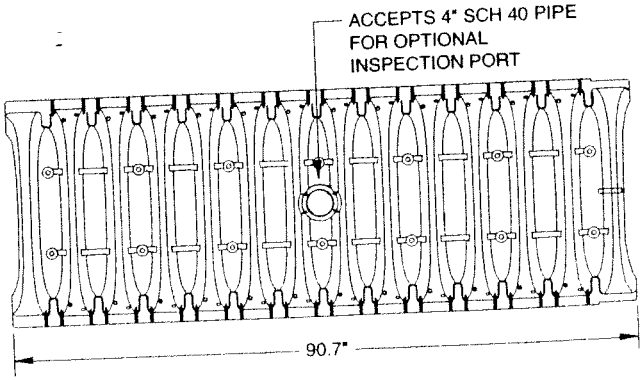
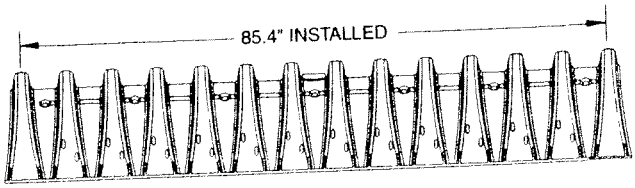


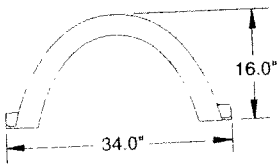
Figure 2
StormTech SC-310 Chamber (not to scale)

Nominal Chamber Specifications

Size (W x H x Installed L)	34.0" x 16.0" x 85.4"
Chamber Storage	14.7 ft³
Minimum Installed Storage*	31.0 ft³
Weight	37 lbs







*This assumes a minimum of 6-inches of stone below, above and between chamber rows and 40% stone porosity.

2.5 STORMTECH CHAMBERS

StormTech's chamber systems have unique features to improve site optimization and reduce product waste. The SC-740 and SC-310 chambers can be cut at the job site in approximately 6.5-inch increments to shorten a row's length. Designing and constructing chamber rows around site obstacles is easily accomplished by including specific cutting instructions or a well placed "cut to fit" note on the design plans. The last chamber of a row can be cut in any of its corrugation's valleys. An end cap placed into the trimmed corrugation's crest completes the row. The trimmed-off piece of a StormTech chamber may then be used to start the next row. See **Figure 3**.

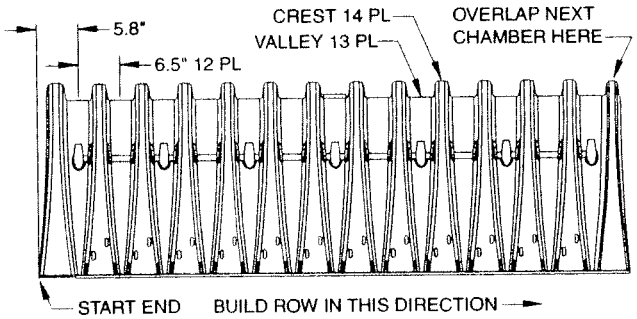
To assist the contractor, StormTech's chambers are molded with simple assembly instructions and arrows that indicate the direction in which to build rows. Rows are formed by overlapping the next chamber's "Start End" corrugation with the previously laid chamber's end corrugation. Two people can safely and efficiently form rows of chambers without complicated connectors, special tools or heavy equipment.
Product Specifications: 2.2, 2.4, 2.9 and 3.2

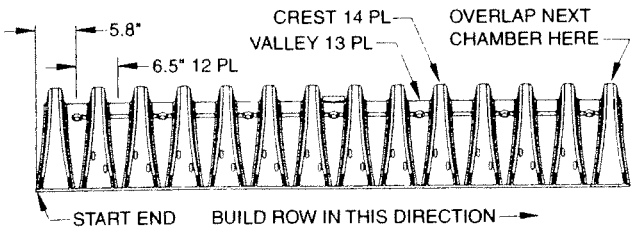
2.6 STORMTECH END CAPS

The StormTech end cap has features which make the chamber system simple to design, easy to build and more versatile than other products. StormTech end caps can be easily secured within any corrugation's crest. A molded-in handle makes attaching the end cap a one-person operation. Tools or fasteners are not required.

StormTech end caps are required at each end of a chamber row to prevent stone intrusion (two per row). The SC-740 end cap will accept up to a 25-inch maximum outside diameter inlet pipe. The SC-310 end cap will accept up to a 12-inch inlet pipe. To aid contractors, inlet pipe cutting guides and a blade-starting slot are molded into the end caps. See **Figure 4**.
Product Specifications: 3.1, 3.2, 3.3 and 3.4

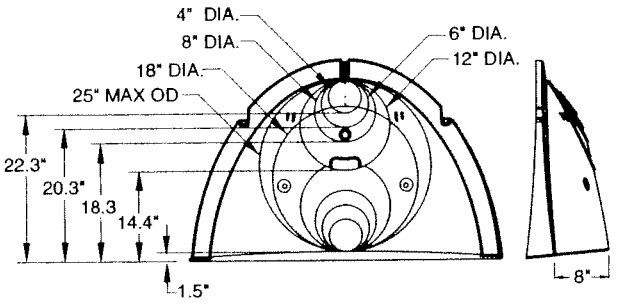
Figure 3
Distance Between Corrugations (not to scale)



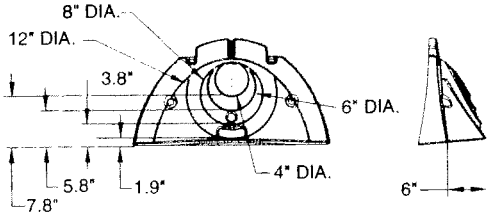


SC-310 chamber

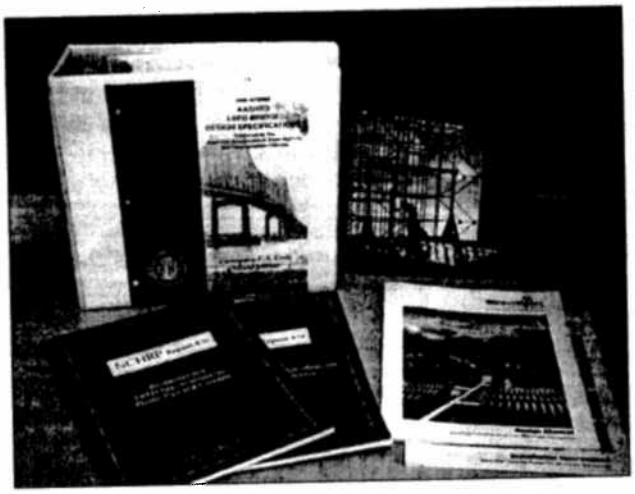
Figure 4
Chamber End Caps (not to scale)



SC-740 end cap



3.0 Structural Capabilities

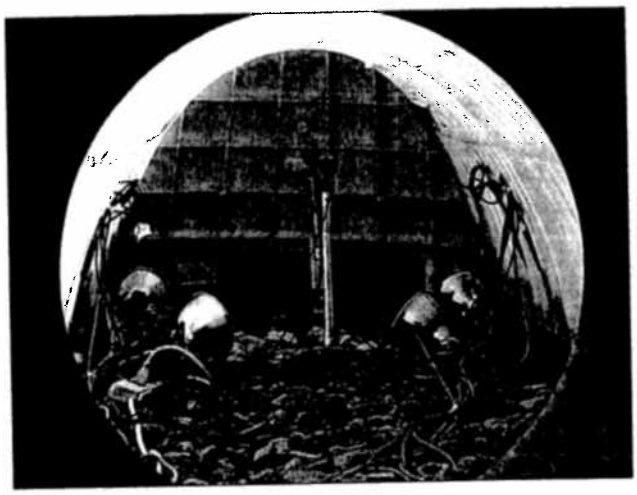


3.1 STRUCTURAL DESIGN APPROACH

StormTech's products are designed to exceed AASHTO LRFD recommended design factors for Earth Loads and HS-20 live loads, with consideration for impact and multiple presences, when installed per StormTech's minimum requirements. Structural performance of StormTech's chambers were assessed utilizing current AASHTO procedures for the design of profile wall thermoplastic culverts (AASHTO LRFD Bridge Design Specifications with Interim Specifications through 2001).

Computer models of the chambers under shallow and deep conditions were developed. Utilizing design forces from the computer models, chamber sections were evaluated using AASHTO procedures that consider thrust and moment, and check for local buckling capacity. The procedures also considered the time-dependent strength and stiffness properties of polypropylene.

These procedures were developed in a research study conducted by the National Cooperative Highway Research Program (NCHRP) for AASHTO, and published as NCHRP Report 438 Recommended LRFD Specifications for Plastic Pipe and Culverts.
Product Specifications: 2.12

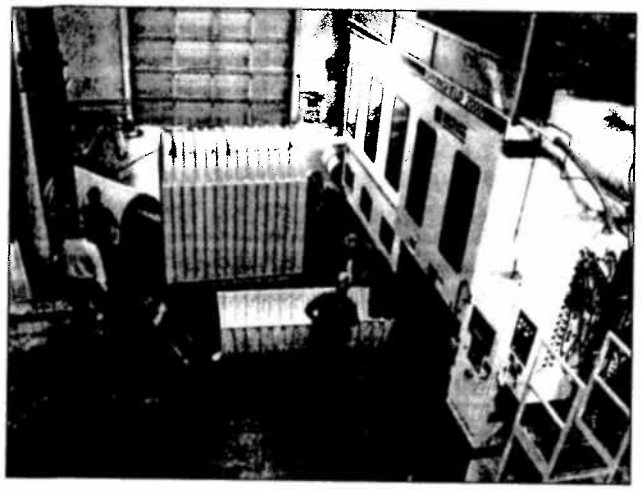


3.2 FULL SCALE TESTING

After developing the StormTech chamber designs, the chambers were subjected to rigorous full-scale testing. The test programs verified the predicted safety factors of the designs by subjecting the chambers to more severe load conditions than anticipated during service life. Capacity under live loads and deep fill was investigated by conducting tests with a range of cover depths.

3.3 INDEPENDENT EXPERT ANALYSIS

StormTech worked closely with the consulting firm Simpson Gumpertz & Heger Inc. (SGH) to develop and evaluate the SC-740 and SC-310 chamber designs. SGH has world-renowned expertise in the design of buried drainage structures. The firm was the principal investigator for the NCHRP research program that developed the structural analysis and design methods recently adopted by AASHTO for thermoplastic culverts. SGH conducted design calculations and computer simulations of chamber performance under various installation and live load conditions. They worked with StormTech to design the full-scale test programs to verify the structural capacity of the chambers. SGH also observed all full-scale tests and inspected the chambers after completion of the tests.



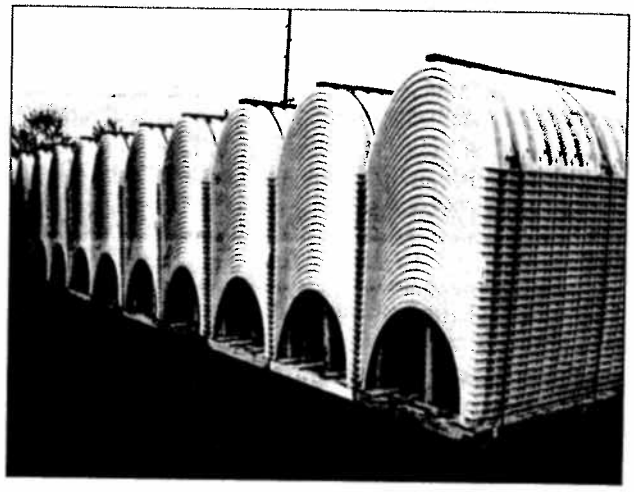
3.4 INJECTION MOLDING

To comply with the structural requirements of AASHTO's LRFD design and analysis methods, StormTech utilizes proprietary injection molding equipment to manufacture the SC-740 and SC-310 chambers and end caps. StormTech invested in this superior process, rather than less precise thermoforming methods, to assure consistent quality and structural performance.

In addition to meeting structural goals, injection molding allows StormTech to design added features and advantages into StormTech's parts including:

- Molded of polypropylene (See Section 3.5)
- Precise control of wall thickness throughout parts
- Precise fit-up of joints and end caps
- Molded-in inspection port fitting
- Molded-in handles on end caps
- Molded-in pipe guides with blade starter slots
- Repeatability for Quality Control (See Section 3.6)

Product Specifications: 2.1, 3.1 and 3.3



3.5 POLYPROPYLENE RESIN

StormTech chambers are injection molded from polypropylene. Polypropylene chambers are inherently resistant to environmental stress cracking and chemicals typically found in stormwater run-off. StormTech's chambers maintain a greater portion of their structural stiffness through higher installation and service temperatures.

3.6 QUALITY CONTROL

StormTech's SC-740 and SC-310 stormwater chambers are manufactured under tight quality control programs. Materials are routinely tested in an environmentally controlled lab that is verified every six months via the external ASTM Proficiency Testing Program. The chambers' material properties are measured and controlled with procedures following ISO 9001:2000 requirements.

Statistical Process Control (SPC) techniques are applied during manufacturing. Established upper and lower control limits are maintained on key manufacturing parameters to maintain consistent product. Additionally, an SPC based finished goods inspection process is used for a number of attributes and variables. StormTech's products are produced in an ISO 9001:2000 certified manufacturing facility.

Product Specifications: 2.13 and 3.6

4.0 Foundation for Chambers

4.1 FOUNDATION REQUIREMENTS

StormTech SC-740 and SC-310 chamber systems and embedment stone may be installed in various native soil types. The sub-grade bearing capacity and chamber cover height determine the required depth of crushed angular stone for the chambers' foundation. The chambers' foundation is the angular stone placed between the subgrade soils and the chambers' feet.

As cover height increases – top of chamber to top of finished grade – the chambers' foundation requirements increase. Foundation strength is the product of the sub-grade soils bearing capacity and the depth of angular stone below the chambers' feet. **Table 1** specifies the required allowable subgrade soil bearing capacities for varying cover heights and foundation depths.

The design engineer is solely responsible for assessing the bearing capacity of the sub-grade soil and applying StormTech's minimum foundation requirements to the system plans. Sub-grade soil conditions should be assessed with consideration of the variety of soil moisture contents expected under a stormwater system.

Table 1 – Required Allowable Subgrade Soil Bearing in Thousand Pounds per Square Foot (ksf)

Cover Height (ft)	Foundation Depth (in.)		
	6	12	18
8.0 (Max. Allowable)	3.8	2.8	2.3
7.5	3.6	2.7	2.2
7.0	3.5	2.6	2.1
6.5	3.3	2.5	2.0
6.0	3.2	2.4	2.0
5.5	3.1	2.3	2.0
5.0	3.0	2.3	2.0
4.5	3.0	2.2	2.0
4.0	2.9	2.2	2.0
3.5	2.9	2.2	2.0
3.0	2.8	2.1	2.0
2.5	2.7	2.0	2.0
2.0	2.6	2.0	2.0
1.5 (Min. Allowable)	2.5	2.0	2.0

4.2 WEAKER SOILS

For sub-grade soils with allowable bearing capacity less than 2000 pounds per square foot (2.0 ksf), a geotechnical engineer should evaluate the specific conditions. These soils are often highly variable, may contain organic materials and could be more sensitive to moisture. A geotech's recommendations may include increasing the stone foundation to greater than 18 in., improving the bearing capacity of the sub-grade soils through compaction, replacement, or other remedial measures including the use of geogrids. The use of an impermeable liner may also be considered for systems installed in subgrade soils that are highly affected by moisture. The project engineer is responsible for ensuring overall site settlement is within acceptable limits. A geotechnical engineer should always review installation of StormTech chambers on organic soils.

4.3 CHAMBER SPACING OPTION

StormTech always requires a minimum of 6" clear spacing between the feet of chambers rows. However, increasing the spacing between chamber rows may allow the application of StormTech chambers with either less foundation stone or with weaker subgrade soils. This may be a good option where a site's vertical restrictions prevent the use of a deeper foundation. Contact StormTech's technical service department for more information on this option. In all cases, StormTech recommends consulting a geotechnical engineer for subgrade soils with a bearing capacity less than 2.0 ksf.

5.0 Required Materials/Row Separation

5.1 CHAMBER ROW SEPARATION

StormTech SC-740 and SC-310 chambers must be specified with a minimum 6-inch space between the feet of adjacent parallel chamber rows. 12 inches are required between the foot of a perpendicular row and the adjacent rows' end caps. Increasing the space between rows is acceptable. This will increase the storage volume due to additional stone voids.

5.2 STONE SURROUNDING CHAMBERS

Refer to **Table 2** for acceptable stone materials. StormTech requires crushed, angular stone below, between and 6 inches above chambers as shown in **Figure 5**. The majority of stone used must be between ¾-inch to 2-inch in size. Subrounded and rounded stone are not acceptable.

5.3 GEOTEXTILE SEPARATION REQUIREMENT

A non-woven geotextile that meets AASHTO M288 Class 2 Separation requirements must be applied as a separation layer to prevent soil intrusion into the angular stone as shown in **Figure 5**. The geotextile is required between the angular stone and: the subgrade soils; the excavation's sidewalls and; the fill materials. The geotextile should completely envelope the angular stone. Overlap adjacent geotextile rolls per AASHTO M288 separation guidelines. See **Table 4** for a list of acceptable geotextiles.

5.4 FILL ABOVE CHAMBERS

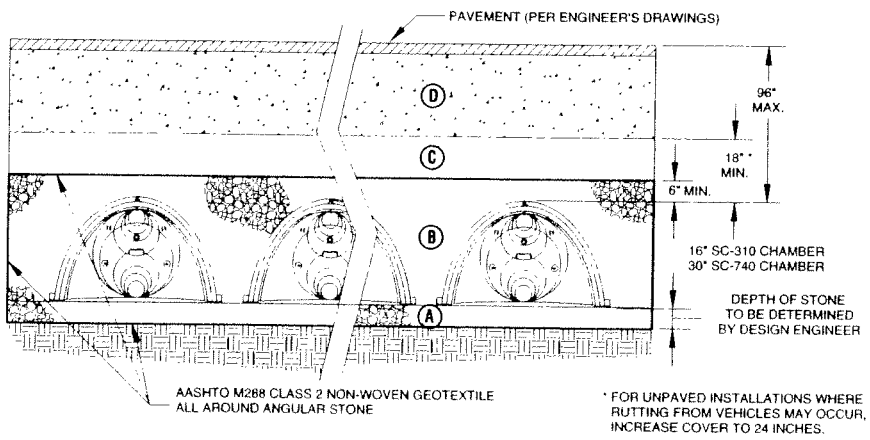
Refer to **Table 2** and **Figure 5** for acceptable fill material above the 6 inches of washed crushed angular stone. StormTech requires a minimum of 18 inches and a maximum of 96 inches of fill material (including the 6 inches of stone above chambers). StormTech requires a minimum of 24 inches of fill in non-paved installations where rutting from vehicles may occur. **Table 2** provides details on soil class and compaction requirements for suitable fill materials.

TABLE 2 – Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation	AASHTO M145 Designation	Compaction/Density Requirement
(D) Fill Material from 18" elevation to grade above chambers	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	N/A	Prepare per engineer's plans. Paved installations may have stringent material and preparation requirements.
(C) Fill Material for 6" to 18" elevation above chambers (24" for unpaved installations)	Granular well-graded soil/ aggregate mixtures, <35% fines	3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	A-1 A-2 A-3	Compact in 6" lifts to a minimum 95% Standard Proctor density. Roller gross vehicle weight not to exceed 12,000 lbs. Dynamic force not to exceed 20,000lbs.
(B) Embedment Stone surrounding and to a 6" elevation above Chambers	Washed, angular stone with the majority of particles between ¾-2"	3, 357, 4, 467, 5, 56, 57	N/A	No compaction required.
(A) Foundation Stone below Chambers	Washed, angular stone with the majority of particles between ¾-2"	3, 357, 4, 467, 5, 56, 57	N/A	Plate compact or roll to achieve a 95% Standard Proctor Density.

PLEASE NOTE: The listed AASHTO designations are for gradations. The stone must also be washed, crushed angular. For example, the stone must be specified as washed, crushed, angular No. 4. stone.

FIGURE 5 – Fill Material Locations



6.0 Inlets for Chambers

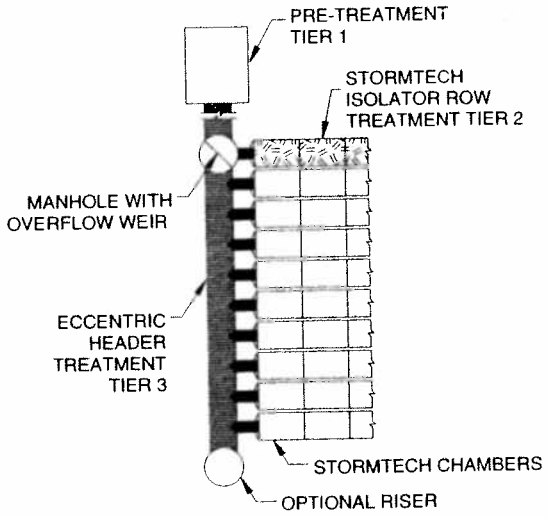
The design flexibility of a Stormtech chamber system includes many inletting possibilities. Contact StormTech's technical service department for guidance on designing an inlet system to meet specific site goals.

6.1 TREATMENT TRAIN

A properly designed inlet system can ensure good water quality, easy inspection & maintenance, and a long system service life. StormTech recommends a treatment train approach for inletting an underground stormwater management system under a typical commercial parking area. *Treatment train* is an industry term for a multi-tiered water quality network. As shown in **Figure 6**, a StormTech recommended inlet system can inexpensively have up to 3 tiers of treatment upstream of the StormTech chambers:

Tier 1 – Pre-treatment (BMP)
Tier 2 - StormTech Isolator Row
Tier 3 - Eccentric Pipe Header-Manifold

Figure 6 – Typical StormTech Treatment Train Inlet System



6.2 PRE-TREATMENT (BMP) – TREATMENT TIER 1

Typically, some level of pre-treatment of the stormwater is required prior to entry into a stormwater system. By treating the stormwater prior to entry into the system, the service life of the system can be extended, pollutants such as hydrocarbons may be captured, and local regulations met. Pre-treatment options are often described as a Best Management Practice or simply a BMP.

Pre-treatment devices differ greatly in complexity, design and effectiveness. Depending on a site's characteristics and treatment goals, the simple, least expensive pre-treatment solutions can sometimes be just as effective as the complex systems. Options include a simple deep sumped manholes with a 90° bend on its outlet, baffle boxes, swirl concentrators, sophisticated filtration devices, and devices that combine these processes. Some of the most effective pre-treatment options combine engineered site grading with vegetation such as bio-swales or grassy strips.

The type of pretreatment device specified as the first level of treatment up-stream of a StormTech chamber system can vary greatly throughout the country and from site-to-site. It is the responsibility of the design engineer to understand the water quality issues and design a stormwater treatment system that will satisfy local regulators and follow applicable laws. A design engineer should apply their understanding of local weather conditions, site topography, local maintenance requirements, expected service life, etc...to select an appropriate stormwater pre-treatment system.

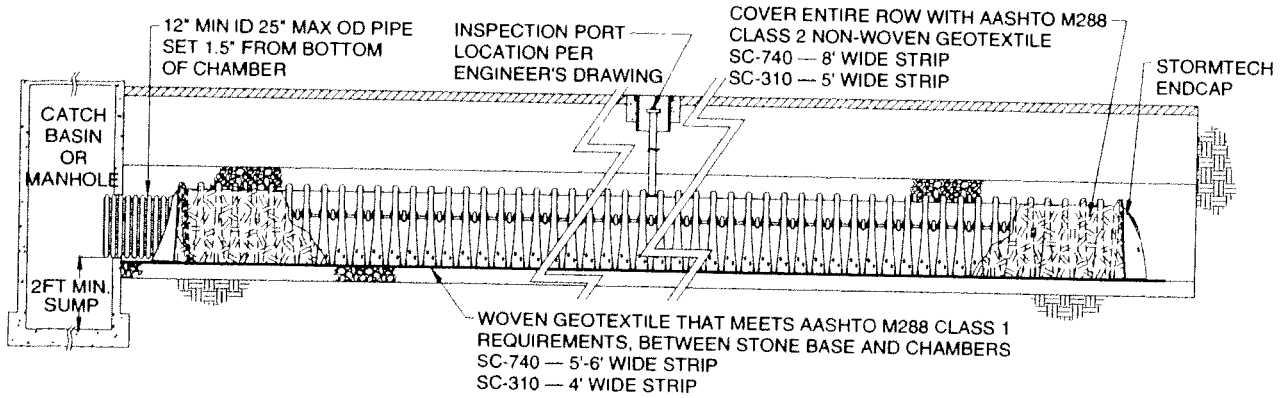
6.3 STORMTECH ISOLATOR ROW – TREATMENT TIER 2

Stormtech has a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance. The StormTech Isolator Row is a row of standard StormTech chambers surrounded with appropriate filter fabrics and connected to a manhole for easy access. This application basically creates an extended detention basin that allows water to egress through the surrounding filter fabric while sediment is trapped within. It may be best to think of the Isolator Row as a first-flush treatment device. *First-Flush* is a term typically used to describe the first ½" to 1" of rainfall or runoff on a site. The majority of stormwater pollutants are carried in the sediments of the first-flush, therefore the Isolator Row can be an effective component of a treatment train.

The StormTech Isolator Row should be designed with a manhole with an overflow weir at its upstream end. The manhole is connected to the Isolator Row with a short length of 12" ID through 25" OD pipe set near the bottom of the StormTech SC-740 EndCap. The weired manhole is multi-purposed. It can provide access to the StormTech Isolator row for both inspection and maintenance. The overflow weir with its crest set even with the top of chambers allows stormwater in excess of the Isolator Row's storage/conveyance capacity to bypass into the chamber system through the downstream Eccentric header/manifold system.

Specifying and installing proper geotextiles is essential for efficient operation and to prevent damage to the system during the JetVac maintenance process. A strip of woven geotextile that meets AASHTO M288 Class 1 requirements is required between the chambers and their stone foundation. This strong filter fabric traps sediments and protects the stone base during maintenance. A strip of non-woven AASHTO M288 Class 2 geotextile is draped over the Isolator chamber row. This 6 – 8 oz. non-woven filter fabric prevents sediments from migrating out of the

Figure 7 – StormTech Isolator Row Detail



chambers' perforations while allowing modest amounts of water to flow out of the Isolator Row. **Figure 7** is a detail of the Isolator Row that shows proper application of the geotextiles.

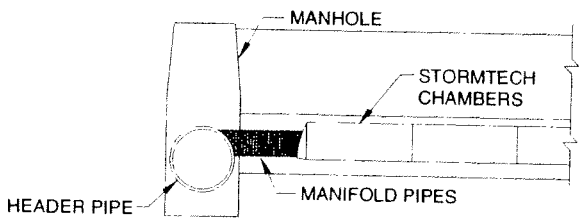
Inspection is easily accomplished through the upstream manhole or optional inspection ports. If specified, inspection ports should be located approximately every tenth chamber along the Isolator row or where practical to facilitate inspection. Maintenance of an Isolator Row is fast and easy using the JetVac process through the upstream manhole. Section 13.0 explains the Inspection and Maintenance process in more detail.

Each SC-740 chamber in an Isolator row will store 45.9 cubic feet of first-flush stormwater. During and between storm events an Isolator Row will allow stormwater to egress at a rate of 0.25 cfs or less per chamber. A bed of StormTech chambers may have multiple Isolator rows to accommodate required first-flush volumes.

6.4 ECCENTRIC HEADER SYSTEM – TREATMENT TIER 3

The third tier of the treatment train is the eccentric header system. This is much like a typical header system except that the inlet pipes are smaller and located at a higher invert than the header pipe. This is accomplished by building the header system with reducer tees installed upside down so a sump is created within the large diameter header pipe as shown in **Figure 8.** A typical eccentric header system might have a 48" header pipe with 18" manifolds creating a 30-inch header sump.

Figure 8 – Typical Eccentric Header System



The upstream end of the eccentric header system will typically be connected directly to the downstream side of the Isolator Row's weired manhole as shown in **Figure 6**. The downstream end of the header pipe may have a riser or manhole to facilitate inspection and maintenance. Pipe companies can provide more detailed information on designing a header system optimized for trapping TSS.

6.5 TREATMENT TRAIN CONCLUSION

The treatment train is a highly effective water-quality approach that does not add significant cost to a StormTech system being installed under commercial parking areas. Some type of pre-treatment device, perhaps as simple as a catchbasin or manhole, is usually required on all stormwater systems. The StormTech Isolator Row adds a significant level of treatment, easy inspection and maintenance, while maintaining storage volume credit for the cost of a modest amount geotextiles. Finally, a pipe header-manifold system is a well recognized component of a chamber inlet system. Inverting the reducer tees creates an eccentric header system that can be easily inspected and maintained. This treatment train concept provides three levels of treatment, inspection and maintenance upstream of the StormTech detention/retention bed with little additional expense.

6.6 OTHER INLET OPTIONS

While the three-tiered treatment train approach is the recommended method of inletting StormTech chambers for typical under-commercial parking application, there are other effective inlet methods that may be considered. For instance, Isolator Rows, while adding an inexpensive level of confidence, are not always necessary. A header system with fewer inlets can be designed to further minimize the cost of a StormTech system. There may be applications where stormwater pre-treatment may not be necessary at all and the system can be inlet directly from the source. In other cases it may make sense to design a system with a treatment device downstream of

6.0 Inlets for Chambers

the StormTech detention system so water can be treated at lower rates prior to releasing from the site. Contact StormTech's Technical Service Department to discuss inlet options.

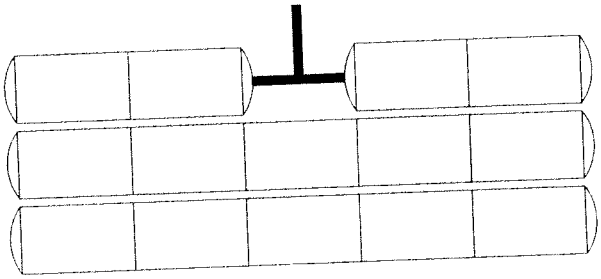
6.7 LATERAL FLOW RATES

The angular stone surrounding the StormTech chambers allows the rapid conveyance of stormwater between chamber rows. Stormwater will rise and fall evenly within a bed of chambers. A single StormTech chamber is able to release or accept stormwater at a rate of at least 0.5 cfs through the surrounding stone.

6.8 INLETTING PERPENDICULAR TO A ROW OF CHAMBERS

There is an easy, inexpensive method to perpendicularly inlet a row of chambers. Simply replace the chamber with a tee where the inlet pipe intersects the row. From the tee, short lengths of pipe may be used to penetrate the endcaps used to terminate the two new openings in the row. **Figure 9** is a typical detail of the perpendicular inlet method.

Figure 9 – Perpendicular Inlet



6.9 MAXIMUM INLET PIPE VELOCITIES TO PREVENT SCOURING OF THE STONE FOUNDATION

This section is applicable to the classic manifold and emergency overflow inlet piping. Isolator Rows are protected from scouring by the woven geotextile.

To prevent scouring of the washed, crushed, angular stone foundation, inlet pipe flow velocities must not exceed those listed in **Table 3**. Flow velocities greater than those listed may cause excess scouring at the inlet water's impact zone, which can be detrimental to the angular stone's performance as a structural foundation. In these cases, scour control measures must be implemented. Simple scour control measures include applying rip-rap, geotextile material or splash dissipators to the inlet water's projected impact zone. Many designers implement scour control measures as a general practice, regardless of flow velocity.

TABLE 3 – Maximum Inlet Velocity in Feet Per Second to Prevent Scouring of an Unprotected 1-inch to 2-inch Angular Stone Foundation.

Inlet Pipe Diameter (in.)	Maximum Inlet Pipe Velocities (feet per second)
4	2.43
6	2.61
8	2.73
10	2.44
12	2.19
15	2.00
18	1.88
24	1.74

TABLE 4 – Some Suitable Geotextiles

Manufacturer	AASHTO M288 Class 2 Non-Woven*	AASHTO M288 Class 1 Woven**
Amoco Fabrics and Fibers (Part of BP)	ProPex 4506 ProPex 4508 ProPex 4551 ProPex 4552 ProPex 4553	ProPex 2006 ProPex 2016 ProPex 2044
Belton Industries	—	Beltech 315 Style 883
Carthage Mills	FX-60HS, FX-80HS	FX-66
Contech Const. Products	C-70NW	—
GSE Lining Technology	NW6, NW8	—
Maccaferri	MacTex MX245 MacTex MX275	—
Mirafi Const. Products	Mirafi 160N Mirafi 180N	Mirafi 600X Filterweave 403 Filterweave 404 Geolon HP570 Geolon HP665 Geolon HP770
Pavco - Amanco	NT 3000, NT 4000	TR 4000
SI Geosolutions	Geotex 601 Geotex 801	Geotex 315ST
TNS Advanced Tech.	R 060, R070 R 080, R100	M 403
US Fabrics	US 205NW-C	US 315
Webtec	TeraTex N06 TeraTex N08	TeraTex HD

*AASHTO M288 Class 2 Non-Woven Geotextile Application: 1. Separation layer between angular stone cover and fill to prevent fines intrusion. 2. Filter layer over the chambers of the Stormtech Isolator™ Row to prevent fines migration out of row while maintaining adequate hydraulic flows.

**AASHTO M288 Class 1 Woven Geotextile Application: Stabilization layer for the angular stone foundation of the StormTech Isolator™ Row to prevent scouring of the stone base during the JetVac maintenance procedure, modest hydraulic flows maintained.

7.0 OUTLETS FOR STORMTECH CHAMBER SYSTEMS

The majority of StormTech installations are detention systems and have some type of outlet structure. The voids in the angular stone surrounding Stormtech's chambers are stormwater's primary source of conveyance within a bed and also a good source of water for outletting a system. Perforated pipe embedded within the stone can be used to tap the collected stormwater.

To drain the system completely, the outlet pipe should be located at or below the bottom of the chamber's angular stone base. Although it's not usually necessary, some beds may be designed with a pitched base to ensure complete drainage of the system. A grade of ½% is usually satisfactory.

An outlet pipe may be located at a higher invert within a bed. This allows a designed volume of water to infiltrate while excess volumes are outlet as necessary. This is an excellent method of recharging groundwater, replicating a site's pre-construction hydraulics.

Depending on the bed layout and inverts, outlet pipes should be placed in the angular stone along the bed's perimeter as shown in **Figures 10** and **11**. Solid outlet pipes may also be used to penetrate the StormTech end caps at the designed outlet invert as shown in **Figure 12**. An Isolator Row should not be directly penetrated with an outlet pipe.

In detention and retention applications the discharge of water from the stormwater management system is determined based on the hydrology of the area and the hydraulic design of the system. It is the design engineer's responsibility to design an outlet system that meets their hydraulic objectives while following local laws and regulations.

Figure 10 – Underdrain Parallel

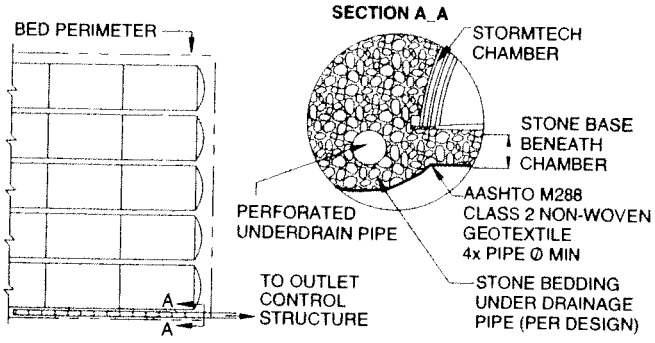


Figure 11 – Underdrain Perpendicular

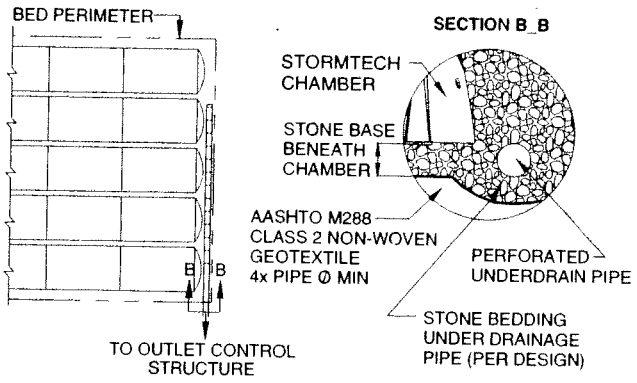
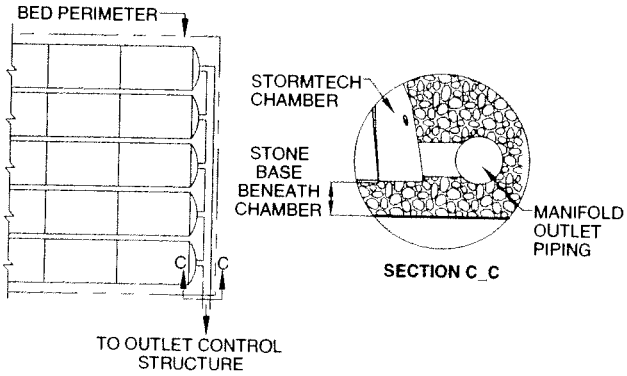


Figure 12 – Outlet Manifold



8.0 Incremental Storage Volumes

Table 5 and **Table 6** provide incremental storage volumes for SC-310 and SC-740 chamber systems. This information may be used to calculate a detention/retention system's stage storage volume.

Product Specifications: 1.1, 2.2, 2.3, 2.4 and 2.6

TABLE 5 – SC-310 Incremental Storage Volumes Per Chamber
Assumes 40% Stone Porosity. Calculations are Based Upon a 6-inch Stone Base Under the Chambers.

Depth of Water in System (in)	Cumulative Chamber Storage (ft^3)	Total System Cumulative Storage (ft^3)
28	↑ 14.70	31.00
27	↑ 14.70	30.21
26	Stone 14.70	29.42
25	Cover 14.70	28.63
24	↓ 14.70	27.84
23	↓ 14.70	27.05
22	14.70	26.26
21	14.64	25.43
20	14.49	24.54
19	14.22	23.58
18	13.68	22.47
17	12.99	21.25
16	12.17	19.97
15	11.25	18.62
14	10.23	17.22
13	9.15	15.78
12	7.99	14.29
11	6.78	12.77
10	5.51	11.22
9	4.19	9.64
8	2.83	8.03
7	1.43	6.40
6	↑ 0	4.74
5	↑ 0	3.95
4	Stone 0	3.16
3	Foundation 0	2.37
2	↓ 0	1.58
1	↓ 0	0.79

Note: Add 0.79 cu. ft. of storage for each additional inch of stone foundation.

TABLE 6 – SC-740 Incremental Storage Volumes Per Chamber
Assumes 40% Stone Porosity. Calculations are Based Upon a 6-inch Stone Base Under the Chambers.

Depth of Water in System (in)	Cumulative Chamber Storage (ft^3)	Total System Cumulative Storage (ft^3)
42	↑ 45.90	74.90
41	↑ 45.90	73.77
40	Stone 45.90	72.64
39	Cover 45.90	71.52
38	↓ 45.90	70.39
37	↓ 45.90	69.26
36	45.90	68.14
35	45.85	66.98
34	45.69	65.75
33	45.41	64.46
32	44.81	62.97
31	44.01	61.36
30	43.06	59.66
29	41.98	57.89
28	40.80	56.05
27	39.54	54.17
26	38.18	52.23
25	36.74	50.23
24	35.22	48.19
23	33.64	46.11
22	31.99	44.00
21	30.29	41.85
20	28.54	39.67
19	26.74	37.47
18	24.89	35.23
17	23.00	32.96
16	21.06	30.68
15	19.09	28.36
14	17.08	26.03
13	15.04	23.68
12	12.97	21.31
11	10.87	18.92
10	8.74	16.51
9	6.58	14.09
8	4.41	11.66
7	2.21	9.21
6	↑ 0	6.76
5	↑ 0	5.63
4	Stone 0	4.51
3	Foundation 0	3.38
2	↓ 0	2.25
1	↓ 0	1.13

Note: Add 1.13 cu. ft. of storage for each additional inch of stone foundation.

9.0 Design Considerations

StormTech

9.1 EROSION CONTROL

Erosion and sediment control measures must be integrated into the plan to protect the stormwater system both during and after construction. These practices may have a direct impact on the system's infiltration performance and longevity. Vegetation, temporary sediment barriers (silt fences, hay bales, fabric-wrapped catch basin grates), and strategic stormwater runoff management may be used to control erosion and sedimentation.

9.2 SITE IMPROVEMENT TECHNIQUES

When site conditions are less than optimal, StormTech recognizes many methods for improving a site for construction. Some techniques include the removal and replacement of poor materials, the use of engineered subgrade materials, aggregates, chemical treatment, and mechanical treatments including the use of geosynthetics. StormTech recommends referring to AASHTO M-288 guidelines for the appropriate use of geotextiles.

StormTech also recognizes geogrid as a potential component of an engineered solution to improve site conditions or as a construction tool for the experienced contractor. StormTech chamber systems are compatible with the use of geosynthetics. The use of geosynthetics or any other site improvement method does not eliminate or modify any of StormTech's requirements. **It is the ultimate responsibility of the project engineer to ensure that site conditions are suitable for a StormTech chamber system.**

9.3 COLD TEMPERATURE PERFORMANCE

When designing drainage systems for cold temperature environments, several factors must be considered including frozen sub-grade soils, frost heaves, ice expansion, and surface pond hazards.

Many types of frozen sub-grade soils can prevent or restrict stormwater infiltrative rates. This is only a concern for retention systems located within the frost zone. An emergency overflow outlet is a simple method to address the rare occasion when frozen ground and excessive rains combine.

Ice expansion and frost heaves may destroy rigid drainage structures such as those manufactured from concrete. StormTech's plastic chambers have the designed-in flexibility to withstand expansion and heave forces.

Surface ponds can present many hazards including the dangers associated with thin ice. Stormwater detention/retention systems placed underground can eliminate this concern, while insulating stormwater and subgrade soils from freezing surface temperatures.

10.0 System Sizing

For quick calculations, refer to the Materials Worksheet on StormTech's website at **www.stormtech.com**.

10.1 SYSTEM SIZING

The following steps provide the calculations necessary to size a system. The worksheet on page 17 itemizes these calculations and costs. If you need assistance determining the number of chambers per row or customizing the bed configuration to fit a specific site, call StormTech's Technical Services Department at **1-888-892-2694.**

1) Determine the amount of storage volume (V_S) required.

It is the design engineer's sole responsibility to determine the storage volume required by local codes.

TABLE 7 – Storage Volume Per Chamber

	Bare Chamber Storage	Chamber and Stone Stone Foundation Depth		
		6"	12"	18"
StormTech SC-740	45.9	74.9	81.7	88.4
StormTech SC-310	14.7	31.0	35.7	40.4

Note: Storage volumes are in cubic feet per chamber. Assumes 40% porosity for the stone plus the chamber volume.

2) Determine the number of chambers (C) required.

To calculate the number of chambers needed for adequate storage, divide the storage volume (Vs) by the volume of the selected chamber, as follows:
C = Vs / Volume per Chamber

3) Determine the required bed size (S).

To find the size of the bed, multiply the number of chambers needed (C) by either:
StormTech SC-740 bed area per chamber = 33.8 ft²
StormTech SC-310 bed area per chamber = 23.7 ft²
S = (C x bed area per chamber) + (1 foot x bed perimeter in feet)

NOTE: It is necessary to add one foot around the perimeter of the bed for end caps and working space.

4) Determine the amount of stone (Vst) required.

TABLE 8 – Amount of Stone Per Chamber in Tons

	Stone Foundation Depth		
	6"	12"	18"
StormTech SC-740	3.8 (2.8 yd³)	4.6 (3.3 yd³)	5.5 (3.9 yd³)
StormTech SC-310	2.1 (1.5 yd³)	2.7 (1.9 yd³)	3.4 (2.4 yd³)

Note: Assumes 6 inches of stone above, and between chambers.

To calculate the total amount of washed, crushed angular stone required, multiply the number of chambers (c) by the selected tons of stone from **Table 8.**
NOTE: Washed, crushed angular stone is also required around the perimeter of the system.

5) Determine the volume of excavation (Ex) required.
6) Determine the area of filter fabric (F) required.

TABLE 9 – Volume of Excavation Per Chamber

	Stone Foundation Depth		
	6"	12"	18"
StormTech SC-740	5.5	6.2	6.8
StormTech SC-310	2.9	3.4	3.8

Note: Volumes are in cubic yards per chamber. Assumes 6 inches of separation between chamber rows and 18 inches of cover. The volume of excavation will vary as the depth of the cover increases.

Each additional foot of cover will add a volume of excavation of 1.3 cu. yds. per SC-740 and 0.9 cu. yds. per SC-310 chamber.

The bottom and sides of the bed and the top of the angular stone must be covered with a non-woven geotextile (filter fabric) that meets AASHTO M288 Class 2 requirement. The area of the sidewalls must be calculated and a 2-foot overlap must be included where two pieces of filter fabric are placed side-by-side or end-to-end. Geotextiles typically come in 15 foot wide rolls.

7) Determine the number of end caps (E_C) required.

Each row of chambers requires two end caps.
E_C = number of rows x 2

13.0 Inspection and Maintenance

13.1 TREATMENT TRAIN INSPECTION AND MAINTENANCE

The StormTech recommended treatment train inlet system has three tiers of treatment upstream of the StormTech chambers. It is recommended that inspection and maintenance (I&M) be initiated at the furthest upstream treatment tier and continue downstream as necessary. The following I&M procedures follow this approach providing I&M information in the following order: Tier 1 – Pretreatment (BMP); Tier 2 – StormTech Isolator Row, and ; Tier 3 – Eccentric Pipe Header System.

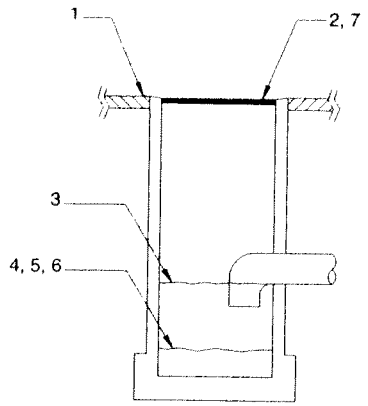
13.2 CATCHBASIN/MANHOLE I&M

Typically a stormwater system will have catchbasins and manholes upstream of the detention/retention system. In some cases these may be the only pre-treatment devices. Regular I&M of catchbasins and manholes should be scheduled and performed as part of a site's routine maintenance plan.

Catchbasin/Manhole – Step-by-Step Maintenance Procedures

1) Inspect catch basins and manholes upstream of StormTech chambers for sediment
2) Remove grate or cover
3) Skim off oils and floatables
4) Using a stadia rod, measure the depth of sediment
5) If sediment is at a depth greater than 6" proceed to step 6. If not proceed to step 7.
6) Vacuum or manually remove sediment
7) Replace grate
8) Record depth & date and schedule next inspection

Figure 17 – Catchbasin/Manhole I&M Steps



13.3 PRE-TREATMENT DEVICE I&M

Manufacturer's I&M procedures should be followed for proprietary pretreatment devices such as baffle boxes, swirl concentrators, oil-water separators, and filtration units. **Table 10** provides some general guidelines but is not a substitute for a manufacturer's specific instructions.

TABLE 10 – Pretreatment Inspection and Maintenance Guidelines

SEDIMENT CONTROL INSPECTION	INSPECTION*	MAINTENANCE**
StormTech Isolator™ Row	Bi-Annually	JetVac - Culvert Cleaning Nozzle Preferred
Sediment Basin	Quarterly or after large storm event	Excavate sediment
Catch Basin Sump	Quarterly	Excavate,pump, or vacuum
Sedimentation Structure	Quarterly	Excavate,pump, or vacuum
Catch Basin Filter Bags	After all storm events	Clean and/or replace filter bags
Porous Pavement	Quarterly	Sweep Pavement
Pipe Header Design	Quarterly	Excavate,pump, or vacuum
Water Quality Inlet	Quarterly	Excavate,pump, or vacuum
Sand Filters	Quarterly or after storm event	Remove & replace sand filter

** This schedule does not account for regional or site variables. Local municipal guidelines should be followed for inspection when available.*

*** The methods stated are minimum guidelines for removal and cleaning of system. Other methods may apply.*

13.0 Inspection & Maintenance

13.4 ISOLATOR™ ROW INSPECTION

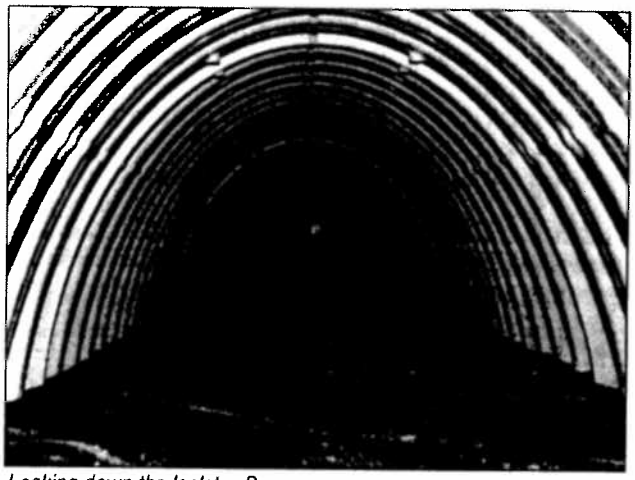
Regular inspection and maintenance are essential to assure a properly functioning stormwater system. Inspection is easily accomplished through the manhole or optional inspection ports of an Isolator Row. Please follow local and OSHA rules for a confined space entry.

Inspection ports can allow inspection to be accomplished completely from the surface without the need for a confined space entry. Inspection ports provide visual access to the system with the use of a flashlight. A stadia rod may be inserted to determine the depth of sediment. If upon visual inspection it is found that sediment has accumulated to an average depth exceeding 3 inches, cleanout is required.

A StormTech Isolator Row should initially be inspected immediately after completion of the site's construction. While every effort should be made to prevent sediment from entering the system during construction, it is during this time that excess amounts of sediments are most likely to enter any stormwater system. Inspection and maintenance, if necessary, should be performed prior to passing responsibility over to the site's owner. Once in normal service, a StormTech Isolator Row should be inspected bi-annually until an understanding of the sites characteristics is developed. The site's maintenance manager can then revise the inspection schedule based on experience or local requirements.

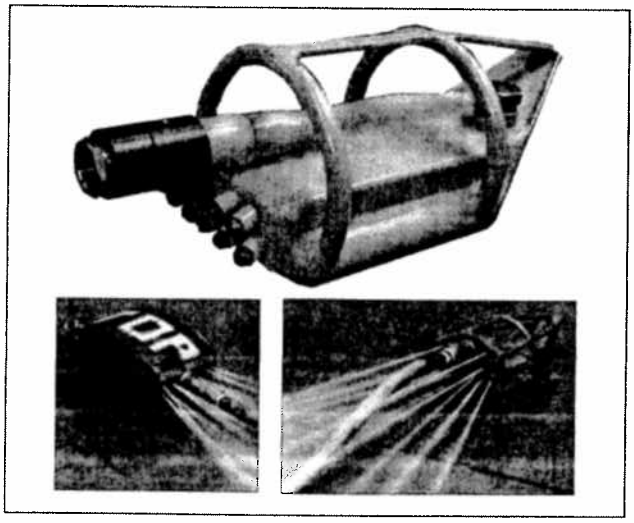
13.5 ISOLATOR ROW MAINTENANCE

JetVac maintenance is required if sediment has been collected to an average depth of 3 inches or more inside the Isolator Row. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, a wave of suspended sediments is flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have a minimum of 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. The JetVac process shall only be performed on StormTech Rows that have AASHTO class 1 woven geotextile over their angular base stone.



Looking down the Isolator Row.

A typical JetVac truck. (This is not a StormTech product.)



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

STORMTECH ISOLATOR™ ROW - STEP-BY-STEP MAINTENANCE PROCEDURES

Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

i. Remove cover from manhole at upstream end of Isolator Row

ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry

2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process

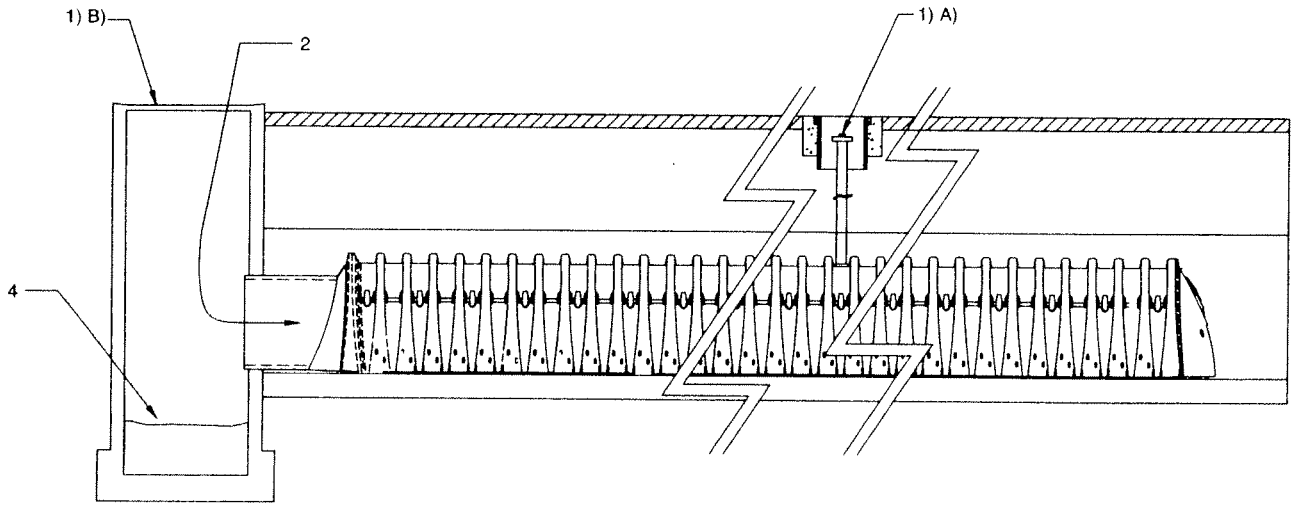
A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable
B) Apply multiple passes of JetVac until backflush water is clean
C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system following the procedures for Classic Manifold Inlet System

Figure 18

StormTech Isolator Row (not to scale)



13.0 Inspection & Maintenance

13.6 ECCENTRIC PIPE HEADER INSPECTION

Theses guidelines do not supercede a pipe manufacturer's recommended I&M procedures. Consult with the manufacturer of the pipe header system for specific I&M procedures. Inspection of the header system should be carried out quarterly. On sites which generate higher levels of sediment more frequent inspections may be necessary. Headers may be accessed through risers, access ports or manholes. Measurement of sediment may be taken with a stadia rod or similar device. Clean-out of sediment should occur when the sediment volume has reduced the storage area by 25% or the depth of sediment has reached approximately 25% of the diameter of the structure.

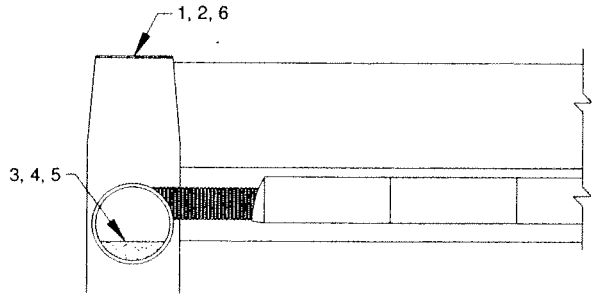
13.7 ECCENTRIC PIPE HEADER MAINTENANCE

Cleanout of accumulated material should be accomplished by vacuum pumping the material from the header. Cleanout should be accomplished during dry weather. Care should be taken to avoid flushing sediments out through the outlet pipes and into the chamber rows.

Eccentric Header Step-by-Step Maintenance Procedures

1. Locate manholes, access ports or risers connected to the header system
2. Remove grates or covers
3. Using a stadia rod, measure the depth of sediment
4. If sediment is at a depth of about 25% pipe volume or 25% pipe diameter proceed to step 5. If not proceed to step 6.
5. Vacuum pump the sediment. Do not flush sediment out inlet pipes.
6. Replace grates and covers
7. Record depth & date and schedule next inspection

Figure 19 – Manifold Maintenance



14.0 General Notes

StormTech

1. StormTech LLC ("StormTech") requires installing contractors to use and understand StormTech's latest Installation Instructions prior to beginning system installation.

2. Our Technical Services Department offers installation consultations to installing contractors. Contact our Technical Service Representatives at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can then answer questions or address comments on the StormTech chamber system and inform the Installing contractor of the minimum installation requirements before beginning the system's construction. Call **1-888-892-2694** to speak to a Technical Service Representative or visit **www.stormtech.com** to receive a copy of our Installation Instructions.

3. StormTech's requirements for systems with pavement design (asphalt, concrete pavers, etc.): Minimum cover is 18 inches not including pavement; Maximum cover is 96 inches including pavement design. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is 24 inches, maximum cover is 96 inches.

4. The contractor must report any discrepancies with the bearing capacity of the chamber foundation materials to the design engineer.

5. AASHTO M288 Class 2 non-woven geotextile (filter fabric) must be used as indicated in the project plans.

6. Stone placement between chamber rows and around perimeter must follow instructions as indicated in the most current version of StormTech's Installation Instructions.

7. Backfilling over the chambers must follow requirements as indicated in the most current version of StormTech's Installation Instructions.

8. The contractor must refer to StormTech's Installation Instructions for a Table of Acceptable Vehicle Loads at various depths of cover. This information is also available at StormTech's website: **www.stormtech.com.** The contractor is responsible for preventing vehicles that exceed StormTech's requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.

9. The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.

10. StormTech product warranty is limited. See current Product Warranty for details. To acquire a copy call StormTech at **1-888-892-2694** or visit **www.stormtech.com.**

15.0 StormTech Product Specifications

1.0 GENERAL

1.1 StormTech chambers are designed to control stormwater runoff. As a subsurface retention system, StormTech chambers retain and allow effective infiltration of water into the soil. As a subsurface detention system, StormTech chambers detain and allow for the metered flow of water to an outfall.

2.0 CHAMBER PARAMETERS

2.1 The Chamber shall be injection molded of Polypropylene resin to be inherently resistant to environmental stress cracking (ESCR), and to maintain adequate stiffness through higher temperatures experienced during installation and service.

2.2 The nominal chamber dimensions of the StormTech SC-740 shall be 30.0 inches tall, 51.0 inches wide and 90.7 inches long. The nominal chamber dimensions of the StormTech SC-310 shall be 16.0 inches tall, 34.0 inches wide and 90.7 inches long. The installed length of a joined chamber shall be 85.4 inches.

2.3 The chamber shall have a continuously curved section profile.

2.4 The chamber shall be open-bottomed.

2.5 The chamber shall incorporate an overlapping corrugation joint system to allow chamber rows of almost any length to be created. The overlapping corrugation joint system shall be effective while allowing a chamber to be trimmed to shorten its overall length.

2.6 The nominal storage volume of a joined StormTech SC-740 chamber shall be 74.9 cubic feet per chamber when installed per StormTech's typical details (includes the volume of crushed angular stone with an assumed 40% porosity). This equates to 2.2 cubic feet of storage/square foot of bed. The nominal storage volume of an installed StormTech SC-310 chamber shall be 31.0 cubic feet per chamber when installed per StormTech's typical details (includes the volume of crushed angular stone with an assumed 40% porosity). This equates to 1.3 cubic feet of storage/square foot of bed.

2.7 The chamber shall have forty-eight orifices penetrating the sidewalls to allow for lateral conveyance of water.

2.8 The chamber shall have two orifices near its top to allow for equalization of air pressure between its interior and exterior.

2.9 The chamber shall have both of its ends open to allow for unimpeded hydraulic flows and visual inspections down a row's entire length.

2.10 The chamber shall have 14 corrugations.

2.11 The chamber shall have a circular, indented, flat surface on the top of the chamber for an optional 4-inch inspection port or clean-out.

2.12 The chamber shall be analyzed and designed using AASHTO methods for thermoplastic culverts contained in the LRFD Bridge Design Specifications, 2nd Edition, including Interim Specifications through 2001. Design live load shall be the AASHTO HS20 truck. Design shall consider earth and live loads as appropriate for the minimum to maximum specified depth of fill.

2.13 The chamber shall be manufactured in an ISO 9001:2000 certified facility.

3.0 END CAP PARAMETERS

3.1 The end cap shall be injection molded of Polypropylene resin to be inherently resistant to environmental stress cracking, and to maintain adequate stiffness through higher temperatures experienced during installation and service.

3.2 The end cap shall be designed to fit into any corrugation of a chamber, which allows: capping a chamber that has its length trimmed; segmenting rows into storage basins of various lengths.

3.3 The end cap shall have saw guides to allow easy cutting for various diameters of pipe that may be used to inlet the system.

3.4 The end cap shall have excess structural adequacies to allow cutting an orifice of any size at any invert elevation.

3.5 The primary face of an end cap shall be curved outward to resist horizontal loads generated near the edges of beds.

3.6 The end cap shall be manufactured in an ISO 9001:2000 certified facility.

16.0 Standard Limited Warranty

StormTech

STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

(A) This Limited Warranty applies solely to the StormTech chambers and end plates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and end plates are collectively referred to as the "Products."

(B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.

(C) **THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

(D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. **UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.**

(E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.

(F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.

(G) **THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLECT; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.**

StormTech
Detention • Retention • Recharge
Subsurface Stormwater Management℠
20 Beaver Road, Suite 104 | Wethersfield | Connecticut | 06109
860.529.8188 | 888.892.2694 | fax 866.328.8401 | www.stormtech.com

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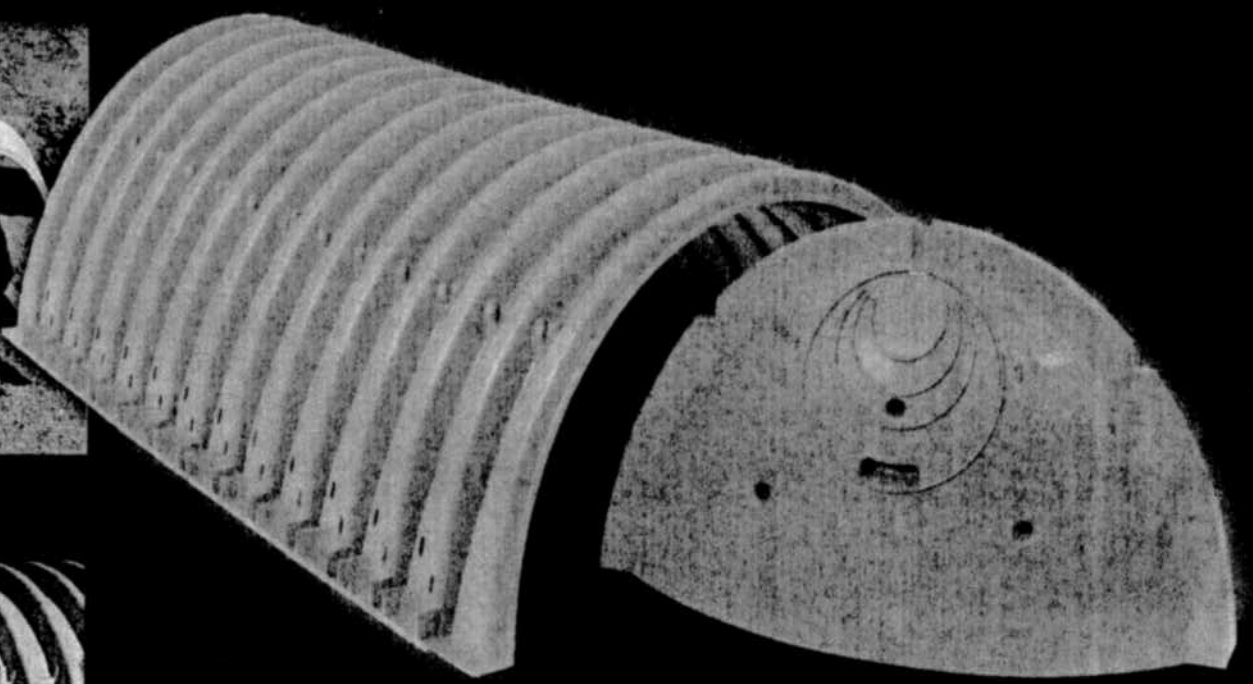
Product Catalog

Underground Stormwater Chambers



Save Valuable Land and Protect Water Resources℠

StormTech®

Detention • Retention • Recharge

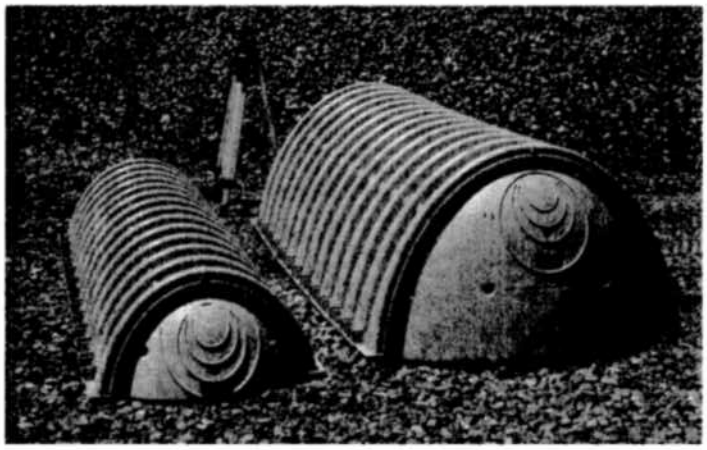
Subsurface Stormwater Management℠

StormTech® Subsurface Stormwater Management

The advanced design of StormTech's chambers allows stormwater professionals to create more profitable, environmentally sound installations. Compared with other subsurface systems, StormTech's innovative chambers offer lower overall installed costs, superior design flexibility and enhanced long-term performance.

Superior Design Flexibility for Optimal Land Use

StormTech chambers are ideal for commercial, municipal and residential applications. One of the key advantages of the StormTech chamber system is design flexibility. StormTech chambers can be configured into beds or trenches, in centralized or decentralized layouts to fit on nearly any site.



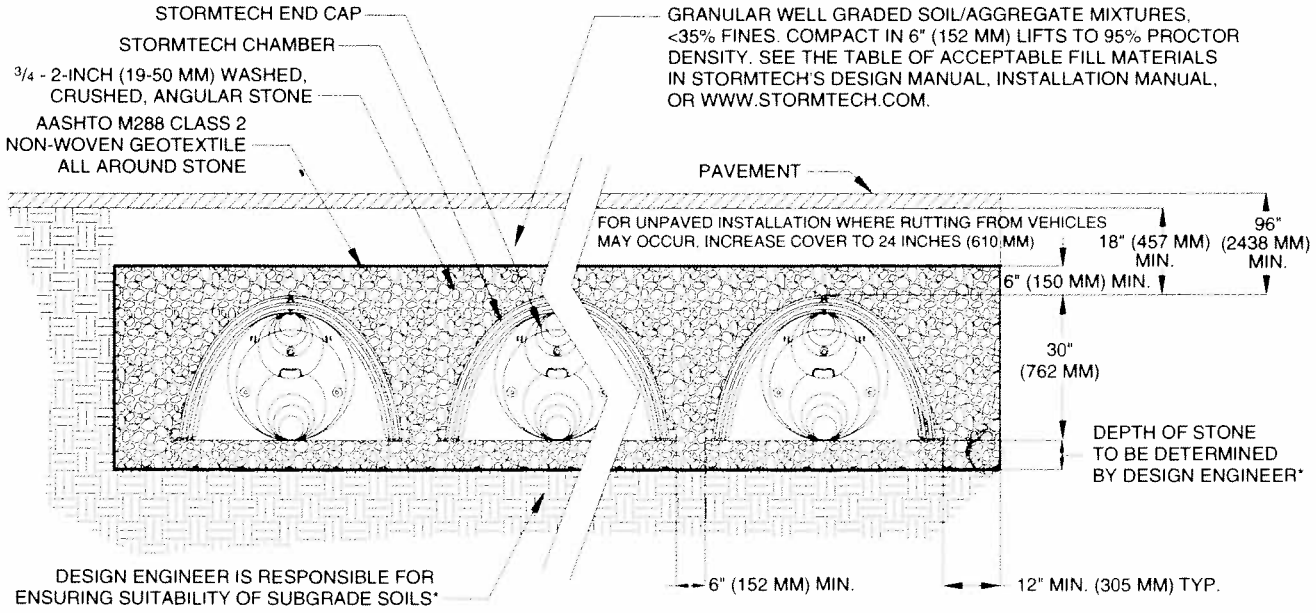
L to R: SC-310 chamber and SC-740 chamber

Product Features and Benefits

The advanced features and innovative technology of StormTech chambers streamline installations while lowering overall installed costs. StormTech chambers offer these unique advantages:

- Lightweight, two people can install chambers quickly and easily, saving time and money
- Extensive product research & development and rigorous testing ensure long term reliability and performance
- Versatile product design accommodates a wide range of site constraints with cost-effective system designs
- The chamber length can be cut in 6.5" (165 mm) increments – reducing waste and optimizing the use of available space
- Injection molded polypropylene ensures precise control of wall thickness and product consistency
- Isolator Row – a patent pending technique to inexpensively enhance total suspended solids (TSS) removal and provide easy access for inspection and maintenance
- Corrugated Arch Design – a proven geometry for structural integrity under H-20 live loads and deep burial loads, also provides high storage capacity

Typical Cross Section Detail (not to scale)



Detention-Retention-Recharge

The StormTech SC-740 chamber optimizes storage volumes in relatively small footprints by providing 2.2 ft³/ft² (0.67 m³/m²) (minimum) of storage. This can decrease excavation, backfill and associated costs. The StormTech SC-310 chamber is ideal for systems requiring low-rise and wide-span solutions. The chamber allows the storage of large volumes, 1.3 ft³/ft² (0.4 m³/m²) (minimum), at minimum depths.

StormTech SC-740 Chamber
(not to scale)

Nominal Chamber Specifications

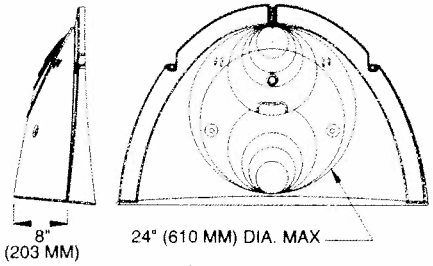
Size (L x W x H)
85.4" x 51.0" x 30.0"
(2169 x 1295 x 762 mm)

Chamber Storage
45.9 ft³ (1.30 m³)

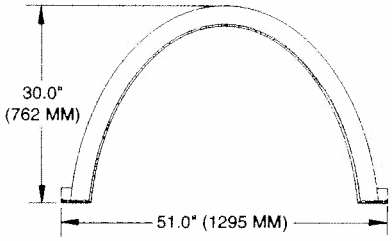
Minimum Installed Storage*
74.9 ft³ (2.12 m³)

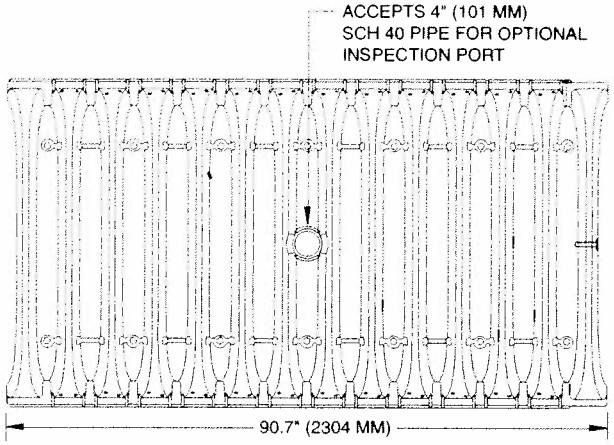
Weight
74.0 lbs (33.6 kg)

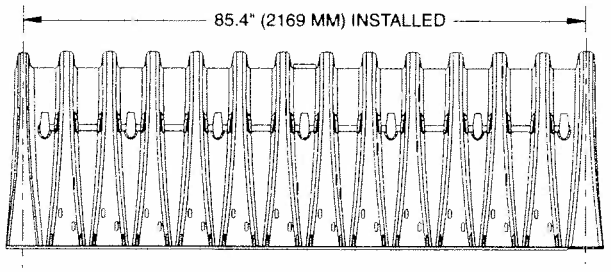
Shipping
30 chambers/pallet
60 end caps/pallet
12 pallets/truck



SC-740 end cap







SC-740 chamber

StormTech SC-310 Chamber
(not to scale)

Nominal Chamber Specifications

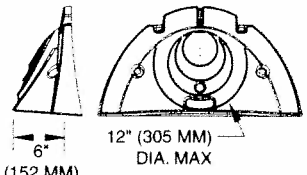
Size (L x W x H)
85.4" x 34.0" x 16.0"
(2169 x 864 x 406 mm)

Chamber Storage
14.7 ft³ (0.42 m³)

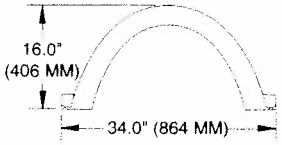
Minimum Installed Storage*
31.0 ft³ (0.88 m³)

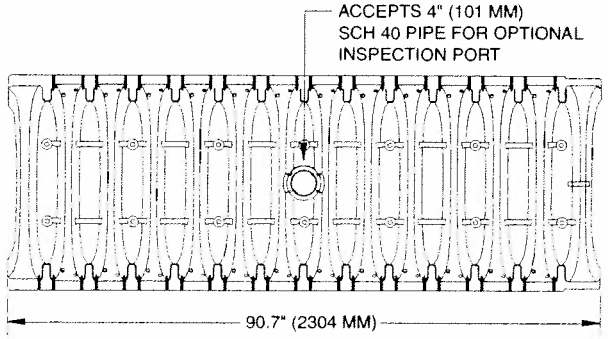
Weight
37.0 lbs (16.8 kg)

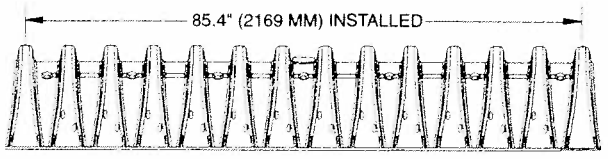
Shipping
41 chambers/pallet
108 end caps/pallet
18 pallets/truck



SC-310 end cap







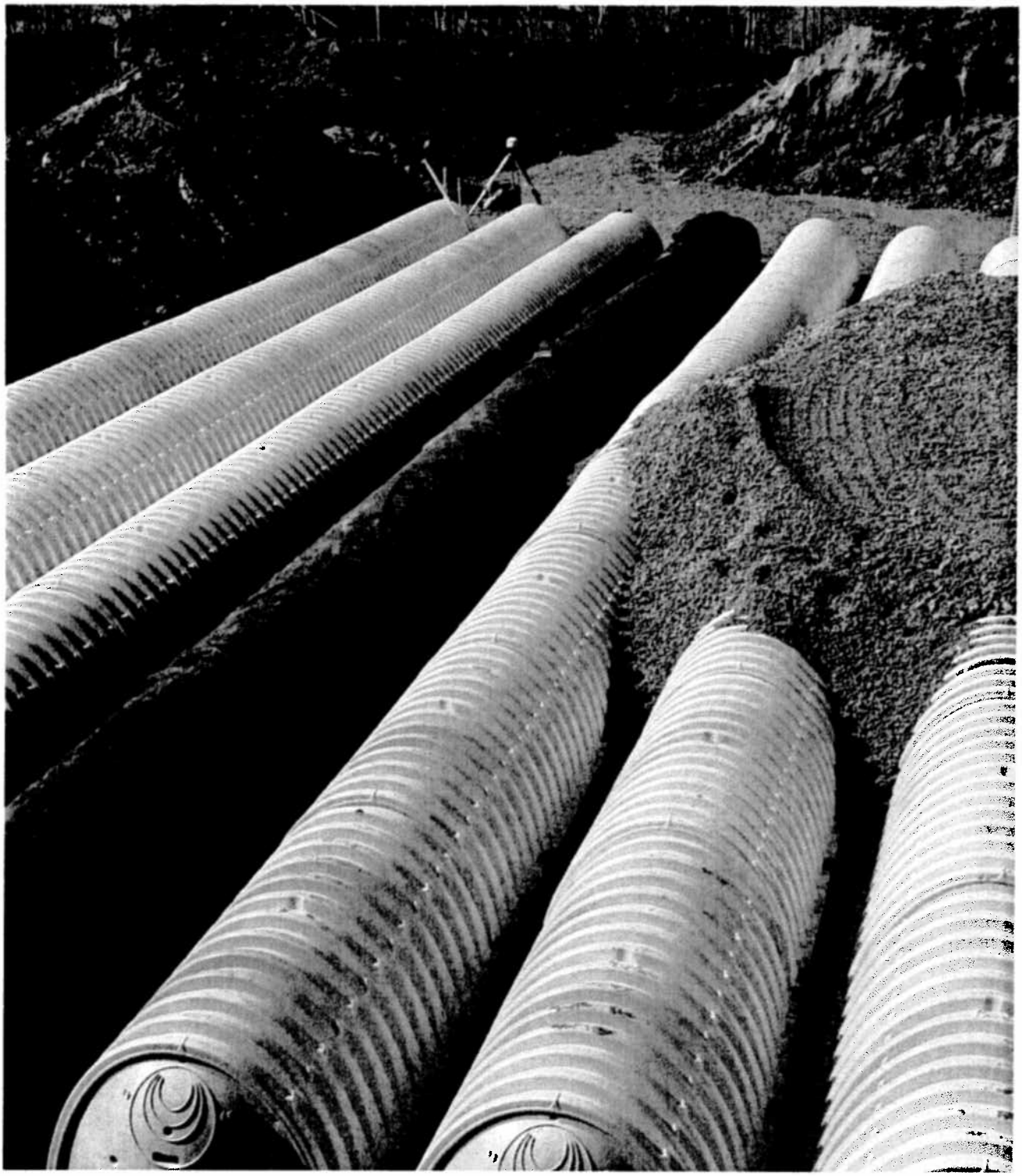
SC-310 chamber

*This assumes a minimum of 6 inches (152 mm) of stone below, above and between chamber rows.

StormTech®

Detention • Retention • Recharge

Subsurface Stormwater Management℠



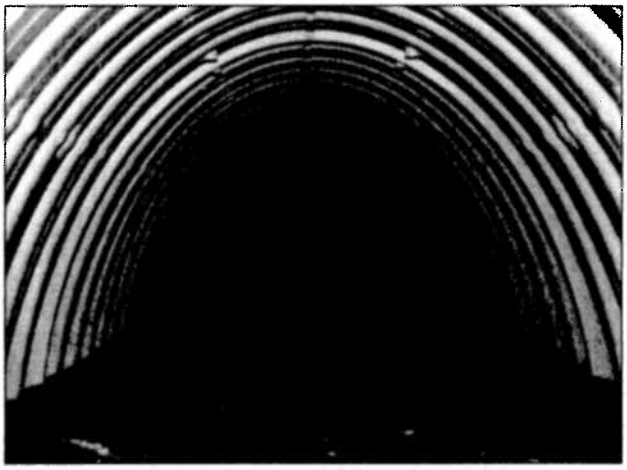
Isolator™ Row O&M Manual

StormTech® Chamber System for Stormwater Management

1.0 The Isolator™ Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patent pending technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.



Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR™ ROW

The Isolator Row is a row of StormTech chambers, either SC-740 or SC-310 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

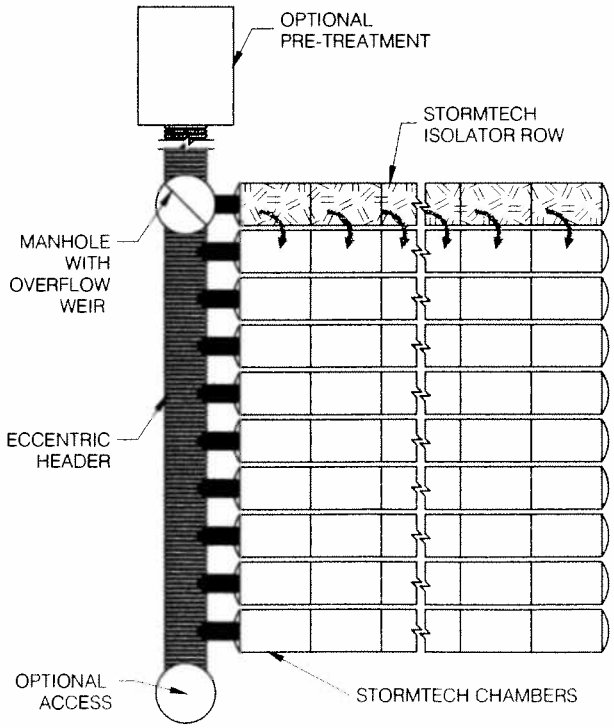
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

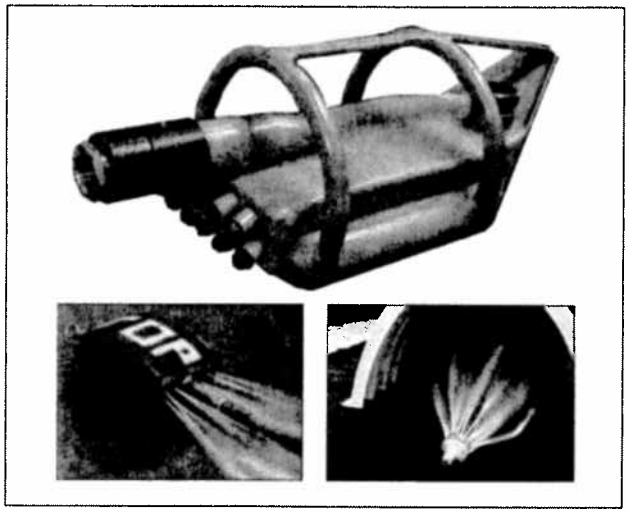
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

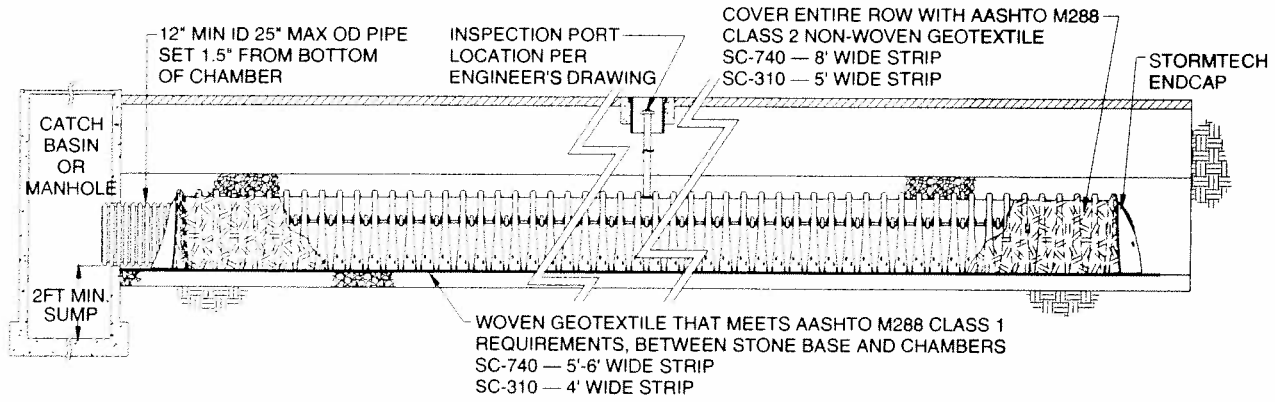
The Isolator Row was designed to reduce the cost of periodic maintenance. By "isolating" sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45" are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

StormTech Isolator Row (not to scale)



3.0 Isolator Row Step By Step Maintenance Procedures

Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

i. Remove cover from manhole at upstream end of Isolator Row

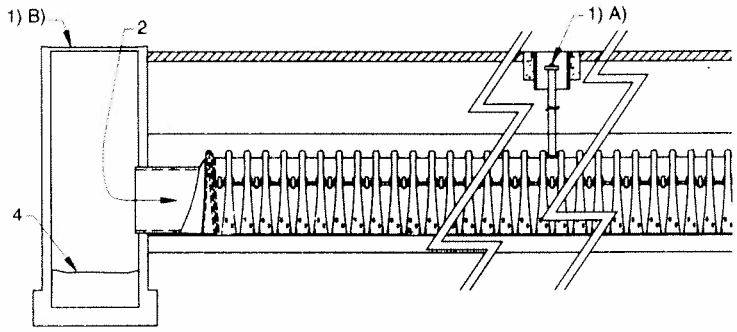
ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry

2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

StormTech Isolator Row (not to scale)



Step 2) Clean out Isolator Row using the JetVac process

A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable

B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings		Sediment Depth (1) - (2)	Observations/Actions	Inspector
	Fixed point to chamber bottom (1)	Fixed point to top of sediment (2)			
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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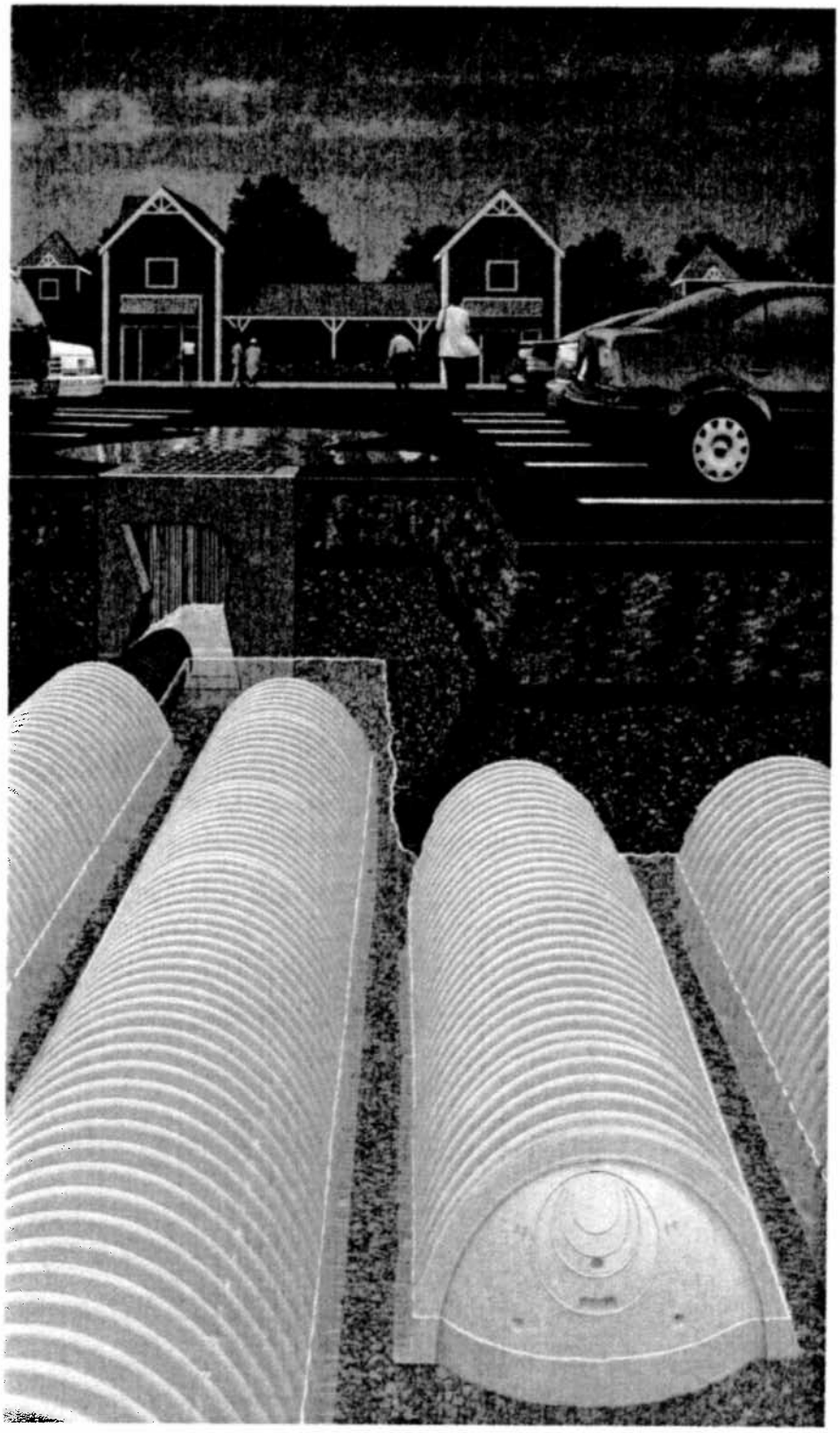
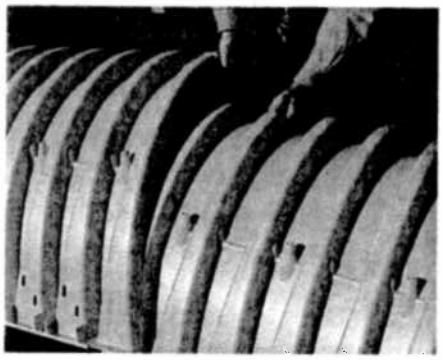
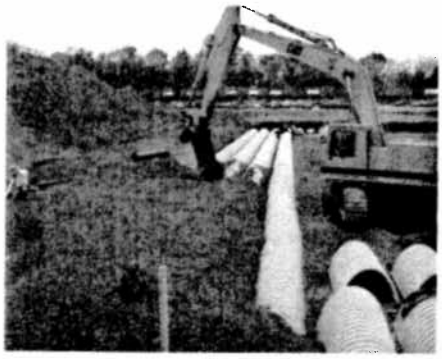






Installation Instructions

StormTech® Chamber System for Stormwater Management

Before You Begin

REQUIRED MATERIALS AND EQUIPMENT LIST

- Acceptable 3/4 inch – 2 inch washed, crushed, angular stone per **Tables 4 & 5** on page 10
- Acceptable fill materials per **Table 5** on page 10
- Filter fabric
- StormTech end caps
- StormTech chambers
- Reciprocating saw or router (to custom cut end cap holes)
- OSHA compliance
- Stone bucket
- Tracked excavator
- Transit or laser
- Vibratory roller with maximum gross vehicle weight of 12,000 lbs and a maximum dynamic force of 20,000 lbs

Requirements for System Installation

1 StormTech LLC requires installing contractors to use and understand StormTech's most current installation instructions prior to beginning system installation.

All illustrations and photographs are examples of typical situations. Actual designs may vary. Be sure to follow the engineer's drawings.

2 StormTech offers installation consultations to installing contractors. Contact StormTech at least 30 days prior to system installation to arrange a pre-installation consultation. Our representatives can answer questions, address comments and provide information about the StormTech chamber system's installation requirements. Call **1-888-892-2694** or visit **www.stormtech.com** to receive the most current version of our installation instructions.

3 Contact local underground utility companies prior to construction.

4 All StormTech system designs must be certified by a registered professional engineer.

5 StormTech's requirements for systems with a pavement design (asphalt, concrete pavers, etc.): Minimum cover is 18 inches not including pavement; maximum cover is 96 inches including pavement design. For installations that do not include pavement, where rutting from vehicles may occur, minimum required cover is 24 inches, maximum cover is 96 inches.

6 The contractor must report any discrepancies with the system subgrade soil's bearing capacity to the design engineer.

7 Check chambers for shipping damage prior to installation. Units that have been damaged must not be installed. Contact StormTech immediately upon discovery of any damage.

8 Filter fabric must be used as indicated in the engineer's drawings.

9 To maintain row separation distances and prevent chamber displacement, place stone between chamber rows and around perimeter as required by the most current version of StormTech's Installation Instructions.

10 Backfilling of the chamber system must be in accordance with the most current version of StormTech's Installation Instructions.

11 The contractor must refer to StormTech's Installation Instructions for Tables of Acceptable Vehicle Loads at various depths of cover. This information is also available at **www.stormtech.com**. The contractor is responsible for preventing vehicles that exceed StormTech's requirements from traveling across or parking over the stormwater system. Temporary fencing, warning tape and appropriately located signs are commonly used to prevent unauthorized vehicles from entering sensitive construction areas.

12 The contractor must apply erosion and sediment control measures to protect the stormwater system during all phases of site construction per local codes and design engineer's specifications.

Requirements for System Installation

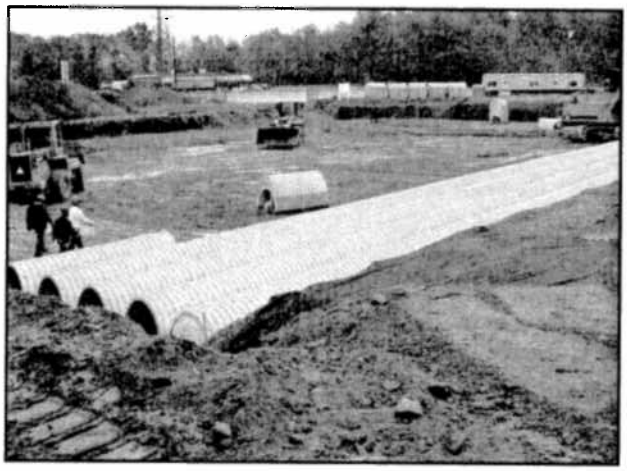
StormTech

13 StormTech products must be designed and installed in accordance with StormTech's minimum requirements. Failure to do so will void the limited warranty.

14 StormTech product warranty is limited. See current product warranty for details. To acquire a copy call StormTech at **1-888-892-2694** or visit **www.stormtech.com.**

15 For installation instructions for any additional structures or fittings not covered in these instructions, contact StormTech at 888-892-2694.

Requirements for Excavating and Preparing the Site



Left side of bed being prepared while right side is concurrently installed.

Filter fabric and underdrains installed.

1 Excavate and level the designated area. Be sure to excavate at least one extra foot around the perimeter to allow for proper fit and adequate compaction.

2 Excavation must be free of standing water. Dewatering measures must be taken if required. Positive drainage of the excavation must be maintained.

3 Prepare the chamber bed's subgrade soil as outlined in the engineer's drawings.

4 Place AASHTO M288 Class 2 non-woven filter fabric over the prepared subgrade soils. **Table 3** lists suitable geotextiles. The filter fabric must overlap at least 2 feet where the edges of the fabric meet.

5 Place AASHTO M288 Class 2 non-woven filter fabric around the perimeter of the excavated bed as specified in the engineering drawings.
NOTE: (Fabric is required over the top of the entire chamber system after the 6" of stone is placed over chambers.)

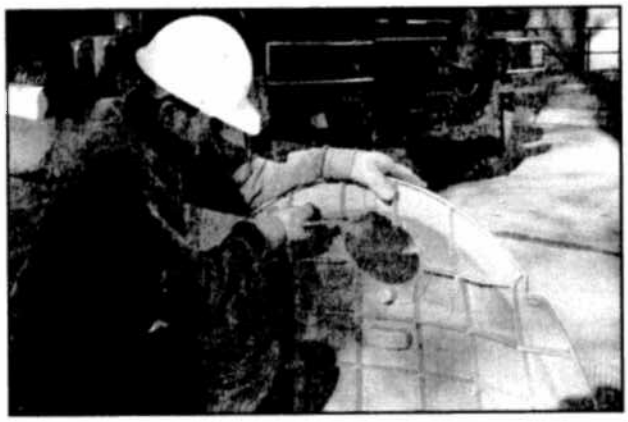
6 Perforated pipe outlet underdrains may be designed within the one foot stone perimeter. Install perforated pipe outlet underdrains as required by the engineer's drawings.

7 Place acceptable 3/4 - 2 inch washed, crushed, angular stone foundation material over the entire bottom surface of the bed (see **Tables 4 & 5** for stone requirements). Refer to the engineer's drawings for subgrade soil preparation and required stone foundation thickness.

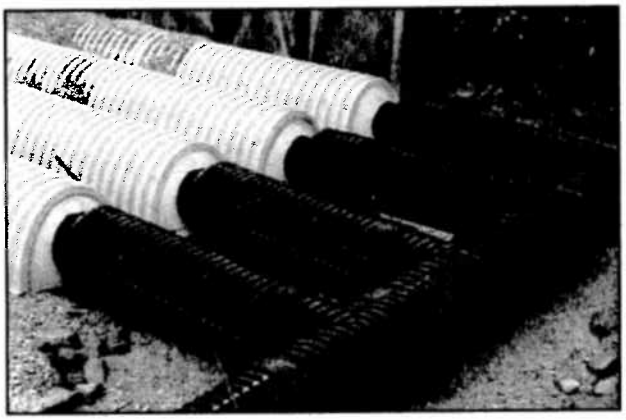
8 Compact the stone using a vibratory roller with its full dynamic force applied to achieve a flat surface.

Requirements for Assembling Inlet Pipes

NOTE: Depending on the system's design, it may be advantageous to lay out the inlet and outlet pipe systems prior to forming the bed of chambers.



Cut an opening for the distribution pipe.



24"- 18" reducers installed to stay within the 25" maximum OD limit for the SC-740.

1 Temporarily layout the header/manifold system according to the engineer's drawings.

2 Stone foundation scour control measures such as splash pads, riprap, or geotextiles may be required by the design engineer. Locate and install scour control measures per engineer's drawings if required.

3 Set first chamber of each row aligned with their inlet pipes if applicable. A minimum 6 inch* clear spacing, measured between feet, is required between adjacent rows. Separate chambers and inlet fittings as necessary to maintain 6 inch clear space between chamber rows.

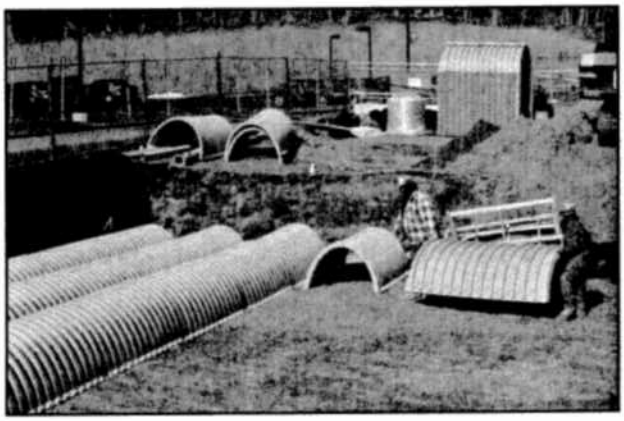
4 With a reciprocating saw, cut an opening for the inlet piping in the applicable endcaps at the specified invert height.
NOTE: Inlet pipe openings may be cut anywhere on an endcap. To do this, take a short length of pipe and use a marker to draw an outline of the pipe on the endcap at the correct height.

5 Insert the distribution pipes into the endcaps.

6 Once chamber spacing requirements are met, the header/ manifold system may be permanently assembled.

***6 inches is the minimum recommended spacing. A wider spacing may be required as indicated on the engineer's drawings.**

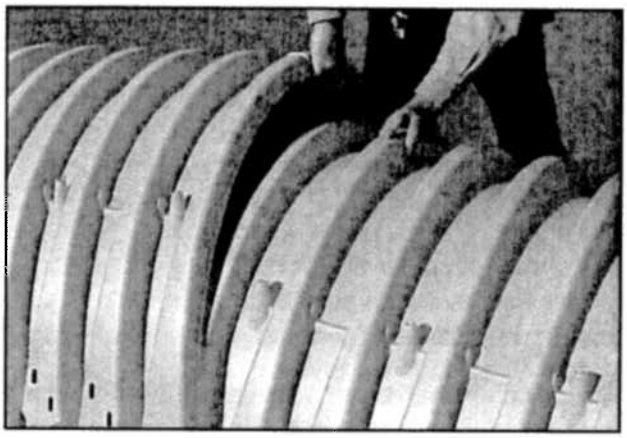
Requirements for Installing the Chambers



Maintain a minimum of 6" between chamber feet.

1 To begin building the chamber bed, orient the chambers so the end labeled "Build Rows in This Direction" is closest to the bed's edge and the arrows point in the direction of the build. ***Maintain a minimum 6 inch separation between chamber rows (measurement taken from the foot of chambers).***

Requirements for Joining the Chambers

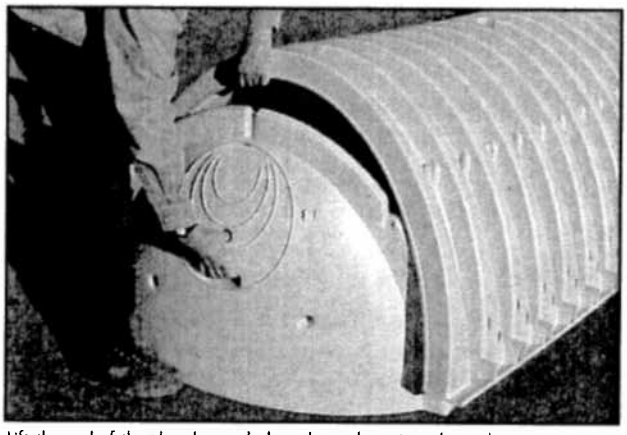


Construct the chamber bed by overlapping the chamber's end corrugations.

Although not visible to the eye, a chamber's end corrugations are sized differently to allow for an overlapping joint. To ensure proper joint fit, orient all chambers in the bed with their arrows pointing in the direction of the build. The chamber's overlapping feet are a distinguishing feature to help quickly identify the proper chamber orientation.

1 Construct the chamber bed by joining the chambers lengthwise in rows. Attach chambers by overlapping the end corrugation of one chamber onto the end corrugation of the last chamber in the row. Be sure that chamber placement does not exceed the reach of the construction equipment used to place the stone.
NOTE: Do not overlap more than one corrugation.

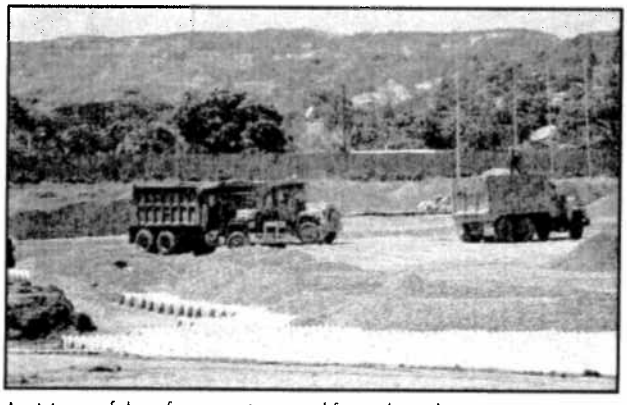
Requirements for Attaching the End Caps



Lift the end of the chamber and place the end cap into the end corrugation.

1 Lift the end of the chamber a few inches off the ground. With the curved face of the end cap facing outward, place the end cap into the chamber's end corrugation.
NOTE: End caps are required only at the beginning and the end of each row of chambers.

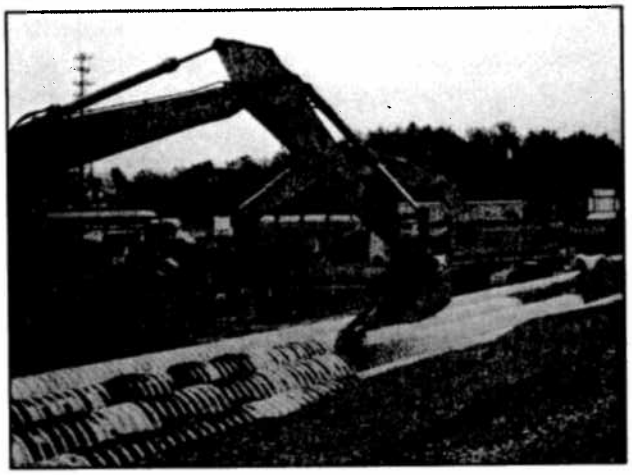
Requirements for Placing Stone Over the Chambers



A minimum of three feet cover is required for trucks to dump stone.
(See page 7, Section 4)

Angular stone meeting the specifications in **Tables 4 & 5** and **Figure 1** on page 10 may be placed over the chambers with an excavator, pushed with a dozer or walked in with a stone conveyer boom. Each method has benefits and limitations. These three processes will be explained separately, however there are some common requirements for each: The 6 inch minimum clear spacing must always be maintained between adjacent StormTech's chamber rows; and, construction vehicle loads must not exceed the requirements of **Tables 1 & 2** on page 9.

Requirements for Placing Stone with an Excavator



Carefully ladle 3/4 – 2 inch washed, crushed, angular stone over the centerline of the chamber row.

Placing stone with an excavator is currently the most common method of placing stone over StormTech's chambers. Its biggest limitation is the reach of the excavator arm. For larger beds it is common practice to work across a bed by joining only a few rows of chambers and placing their angular stone embedment, the filter fabric and soil fill before moving onto the next few rows.

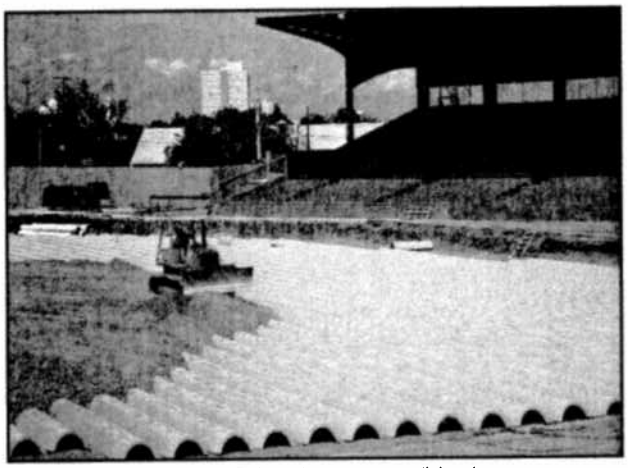
A bed may be built either parallel to or perpendicular to the chamber row's direction with this process. The excavator typically works inside the excavation, leading the way across the bed. It is also possible for the excavator to work at grade over the recently placed chambers following the build across. If this process is done it is required that the depth of cover between tops of chambers and the excavator's tracks be the minimum required by **Tables 1 & 2** on page 9.

1 Anchor chambers by carefully ladling angular stone directly over the centerline of the chambers. Evenly distribute stone to minimize chamber movement while maintaining row separation distances.

2 After chambers are anchored, continue to place the stone, surrounding the chambers and filling the perimeter areas to a minimum of 6 inches over the top of chambers. **Do not drive equipment over the chambers without minimum cover required by Tables 1 & 2** on page 9.

3 Repeat steps 1 & 2 until all the chambers are laid to the dimensions of the engineer's drawing.

Requirements for Pushing Stone with a Dozer



Low ground pressure track vehicle pushing stone parallel with rows.

A dozer may be used to push the angular stone embedment into place over the chambers. There are some strict requirements for this process.

1 **All stone must be pushed in a direction parallel with the rows of chambers.** Pushing stone perpendicular across chamber rows may cause the chambers to move, possibly reducing the required 6 inch minimum spacing between rows.

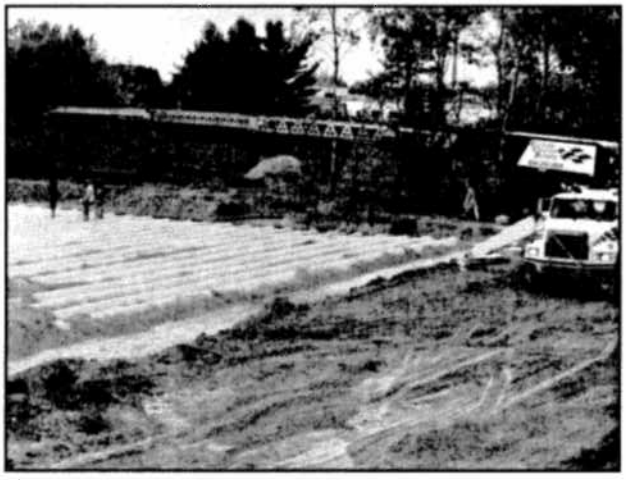
2 Always maintain the required cover between the tops of chambers and the dozer tracks, per **Table 2** on page 9. The contractor must check **Table 2** on page 9 to determine if their construction vehicles can be used over the chamber bed.

Requirements for Pushing Stone with a Dozer (cont.)

3 The angular stone cover height should never differ by more than 2 feet over adjacent chambers unless there is a minimum cover of 3 feet over the chambers. Stone should be pushed in small piles and spread evenly to prevent movement of chamber rows.

4 Full dump trucks must not drive over or dump stone over StormTech chambers unless there is a minimum of 3 feet of cover over the chambers. It is convenient for truckers to dump stone as close to the dozer as practical, however a full truck is often the heaviest load on a construction site. Raising the body to dump stone significantly increases the rear wheel loads. Three feet of cover is the minimum requirement for dumping stone over StormTech chambers.

Requirements Placing Stone with a Telescoping Conveyer Boom



Placing stone with the conveyor boom extended.

Evenly distributing stone with conveyor boom.

Telescoping aggregate conveyer trucks are becoming increasingly popular at construction sites. Their use can save a significant amount of time, money and free up other heavy equipment for other uses. They are only limited by the range of the boom. Typical trucks have a boom range between 50 to 130 feet. Booms can convey up to 360 cubic feet of stone per hour.

1 Anchor chambers by carefully ladling angular stone directly over the centerline of the chambers. Evenly distribute stone to minimize chamber movement while maintaining row separation distances.

2 After chambers are anchored, continue to place the stone, surrounding the chambers and filling the perimeter areas to a minimum of 6 inches over the top of chambers. **Do not drive equipment over the chambers without minimum cover required by Tables 1 & 2 on page 9.**

3 Repeat steps 1 & 2 above until all the chambers are laid to the dimensions of the engineer's drawings.

Requirements for Backfilling the System

Roll out filter fabric.

Backfill the bed using an acceptable fill material.

Continue to backfill the chamber bed.

1 Place the required angular stone over the entire bed area as described in previous sections.

2 Cover the entire installation area with AASHTO M288 Class 2 non-woven filter fabric. Take the fabric from the perimeter and lay it over the top of the stone. The filter fabric must overlap at least 2 feet where the edges of the fabric meet.

3 The first 12 inches of fill material must meet the requirements of **Table 5** on page 10. Backfill over the top of the filter fabric in lifts that do not exceed 6 inches. Distribute the fill with a construction vehicle that meets the maximum wheel loads or ground pressure limits specified in **Tables 1 & 2** on page 9.

4 Compact each lift of backfill as specified in the engineer's drawings. StormTech requires compacting to a minimum of 95% of the Standard Proctor density. Use a walk-behind or vibratory roller not to exceed a maximum gross vehicle weight of 12,000 lbs and a maximum dynamic force of 20,000 lbs.

5 Continue to backfill over the chamber bed in 6 inch maximum lifts until the specified grade is achieved. StormTech's cover requirements are 18 inches minimum and 96 inches maximum over the top of the chambers. For pavement sub-base or special fill requirements, see engineer's drawings.

The backfill height differential should never differ by more than 2 feet over adjacent chambers. Minimum cover heights must be met before vehicles are allowed on top of the system. Large rocks and organic matter such as roots, stumps, etc. must not be part of the backfill material. Refer to **Table 5** on page 10 for Acceptable Cover Materials or contact the design engineer for approved fill types.

Acceptable Vehicle Loads

StormTech

TABLE 1 – Maximum Allowable Axle Loads for Wheeled Vehicles at Various Cover Depths

Fill Depth (in. over chamber)	Max. Axle Load (lbs)
6	8,000
12	16,000
18 with pavement	32,000
24+ without pavement	32,000

NOTE: 36" of cover over the chambers is required for full dump truck travel and dumping. See instruction number 4 on page 7.

TABLE 2 – Maximum Allowable Ground Pressures for Various Vehicle Track Widths and Fill Depths

Fill Depth (in. over chamber)	Track Width (in.)	Max. Ground Pressure (PSF)*
6	12	1070
	18	900
	24	800
	30	760
	36	720
12	12	1540
	18	1190
	24	1010
	30	910
	36	840
18	12	2010
	18	1480
	24	1220
	30	1060
	36	950

** Ground pressure is vehicle operating weight divided by total truck contact area for both tracks. Call StormTech at **1-888-892-2694** or visit **www.stormtech.com** for examples of allowable tracked vehicles.*

Acceptable Geotextiles

TABLE 3 – Some Suitable Geotextiles

Manufacturer	AASHTO M288 Class 2 Non-Woven*	AASHTO M288 Class 1 Woven**
Amoco Fabrics and Fibers (Part of BP)	ProPex 4506, ProPex 4508, ProPex 4551, ProPex 4552, ProPex 4553	ProPex 2006, ProPex 2016, ProPex 2004
Belton Industries	—	Beltech 315 Style 883
Carthage Mills	FX-60HS, FX-80HS	FX-66
Contech Const. Products	C-70NW	—
GSE Lining Technology	NW6, NW8	—
Maccaferri	MacTex MX245, MacTex MX275	—
Mirafi Const. Products	Mirafi 160N, Mirafi 180N	Mirafi 600X, Filterweave 403, Filterweave 404 Geolon HP570, Geolon HP665, Geolon HP770
Pavco - Amanco	NT 3000, NT 4000	TR 4000
SI Geosolutions	Geotex 601, Geotex 801	Geotex 315ST
TNS Advanced Tech.	R 060, R070, R 080, R100	M 403
US Fabrics	US 205NW-C	US 315
Webtec	TeraTex N06, TeraTex N08	TeraTex HD

*AASHTO M288 Class 2 Non-Woven Geotextile Application: 1. Separation layer between angular stone cover and fill to prevent fines intrusion. 2. Filter layer over the chambers of the Stormtech Isolator™ Row to prevent fines migration out of row while maintaining adequate hydraulic flows.

**AASHTO M288 Class 1 Woven Geotextile Application: Stabilization layer for the angular stone foundation of the StormTech Isolator™ Row to prevent scouring of the stone base during the JetVac maintenance procedure, modest hydraulic flows maintained.

Acceptable Fill Materials

TABLE 4 – Criteria for Acceptable 3/4 – 2 Inch Washed, Crushed, Angular Stone

Washed Crushed Stone	Description	Criteria
Acceptable	Angular	Stones have sharp edges and relatively plane sides with unpolished surfaces
	Subangular	Stones are similar to angular description but have rounded edges
Unacceptable	Subrounded	Stones have nearly plane sides but have well-rounded corners and edges
	Rounded	Stones have smoothly curved sides and no edges

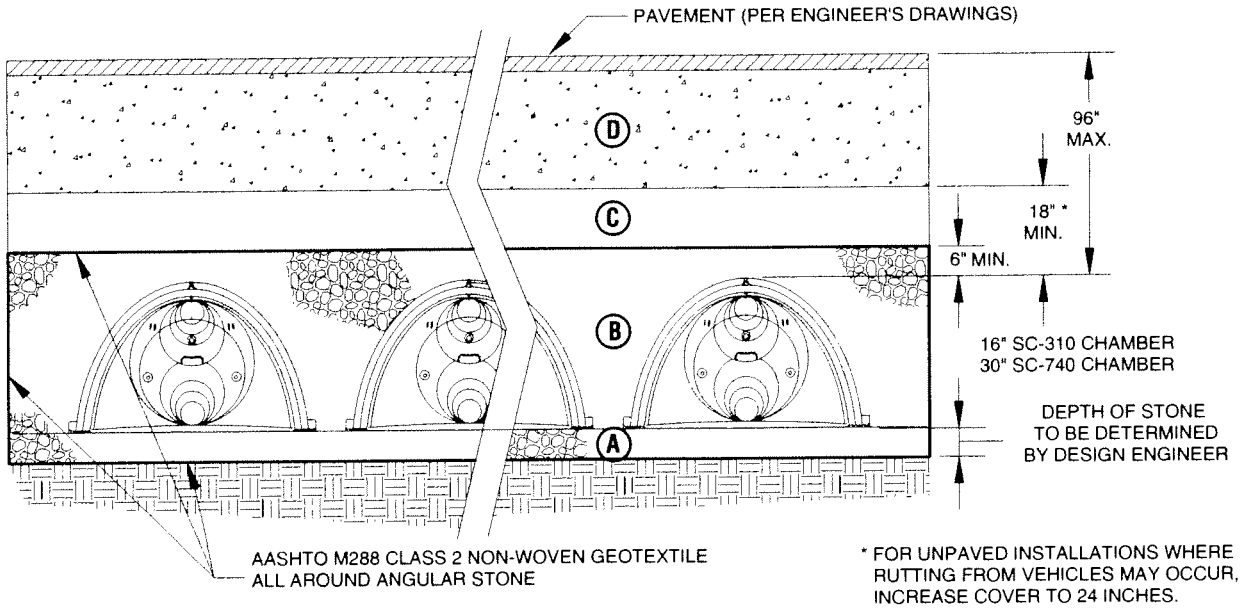
NOTE: See Ⓐ & Ⓑ of Table 5 for additional angular stone requirements.

TABLE 5 – Acceptable Fill Materials

Material Location	Description	AASHTO M43 Designation	AASHTO M145 Designation	Compaction/Density Requirement
Ⓓ Fill Material from 18" to grade above chambers	Any soil/rock materials, native soils or per engineer's plans. Check plans for pavement subgrade requirements.	N/A	N/A	Prepare per engineer's plans. Paved installations may have stringent material and preparation requirements.
Ⓒ Fill Material for 6" to 18" elevation above chambers (24" for unpaved installations)	Granular well-graded soil/ aggregate mixtures, <35% fines	3, 357, 4, 467, 5, 56, 57, 6, 67, 68, 7, 78, 8, 89, 9, 10	A-1 A-2 A-3	Compact in 6" lifts to a minimum 95% Standard Proctor density. Roller gross vehicle weight not to exceed 12,000 lbs. Dynamic force not to exceed 20,000lbs.
Ⓑ Embedment Stone surrounding and to a 6" elevation above Chambers	Washed, angular stone with the majority of particles between 3/4-2"	3, 357, 4, 467 5, 56, 57	N/A	No compaction required.
Ⓐ Foundation Stone below Chambers	Washed, angular stone with the majority of particles between 3/4-2"	3, 357, 4, 467 5, 56, 57	N/A	Plate compact or roll to achieve a 95% Standard Proctor Density.

PLEASE NOTE: The listed AASHTO designations are for gradations. The stone must also be washed, crushed angular. For example, the stone must be specified as washed, crushed, angular No. 4. stone.

FIGURE 1 – Fill Material Locations



Requirements for Assembling the StormTech Isolator Row

StormTech

The StormTech Isolator Row is a row of chambers designed to trap sediments in stormwater and provide access for inspection and maintenance. The StormTech Isolator Row is a row of StormTech chambers surrounded with two types of filter fabric: a strip of AASHTO M288 Class 1 woven geotextile laid down between the foundation stone and the row of chambers, and; a strip of AASHTO M288 Class 2 non-woven geotextile draped over the row of chambers. Note that the tough, woven geotextile is required on the bottom to provide a durable surface for future maintenance procedures. See **Table 3** on page 9 for a list of Acceptable Geotextiles. Isolator Row configurations are custom designed for each project and may vary from project to project. The actual layout shall be installed according to the engineer's drawings and these installation instructions.

1 The Isolator Row is designed with an access manhole just upstream of the Isolator Row inlet. It is recommended that the access manhole be installed prior to assembling the Isolator Row. The access manhole generally contains a high flow weir that diverts the first flows to the Isolator Row. Flows that exceed the design capacity of the Isolator Row over top the bypass weir and discharge to the distribution manifold. For weir construction details, see the engineer's drawings.

2 Installation of the Isolator Row may begin after the stone foundation is laid and prepared per the engineer's drawings. See *Requirements for Excavating and Preparing the Site* in this manual.

3 Layout the Isolator Row. For detailed layout dimensions, see the engineer's drawings or StormTech layout details for the project.

4 Roll out a continuous strip of AASHTO M288 Class 1 woven geotextile over the angular stone foundation so the open bottom area of Isolator Row chambers will be completely covered. There must not be any seams in the woven geotextile. **Table 3** lists acceptable woven geotextiles. See **Figure 2** for the width of the fabric strip required.

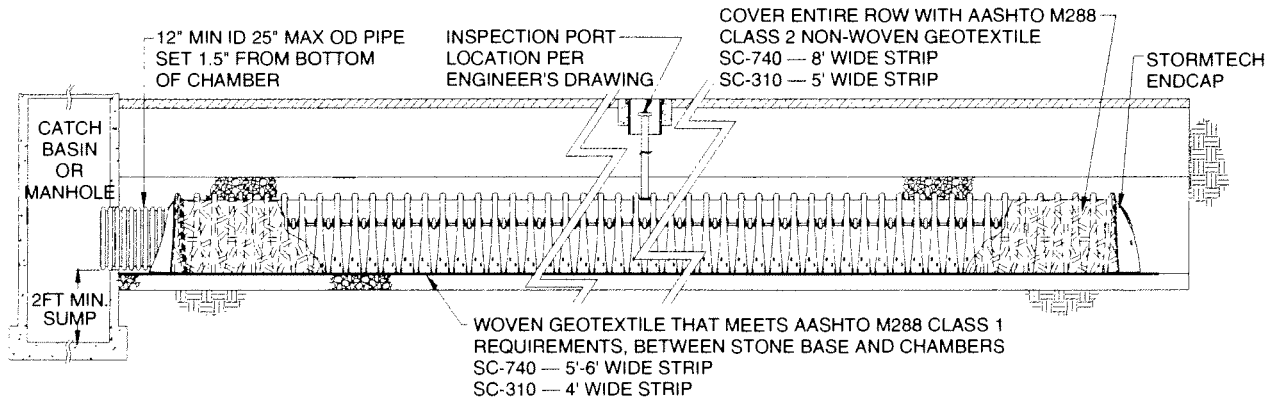
5 Form the Isolator Row by joining Stormtech chambers centered over the woven geotextile. *See Requirements for Joining Chambers* in this manual.

6 A short segment of pipe is typically used to connect the manhole to the Isolator Row through a StormTech endcap. See *Requirements for Attaching Inlet Pipes* in this manual for direction on connecting the pipe to the endcap.

7 Drape a strip of AASHTO M288 Class 2 non-woven geotextile over the row of chambers. This is the same type of non-woven filter fabric used as a separation layer around the angular stone of a StormTech system. A single continuous piece is preferred. **Table 3** lists suitable non-woven geotextiles.

8 See *Requirements for Placing Stone and Requirements for Backfilling the System* in this manual for directions on completing the Isolator Row installation.

FIGURE 2 – StormTech Isolator Row Detail



STANDARD LIMITED WARRANTY OF STORMTECH LLC ("STORMTECH"): PRODUCTS

(A) This Limited Warranty applies solely to the StormTech chambers and endplates manufactured by StormTech and sold to the original purchaser (the "Purchaser"). The chambers and endplates are collectively referred to as the "Products."

(B) The structural integrity of the Products, when installed strictly in accordance with StormTech's written installation instructions at the time of installation, are warranted to the Purchaser against defective materials and workmanship for one (1) year from the date of purchase. Should a defect appear in the Limited Warranty period, the Purchaser shall provide StormTech with written notice of the alleged defect at StormTech's corporate headquarters within ten (10) days of the discovery of the defect. The notice shall describe the alleged defect in reasonable detail. StormTech agrees to supply replacements for those Products determined by StormTech to be defective and covered by this Limited Warranty. The supply of replacement products is the sole remedy of the Purchaser for breaches of this Limited Warranty. StormTech's liability specifically excludes the cost of removal and/or installation of the Products.

(C) **THIS LIMITED WARRANTY IS EXCLUSIVE. THERE ARE NO OTHER WARRANTIES WITH RESPECT TO THE PRODUCTS, INCLUDING NO IMPLIED WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

(D) This Limited Warranty only applies to the Products when the Products are installed in a single layer. **UNDER NO CIRCUMSTANCES, SHALL THE PRODUCTS BE INSTALLED IN A MULTI-LAYER CONFIGURATION.**

(E) No representative of StormTech has the authority to change this Limited Warranty in any manner or to extend this Limited Warranty. This Limited Warranty does not apply to any person other than to the Purchaser.

(F) Under no circumstances shall StormTech be liable to the Purchaser or to any third party for product liability claims; claims arising from the design, shipment, or installation of the Products, or the cost of other goods or services related to the purchase and installation of the Products. For this Limited Warranty to apply, the Products must be installed in accordance with all site conditions required by state and local codes; all other applicable laws; and StormTech's written installation instructions.

(G) **THE LIMITED WARRANTY DOES NOT EXTEND TO INCIDENTAL, CONSEQUENTIAL, SPECIAL OR INDIRECT DAMAGES. STORMTECH SHALL NOT BE LIABLE FOR PENALTIES OR LIQUIDATED DAMAGES, INCLUDING LOSS OF PRODUCTION AND PROFITS; LABOR AND MATERIALS; OVERHEAD COSTS; OR OTHER LOSS OR EXPENSE INCURRED BY THE PURCHASER OR ANY THIRD PARTY. SPECIFICALLY EXCLUDED FROM LIMITED WARRANTY COVERAGE ARE DAMAGE TO THE PRODUCTS ARISING FROM ORDINARY WEAR AND TEAR; ALTERATION, ACCIDENT, MISUSE, ABUSE OR NEGLECT; THE PRODUCTS BEING SUBJECTED TO VEHICLE TRAFFIC OR OTHER CONDITIONS WHICH ARE NOT PERMITTED BY STORMTECH'S WRITTEN SPECIFICATIONS OR INSTALLATION INSTRUCTIONS; FAILURE TO MAINTAIN THE MINIMUM GROUND COVERS SET FORTH IN THE INSTALLATION INSTRUCTIONS; THE PLACEMENT OF IMPROPER MATERIALS INTO THE PRODUCTS; FAILURE OF THE PRODUCTS DUE TO IMPROPER SITING OR IMPROPER SIZING; OR ANY OTHER EVENT NOT CAUSED BY STORMTECH. THIS LIMITED WARRANTY REPRESENTS STORMTECH'S SOLE LIABILITY TO THE PURCHASER FOR CLAIMS RELATED TO THE PRODUCTS, WHETHER THE CLAIM IS BASED UPON CONTRACT, TORT, OR OTHER LEGAL THEORY.**

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Liners for Detention Systems

Tech Sheet # 2
Rev. 1/13/04

General:

StormTech chambers offer the distinct advantage and versatility that allow them to be designed as an open bottom *detention or retention* system. In fact the vast majority of StormTech installations and designs are *open bottom detention* systems. Using an open bottom system enables treatment of the storm water through the underlying soils and provides a volume safety factor based on the infiltrative capacity of the underlying soils.

In some applications, however, water-tight detention systems may be required. This memo provides guidance for the design and installation of impervious liners for water-tight detention systems using StormTech chambers. The major points of the memo are:

- Infiltration of stormwater is generally a desirable stormwater management practice, often required by regulations. Lined systems should only be specified where unique site conditions preclude infiltration.
- Geomembrane liners provide an effective and viable means to contain stormwater in StormTech subsurface systems where infiltration is undesirable or prohibited.
- PVC and LLDPE are the most cost effective, installed membrane materials.
- Enhanced puncture resistance from angular aggregate on the water side and from protrusions on the soil side can be achieved by placing a non-woven geotextile reinforcement on each side of the geomembrane. A sand underlayment in lieu of the geotextile reinforcement on the soil side may be considered when cost effective.
- Installed liner costs with membrane reinforcement fabric range from $0.30 to $1.15 per square foot. Installed costs from $0.50 to $0.80 per square foot are realistic.

Membrane Materials:

Polyvinyl chloride (PVC) is an effective liner material for StormTech systems. PVC offers good chemical resistance to contaminant concentrations typical of highway runoff and to chlorides from road salting applications. Non-reinforced 30 mil PVC liners are recommended for StormTech systems and a service life in excess of 20 years is expected. PVC is flexible. It can be folded without damage and is typically prefabricated and shipped to the jobsite. Panels as large as 20,000 sqft can be prefabricated into a 4000 lb panel (30 mil is 0.195 lbs/sqft, SG = 1.2). PVC has the versatility to be field solvent welded, taped or field heat welded. A very significant advantage of PVC is that an excavation contractor can install a PVC liner without specialty crews. Solvent welding of seams, patches and pipe boots can all be done by the excavation contractor making PVC the lowest cost liner alternative.

The PVC compound includes fillers and plasticizers to reduce cost and UV inhibitors to extend the service life under exposure to sunlight. Under prolonged sunlight exposures such as in a permanent surface pool, these additives can leach into the pool and reach concentrations harmful to aquatic life. More stable PVC compounds referred to as "fish safe" are sometimes used for pond liners and may be considered for StormTech liners at a cost increase of about $0.05 / sqft. However, since StormTech systems are subsurface, where

sunlight does not attack the PVC, and stormwater is detained for short durations, typically 48 hours or less, there is little opportunity for accumulation of leachates.
Recommended Configuration: 30 mil PVC with 8 ounce non-woven reinforcement fabric underlayment and overlayment, open top with high flow bypass.
Recommended Restriction: Do not use for fuel spill containment.
Cost: Estimated installed costs for 30 mil PVC with non-woven reinforcements range from $0.55 / sqft for a 20,000 sqft project to $0.46 / sqft for a 100,000 sq ft project installed by the excavation contractor.

Linear low density polyethylene (LLDPE) is a very inert material that offers excellent chemical resistance and is "fish safe". LLDPE is an effective liner system for StormTech systems, particularly for small projects where the entire liner can be prefabricated in one piece or when using taped seams. LLDPE is flexible up to 30 mil but thicknesses greater than 30 mil should not be folded without potential damage. 30 mil LLDPE is recommended and a service life in excess of 20 years is expected. Extra care should be taken to protect against puncture. A minimum 8-ounce non-woven fabric reinforcement underlayment and 12-ounce overlayment should be specified. The underlayment reinforcement should be increased to 12-ounce where water tightness is essential and increased puncture risk exists. Panels as large as 27,000 sqft can be prefabricated into a 4000 lb roll (30 mil is 0.15 lbs/sqft). LLDPE has a specific gravity less than 1.0. LLDPE seams can be taped or field heat welded.

Recommended Configuration: 30 mil LLDPE with 8 ounce non-woven reinforcement fabric underlayment and 12-ounce overlayment, open top with high flow bypass.
Recommended Restriction: Do not use for fuel spill containment.
Cost: Estimated costs for 30 mil LLDPE with non-woven reinforcements range from $0.52 / sqft installed by the excavation contractor to $0.80 / sqft with field seam welding by a specialty contractor for a 20,000 sqft project to $0.70 / sqft for a 100,000 sq ft project installed by a specialty contractor.

Reinforced Polypropylene (RPP), EPDM *and* ***XR-5*** are excellent materials for lining systems due to their flexibility, durability and excellent chemical and UV resistance. RPP and XR-5 with welded seams are recommended for fuel spill applications. Although excellent lining materials, they generally exceed the engineering requirements for typical applications and are higher in cost than PVC or LLDPE. Thicknesses of 30-mil or more are recommended.

Cost: Estimated costs for 36 mil PP and 8 oz non-woven reinforcements range from $0.90 / sqft for a 20,000 sqft project installed by the excavation contractor to $0.80 / sqft for a 100,000 sq ft project installed by a specialty contractor.

Polyethylene (PE) materials are generally inert, offer excellent chemical resistance and are "fish safe". Although ***medium density polyethylene (MDPE)*** liners are widely used for sanitary landfills and fish ponds, they are generally much higher in total cost and are not likely to be cost effective StormTech lining materials. ***High density polyethylene (HDPE)*** is not flexible enough to resist puncture and conform to the excavation. Cost aside, MDPE is an acceptable liner material for StormTech systems but should be limited to subgrades that are well prepared, without protrusions and must be field seamed.

Cost: Estimated costs for 30 mil MDPE and non-woven reinforcements range from $1.15/sqft for a 20,000 sqft project installed by the excavation contractor to $0.80/sqft for a 100,000 sq ft project installed by a specialty contractor.

Reinforcement Materials:

6-ounce	ADS 0601 or equal (M288 Class 2 Std StormTech separation fabric) over the top of stone
8-ounce	ADS 0801 or equal for use as reinforcement for PVC, RPP and LLDPE
12-ounce	ADS1201 or equal for use as reinforcement for LLDPE and other PE membranes

Design & Construction:

Freeboard versus sealed vessel: The lining system can be configured in two ways: 1) the membrane completely seals the top of the system forming a closed, sealed vessel or 2) the membrane extends up the vertical sidewall to the top of the embedment stone plus some additional freeboard forming an open top system. The sealed system increases the liner cost by 80% or more. When a sealed vessel system is designed, venting may be required since inlet piping laid flat or otherwise surcharged may not provide venting during high intensity rainfalls. Design factors to evaluate the open top versus sealed vessel approach:

- The purpose of the liner should be a factor in determining whether a closed top is necessary. For example; a liner required by permit to preclude any introduction of stormwater to contaminated soils might require a sealed vessel with water tight piping.
- A design that includes an over flow weir to bypass the peak flow of the design storm would enable the open top approach in most applications. The weir crest elevation should be set such that the crest elevation plus the head on the weir necessary to pass the peak flow is less than the elevation of the top of liner.

Seaming Options:

1. ***Prefabricated vs. Field*** Prefabricated seams are preferable to field seams for all liner materials whenever possible.
2. ***Solvent Welded*** PVC only, low cost, water tight
3. ***Heat Welded*** Costly, water tight, require trained seamer, for all liner materials .
4. ***Taped*** Cost effective, M50-RC Gray distributed by Titus Industrial Group recommended, single sided $0.58 / lin ft for 4" width, for all liner materials. No water tightness data is available but is suggested by manufacturer for water tight applications when leakage tests are not required.
5. ***Overlapped*** Not water tight, no leakage rates available, suggest 4 ft overlap for all materials.

Buoyancy: Due primarily to the weight of the stone, the weight of the dry, lined, watertight StormTech system exceeds the buoyant force for the empty chamber, maximum groundwater elevation condition.

Installation:

Installation should be in accordance with the manufacturer's instructions. Associations representing membrane materials have developed installation standards for the respective lining materials as follows:

- "PVC Geomembrane Fabrication and Installation Document" by the PGI (PVC Geomembrane Institute) January 2000 http://Pgi-tp.cee.uiuc.edu/forweb/fabAndInstall.pdf
- "HDPE Geomembrane Installation Specification" by the International Association of Geosynthetic Installers. Revised February 2000

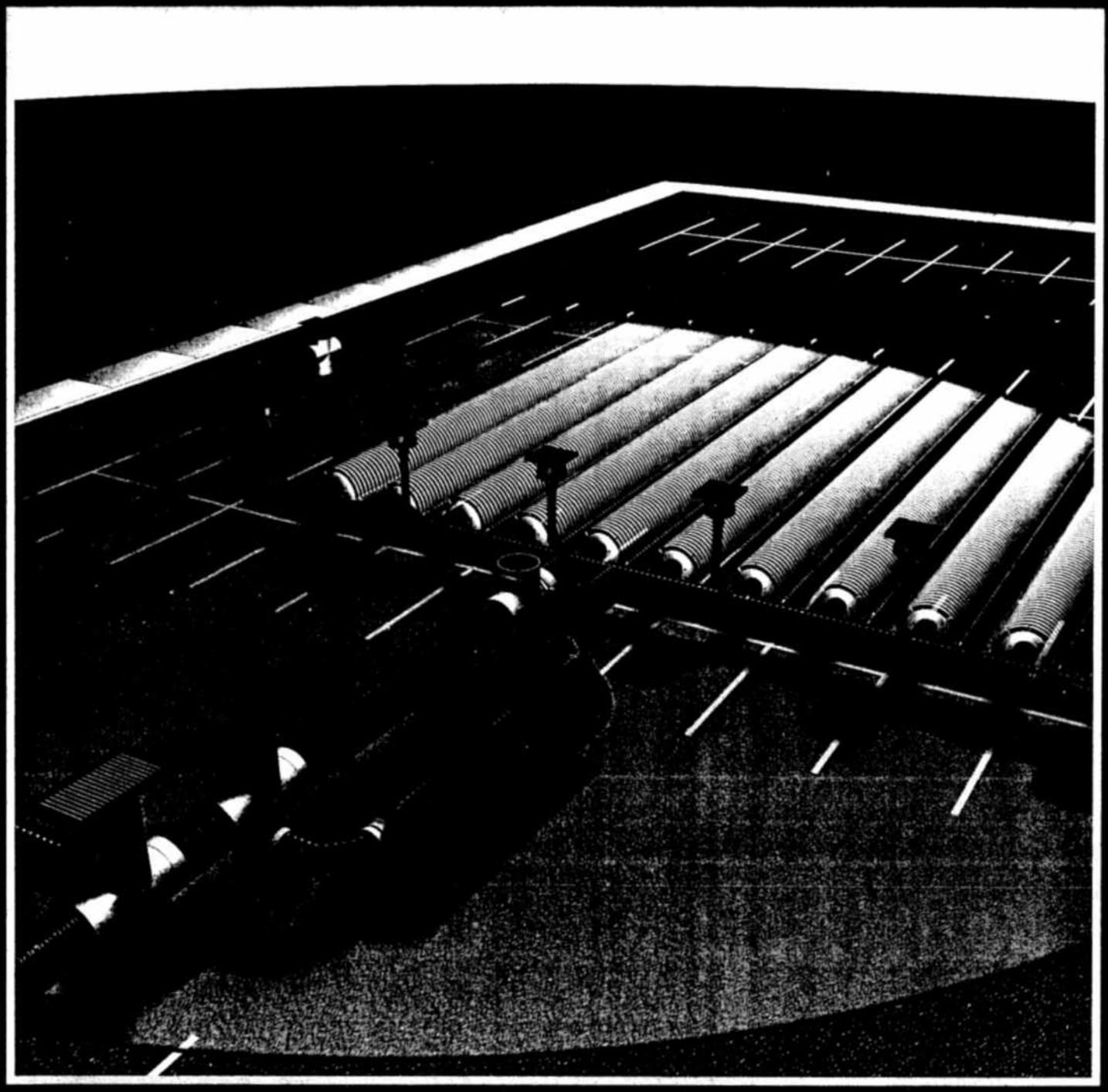
PVC and LLDPE liners should not be installed at temperatures less than 32° F or on windy days. Wind can catch the liner and be extremely dangerous to laborers. Stones and other protrusions should always be removed from the excavation. Rolling with a steel wheeled roller is recommended for all rocky soils to knock down protrusions. The non-woven reinforcement is then placed. An "anchor trench" about 24" deep by 12" wide may be dug around the top of the excavation to fix the top of the reinforcement and liner at the top of the excavation. Liners are flapped by laborers to get air under the liner to enable easy drag across bed.

Corners are generally formed by folding or "pleating" excess liner material. Pipe penetrations are sealed by "seaming" a boot to the liner and clamping the boot to the pipe. Seaming at low temperatures (32° F minimum) requires preheating of the material.

A non-woven reinforcement is placed over the membrane. Stone should be placed carefully to avoid puncture from long free falls. Similarly, additional care must be taken when spreading and compacting bedding stone to prevent stones from puncturing the liner during construction.

For additional information please contact StormTech at (888) 892-2694.

ADS Water Quality Units



Engineered structures for storm water pollutant removal

ADS

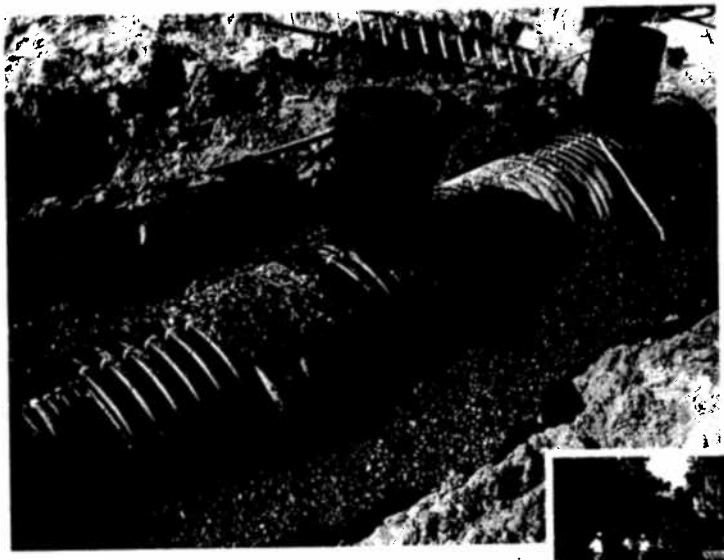
Standards for storm water quality will necessarily vary by location and land use. The most targeted sources of runoff pollution are paved areas in urban and industrial sites. These are generally small (< 1 acre), or 40 ha with high traffic loads, such as parking lots and gas stations, that generate significant concentrations of contaminant particles and hydrocarbons.

Because of land constraints, ADS underground Water Quality Units* have become an increasingly efficient solution for treating storm water. These durable, lightweight structures have been specifically designed for fast installation and easy maintenance.

Benefits

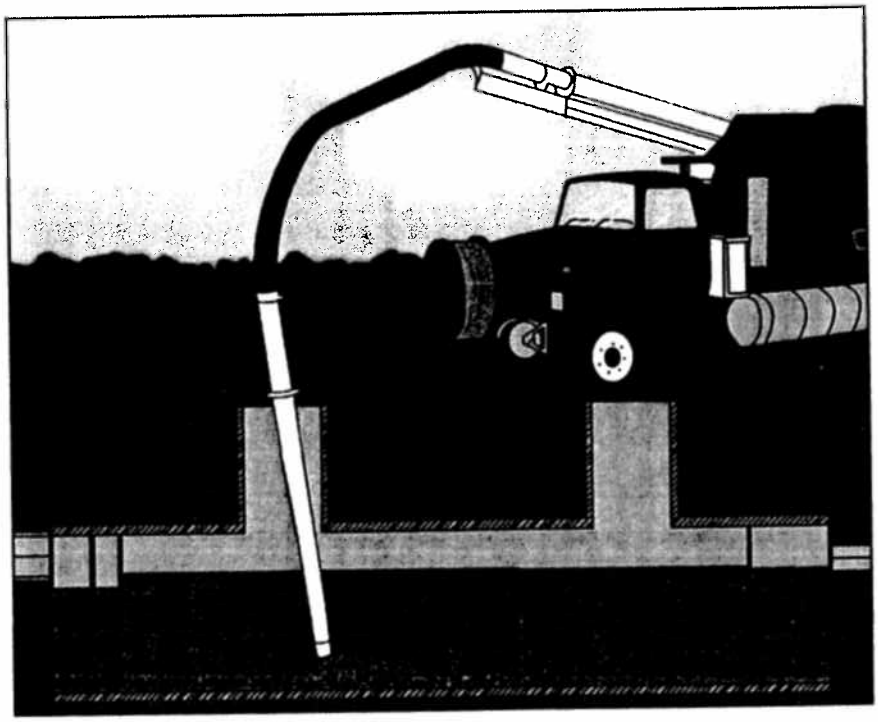
- Laboratory tests have shown an 80% TSS removal rate.
- Removes floatable debris such as oils and greases.
- Available in 36" (900mm) through 60" (1500mm) diameters.
- Lightweight High Density Polyethylene (HDPE) unit installs easily with a minimum of manpower. Heavy cranes are not necessary to install the unit.
- Each unit is fitted with access risers for easy inspection and maintenance of the sediment and oil chambers.
- The unit is inexpensive because the design is simple and there are no moving parts.
- The bypass system prevents re-suspension of captured solids by diverting water flows greater than the first flush.
- HDPE resists abrasion and chemicals found in storm water and in the surrounding soil.

*Patent Pending



The Patent Pending ADS Water Quality Unit is lightweight and easy to install, requiring little in the way of manpower or heavy equipment.

A bypass system (right) is installed to prevent water flows greater than the first flush from re-suspending captured pollutant particles.



The ADS Water Quality Unit is fitted with access risers for easy inspection and maintenance.

Standard Models

Product Number	Diameter (in) (mm)	Length (ft) (m)	Inlet Size (in) (mm)	Outlet Size (in) (mm)	Treated Flow Rate (cfs) (L/s)	Sed. Vol. (ft^3) (m^3)	Oil Vol. (ft^3) (m^3)	Sieve Size
3620WQA	36 (900)	20 (6)	10 (250)	8 (200)	1.5 (42)	65 (1.8)	30 (0.8)	140
3640WQA	36 (900)	40 (12)	10 (250)	10 (250)	3.2 (91)	137 (3.9)	63 (1.8)	140
3620WQB	36 (900)	20 (6)	10 (250)	6 (150)	0.7 (20)	65 (1.8)	30 (0.8)	200
3640WQB	36 (900)	40 (12)	10 (250)	8 (200)	1.6 (45)	137 (3.9)	63 (1.8)	200
4220WQA	42 (1050)	20 (6)	12 (300)	8 (200)	1.75 (49)	83 (2.3)	38 (1.1)	140
4240WQA	42 (1050)	40 (12)	12 (300)	12 (300)	3.66 (104)	175 (5.)	81 (2.3)	140
4220WQB	42 (1050)	20 (6)	12 (300)	6 (150)	0.86 (24)	83 (2.3)	38 (1.1)	200
4240WQB	42 (1050)	40 (12)	12 (300)	8 (200)	1.83 (52)	175 (5.)	81 (2.3)	200
4820WQA	48 (1200)	20 (6)	12 (300)	8 (200)	2.26 (64)	116 (3.3)	55 (1.6)	140
4840WQA	48 (1200)	40 (12)	12 (300)	12 (300)	4.78 (135)	245 (6.9)	115 (3.3)	140
4820WQB	48 (1200)	20 (6)	12 (300)	6 (150)	1.13 (32)	116 (3.3)	55 (1.6)	200
4840WQB	48 (1200)	40 (12)	12 (300)	10 (250)	2.39 (68)	245 (6.9)	115 (3.3)	200
6020WQA	60 (1500)	20 (6)	15 (375)	10 (250)	2.95 (84)	183 (5.2)	87 (2.5)	140
6040WQA	60 (1500)	40 (12)	15 (375)	15 (375)	6.23 (176)	385 (10.9)	184 (5.2)	140
6020WQB	60 (1500)	20 (6)	15 (375)	8 (200)	1.47 (42)	183 (5.2)	87 (2.5)	200
6040WQB	60 (1500)	40 (12)	15 (375)	10 (250)	3.12 (88)	385 (10.9)	184 (5.2)	200

140 sieve is equal to a particle size of 0.0042" (0.106mm)
200 sieve is equal to a particle size of 0.0030" (0.075mm)

Design variations

The standard models listed above will provide efficient removal of pollutant particles and hydrocarbons for the majority of site conditions. For unusual conditions, ADS can recommend a system combining a variety of sizes and configurations.

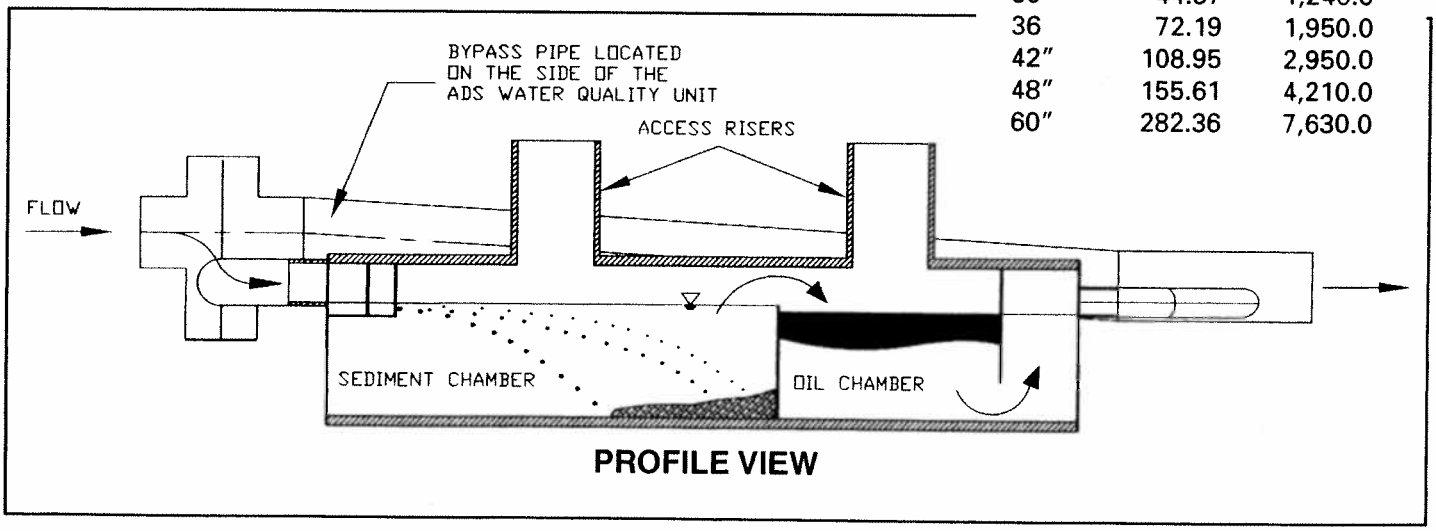
ADS can also incorporate other pollutant control features into the drainage network. These include inlet protection devices, trash screens, filtration systems, and a large selection of sediment prevention products from our strategic partner, SI® Geosolutions.

Peak Flow Rate

The by-pass pipe of the ADS WQU is designed to convey the peak storm water flow of the storm line.

For example, @ a 1% slope, peak flow rates for the by-pass line are as follows:

	CFS	L/S
12"	3.8419	103.9
15"	6.971	188.0
18"	11.343	307.0
24"	24.451	661.0
30"	44.37	1,240.0
36	72.19	1,950.0
42"	108.95	2,950.0
48"	155.61	4,210.0
60"	282.36	7,630.0



PROFILE VIEW

Design principles

Available in 36" (900mm) through 60" (1500mm) diameters, ADS Water Quality Units are modified sections of N-12® pipe with weir plates at certain locations and heights to remove high percentages of sediment and oils from the first flush of a storm event. They can be installed at any point in the subsurface drainage system, and are ideally suited to treat "hot spots" in existing storm water lines.

The unit is designed using the fundamental principles of Stoke's Law and a standard orifice outlet control. The settling velocity of a particle is calculated based on the smallest particle to be removed. Standard units offer a choice of 140 or 200 sieve size.

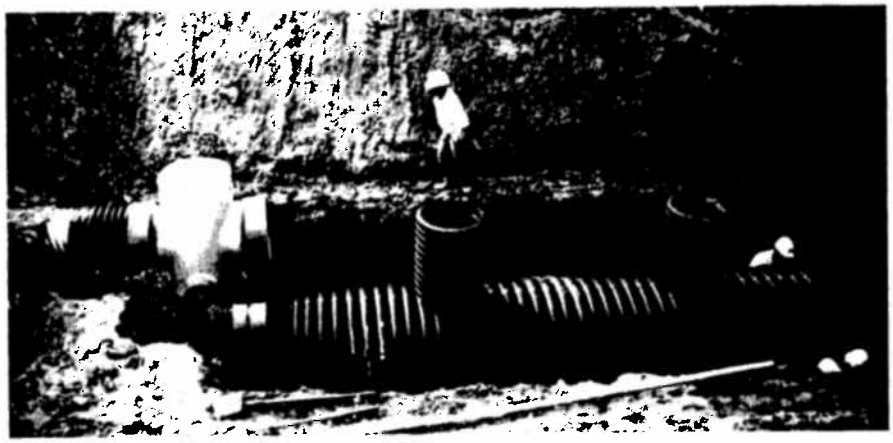
140 Sieve Size	200 Sieve Size
0.0042" Particle Dia. 106 μm	0.0030" Particle Dia. 75 μm

The outlet orifice is sized to release a typical first flush discharge, and to redirect any excess flow to a bypass piping system installed with the unit.

Sizing and Installation

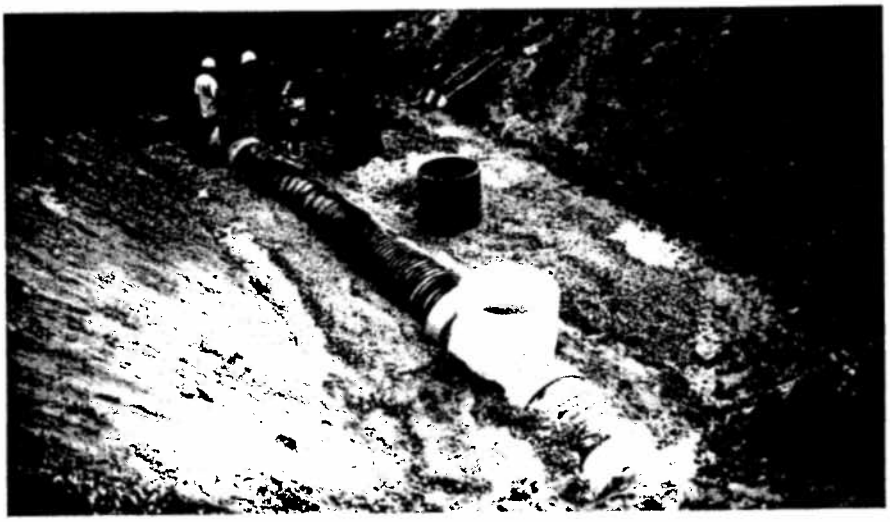
Installation of Water Quality Units follows the same accepted practices as for the installation of large diameter flexible pipe.

Basic information is shown on this and the following page. Specific installation instructions, along with details on specifying the proper size of a Water Quality Unit, are contained in ADS Product Note 3.140 and the HDPE Water Quality Unit Specification, each of which can be downloaded from the ADS Web site at www.ads-pipe.com.



Setting the Water Quality Unit and the inlet tee fitting

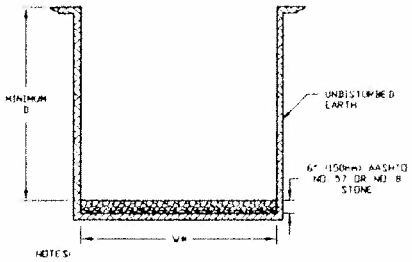
Bedding and backfilling the unit in 12" lifts



Backfill over the Water Quality Unit and installation of bypass line complete

Installation Details

1. Trench and Bedding Preparation for Unit



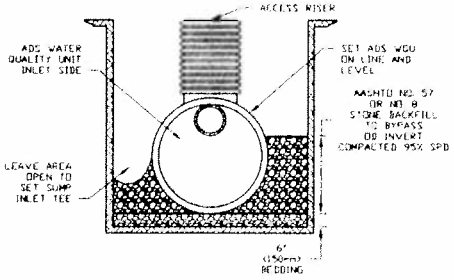
NOTES:

1. AVOID EXCESSIVE GROUND WATER IN THE TRENCH. DE-WATER AS NECESSARY.
2. PROVIDE SHEETING OR SHORING AS REQUIRED.
3. MAXIMUM COVER HEIGHT MEASURED FROM THE TOP OF THE UNIT TO FINAL GRADE SHALL NOT EXCEED 8' (2.4M).

ADS UNIT SIZE	MINIMUM D	MINIMUM W*
36" (900mm)	4.5' (1.35M)	6.5' (1.95M)
42" (1050mm)	5.0' (1.50M)	7.0' (2.10M)
48" (1200mm)	5.5' (1.65M)	7.5' (2.25M)
60" (1500mm)	7.5' (2.25M)	8.5' (2.55M)

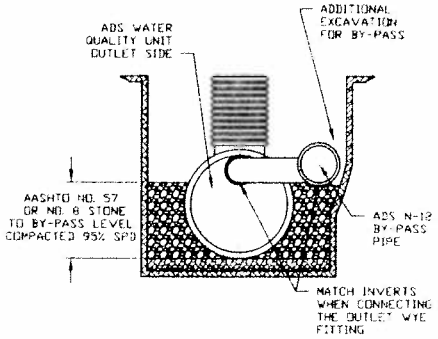
* TRENCH WIDTH DOES NOT ACCOUNT FOR BY-PASS PIPE. THIS ESTIMATE IS FOR THE MAIN UNIT ONLY.

2. Placing Unit and Initial Backfill



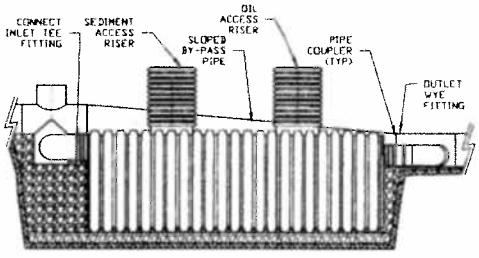
1. UTILIZE CARE WHEN LOWERING UNIT INTO THE TRENCH. HANDLE USING NYLON SLINGS AND TWO PICK POINTS.
2. PLACE BACKFILL AROUND THE UNIT IN UNIFORM 8"-12" (200mm-300mm) LIFTS, COMPACTED TO 95% SPD.
3. WHEN THE UNIT CONSISTS OF 2 SECTIONS, PLACE THE DOWNSTREAM SECTION FIRST. PROPERLY LUBE THE BELL AND SPIGOT, CONNECT AND HOME THE REMAINING SECTIONS.

3. Connecting the Bypass (Outlet Bend)



1. START ON THE DOWNSTREAM END BY CONNECTING THE OUTLET FITTING. BE SURE TO MATCH INVERTS OF UNIT OUTLET AND BYPASS PIPE.
2. BY-PASS FITTINGS CAN BE CONNECTED USING THE SAME COUPLERS AS THE MAIN STORM SEWER PIPE. COUPLERS MAY BE SPLIT COUPLERS, IN-LINE BELL COUPLERS, SNAP COUPLERS, BELL-BELL COUPLERS OR WELDED COUPLERS.

4. Connecting the Bypass (Inlet End)

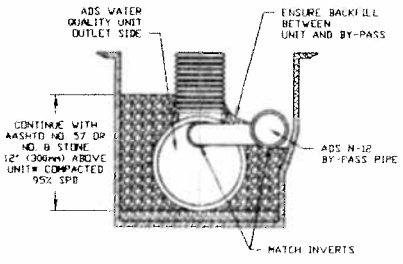


1. CONTINUE CONNECTING THE BY-PASS PIPE TO THE UPSTREAM END OF THE UNIT.
2. FINISH THE BY-PASS CONNECTION TO THE UNIT BY CONNECTING THE INLET TEE FITTING.

NOTE:

PLEASE CONSULT WITH YOUR ADS REPRESENTATIVE ON THE AMOUNT OF FALL FROM THE BY-PASS INLET INVERT TO THE BY-PASS OUTLET INVERT.

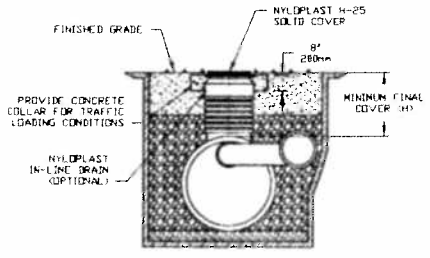
5. Backfill Around the Unit and Bypass



1. CONTINUE BACKFILL WITH AASHTO NO.57, 1" TO NO.4 SIEVE OR AASHTO NO.8, 3/8" TO NO.8 SIEVE, (PER AASHTO M43 OR ASTM D448) STONE TO 12" (300mm) ABOVE WATER QUALITY UNIT.
2. FILL UNIT WITH WATER TO THE TOP OF THE SEDIMENT WEIR PLATE ONCE BACKFILL IS PLACED AND COMPACTED 12" (300MM) ABOVE THE UNIT.

* FOR 60" (1500mm) UNITS CONTINUE BACKFILL WITH AASHTO NO.57, 1" TO NO.4 SIEVE OR AASHTO NO.8, 3/8" TO NO.8 SIEVE (PER AASHTO M43 OR ASTM D448) TO 24" (600mm) ABOVE WATER QUALITY UNIT.

6. Final Cover and Riser Extensions



NOTES:

1. PLEASE FOLLOW THE INSTALLATION GUIDELINES OF ADS PRODUCT NOTE 3.115 WHEN INSTALLING ADS N-12 PIPE ON THE BY-PASS CONNECTION OR IN OTHER DRAINAGE APPLICATIONS ON THE SITE.
2. ALL RISER EXTENTIONS TO GRADE SHOULD BE COORDINATED THROUGH YOUR ADS REPRESENTATIVE.

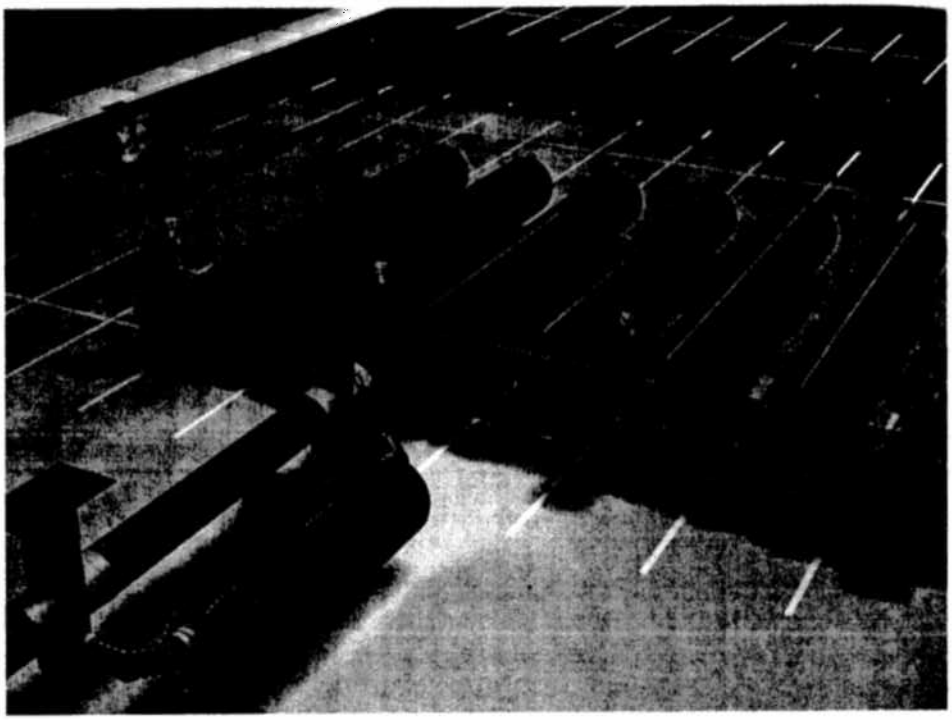
FOR NON-TRAFFIC LOADING: H = 12" (300mm) COVER FOR 36" (900mm), 42" (1050mm), AND 48" (1200mm) UNITS MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF BITUMINOUS PAVEMENT OR TOP OF RIGID PAVEMENT. H = 24" (600mm) COVER FOR 60" (1500mm) PIPE.

FOR TRAFFIC LOADING H = 24" (600mm) COVER FOR 36" (900mm), 42" (1050mm), 48" (1200mm), AND 60" 1500mm) MEASURED FROM THE TOP OF THE PIPE TO THE BOTTOM OF BITUMINOUS PAVEMENT OR TOP OF RIGID PAVEMENT.

CAD/PDF drawings can be accessed from www.ads-pipe.com.

For many drainage sites, the Water Quality Unit by itself can provide the required degree of pollutant removal. Certain sites, however, with higher concentrations of hydrocarbons or sediment runoff will need further treatment upstream and/or downstream of the Unit. This multi-tiered approach to storm water quality is known as the *treatment train.*

Upstream measures include sediment prevention (vegetated swales, etc.) and inlet protection devices such as screens, filters and silt fences. These techniques are designed to prevent a large percentage of pollutants from ever entering the storm drain system. For impervious surfaces such as paved parking areas, catch basin insert filters are most commonly used for early stage treatment.

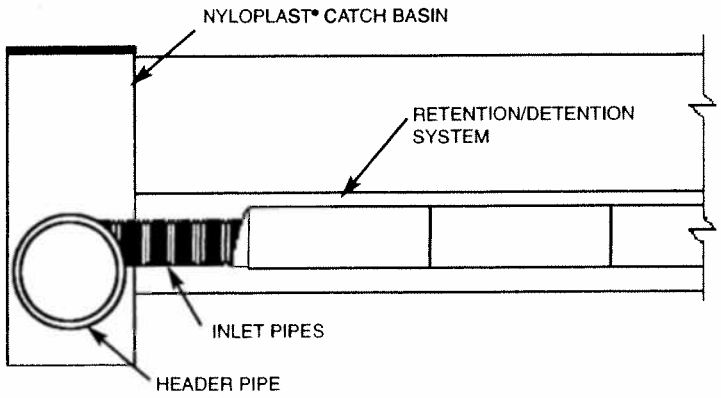


Retention/Detention

Treatment downstream from the Water Quality Unit generally involves some form of retention or detention system. Retention allows accumulated storm water to gradually percolate into the surrounding soil, while detention meters the water through an outlet to a ditch, stream or other receiving area.

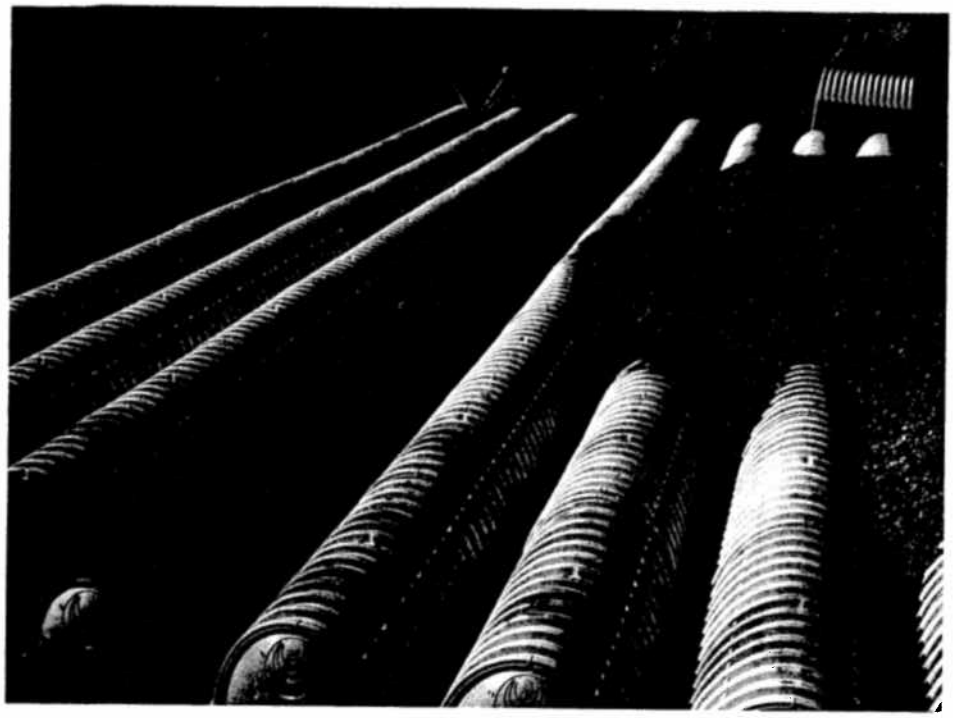
Inlet designs to such underground storage vessels can also enhance pollutant removal. The "eccentric header system" consists of a large diameter manifold pipe with an invert positioned lower than those of the smaller inlet pipes to the storage vessels. The large header pipe thus acts as a sump into which suspended particles may settle. Manholes and/or risers may be installed to facilitate inspection and cleaning.

Designers can choose between two methods of constructing the retention or detention system. The first is the use of ADS N-12® large diameter corrugated high density polyethylene pipe, known for its economy and ease of installation. ADS supplies a complete line of pipe, fittings and fabricated manifolds, along with detailed sizing, design and installation instructions on CD.



The "eccentric header" is installed with its invert lower than the inlet pipes, thus acting as a sump to collect suspended sediment.

StormTech® Chambers



The other design choice for retention and detention involves the use of StormTech® underground chambers. A chamber conveys water laterally through its sidewall openings, as well as through the angular stone foundation and backfill, to maintain a constant elevation in a bed.

The durable, chemical-resistant polypropylene chambers are offered in two sizes: (1) the SC-740 chamber provides 2.2 ft^3/ft^2 (6.7 m^3/m^2) of storage, and (2) the SC-310 low profile unit allows 1.3 ft^3/ft^2 (4.0 m^3/m^2) of storage. Chambers can be cut at 6.5" intervals, providing excellent design flexibility for nearly all sites. They can be centralized or decentralized, configured into beds or trenches of varying sizes and shapes, and installed easily around utilities or other obstructions. Molded end caps are provided to seal each end of a row against backfill intrusion.

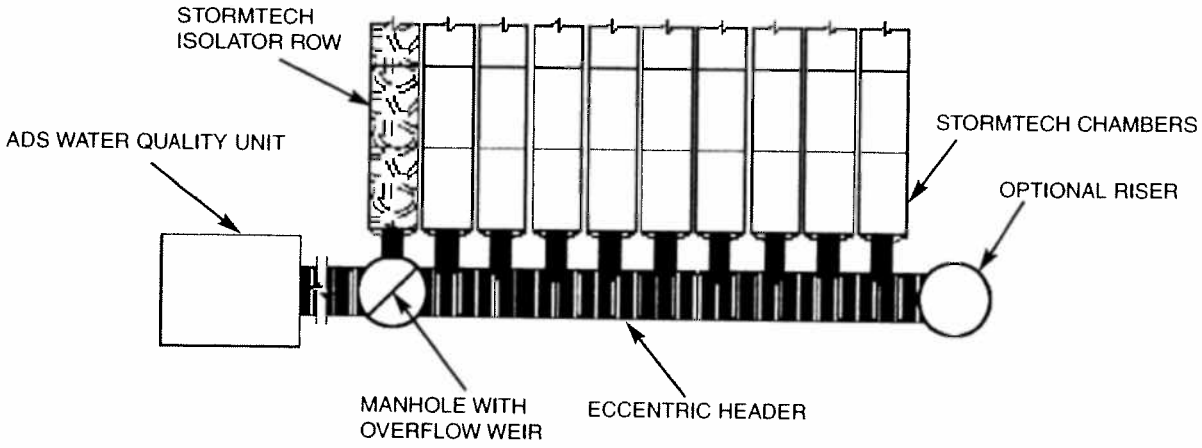
StormTech Isolator Row™ for additional TSS removal

Pre-treated storm water is inlet into selected chamber rows through the StormTech Isolator Row, often augmented by an eccentric header system. The Isolator Row is a patent-pending structure that acts as an extended detention basin, allowing water to exit through its surrounding filter fabric while sediment is trapped within. The Row inexpensively enhances TSS removal, and can be equipped with inspection ports for fast and easy maintenance and cleaning.

A manhole with an overflow weir should be installed at the upstream end of the Isolator Row. The manhole is connected to the Isolator Row with a short length of 12" (300mm) through 18" (450mm) N-12® pipe set near the bottom of the StormTech SC-740 end cap.

Treatment train inspection and maintenance

It is recommended that inspection and maintenance be initiated at the furthest upstream treatment tier and continue downstream as necessary.



Technical assistance available

Every drainage site has its own set of variables which affect Water Quality Unit selection. ADS engineers have developed a wealth of technical information on unit sizing and proper installation, much of which is published in ADS Product Note 3.140 (go to www.ads-pipe.com to download). Or you can talk to one of our water quality specialists to discuss your particular application parameters. Just call 1-800-821-6710.

ADS Sales and Service Locations

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- **MIDWEST/NORTHEAST**
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- **SOUTHERN**
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  1-800-733-9987
- **WESTERN**
  WASHOUGAL, WA
  1-800-733-8523
- **MANUFACTURING FACILITY LOCATIONS**

For more information on ADS storm water quality technology, log on to www.ads-pipe.com, or call 1-800-821-6710.

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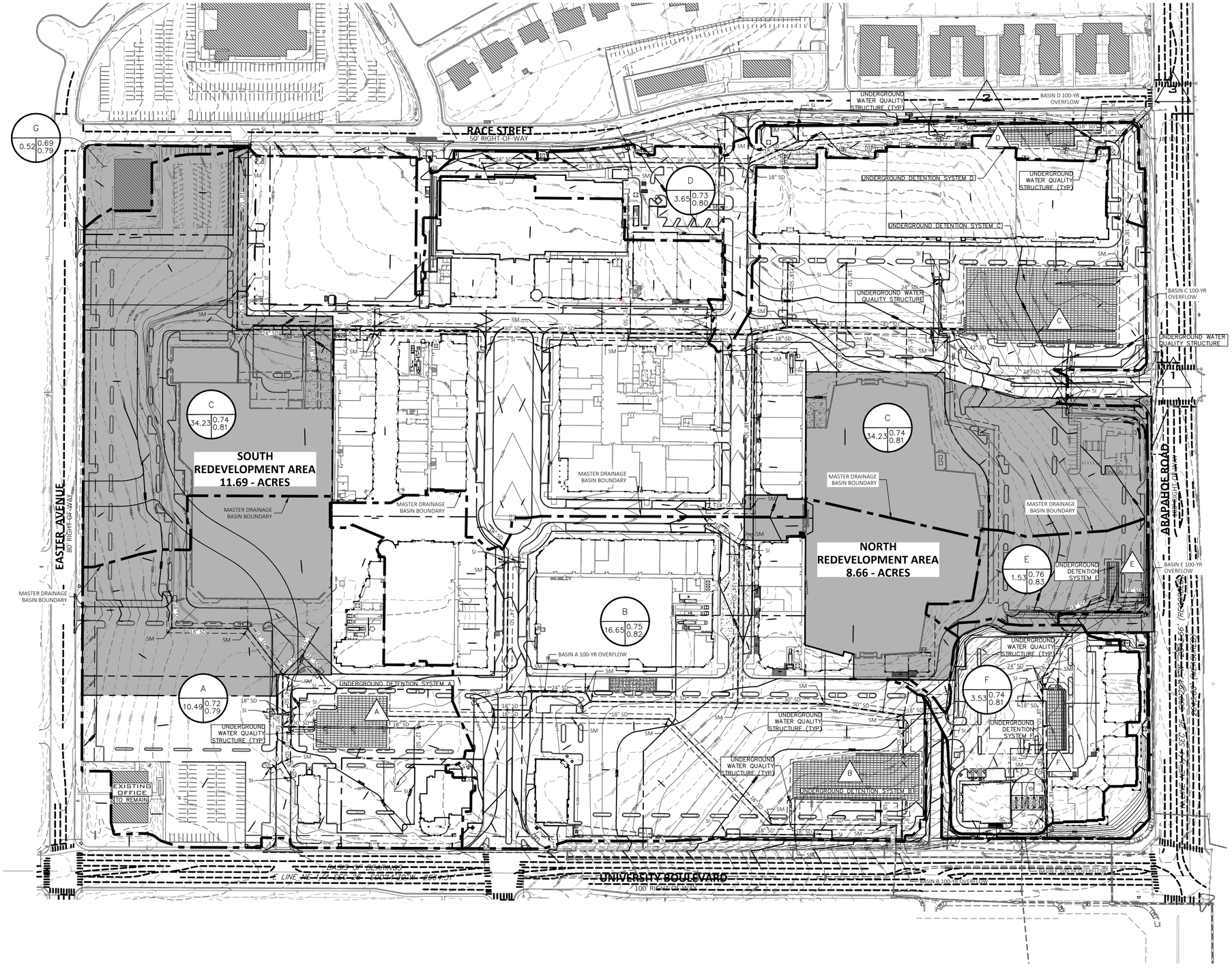

LEGEND

- PROPERTY LINE
- EXISTING CONTOUR
- 5560 EXISTING CONTOUR
- EXISTING LINE WITH MANHOLE AND INLET
- EXISTING UNDERGROUND DETENTION
- EXISTING WATER QUALITY UNIT
- EXISTING CURB AND GUTTER
- BASIN BOUNDARY
- REDEVELOPMENT AREA HATCH
- FLOW ARROW
- SI STORM SEWER INLET
- SM STORM SEWER MANHOLE
- A / B C D — BASIN DESCRIPTION
  A - DESIGNATOR
  B - AREA
  C - 10 YEAR RUNOFF COEFFICIENT
  D - 100 YEAR RUNOFF COEFFICIENT
- E — DESIGN POINT

BENCHMARK

BENCHMARK 1 IS PART OF THE ARAPAHOE COUNTY VERTICAL CONTROL NETWORK NO. 52 (TWN: 2077-24-3; BENORGN: AC-86-12) AND IS AN ALUMINUM CAP SET AT THE BACK OF THE WALK AT THE SOUTHEAST CORNER OF PEAKVIEW AVE. AND UNIVERSITY BLVD., SET AT THE SOUTHWEST CORNER OF AN INLET BOX. INLET BOX IS AT THE EAST CURB RETURN ON PEAKVIEW, 47.8 FEET SOUTHWEST OF A FIRE HYDRANT. ELEVATION: 5511.41' (NGVD 29)

BENCHMARK 2 IS A PK NAIL 1.18' NORTH AND 1.18' EASE OF THE CENTERLINE INTERSECTION OF EAST EASTER AVENUE AND SOUTH RACE STREET. APPROXIMATELY 25' NORTH OF THE SOUTH CURB LINE FOR EAST EASTER AVENUE. ELEVATION: 5589.63' (NGVD 29).

GENERAL NOTES

1. THIS DRAINAGE MAP SHOWS THE EXISTING DRAINAGE BASINS AND EXISTING STORM SEWER INFRASTRUCTURE. THE PROPOSED SITE IMPROVEMENTS AND ADDITIONAL OR MODIFIED INFRASTRUCTURE WILL BE DESIGNED AND SHOWN ON THE INDIVIDUAL SITE PLAN SUBMITTALS, ALONG WITH THE REQUIRED PHASE III DRAINAGE REPORTS SPECIFIC TO EACH REDEVELOPMENT AREA.
2. BASIN D ISN'T AFFECTED BY EITHER THE SOUTH OR NORTH REDEVELOPMENT AREA AND THEREFORE ISN'T INCLUDED IN ANY OF THE PROPOSED CALCULATIONS. THE VALUES SHOWN FOR BASIN D ARE FROM THE ORIGINAL PHASE III DRAINAGE REPORT.

BASIN SUMMARY

BASIN DESIGNATION	DESIGN PT DESIGNATION	AREA (ACRES)	C - 10YR	C - 100YR	% IMPERV.
A	A	10.49	0.70	0.78	84.2%
B	B	16.65	0.74	0.81	87.3%
C	C	33.04	0.74	0.81	87.5%
D	D	4.27	0.67	0.75	81.3%
E	E	1.30	0.76	0.83	89.3%
F	F	3.53	0.74	0.81	87.3%
G	C	0.52	0.68	0.79	75%

REDEVELOPMENT AREA BASIN SUMMARY

BASIN DESIGNATION	DESIGN PT DESIGNATION	AREA (ACRES)	C - 10YR	C - 100YR	% IMPERV.
A - SOUTH	A	4.06	0.68	0.79	75%
B - NORTH	B	2.50	0.79	0.85	90%
C - SOUTH	C	7.11	0.68	0.79	75%
C - NORTH	C	4.64	0.79	0.85	90%
E - NORTH	E	1.53	0.79	0.85	90%
F - NORTH	F	0.11	0.79	0.85	90%
G - SOUTH	C	0.52	0.68	0.79	75%

N

100 50 0 100

SCALE 1" = 100'

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DRAINAGE MAP

STREETS AT SOUTHGLENN

CENTENNIAL, COLORADO

DESCRIPTION
1ST SUBMITTAL
2ND SUBMITTAL

DATE
05.03.2021
09.17.2021

JOB NO. 19.048

DRAINAGE MAP

1 OF 1