Resiliency Through Restoration:
West Harbor Road/East Chew Avenue Flood Mitigation Feasibility Assessment and Conceptual Design

Town of St. Michaels, Maryland

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Background

The Town of St. Michaels completed the Harbor and Stormwater Infrastructure Study in early 2021 which identified the area around West Harbor Road and East Chew Avenue as a priority area to provide resiliency improvements. Both stormwater flooding and sea level rise are major issues impacting the resiliency of St. Michaels. The Study identified potential green, gray, or hybrid approaches to provide flooding and stormwater flooding mitigation against current conditions and future sea level rise and protect the residents, hotel, Town slips and associated parking along these streets. Potential solutions were identified but did not go as far as providing full concepts or community buy-in of specific practices in that area. The direct excerpts from the study are included as *Appendix A*.

This Resiliency through Restoration for West Harbor Road and East Chew Avenue Flood Mitigation Feasibility Assessment and Concept Design report details the process and decisions for the focus area. This moves beyond just potential ideas and determines solutions based on further analysis and community input. The improvements and options for reducing flood impacts are detailed in the report. The final concepts will integrate green and grey infrastructure improvements and reduce current and future flood impacts currently and beyond 2050 while maintaining access to the public docks, boat ramp, parking lot and West Harbor Road and East Chew Avenue. The feasibility of these approaches has been evaluated and the stormwater analysis is included as *Appendix G*.

In addition to this report, visualizations, cross sections and landscape renderings have been created so that residents and business owners can see how these changes would look in relation to current conditions along with concept designs that are included as a supplemental volume as smaller scale 11x17 plans, but the full size plans reside with the Town staff. The feasibility assessment and accompanying concept designs will directly lead into the final construction document design and permitting since public input, community buy-in and support, and constructability review are completed.

Resiliency for the Public Slip area is a concern due to the projected sea level rise of over 1.3' by 2050 per the Sea-level Rise Projections for Maryland 2018 by the University of Maryland Center for Environmental Science (Boesch, et al., 2023). The number of projected high tide floodings days is anticipated to be between 50-155 days per data provided by NOAA. That is well above the current rate of nuisance flooding in the area and if the number of impacted days of high tide flooding are realized, the focus area will

Works Cited

Boesch, D., Baecher, G., Boicourt, W., Cullather, R., Dangendorf, S., Henderson, G., Kilbourne, H., Kirwan, M., Kopp, R., Land, S., Li, M., McClure, K., Nardin, W., Sweet, W. (2023). *Sea-level Rise Projections for Maryland 2023.* Cambridge, MD: University of Maryland Center for Environmental.

be adversely impacted. Building resilience, mitigating high tide, storm, and sea level rise flooding impacts now and through 2050 while improving the aesthetic and usability of the focus area and making less likely to flood and impact public safety are key outcomes of these mitigation strategies.

Raising the bulkhead to a higher elevation to keep tidal waters off the upland areas is a simple and effective strategy until it is recognized that both stormwater flooding as well as tidal waters entering the focus area via the outfall pipes compounds the issues and increases localized flooding. These compounding issues in the focus area made identifying solutions more problematic.

Community Input

Public input sessions were important to understand the current uses, shortcomings, possible improvements, and desires of the residents, users, and stakeholders. The first roundtable was open to the public and was successful in gathering knowledge of the area. The next on-site meeting with the Watermen was important to analyze their usage and needs for the area.

Many of the overarching concerns were understood prior to the meeting (higher tides overtopping the bulkhead, storms inundating the stormwater network, small boat ramp underutilized and difficult to maneuver) but other issues and ideas arose from the public round table. One point brought to light was the lack of safe areas for pedestrians as it is a highly traveled area on foot. Many of the residents walk in the area and the visitors staying at the Inn walk to Town for shopping and to eat. Another issue brought up frequently was the intensity of the overhead lighting in the area along the existing parking. Below is a list of the issues that were heard and used to craft the conceptual plans:

- There is not a safe place for pedestrians to walk currently, so they will walk in the middle of the street and behind parked cars. Both residents that frequent the area for exercise and the Inn guests that stroll into Town for dinner and shopping are the predominant pedestrians frequently in the area.
    - The idea of a boardwalk at the back of the bulkhead was well received and liked by all that participated.
- The frequency of tidal inundation over the bulkhead has increased over the past few years. The surges are keeping the ditches connected to the stormwater system wetter for longer periods of time as well.
- The overhead power lines are obtrusive and unsightly.
    - The idea of antique lighting (like Muskrat Park) in the parking area with underground power lines was well received and offered as a solution.
- The “safety” lighting is too bright; the LED provides too much light and is a detriment to the area instead of illuminating it.

- The small boat ramp is very rarely used except for launching a kayak occasionally.
    - It is also the lowest point, allowing high tides and surge tides to enter Harbor Rd through the boat ramp first.
- The parking area is only close to full on summer Saturdays and Holiday weekends, although much of the Holiday parking is overflow from the Inn.
- Several times a day, especially at dusk, people will stop at the head of the slip area off East Chew Avenue St and take a picture looking across the water at the old Steak House on Mulberry St.
    - The idea of a pocket park or at least a bench area where many stop to take a photo was introduced and well received.
- Localized flooding and increased runoff is becoming more problematic in the focus area. Some of this is believed to be due to new construction, lack of maintenance on drainage infrastructure and ditches, and increased intensities in storms.
- There is not water or electricity available presently at the top of the bulkheads. Providing that can easily be designed as part of the new design.
- Raising the bulkhead is not a huge dealbreaker to boaters if accessible piers can be incorporated. If the piers were to be raised too high, getting on and off the boat at low tide in the dark will be problematic. Other areas have increased the height of the fixed piers, and it becomes difficult to unload full bushels and gear with the new height difference.
- Pedestrians wandering around the area were not a huge concern, but if there were a way to provide a safe defined area for them it would improve the area. And it would potentially keep the public and people wandering away from the workboats, gear, and rear of their vehicles.
- A few of the watermen have slips on the other side of the small boat ramp, where the signage for parking is different. If there was a way to group them all together in a line, it would be easier to have differing finishes and approaches to the redesign. A section can be utilitarian for the watermen then change to a more park-like feel for the recreational section.
- Parking on busy weekends was discussed. Overflow from the Inn next door tends to take over the spaces designated for the watermen sometimes before the time shown on the signage. This will be reviewed, and potential approaches investigated for the concept plan.
- Previous work done to the bulkhead and piers was performed during crab season. That was problematic for the watermen. A note will be made to perform the work when they are not active in this area to avoid causing issues with their daily work routine.

Concept Plans/Options

GMB crafted several options that were discussed with the St. Michaels Climate Change/Sea Level Rise Commission (CCSLRC). These were discussed as a team, with pros and cons of each option presented. The possible options were:

- Floating vs fixed piers
- Wooden boardwalk walkway vs brick paver walkway
- Elevation of the bulkhead vs installation of a berm behind the current bulkhead location
- Boardwalk at top of bulkhead vs a painted pedestrian walkway nearer the street
- Keeping West Harbor Road Rd intact vs elevating the entire roadway to improve stormwater runoff
- Eliminating parking vs putting back essentially a similar number of spaces
- Providing flood protection to elevation 4.0’ or elevation 5.0’.

From the discussion, the ideas were narrowed to two options: one with a vegetated berm and walkway on top (Option A) and another raising the elevation of the bulkhead in its current location with a walkway at the top of the bulkhead (Option B.) There were some minor other differences within the two plans, but they could be interchanged or applied to either option. These two options were presented to the public at the library in July where a lot of information was discussed, and the options dissected individually. After this point, a concise focus of individual selections was pushed forward for a final concept plan.

Recommended Improvements

Upon reviewing the options with Town of St. Michaels stakeholders, the pros and cons as well as the costs/maintenance/lifecycle of the options were reviewed and analyzed. The following items/decisions were chosen to make up the final concept plan:

- New bulkhead raised to elevation 5.0’ in the same location
- Closure of the small boat ramp
- 5’ wide pedestrian walkway at the top of the new bulkhead to create a promenade
- 2 bioretention/rain garden areas to satisfy Critical Area requirements of stormwater management treatment for the redevelopment project
- Reduction of parking spaces while maintaining the 2 boat trailer parking spaces in the current location at the northern portion of the site.
- Introduction of green space between the walkway and the parking spaces
- Low-level bollard-type lighting along the new walkway
    - Removal of the overhead lighting currently present, especially at the corner of East Chew Avenue and West Harbor Road
- Allowance for installation of water bibs between slips
- Provide an area for a pocket park along East Chew Avenue

- Install tide gates on the 7 outfall pipes to the harbor
- Install individual small-scale pump stations on each of the 7 discharge pipes to assist with stormwater flooding in the area. In follow up meetings, the issue of a large-scale pump station versus the individual systems was discussed in depth. This issue is also detailed in the Stormwater Management Section and *Appendix G.*
- Improve the large boat ramp; raising it to elevation 5.0' at the top to provide a continuous elevation "wall" for flood protection in the area
- Removal of the shack currently situated to the north of the small boat ramp
- Consolidation of the watermen to the northern section of slips
- Provide a kayak launch area off East Chew Avenue
- The extents of the construction would stop at the edge of the current valley gutter along both West Harbor Road and East Chew Avenue, essentially keeping the limits of disturbance strictly on the Town's property and not crossing into adjacent Rights-of-Way or private property. The focus area remained on the parcel owned by the Town of St. Michaels.

The memorandum detailing and outlining the desired options from the CC/SLRC of St. Michaels is included in *Appendix B*.

Recommended Concept Design Criteria

The initial study as well as the grant solicitation for this design exercise utilized the idea of achieving an elevation 4.0' above MSL for resiliency towards 2050. Upon further discussions and research by members of the Waterways Management Advisory Board, the CC/SLRC, and Town of St. Michaels, the level of protection and desired top goal was increased to elevation 5.0'. This proved to be a little more challenging, but not impossible. The neighbor on the corner of East Chew Avenue recently updated his bulkhead and was able to achieve a top elevation of the new bulkhead of +/-4.5' with low lying yard elevations.

Once the elevation was determined, the choice was between keeping the bulkhead (newly replaced in-kind) with a top elevation of 3.0' and providing a 2' high berm sloping away at 3:1/4:1 into the existing parking area or to simply elevate the bulkhead to elevation 5.0'. The concern with the berm was the maintenance, trash collection, viability of the grass and cutting of it, and the biggest one: erosion. While berming along the water's edge and providing green space along the shoreline has been a technique utilized for decades, finding a similar installation with a berm on top of a bulkhead proved to be nearly impossible. Mixing the 2 techniques of the berm and bulkhead may appear like a sound strategy, however the actual installation and logistics has a high potential for negative impacts in the future. If the berm were to wash away due to a higher tide above the bulkhead, the mitigation practice loses its effectiveness. In addition, the infrastructure

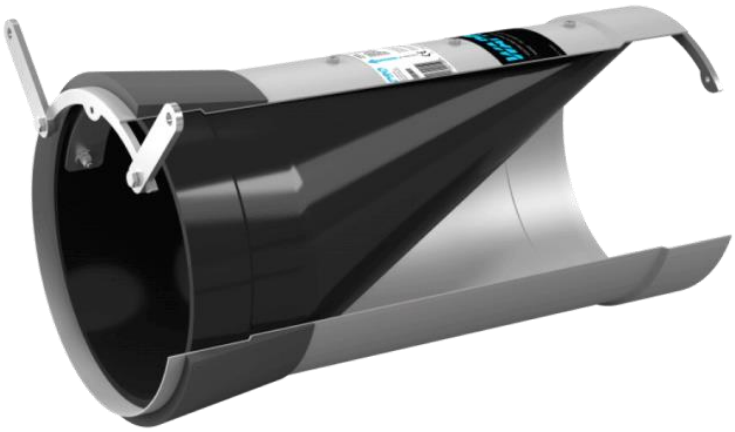
damage potential to the walkway and the parking lot could serve as a financial burden on St. Michaels.

Raising the bulkhead has its own challenges. Anytime a higher wall is created along a body of water, a dam of sorts is created behind it causing ponding of stormwater runoff. This case is no different. Showing and understanding a raised bulkhead is a simple concept. Managing the stormwater on the area behind the raised bulkhead without raising the entire area is the challenging issue.

Flood Mitigation Strategies, Recommendations

Tide Gates

The seven existing outfalls to the marina waters as shown on the plans do not have tide gates installed at this time. This is both a good and a bad thing currently. When the tide levels are lower, the SWM runoff can easily enter the open waters without hindrance. When tides are higher, the tidal waters can freely travel up the outfall pipes and surcharge the catchbasins and other collection points along their network. Some of these entrance points that are frequently inundated with tidal waters are along Meadow Avenue, and when the tide level is above elevation 2.0' the backyards experience tidal flooding. Without tide gates, there is nothing stopping the free flow of water up the pipes and into these ditches. Installation of tide gates will limit the tidal waters flooding the lower upland areas such as the catch basins and ditches along the network. However, with this mitigation strategy the stormwater issue becomes more detailed. Having a tide gate on the outfall requires a certain head pressure (height above the tidal water level) to open the gate and discharge the stormwater to the open waters. This is typically between 12" and 18" of head. When the tide is at the same elevation of the rims of the catch basin, there will not be enough head pressure to open the gates and localized flooding will occur.



Example of a Wapro tide gate/backflow preventer to be installed in each of the 7 discharge pipes.

With sea levels rising, backflow flooding in the private yards from the tide will become more frequent. To combat this, tide gates will be needed. In placing the tide gates, the open discharge of stormwater that is achieved now will be disrupted. The next section discusses the strategies and approaches to battle the stormwater flooding locally in the focus area. But, ultimately, the tide gates/backflow preventers will be needed to mitigate tidal flooding and provide resilience to the focus area into the future.

Stormwater Management

The flooding realized in St. Michaels comes from tidal surges as well as stormwater runoff. The tidal flooding will be addressed with the raising of the bulkhead as well as tide gates. This leaves the stormwater runoff flooding to be addressed. The area around the Public Slips is affected by stormwater flooding on an increasingly frequent basis. To provide a solution, the existing stormwater management network needed to be evaluated. GMB analyzed the area draining to and through the public slip area. Overall, there are 52 acres of St. Michaels and adjacent lands discharging to the open waters though the 7 outfall pipes. Many of the outfalls are just 12” in diameter and only carry water from the edge of West Harbor Road Rd to the bulkhead. There is also a portion of the high school property that ends up discharging to the marina area.

Drainage Area Map to the Focus Area

With sea levels projected to rise around 1.4’ by 2050, the focus area can be made more resilient with some improvements. Addressing the sea level rise and tidal surges with the raised bulkhead and tide gates will alleviate the majority of daily flooding outside of storm surges that bring higher high tides. Only when the tide level is over 5.0’ will the new bulkhead be overtopped. The remaining approaches will address the resiliency of the focus area as it pertains to the flooding occurring from stormwater runoff, which may occur at low tide, high tide, or during tidal surges from storms.

There are not any impoundments, ponds, intentional blockages, or tide gates to impede the flow. That works both ways. The stormwater can drain into the harbor area freely, and the tide can freely flow into the pipe network. During low tides this free flow aids in quick drainage of the stormwater as it simply goes through the piping into the open water via the natural head pressure and does not back up unless there is an intense downpour. Without ponds, there is no detention capacity in the systems or the network. The runoff makes its way to the Public Slip area, enters the catchbasins, and is overboard into the open waters. When an intense rainfall occurs, there is a large amount of runoff entering the individual systems, which frequently causes temporary ponding outside the catchbasins.

The initial Harbor and Stormwater Infrastructure Study speaks to the potential for a large-scale pump station for stormwater runoff. The area identified as a possible site was under the parking area along East Chew Avenue. When performing the current analysis, it was discovered that only the 3 or 4 outfalls along East Chew Avenue could easily be connected to a cistern/pump station system if placed in this area. Connecting the additional discharge pipes is nearly impossible due to the spread of the catch basin locations. There would need to be a piping network run from the large boat ramp all along West Harbor Drive to East Chew Avenue. Further, the volume needed to store an amount of runoff from the 52 acre drainage area would be way larger than the space available. With new bulkheading and the associated tie backs, installing a cistern and large-scale pump system would be an exercise of squeezing new large-scale infrastructure into the area without the capacity for it. This would result in a detriment to the area while only solving the stormwater flooding on lower intensity rainfalls. The backup generators would need to be above ground and be placed where the Park has been identified for the revitalization. And a large pump station could cost above $2million and only solve a portion of the stormwater water flooding and only at lower volume rainfall events.

In order to provide proper SWM runoff storage in the public slip area (NOT just the parking along East Chew Avenue,) there is not enough area to install a cistern to contain the runoff from the 52 acre drainage area prior to manipulating the runoff with a large-scale pump station (or two.) The cost-benefit ratio does not compute. During the analysis of the runoff to the focus area, 4 of the existing 7 outfalls are functioning as desired and will continue to do so with higher tides if assisted with smaller pump systems. The other 3

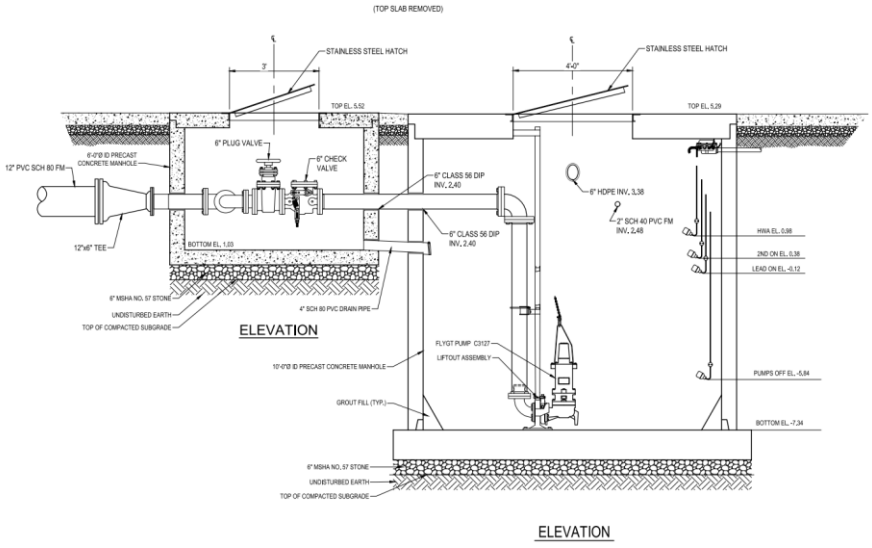
become inundated at the present time and will continue to function at less than desired levels in the future. Connecting any of the 4 that are functioning properly to a large-scale system is finding a problem for the solution. There is no reason to alter the ones that are functioning as intended and will continue to function as such into the future with sea level rise and assistance from individual pump systems.

To provide a resilient solution, small-scale individual pump station systems are proposed for each of the outfall pipes. This provides a solution that is manageable, cost-effective, less burdensome on maintenance, and won't create a full disaster if failure were to occur. It should be noted that there is not a silver bullet or elegant solution for the focus area that will completely eradicate flooding all together. All these strategies combined will provide a resilient solution that is manageable for the Town, area residents, and the stake holders. In the future, during extremely high tide events, there *may* be overtopping of the new bulkhead. However, the new elevation proposed of 5.0' for the bulkhead will provide flood mitigation for all but the highest of surges through its serviceable life. Regarding the stormwater, higher intensity rainfalls with heavy downpours in an extremely short period of time that have become more frequent for the region will have a temporary impact to the area, just as it does now. Currently, a heavy downpour, even at low tide, inundates the system and causes localized flooding for a short period of time. With small individual pump stations at each catch basin, they can be sized for runoff draining to them and aid in moving the water from the roadway area to the open waters. In effect, they will act as a bilge system for each catch basin. As discussed in the tide gate section, the head pressure is an issue and will be even more so in the future with higher tide levels. The runoff will need to be mechanically manipulated to remove it from the surface to the open waters. Short of elevating the entire area and the specifically the area around the catch basins (much of which was recently improved as part of the rebuild of West Harbor Road) or providing a costly large-scale pump station (or two) the individual pumps provided at each catch basin makes the most sense and provides flood mitigation to the area caused by rainfall runoff.

The next phase for final construction documents will completely identify the size and number of pumps needed for each outfall. Each system will be evaluated for the drainage area to that outfall and pump sizing and number properly determined. Each unit has its own drainage area currently. Altering these drainage areas would require a massive effort to modify drainage patterns for the 52 acres, outfall locations, permitting, and buy-in, both in the form of support and fiscal contributions. For this concept plan, general vault sizes are shown on the plan over top of the outfall pipes. The pump(s) can be installed in these vaults with access hatches on the surface to install, service, or replace the pumps. A control pedestal can be installed at the head of the parking space easily. And a small diameter (2" to 3") discharge pipe can be run parallel to the existing outfall pipe to discharge the pumped runoff to the open waters. This approach has been discussed with MDE and will not require additional permitting for the individual pumps or their outfalls to the tidal waters. Each individual system will draw down the runoff to each catch basin,

maintaining the existing drainage patterns. And will serve as a bilge pump for each system moving the water overboard to the open waters at a quicker rate than waiting for the head pressure to alleviate the standing water or evaporation to serve to remove the standing water. Again, this will not completely alleviate flooding in the vicinity but will greatly improve the situation during rainfall events at high tides in the future.

Isolating the outfalls and fitting them with smaller pumps individually will allow for control of each one independently. It is possible that several of the stations will receive the same size pump and vault. This would provide ease of having back up pumps available for more than one system. However, final design will determine the actual number of pumps and individual sizing required for each outfall. Sizing will be based on the peak flow for the 2-year rainfall event while considering the storage in the vault, depth to pumps, peak runoff times and rates to the system, and elevation of the catch basins. The smaller pump station units will not completely alleviate temporary flooding on occasions, but neither would the large-scale system that would require much more space, cost, and maintenance. The smaller units will have vaults that will allow for additional pumps to be installed in the case that sea level rises faster than predicted or if the runoff to the individual catch basins increases or functions differently in the future due to development, alterations in the drainage area, or fluctuations in the weather patterns and more intense storms become more common. During rainfalls at lower tides, the outfalls will continue to function as they do currently. In the future, as the head difference between the catch basins and the tide level becomes more problematic, additional pumps can be added easily. Individual pump sizing and number of pumps to handle the 2 year and the majority of a standard 25-year rainfall event will be determined and sized for the permitting and construction phase.



Example of an individual Pump Station system recently installed on the Eastern Shore

Hardscape Improvements, Recommendations

Bulkhead

There are 3 different sections of bulkhead currently in place. The portion around East Chew Avenue to the bump out along West Harbor Road is the oldest and will need to be replaced in the near future. The next is the section from the bump out to the small boat ramp. And then the last section between the small and large boat ramps. While proposing to raise the bulkhead and provide flood mitigation to the entire area, all the bulkheads must be replaced at the same time. Phasing is not a viable option to provide resiliency and mitigate the adverse effects of tidal flooding. Installing vinyl sheet piling like Shore Guard will offer a long-lasting solution for the bulkhead's lifespan.

Example of a shore Guard vinyl sheet piling bulkhead with wooden top cap. The top cap can be expanded to encompass the boardwalk.

Piers and Pilings

The current finger piers are in various conditions with various sizes. With the renovation, new piers with new pilings should be installed. To ensure a consistent lifecycle all items should be replaced with a consistent size and finish. Installing new pilings in the same location as the current piles can provide a long lifespan and service life of the pilings. It

also allows for easy permitting as the location of the piles will be the same. When installed, they should be taller than the current height cut off at an elevation of +/-8.0’ to allow for the piers to be elevated vertically over the life of the public slip area and to accommodate sea level rise in the future.

The finger piers are situated at the same elevation as the top of the bulkhead now; approximately elevation 3.0’. When the bulkhead is raised to elevation 5.0’ to provide flood protection the piers cannot be raised to this height now. Logistically, raising the finger piers 2’ with the current tide levels would not work getting on and off boats. With current low tides below 0.0’ there would be a difference of over 5’ between the boat and the finger pier. The elevation decided for the piers to be installed is 3.8’, which provides an elevation slightly higher than the current finger piers and only 2 steps down from the top of the proposed bulkhead/boardwalk. Over time, as sea level rises, the piers can be moved vertically to accommodate the additional water and keep the piers dry for access to the boats. This ability to be modular and altered easily removes the requirement for rebuilding or permitting in the future. The infrastructure: pilings and finger pier structures, will be present and will just need to be reinstalled at a higher elevation.

Floating piers were discussed, but the cost and additional width needed for proper use prohibited their inclusion in the design. They require ramps instead of static wooden steps. And the suggested width for installation in a public facility per the manufacturers is 4’ to provide adequate buoyancy and stability. The current piers to be replaced vary in width, but many are in the 3’ in width or less range.

Example of a local boardwalk with a step down pier similar in width to the Public Slip area

Finishes/Treatments

In the discussions, the consensus on the 5-foot-wide elevated walkway to be installed at the top of the new bulkhead was to be wooden in nature. Other options could be porous concrete or pervious brick pavers, however, these add maintenance concerns and cost to the installation. Having a boardwalk is a common finish for a walkway around water and will fit in with other walkways around St. Michaels.

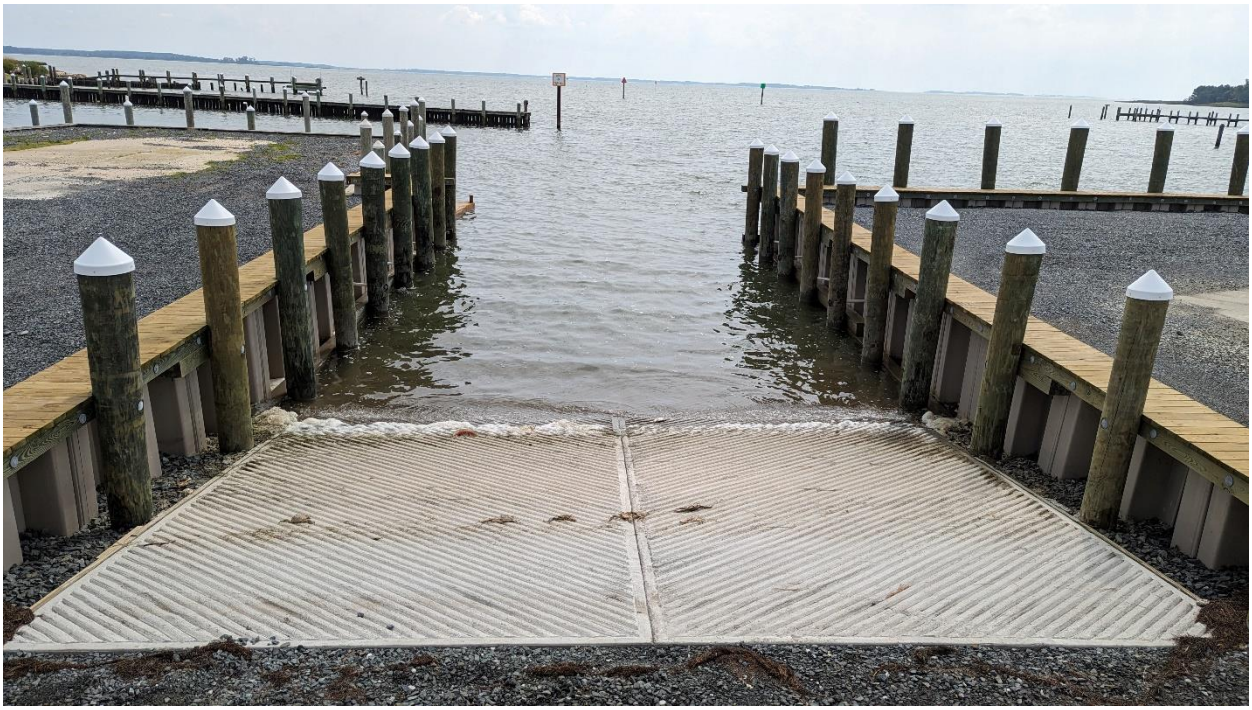
Example of a boardwalk promenade at the top of bulkhead

Boat Ramps

The small boat ramp in the middle of the project site along West Harbor Road is underutilized and difficult to maneuver. It was constructed utilizing DNR funding initially. However, DNR also funded the larger boat ramp at the end of West Harbor Road. If is desired to remove the small boat ramp since it is underutilized and is the lowest point along the roadway, allowing tidal waters onto the roadway and flooding first. Upon initial discussions with DNR, it has been determined that closing the small boat ramp will not be an issue with them nor cause any hardship for the Town. These discussions are ongoing between members of the CC/SLRC and DNR to ensure the Town follows proper procedures in closing access to the small boat ramp.

The large boat ramp currently has a top elevation of approximately 3.4'. To ensure a consistent flood proofing edge along the project, this will need to be raised to elevation 5.0'. In achieving this top elevation consistent with the bulkhead, a new ramp will need to be constructed with a similar top line location, just raised. This will push the toe of the ramp channelward. DNR and MDE are revitalizing several ramps currently and

understand the need for flood mitigation and raising of elevations. A full design meeting the 14% slope on the ramp will be needed with submission to MDE for their review and approval. As the large boat ramp was funded by DNR, they will be involved with the alterations and improvements to the ramp.



Example of a newly completed boat ramp designed by GMB

Parking

The current parking layout has 48 usable spaces, not including room for additional parking spots where the shed is located. The parking area now is nearly 100% impervious while also stretching from the concrete valley gutter to the back of the existing bulkhead, which is anywhere from 22’ to over 30’ deep. An informal parking study was performed by CC/SLRC members during the summer at peak usage times. These results are included in *Appendix D*. The proposed plan shows 42 spaces, head-in parking, with 4 spaces shown at 18’x9’ and the remaining at 20’x9’. This also includes 2 handicap accessible spaces required for a public facility.

The parking area has been shown to be paved. There have been discussions of a pervious material, however with the low elevations of the parking area, there are concerns of ground water seeping up and through the porous treatment. The current drainage patterns are not being altered. The water will still drain to the catch basins. Installing a permeable surface in the parking spaces would reduce a minimal amount of runoff as it will just be the rain running off the spaces themselves that will be reduced. Installing a more expensive and maintenance intensive surface does not seem to make sense with

the limited positives it would provide, although it could be evaluated and bid as an alternative installation. A brick paver surface could be installed to match the parking spaces at Muskrat Park, but the cost would be higher than simply pavement. As detailed below, the stormwater management requirements have been covered in the raingardens. Any additional pervious surface in the parking area is to provide increased green space as well as a reduction in the impervious surface.

Area Lighting

The residents in the area brought up the extreme lighting coming from the cobra head fixtures on the existing power poles. To combat this bright lighting, low level bollard lighting along the path has been proposed. After installation, the level of lighting needed for the area should be reviewed, as the cobra headlights may not be needed, or the intensity of the lighting in them could be reduced. The highest use during dark times needing lighting will be the pedestrians in the vicinity. With the new installation of the boardwalk, the low-level bollard lights make the most sense to light the walkway. There are other areas in St. Michaels that currently have similar fixtures installed, and that theme/style could be continued in the Public Slip area.

Example of bollard style 360 lighting for boardwalk*

Greenscape Improvements, Recommendations

Critical Area

With work proposed within 100' of the shoreline/tidal waters, Critical Area requirements and review kicks in. To meet the requirements of their code, a bit of stormwater management is needed. Two raingardens have been proposed within the old parking area. Between the two raingardens, there is 90sf of surface area that is treating approximately 2,220sf of direct drainage area off Harbor Road. Per *Appendix E*, the 10% worksheet spreadsheet result show this is sufficient for the SWM requirements of Critical Areas. The raingardens will need to be constructed with the biomix per the MDE standards and planted with native species. It is suggested that fall planting for both raingardens will lead to the best chance of success, however spring plantings can also be accomplished prior to opening of the slips for the season.

The amount of impervious area has also been reduced in the focus area. With a total lot area of approximately 32,115sf, there is currently 31,530sf of impervious cover for 98%. The proposed plan, with the raingardens and the green planting spaces, has an impervious cover of 66%.

Example of a raingarden retrofit in previous parking area.

In addition to the raingardens, green areas between the boardwalk and the parking spaces are proposed. These will soften the area, reduce the amount of impervious surfaces, provide some stormwater treatment for a minimal area, and create an aesthetically pleasing area out of a currently monotone area. All of these improvements will enhance the public space while meeting the Critical Area requirements.

Final planting plans for the raingardens will include native non-invasive species approved for installation throughout the Chesapeake Bay region and in the planting zone for St. Michaels. Examples of native species that can be planted include Alumroot, Black-eyed

Susans, Butterfly Weed, Blue Sedge, Wool Rush, Yellow Indiangrass, Common Witchhazel, Inkberry Holly, Northern Bayberry, and even Serviceberry. These can be planted in both the raingardens as well as the planting strips and are subject to availability as these species have become more popular for their inclusion in greening projects, retrofitting stormwater projects, and private home use for native species and pollinator gardens due to their ability to thrive in proposed conditions, current climate, and ese of care.

The worksheets for the Critical Area Submission indicate that the area provided on the concept plans sufficiently meets the SWM requirements of the Critical Area submission have been included in the *Appendix* to this report. These worksheets are included in *Appendix E*.

This site has no official records for State or Federal listed, candidate, proposed, or rare plant or animal species within the project area. The letter from Maryland DNR Wildlife Heritage Service is Included in *Appendix F*.

Adjacent Areas

The new bulkhead will need to be tied to the corner bulkhead that has recently been replaced at 219 East Chew Avenue. This is a standard practice as it was tied-in previously and is accomplished every day with new bulkhead installations.

The area by the Inn on their property will need to be raised as well. This will require coordination with the owners to ensure the flood mitigation elevation of 5.0’ is achieved for a consistent mitigation elevation. Initial discussions have been held with the owner and they are receptive to working with the Town to ensure they continue the mitigation project from the corner of the big boat ramp to the corner of their Inn, ensuring that tides below 5.0’ will not flood the area as it does currently. More detail on the Inn property will be needed in the future to blend the project to their structure.

Pocket Park

Several of the people attending the initial public outreach session stated that several times a day they would see people stop along the bulkhead off East Chew Avenue and take a photo looking across the water northwest. This area is currently occupied by parking spaces. In conjunction with the reduction of parking spaces, introduction of the boardwalk promenade, greening of the entire project, and to encourage those wanting to enjoy the beauty of St. Michaels, the idea of a small pocket park along East Chew Avenue was born.

This is a found gem that needs to be properly developed as a true amenity for the Town of St. Michaels. The space could be developed utilizing a design contest, bidding for private programming and design through public input (RFP process), or by Town staff and stakeholders already on board. The area has been left a blank canvas for the park to grow into a feature for the area residents and visitors.

The adjacent roadway will remain untouched along East Chew Avenue. The new boardwalk will be installed at elevation 5.0' as the remaining areas. This allows for various levels within the park, if desired. It also allows for planting areas and greening. There could be benches with a hardscape pattern as a central feature. The options are wide open for the park, with the surrounding areas improved with a park in mind. There is nothing proposed in the concept plan for the remaining area that would hamper the development of the park or access to the area.

Permits/Approvals Needed

With redevelopment of areas greater than 5,000sf comes permitting submissions and reviews. This project will require review and approval from the following agencies for various portions of the project:

- Critical Area Commission (CAC)
    - Stormwater is required for the redevelopment. The above section details the requirements, and also includes the worksheets needed for submission to the CAC.
        - Once the final raingarden designs are finalized with the details, planting plan is completed, the submission can be made to the state for their review. This submission should be made once the construction documents are completed.
    - Forest Conservation plans will not be needed since the entire site is in the critical area buffer.
- Maryland Department of the Environment (MDE)
    - The large boat ramp will be reconstructed to raise its elevation 5.0' will require submission and review by MDE. This is a standard procedure as they review several per month, many of them submitted by GMB on behalf of our client.
        - Once the final construction documents are completed, the drawings and the permit application can be submitted to MDE for their review.
    - The new pumped discharges will need a review by MDE. However, they will not require new discharge permits (confirmed by MDE.) The existing discharges (7 of them) will remain. The new exits through the bulkhead will need to be reviewed by MDE. Splash pads will be needed on the discharges to avoid erosion.

        - Once the new pumps are designed, sized, detailed, and sorted, the submission to MDE can be made. United State Army Corps of Engineers will be copied on this submission; however, they typically defer to MDE reviews for any comments and approval.
    - With MDE permitting, a minimal amount of dredging is allowed basically as maintenance to the area. Over time the slips become hollowed out while piling up between them. To an extent, these areas can be leveled and dredged to improve the area. However, in providing access to boats for the future, an expanded dredging plan might be considered. Currently the issue of shallow areas has not been brough up. But this could be done as routine maintenance for the entire gut area, possibly with a cost share with the area users, to dredge the harbor channel area.
- St. Michaels Waterways Management Advisory Board (WMAB)
    - The new bulkhead is proposed to be replaced in the same location as the existing bulkhead. The WMAB will need to approve the bulkhead replacement. Outside of the new boat ramp, it is not sure if the bulkhead will require MDE permitting. It is our understanding that typically if a bulkhead is replaced in kind, the review time is extremely minimized, if required at all. Consultation with MDE will be required for understanding of their permitting requirements for the bulkhead during the next phase. This will be sorted prior to final permits/construction set completion.
- Maryland Department of the Environment (MDE) Environmental Review
    - A letter from Lori Byrne of MDE Wildlife and Heritage Service has been received stating that no official records for State or Federal listed, candidate, proposed, or rare plant or animal species exist within the project area. This letter is in *Appendix F*.
- Town of St. Michaels
    - Stormwater Management review will be covered by the raingardens and the Critical Area submission. This will check all SWM needed for the site
    - Grading plans will be reviewed by the Town. They have been involved in the process from the beginning.
- Talbot Conservation District
    - Sediment and Erosion Control plans for the final design will need to be submitted to the Talbot County Conservation District for their review and approval. These plans include standard items like silt fence, coffer dams, and inlet protections that need to be implemented during construction.
- Other considerations:
    - Electrical:
        - Providing power for the low-level bollard lighting will require a discussion with the electric provider. Many localities rent lighting fixtures located on public lands from the power company for a flat monthly fee. This could be the case on this project as well.

        - New electrical services will be needed for the pumps. A singular meter could be possible for this, with it set in the vicinity of the large boat ramp.
    - Water:
        - It is our understanding that the Town currently has funds for the installation of water pedestals. If the funding can be extended, the water pedestal installation can be accomplished during the overall construction to avoid any unforeseen issues by installing them early. Having to install new tiebacks for the bulkhead or electrical services for the lighting around water lines is not ideal.
    - Talbot County:
        - Since tide gates and pumps are proposed on the 2 stormdrain lines that come down Meadow St., reaching out to the Public Works Director for the county for buy-in is advised prior to completion of final plans.

Engineer's Estimate for Final Construction Documents/Permit Drawings

Remaining items for completion of plans for construction:

• Marine items:	
○ Design of new Bulkhead with top elevation 5.0'	$30,000
○ Redesign of the boat ramp to achieve elevation 5.0' at the top	$8,000
○ Drawings for pier replacement in-kind	$2,500
• SWM items:	
○ Pump vault design	$5,000
○ Pump sizing for each of the 7 outfalls	$25,000
▪ Including electrical and controls	
○ Tide gate design for each of the 7 outfalls	$1,500
○ Raingarden/bioretention area designs including plantings	$5,000
• Other considerations:	
○ Parking layout, ADA spaces, fine grading, access to the walkway, walkway design, pedestrian pathways and ADA compliance	$5,000
○ Bollard lighting layout and power	$5,000
○ Offsite grading to achieve a connection for elevation 5.0'	$1,000
• Submissions:	
○ Critical Area Commission	$1,000
○ Talbot County SCD	$2,000
○ Talbot county Public Works (SWM alterations to their discharges)	$1,500
○ MDE for discharges from the pumps	$2,500
	$95,000

Total cost estimate to complete construction documents and bid package with permit drawings: $95,000.

Potential Funding Sources for Final Design Drawings

There are a few grant programs that will fund flood mitigation and resiliency projects for public facilities. Nearly all programs will require St. Michaels and flood resiliency to be included in the County Hazard Mitigation Plan that is adopted.

The following is a list of potential funding sources to complete the full design and construction documents for permit submission to be prepared for implantation grant applications in the future. It is advisable to discuss federal funding options and programs with State Hazard Mitigation Officer (Caitlin Whiteleather is the current acting SHMO) and the FEMA Region 3 representative (Barbara Smith) as they typically change slightly from year to year.

FEMA Flood Mitigation Assistance (FMA)
https://www.fema.gov/grants/mitigation/flood-mitigation-assistance

- Utilized for Localized Flood Risk Reduction Projects
- Program typically opens in October and are due to the state for clearinghouse review in January for submission to FEMA by the end of February
- 75% federal share, 25% non-federal share
    - The non-federal can be Town reserves, other non-federally based grants, or a combination of in-kind services
    - This could be altered to 90%/10% if utilizing earmarked funding from the BIL

FEMA Pre-Disaster Mitigation (PDM) Grant Program
https://www.fema.gov/grants/mitigation/pre-disaster

- Requires Congressional Solicited Funding
- Limited to 100 projects (in FY2024)
- March due date, with Environmental and Historic Preservation review following, and National Technical Review if successfully completing previous reviews.

FEMA Hazard Mitigation Grant Program (HMGP)
https://www.fema.gov/grants/mitigation/hazard-mitigation

- Funds flood reduction projects and drainage improvement projects to reduce flooding
- Nature-based solutions are a bonus (the raingardens and greening of currently impervious spaces helps in this regard)
- States submit for funding on behalf of the Town as a sub-applicant
    - State will receive up to 15% of the first $2 billion
    - Requires a project to be sponsored by the State

FEMA Building Resilient Infrastructure and Communities (BRIC)
https://www.fema.gov/grants/mitigation/building-resilient-infrastructure-communities

- Program typically opens in October and are due to the state for clearinghouse review in January for submission to FEMA by the end of February.
- May not be the proper fit with simple infrastructure improvements

When submitting to the above FEMA grant programs, the project can also be submitted to the MDE Comprehensive Flood Management Grant Program which serves as the state clearinghouse for the FEMA programs. The CFMGP coordinates closely with the Maryland Department of Emergency Management (MDEM). MDEM is the lead agency to request federal funds through Federal Emergency Management Agency (FEMA), while Maryland Department of the Environment (MDE) is the lead for CFMGP, a State grant program. Federal Hazard Mitigation Assistance grant programs (incl. HMGP, BRIC, and FMA grants) may fund up to 75% of the cost of flood mitigation projects, while the remaining 25% can be evenly split between the State CFMGP and the local governments.

Maryland DNR CoastSmart Grants Gateway
https://dnr.maryland.gov/ccs/coastsmart/Pages/default.aspx

- Outcome 5 – State Waterways Improvement Fund Grants
    - Provide funding for improvements to public boating facilities
    - Could be applicable to the bulkhead, pilings, piers, and boat ramp construction
    - The next window for applying is the third quarter of 2024

Maryland DNR Community Parks and Playgrounds Program Grant
https://dnr.maryland.gov/land/Pages/ProgramOpenSpace/CPP-Grant-Process.aspx

- Funding for the design and future implementation of the public park

Engineer's Construction Cost Estimate

ITEM	Quantity		Construction Estimate	
	Number	Unit	Unit Cost	Total
Gen'l Demo	1	LS	$325,000	$325,000
Mobilization	1	LS	$75,000	$75,000
ENS Controls	1	LS	$5,000	$5,000
				$405,000
Backfill	500	CY	$40	$20,000
Planting/Mulching	9,300	SF	$5	$46,500
Top Soil	260	CY	$40	$10,400
Rain Gardens	2	LS	$18,500	$37,000
Paving	11,300	SF	$12	$135,600
Gravel sub-base	11,300	SF	$3	$33,900
Curbing	900	LF	$35	$31,500
Pump Vaults	7	Ea	$8,000	$56,000
Pumps	7	Ea	$10,000	$70,000
Discharges	7	Ea	$1,500	$10,500
Wapro Tide Gates	7	Ea	$12,500	$87,500
Bollard Style Lights	50	Ea	$2,500	$125,000
Kayak Launch	1	LS	$25,000	$25,000
				$688,900
Bulkheading	675	LF	$850	$573,750
Boat Ramp	1	LS	$350,000	$350,000
Piers/Walkways	4500	SF	$125	$562,500
Pilings	100	Ea	$500	$50,000
				$1,536,250
		subtotal		***$2,630,150***
		30% contingency		***$789,045***
		Grand Total		**$3,419,195**

Appendix A

Excerpt from the Harbor and Stormwater Infrastructure Study

For St. Michaels, MD

Completed by GMB in Early 2021

- Recommendations for the study area
- Vulnerability assessment and inundation maps
- Possible strategies and design costs for them

Report:
Regarding specific improvements to existing conditions and infrastructure, we recommend the following Strategies:

1. *The most extensive storm drain network entering the head of the Harbor crosses East Chew Ave and comes from the streets to the south of Chew. This area suffers from flooding during rainfall events, and even more extensive during intense rain during high tides. The parking lot at the head of the harbor along East Chew typically takes the brunt of the impact becoming inundated more frequently recently.*
    - *Increase the size of the pipes within the network; both in Chew and the network coming from Meadow St when those roads are due for maintenance or repaving.*
    - *Provide a cistern box with the parking lot along East Chew Ave. The discharge to the harbor can be controlled internally with a tide gate, not allowing the river water to adversely affect the stormwater drainage system. The runoff from the rain can be stored in the cistern and the pipe network, then discharged to the harbor when the tide recedes. Getting the standing water off the roadway will minimize adverse effects on the Town's roadways and private property. In addition, it will minimize standing water affecting vehicular traffic in the area. In the case of emergency vehicles or Town employees needing access, detours will not be needed.*

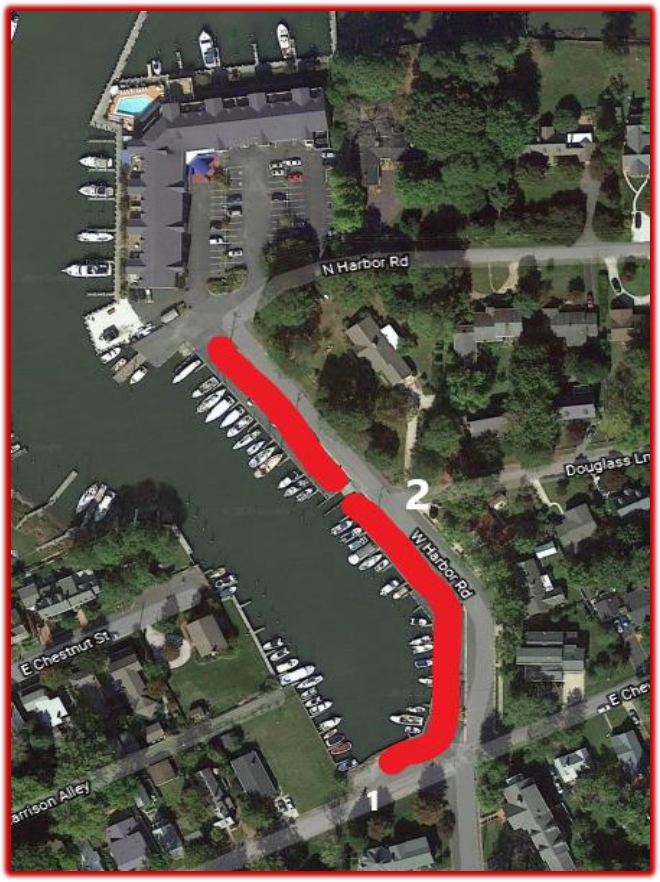
Approximate budget for cistern box design: $50,000
Possible funding sources: Chesapeake and Coastal Grants Gateway (CoastSmart) or G3 for design. WAG for design if there were additional green elements in the overall drainage project.

Representation of 1.31' of Sea Level Rise in 2050

2. *West Harbor Road would be appropriate for elevating; however, the street was recently reconstructed including the infrastructure underground. In lieu of elevating the recently completed street, a berm along the back of the bulkhead could be installed. The road could remain as one-way with parallel parking on the harbor side of West Harbor Road. This would maintain the access to the existing neighborhood homes and the hotel. The existing parking lot would be converted to an earthen berm, reducing the amount of impervious area, adding green infrastructure, and reducing the amount of rain runoff directly entering the River without treatment. The top of the berm can be elevated to protect the residences and Town infrastructure and be linked with the cistern element discussed above. While it is not critical that these elements be constructed at the same time, furthering their development and implementation should be linked as phases of the same flood mitigation project for that area.*

Approximate budget for earthen berm and West Harbor Road design: $25,000
Possible funding sources: Chesapeake and Coastal Grants Gateway (CoastSmart) or G3 for design. WAG for design if there were additional green elements in the overall drainage project.

Representation of a 4' tidal surge showing inundated areas



Area for Strategy 1 and 2

Appendix B

Findings from Public Input and Usage Meeting, March 30, 2023

- Area residents, users, and stakeholders were in attendance
- Roundtable inquiring about current issues, uses, and recommended improvements were discussed

St. Michaels Public Input Session Synopsis, March 30, 2023

George, Miles & Buhr, LLC (GMB) in association with the Town of St. Michaels held an informal public input session with the slip holders and residents in the vicinity of the Public Slip Area in Town. It was held at the Boy Scout Cabin just a block from the focus area from 4pm to 7pm with an open-door policy. The session was advertised on the Town website along with notifications sent out via constant contact to those that are on the distribution list.

The session was well attended with a mix of residents and slip holders. Over 15 citizens were in attendance. In addition, many from the Waterways Commission, the Climate Change/Sea Level Rise Commission, and Town staff were also present, listening to the discussions and providing some feedback to the engaged citizens.

The basis of the session was to determine, without leading, what was currently a strong suit of the slip area, what needs to be improved, what's lacking, and what would be a final outcome to improve the area that the citizens would like to see. There were some overall items that stood out above others and were frequently brought to our attention without leading questions or answering together in a group:

- *There isn't a safe place for pedestrians to walk currently, so they will walk in the middle of the street. Both residents that frequent the area for exercise or the Inn guests that stroll into Town for dinner and shopping are the predominant pedestrians frequently in the area.*
    - *The idea of a boardwalk at the back of the bulkhead was well received and liked by all that participated.*
- *The frequency of inundation over the bulkhead has increased over the past few years. The surges are keeping the ditches connected to the stormwater system wetter for longer periods of time as well.*
- *The overhead power lines are obtrusive and unsightly.*
    - *The idea of antique lighting (like Muskrat Park) in the parking area with underground power lines was well received and offered as a solution.*
- *The "safety" lighting is too bright; the LED provides too much light and is a detriment to the area instead of illuminating it.*
- *The small boat ramp is very rarely used except for launching a kayak occasionally.*
    - *It is also the lowest point, allowing high tides and surge tides to enter Harbor Rd through the boat ramp first.*
- *The parking area is only close to full on summer Saturdays and Holiday weekends, although much of the Holiday parking is overflow from the Inn.*
- *Several times a day, especially at dusk, people will stop at the head of the slip area off East Chew St and take a picture looking across the water at the old Steak House on Mulberry St.*

    - *The idea of a mico-park or at least a bench area where many stop to take a photo was introduced and well received.*
- *Localized flooding and increased runoff is becoming more problematic in the focus area. Some of this is believed to be due to new construction, lack of maintenance on drainage infrastructure and ditches, and increased intensities in storms.*

Appendix C

Findings from Public Input and Usage Meeting with the Watermen that Dock in the Focus Area, April 11, 2023

- Area watermen that rent slips in the Public area were in attendance
- Discussions about improvements, their needs, and potential logistics for loading and unloading were discussed

St. Michaels Public Input Session with the Watermen Synopsis, April 11, 2023

George, Miles & Buhr, LLC (GMB) in association with the Town of St. Michaels held an informal public input session with the watermen that dock along the West Harbor Road bulkhead area in Town. It was held on-site in the parking lot behind the workboats. Three watermen were gracious enough to have an open discussion with us about the improvements to the slip area and the mitigation techniques against sea level rise and tidal surges.

Similar to the residents and slip holders session, they want the area to continue as a viable option for them. The current configuration presents easy access parking and a direct route to the crabbing areas in the Miles River. Some of the concerns and ideas presented by the watermen were:

- *There isn't water or electric available presently at the top of the bulkheads. Providing that can easily be designed as part of the new design. (The Town already has funding to install water to the slip areas and will most likely perform that work in the fall when there is less traffic, and a more concise idea of the new design is understood.)*
- *Raising the bulkhead isn't a huge dealbreaker to them if floating piers for access can be incorporated. If the piers and bulkhead were to be raised too high, getting on and off the boat at low tide in the dark will be problematic. Other areas have increased the height of the fixed piers and it becomes difficult to unload full bushels and gear with the new height difference.*
- *Pedestrians wandering around the area weren't a huge concern, but if there were a way to provide a safe defined area for them it would improve the area. And it would potentially keep the public and people wandering away from the workboats, gear, and rear of their vehicles.*
- *A few of the watermen have slips on the other side of the small boat ramp; where the signage for parking is different. If there was a way to group them all together in a line, it would be easier to have differing finishes and approaches to the redesign. A section can be utilitarian for the watermen then change to a more park-like feel for the recreational section.*
- *Parking on busy weekends was discussed. Overflow from the Inn next door tends to take over the spaces designated for the watermen sometimes before the time shown on the signage. This will be reviewed, and potential approaches investigated for the concept plan.*
- *Previous work done to the bulkhead and piers was performed during crab season. That was problematic for the watermen. A note will be made to perform the work when they aren't active at this area to avoid causing issues with their daily work routine.*

Appendix D

Parking Study Performed by Members of the CC/SLRC of St. Michaels

- Parking Study Breakdown by Members
- Parking Survey Tabulations

July 5, 2023

St. Michaels Harbor Parking Survey

Background

A parking occupancy study was conducted to determine parking usage along the Harbor area. The goal being to determine if the parking could be modified by the West Harbor Road/East Chew Avenue Flood Mitigation Feasibility Assessment and Conceptual Design work, currently being conducted by GMB consultants. The survey was completed for several weeks in June and through the July 4 weekend. The attached survey shows the dates, times, weather conditions and notes any special events that occurred. The weather was almost always sunny and conducive to maximum slip holder boat usage. A total of 16 parking counts were taken.

Currently there are 48 parking spaces along the harbor extending from the large boat ramp south along W. Harbor and around to E. Chew. There is only one dedicated trailer parking area which is adjacent to the watermen's shed.

The survey is broken down into three areas:

- The area closest to the hotel south to the small boat ramp.
- The area along W. Harbor Road from the small boat ramp to E. Chew Street.
- The area along E. Chew Street.

While the survey indicates whether the spaces were occupied by watermen or visitors' vehicles, the percentages noted include both. Counts were done at different times of the day to observe expected peaks as well as when typical parking usage might be expected. While on-street parking was not counted, it is noted that on-street parking opposite the harbor parking areas exists along E. Chew and along a portion of W. Harbor Road. *Note that an addendum has been added on the last page*.

Findings

Over the course of the survey, there were two special events in town. The CBMM Antique Boat Show was the weekend of June 16-18, and the fourth of July fireworks and children's parade was the weekend of July 1-4. As one would expect, usage of the parking areas was the greatest during these events. The maximum watermen usage of the parking near the hotel was typically five trucks, with one more waterman truck located just south of the small boat ramp and one waterman truck located at the intersection of E. Chew and W. Harbor. Only one time was a trailer

observed in a parking space. The rest of the occupied parking was either slip holders or visitors.

When there is a special event in town, such as the fireworks, Christmas in St. Michaels, and certain other popular events, parking throughout town is at a premium and one can never have enough parking spaces when hundreds of vehicles enter the town. However, for the other 350-360 days a year, there are unused parking spaces along the harbor, some of which might be repurposed as green areas and/or stormwater management uses. So, the question arises, do you base your planning on a few special events or do you base parking on normal everyday usage? And in this case, is hardscape and vacant parking along prime waterfront areas the highest and best use, or are there other more aesthetic and environmentally beneficial uses available?

Several years ago, some parking areas were signed to be occupied only by boat slip holders. During the survey there have always been spaces available in the area from E. Chew to the small boat ramp as the surveyed usage in that area never exceeded 50% of the spaces. Thus, it appears that boat slip users do not have a particularly difficult time finding parking near their boat.

Conclusions

One can extract one's own conclusions from the survey, but my observations indicate that the parking along E. Chew is lightly used with typical counts showing occupancy of well under 50%, except for the evening of the fireworks display. Therefore, the area could be largely redeveloped to a green area to help control stormwater management from the surrounding properties and streets. Two or three spaces to the west could be retained.

The area from E. Chew to the small boat ramp never had more than 50% of its parking spaces utilized, again except for the fireworks display, so there would seem to be an opportunity to create limited green spaces at intervals throughout this area. Plus, vehicles that may have formerly parked along E. Chew, could conceivably move to this area.

The parking from the small boat ramp to the hotel is primarily used by the watermen and overflows from the hotel. This area had parking counts of 100% occupancy on three occasions and 91% on two other occasions. This area should probably remain as is.

I would note that the zoning requirement for marine services requires 1 parking space per 10 slips, plus spaces for employees and retail floor area, which of course, would not apply in this situation.

Of the 48 spaces that exist today, in my opinion, somewhere between 35-40 spaces would adequately serve the parking needs of the slip holders, watermen and visitors. On special event days, parking at the school or on-street parking along nearby streets could be a reasonable alternative for visitors.

Dennis Glackin

Addendum

Roy Myers took an additional parking count the evening of July 1 at 7:30 pm prior to the fireworks. His count has been added to the table of parking occupancy for 7:30 that evening when many people come to the harbor area to watch the fireworks. His count shows virtually every space occupied in connection with the special event. Also please note that there were more vehicles squeezed into the area between the large boat ramp and small boat ramp than are spaces and include cars parked on the street next to the shed. Roy also noted that there were 6 cars parked on East Chew starting at David Parkerson's house going toward Talbot and an additional 2 cars parked on the opposite side of the street. There were 7 cars parked on the opposite side of West Harbor Road from the harbor starting at East Chew and going up to the next side street. I think we would all agree that this is probably the worst-case event for parking along the harbor area.

West Harbor Road and East Chew Avenue
Harbor Parking Study

July 5, 2023

Date	Time	Weather	# of spaces	# of Vehicles Waterman Area	% used	# of spaces	# of Vehicles Area South of Small Boat Ramp	% Used	# of spaces	# of Vehicles Area Along E. Chew	% Used	Notes
6/10/2023 Saturday	11:08 AM	Sunny	11	4 Watermen 3 Visitors	64%	27	2 Watermen 0 Visitors	7%	10	0 Watermen 1 Visitor	10%	
6/11/2023 Sunday	12:40 PM	Sunny	11	1 Watermen 1 Visitor	18%	27	0 Watermen 0 Visitors	0%	10	0 Watermen 0 Visitors	0%	
6/11/2023 Sunday	2:00 PM	Sunny	11	1 Watermen 0 Visitors	9%	27	2 Watermen 1 Visitor	11%	10	0 Watermen 1 Visitor	10%	
6/13/2023 Tuesday	1:30 PM	Sunny	11	4 watermen 0 Visitors	36%	27	1 waterman 0 Visitors	4%	10	0 Watermen 1 Visitor	10%	
6/16/2023 Friday	1:45 PM	Sunny	11	5 watermen 6 Visitors	100%	27	2 Watermen 4 Visitors	22%	10	0 Watermen 1 Visitor	10%	Antique Boat Show Weekend
6/16/2023 Friday	4:45 PM	Sunny	11	1 Watermen 9 Visitors	91%	27	1 Watermen 4 Visitors	19%	10	0 Watermen 0 Visitors	0%	Antique Boat Show Weekend
6/17/2023 Saturday	10:30 AM	Sunny	11	3 watermen 2 Visitors	45%	27	1 Watermen 8 Visitors + 1 trailer	37%	10	0 Watermen 0 Visitors	0%	17 trailers parked at school Antique Boat Show Weekend
6/17/2023 Saturday	4:40 PM	Sunny	11	0 Watermen 11 Visitors	100%	27	0 Watermen 13 Visitors	48%	10	0 Watermen 4 Visitors	40%	Antique Boat Show Weekend
6/18/2023 Sunday	4:05 PM	Sunny	11	0 Watermen 7 Visitors	64%	27	0 Watermen 8 Visitors	30%	10	0 Watermen 5 Visitors	50%	Antique Boat Show Weekend
6/22/2023 Thursday	12:30 PM	Cloudy	11	2 Watermen 0 Visitors	18%	27	1 Waterman 2 Visitor	11%	10	0 Watermen 0 Visitors	0%	
6/24/2023 Saturday	12:00 PM	P. Cloudy	11	4 Watermen 1 Visitor	45%	27	1 Watermen 4 Visitors	19%	10	0 Watermen 3 Visitors	30%	

Note: Percent utilized includes watermen and visitors

West Harbor Road and East Chew Avenue

Harbor Parking Study

July 5, 2023

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	R	S
38																		
39	6/25/2023	4:00 PM	Sunny		11	0 Watermen	36%		27	0 Watermen	26%		10	0 Watermen	30%			
40	Sunday					4 Visitors				7 Visitors				3 Visitors				
41																		
42	6/27/2023	7:00 PM	Cloudy		11	1 Watermen	9%		27	0 Watermen	7%		10	0 Watermen	0%			
43	Tuesday					0 Visitors				2 Visitors				0 Visitors				
44																		
45	7/1/2023	2:30 PM	P Cloudy		11	0 Watermen	36%		27	0 Watermen	33%		10	Watermen	90%	Some hotel overflow		
46	Saturday					4 Visitors				9 Visitors				9 Visitors				
47																		
48	7/1/2023	7:30 PM	P. Cloudy		11	18 Visitors	164%		27	25 Visitors	93%		10	10 Visitors	100%	Fireworks		
49	Saturday																	
50																		
51	7/2/2023	6:30 PM	Sunny		11	0 Watermen	91%		27	0 Watermen	44%		10	0 Watermen	60%			
52	Sunday					10 Visitors				12 Visitors				6 Visitors				
53																		
54	7/4/2023	10:30 AM	Sunny		11	2 Watermen	18%		27	1 Watermen	7%		10	0 Watermen	40%	Children's Parade		
55	Tuesday					0 Visitors				1 Visitor				4 Visitors				
56																		
57									**Existing Spaces 48**									

Note: Percent utilized includes watermen and visitors

Appendix E

Critical Area Calculations and 10% Spreadsheet

- Calculations Summary
- Raingarden Analysis

Calculation Summary

Critical Area 10% Calculations

Removal Requirement, RR (lbs P / yr)	**-0.18**
after non-structural and micro-scale BMPs (Steps 5 and 6)	
Total Load Reduction (lbs P / year)	0.12
Total Load Reduction Remaining (lbs P / yr)	**0.00**
after structural practices (Step 9)	
Total Load Reduction (lbs P / year)	0.12
Total Load Reduction Remaining (lbs P / yr)	**0.00**

MDE's ESD to the MEP Calculations

ESD Runoff Volume, ESDv (cf)	0.00
Total Treatment Volume (cf)	706.94

WQv or ESDv Treated (cf)	770.25
PE achieved (inches)	N/A

Entire ESDv Treated Through Environmental Site Design?	YES
ESDv Remaining? (cf)	0.00
If ESDV is not fully treated, is ESD to MEP achieved?	0.00

Redevelopment WQv Requirements Met Through Environmental Site Design?	YES
WQv Remaining? (cf)	0.00

New Development WQv Requirements Met Through Environmental Site Design?	N/A
WQv Remaining? (cf)	0.00

VERSION 4.2

Maryland ESD Calculations and 10% Phosphorus Removal

Last Update: 12/5/2016

Project Name:	**St Michaels public Slip Area**
Date:	**21-Sep-23**
	data input cells
	calculation cells

Step 1: Complete ESD Implementation Checklist

Check all of the Following ESD Practices That Were Implemented at Site	*Yes - No - N/A*
Environmental Mapping Was Conducted at Site Prior to Layout	*N/A*
Natural Areas Were Conserved (e.g., forests, wetlands, steep slopes, floodplains)	*N/A*
Stream, Wetland and Shoreline Buffers Were Reserved	*N/A*
Disturbance of Permeable Soils Was Minimized	*N/A*
Natural Flow Paths Were Maintained Across the Site	*YES*
Building Layout Was Fingerprinted to Reduce Clearing and Grading at Site	*N/A*
Site Grading Promoted Sheetflow From Impervious Areas to Pervious Ones	*YES*
Site Design Was Evaluated to Reduce Creation of Needless Impervious Cover	*YES*
Site Design Was Evaluated to Maximize Disconnection of Impervious Cover	*YES*
Site Design Was Evaluated to Identify Potential Hotspot Generating Area for Stormwater Treatment	*YES*
Erosion and Sediment Control Practices and Post Construction Stormwater Management Practices Were Integrated into a Comprehensive Plan	*YES*
Tree PlantingWas Used at the Site to Convert Turf Areas into Forest	*N/A*

Step 2: Calculate Site Imperviousness and Water Quality Volume, WQv (for redevelopment)

Site Area, A (acres)	0.74	
Existing Impervious Surface Area (acres)	0.73	
Proposed Impervious Surface Area (acres)	0.57	
Rainfall Depth, P (in)	1.0	
Existing Imperviousness, I_{pre}	98.6%	
Proposed Imperviousness, I_{post}	77.0%	
Water Quality Calculation for Redevelopment Only		
Required Treatment Area (acres)	0.21	
Runoff Coefficient, Rv	0.95	
Water Quality Volume, WQv (cf)	**707**	

Step 4: Calculate Environmental Site Design (ESD) Rainfall Target, P_E

Development Category (for ESD)	**Redevelopment**	
% Soil Type A	0%	
% Soil Type B	0%	
% Soil Type C	100%	
% Soil Type D	0%	
Pre-Developed Condition, RCN_{woods}	70	
Soil Type A ESD Rainfall Target, P_E (in)	0.00	
Soil Type B ESD Rainfall Target, P_E (in)	0.00	
Soil Type C ESD Rainfall Target, P_E (in)	0.00	
Soil Type D ESD Rainfall Target, P_E (in)	0.00	
Maximum P_E (in)	2.7	
Site ESD Rainfall Target, P_E (in)		0.00
ESD Runoff Depth, Q_E (in)		0.00
ESD Runoff Volume, ESDv (cf)		**0**
Total Treatment Volume (cf)		**707**

Step 3: Calculate Phosphorous Removal Requirement, RR for Critical Area Sites

Development Category (for 10%)	**Redevelopment**
New Development	
Average Annual Predevelopment Load, Lpre (lbs P / yr)	0.37
Redevelopment:	
Predevelopment Runoff Coefficient, Rv_{pre}	0.94
Phosphorous Mean Concentration, C (mg/L)	0.3
Average Annual Predevelopment Load, L_{pre} (lbs P / yr)	1.70
Post-Development Runoff Coefficient, Rv_{post}	0.74
Average Annual Post-Development Load, L_{post} (lbs P / yr)	1.35
Removal Requirement, RR (lbs P / yr)	**-0.18**

Step 5: Select Nonstructural Practices to Treat the ESD Rainfall Target

Nonstructural Practices	P_E Credit Description	Contributing Drainage Area (sf)	Direct WQv or ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	P_E Credit (in)	WQV or ESDv credit (cf)	Runoff Volume Remaining (cf)	Baseline Phosphorous Removal Efficiency	*Critical Area Credits* Average Adjusted Removal Efficiency Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Disconnection of Rooftop Runoff (A/B Soils)	Up to 1 inch credit provided based upon disconnection flow length.	0	0	N/A	0.00	0	0	50%	0%	0.00	0.00	0.00
Disconnection of Rooftop Runoff (C/D Soils)	Up to 1 inch credit provided based upon disconnection flow length.	0	0	N/A	0.00	0	0	25%	0%	0.00	0.00	0.00
Disconnection of Non-Rooftop Runoff (A/B Soils)	Up to 1 inch credit provided based upon disconnection and contributing flow lengths.	0	0	N/A	0	0	0	50%	0%	0.00	0.00	0.00
Disconnection of Non-Rooftop Runoff (C/D Soils)	disconnection and contributing flow lengths.	0	0	N/A	0	0	0	25%	0%	0.00	0.00	0.00
Sheetflow to Conservation Areas (A/B Soils)	Up to 1 inch credit provided based upon conservation area width.	0	0	0	0	0	0	50%	0%	0.00	0.00	0.00
Sheetflow to Conservation Areas (C/D Soils)	Up to 1 inch credit provided based upon conservation area width.	0	0	0	0	0	0	25%	0%	0.00	0.00	0.00

Step 6: Select Micro-Scale Practices to Treat the ESD Rainfall Target

Micro-Scale Practices	P_E Credit Description	Contributing Drainage Area (sf)	Direct ESDv Received by Practice (cf)	WQv or ESDv from Up-Gradient Practices (cf)	WQv or ESDv credit (cf)	Runoff Volume Remaining (cf)	Baseline Phosphorous Removal Efficiency	Average Adjusted Removal Efficiency Rate	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Green Roof (Level 1)	ESDv credit is based on roof thickness	0	0	N/A	0	0	45%	0%	0.00	0.00	0.00
Green Roof (Level 2)	ESDv credit is based on roof thickness	0	0	N/A	0	0	60%	0%	0.00	0.00	0.00
Pemeable Pavement (A Soils)	ESDv credit is based on subbase thickness	0	0	N/A	0	0	80%	0%	0.00	0.00	0.00
Pemeable Pavement (B Soils)	ESDv credit is based on subbase thickness	0	0	N/A	0	0	80%	0%	0.00	0.00	0.00
Pemeable Pavement (C Soils)	ESDv credit is based on subbase thickness	0	0	N/A	0	0	40%	0%	0.00	0.00	0.00
Rainwater Harvesting	ESDv credit is based on design storage volume and annual use	0	0	0	0	0	45%	0%	0.00	0.00	0.00
Submerged Gravel Wetlands	ESDv credit is based on design storage volume	0	0	0	0	0	60%	0%	0.00	0.00	0.00
Micro-Infiltration/Dry Wells	ESDv credit is based on design storage volume	0	0	0	0	0	65%	0%	0.00	0.00	0.00
Rain Gardens (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	65%	0%	0.00	0.00	0.00
Rain Gardens (C/D Soils)	ESDv credit is based on design storage volume	2,200	470	0	470	0	25%	33%	0.12	0.04	0.08
Micro-Bioretention (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	75%	0%	0.00	0.00	0.00
Micro-Bioretention (C/D Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	50%	0%	0.00	0.00	0.00
Landscape Infiltration	ESDv credit is based on design storage volume	1,500	321	0	300	21	75%	97%	0.08	0.08	0.00
Grass Swales (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	40%	0%	0.00	0.00	0.00
Grass Swales (C/D Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	20%	0%	0.00	0.00	0.00
Bio-swales (A/B Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	75%	0%	0.00	0.00	0.00
Bio-swales (C/D Soils)	ESDv credit is based on design storage volume	0	0	0	0	0	50%	0%	0.00	0.00	0.00
Wet Swales	ESDv credit is based on design storage volume	0	0	0	0	0	40%	0%	0.00	0.00	0.00

Step 7: Check for ESDv to MEP compliance and Revise Site If Necessary

Drainage Area Treated (sf)	3,700	**WQv or ESDv Treated (cf)**	770	Total Load Reduction (lbs P / year) 0.12
		P_E achieved (inches)	N/A	**Total Load Reduction Remaining (lbs P / yr) 0.00**
		Entire ESDv Treated Through Environmental Site Design?	**YES**	
		ESDv Remaining? (cf)	**0**	
		If ESDV is not fully treated, is ESD to MEP achieved?		
		Redevelopment WQv Requirements Met Through Environmental Site Design?	**YES**	
New Development Water Quality Volume Requirements		**WQv Remaining? (cf)**	**0**	
Required Treatment Area (acres)	0.00			
Runoff Coefficient, Rv	0.95			
Water Quality Volume, WQv (cf)	**0**	**New Development WQv Requirements Met Through Environmental Site Design?**	**N/A**	
		WQv Remaining? (cf)	**0**	

Step 8: Determine Reduced RCN and Volume Management Requirements Based Upon P_E Achieved

Reduced RCN for Type A Soils	N/A		
Reduced RCN for Type B Soils	N/A		
Reduced RCN for Type C Soils	N/A		
Reduced RCN for Type D Soils	N/A		
Composite Reduced RCN	**N/A**		
Q_E (in) for Reduced RCN	N/A	Q_E (in) for RCN of 55	0.12
V (ft^3) for Reduced RCN	N/A	V (ft^3) for RCN of 55	92
Volume Management Required (cf)	**0**		

Step 9: Select Structural Practices to Meet Volume Management Requirements

Structural Practices	Contributing Drainage Area (sf)	% Impervious Cover	Direct ESDv Received by Practice (cf)	ESDv from Upstream Practices (cf)	Treatment Volume (cf)	Phosphorous Removal Efficiency	*Critical Area Credits* Adjusted Phosphorus Removal Efficiency	P Load to Practice (lbs/yr)	Load Reduction (lbs/yr)	Remaining Load (lbs/yr)
Stormwater Ponds (Level 1)	0	0%	0	0	0	50%	0%	0.00	0.00	0.00
Stormwater Ponds (Level 2)	0	0%	0	0	0	75%	0%	0.00	0.00	0.00
Stormwater Wetlands (Level 1)	0	0%	0	0	0	50%	0%	0.00	0.00	0.00
Stormwater Wetlands (Level 2)	0	0%	0	0	0	75%	0%	0.00	0.00	0.00
Stormwater Filtering Systems (Level 1)	0	0%	0	0	0	60%	0%	0.00	0.00	0.00
Stormwater Filtering Systems (Level 2)	0	0%	0	0	0	65%	0%	0.00	0.00	0.00
Stormwater Infiltration (Level 1)	0	0%	0	0	0	60%	0%	0.00	0.00	0.00
Stormwater Infiltration (Level 2)	0	0%	0	0	0	90%	0%	0.00	0.00	0.00
			Total structural CPv provided		0	Total Load Reduction (lbs P / year)				0.12
			Management Requirement Met?		**YES**	**Total Load Reduction Remaining (lbs P / yr)**				**0.00**
			Volume Remaining (cf)		**0**					

Appendix F

Wildlife Heritage Letter from DNR

- Official letter stating no State or Federal listed, candidate, [proposed, or rare plant or animal species are within the project area

MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

Wes Moore, Governor
Aruna Miller, Lt. Governor
Josh Kurtz, Secretary
David Goshorn, Deputy Secretary

November 21, 2023

Brent R. Jett
GMB Architects/Engineers
400 High Street
Seaford, DE 19973

RE: Environmental Review for Redevelopment and Flood Mitigation Strategies - Public Slip St. Michaels, East Chew Road and West Harbor Road, Tax Map 201, Parcel 1289, Talbot County, Maryland.

Dear Mr. Jett:

The Wildlife and Heritage Service has no official records for State or Federal listed, candidate, proposed, or rare plant or animal species within the project area shown on the map provided. As a result, we have no specific concerns regarding potential impacts to such species or recommendations for protection measures at this time. If the project changes in the future such that the limits of proposed disturbance or overall site boundaries are modified, please provide us with revised project maps and we will provide you with an updated evaluation.

Thank you for allowing us the opportunity to review this project. If you should have any further questions regarding this information, please contact me at lori.byrne@maryland.gov or at (410) 260-8573.

Sincerely,

Lori A. Byrne

Lori A. Byrne,
Environmental Review Coordinator
Wildlife and Heritage Service
MD Dept. of Natural Resources

ER# 2023.1618.TA
Cc: C. Jones, CAC

Appendix G

Stormwater Management and Runoff Analysis West Harbor Rd. and East Chew Ave.

- Synopsis of the existing conditions and the potential solution
- Summary Chart for the 2-yr, 25-yr, and 100-yr storm events for the individual catchbasins/outfalls to the harbor
- Drainage Area Map
- Hydrocad reports for the 7 open discharge systems to the marina area, draining +/-52 acres of St. Michaels and surrounding areas, currently without tide gates.
    - The first report covers the situation with tide elevation at -1. This represents a rainfall event in 2023 at low tide.
    - The second report analyzes a rainfall event with tide elevation 2.0. This represents a high tide in 2023, or an ebb/flow tide in 2050.
- Critical Area Calculations

Stormwater issue at public slip area at West Harbor Rd and East Chew.

Currently the stormwater runoff from the drainage area to the harbor area (approximately 50 ac.) just enters the open water via the catch basins and stormwater piping network. There are seven (7) individual discharge pipes to the harbor waters from West Harbor and East Chew. Many of them are basic systems with just a catch basin between West Harbor Rd and the harbor waters utilizing a 12" concrete pipe to discharge the collected runoff overboard. No ponds or retention systems exist. Only the dual pipes running down Meadow from the High School area are longer runs and provide drainage from a larger area as well as having a larger pipe size (22x34 elliptical concrete pipe.)

There aren't any impoundments, ponds, intentional blockages, or tide gates to impede the flow. That works both ways. The stormwater can drain into the harbor area freely, and the tide can freely flow into the pipe network. During low tides this free flow aids in quick drainage of the stormwater as it simply goes through the piping into the open water via the natural head pressure and doesn't back up unless there is an intense downpour. Without ponds, there is no detention capacity in the systems or the network. The runoff makes its way to the Public Slip area, enters the catchbasins, and is overboard into the open waters. When an intense rainfall occurs, there is a large amount of runoff entering the individual systems, which frequently causes temporary ponding outside the catchbasins.

At higher tides, the drainage is hampered a bit because the head difference between the entrance to the catch basin rim elevations can be just above or even lower than the open water levels. (This will occur in the future when additional sea level rise is realized and present at high tides.) The lack of impediment remains, but the backflow of the tide into the system increases, even during times of no precipitation.

Applying a tide gates on the outfalls could make the situation worse at higher tides. There is a head differential that is needed for the gate to open and release runoff in the pipes. (The Wapro, installed in a 12" pipe, needs 14" of head over the tide to open for discharge.) Allowing the runoff to build up in the catch basin would cause flooding within minutes, exacerbating the situation. Currently, stormwater collects and slowly discharges, and even this inundates the system. Causing longer discharge times with installing tide gates would make a bad situation worse for the area. And with rising sea levels, this would get even worse in the future with limited elevation differentials to gain enough head to open the tide gate. Without intervention from pumps, the flooding will get worse despite raising the bulkhead and keeping the tidal waters off the upland areas in the focus area.

The original report touched base on the potential of a cistern and pump station system. After further investigation, and the proposed location of a large-scale cistern would only service the 3 discharge pipes along Chew. Connecting and including the other 4 discharges would require

either an extensive network to get the runoff to the cistern, or a completely separate pump station and cistern system itself. This is problematic, with both driving costs up and functionality down. And it really doesn't solve the problem since the amount of storage required to eliminate flooding in the area isn't available. There would still be localized flooding with a large-scale pump station.

After running hydrologic analysis of the 52 acre drainage area utilizing HydroCAD, four (4) of the seven (7) outfalls are functioning as desired currently for the lower total rainfall amount storms. However, three (3) are problematic and not able to handle the runoff in an effective manner. And these three are not located adjacent to each other. Installing a system to connect the catchbasins into a single network would incur a large cost, require additional demolition and expansion of the construction area into the recently renovated West Harbor Rd, increase the maintenance burden, have a high replacement cost factor, and potentially put the outfalls that are functioning properly in a position where their effectiveness would decline. This doesn't even touch base on the space needed, depth of the cistern required, and how all that affects the surface improvements. Tiebacks for the bulkhead, pervious materials, raingardens, buried electric and service lines, and utilities within the roadway would and could be affected negatively while attempting to size a holding tank large enough to properly serve the drainage area.

Instead of a large system, it is proposed to install individual pumps for each outfall. This will allow for the current piping system to remain. This lowers the cost, maintenance, and adjustments for the new bulkhead tiebacks. It also minimizes the MDE permitting requiring additional outfalls. This allows for modularity in the system; St. Michaels will be able to upsize pumps or add additional pumps as sea level rises and/or rainfalls continue to become more intense in nature. It also allows for tide gates/backflow preventers to be installed on the pipes to keep tidal surges out of the stormwater network that currently has an adverse flooding impact on upstream properties. Each drainage area to each catch basin/discharge pipe can be sized for the need individually, but when totaled together, won't be as expensive as a large-scale network system. If, for some reason, one pump was to fail, the drainage is connected enough with the elevations in the valley gutter along West Harbor that a neighboring system will assist in a time of need. A vault for housing the pump(s) can be placed over the existing outfall pipe, electric service is available directly in the area, and the discharge can go directly into the harbor. Mechanically drawing down the stormwater runoff will occur faster than the current method of allowing it to dissipate into the harbor water utilizing the head pressure.

The chart below shows the analysis of the 2-yr, 25-yr, and 100-yr rainfall events, and depicts the water elevation at the catchbasins at the peak of these events. The catch basin elevations range from 2.9' to 3.1', so generally anything over elevation 3.0' indicates flooding in the street. Note that 3 of the current catch basins are prone to flooding currently when the tide is even at -1.0'; a standard low tide and 3" of rain is received. This worsens when it's a high tide, but not even

up over the bulkhead as some tides have been recently in the past year. As predicted, these same 3 catch basins function at an even worse rate during a 25 year storm event; +/-7.5” of rain. During a higher tide, there are 2 additional catch basins that begin to struggle during the 25-yr event. (For comparison, Tropical Storm Isaias recorded approximately 5.1” of rainfall in St. Michaels and Easton recorded approximately 6.5”.)

Utilizing these charts and the associated Hydrocad output from the various storm events will serve to provide proper pump sizing for the 2-yr rainfall event while also serving to provide adequate pumping for the majority of the 25-yr rainfall event. These pumps will not completely eliminate localized flooding at the catch basins and in the streets during extremely intense deluges, but will move the runoff off the surface faster than without any pumping present in the future.

2-yr, 25-yr, and 100-yr Analysis for Individual Catch Basins Summary

2-yr

			tide=-1.0 water el at cb	tide=2 Water el at cb	vol (cf)
18"	9S	E Chew	6.32	7.63	*104,000*
22x34	1S	DA1	5.44	6.24	*211,000*
22x34	4S	DA2	0.96	2.31	*55,000*
12"	5S	DA3	0.88	2.21	*8,800*
12"	6S	DA4	1.13	2.53	*13,400*
12"	7S	DA5	3.66	5.11	*28,400*
12"	8S	DA6	1.03	2.12	*5,700*

25-yr

			tide=-1.0 water el at cb	tide=2 Water el at cb	vol (cf)
18"	9S	E Chew	21.88	23.19	*210,000*
22x34	1S	DA1	17.17	17.98	*420,000*
22x34	4S	DA2	1.89	3.29	*116,000*
12"	5S	DA3	1.55	2.89	*20,400*
12"	6S	DA4	2.69	4.24	*28,200*
12"	7S	DA5	14.61	16.06	*62,000*
12"	8S	DA6	1.43	2.51	*11,900*

100-yr

			tide=-1.0 water el at cb	tide=2 Water el at cb
18"	9S	E Chew	36.2	37.51
22x34	1S	DA1	27.97	28.78
22x34	4S	DA2	2.81	4.23
12"	5S	DA3	2.19	3.53
12"	6S	DA4	4.31	5.86
12"	7S	DA5	25.28	26.73
12"	8S	DA6	1.8	2.88

Drainage Area Map for 7 outfalls through Public Slip Area

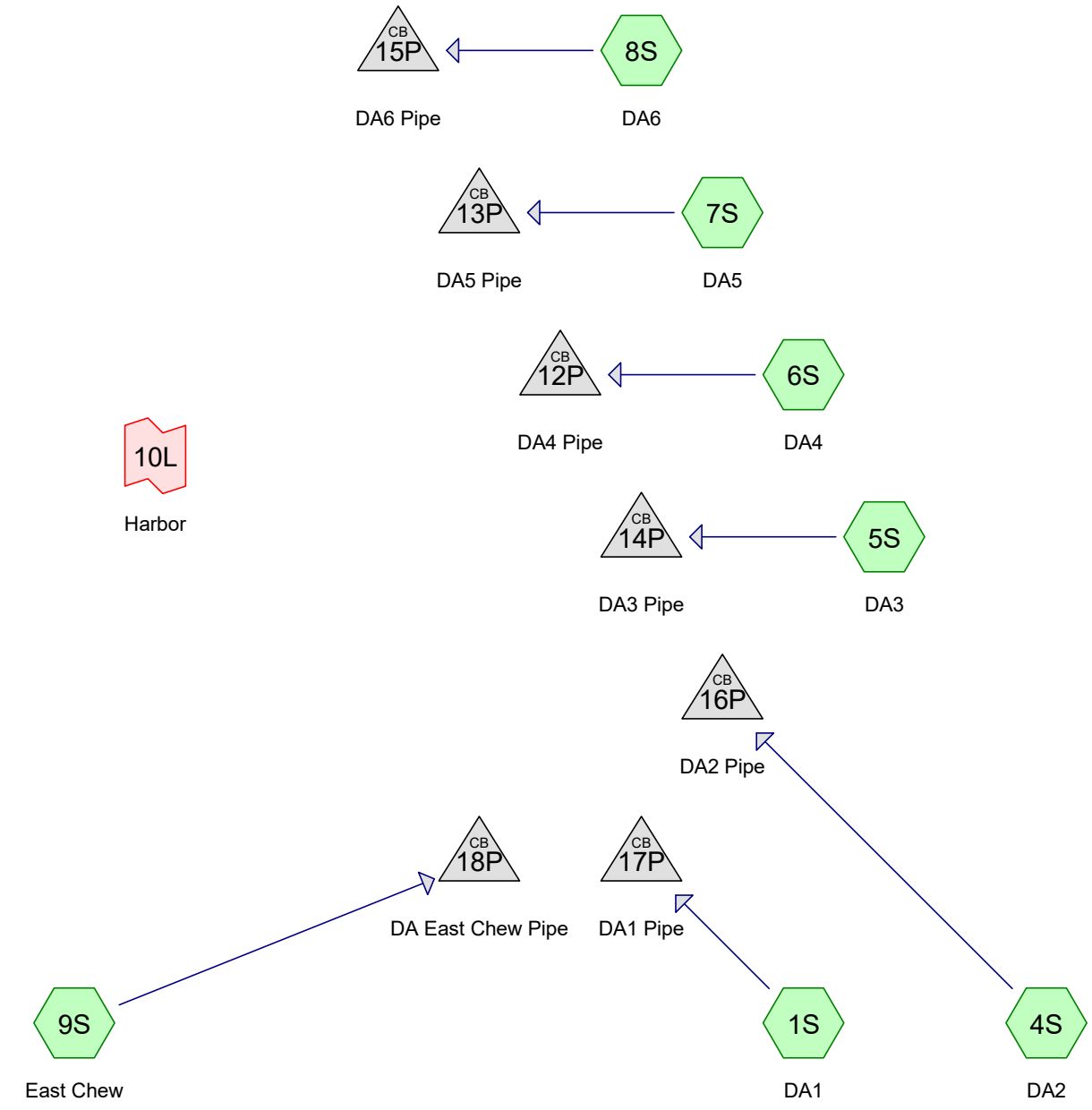
Land Use	RATING	DA ID	SQFT Area	Acre Area		inv out at water	inv in at inlet	length	size	pipe result		2yr		10 yr
1/2 Acre Lots	D	East Chew	65718.8553	1.5087	9s	-0.45	-0.06	55	18"	0.71%	97 cf	2.51 af	109335 cf	4.454 af
1/3 Acre Lots	D	East Chew	58599.7469	1.3453			inlet					39 cfs		
1/4 Acre Lots	C	East Chew	177.0451	0.0041				235	15"??		288 cf			
1/4 Acre Lots	D	East Chew	531219.9708	12.1951										
1/8 Acre Lots	D	East Chew	130937.0870	3.0059										
Commercial	D	East Chew	491397.9235	11.2809										
Impervious	C	East Chew	1330.3571	0.0305										
Impervious	D	East Chew	297968.1932	6.8404										
Open Space	D	East Chew	4350.5296	0.0999										
1/2 Acre Lots	D	EX-DA-1	65718.8553	1.5087	1s	-1.35	0.27	74	22x34 rcp		294 cf	5.083 af	221415 cf	9 af
1/3 Acre Lots	D	EX-DA-1	58599.7469	1.3453			inlet					78.85 cfs		
1/4 Acre Lots	C	EX-DA-1	177.0451	0.0041		0.02	-0.37	256	30"	0.30%	1256 cf			
1/4 Acre Lots	D	EX-DA-1	531219.9708	12.1951			inlet							
1/8 Acre Lots	D	EX-DA-1	130937.0870	3.0059		-0.2			22x34 rcp					
Commercial	D	EX-DA-1	491397.9235	11.2809										
Impervious	C	EX-DA-1	1330.3571	0.0305										
Impervious	D	EX-DA-1	297968.1932	6.8404										
Open Space	D	EX-DA-1	4350.5296	0.0999										
1/2 Acre Lots	C	EX-DA-2	8489.3773	0.1949	4s	-1	-0.36	82	22x34 rcp		326 cf	1.317 af	57370 cf	2.45 af
1/2 Acre Lots	D	EX-DA-2	10417.7415	0.2392			inlet					14.71 cfs		
1/3 Acre Lots	C	EX-DA-2	31223.0679	0.7168		-0.62	-0.48	367	30"	0.12%	1801 cf			
1/3 Acre Lots	D	EX-DA-2	100831.1564	2.3148										
1/4 Acre Lots	C	EX-DA-2	9063.9228	0.2081										
1/4 Acre Lots	D	EX-DA-2	70940.9998	1.6286										
Impervious	C	EX-DA-2	15266.4689	0.3505										
Impervious	D	EX-DA-2	68286.5730	1.5676										
1/3 Acre Lots	C	EX-DA-3	4895.4552	0.1124	5s	-0.56	0.16	41	12"			.234 af	10195 cf	.45 af
1/3 Acre Lots	D	EX-DA-3	7560.3713	0.1736			inlet					3.85 cfs		
1/4 Acre Lots	C	EX-DA-3	18443.6269	0.4234		0.31	0.66	27	12"	1.80%				
1/4 Acre Lots	D	EX-DA-3	3295.2615	0.0756						53.4 cf				
Impervious	C	EX-DA-3	17033.5620	0.3910										
Impervious	D	EX-DA-3	4141.6884	0.0951										
1/3 Acre Lots	C	EX-DA-4	1608.8617	0.0369	6s	-0.2	-0.05	25	12"					
1/3 Acre Lots	D	EX-DA-4	18970.4431	0.4355			inlet					.324 af	14115 cf	.6 af
1/4 Acre Lots	C	EX-DA-4	6803.8602	0.1562		0.22	0.94	31	12"			8.15 cfs		
1/4 Acre Lots	D	EX-DA-4	18399.2296	0.4224			open inlet							
1/8 Acre Lots	D	EX-DA-4	15197.0751	0.3489		0.99	1.52	33	12"	1.91%				
Impervious	C	EX-DA-4	4257.0642	0.0977						70.7 cf				
Impervious	D	EX-DA-4	10736.8339	0.2465										
1 Acre Lots	C	EX-DA-5	47575.9426	1.0922	7s	-0.29	0.05	35	12"	1%				1.3 af
1/2 Acre Lots	C	EX-DA-5	1316.4707	0.0302						29 cf		4.06 af	176850 cf	
1/2 Acre Lots	D	EX-DA-5	7699.2417	0.1768								17.46 cfs		
1/3 Acre Lots	D	EX-DA-5	1740.8410	0.0400										
1/4 Acre Lots	C	EX-DA-5	24276.3566	0.5573										
1/4 Acre Lots	D	EX-DA-5	40193.9766	0.9227										
1/8 Acre Lots	C	EX-DA-5	0.0006	0.0000										
1/8 Acre Lots	D	EX-DA-5	5121.1522	0.1176										
Impervious	C	EX-DA-5	30501.4491	0.7002										
Impervious	D	EX-DA-5	17333.4198	0.3979										
1 Acre Lots	C	EX-DA-6	15971.2301	0.3666	8s	-0.35	0.42	37	12"	2.10%		.74 af	32235 cf	.252 af
Impervious	C	EX-DA-6	16038.2920	0.3682						29.1 cf		3.42 cfs		
Impervious	D	EX-DA-6	0.0864	0.0000										

Drainage Analysis for Public Slip Area

St. Michaels, MD

West Harbor Rd. and East Chew Ave.

Tide Elevation -1.0’



Subcat Reach Pond Link

Routing Diagram for Ex 2yr tide minus1

Prepared by {enter your company name here}, Printed 8/24/2023

Project Notes

Rainfall events imported from "2023 April Box Everything.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.470	79	1 acre lots, 20% imp, HSG C (7S, 8S)
0.230	80	1/2 acre lots, 25% imp, HSG C (4S, 7S)
1.920	85	1/2 acre lots, 25% imp, HSG D (1S, 4S, 7S, 9S)
0.870	81	1/3 acre lots, 30% imp, HSG C (4S, 5S, 6S)
4.320	86	1/3 acre lots, 30% imp, HSG D (1S, 4S, 5S, 6S, 7S, 9S)
1.360	83	1/4 acre lots, 38% imp, HSG C (4S, 5S, 6S, 7S)
15.273	87	1/4 acre lots, 38% imp, HSG D (1S, 4S, 5S, 6S, 7S, 9S)
3.474	92	1/8 acre lots, 65% imp, HSG D (1S, 6S, 7S, 9S)
0.150	80	>75% Grass cover, Good, HSG D (1S, 9S)
11.130	98	Paved parking, HSG D (1S, 4S, 5S, 6S, 7S, 8S, 9S)
11.850	95	Urban commercial, 85% imp, HSG D (1S, 9S)
52.047	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
3.930	HSG C	4S, 5S, 6S, 7S, 8S
48.117	HSG D	1S, 4S, 5S, 6S, 7S, 8S, 9S
0.000	Other	
52.047		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.470	0.000	0.000	1.470	1 acre lots, 20% imp	7S, 8S
0.000	0.000	0.230	1.920	0.000	2.150	1/2 acre lots, 25% imp	1S, 4S, 7S, 9S
0.000	0.000	0.870	4.320	0.000	5.190	1/3 acre lots, 30% imp	1S, 4S, 5S, 6S, 7S, 9S
0.000	0.000	1.360	15.273	0.000	16.633	1/4 acre lots, 38% imp	1S, 4S, 5S, 6S, 7S, 9S
0.000	0.000	0.000	3.474	0.000	3.474	1/8 acre lots, 65% imp	1S, 6S, 7S, 9S
0.000	0.000	0.000	0.150	0.000	0.150	>75% Grass cover, Good	1S, 9S
0.000	0.000	0.000	11.130	0.000	11.130	Paved parking	1S, 4S, 5S, 6S, 7S, 8S, 9S
0.000	0.000	0.000	11.850	0.000	11.850	Urban commercial, 85% imp	1S, 9S
0.000	**0.000**	**3.930**	**48.117**	**0.000**	**52.047**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1S	0.00	0.00	55.0	0.0071	0.012	18.0	0.0	0.0
2	1S	0.00	0.00	235.0	0.0050	0.012	15.0	0.0	0.0
3	1S	0.00	0.00	500.0	0.0040	0.012	15.0	0.0	0.0
4	4S	0.00	0.00	82.0	0.0080	0.012	34.0	22.0	0.0
5	4S	0.00	0.00	367.0	0.0012	0.012	30.0	0.0	0.0
6	5S	0.00	0.00	82.0	0.0078	0.011	34.0	22.0	0.0
7	5S	0.00	0.00	367.0	0.0001	0.012	30.0	0.0	0.0
8	6S	0.00	0.00	25.0	0.0060	0.012	12.0	0.0	0.0
9	6S	0.00	0.00	31.0	0.0230	0.012	12.0	0.0	0.0
10	6S	0.00	0.00	33.0	0.0160	0.012	12.0	0.0	0.0
11	7S	0.00	0.00	35.0	0.0010	0.012	12.0	0.0	0.0
12	8S	0.00	0.00	37.0	0.0200	0.012	12.0	0.0	0.0
13	9S	0.00	0.00	55.0	0.0071	0.012	18.0	0.0	0.0
14	9S	0.00	0.00	235.0	0.0050	0.012	15.0	0.0	0.0
15	9S	0.00	0.00	500.0	0.0040	0.012	15.0	0.0	0.0
16	12P	-0.05	-0.20	25.0	0.0060	0.012	12.0	0.0	0.0
17	13P	0.05	-0.29	35.0	0.0097	0.012	12.0	0.0	0.0
18	14P	0.16	-0.56	41.0	0.0176	0.012	12.0	0.0	0.0
19	15P	0.42	-0.35	37.0	0.0208	0.012	12.0	0.0	0.0
20	16P	-0.36	-1.00	82.0	0.0078	0.012	34.0	22.0	0.0
21	17P	0.27	-1.35	74.0	0.0219	0.012	34.0	22.0	0.0
22	18P	-0.06	-0.45	55.0	0.0071	0.012	18.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=24.742 ac 65.94% Impervious Runoff Depth>2.36"
Flow Length=990' Tc=45.0 min CN=92 Runoff=40.86 cfs 4.856 af

Subcatchment 4S: DA2 Runoff Area=7.240 ac 50.29% Impervious Runoff Depth>2.09"
Flow Length=649' Tc=43.7 min CN=89 Runoff=10.99 cfs 1.259 af

Subcatchment 5S: DA3 Runoff Area=1.280 ac 59.98% Impervious Runoff Depth>2.08"
Flow Length=849' Tc=51.4 min CN=89 Runoff=1.74 cfs 0.222 af

Subcatchment 6S: DA4 Runoff Area=1.763 ac 53.49% Impervious Runoff Depth>2.09"
Flow Length=289' Tc=41.8 min CN=89 Runoff=2.76 cfs 0.307 af

Subcatchment 7S: DA5 Runoff Area=4.060 ac 49.97% Impervious Runoff Depth>1.93"
Flow Length=235' Slope=0.0010 '/' Tc=34.8 min CN=87 Runoff=6.67 cfs 0.652 af

Subcatchment 8S: DA6 Runoff Area=0.740 ac 60.00% Impervious Runoff Depth>2.09"
Flow Length=237' Tc=34.5 min CN=89 Runoff=1.32 cfs 0.129 af

Subcatchment 9S: East Chew Runoff Area=12.222 ac 65.70% Impervious Runoff Depth>2.36"
Flow Length=990' Tc=45.0 min CN=92 Runoff=20.18 cfs 2.399 af

Pond 12P: DA4 Pipe Peak Elev=1.13' Inflow=2.76 cfs 0.307 af
12.0" Round Culvert n=0.012 L=25.0' S=0.0060 '/' Outflow=2.76 cfs 0.307 af

Pond 13P: DA5 Pipe Peak Elev=3.66' Inflow=6.67 cfs 0.652 af
12.0" Round Culvert n=0.012 L=35.0' S=0.0097 '/' Outflow=6.67 cfs 0.652 af

Pond 14P: DA3 Pipe Peak Elev=0.88' Inflow=1.74 cfs 0.222 af
12.0" Round Culvert n=0.012 L=41.0' S=0.0176 '/' Outflow=1.74 cfs 0.222 af

Pond 15P: DA6 Pipe Peak Elev=1.03' Inflow=1.32 cfs 0.129 af
12.0" Round Culvert n=0.012 L=37.0' S=0.0208 '/' Outflow=1.32 cfs 0.129 af

Pond 16P: DA2 Pipe Peak Elev=0.96' Inflow=10.99 cfs 1.259 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=82.0' S=0.0078 '/' Outflow=10.99 cfs 1.259 af

Pond 17P: DA1 Pipe Peak Elev=5.44' Inflow=40.86 cfs 4.856 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=74.0' S=0.0219 '/' Outflow=40.86 cfs 4.856 af

Pond 18P: DA East Chew Pipe Peak Elev=6.32' Inflow=20.18 cfs 2.399 af
18.0" Round Culvert n=0.012 L=55.0' S=0.0071 '/' Outflow=20.18 cfs 2.399 af

Link 10L: Harbor
Primary=0.00 cfs 0.000 af

Total Runoff Area = 52.047 ac Runoff Volume = 9.823 af Average Runoff Depth = 2.26"
38.19% Pervious = 19.877 ac 61.81% Impervious = 32.170 ac

Summary for Subcatchment 1S: DA1

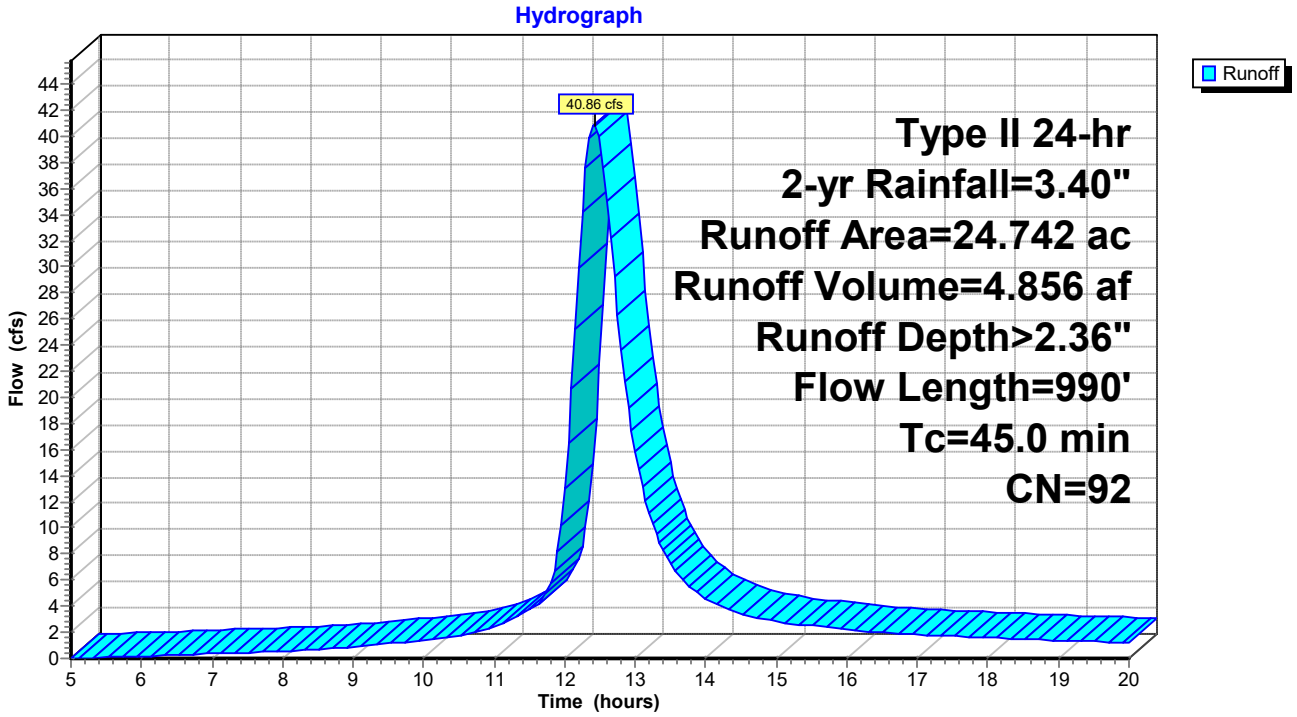
Runoff = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
1.000	85	1/2 acre lots, 25% imp, HSG D
0.900	86	1/3 acre lots, 30% imp, HSG D
8.140	87	1/4 acre lots, 38% imp, HSG D
2.002	92	1/8 acre lots, 65% imp, HSG D
8.000	95	Urban commercial, 85% imp, HSG D
4.600	98	Paved parking, HSG D
0.100	80	>75% Grass cover, Good, HSG D
24.742	92	Weighted Average
8.428		34.06% Pervious Area
16.314		65.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 4S: DA2

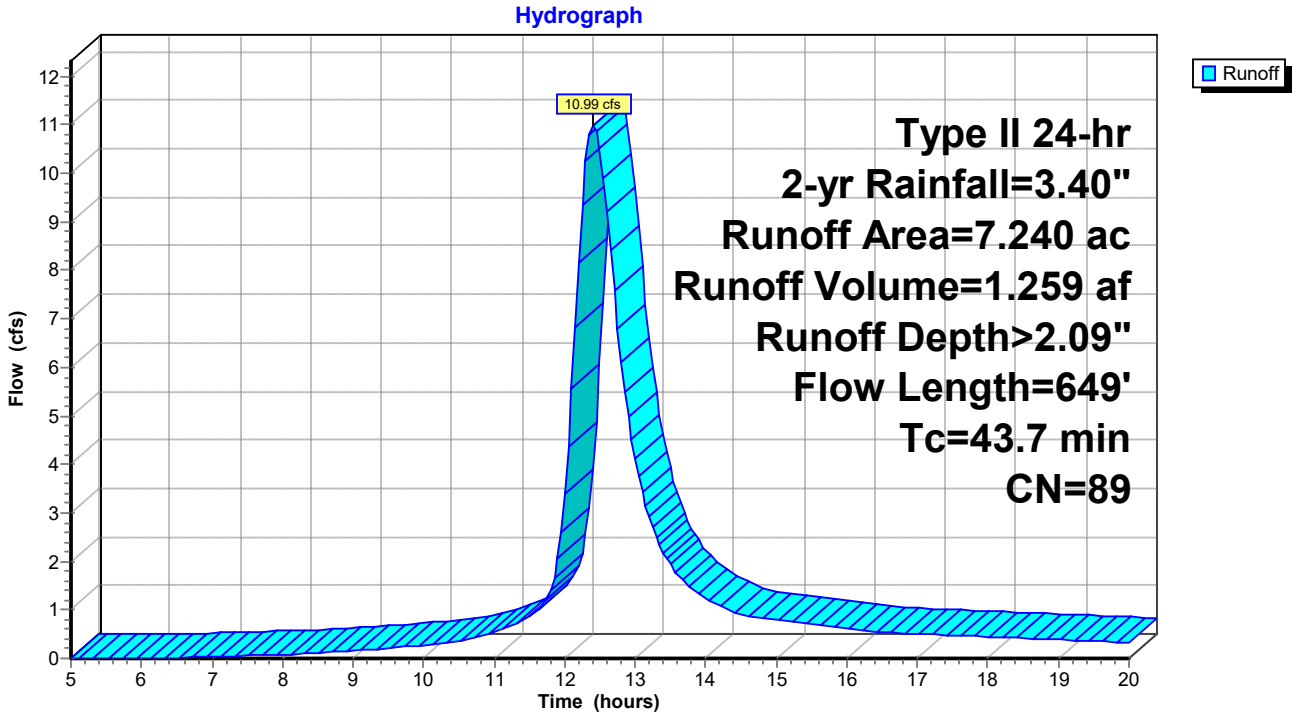
Runoff = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.200	80	1/2 acre lots, 25% imp, HSG C
0.240	85	1/2 acre lots, 25% imp, HSG D
0.720	81	1/3 acre lots, 30% imp, HSG C
2.320	86	1/3 acre lots, 30% imp, HSG D
0.210	83	1/4 acre lots, 38% imp, HSG C
1.630	87	1/4 acre lots, 38% imp, HSG D
1.920	98	Paved parking, HSG D
7.240	89	Weighted Average
3.599		49.71% Pervious Area
3.641		50.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0080	7.45	30.70	**Pipe Channel, RCP_Elliptical 34x22** 34.0" x 22.0", R=24.9" Elliptical Area= 4.1 sf Perim= 7.5' r= 0.55' n= 0.012 Concrete pipe, finished
2.0	367	0.0012	3.14	15.39	**Pipe Channel, RCP_Round 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
43.7	649	Total			

Subcatchment 4S: DA2



Summary for Subcatchment 5S: DA3

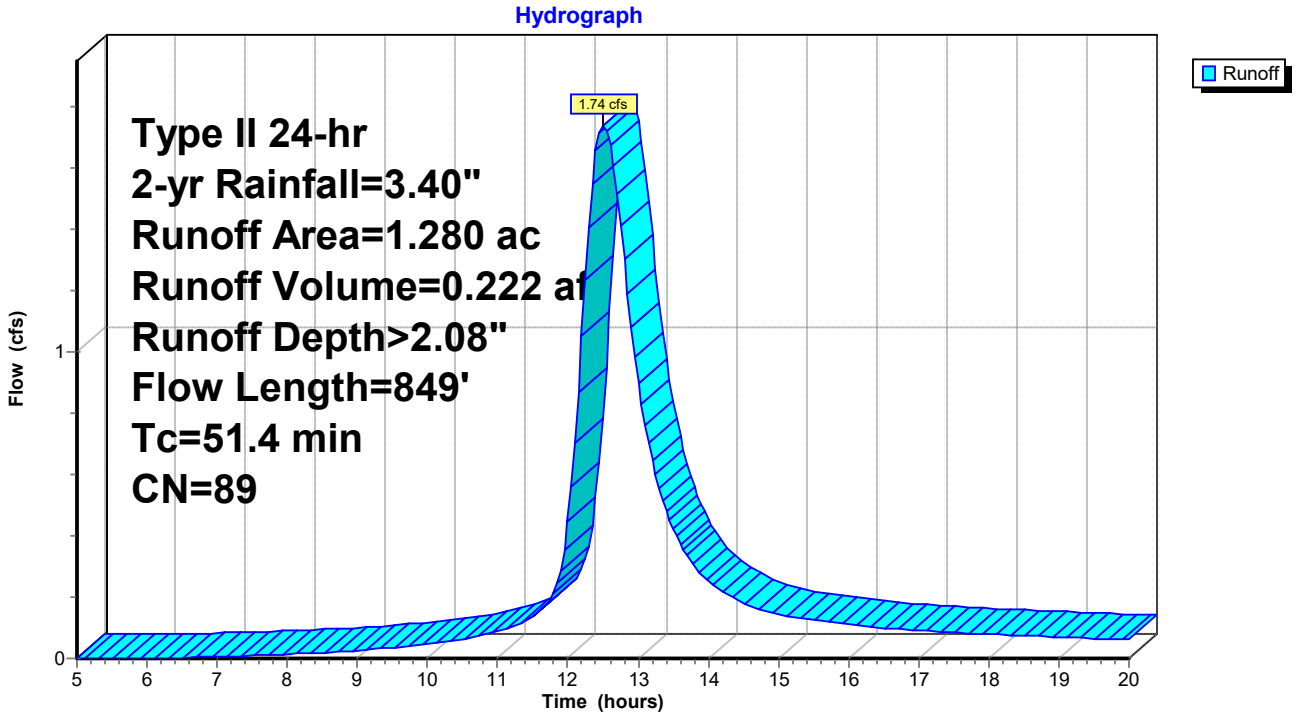
Runoff = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af, Depth> 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.110	81	1/3 acre lots, 30% imp, HSG C
0.170	86	1/3 acre lots, 30% imp, HSG D
0.430	83	1/4 acre lots, 38% imp, HSG C
0.080	87	1/4 acre lots, 38% imp, HSG D
0.490	98	Paved parking, HSG D
1.280	89	Weighted Average
0.512		40.02% Pervious Area
0.768		59.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0078	7.98	32.34	**Pipe Channel, out** 34.0" x 22.0", R=23.0" Elliptical Area= 4.1 sf Perim= 7.4' r= 0.55' n= 0.011 Concrete pipe, straight & clean
6.8	367	0.0001	0.91	4.44	**Pipe Channel, 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
2.9	200	0.0010	1.15	5.73	**Channel Flow, ditch** Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.030 Earth, grassed & winding
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
51.4	849	Total			

Subcatchment 5S: DA3



Summary for Subcatchment 6S: DA4

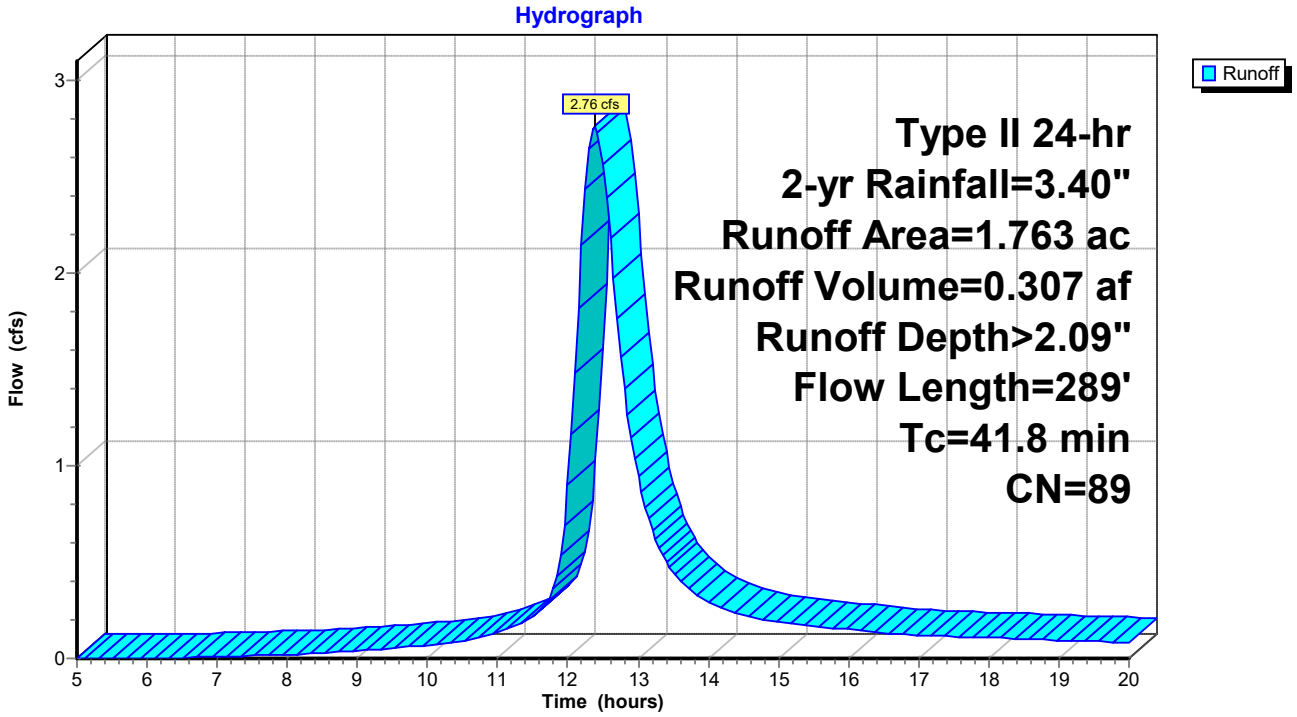
Runoff = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.040	81	1/3 acre lots, 30% imp, HSG C
0.440	86	1/3 acre lots, 30% imp, HSG D
0.160	83	1/4 acre lots, 38% imp, HSG C
0.423	87	1/4 acre lots, 38% imp, HSG D
0.350	92	1/8 acre lots, 65% imp, HSG D
0.350	98	Paved parking, HSG D
1.763	89	Weighted Average
0.820		46.51% Pervious Area
0.943		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0060	3.81	2.99	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	31	0.0230	7.45	5.85	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	33	0.0160	6.22	4.88	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
41.8	289	Total			

Subcatchment 6S: DA4



Summary for Subcatchment 7S: DA5

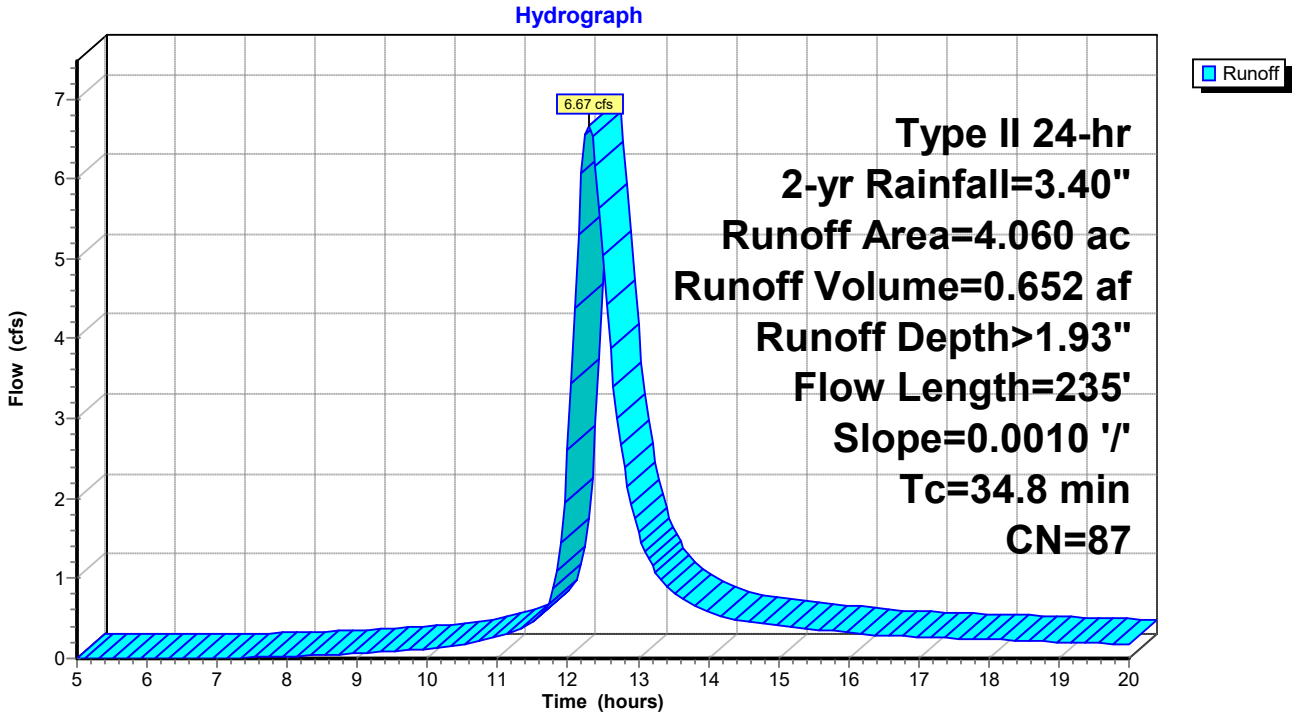
Runoff = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
1.100	79	1 acre lots, 20% imp, HSG C
0.030	80	1/2 acre lots, 25% imp, HSG C
0.180	85	1/2 acre lots, 25% imp, HSG D
0.040	86	1/3 acre lots, 30% imp, HSG D
0.560	83	1/4 acre lots, 38% imp, HSG C
0.930	87	1/4 acre lots, 38% imp, HSG D
0.120	92	1/8 acre lots, 65% imp, HSG D
1.100	98	Paved parking, HSG D
4.060	87	Weighted Average
2.031		50.03% Pervious Area
2.029		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	35	0.0010	1.55	1.22	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.8	235	Total			

Subcatchment 7S: DA5



Summary for Subcatchment 8S: DA6

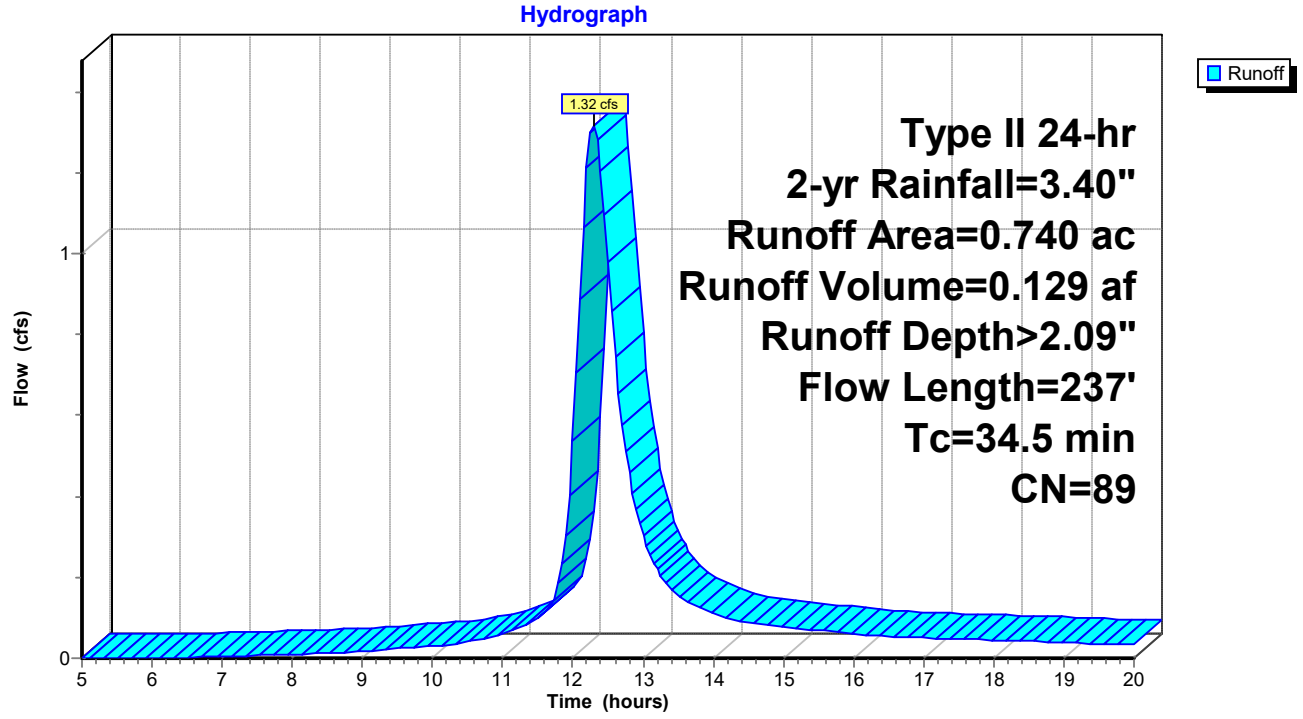
Runoff = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.370	79	1 acre lots, 20% imp, HSG C
0.370	98	Paved parking, HSG D
0.740	89	Weighted Average
0.296		40.00% Pervious Area
0.444		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	37	0.0200	6.95	5.46	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.5	237	Total			

Subcatchment 8S: DA6



Summary for Subcatchment 9S: East Chew

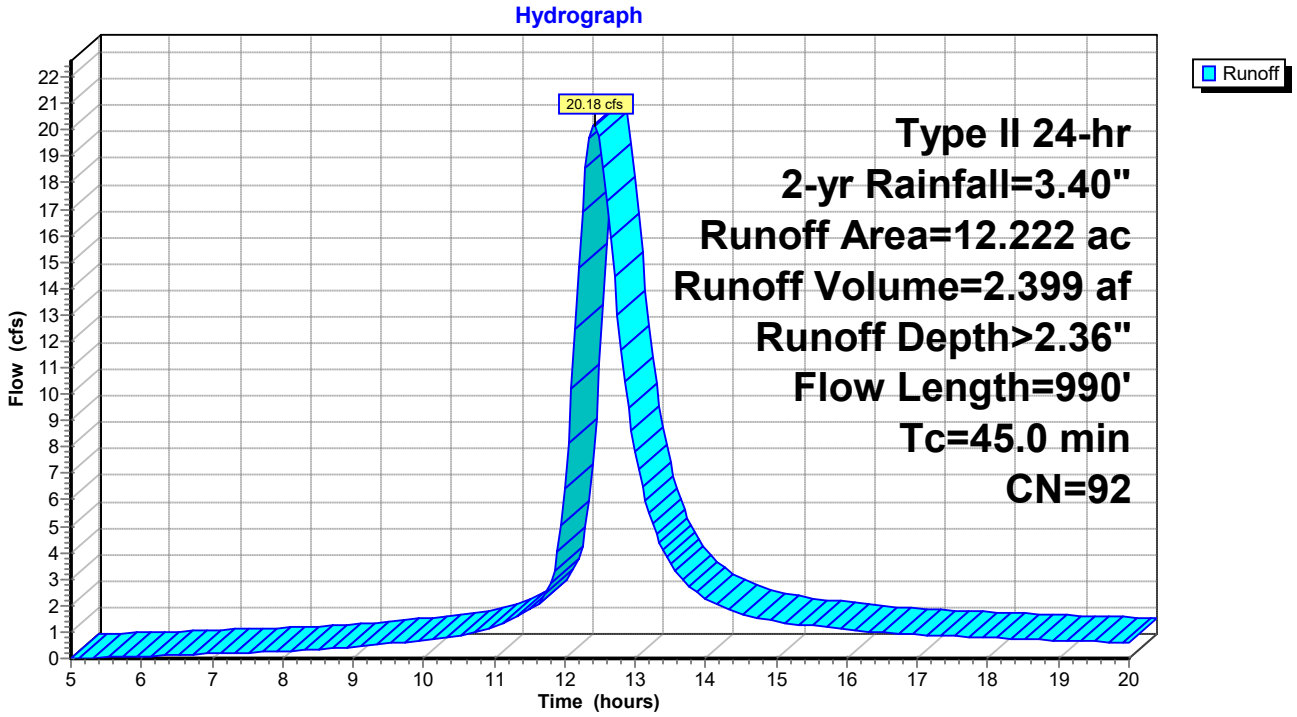
Runoff = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.500	85	1/2 acre lots, 25% imp, HSG D
0.450	86	1/3 acre lots, 30% imp, HSG D
4.070	87	1/4 acre lots, 38% imp, HSG D
1.002	92	1/8 acre lots, 65% imp, HSG D
3.850	95	Urban commercial, 85% imp, HSG D
2.300	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
12.222	92	Weighted Average
4.192		34.30% Pervious Area
8.030		65.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 9S: East Chew



Summary for Pond 12P: DA4 Pipe

[57] Hint: Peaked at 1.13' (Flood elevation advised)

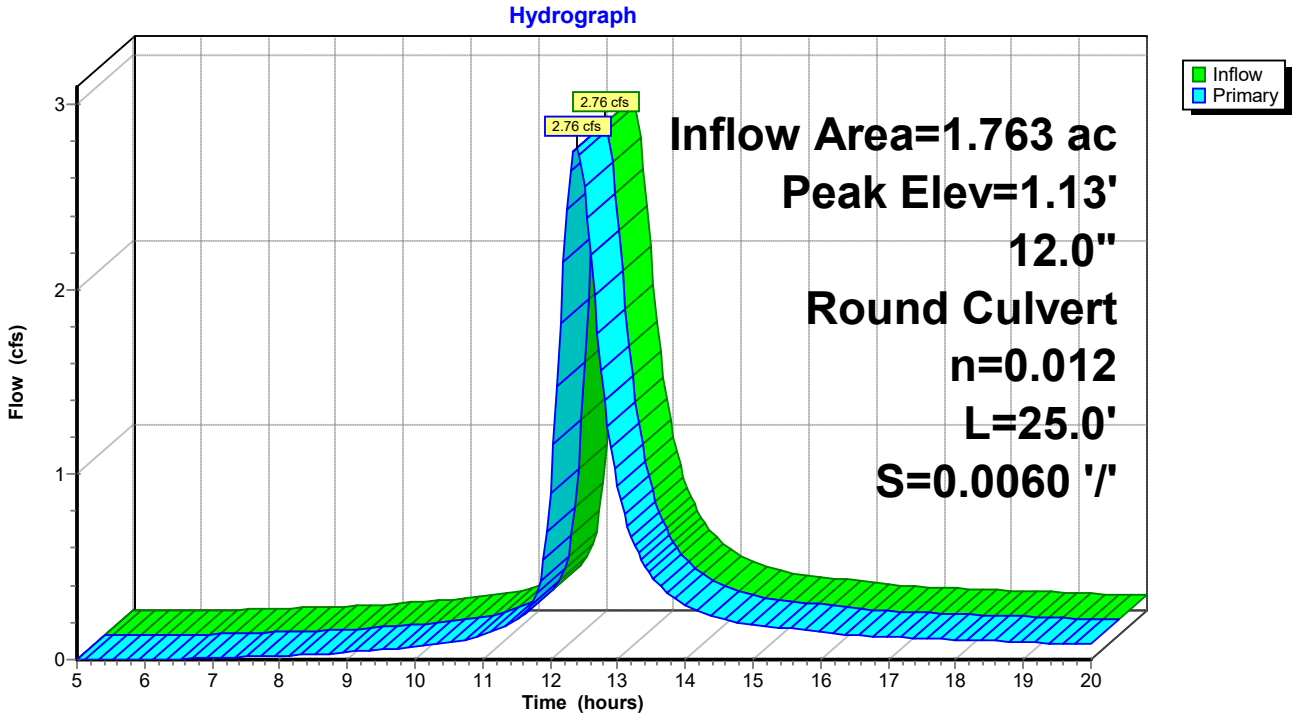
Inflow Area = 1.763 ac, 53.49% Impervious, Inflow Depth > 2.09" for 2-yr event
Inflow = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af
Outflow = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min
Primary = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.13' @ 12.38 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.05'	**12.0" Round Culvert** L= 25.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.05' / -0.20' S= 0.0060 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=2.75 cfs @ 12.38 hrs HW=1.12' TW=-1.00' (Fixed TW Elev= -1.00')
↑**1=Culvert** (Barrel Controls 2.75 cfs @ 3.76 fps)

Pond 12P: DA4 Pipe



Summary for Pond 13P: DA5 Pipe

[58] Hint: Peaked 1.66' above defined flood level

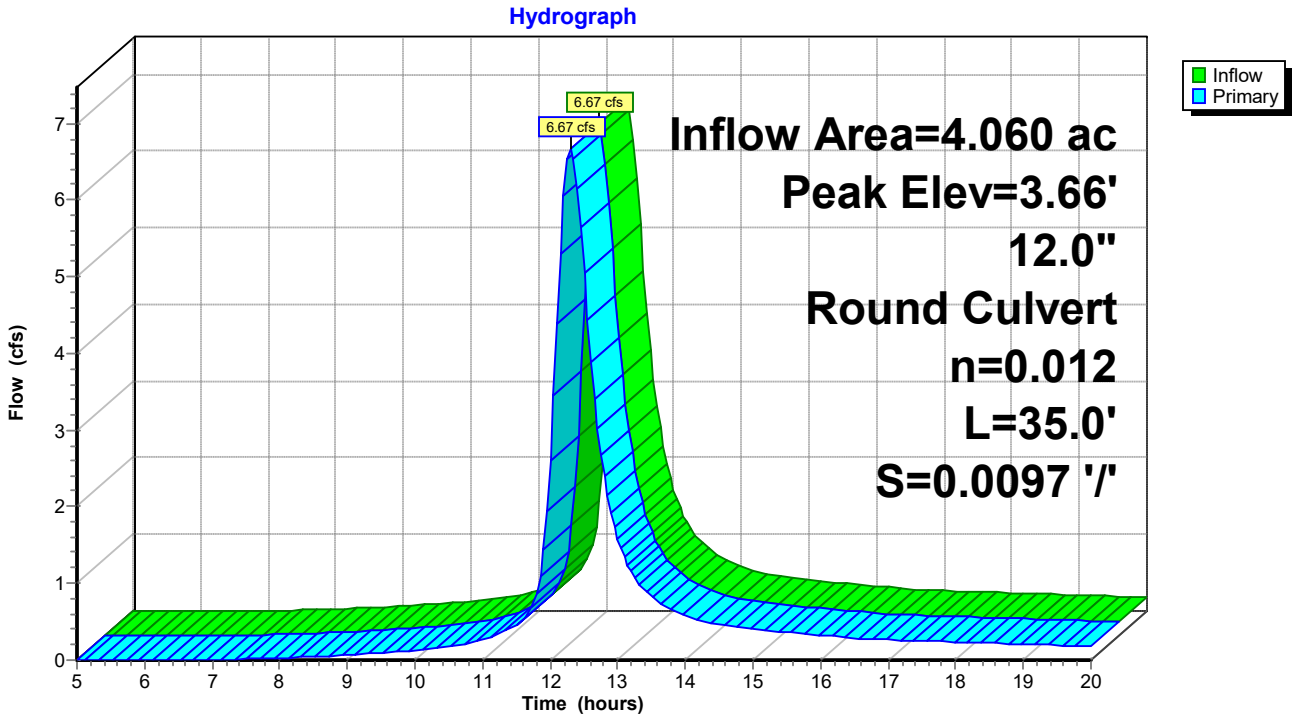
Inflow Area = 4.060 ac, 49.97% Impervious, Inflow Depth > 1.93" for 2-yr event
Inflow = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af
Outflow = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af, Atten= 0%, Lag= 0.0 min
Primary = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.66' @ 12.30 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.05'	**12.0" Round CMP_Round 12"** L= 35.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.05' / -0.29' S= 0.0097 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=6.67 cfs @ 12.30 hrs HW=3.66' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=CMP_Round 12"** (Inlet Controls 6.67 cfs @ 8.49 fps)

Pond 13P: DA5 Pipe



Summary for Pond 14P: DA3 Pipe

[57] Hint: Peaked at 0.88' (Flood elevation advised)

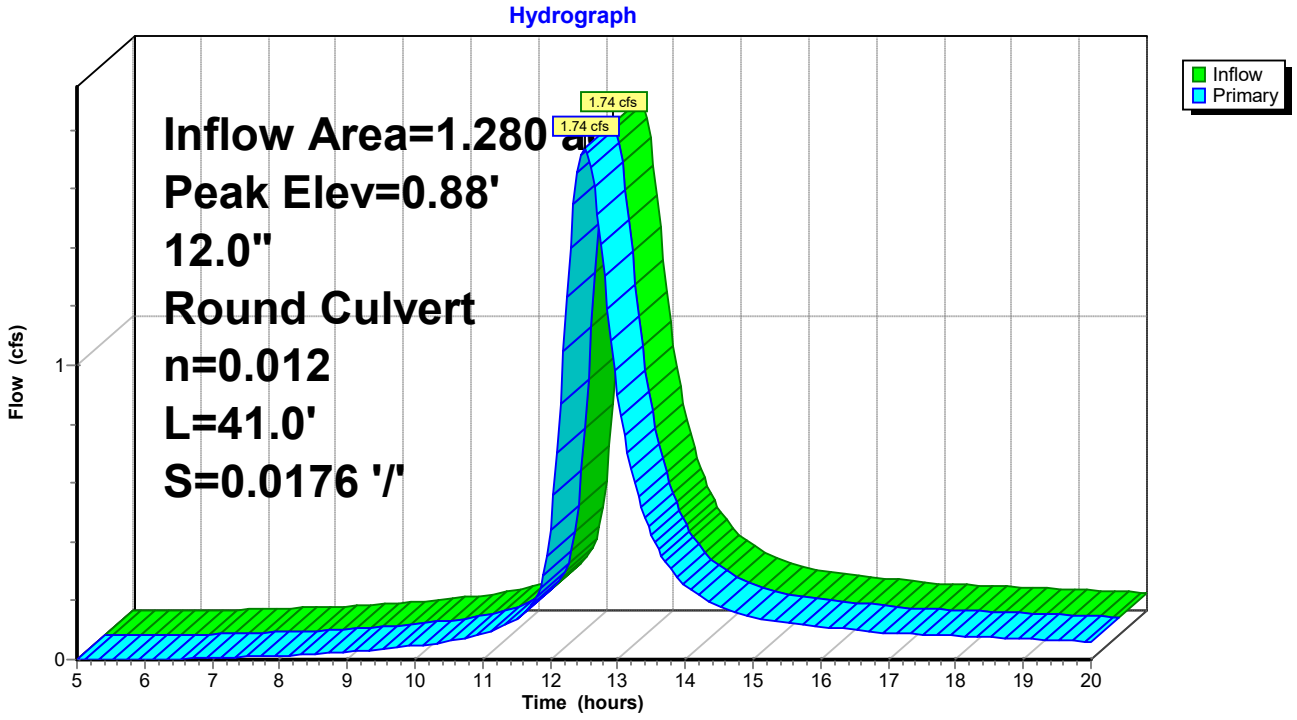
Inflow Area = 1.280 ac, 59.98% Impervious, Inflow Depth > 2.08" for 2-yr event
Inflow = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af
Outflow = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min
Primary = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.88' @ 12.50 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.16'	**12.0" Round Culvert** L= 41.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.16' / -0.56' S= 0.0176 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=1.74 cfs @ 12.50 hrs HW=0.88' TW=-1.00' (Fixed TW Elev= -1.00')
↑**1=Culvert** (Inlet Controls 1.74 cfs @ 2.88 fps)

Pond 14P: DA3 Pipe



Summary for Pond 15P: DA6 Pipe

[58] Hint: Peaked 2.03' above defined flood level

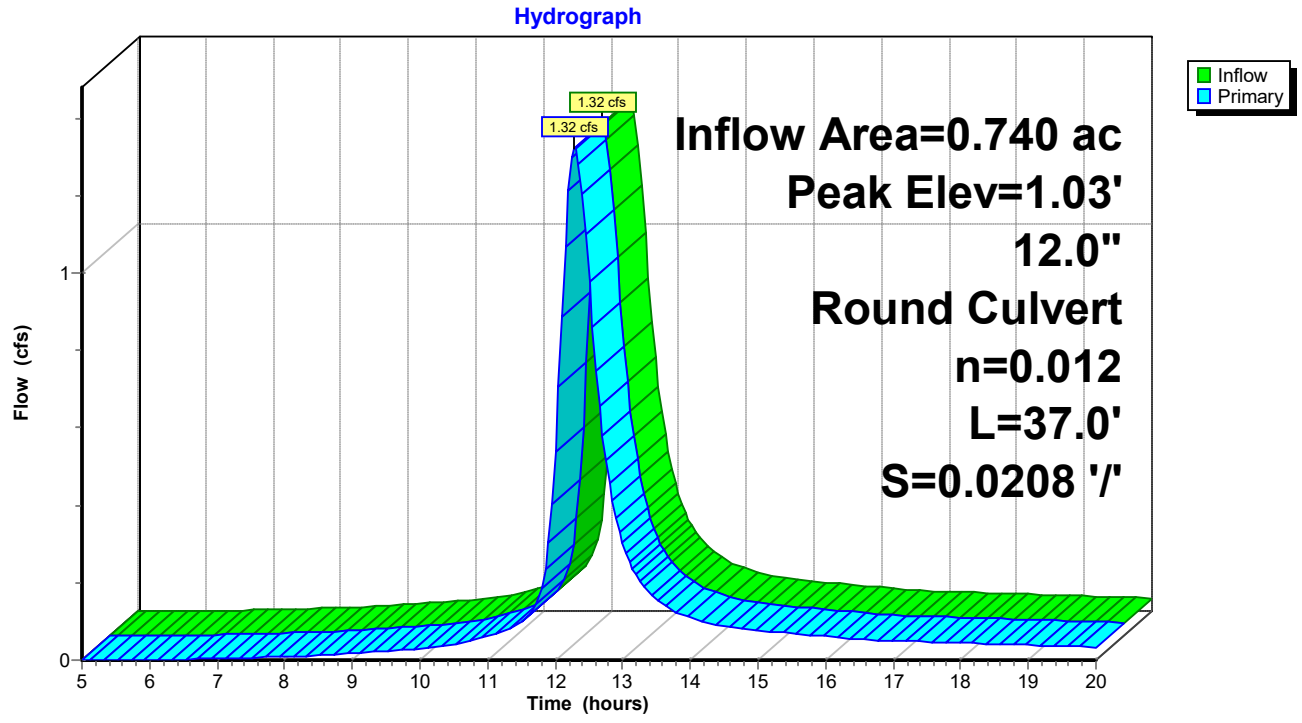
Inflow Area = 0.740 ac, 60.00% Impervious, Inflow Depth > 2.09" for 2-yr event
Inflow = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af
Outflow = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.0 min
Primary = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.03' @ 12.29 hrs
Flood Elev= -1.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.42'	**12.0" Round CMP_Round 12"** L= 37.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.42' / -0.35' S= 0.0208 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.29 hrs HW=1.03' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=CMP_Round 12"** (Inlet Controls 1.32 cfs @ 2.65 fps)

Pond 15P: DA6 Pipe



Summary for Pond 16P: DA2 Pipe

[57] Hint: Peaked at 0.96' (Flood elevation advised)

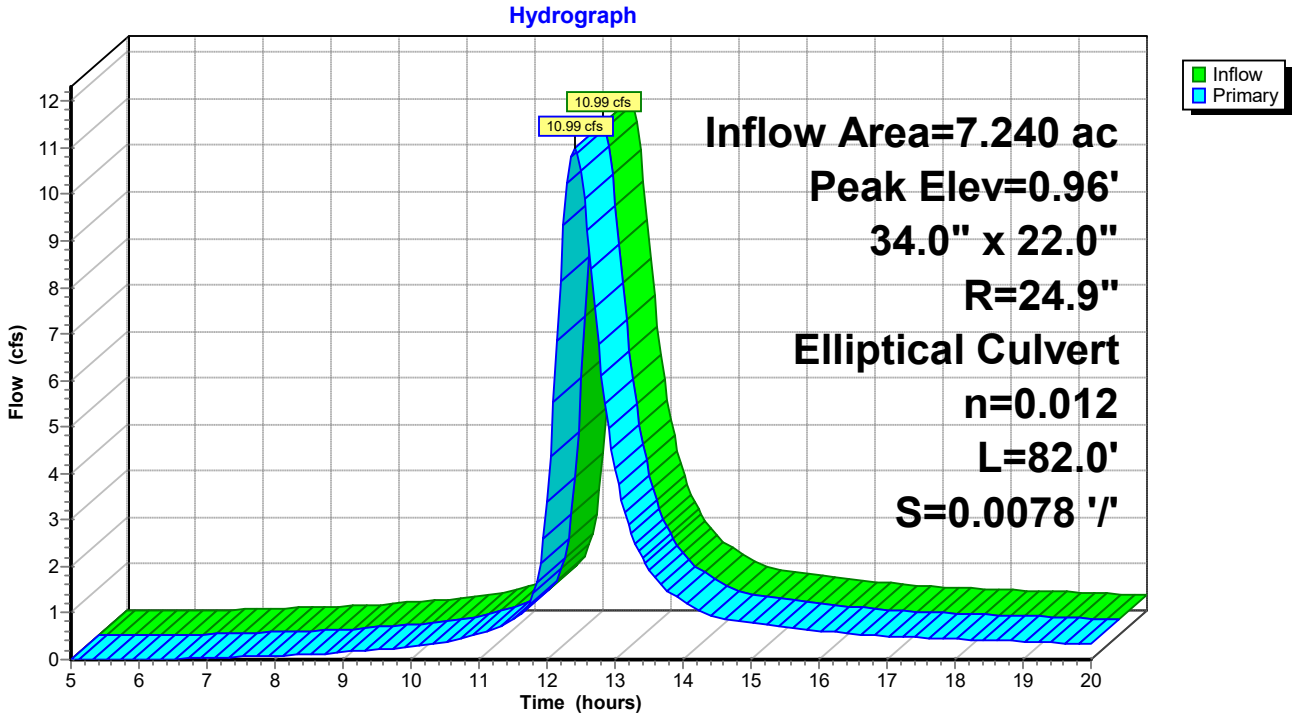
Inflow Area = 7.240 ac, 50.29% Impervious, Inflow Depth > 2.09" for 2-yr event
Inflow = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af
Outflow = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af, Atten= 0%, Lag= 0.0 min
Primary = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 0.96' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.36'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 82.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.36' / -1.00' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=10.98 cfs @ 12.41 hrs HW=0.96' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 10.98 cfs @ 3.47 fps)

Pond 16P: DA2 Pipe



Summary for Pond 17P: DA1 Pipe

[57] Hint: Peaked at 5.44' (Flood elevation advised)

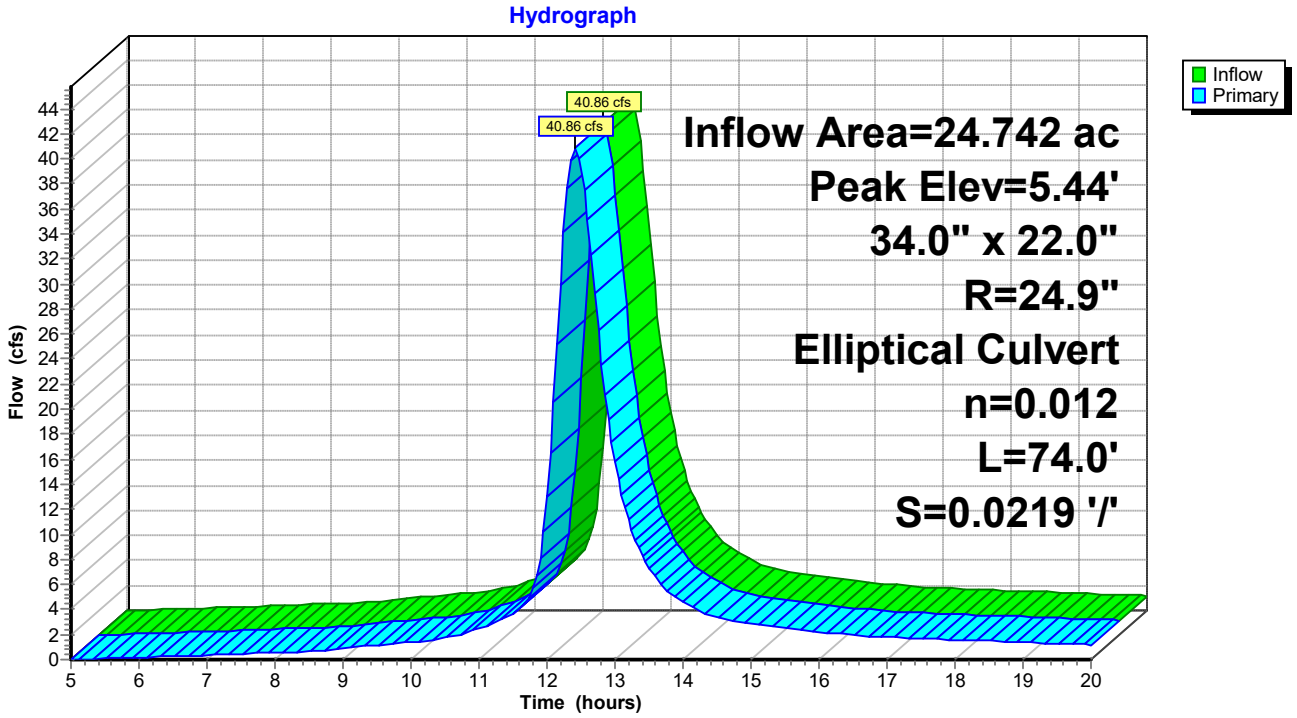
Inflow Area = 24.742 ac, 65.94% Impervious, Inflow Depth > 2.36" for 2-yr event
Inflow = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af
Outflow = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af, Atten= 0%, Lag= 0.0 min
Primary = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.44' @ 12.42 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.27'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 74.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.27' / -1.35' S= 0.0219 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=40.74 cfs @ 12.42 hrs HW=5.42' TW=-1.00' (Fixed TW Elev= -1.00')
↑**1=RCP_Elliptical 34x22** (Inlet Controls 40.74 cfs @ 9.89 fps)

Pond 17P: DA1 Pipe



Summary for Pond 18P: DA East Chew Pipe

[58] Hint: Peaked 4.32' above defined flood level

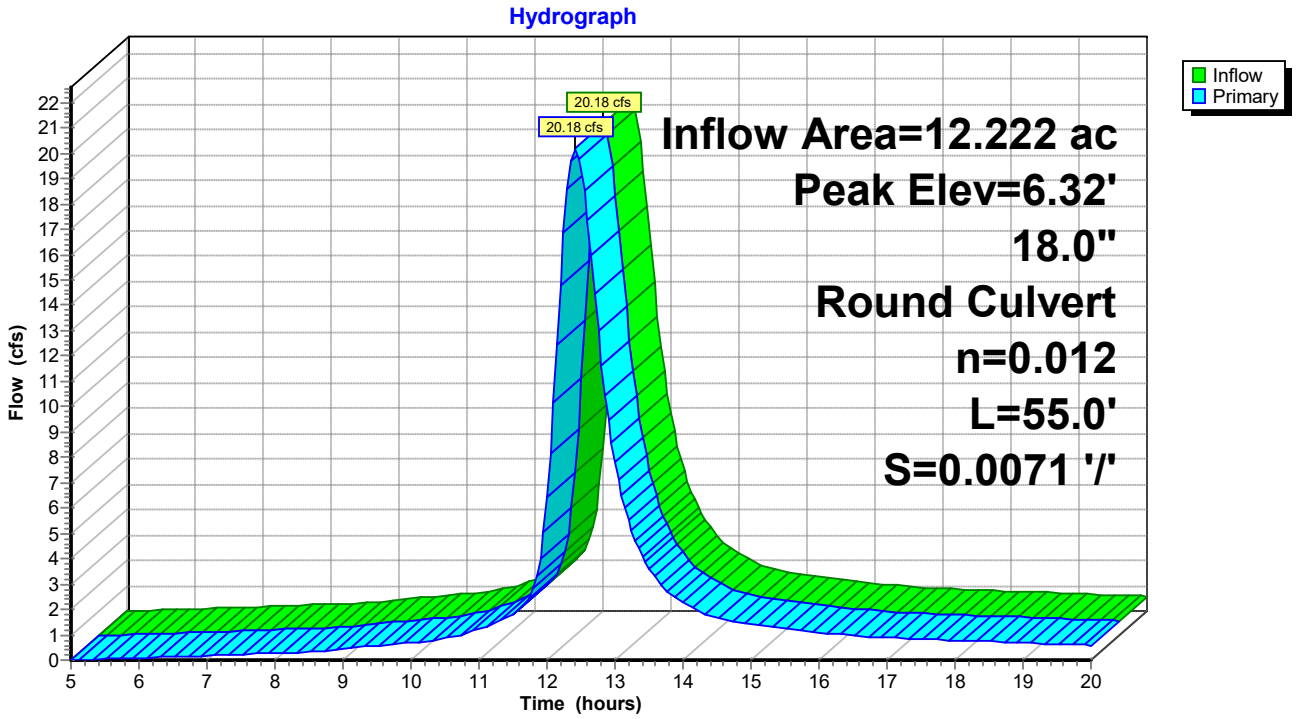
Inflow Area = 12.222 ac, 65.70% Impervious, Inflow Depth > 2.36" for 2-yr event
Inflow = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af
Outflow = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af, Atten= 0%, Lag= 0.0 min
Primary = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.32' @ 12.42 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.06'	**18.0" Round Culvert** L= 55.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.06' / -0.45' S= 0.0071 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=20.12 cfs @ 12.42 hrs HW=6.28' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=Culvert** (Inlet Controls 20.12 cfs @ 11.39 fps)

Pond 18P: DA East Chew Pipe



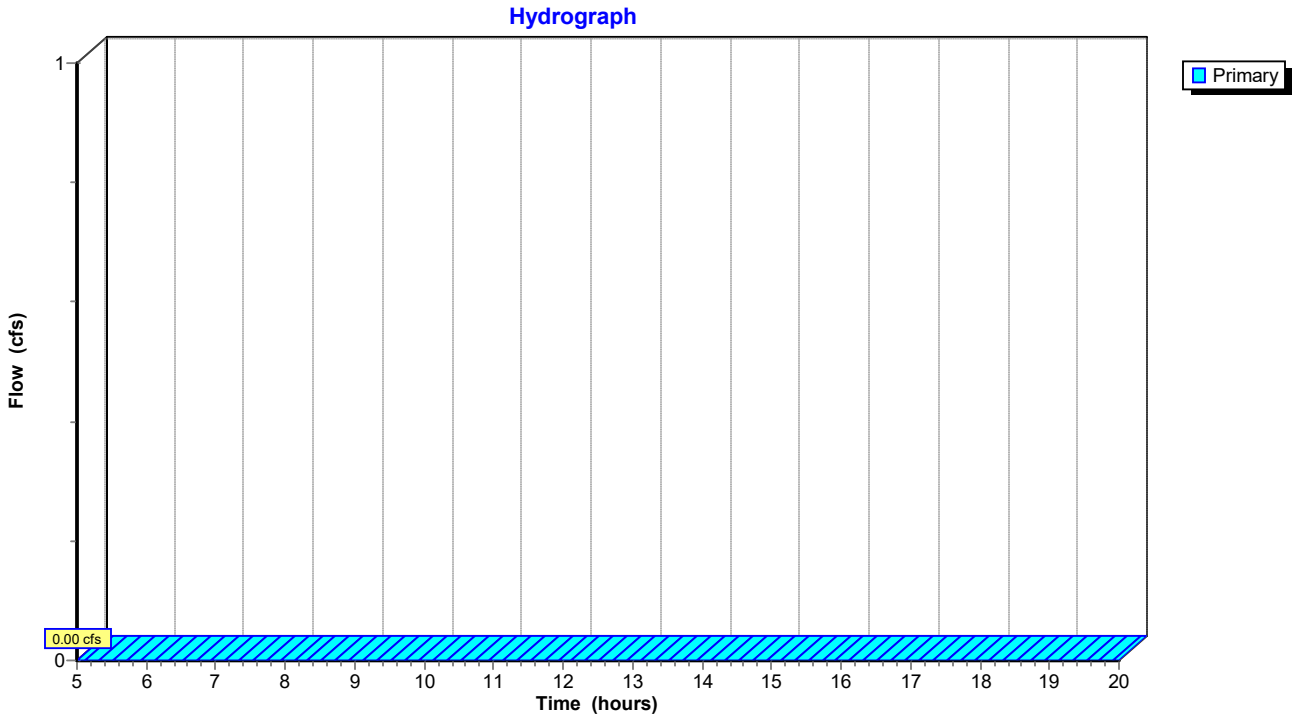
Summary for Link 10L: Harbor

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: Harbor



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=24.742 ac 65.94% Impervious Runoff Depth>4.71"
Flow Length=990' Tc=45.0 min CN=92 Runoff=79.28 cfs 9.714 af

Subcatchment 4S: DA2 Runoff Area=7.240 ac 50.29% Impervious Runoff Depth>4.40"
Flow Length=649' Tc=43.7 min CN=89 Runoff=22.54 cfs 2.655 af

Subcatchment 5S: DA3 Runoff Area=1.280 ac 59.98% Impervious Runoff Depth>4.39"
Flow Length=849' Tc=51.4 min CN=89 Runoff=3.56 cfs 0.468 af

Subcatchment 6S: DA4 Runoff Area=1.763 ac 53.49% Impervious Runoff Depth>4.40"
Flow Length=289' Tc=41.8 min CN=89 Runoff=5.66 cfs 0.647 af

Subcatchment 7S: DA5 Runoff Area=4.060 ac 49.97% Impervious Runoff Depth>4.20"
Flow Length=235' Slope=0.0010 '/' Tc=34.8 min CN=87 Runoff=14.18 cfs 1.421 af

Subcatchment 8S: DA6 Runoff Area=0.740 ac 60.00% Impervious Runoff Depth>4.41"
Flow Length=237' Tc=34.5 min CN=89 Runoff=2.70 cfs 0.272 af

Subcatchment 9S: East Chew Runoff Area=12.222 ac 65.70% Impervious Runoff Depth>4.71"
Flow Length=990' Tc=45.0 min CN=92 Runoff=39.16 cfs 4.799 af

Pond 12P: DA4 Pipe Peak Elev=2.69' Inflow=5.66 cfs 0.647 af
12.0" Round Culvert n=0.012 L=25.0' S=0.0060 '/' Outflow=5.66 cfs 0.647 af

Pond 13P: DA5 Pipe Peak Elev=14.61' Inflow=14.18 cfs 1.421 af
12.0" Round Culvert n=0.012 L=35.0' S=0.0097 '/' Outflow=14.18 cfs 1.421 af

Pond 14P: DA3 Pipe Peak Elev=1.55' Inflow=3.56 cfs 0.468 af
12.0" Round Culvert n=0.012 L=41.0' S=0.0176 '/' Outflow=3.56 cfs 0.468 af

Pond 15P: DA6 Pipe Peak Elev=1.43' Inflow=2.70 cfs 0.272 af
12.0" Round Culvert n=0.012 L=37.0' S=0.0208 '/' Outflow=2.70 cfs 0.272 af

Pond 16P: DA2 Pipe Peak Elev=1.89' Inflow=22.54 cfs 2.655 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=82.0' S=0.0078 '/' Outflow=22.54 cfs 2.655 af

Pond 17P: DA1 Pipe Peak Elev=17.17' Inflow=79.28 cfs 9.714 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=74.0' S=0.0219 '/' Outflow=79.28 cfs 9.714 af

Pond 18P: DA East Chew Pipe Peak Elev=21.88' Inflow=39.16 cfs 4.799 af
18.0" Round Culvert n=0.012 L=55.0' S=0.0071 '/' Outflow=39.16 cfs 4.799 af

Link 10L: Harbor
Primary=0.00 cfs 0.000 af

Total Runoff Area = 52.047 ac Runoff Volume = 19.976 af Average Runoff Depth = 4.61"
38.19% Pervious = 19.877 ac 61.81% Impervious = 32.170 ac

Summary for Subcatchment 1S: DA1

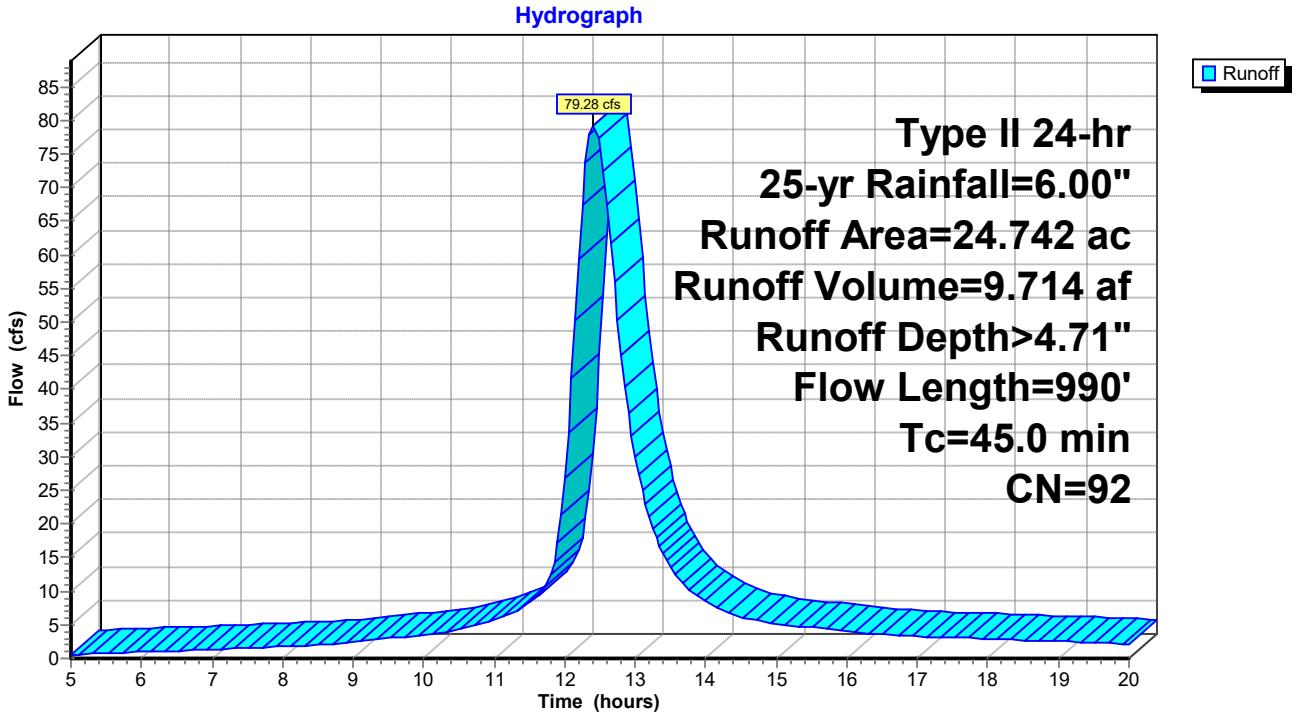
Runoff = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
1.000	85	1/2 acre lots, 25% imp, HSG D
0.900	86	1/3 acre lots, 30% imp, HSG D
8.140	87	1/4 acre lots, 38% imp, HSG D
2.002	92	1/8 acre lots, 65% imp, HSG D
8.000	95	Urban commercial, 85% imp, HSG D
4.600	98	Paved parking, HSG D
0.100	80	>75% Grass cover, Good, HSG D
24.742	92	Weighted Average
8.428		34.06% Pervious Area
16.314		65.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 4S: DA2

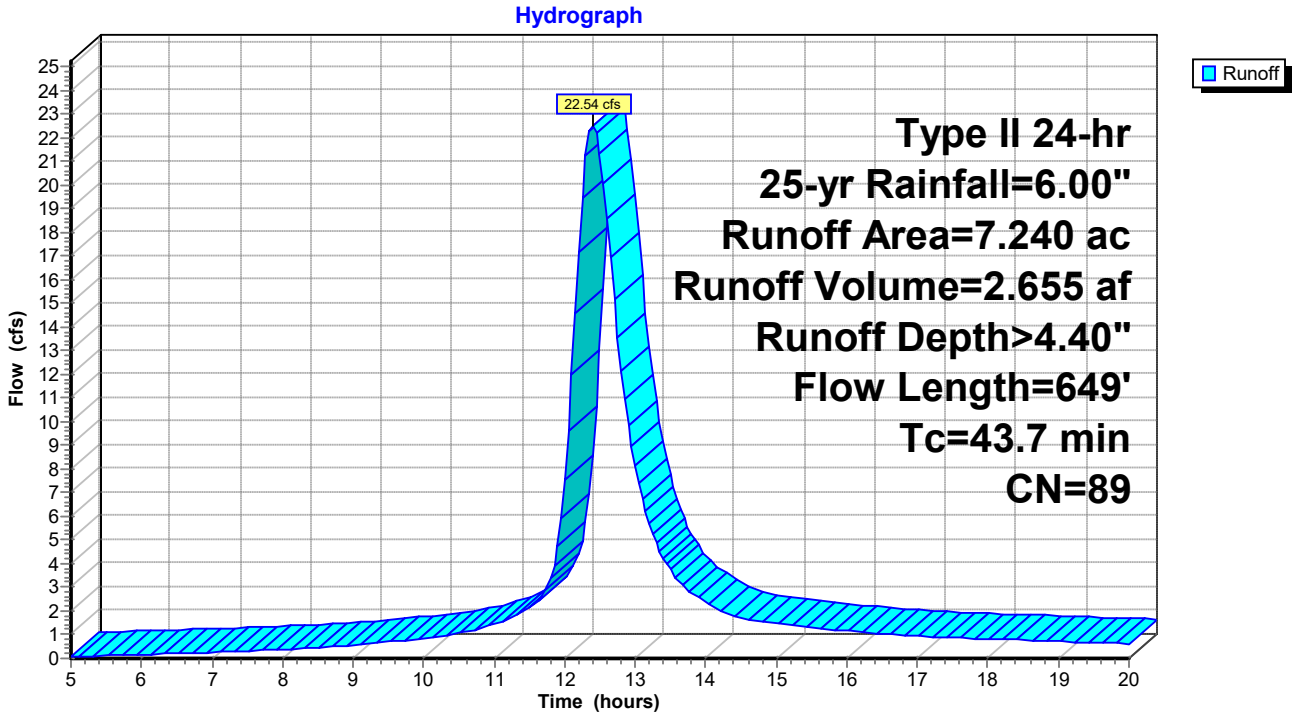
Runoff = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.200	80	1/2 acre lots, 25% imp, HSG C
0.240	85	1/2 acre lots, 25% imp, HSG D
0.720	81	1/3 acre lots, 30% imp, HSG C
2.320	86	1/3 acre lots, 30% imp, HSG D
0.210	83	1/4 acre lots, 38% imp, HSG C
1.630	87	1/4 acre lots, 38% imp, HSG D
1.920	98	Paved parking, HSG D
7.240	89	Weighted Average
3.599		49.71% Pervious Area
3.641		50.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0080	7.45	30.70	**Pipe Channel, RCP_Elliptical 34x22** 34.0" x 22.0", R=24.9" Elliptical Area= 4.1 sf Perim= 7.5' r= 0.55' n= 0.012 Concrete pipe, finished
2.0	367	0.0012	3.14	15.39	**Pipe Channel, RCP_Round 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
43.7	649	Total			

Subcatchment 4S: DA2



Summary for Subcatchment 5S: DA3

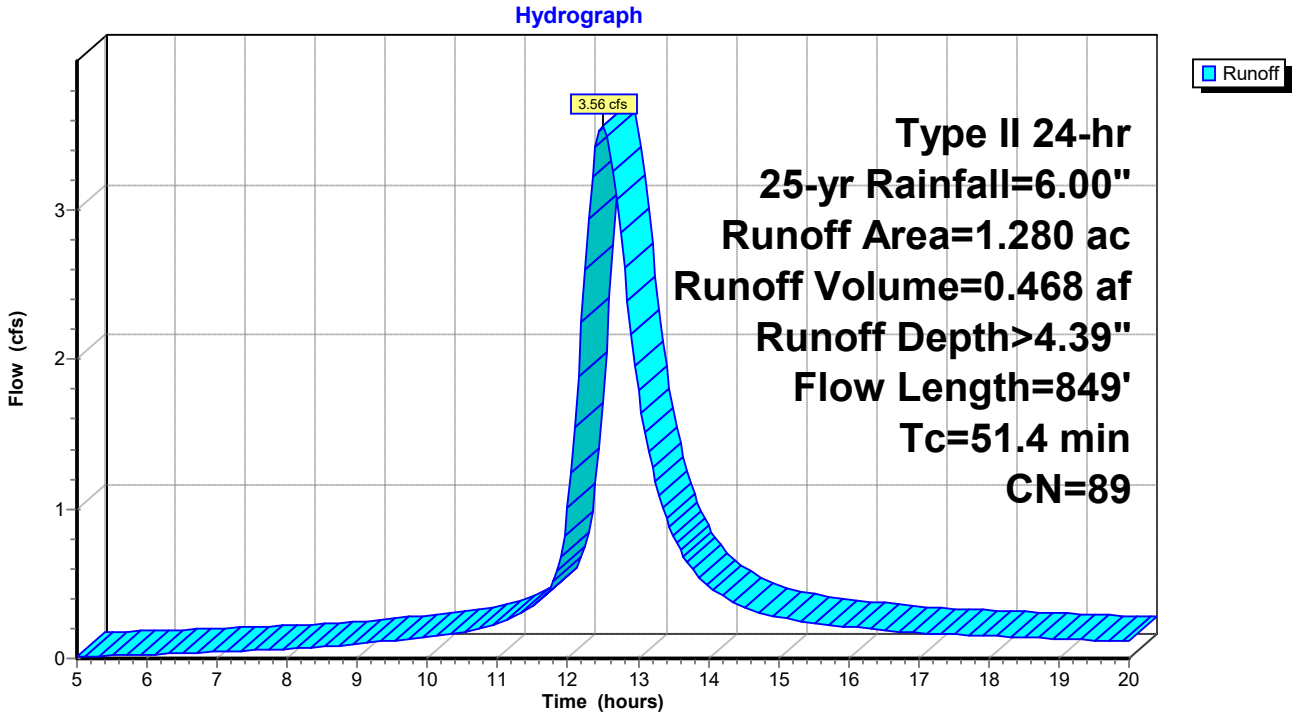
Runoff = 3.56 cfs @ 12.49 hrs, Volume= 0.468 af, Depth> 4.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.110	81	1/3 acre lots, 30% imp, HSG C
0.170	86	1/3 acre lots, 30% imp, HSG D
0.430	83	1/4 acre lots, 38% imp, HSG C
0.080	87	1/4 acre lots, 38% imp, HSG D
0.490	98	Paved parking, HSG D
1.280	89	Weighted Average
0.512		40.02% Pervious Area
0.768		59.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0078	7.98	32.34	**Pipe Channel, out** 34.0" x 22.0", R=23.0" Elliptical Area= 4.1 sf Perim= 7.4' r= 0.55' n= 0.011 Concrete pipe, straight & clean
6.8	367	0.0001	0.91	4.44	**Pipe Channel, 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
2.9	200	0.0010	1.15	5.73	**Channel Flow, ditch** Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.030 Earth, grassed & winding
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
51.4	849	Total			

Subcatchment 5S: DA3



Summary for Subcatchment 6S: DA4

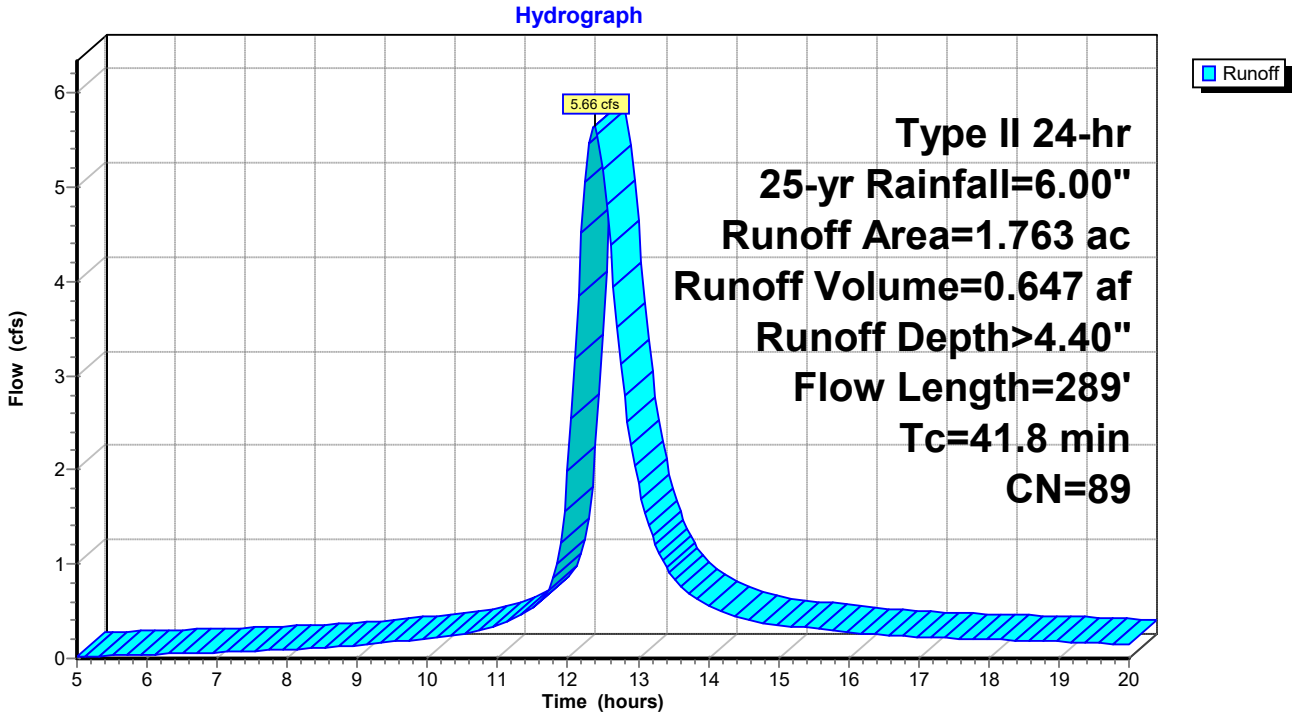
Runoff = 5.66 cfs @ 12.38 hrs, Volume= 0.647 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.040	81	1/3 acre lots, 30% imp, HSG C
0.440	86	1/3 acre lots, 30% imp, HSG D
0.160	83	1/4 acre lots, 38% imp, HSG C
0.423	87	1/4 acre lots, 38% imp, HSG D
0.350	92	1/8 acre lots, 65% imp, HSG D
0.350	98	Paved parking, HSG D
1.763	89	Weighted Average
0.820		46.51% Pervious Area
0.943		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0060	3.81	2.99	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	31	0.0230	7.45	5.85	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	33	0.0160	6.22	4.88	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
41.8	289	Total			

Subcatchment 6S: DA4



Summary for Subcatchment 7S: DA5

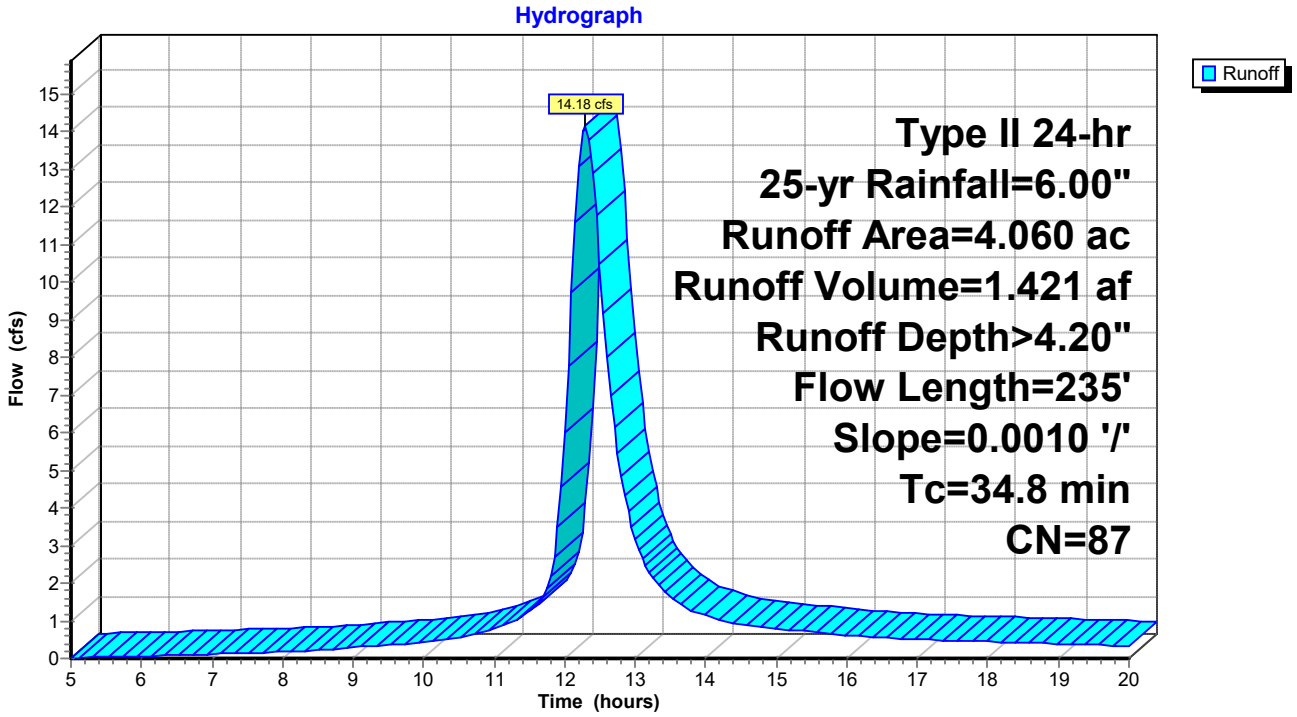
Runoff = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af, Depth> 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
1.100	79	1 acre lots, 20% imp, HSG C
0.030	80	1/2 acre lots, 25% imp, HSG C
0.180	85	1/2 acre lots, 25% imp, HSG D
0.040	86	1/3 acre lots, 30% imp, HSG D
0.560	83	1/4 acre lots, 38% imp, HSG C
0.930	87	1/4 acre lots, 38% imp, HSG D
0.120	92	1/8 acre lots, 65% imp, HSG D
1.100	98	Paved parking, HSG D
4.060	87	Weighted Average
2.031		50.03% Pervious Area
2.029		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	35	0.0010	1.55	1.22	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.8	235	Total			

Subcatchment 7S: DA5



Summary for Subcatchment 8S: DA6

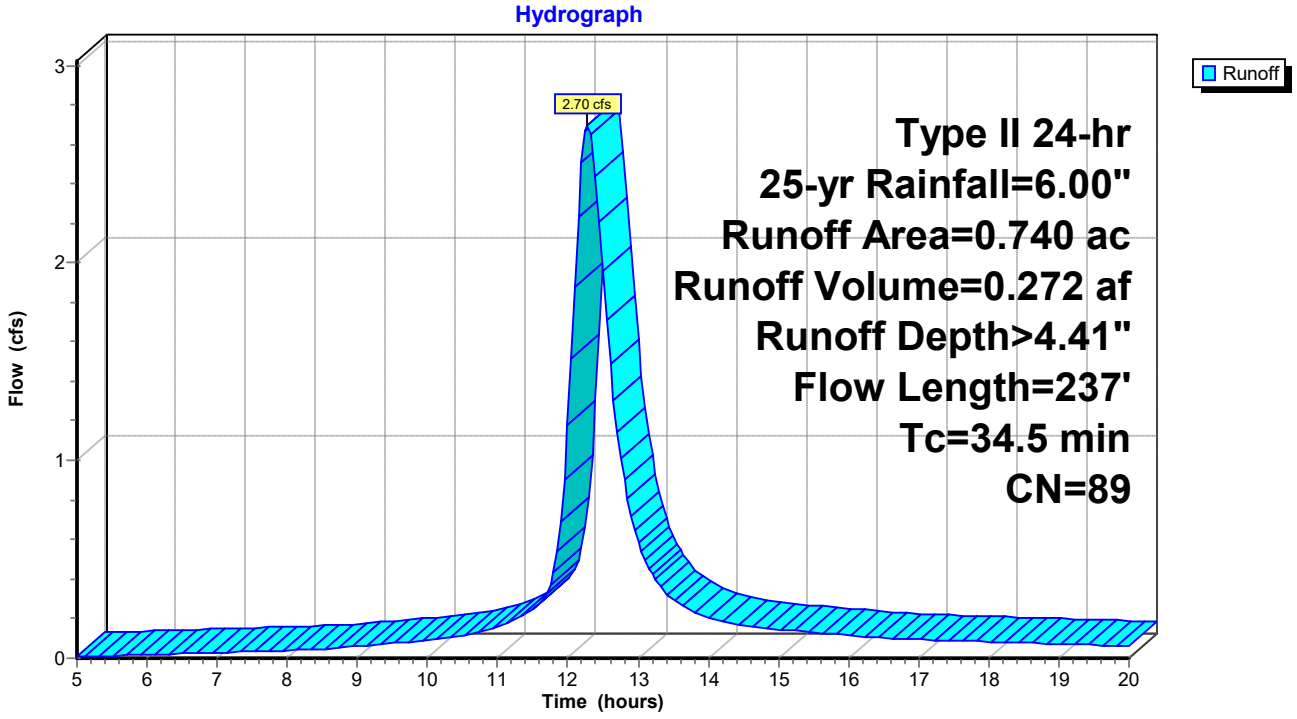
Runoff = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.370	79	1 acre lots, 20% imp, HSG C
0.370	98	Paved parking, HSG D
0.740	89	Weighted Average
0.296		40.00% Pervious Area
0.444		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	37	0.0200	6.95	5.46	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.5	237	Total			

Subcatchment 8S: DA6



Summary for Subcatchment 9S: East Chew

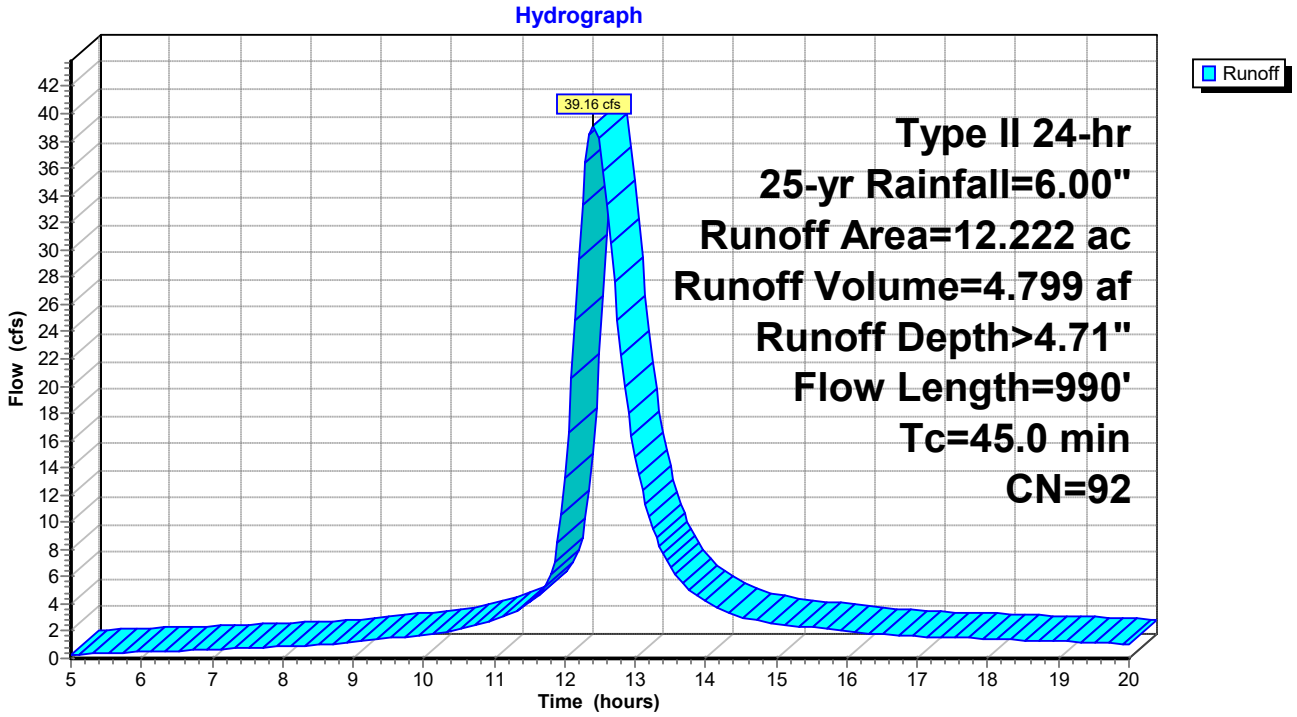
Runoff = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.500	85	1/2 acre lots, 25% imp, HSG D
0.450	86	1/3 acre lots, 30% imp, HSG D
4.070	87	1/4 acre lots, 38% imp, HSG D
1.002	92	1/8 acre lots, 65% imp, HSG D
3.850	95	Urban commercial, 85% imp, HSG D
2.300	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
12.222	92	Weighted Average
4.192		34.30% Pervious Area
8.030		65.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 9S: East Chew



Summary for Pond 12P: DA4 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 2.69' (Flood elevation advised)

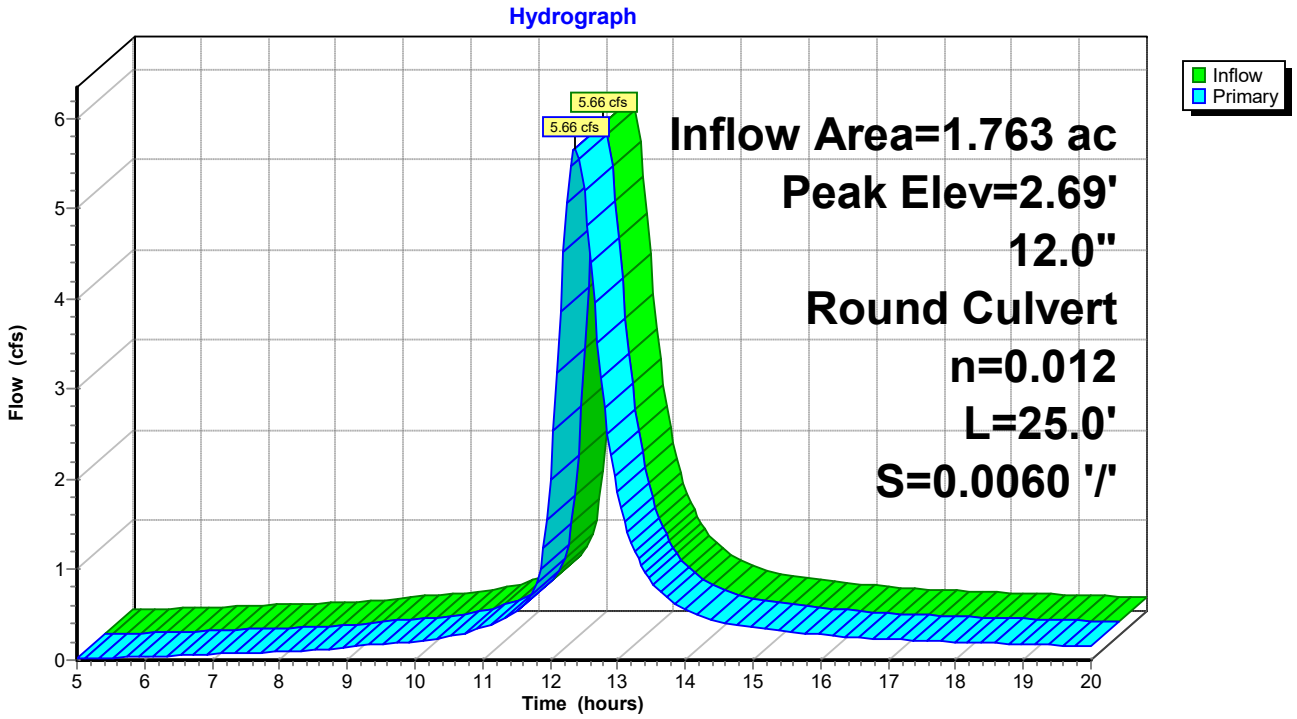
Inflow Area =	1.763 ac,	53.49% Impervious,	Inflow Depth >	4.40"	for 25-yr event
Inflow =	5.66 cfs @	12.38 hrs,	Volume=	0.647 af	
Outflow =	5.66 cfs @	12.38 hrs,	Volume=	0.647 af,	Atten= 0%, Lag= 0.0 min
Primary =	5.66 cfs @	12.38 hrs,	Volume=	0.647 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.69' @ 12.38 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.05'	**12.0" Round Culvert** L= 25.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.05' / -0.20' S= 0.0060 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=5.64 cfs @ 12.38 hrs HW=2.67' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=Culvert** (Inlet Controls 5.64 cfs @ 7.18 fps)

Pond 12P: DA4 Pipe



Summary for Pond 13P: DA5 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 12.61' above defined flood level

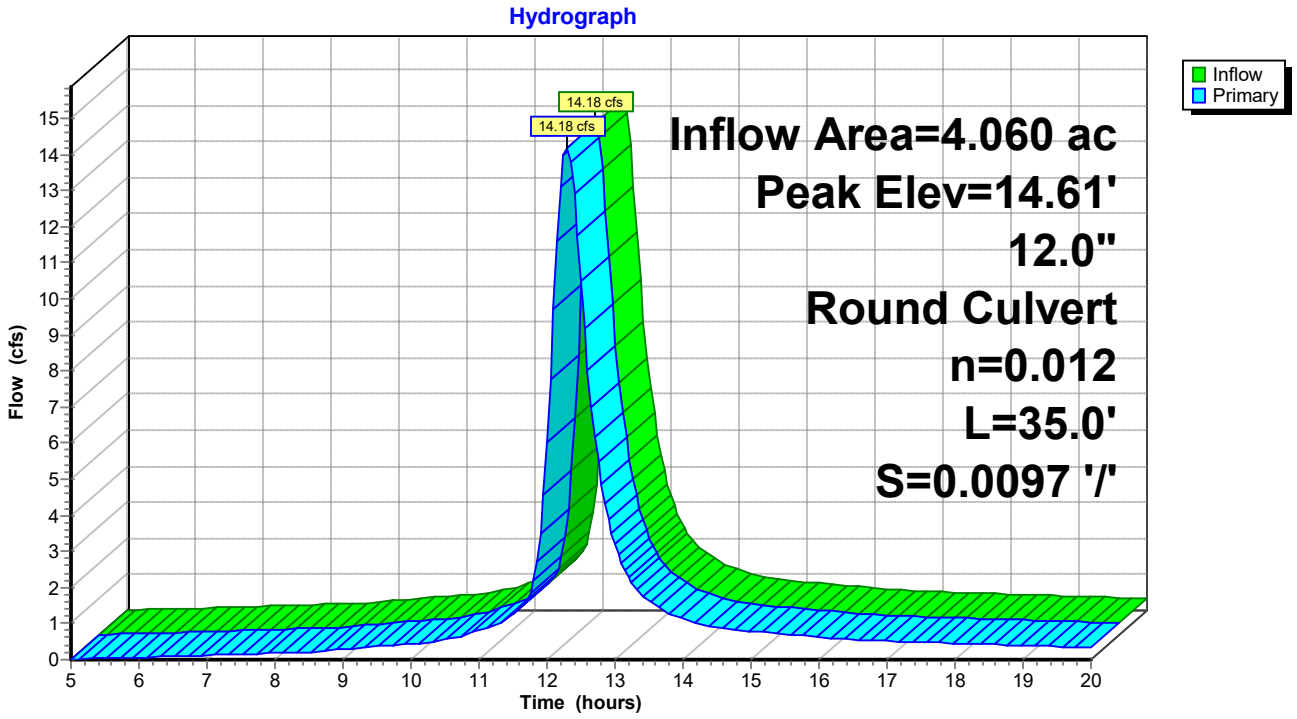
Inflow Area = 4.060 ac, 49.97% Impervious, Inflow Depth > 4.20" for 25-yr event
Inflow = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af
Outflow = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af, Atten= 0%, Lag= 0.0 min
Primary = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 14.61' @ 12.29 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.05'	**12.0" Round CMP_Round 12"** L= 35.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.05' / -0.29' S= 0.0097 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=14.13 cfs @ 12.29 hrs HW=14.52' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=CMP_Round 12"** (Inlet Controls 14.13 cfs @ 18.00 fps)

Pond 13P: DA5 Pipe



Summary for Pond 14P: DA3 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 1.55' (Flood elevation advised)

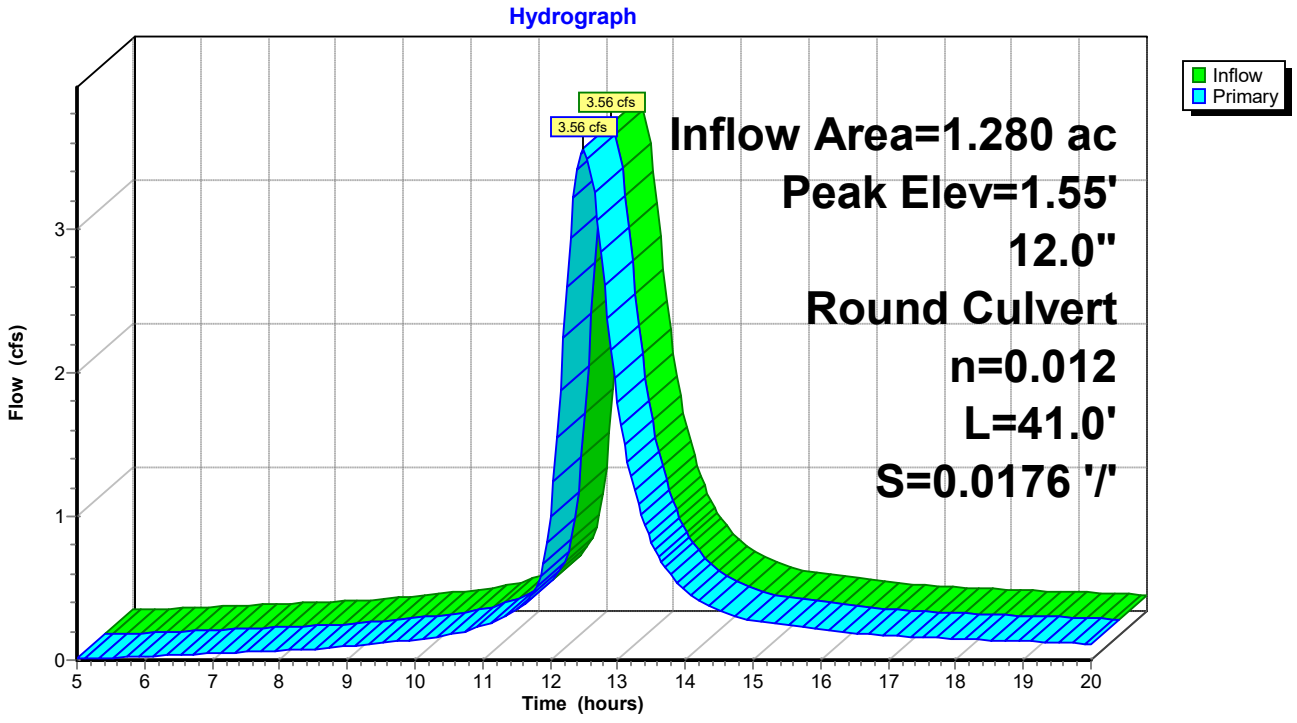
Inflow Area = 1.280 ac, 59.98% Impervious, Inflow Depth > 4.39" for 25-yr event
Inflow = 3.56 cfs @ 12.49 hrs, Volume= 0.468 af
Outflow = 3.56 cfs @ 12.49 hrs, Volume= 0.468 af, Atten= 0%, Lag= 0.0 min
Primary = 3.56 cfs @ 12.49 hrs, Volume= 0.468 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.55' @ 12.49 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.16'	**12.0" Round Culvert** L= 41.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.16' / -0.56' S= 0.0176 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=3.56 cfs @ 12.49 hrs HW=1.55' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=Culvert** (Inlet Controls 3.56 cfs @ 4.53 fps)

Pond 14P: DA3 Pipe



Summary for Pond 15P: DA6 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 2.43' above defined flood level

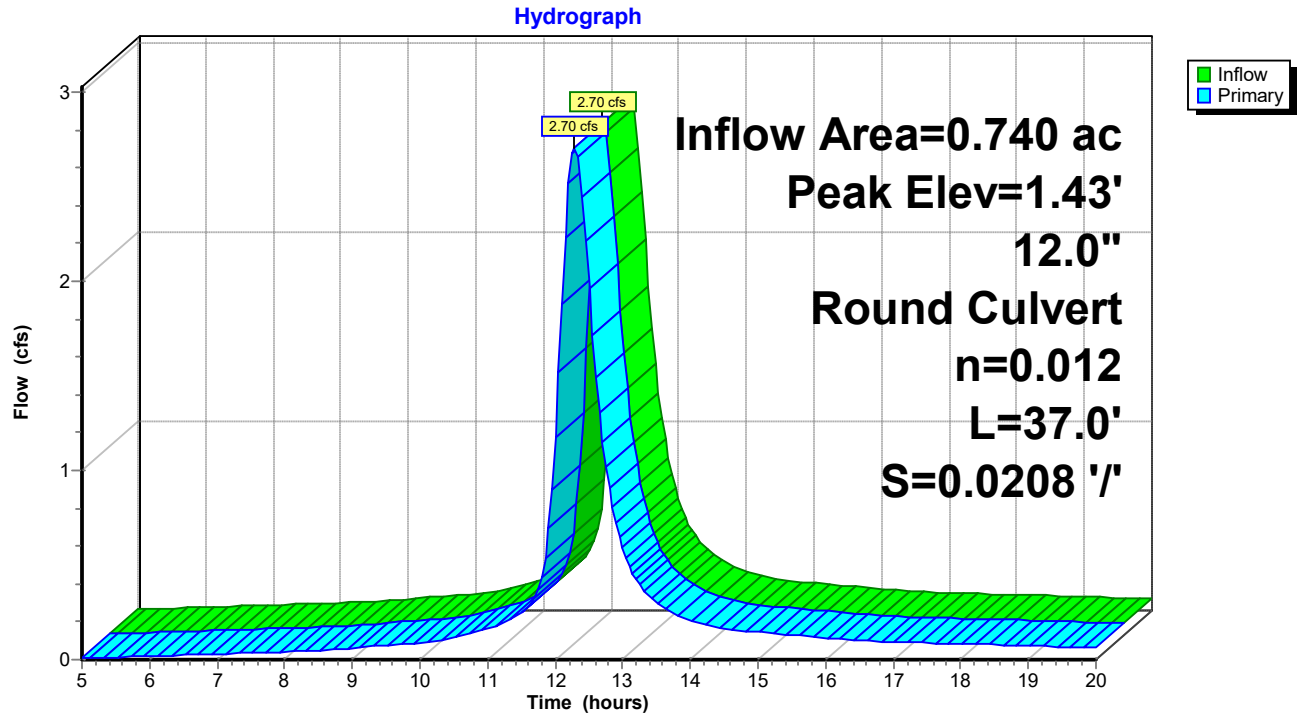
Inflow Area = 0.740 ac, 60.00% Impervious, Inflow Depth > 4.41" for 25-yr event
Inflow = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af
Outflow = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min
Primary = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.43' @ 12.29 hrs
Flood Elev= -1.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.42'	**12.0" Round CMP_Round 12"** L= 37.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.42' / -0.35' S= 0.0208 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=2.69 cfs @ 12.29 hrs HW=1.42' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=CMP_Round 12"** (Inlet Controls 2.69 cfs @ 3.42 fps)

Pond 15P: DA6 Pipe



Summary for Pond 16P: DA2 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 1.89' (Flood elevation advised)

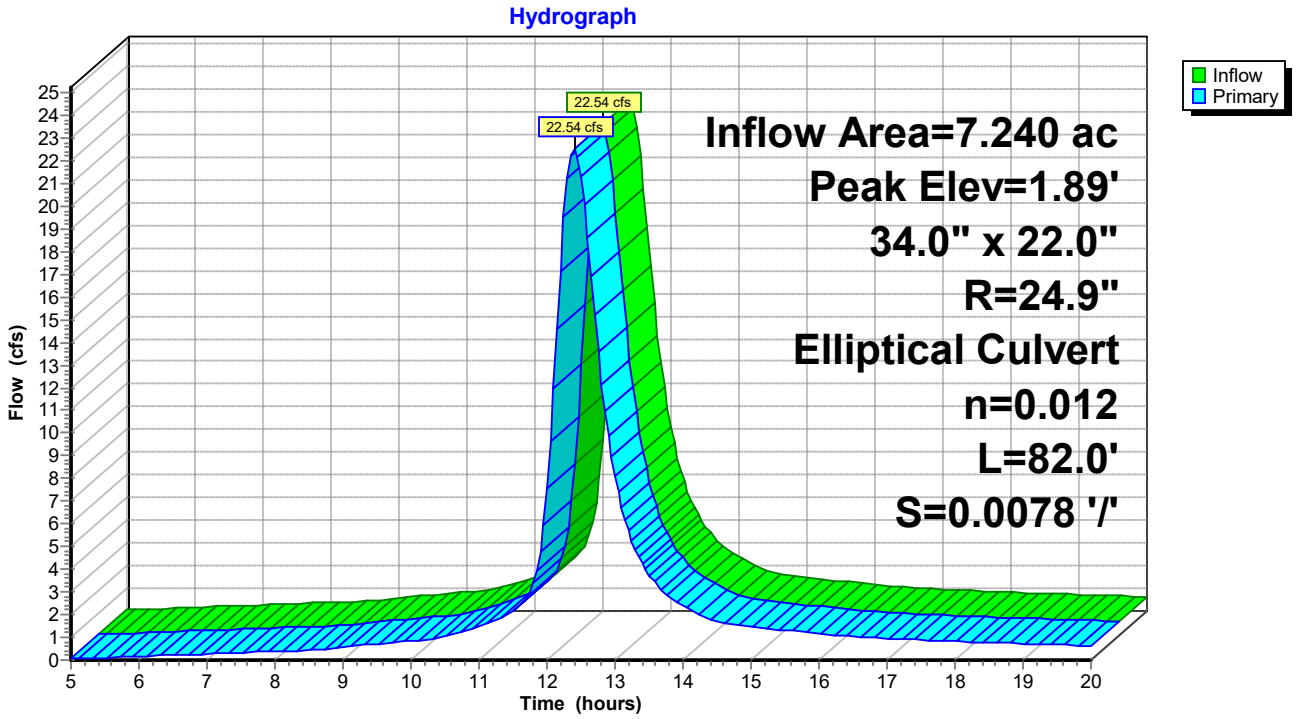
Inflow Area = 7.240 ac, 50.29% Impervious, Inflow Depth > 4.40" for 25-yr event
Inflow = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af
Outflow = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af, Atten= 0%, Lag= 0.0 min
Primary = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.89' @ 12.40 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.36'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 82.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.36' / -1.00' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=22.52 cfs @ 12.40 hrs HW=1.89' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 22.52 cfs @ 5.47 fps)

Pond 16P: DA2 Pipe



Summary for Pond 17P: DA1 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 17.17' (Flood elevation advised)

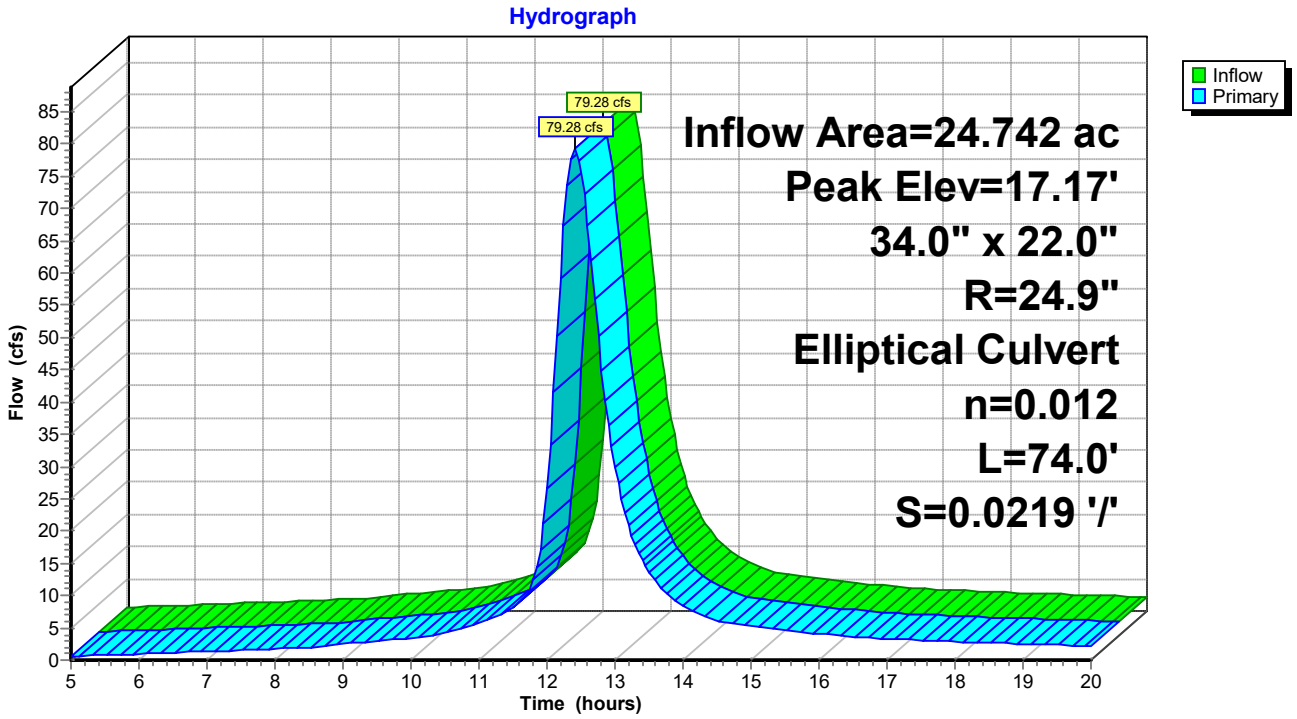
Inflow Area = 24.742 ac, 65.94% Impervious, Inflow Depth > 4.71" for 25-yr event
Inflow = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af
Outflow = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af, Atten= 0%, Lag= 0.0 min
Primary = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 17.17' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.27'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 74.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.27' / -1.35' S= 0.0219 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=79.10 cfs @ 12.41 hrs HW=17.10' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 79.10 cfs @ 19.20 fps)

Pond 17P: DA1 Pipe



Summary for Pond 18P: DA East Chew Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 19.88' above defined flood level

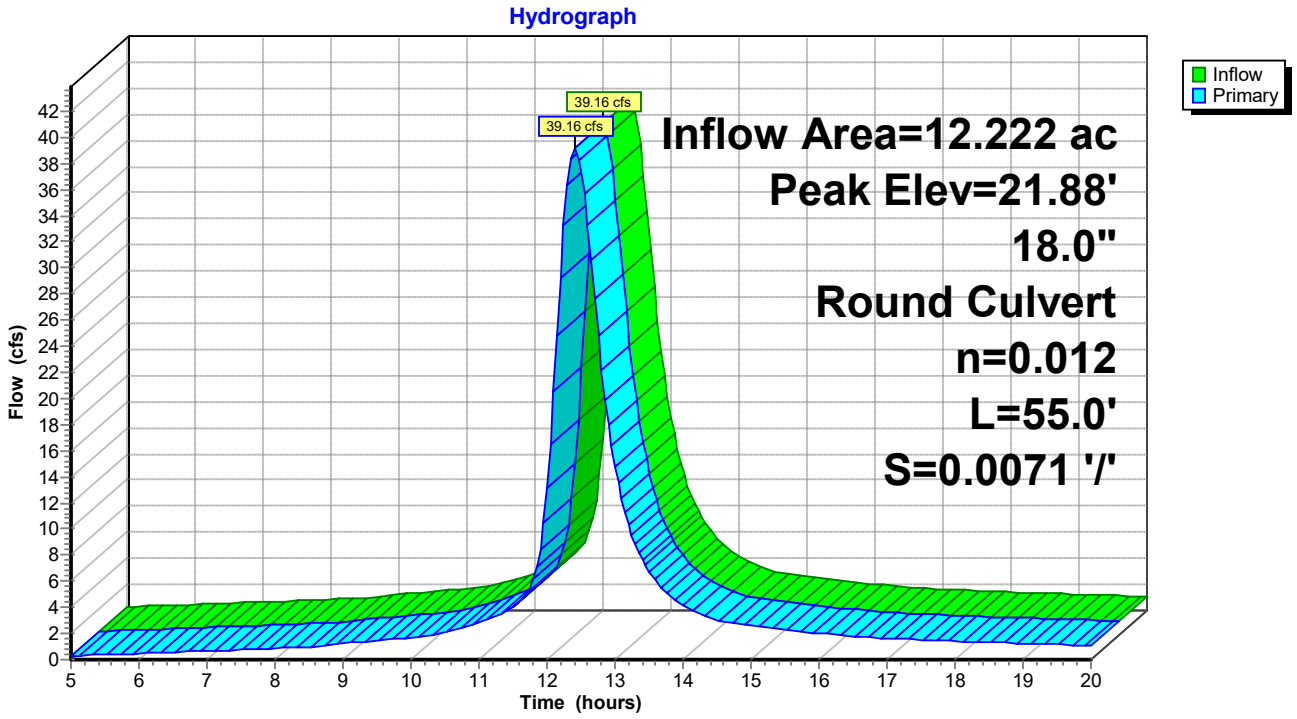
Inflow Area = 12.222 ac, 65.70% Impervious, Inflow Depth > 4.71" for 25-yr event
Inflow = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af
Outflow = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af, Atten= 0%, Lag= 0.0 min
Primary = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 21.88' @ 12.41 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.06'	**18.0" Round Culvert** L= 55.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.06' / -0.45' S= 0.0071 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=39.08 cfs @ 12.41 hrs HW=21.78' TW=-1.00' (Fixed TW Elev= -1.00')
1=Culvert (Inlet Controls 39.08 cfs @ 22.11 fps)

Pond 18P: DA East Chew Pipe



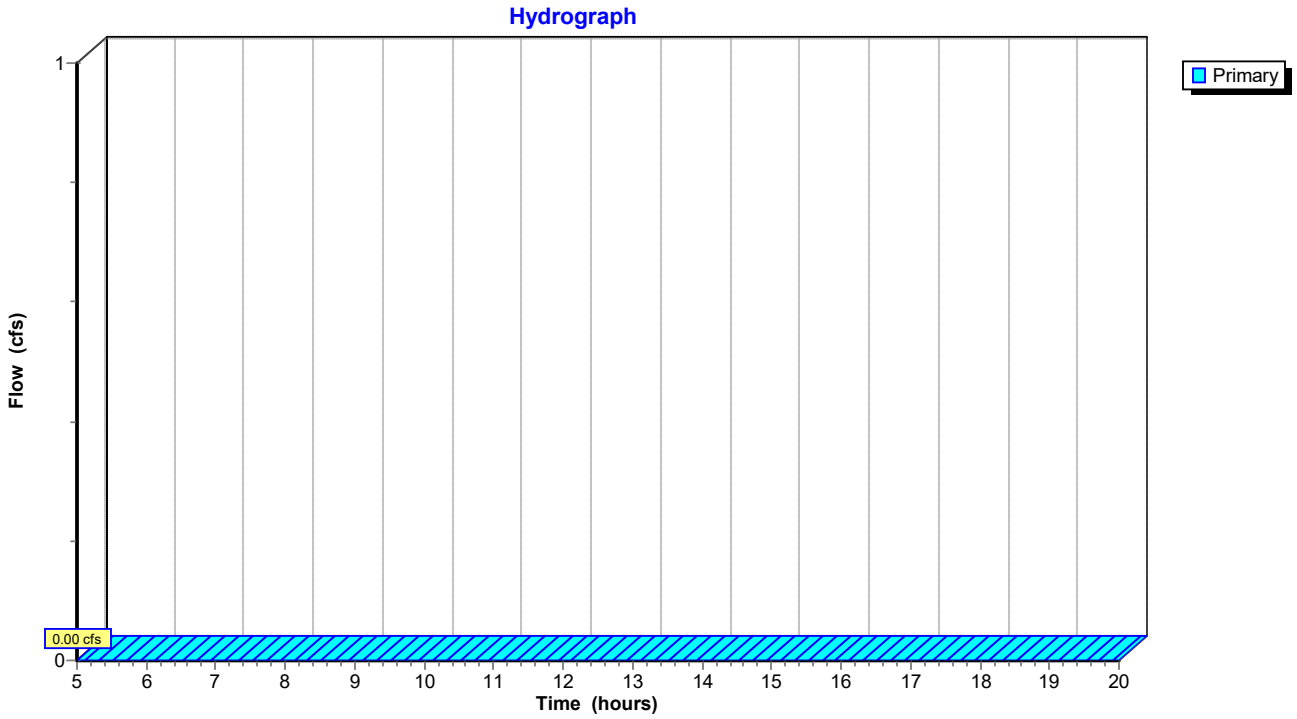
Summary for Link 10L: Harbor

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: Harbor



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=24.742 ac 65.94% Impervious Runoff Depth>6.17"
Flow Length=990' Tc=45.0 min CN=92 Runoff=102.65 cfs 12.722 af

Subcatchment 4S: DA2 Runoff Area=7.240 ac 50.29% Impervious Runoff Depth>5.85"
Flow Length=649' Tc=43.7 min CN=89 Runoff=29.60 cfs 3.531 af

Subcatchment 5S: DA3 Runoff Area=1.280 ac 59.98% Impervious Runoff Depth>5.84"
Flow Length=849' Tc=51.4 min CN=89 Runoff=4.68 cfs 0.623 af

Subcatchment 6S: DA4 Runoff Area=1.763 ac 53.49% Impervious Runoff Depth>5.86"
Flow Length=289' Tc=41.8 min CN=89 Runoff=7.43 cfs 0.860 af

Subcatchment 7S: DA5 Runoff Area=4.060 ac 49.97% Impervious Runoff Depth>5.65"
Flow Length=235' Slope=0.0010 '/' Tc=34.8 min CN=87 Runoff=18.81 cfs 1.910 af

Subcatchment 8S: DA6 Runoff Area=0.740 ac 60.00% Impervious Runoff Depth>5.87"
Flow Length=237' Tc=34.5 min CN=89 Runoff=3.54 cfs 0.362 af

Subcatchment 9S: East Chew Runoff Area=12.222 ac 65.70% Impervious Runoff Depth>6.17"
Flow Length=990' Tc=45.0 min CN=92 Runoff=50.71 cfs 6.285 af

Pond 12P: DA4 Pipe Peak Elev=4.31' Inflow=7.43 cfs 0.860 af
12.0" Round Culvert n=0.012 L=25.0' S=0.0060 '/' Outflow=7.43 cfs 0.860 af

Pond 13P: DA5 Pipe Peak Elev=25.28' Inflow=18.81 cfs 1.910 af
12.0" Round Culvert n=0.012 L=35.0' S=0.0097 '/' Outflow=18.81 cfs 1.910 af

Pond 14P: DA3 Pipe Peak Elev=2.19' Inflow=4.68 cfs 0.623 af
12.0" Round Culvert n=0.012 L=41.0' S=0.0176 '/' Outflow=4.68 cfs 0.623 af

Pond 15P: DA6 Pipe Peak Elev=1.80' Inflow=3.54 cfs 0.362 af
12.0" Round Culvert n=0.012 L=37.0' S=0.0208 '/' Outflow=3.54 cfs 0.362 af

Pond 16P: DA2 Pipe Peak Elev=2.81' Inflow=29.60 cfs 3.531 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=82.0' S=0.0078 '/' Outflow=29.60 cfs 3.531 af

Pond 17P: DA1 Pipe Peak Elev=27.97' Inflow=102.65 cfs 12.722 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=74.0' S=0.0219 '/' Outflow=102.65 cfs 12.722 af

Pond 18P: DA East Chew Pipe Peak Elev=36.20' Inflow=50.71 cfs 6.285 af
18.0" Round Culvert n=0.012 L=55.0' S=0.0071 '/' Outflow=50.71 cfs 6.285 af

Link 10L: Harbor
Primary=0.00 cfs 0.000 af

Total Runoff Area = 52.047 ac Runoff Volume = 26.294 af Average Runoff Depth = 6.06"
38.19% Pervious = 19.877 ac 61.81% Impervious = 32.170 ac

Summary for Subcatchment 1S: DA1

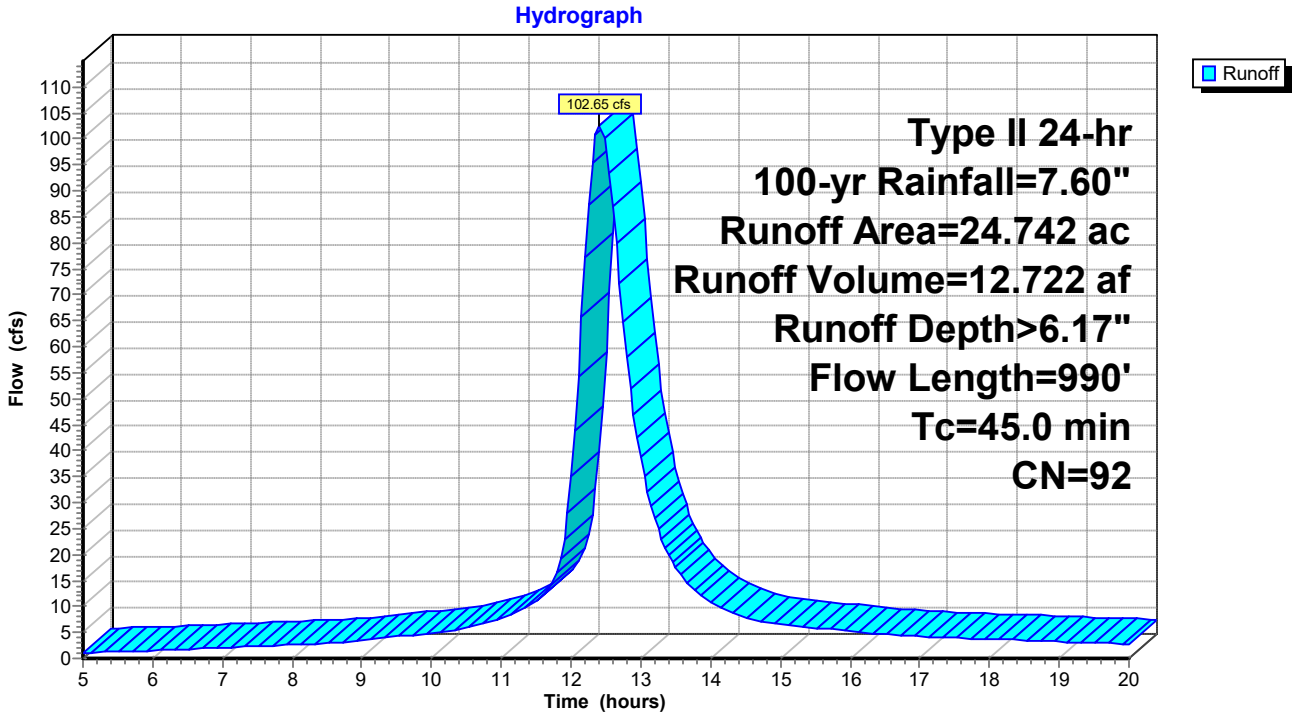
Runoff = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af, Depth> 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
1.000	85	1/2 acre lots, 25% imp, HSG D
0.900	86	1/3 acre lots, 30% imp, HSG D
8.140	87	1/4 acre lots, 38% imp, HSG D
2.002	92	1/8 acre lots, 65% imp, HSG D
8.000	95	Urban commercial, 85% imp, HSG D
4.600	98	Paved parking, HSG D
0.100	80	>75% Grass cover, Good, HSG D
24.742	92	Weighted Average
8.428		34.06% Pervious Area
16.314		65.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 4S: DA2

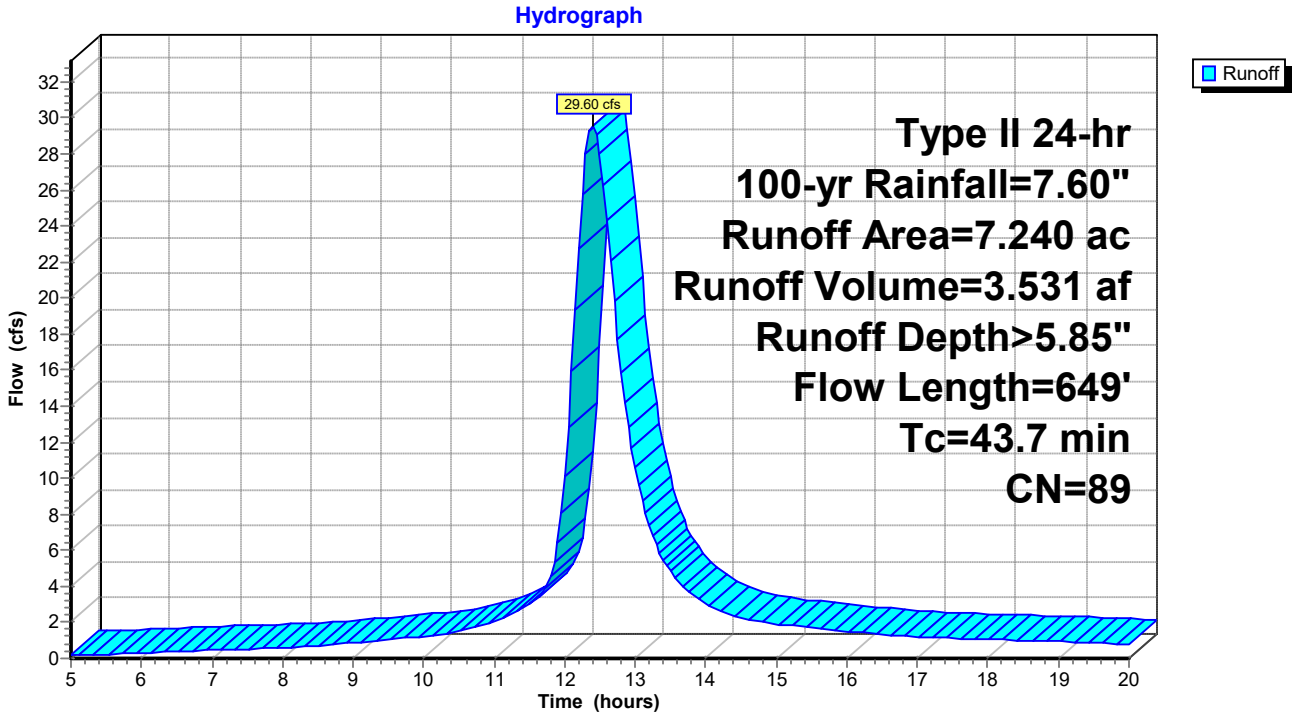
Runoff = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af, Depth> 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.200	80	1/2 acre lots, 25% imp, HSG C
0.240	85	1/2 acre lots, 25% imp, HSG D
0.720	81	1/3 acre lots, 30% imp, HSG C
2.320	86	1/3 acre lots, 30% imp, HSG D
0.210	83	1/4 acre lots, 38% imp, HSG C
1.630	87	1/4 acre lots, 38% imp, HSG D
1.920	98	Paved parking, HSG D
7.240	89	Weighted Average
3.599		49.71% Pervious Area
3.641		50.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0080	7.45	30.70	**Pipe Channel, RCP_Elliptical 34x22** 34.0" x 22.0", R=24.9" Elliptical Area= 4.1 sf Perim= 7.5' r= 0.55' n= 0.012 Concrete pipe, finished
2.0	367	0.0012	3.14	15.39	**Pipe Channel, RCP_Round 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
43.7	649	Total			

Subcatchment 4S: DA2



Summary for Subcatchment 5S: DA3

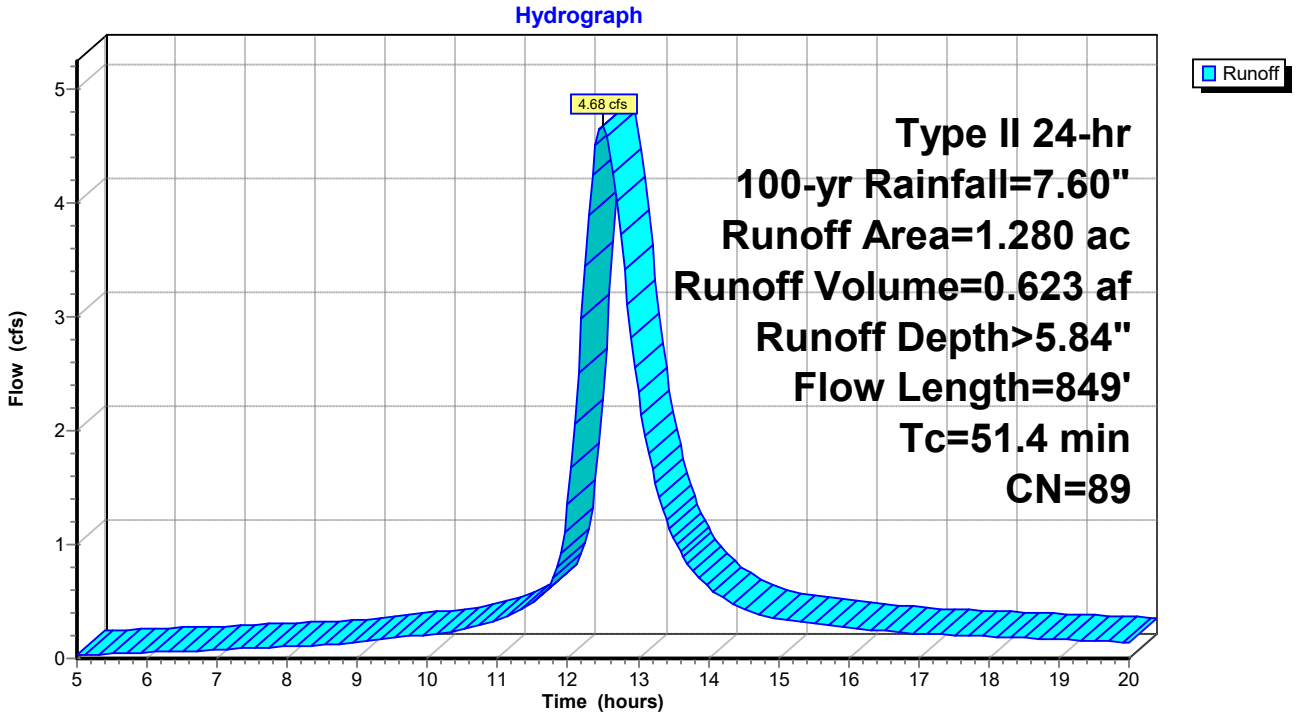
Runoff = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af, Depth> 5.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.110	81	1/3 acre lots, 30% imp, HSG C
0.170	86	1/3 acre lots, 30% imp, HSG D
0.430	83	1/4 acre lots, 38% imp, HSG C
0.080	87	1/4 acre lots, 38% imp, HSG D
0.490	98	Paved parking, HSG D
1.280	89	Weighted Average
0.512		40.02% Pervious Area
0.768		59.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0078	7.98	32.34	**Pipe Channel, out** 34.0" x 22.0", R=23.0" Elliptical Area= 4.1 sf Perim= 7.4' r= 0.55' n= 0.011 Concrete pipe, straight & clean
6.8	367	0.0001	0.91	4.44	**Pipe Channel, 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
2.9	200	0.0010	1.15	5.73	**Channel Flow, ditch** Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.030 Earth, grassed & winding
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
51.4	849	Total			

Subcatchment 5S: DA3



Summary for Subcatchment 6S: DA4

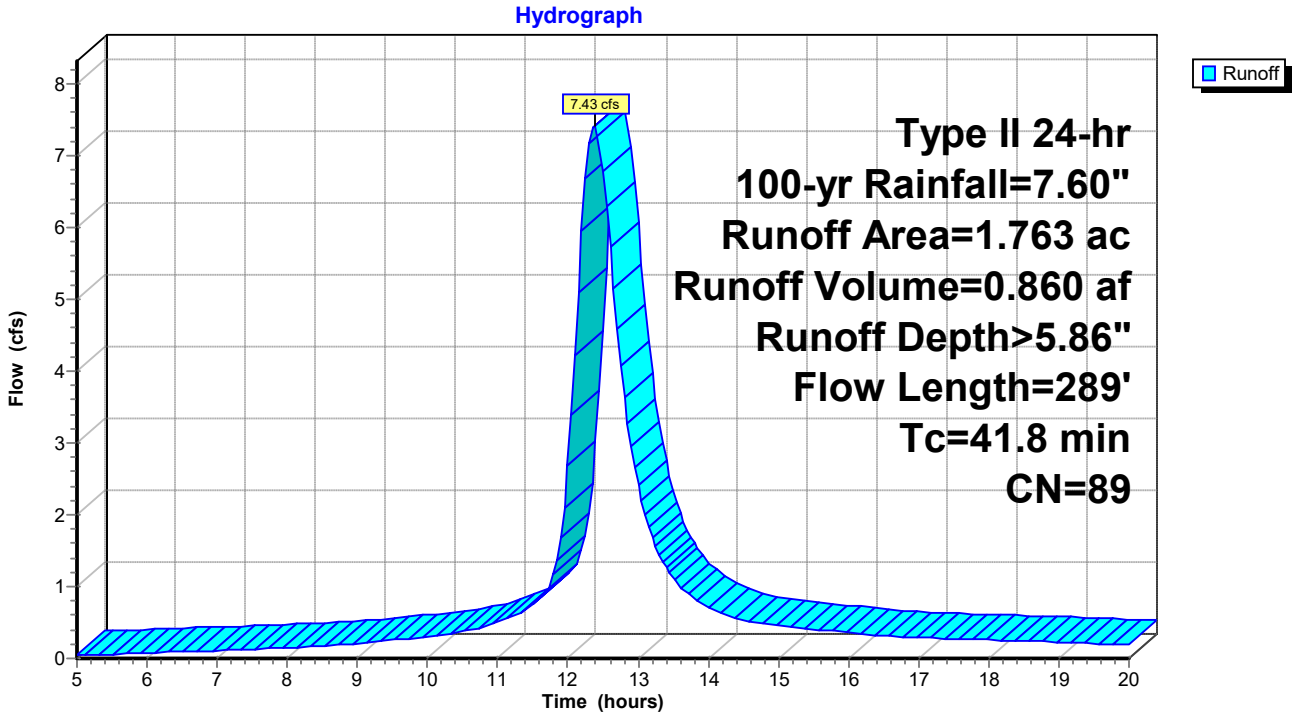
Runoff = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af, Depth> 5.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.040	81	1/3 acre lots, 30% imp, HSG C
0.440	86	1/3 acre lots, 30% imp, HSG D
0.160	83	1/4 acre lots, 38% imp, HSG C
0.423	87	1/4 acre lots, 38% imp, HSG D
0.350	92	1/8 acre lots, 65% imp, HSG D
0.350	98	Paved parking, HSG D
1.763	89	Weighted Average
0.820		46.51% Pervious Area
0.943		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0060	3.81	2.99	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	31	0.0230	7.45	5.85	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	33	0.0160	6.22	4.88	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
41.8	289	Total			

Subcatchment 6S: DA4



Summary for Subcatchment 7S: DA5

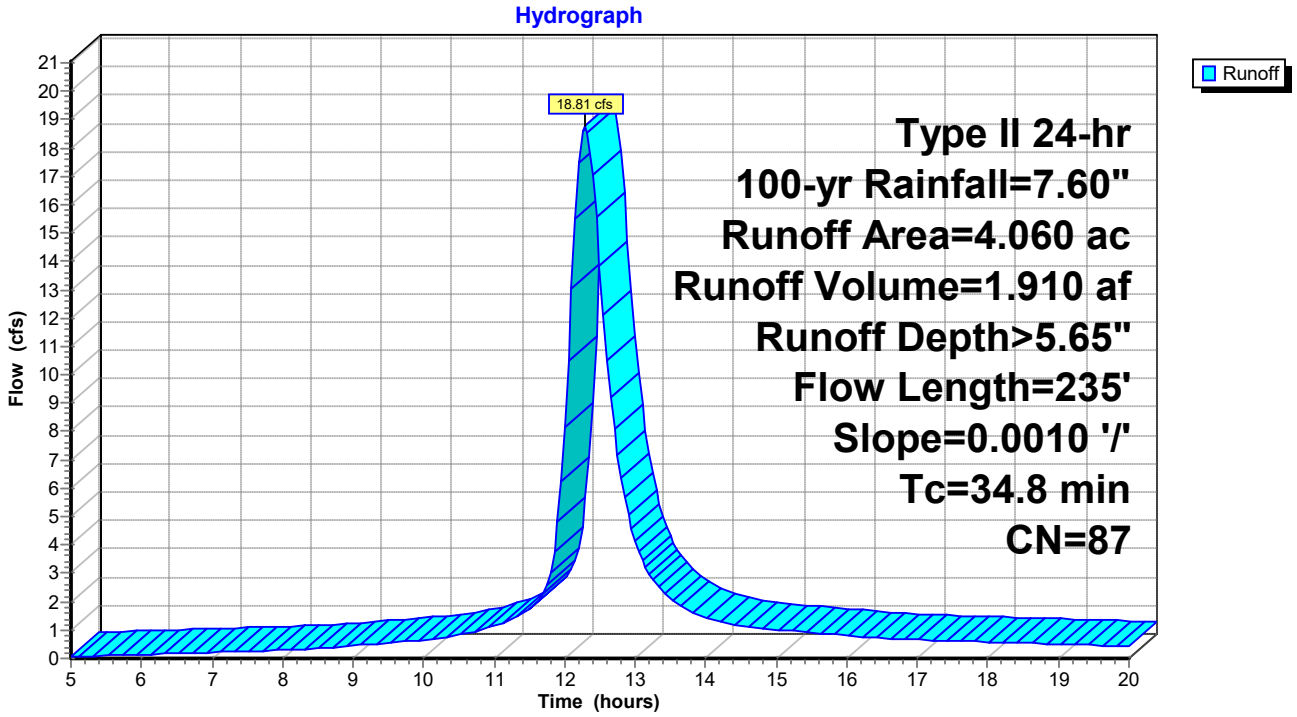
Runoff = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af, Depth> 5.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
1.100	79	1 acre lots, 20% imp, HSG C
0.030	80	1/2 acre lots, 25% imp, HSG C
0.180	85	1/2 acre lots, 25% imp, HSG D
0.040	86	1/3 acre lots, 30% imp, HSG D
0.560	83	1/4 acre lots, 38% imp, HSG C
0.930	87	1/4 acre lots, 38% imp, HSG D
0.120	92	1/8 acre lots, 65% imp, HSG D
1.100	98	Paved parking, HSG D
4.060	87	Weighted Average
2.031		50.03% Pervious Area
2.029		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	35	0.0010	1.55	1.22	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.8	235	Total			

Subcatchment 7S: DA5



Summary for Subcatchment 8S: DA6

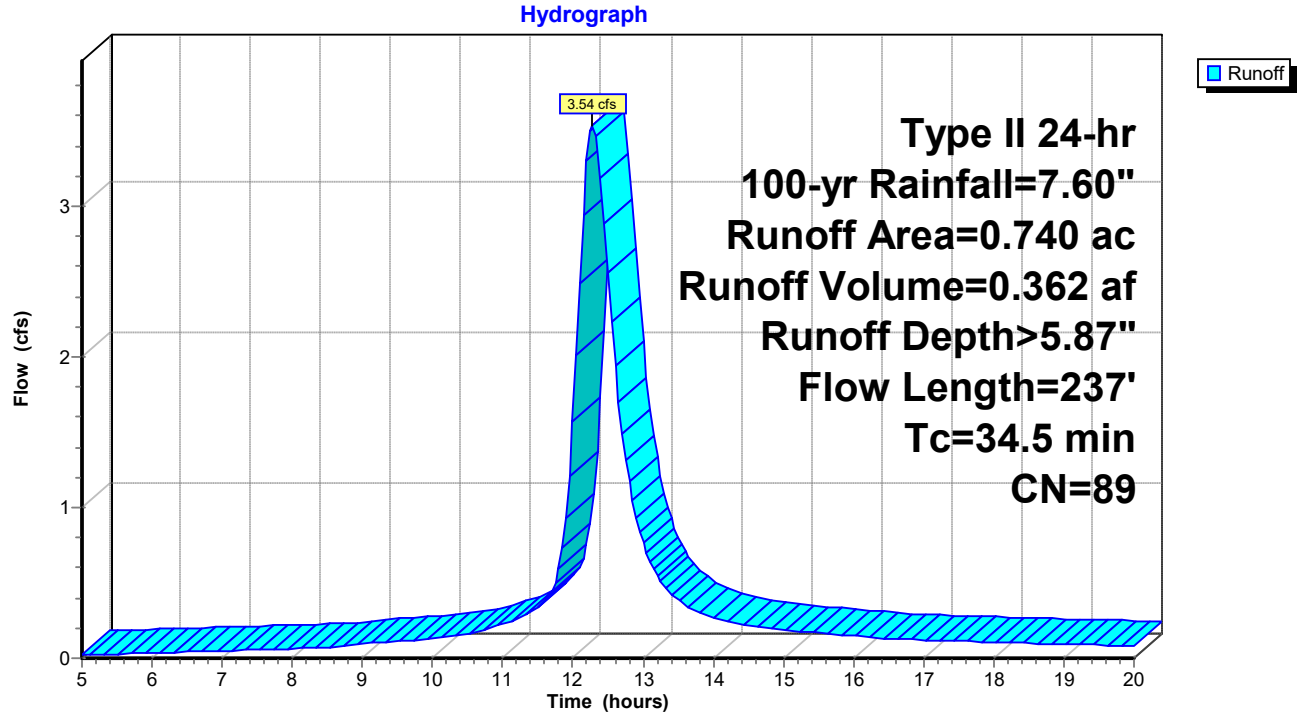
Runoff = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af, Depth> 5.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.370	79	1 acre lots, 20% imp, HSG C
0.370	98	Paved parking, HSG D
0.740	89	Weighted Average
0.296		40.00% Pervious Area
0.444		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	37	0.0200	6.95	5.46	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.5	237	Total			

Subcatchment 8S: DA6



Summary for Subcatchment 9S: East Chew

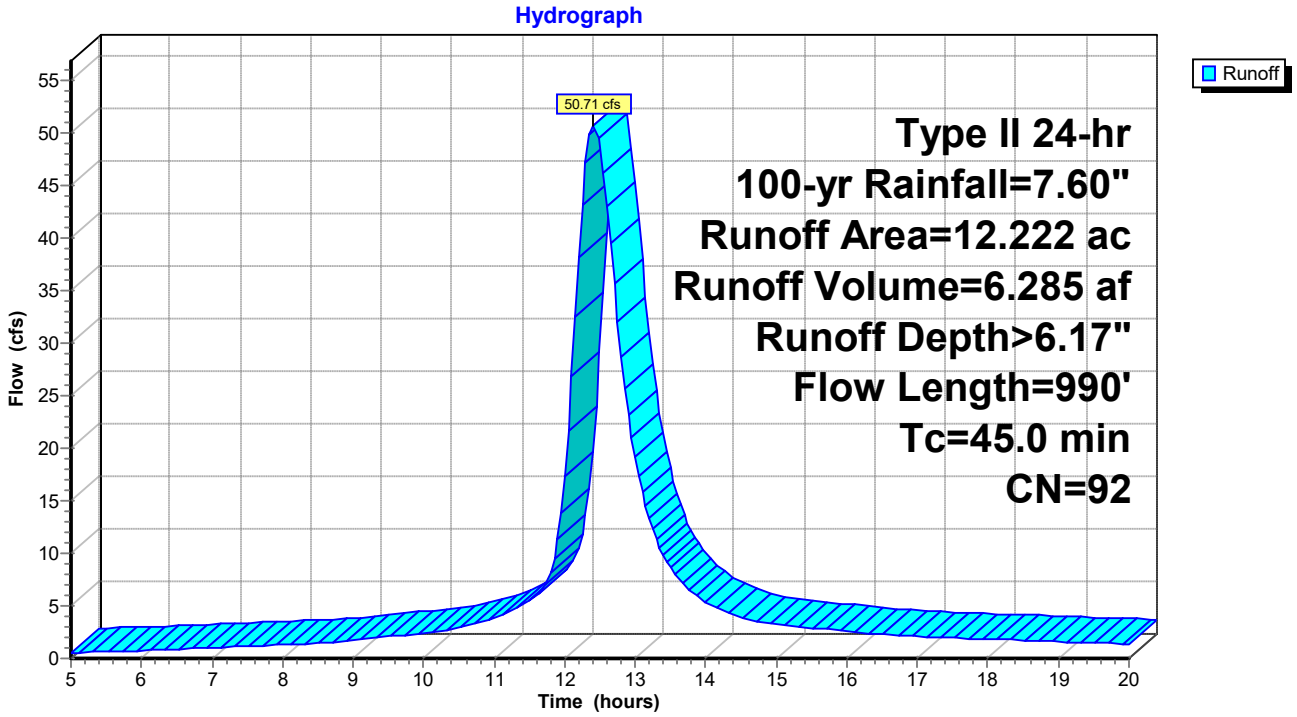
Runoff = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af, Depth> 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.500	85	1/2 acre lots, 25% imp, HSG D
0.450	86	1/3 acre lots, 30% imp, HSG D
4.070	87	1/4 acre lots, 38% imp, HSG D
1.002	92	1/8 acre lots, 65% imp, HSG D
3.850	95	Urban commercial, 85% imp, HSG D
2.300	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
12.222	92	Weighted Average
4.192		34.30% Pervious Area
8.030		65.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 9S: East Chew



Summary for Pond 12P: DA4 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 4.31' (Flood elevation advised)

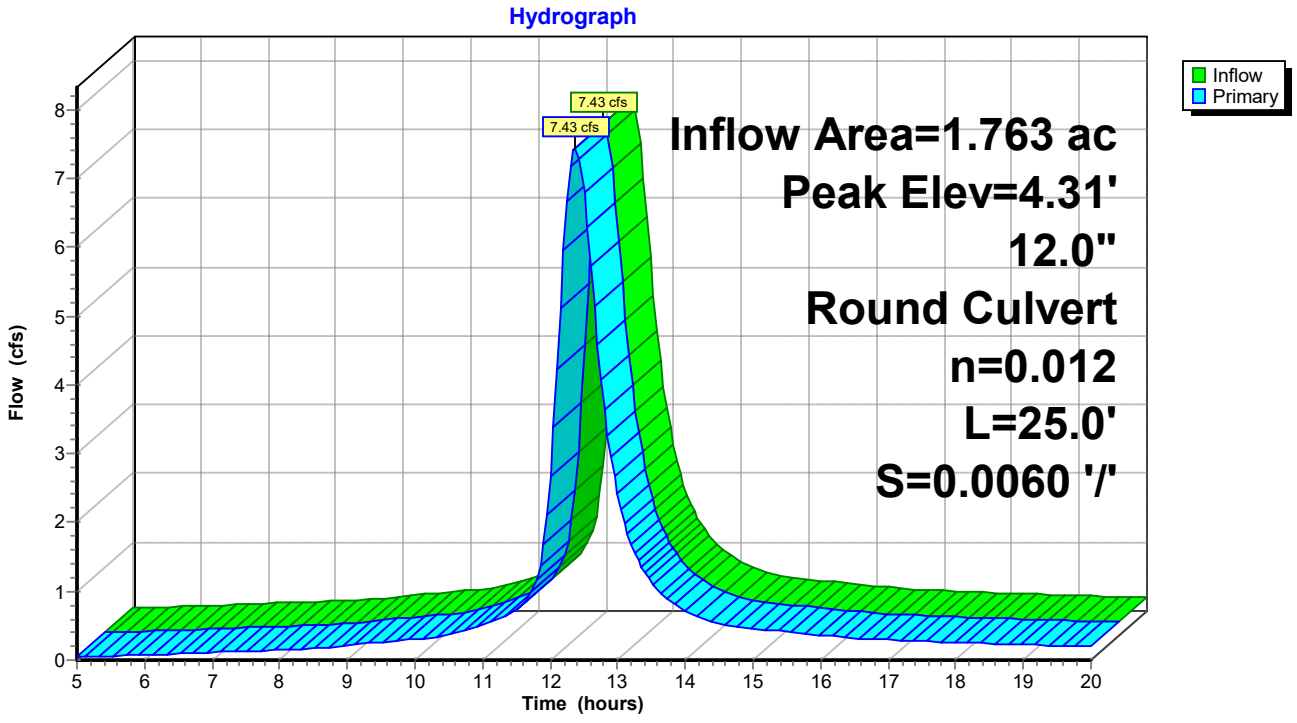
Inflow Area = 1.763 ac, 53.49% Impervious, Inflow Depth > 5.86" for 100-yr event
Inflow = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af
Outflow = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af, Atten= 0%, Lag= 0.0 min
Primary = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.31' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.05'	**12.0" Round Culvert** L= 25.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.05' / -0.20' S= 0.0060 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=7.40 cfs @ 12.37 hrs HW=4.28' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=Culvert** (Inlet Controls 7.40 cfs @ 9.43 fps)

Pond 12P: DA4 Pipe



Summary for Pond 13P: DA5 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 23.28' above defined flood level

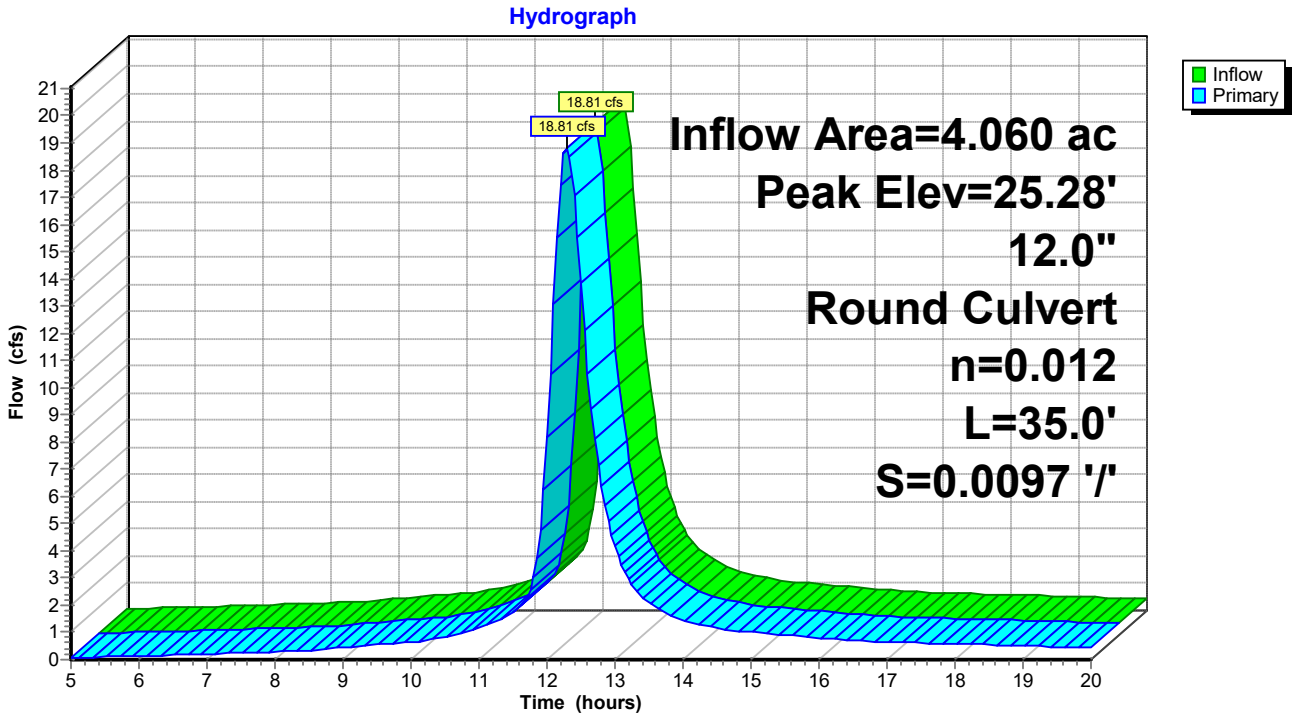
Inflow Area = 4.060 ac, 49.97% Impervious, Inflow Depth > 5.65" for 100-yr event
Inflow = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af
Outflow = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af, Atten= 0%, Lag= 0.0 min
Primary = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 25.28' @ 12.29 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.05'	**12.0" Round CMP_Round 12"** L= 35.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.05' / -0.29' S= 0.0097 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=18.74 cfs @ 12.29 hrs HW=25.10' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=CMP_Round 12"** (Inlet Controls 18.74 cfs @ 23.86 fps)

Pond 13P: DA5 Pipe



Summary for Pond 14P: DA3 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 2.19' (Flood elevation advised)

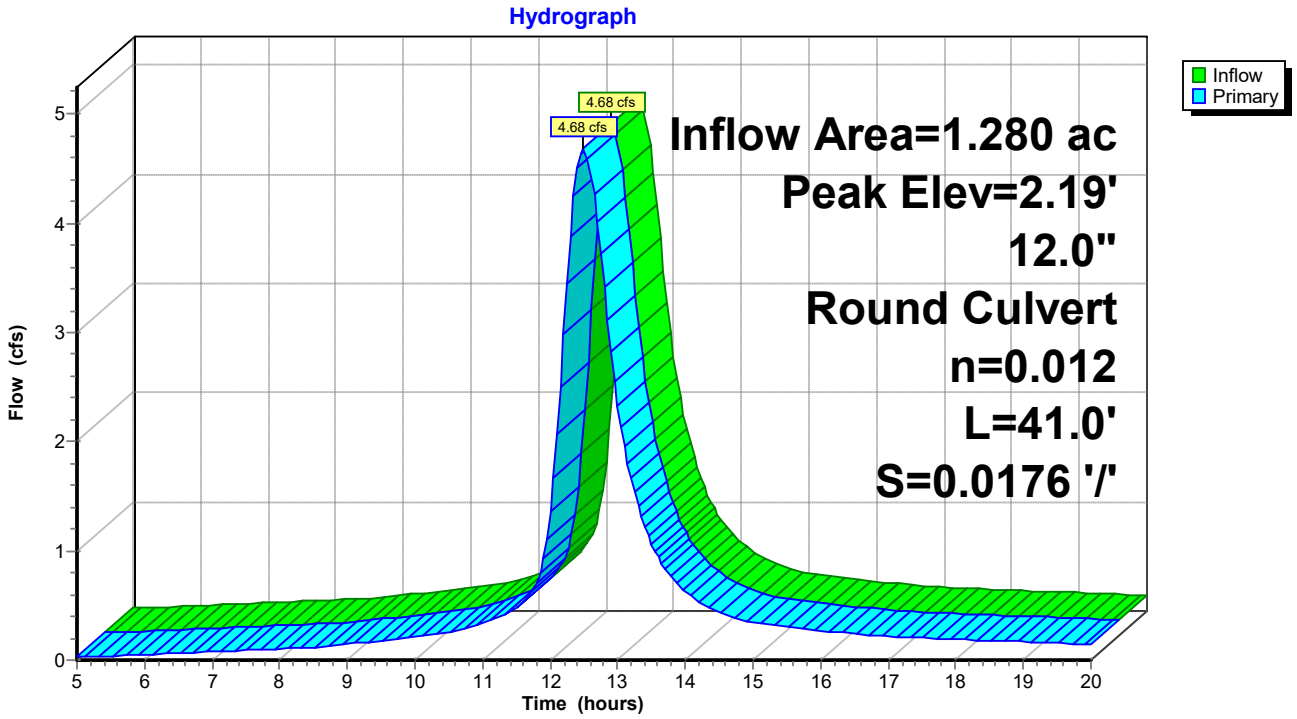
Inflow Area = 1.280 ac, 59.98% Impervious, Inflow Depth > 5.84" for 100-yr event
Inflow = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af
Outflow = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af, Atten= 0%, Lag= 0.0 min
Primary = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.19' @ 12.49 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.16'	**12.0" Round Culvert** L= 41.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.16' / -0.56' S= 0.0176 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=4.67 cfs @ 12.49 hrs HW=2.19' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=Culvert** (Inlet Controls 4.67 cfs @ 5.95 fps)

Pond 14P: DA3 Pipe



Summary for Pond 15P: DA6 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 2.80' above defined flood level

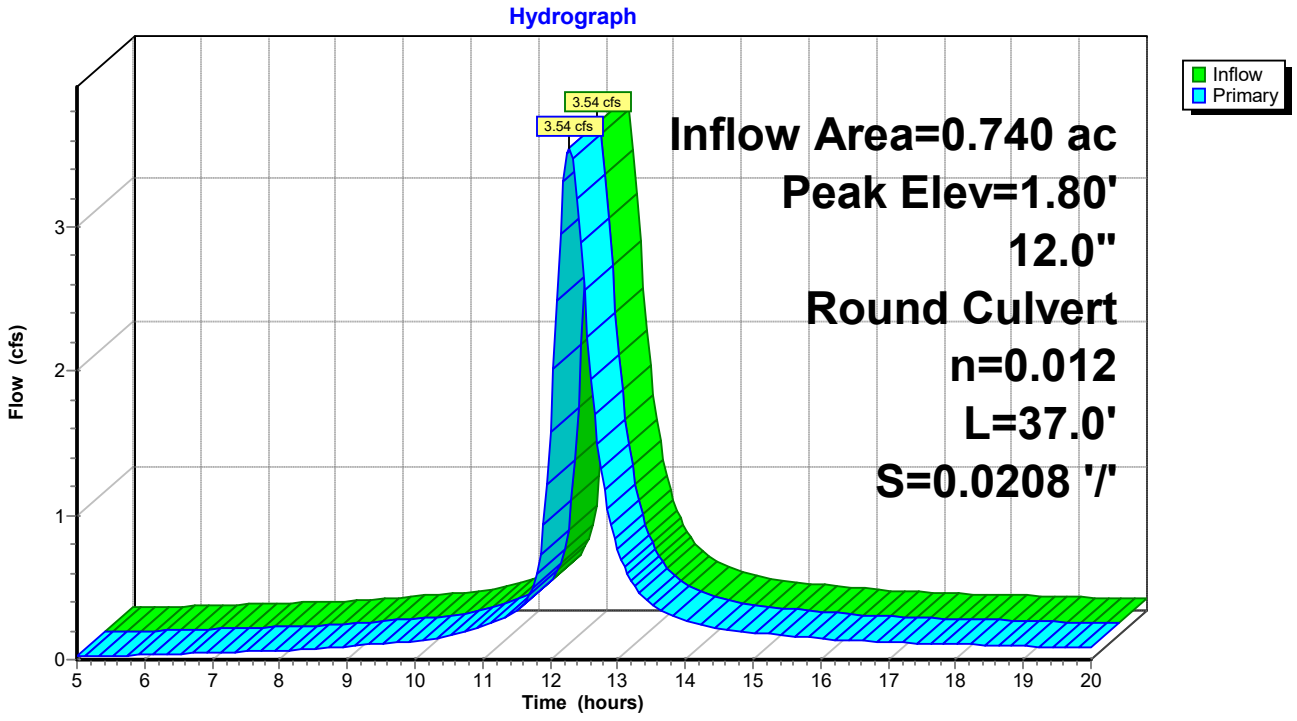
Inflow Area = 0.740 ac, 60.00% Impervious, Inflow Depth > 5.87" for 100-yr event
Inflow = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af
Outflow = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af, Atten= 0%, Lag= 0.0 min
Primary = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 1.80' @ 12.28 hrs
Flood Elev= -1.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.42'	**12.0" Round CMP_Round 12"** L= 37.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.42' / -0.35' S= 0.0208 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=3.53 cfs @ 12.28 hrs HW=1.79' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=CMP_Round 12"** (Inlet Controls 3.53 cfs @ 4.49 fps)

Pond 15P: DA6 Pipe



Summary for Pond 16P: DA2 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 2.81' (Flood elevation advised)

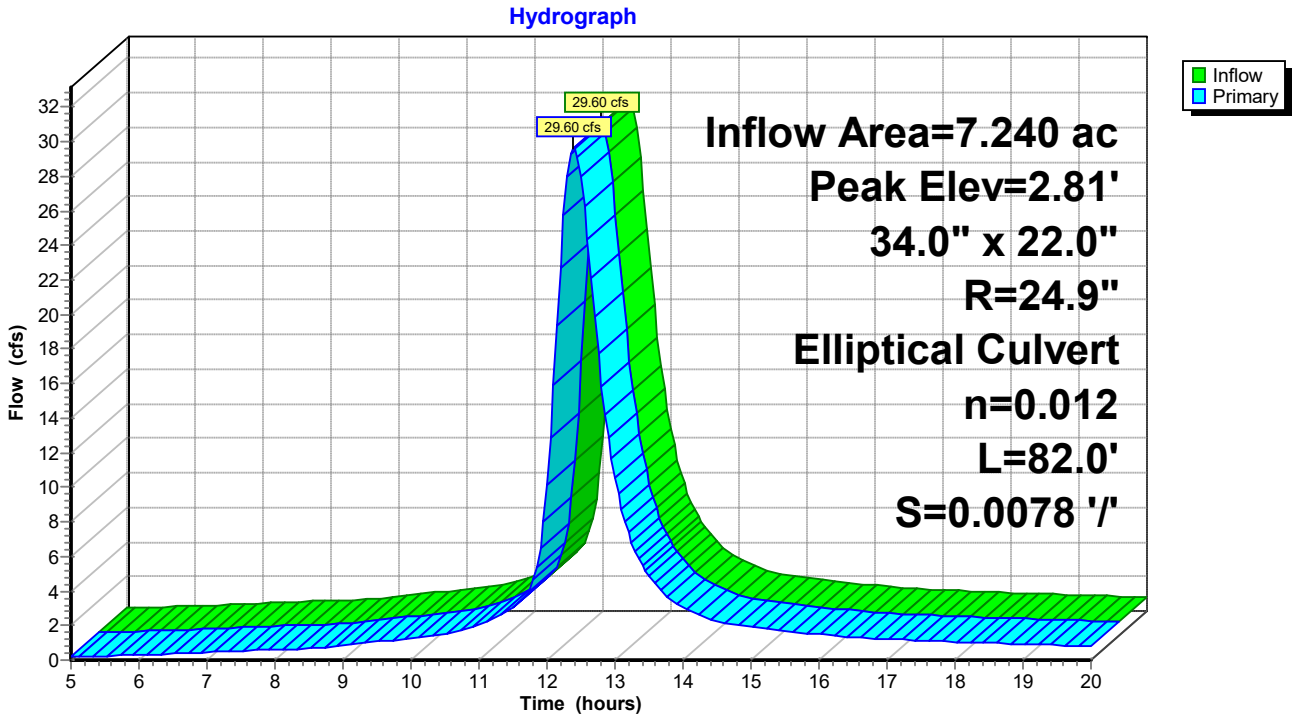
Inflow Area = 7.240 ac, 50.29% Impervious, Inflow Depth > 5.85" for 100-yr event
Inflow = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af
Outflow = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af, Atten= 0%, Lag= 0.0 min
Primary = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.81' @ 12.40 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.36'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 82.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.36' / -1.00' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=29.56 cfs @ 12.40 hrs HW=2.80' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 29.56 cfs @ 7.18 fps)

Pond 16P: DA2 Pipe



Summary for Pond 17P: DA1 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 27.97' (Flood elevation advised)

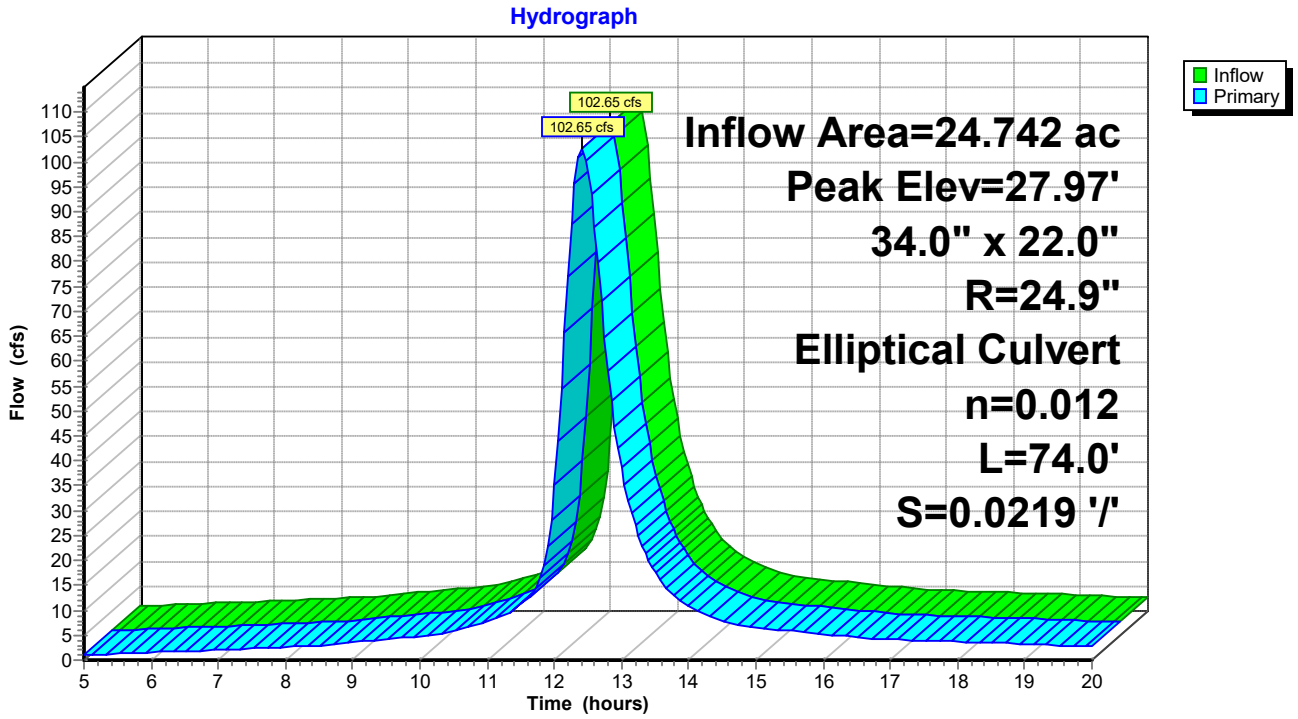
Inflow Area = 24.742 ac, 65.94% Impervious, Inflow Depth > 6.17" for 100-yr event
Inflow = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af
Outflow = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af, Atten= 0%, Lag= 0.0 min
Primary = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 27.97' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.27'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 74.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.27' / -1.35' S= 0.0219 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=102.44 cfs @ 12.41 hrs HW=27.86' TW=-1.00' (Fixed TW Elev= -1.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 102.44 cfs @ 24.87 fps)

Pond 17P: DA1 Pipe



Summary for Pond 18P: DA East Chew Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 34.20' above defined flood level

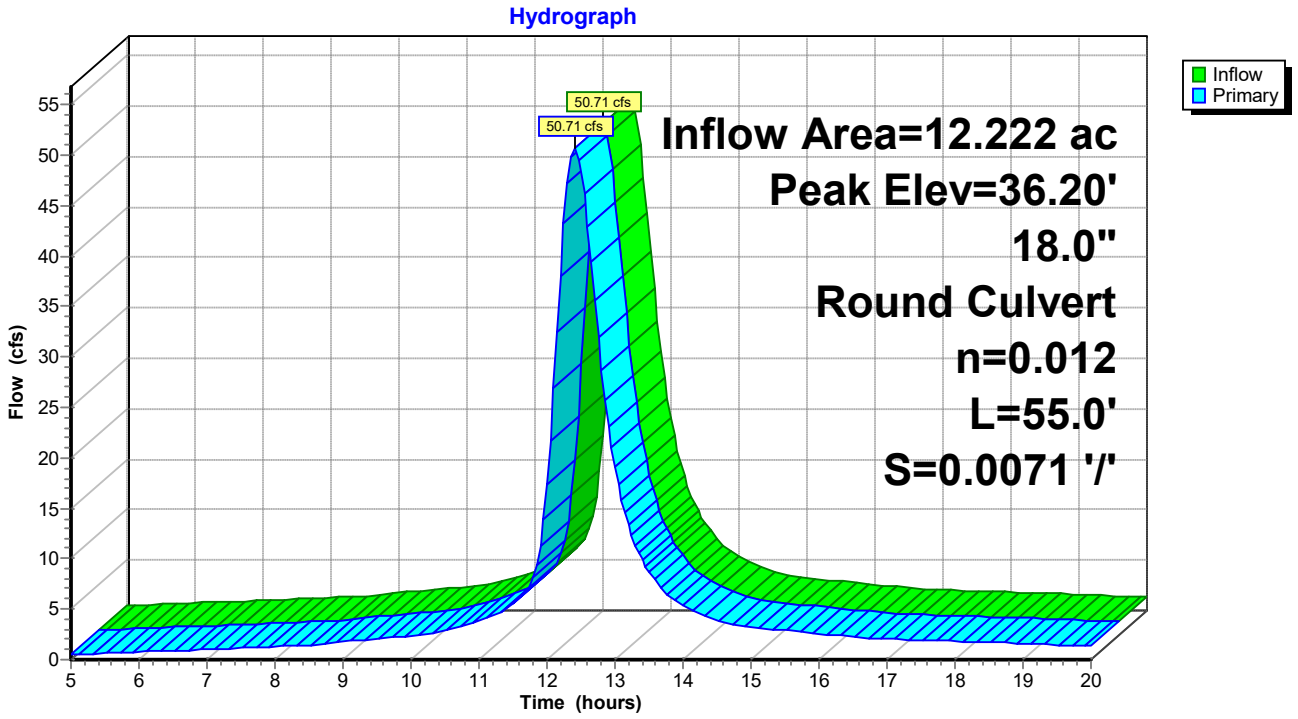
Inflow Area = 12.222 ac, 65.70% Impervious, Inflow Depth > 6.17" for 100-yr event
Inflow = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af
Outflow = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af, Atten= 0%, Lag= 0.0 min
Primary = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 36.20' @ 12.41 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.06'	**18.0" Round Culvert** L= 55.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.06' / -0.45' S= 0.0071 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=50.61 cfs @ 12.41 hrs HW=36.06' TW=-1.00' (Fixed TW Elev= -1.00')
↳**1=Culvert** (Inlet Controls 50.61 cfs @ 28.64 fps)

Pond 18P: DA East Chew Pipe



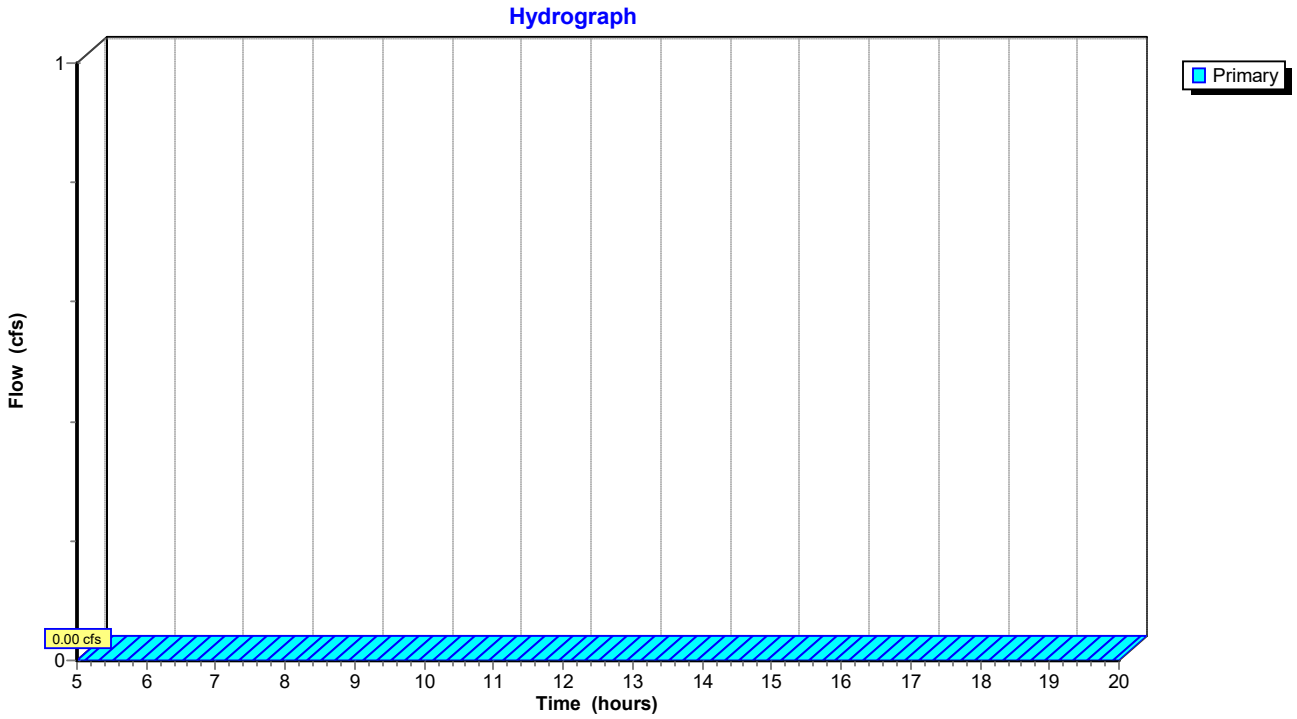
Summary for Link 10L: Harbor

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: Harbor

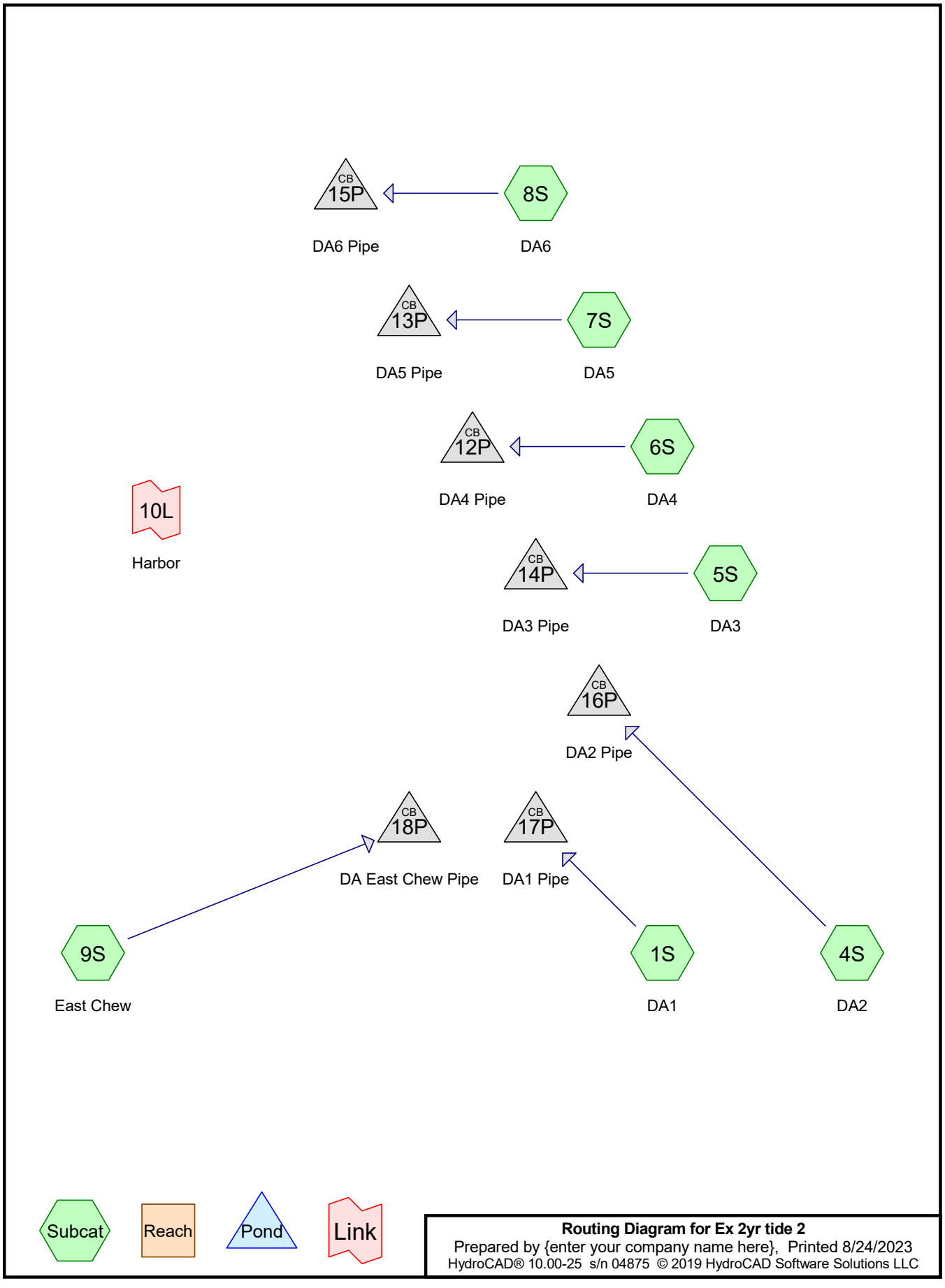


Drainage Analysis for Public Slip Area

St. Michaels, MD

West Harbor Rd. and East Chew Ave.

Tide Elevation 2.0'



Routing Diagram for Ex 2yr tide 2

Prepared by {enter your company name here}, Printed 8/24/2023

Project Notes

Rainfall events imported from "2023 April Box Everything.hcp"

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.470	79	1 acre lots, 20% imp, HSG C (7S, 8S)
0.230	80	1/2 acre lots, 25% imp, HSG C (4S, 7S)
1.920	85	1/2 acre lots, 25% imp, HSG D (1S, 4S, 7S, 9S)
0.870	81	1/3 acre lots, 30% imp, HSG C (4S, 5S, 6S)
4.320	86	1/3 acre lots, 30% imp, HSG D (1S, 4S, 5S, 6S, 7S, 9S)
1.360	83	1/4 acre lots, 38% imp, HSG C (4S, 5S, 6S, 7S)
15.273	87	1/4 acre lots, 38% imp, HSG D (1S, 4S, 5S, 6S, 7S, 9S)
3.474	92	1/8 acre lots, 65% imp, HSG D (1S, 6S, 7S, 9S)
0.150	80	>75% Grass cover, Good, HSG D (1S, 9S)
11.130	98	Paved parking, HSG D (1S, 4S, 5S, 6S, 7S, 8S, 9S)
11.850	95	Urban commercial, 85% imp, HSG D (1S, 9S)
52.047	**91**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
3.930	HSG C	4S, 5S, 6S, 7S, 8S
48.117	HSG D	1S, 4S, 5S, 6S, 7S, 8S, 9S
0.000	Other	
52.047		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	1.470	0.000	0.000	1.470	1 acre lots, 20% imp	7S, 8S
0.000	0.000	0.230	1.920	0.000	2.150	1/2 acre lots, 25% imp	1S, 4S, 7S, 9S
0.000	0.000	0.870	4.320	0.000	5.190	1/3 acre lots, 30% imp	1S, 4S, 5S, 6S, 7S, 9S
0.000	0.000	1.360	15.273	0.000	16.633	1/4 acre lots, 38% imp	1S, 4S, 5S, 6S, 7S, 9S
0.000	0.000	0.000	3.474	0.000	3.474	1/8 acre lots, 65% imp	1S, 6S, 7S, 9S
0.000	0.000	0.000	0.150	0.000	0.150	>75% Grass cover, Good	1S, 9S
0.000	0.000	0.000	11.130	0.000	11.130	Paved parking	1S, 4S, 5S, 6S, 7S, 8S, 9S
0.000	0.000	0.000	11.850	0.000	11.850	Urban commercial, 85% imp	1S, 9S
0.000	**0.000**	**3.930**	**48.117**	**0.000**	**52.047**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	1S	0.00	0.00	55.0	0.0071	0.012	18.0	0.0	0.0
2	1S	0.00	0.00	235.0	0.0050	0.012	15.0	0.0	0.0
3	1S	0.00	0.00	500.0	0.0040	0.012	15.0	0.0	0.0
4	4S	0.00	0.00	82.0	0.0080	0.012	34.0	22.0	0.0
5	4S	0.00	0.00	367.0	0.0012	0.012	30.0	0.0	0.0
6	5S	0.00	0.00	82.0	0.0078	0.011	34.0	22.0	0.0
7	5S	0.00	0.00	367.0	0.0001	0.012	30.0	0.0	0.0
8	6S	0.00	0.00	25.0	0.0060	0.012	12.0	0.0	0.0
9	6S	0.00	0.00	31.0	0.0230	0.012	12.0	0.0	0.0
10	6S	0.00	0.00	33.0	0.0160	0.012	12.0	0.0	0.0
11	7S	0.00	0.00	35.0	0.0010	0.012	12.0	0.0	0.0
12	8S	0.00	0.00	37.0	0.0200	0.012	12.0	0.0	0.0
13	9S	0.00	0.00	55.0	0.0071	0.012	18.0	0.0	0.0
14	9S	0.00	0.00	235.0	0.0050	0.012	15.0	0.0	0.0
15	9S	0.00	0.00	500.0	0.0040	0.012	15.0	0.0	0.0
16	12P	-0.05	-0.20	25.0	0.0060	0.012	12.0	0.0	0.0
17	13P	0.05	-0.29	35.0	0.0097	0.012	12.0	0.0	0.0
18	14P	0.16	-0.56	41.0	0.0176	0.012	12.0	0.0	0.0
19	15P	0.42	-0.35	37.0	0.0208	0.012	12.0	0.0	0.0
20	16P	-0.36	-1.00	82.0	0.0078	0.012	34.0	22.0	0.0
21	17P	0.27	-1.35	74.0	0.0219	0.012	34.0	22.0	0.0
22	18P	-0.06	-0.45	55.0	0.0071	0.012	18.0	0.0	0.0

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=24.742 ac 65.94% Impervious Runoff Depth>2.36"
Flow Length=990' Tc=45.0 min CN=92 Runoff=40.86 cfs 4.856 af

Subcatchment 4S: DA2 Runoff Area=7.240 ac 50.29% Impervious Runoff Depth>2.09"
Flow Length=649' Tc=43.7 min CN=89 Runoff=10.99 cfs 1.259 af

Subcatchment 5S: DA3 Runoff Area=1.280 ac 59.98% Impervious Runoff Depth>2.08"
Flow Length=849' Tc=51.4 min CN=89 Runoff=1.74 cfs 0.222 af

Subcatchment 6S: DA4 Runoff Area=1.763 ac 53.49% Impervious Runoff Depth>2.09"
Flow Length=289' Tc=41.8 min CN=89 Runoff=2.76 cfs 0.307 af

Subcatchment 7S: DA5 Runoff Area=4.060 ac 49.97% Impervious Runoff Depth>1.93"
Flow Length=235' Slope=0.0010 '/' Tc=34.8 min CN=87 Runoff=6.67 cfs 0.652 af

Subcatchment 8S: DA6 Runoff Area=0.740 ac 60.00% Impervious Runoff Depth>2.09"
Flow Length=237' Tc=34.5 min CN=89 Runoff=1.32 cfs 0.129 af

Subcatchment 9S: East Chew Runoff Area=12.222 ac 65.70% Impervious Runoff Depth>2.36"
Flow Length=990' Tc=45.0 min CN=92 Runoff=20.18 cfs 2.399 af

Pond 12P: DA4 Pipe Peak Elev=2.53' Inflow=2.76 cfs 0.307 af
12.0" Round Culvert n=0.012 L=25.0' S=0.0060 '/' Outflow=2.76 cfs 0.307 af

Pond 13P: DA5 Pipe Peak Elev=5.11' Inflow=6.67 cfs 0.652 af
12.0" Round Culvert n=0.012 L=35.0' S=0.0097 '/' Outflow=6.67 cfs 0.652 af

Pond 14P: DA3 Pipe Peak Elev=2.21' Inflow=1.74 cfs 0.222 af
12.0" Round Culvert n=0.012 L=41.0' S=0.0176 '/' Outflow=1.74 cfs 0.222 af

Pond 15P: DA6 Pipe Peak Elev=2.12' Inflow=1.32 cfs 0.129 af
12.0" Round Culvert n=0.012 L=37.0' S=0.0208 '/' Outflow=1.32 cfs 0.129 af

Pond 16P: DA2 Pipe Peak Elev=2.31' Inflow=10.99 cfs 1.259 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=82.0' S=0.0078 '/' Outflow=10.99 cfs 1.259 af

Pond 17P: DA1 Pipe Peak Elev=6.24' Inflow=40.86 cfs 4.856 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=74.0' S=0.0219 '/' Outflow=40.86 cfs 4.856 af

Pond 18P: DA East Chew Pipe Peak Elev=7.63' Inflow=20.18 cfs 2.399 af
18.0" Round Culvert n=0.012 L=55.0' S=0.0071 '/' Outflow=20.18 cfs 2.399 af

Link 10L: Harbor
Primary=0.00 cfs 0.000 af

Total Runoff Area = 52.047 ac Runoff Volume = 9.823 af Average Runoff Depth = 2.26"
38.19% Pervious = 19.877 ac 61.81% Impervious = 32.170 ac

Summary for Subcatchment 1S: DA1

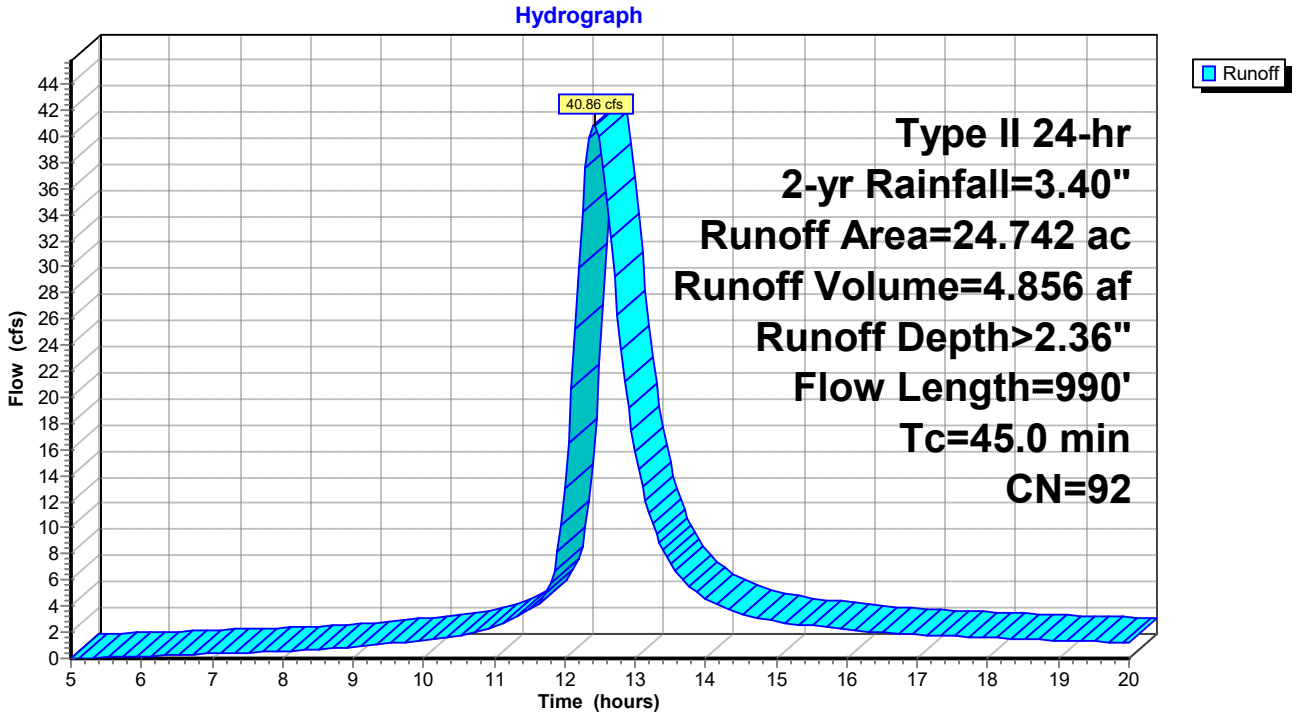
Runoff = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
1.000	85	1/2 acre lots, 25% imp, HSG D
0.900	86	1/3 acre lots, 30% imp, HSG D
8.140	87	1/4 acre lots, 38% imp, HSG D
2.002	92	1/8 acre lots, 65% imp, HSG D
8.000	95	Urban commercial, 85% imp, HSG D
4.600	98	Paved parking, HSG D
0.100	80	>75% Grass cover, Good, HSG D
24.742	92	Weighted Average
8.428		34.06% Pervious Area
16.314		65.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 4S: DA2

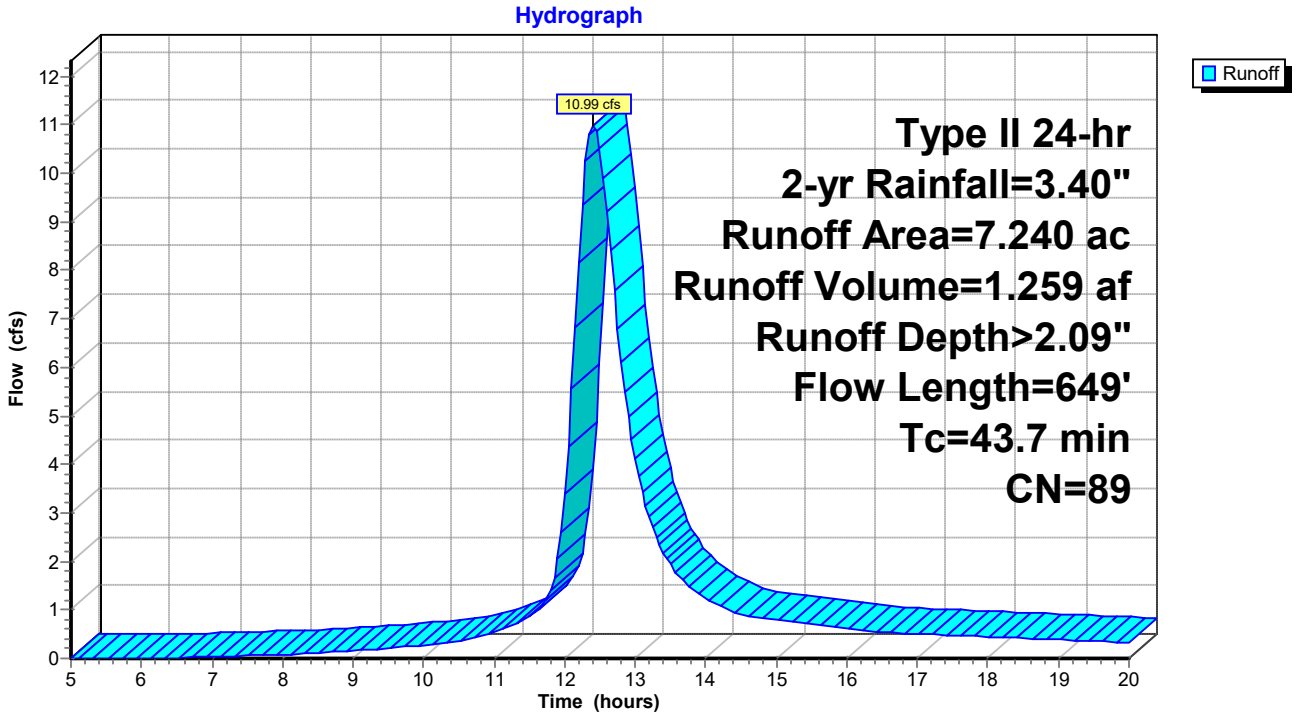
Runoff = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.200	80	1/2 acre lots, 25% imp, HSG C
0.240	85	1/2 acre lots, 25% imp, HSG D
0.720	81	1/3 acre lots, 30% imp, HSG C
2.320	86	1/3 acre lots, 30% imp, HSG D
0.210	83	1/4 acre lots, 38% imp, HSG C
1.630	87	1/4 acre lots, 38% imp, HSG D
1.920	98	Paved parking, HSG D
7.240	89	Weighted Average
3.599		49.71% Pervious Area
3.641		50.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0080	7.45	30.70	**Pipe Channel, RCP_Elliptical 34x22** 34.0" x 22.0", R=24.9" Elliptical Area= 4.1 sf Perim= 7.5' r= 0.55' n= 0.012 Concrete pipe, finished
2.0	367	0.0012	3.14	15.39	**Pipe Channel, RCP_Round 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
43.7	649	Total			

Subcatchment 4S: DA2



Summary for Subcatchment 5S: DA3

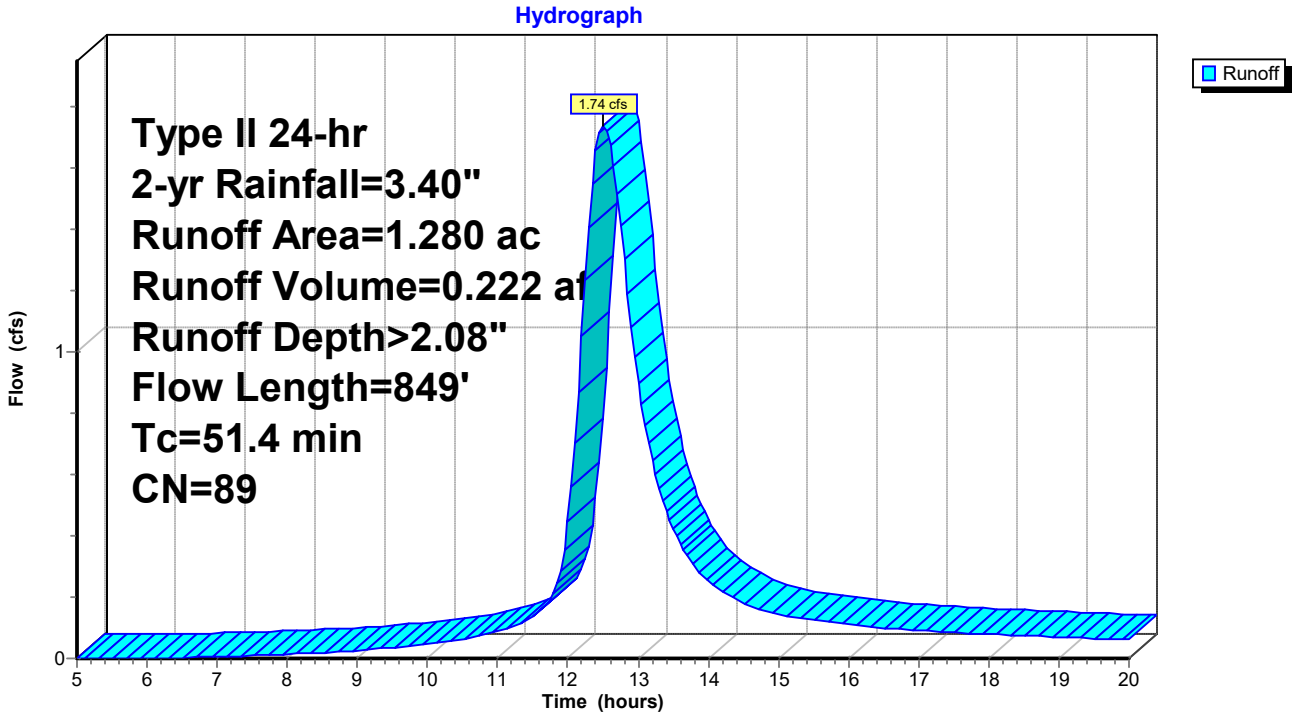
Runoff = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af, Depth> 2.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.110	81	1/3 acre lots, 30% imp, HSG C
0.170	86	1/3 acre lots, 30% imp, HSG D
0.430	83	1/4 acre lots, 38% imp, HSG C
0.080	87	1/4 acre lots, 38% imp, HSG D
0.490	98	Paved parking, HSG D
1.280	89	Weighted Average
0.512		40.02% Pervious Area
0.768		59.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0078	7.98	32.34	**Pipe Channel, out** 34.0" x 22.0", R=23.0" Elliptical Area= 4.1 sf Perim= 7.4' r= 0.55' n= 0.011 Concrete pipe, straight & clean
6.8	367	0.0001	0.91	4.44	**Pipe Channel, 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
2.9	200	0.0010	1.15	5.73	**Channel Flow, ditch** Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.030 Earth, grassed & winding
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
51.4	849	Total			

Subcatchment 5S: DA3



Summary for Subcatchment 6S: DA4

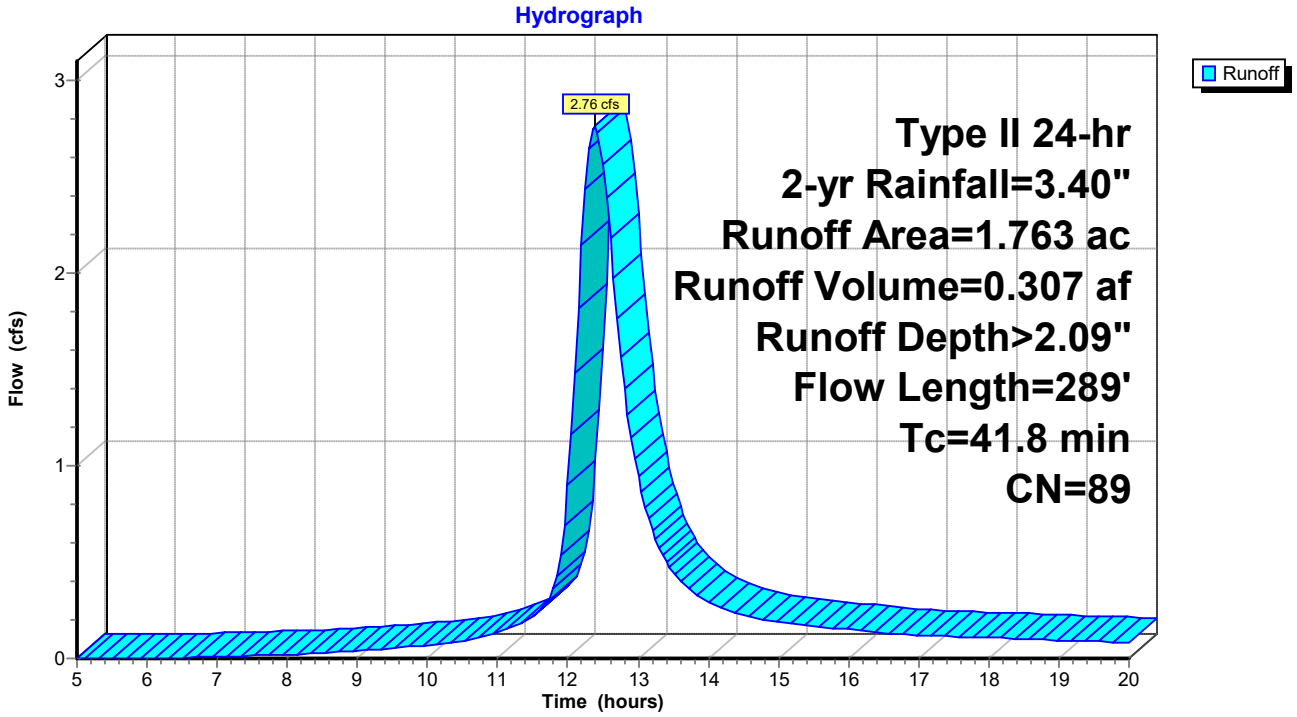
Runoff = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.040	81	1/3 acre lots, 30% imp, HSG C
0.440	86	1/3 acre lots, 30% imp, HSG D
0.160	83	1/4 acre lots, 38% imp, HSG C
0.423	87	1/4 acre lots, 38% imp, HSG D
0.350	92	1/8 acre lots, 65% imp, HSG D
0.350	98	Paved parking, HSG D
1.763	89	Weighted Average
0.820		46.51% Pervious Area
0.943		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0060	3.81	2.99	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	31	0.0230	7.45	5.85	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	33	0.0160	6.22	4.88	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
41.8	289	Total			

Subcatchment 6S: DA4



Summary for Subcatchment 7S: DA5

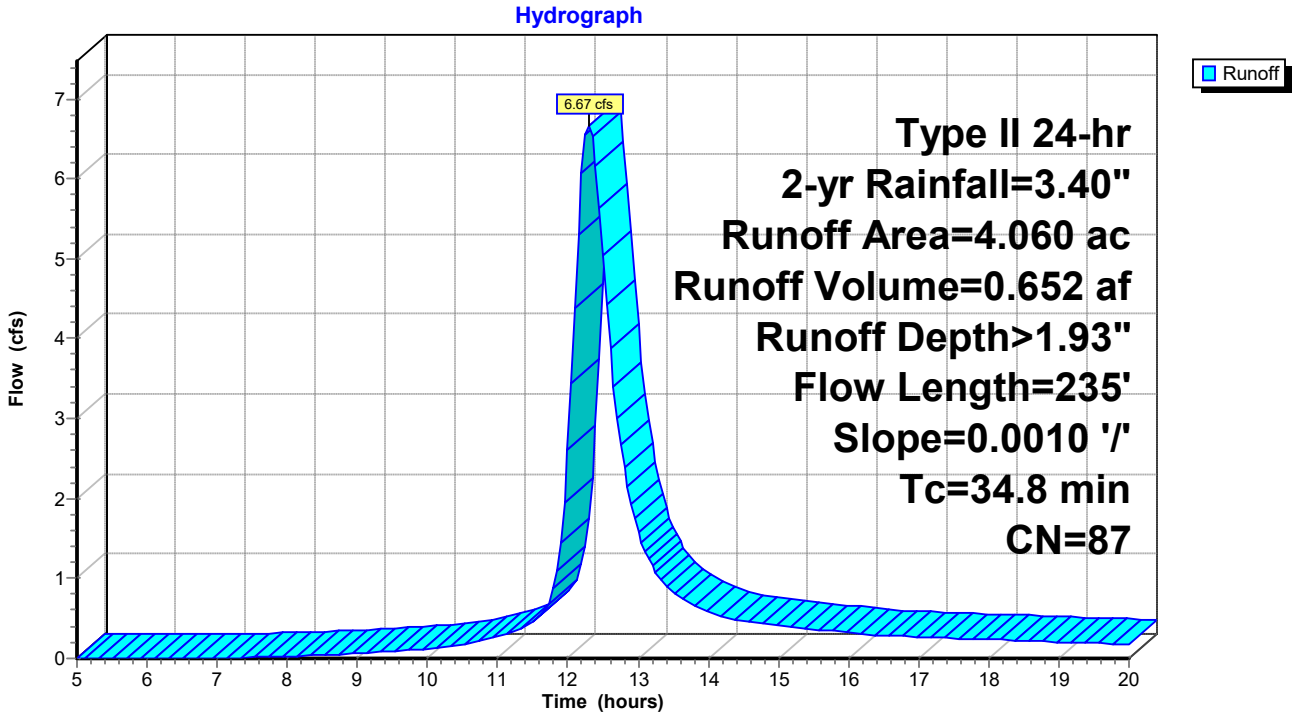
Runoff = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af, Depth> 1.93"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
1.100	79	1 acre lots, 20% imp, HSG C
0.030	80	1/2 acre lots, 25% imp, HSG C
0.180	85	1/2 acre lots, 25% imp, HSG D
0.040	86	1/3 acre lots, 30% imp, HSG D
0.560	83	1/4 acre lots, 38% imp, HSG C
0.930	87	1/4 acre lots, 38% imp, HSG D
0.120	92	1/8 acre lots, 65% imp, HSG D
1.100	98	Paved parking, HSG D
4.060	87	Weighted Average
2.031		50.03% Pervious Area
2.029		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	35	0.0010	1.55	1.22	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.8	235	Total			

Subcatchment 7S: DA5



Summary for Subcatchment 8S: DA6

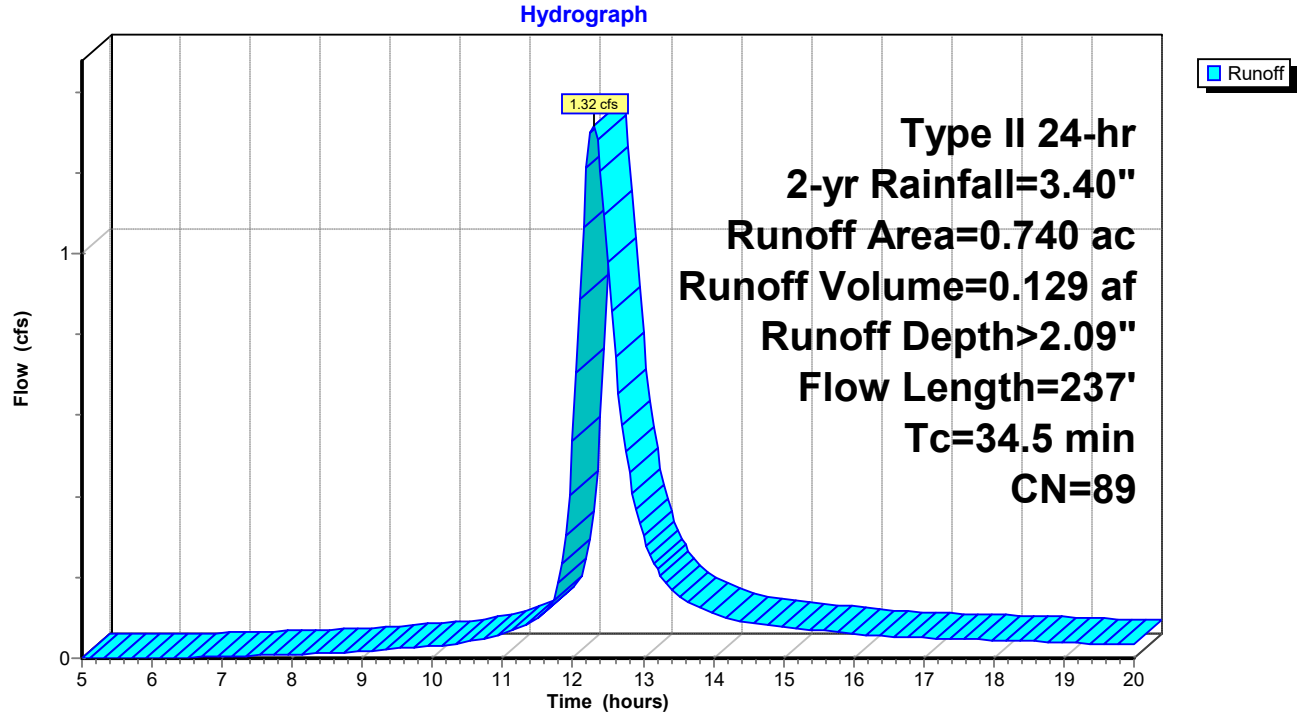
Runoff = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af, Depth> 2.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.370	79	1 acre lots, 20% imp, HSG C
0.370	98	Paved parking, HSG D
0.740	89	Weighted Average
0.296		40.00% Pervious Area
0.444		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	37	0.0200	6.95	5.46	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.5	237	Total			

Subcatchment 8S: DA6



Summary for Subcatchment 9S: East Chew

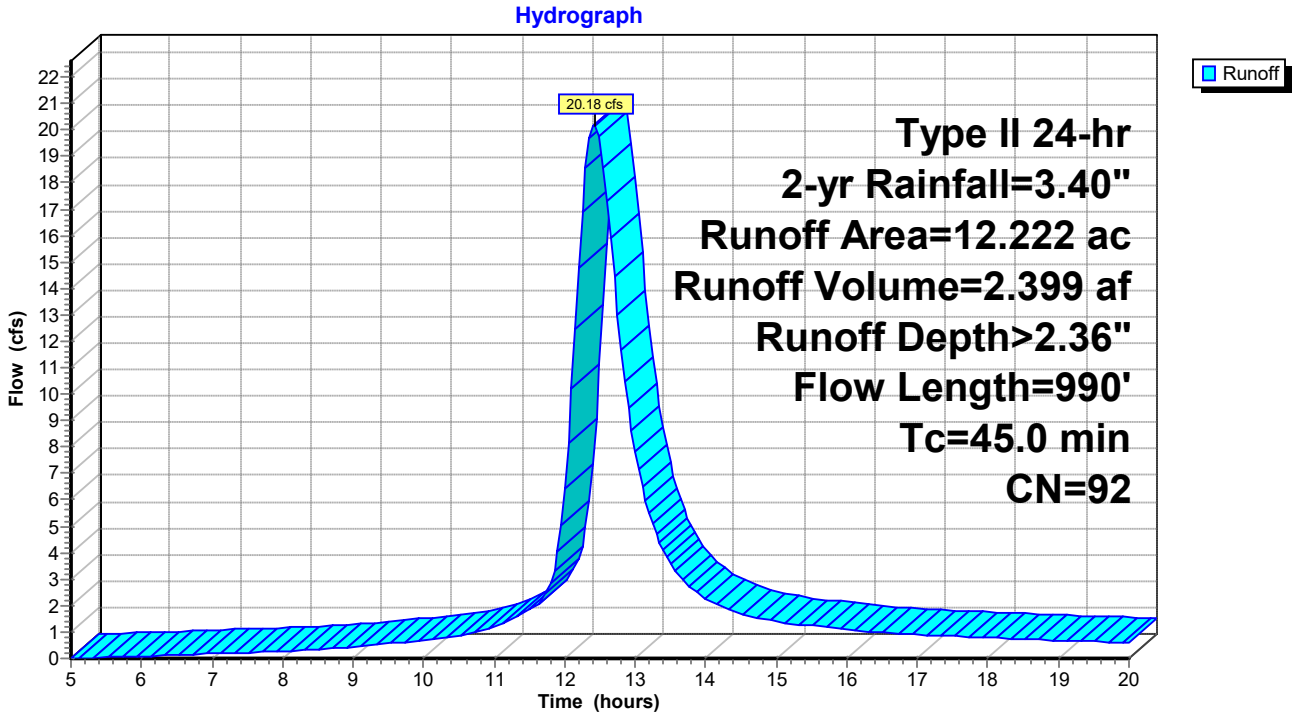
Runoff = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af, Depth> 2.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=3.40"

Area (ac)	CN	Description
0.500	85	1/2 acre lots, 25% imp, HSG D
0.450	86	1/3 acre lots, 30% imp, HSG D
4.070	87	1/4 acre lots, 38% imp, HSG D
1.002	92	1/8 acre lots, 65% imp, HSG D
3.850	95	Urban commercial, 85% imp, HSG D
2.300	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
12.222	92	Weighted Average
4.192		34.30% Pervious Area
8.030		65.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 9S: East Chew



Summary for Pond 12P: DA4 Pipe

[57] Hint: Peaked at 2.53' (Flood elevation advised)

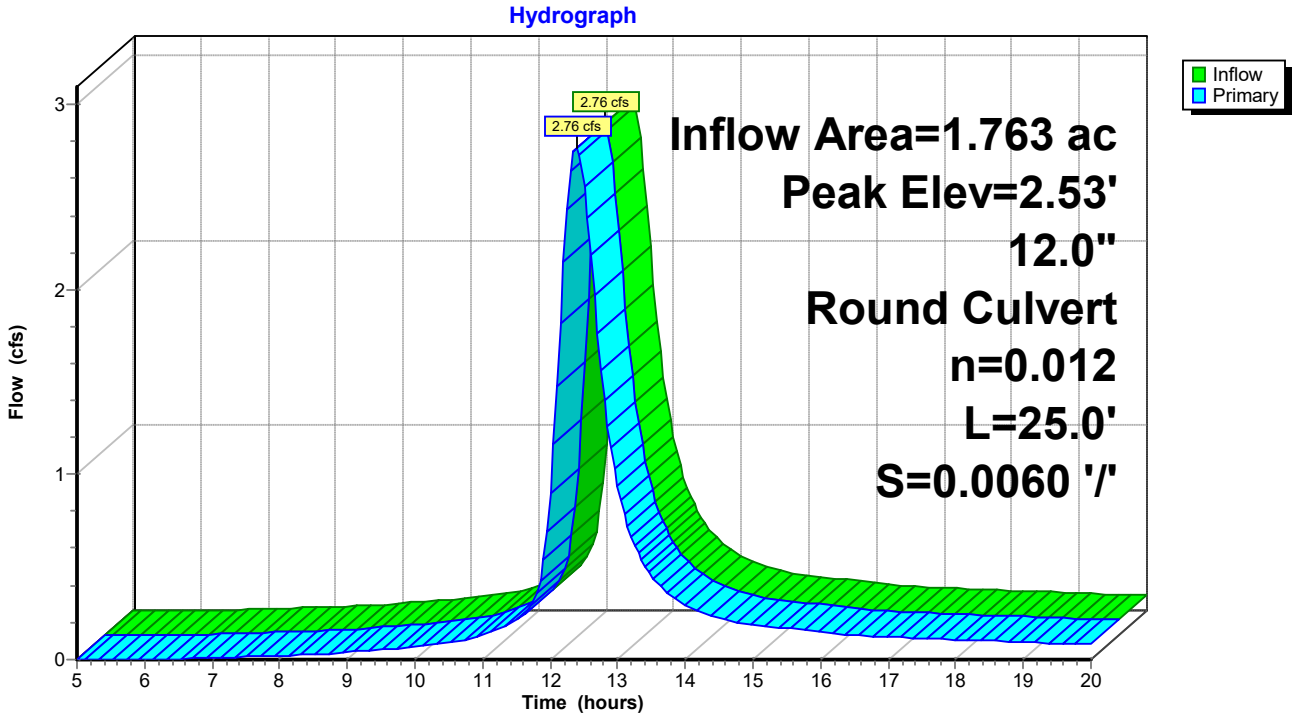
Inflow Area = 1.763 ac, 53.49% Impervious, Inflow Depth > 2.09" for 2-yr event
Inflow = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af
Outflow = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af, Atten= 0%, Lag= 0.0 min
Primary = 2.76 cfs @ 12.38 hrs, Volume= 0.307 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.53' @ 12.38 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.05'	**12.0" Round Culvert** L= 25.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.05' / -0.20' S= 0.0060 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=2.75 cfs @ 12.38 hrs HW=2.53' TW=2.00' (Fixed TW Elev= 2.00')
1=Culvert (Inlet Controls 2.75 cfs @ 3.51 fps)

Pond 12P: DA4 Pipe



Summary for Pond 13P: DA5 Pipe

[58] Hint: Peaked 3.11' above defined flood level

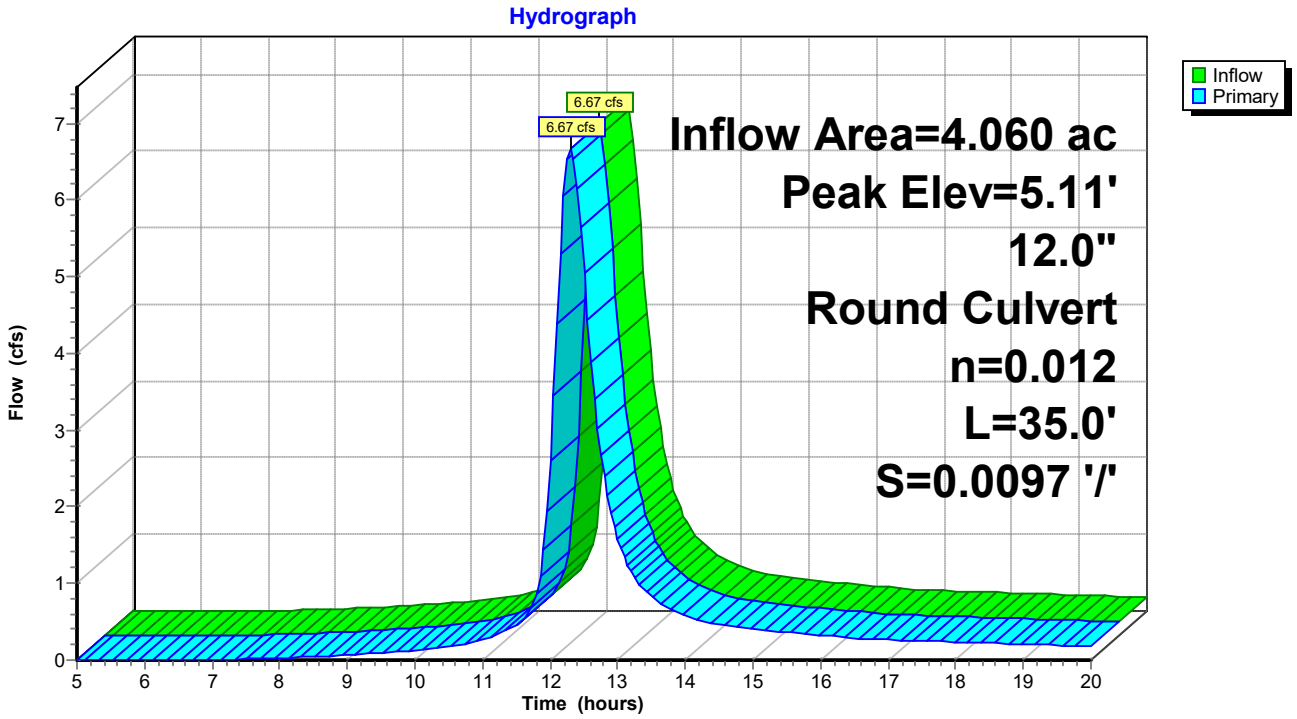
Inflow Area = 4.060 ac, 49.97% Impervious, Inflow Depth > 1.93" for 2-yr event
Inflow = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af
Outflow = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af, Atten= 0%, Lag= 0.0 min
Primary = 6.67 cfs @ 12.30 hrs, Volume= 0.652 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.11' @ 12.30 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.05'	**12.0" Round CMP_Round 12"** L= 35.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.05' / -0.29' S= 0.0097 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=6.67 cfs @ 12.30 hrs HW=5.11' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=CMP_Round 12"** (Inlet Controls 6.67 cfs @ 8.49 fps)

Pond 13P: DA5 Pipe



Summary for Pond 14P: DA3 Pipe

[57] Hint: Peaked at 2.21' (Flood elevation advised)

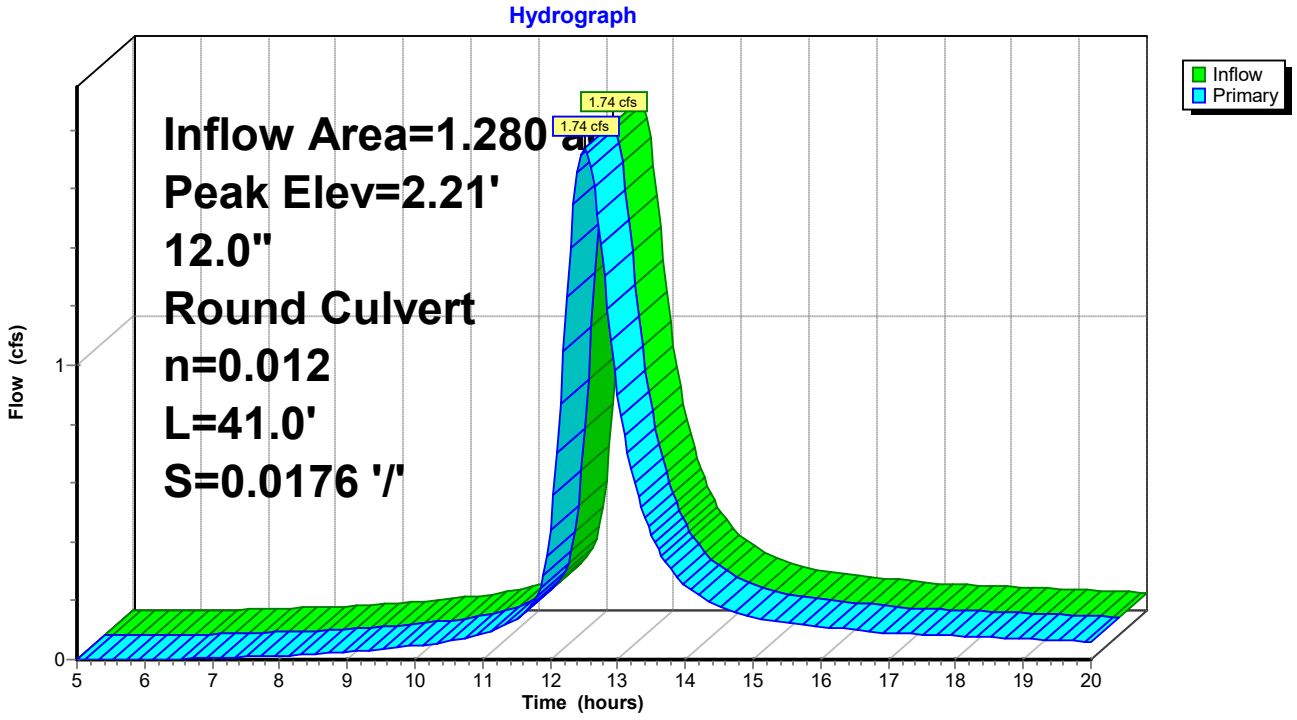
Inflow Area = 1.280 ac, 59.98% Impervious, Inflow Depth > 2.08" for 2-yr event
Inflow = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af
Outflow = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af, Atten= 0%, Lag= 0.0 min
Primary = 1.74 cfs @ 12.50 hrs, Volume= 0.222 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.21' @ 12.50 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.16'	**12.0" Round Culvert** L= 41.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.16' / -0.56' S= 0.0176 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=1.74 cfs @ 12.50 hrs HW=2.21' TW=2.00' (Fixed TW Elev= 2.00')
1=Culvert (Inlet Controls 1.74 cfs @ 2.21 fps)

Pond 14P: DA3 Pipe



Summary for Pond 15P: DA6 Pipe

[58] Hint: Peaked 3.12' above defined flood level

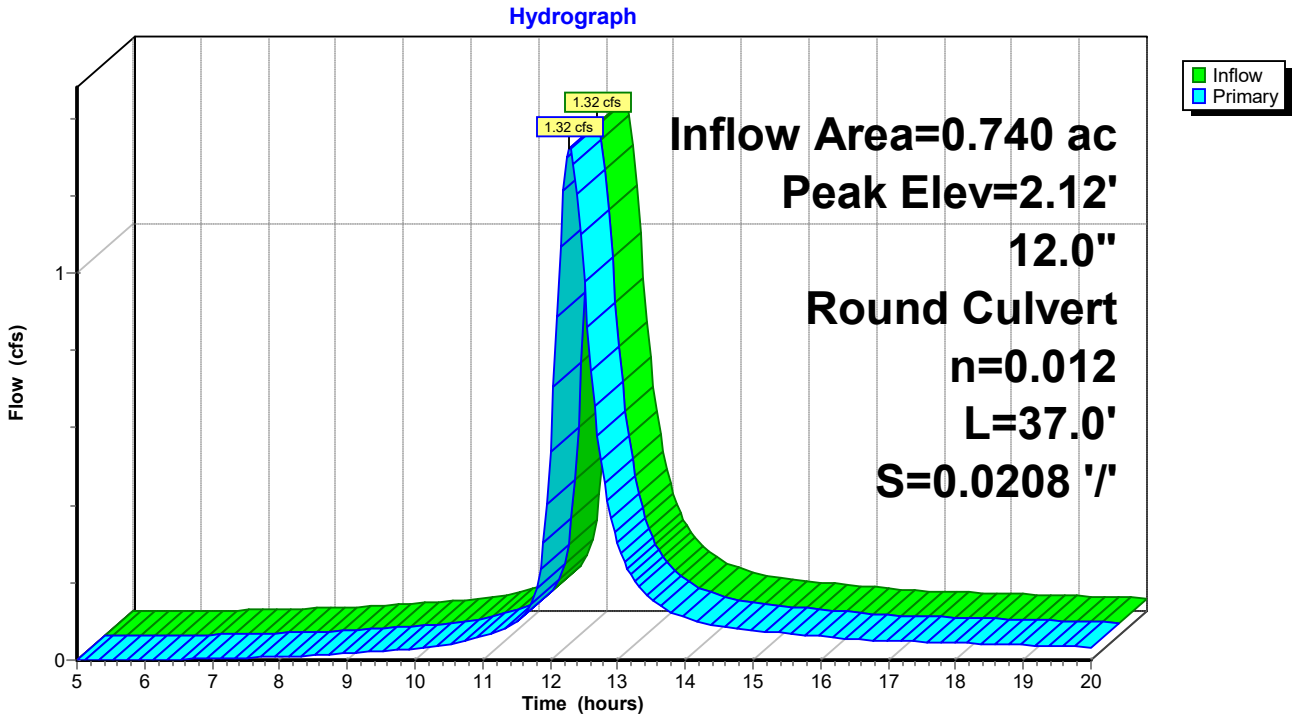
Inflow Area = 0.740 ac, 60.00% Impervious, Inflow Depth > 2.09" for 2-yr event
Inflow = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af
Outflow = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af, Atten= 0%, Lag= 0.0 min
Primary = 1.32 cfs @ 12.29 hrs, Volume= 0.129 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.12' @ 12.29 hrs
Flood Elev= -1.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.42'	**12.0" Round CMP_Round 12"** L= 37.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.42' / -0.35' S= 0.0208 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=1.32 cfs @ 12.29 hrs HW=2.12' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=CMP_Round 12"** (Inlet Controls 1.32 cfs @ 1.68 fps)

Pond 15P: DA6 Pipe



Summary for Pond 16P: DA2 Pipe

[57] Hint: Peaked at 2.31' (Flood elevation advised)

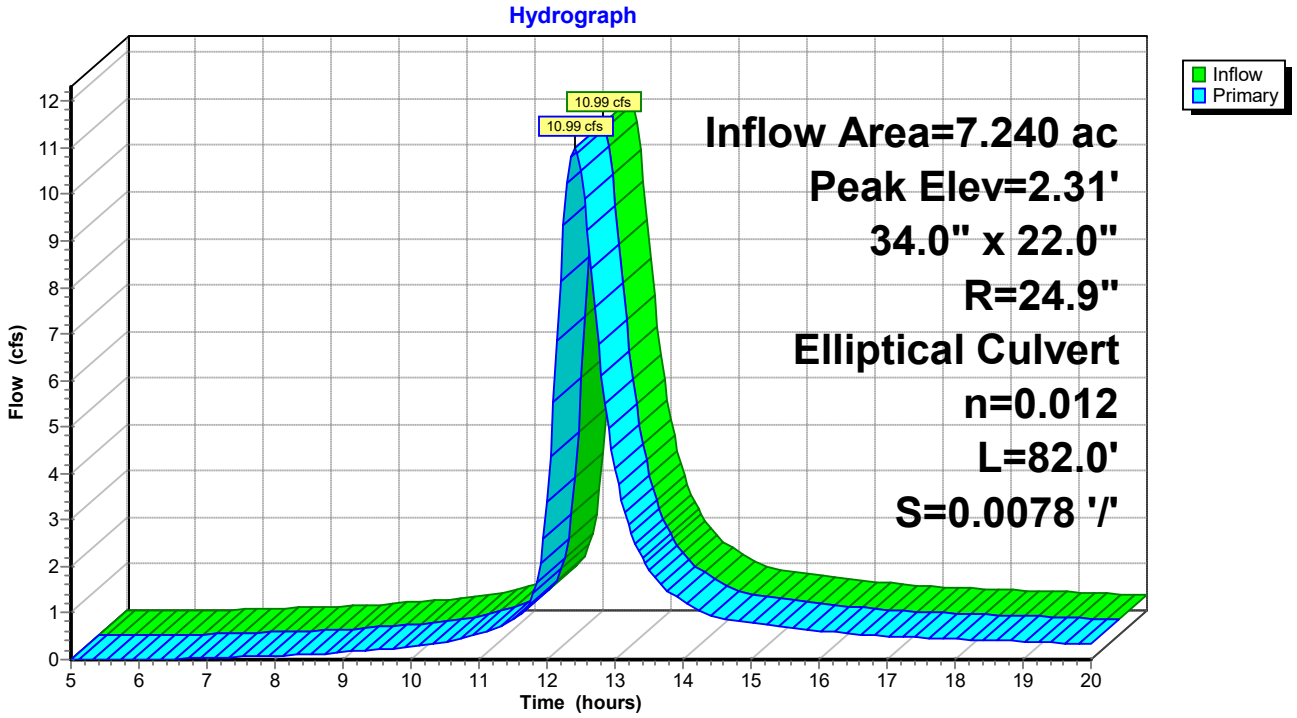
Inflow Area = 7.240 ac, 50.29% Impervious, Inflow Depth > 2.09" for 2-yr event
Inflow = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af
Outflow = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af, Atten= 0%, Lag= 0.0 min
Primary = 10.99 cfs @ 12.41 hrs, Volume= 1.259 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.31' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.36'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 82.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.36' / -1.00' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=10.98 cfs @ 12.41 hrs HW=2.31' TW=2.00' (Fixed TW Elev= 2.00')
1=RCP_Elliptical 34x22 (Inlet Controls 10.98 cfs @ 2.67 fps)

Pond 16P: DA2 Pipe



Summary for Pond 17P: DA1 Pipe

[57] Hint: Peaked at 6.24' (Flood elevation advised)

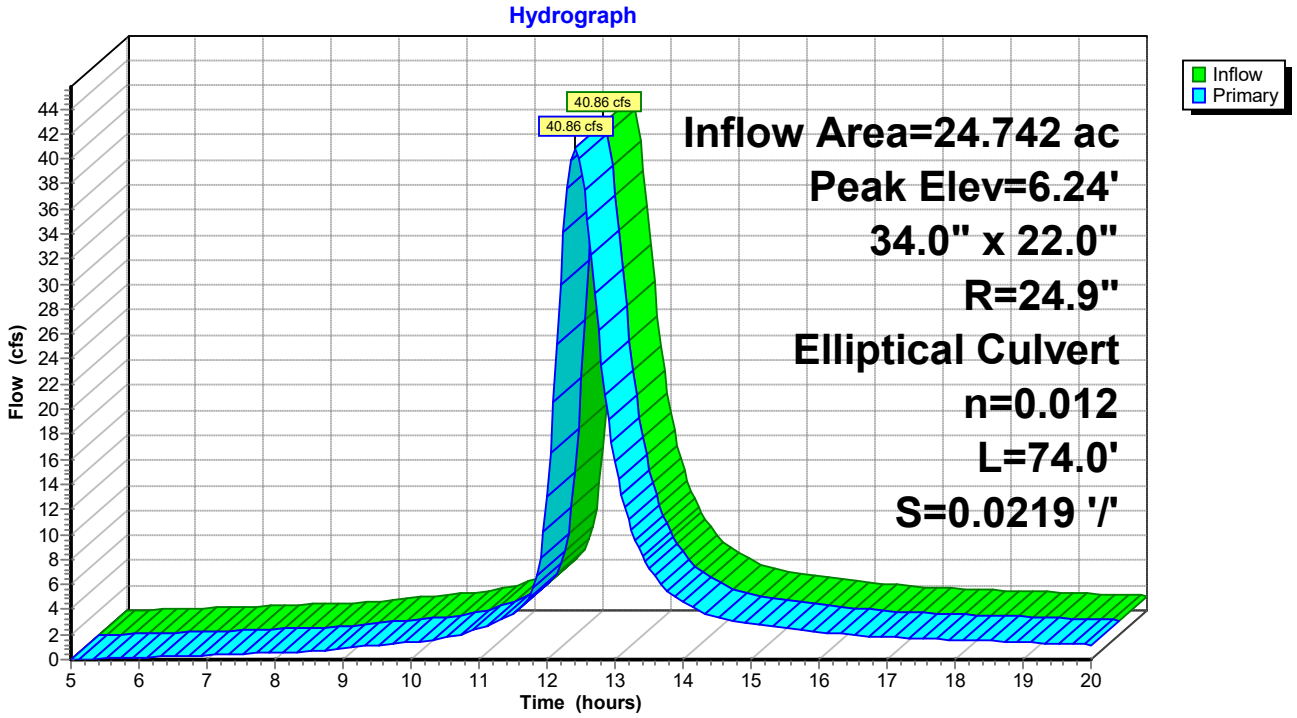
Inflow Area = 24.742 ac, 65.94% Impervious, Inflow Depth > 2.36" for 2-yr event
Inflow = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af
Outflow = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af, Atten= 0%, Lag= 0.0 min
Primary = 40.86 cfs @ 12.42 hrs, Volume= 4.856 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 6.24' @ 12.42 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.27'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 74.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.27' / -1.35' S= 0.0219 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=40.74 cfs @ 12.42 hrs HW=6.22' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 40.74 cfs @ 9.89 fps)

Pond 17P: DA1 Pipe



Summary for Pond 18P: DA East Chew Pipe

[57] Hint: Peaked at 7.63' (Flood elevation advised)

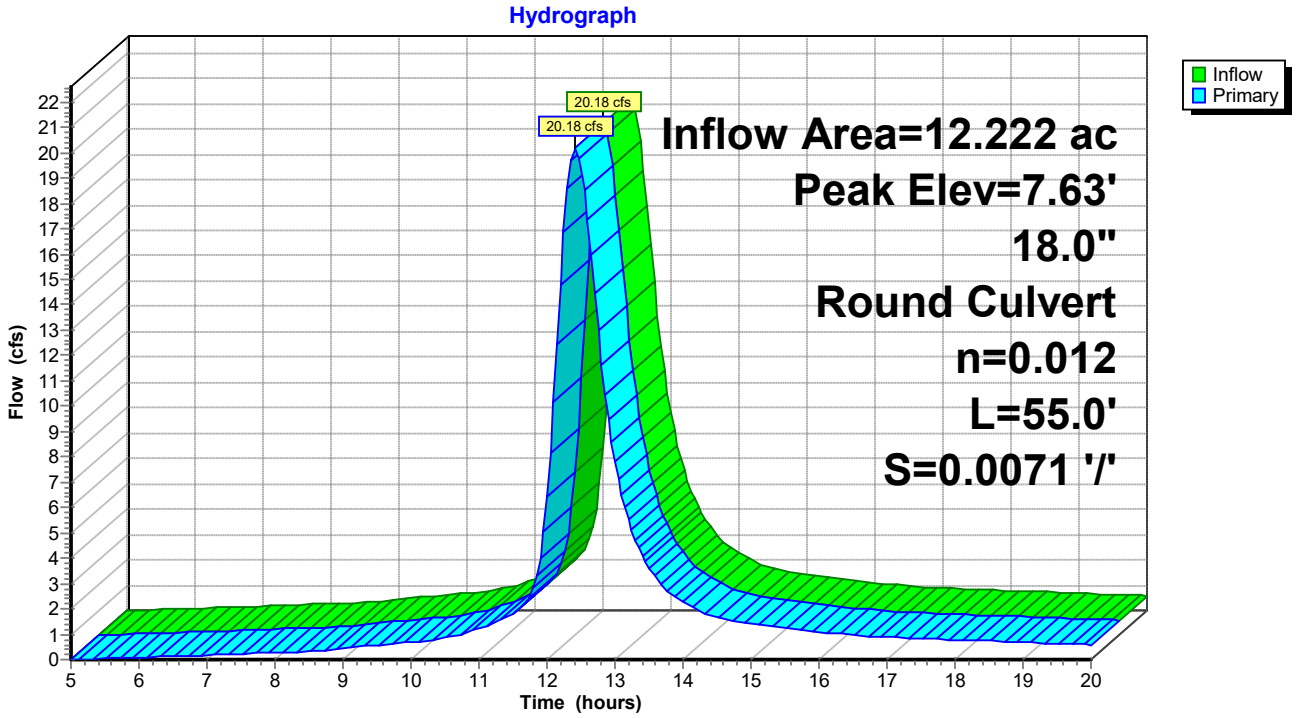
Inflow Area = 12.222 ac, 65.70% Impervious, Inflow Depth > 2.36" for 2-yr event
Inflow = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af
Outflow = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af, Atten= 0%, Lag= 0.0 min
Primary = 20.18 cfs @ 12.42 hrs, Volume= 2.399 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 7.63' @ 12.42 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.06'	**18.0" Round Culvert** L= 55.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.06' / -0.45' S= 0.0071 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=20.12 cfs @ 12.42 hrs HW=7.59' TW=2.00' (Fixed TW Elev= 2.00')
↑**1=Culvert** (Inlet Controls 20.12 cfs @ 11.39 fps)

Pond 18P: DA East Chew Pipe



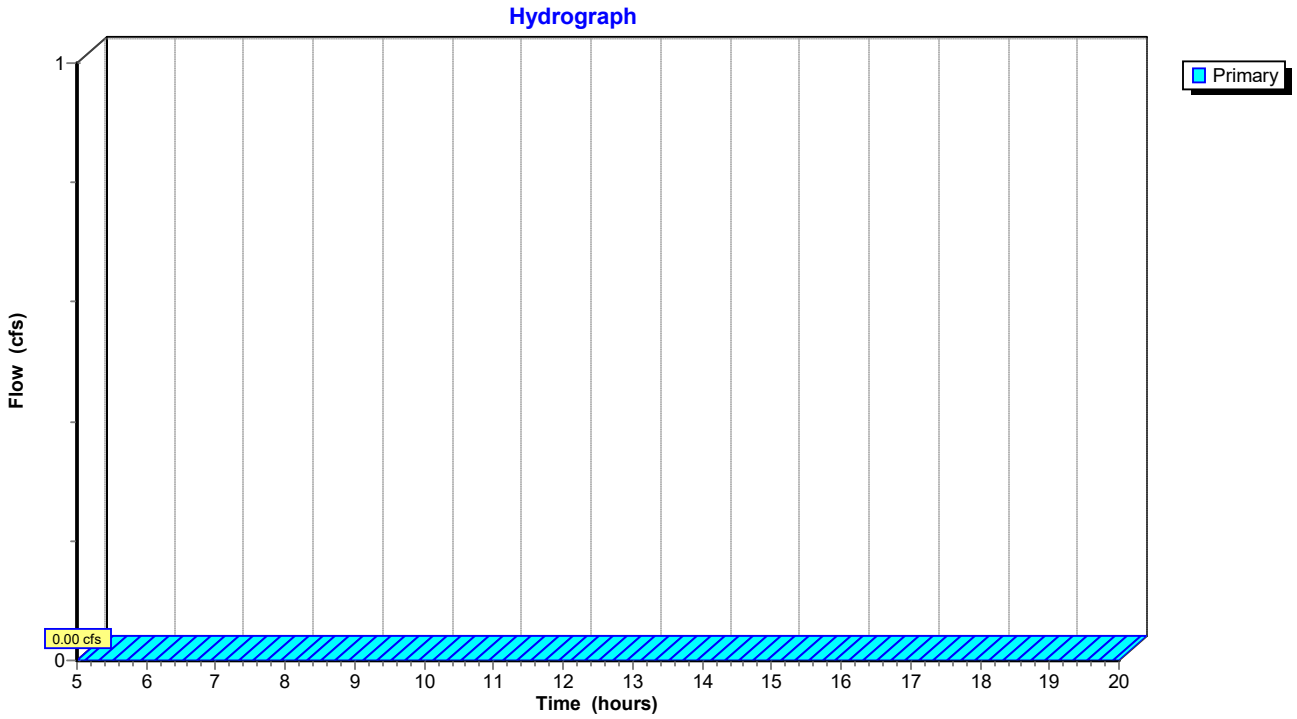
Summary for Link 10L: Harbor

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: Harbor



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=24.742 ac 65.94% Impervious Runoff Depth>4.71"
Flow Length=990' Tc=45.0 min CN=92 Runoff=79.28 cfs 9.714 af

Subcatchment 4S: DA2 Runoff Area=7.240 ac 50.29% Impervious Runoff Depth>4.40"
Flow Length=649' Tc=43.7 min CN=89 Runoff=22.54 cfs 2.655 af

Subcatchment 5S: DA3 Runoff Area=1.280 ac 59.98% Impervious Runoff Depth>4.39"
Flow Length=849' Tc=51.4 min CN=89 Runoff=3.56 cfs 0.468 af

Subcatchment 6S: DA4 Runoff Area=1.763 ac 53.49% Impervious Runoff Depth>4.40"
Flow Length=289' Tc=41.8 min CN=89 Runoff=5.66 cfs 0.647 af

Subcatchment 7S: DA5 Runoff Area=4.060 ac 49.97% Impervious Runoff Depth>4.20"
Flow Length=235' Slope=0.0010 '/' Tc=34.8 min CN=87 Runoff=14.18 cfs 1.421 af

Subcatchment 8S: DA6 Runoff Area=0.740 ac 60.00% Impervious Runoff Depth>4.41"
Flow Length=237' Tc=34.5 min CN=89 Runoff=2.70 cfs 0.272 af

Subcatchment 9S: East Chew Runoff Area=12.222 ac 65.70% Impervious Runoff Depth>4.71"
Flow Length=990' Tc=45.0 min CN=92 Runoff=39.16 cfs 4.799 af

Pond 12P: DA4 Pipe Peak Elev=4.24' Inflow=5.66 cfs 0.647 af
12.0" Round Culvert n=0.012 L=25.0' S=0.0060 '/' Outflow=5.66 cfs 0.647 af

Pond 13P: DA5 Pipe Peak Elev=16.06' Inflow=14.18 cfs 1.421 af
12.0" Round Culvert n=0.012 L=35.0' S=0.0097 '/' Outflow=14.18 cfs 1.421 af

Pond 14P: DA3 Pipe Peak Elev=2.89' Inflow=3.56 cfs 0.468 af
12.0" Round Culvert n=0.012 L=41.0' S=0.0176 '/' Outflow=3.56 cfs 0.468 af

Pond 15P: DA6 Pipe Peak Elev=2.51' Inflow=2.70 cfs 0.272 af
12.0" Round Culvert n=0.012 L=37.0' S=0.0208 '/' Outflow=2.70 cfs 0.272 af

Pond 16P: DA2 Pipe Peak Elev=3.29' Inflow=22.54 cfs 2.655 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=82.0' S=0.0078 '/' Outflow=22.54 cfs 2.655 af

Pond 17P: DA1 Pipe Peak Elev=17.98' Inflow=79.28 cfs 9.714 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=74.0' S=0.0219 '/' Outflow=79.28 cfs 9.714 af

Pond 18P: DA East Chew Pipe Peak Elev=23.19' Inflow=39.16 cfs 4.799 af
18.0" Round Culvert n=0.012 L=55.0' S=0.0071 '/' Outflow=39.16 cfs 4.799 af

Link 10L: Harbor
Primary=0.00 cfs 0.000 af

Total Runoff Area = 52.047 ac Runoff Volume = 19.976 af Average Runoff Depth = 4.61"
38.19% Pervious = 19.877 ac 61.81% Impervious = 32.170 ac

Summary for Subcatchment 1S: DA1

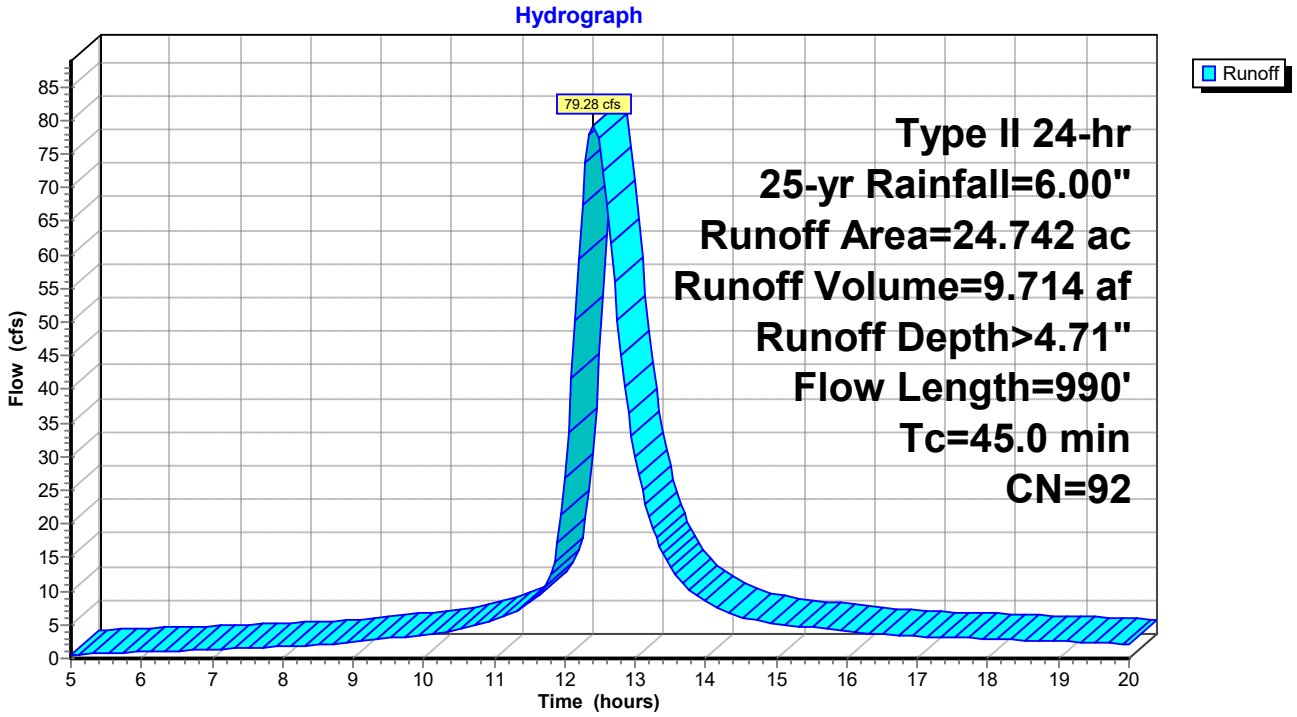
Runoff = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
1.000	85	1/2 acre lots, 25% imp, HSG D
0.900	86	1/3 acre lots, 30% imp, HSG D
8.140	87	1/4 acre lots, 38% imp, HSG D
2.002	92	1/8 acre lots, 65% imp, HSG D
8.000	95	Urban commercial, 85% imp, HSG D
4.600	98	Paved parking, HSG D
0.100	80	>75% Grass cover, Good, HSG D
24.742	92	Weighted Average
8.428		34.06% Pervious Area
16.314		65.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 4S: DA2

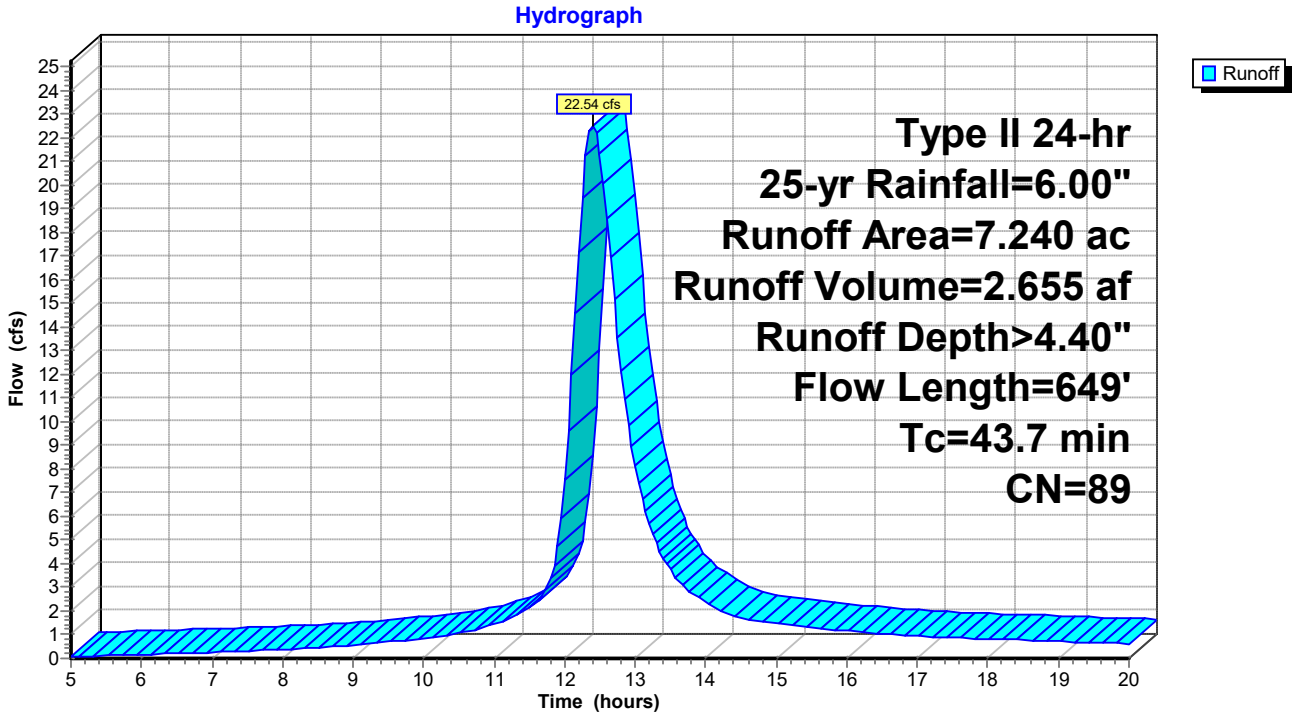
Runoff = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.200	80	1/2 acre lots, 25% imp, HSG C
0.240	85	1/2 acre lots, 25% imp, HSG D
0.720	81	1/3 acre lots, 30% imp, HSG C
2.320	86	1/3 acre lots, 30% imp, HSG D
0.210	83	1/4 acre lots, 38% imp, HSG C
1.630	87	1/4 acre lots, 38% imp, HSG D
1.920	98	Paved parking, HSG D
7.240	89	Weighted Average
3.599		49.71% Pervious Area
3.641		50.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0080	7.45	30.70	**Pipe Channel, RCP_Elliptical 34x22** 34.0" x 22.0", R=24.9" Elliptical Area= 4.1 sf Perim= 7.5' r= 0.55' n= 0.012 Concrete pipe, finished
2.0	367	0.0012	3.14	15.39	**Pipe Channel, RCP_Round 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
43.7	649	Total			

Subcatchment 4S: DA2



Summary for Subcatchment 5S: DA3

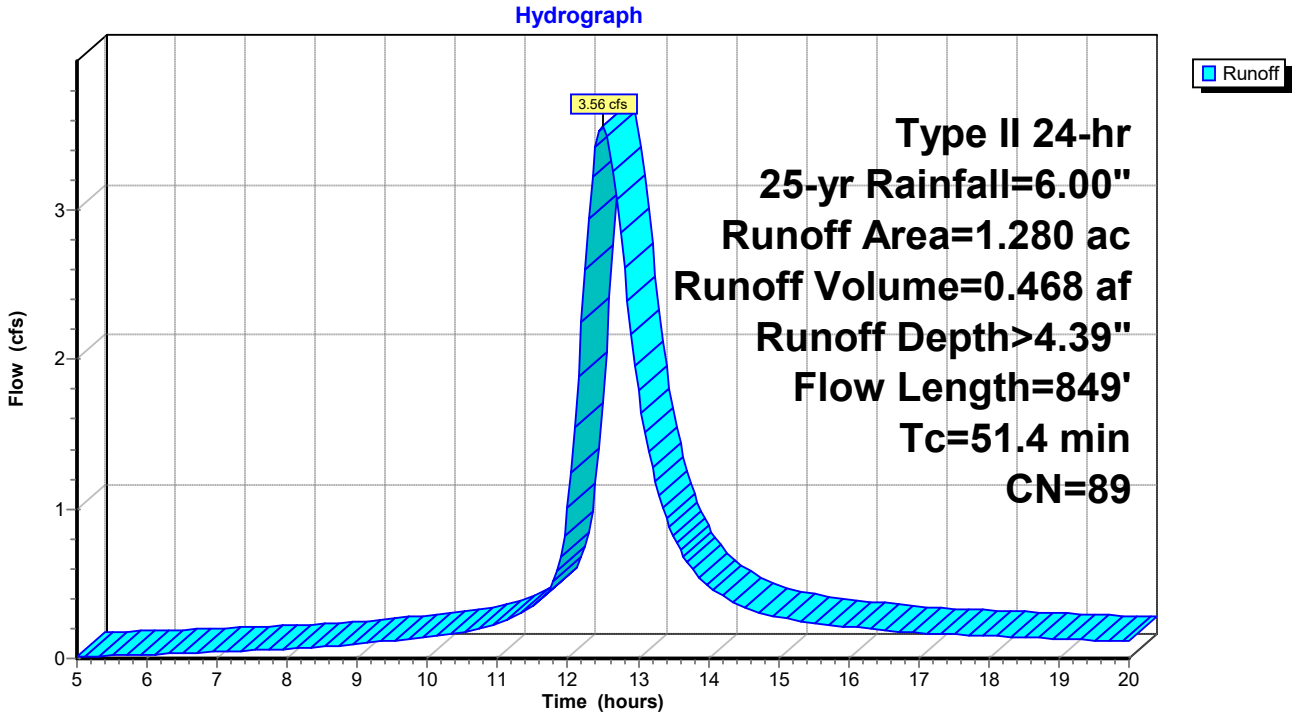
Runoff = 3.56 cfs @ 12.49 hrs, Volume= 0.468 af, Depth> 4.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.110	81	1/3 acre lots, 30% imp, HSG C
0.170	86	1/3 acre lots, 30% imp, HSG D
0.430	83	1/4 acre lots, 38% imp, HSG C
0.080	87	1/4 acre lots, 38% imp, HSG D
0.490	98	Paved parking, HSG D
1.280	89	Weighted Average
0.512		40.02% Pervious Area
0.768		59.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0078	7.98	32.34	**Pipe Channel, out** 34.0" x 22.0", R=23.0" Elliptical Area= 4.1 sf Perim= 7.4' r= 0.55' n= 0.011 Concrete pipe, straight & clean
6.8	367	0.0001	0.91	4.44	**Pipe Channel, 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
2.9	200	0.0010	1.15	5.73	**Channel Flow, ditch** Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.030 Earth, grassed & winding
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
51.4	849	Total			

Subcatchment 5S: DA3



Summary for Subcatchment 6S: DA4

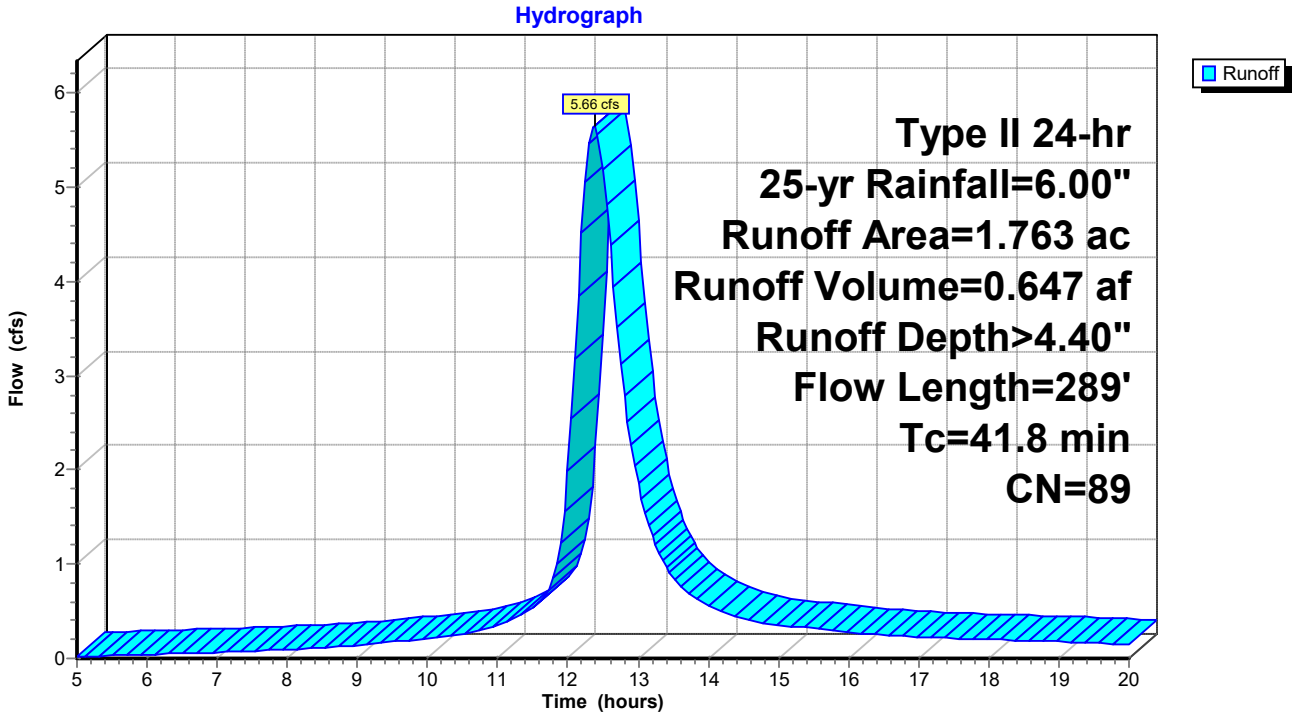
Runoff = 5.66 cfs @ 12.38 hrs, Volume= 0.647 af, Depth> 4.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.040	81	1/3 acre lots, 30% imp, HSG C
0.440	86	1/3 acre lots, 30% imp, HSG D
0.160	83	1/4 acre lots, 38% imp, HSG C
0.423	87	1/4 acre lots, 38% imp, HSG D
0.350	92	1/8 acre lots, 65% imp, HSG D
0.350	98	Paved parking, HSG D
1.763	89	Weighted Average
0.820		46.51% Pervious Area
0.943		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0060	3.81	2.99	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	31	0.0230	7.45	5.85	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	33	0.0160	6.22	4.88	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
41.8	289	Total			

Subcatchment 6S: DA4



Summary for Subcatchment 7S: DA5

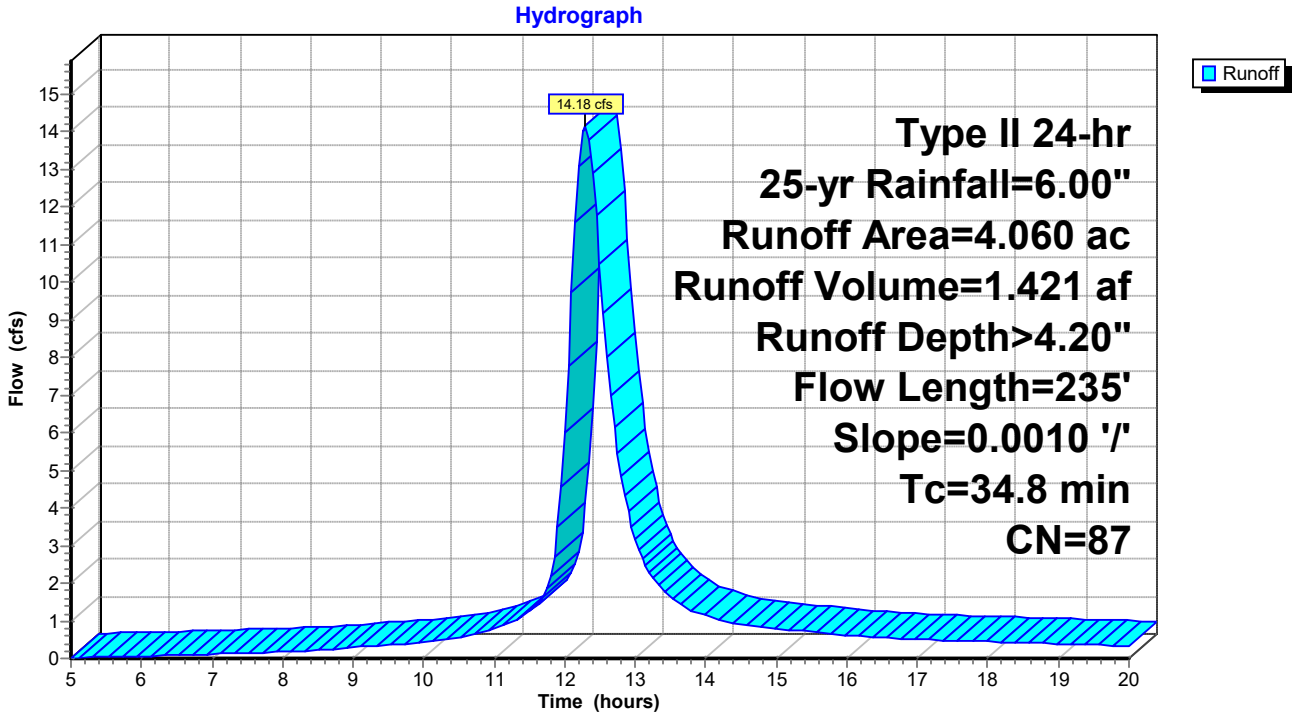
Runoff = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af, Depth> 4.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
1.100	79	1 acre lots, 20% imp, HSG C
0.030	80	1/2 acre lots, 25% imp, HSG C
0.180	85	1/2 acre lots, 25% imp, HSG D
0.040	86	1/3 acre lots, 30% imp, HSG D
0.560	83	1/4 acre lots, 38% imp, HSG C
0.930	87	1/4 acre lots, 38% imp, HSG D
0.120	92	1/8 acre lots, 65% imp, HSG D
1.100	98	Paved parking, HSG D
4.060	87	Weighted Average
2.031		50.03% Pervious Area
2.029		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	35	0.0010	1.55	1.22	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.8	235	Total			

Subcatchment 7S: DA5



Summary for Subcatchment 8S: DA6

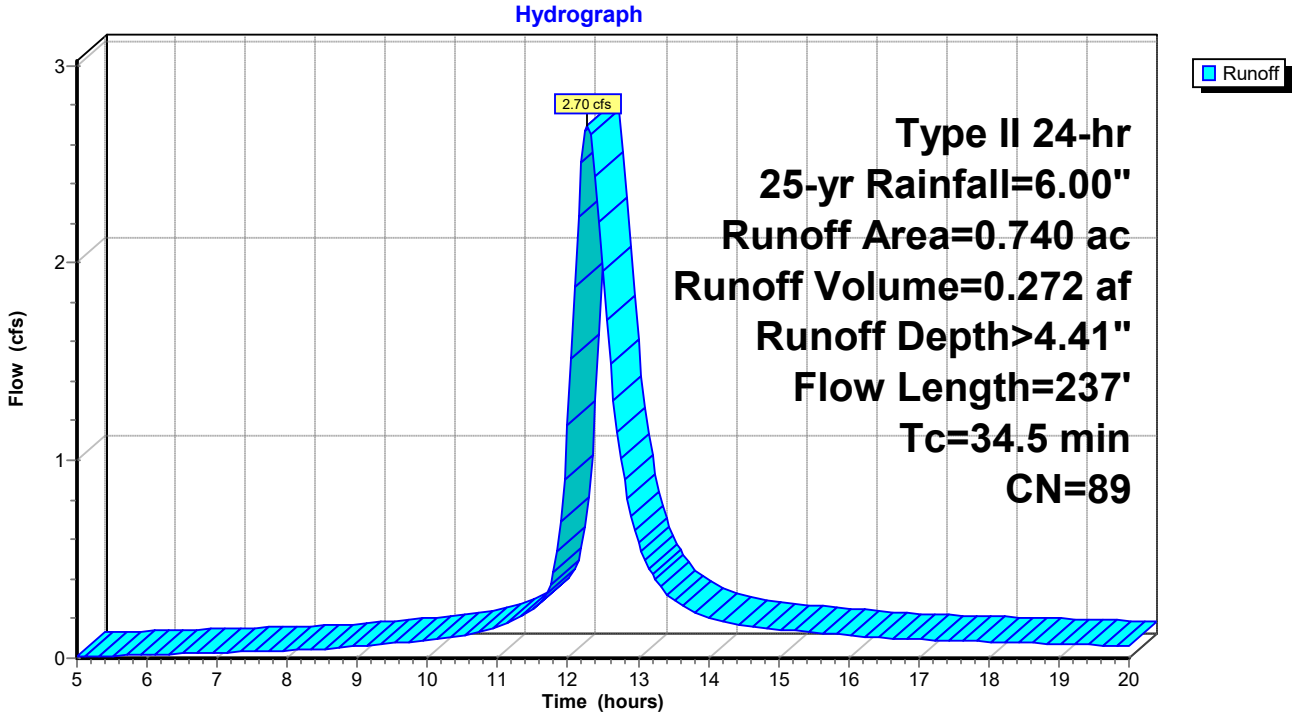
Runoff = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af, Depth> 4.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.370	79	1 acre lots, 20% imp, HSG C
0.370	98	Paved parking, HSG D
0.740	89	Weighted Average
0.296		40.00% Pervious Area
0.444		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	37	0.0200	6.95	5.46	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.5	237	Total			

Subcatchment 8S: DA6



Summary for Subcatchment 9S: East Chew

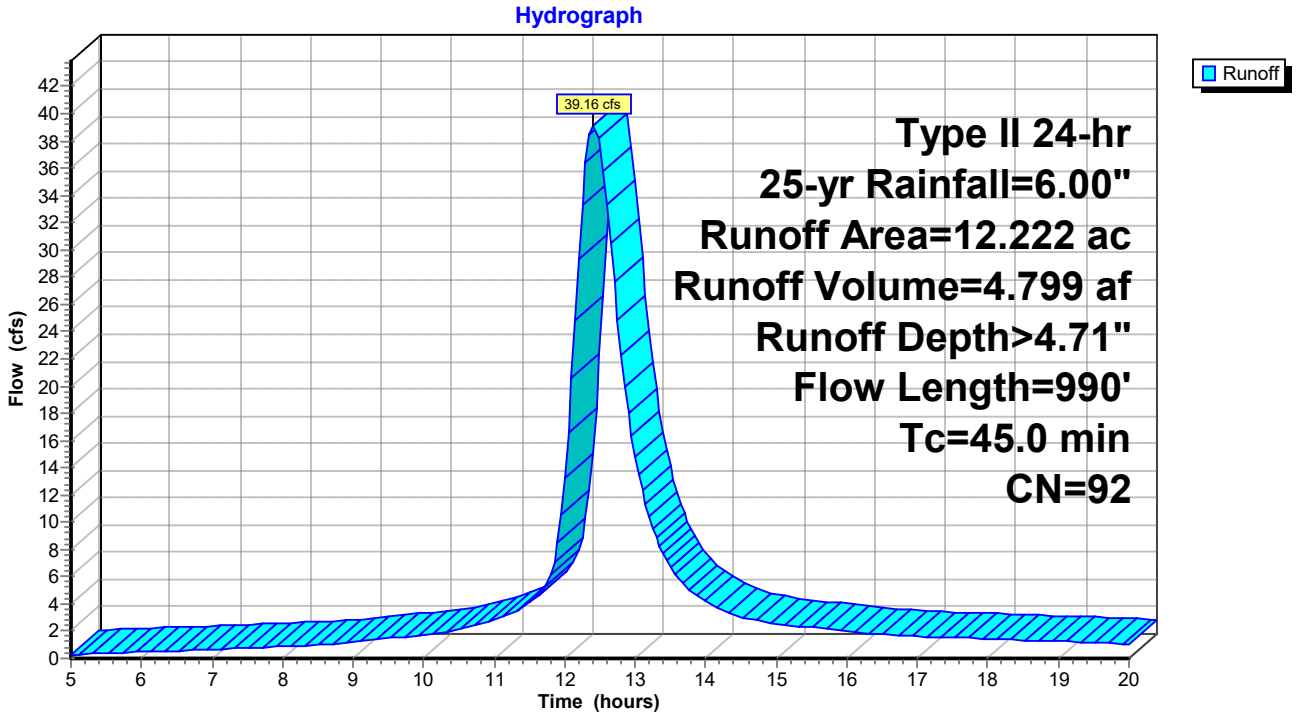
Runoff = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af, Depth> 4.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 25-yr Rainfall=6.00"

Area (ac)	CN	Description
0.500	85	1/2 acre lots, 25% imp, HSG D
0.450	86	1/3 acre lots, 30% imp, HSG D
4.070	87	1/4 acre lots, 38% imp, HSG D
1.002	92	1/8 acre lots, 65% imp, HSG D
3.850	95	Urban commercial, 85% imp, HSG D
2.300	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
12.222	92	Weighted Average
4.192		34.30% Pervious Area
8.030		65.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 9S: East Chew



Summary for Pond 12P: DA4 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 4.24' (Flood elevation advised)

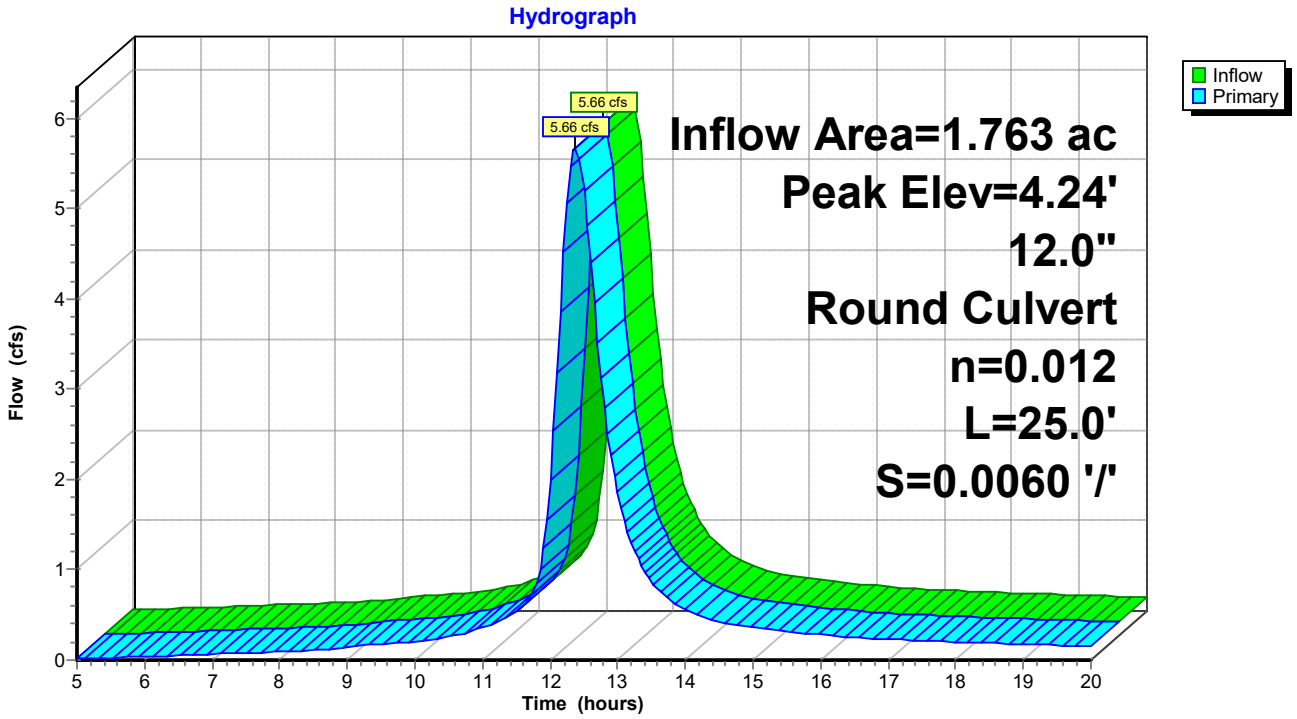
Inflow Area = 1.763 ac, 53.49% Impervious, Inflow Depth > 4.40" for 25-yr event
Inflow = 5.66 cfs @ 12.38 hrs, Volume= 0.647 af
Outflow = 5.66 cfs @ 12.38 hrs, Volume= 0.647 af, Atten= 0%, Lag= 0.0 min
Primary = 5.66 cfs @ 12.38 hrs, Volume= 0.647 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.24' @ 12.38 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.05'	**12.0" Round Culvert** L= 25.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.05' / -0.20' S= 0.0060 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=5.64 cfs @ 12.38 hrs HW=4.22' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=Culvert** (Inlet Controls 5.64 cfs @ 7.18 fps)

Pond 12P: DA4 Pipe



Summary for Pond 13P: DA5 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 14.06' above defined flood level

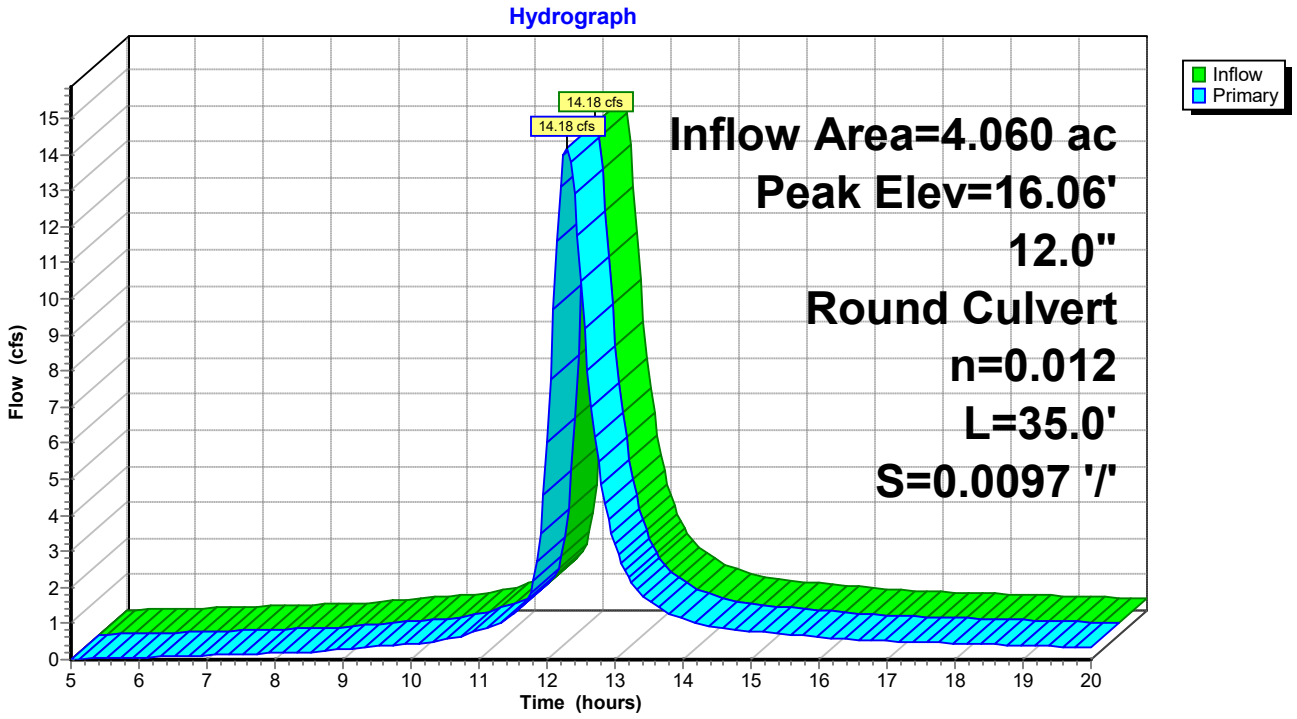
Inflow Area = 4.060 ac, 49.97% Impervious, Inflow Depth > 4.20" for 25-yr event
Inflow = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af
Outflow = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af, Atten= 0%, Lag= 0.0 min
Primary = 14.18 cfs @ 12.29 hrs, Volume= 1.421 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 16.06' @ 12.29 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.05'	**12.0" Round CMP_Round 12"** L= 35.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.05' / -0.29' S= 0.0097 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=14.13 cfs @ 12.29 hrs HW=15.97' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=CMP_Round 12"** (Inlet Controls 14.13 cfs @ 18.00 fps)

Pond 13P: DA5 Pipe



Summary for Pond 14P: DA3 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 2.89' (Flood elevation advised)

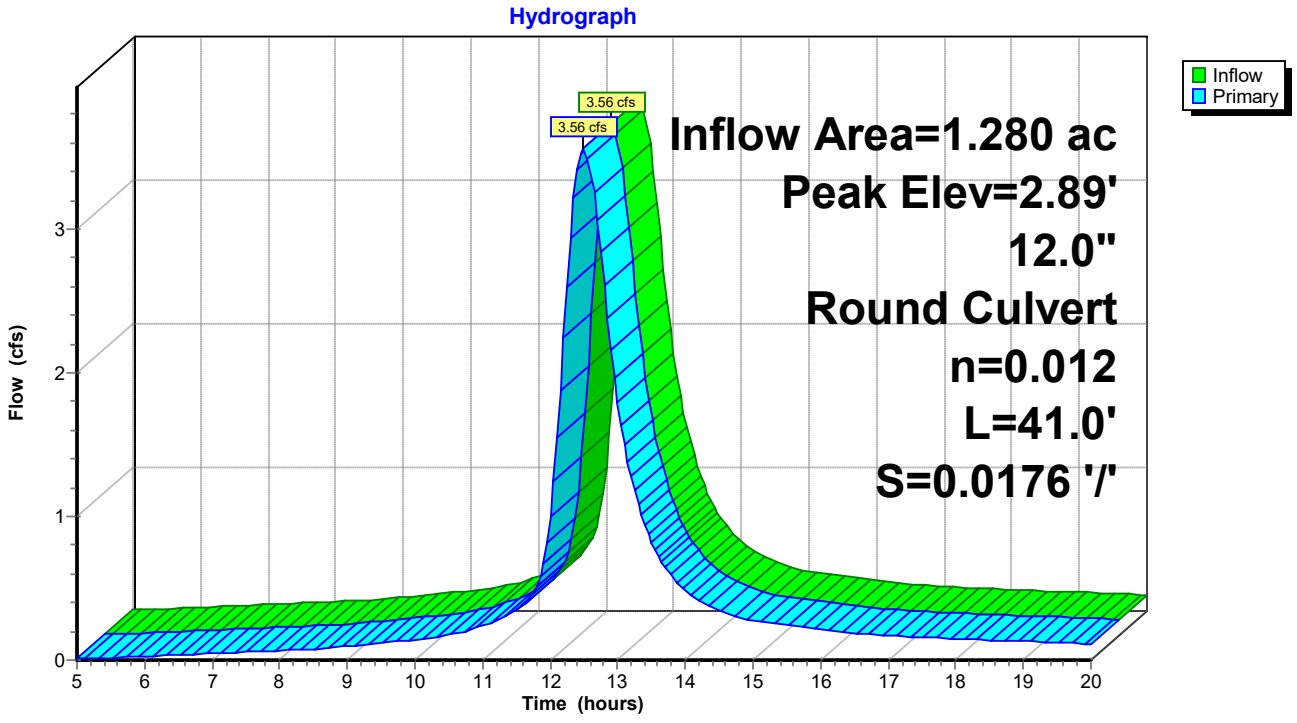
Inflow Area =	1.280 ac,	59.98% Impervious,	Inflow Depth >	4.39"	for 25-yr event
Inflow =	3.56 cfs @	12.49 hrs,	Volume=	0.468 af	
Outflow =	3.56 cfs @	12.49 hrs,	Volume=	0.468 af,	Atten= 0%, Lag= 0.0 min
Primary =	3.56 cfs @	12.49 hrs,	Volume=	0.468 af	

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.89' @ 12.49 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.16'	**12.0" Round Culvert** L= 41.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.16' / -0.56' S= 0.0176 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=3.56 cfs @ 12.49 hrs HW=2.89' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=Culvert** (Inlet Controls 3.56 cfs @ 4.53 fps)

Pond 14P: DA3 Pipe



Summary for Pond 15P: DA6 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 3.51' above defined flood level

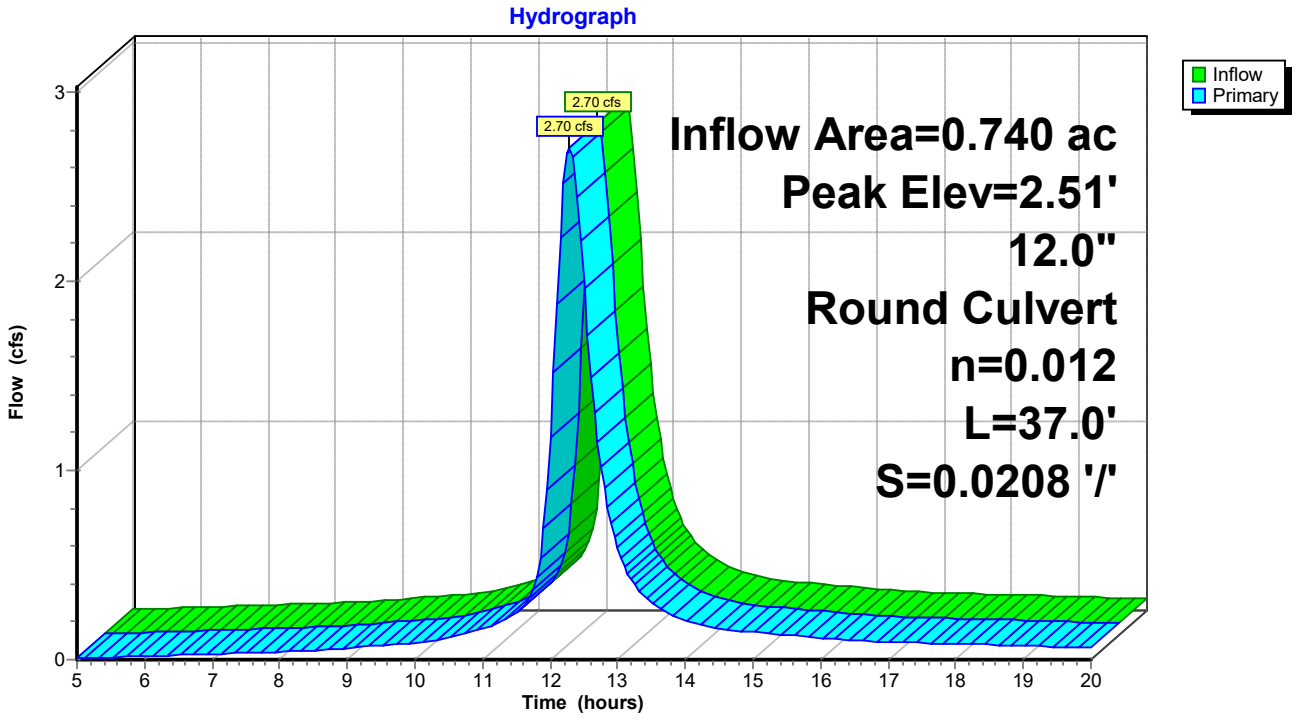
Inflow Area = 0.740 ac, 60.00% Impervious, Inflow Depth > 4.41" for 25-yr event
Inflow = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af
Outflow = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min
Primary = 2.70 cfs @ 12.29 hrs, Volume= 0.272 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.51' @ 12.29 hrs
Flood Elev= -1.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.42'	**12.0" Round CMP_Round 12"** L= 37.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.42' / -0.35' S= 0.0208 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=2.69 cfs @ 12.29 hrs HW=2.51' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=CMP_Round 12"** (Inlet Controls 2.69 cfs @ 3.42 fps)

Pond 15P: DA6 Pipe



Summary for Pond 16P: DA2 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 3.29' (Flood elevation advised)

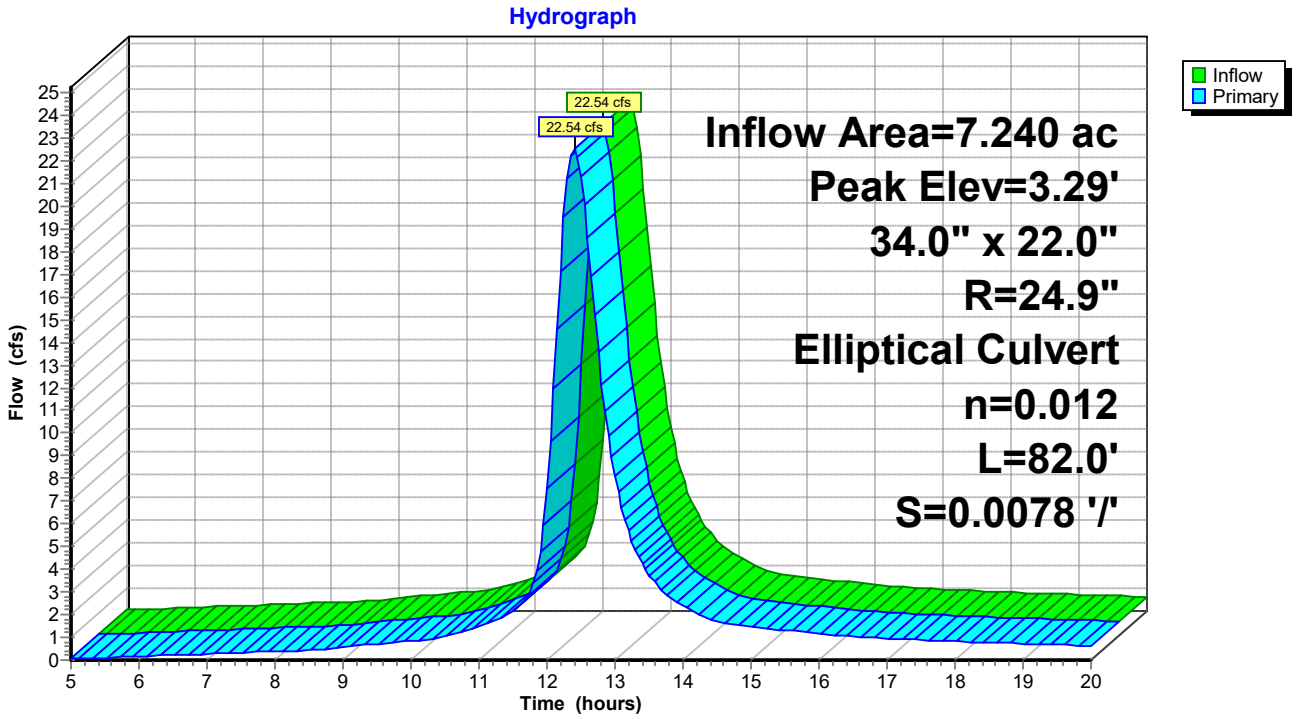
Inflow Area = 7.240 ac, 50.29% Impervious, Inflow Depth > 4.40" for 25-yr event
Inflow = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af
Outflow = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af, Atten= 0%, Lag= 0.0 min
Primary = 22.54 cfs @ 12.40 hrs, Volume= 2.655 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.29' @ 12.40 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.36'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 82.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.36' / -1.00' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=22.52 cfs @ 12.40 hrs HW=3.29' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 22.52 cfs @ 5.47 fps)

Pond 16P: DA2 Pipe



Summary for Pond 17P: DA1 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 17.98' (Flood elevation advised)

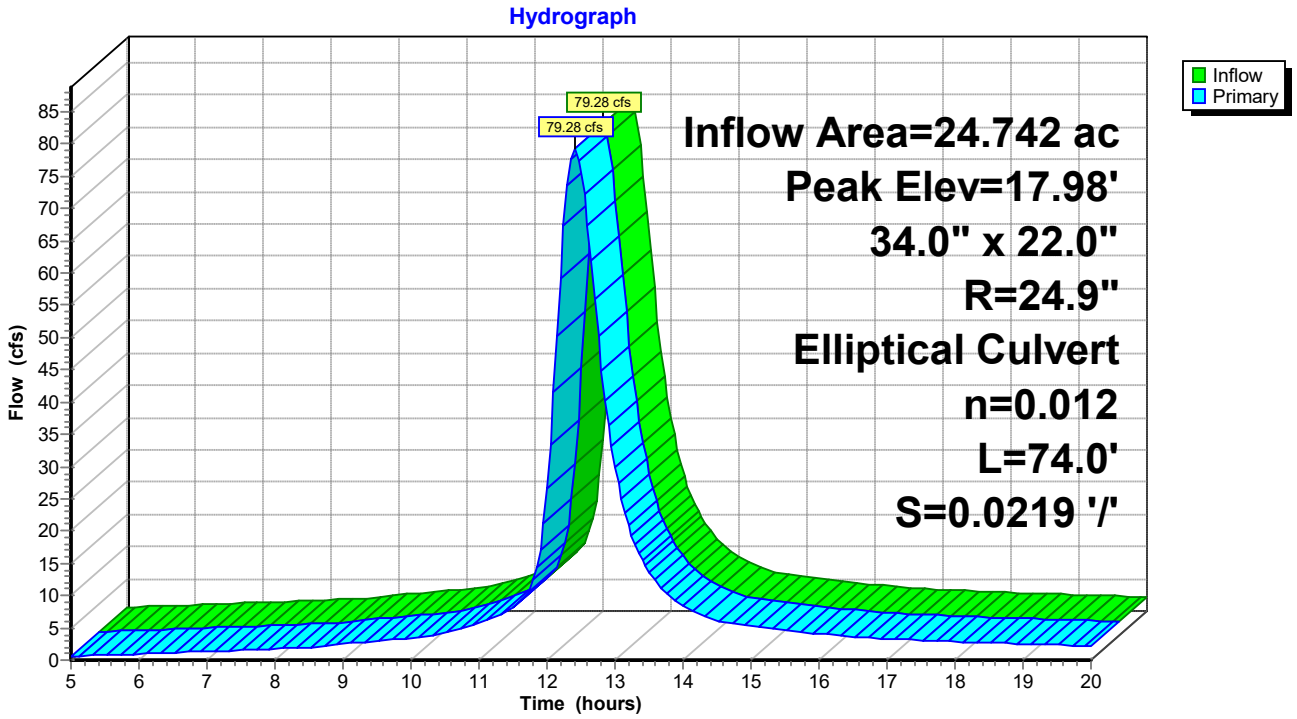
Inflow Area = 24.742 ac, 65.94% Impervious, Inflow Depth > 4.71" for 25-yr event
Inflow = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af
Outflow = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af, Atten= 0%, Lag= 0.0 min
Primary = 79.28 cfs @ 12.41 hrs, Volume= 9.714 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 17.98' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.27'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 74.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.27' / -1.35' S= 0.0219 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=79.10 cfs @ 12.41 hrs HW=17.91' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 79.10 cfs @ 19.20 fps)

Pond 17P: DA1 Pipe



Summary for Pond 18P: DA East Chew Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 23.19' (Flood elevation advised)

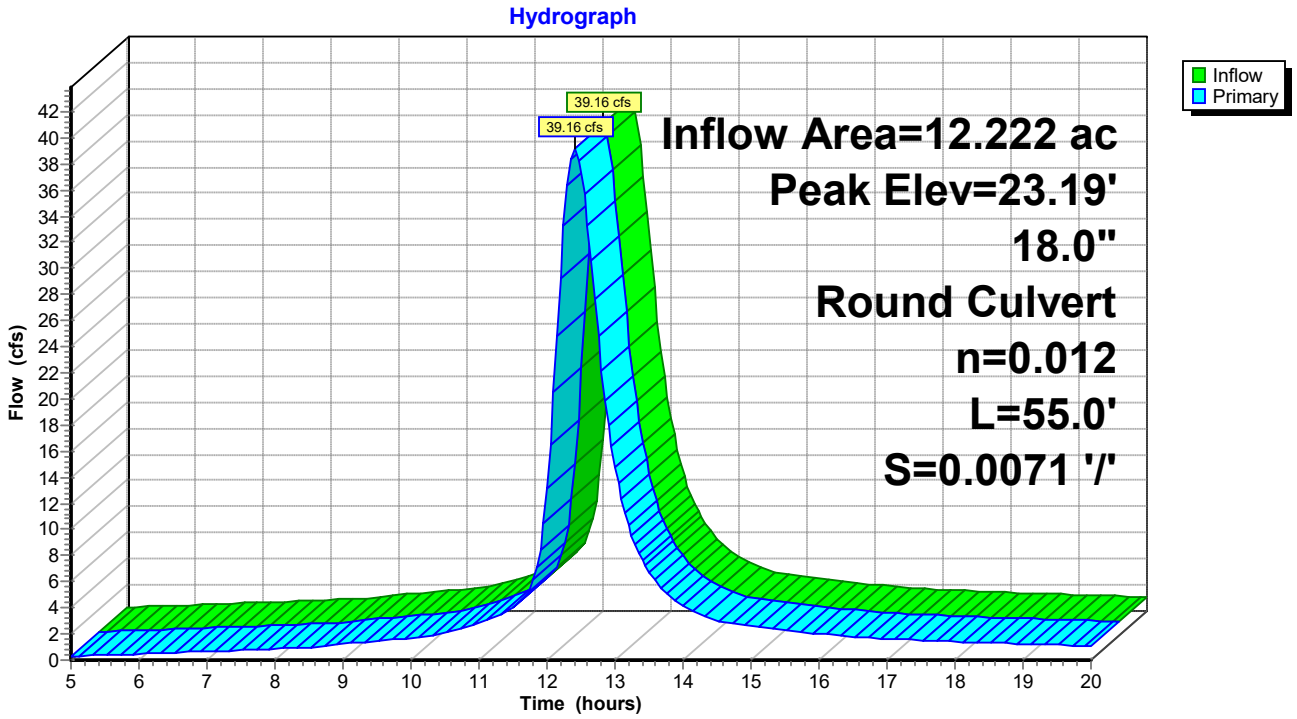
Inflow Area = 12.222 ac, 65.70% Impervious, Inflow Depth > 4.71" for 25-yr event
Inflow = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af
Outflow = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af, Atten= 0%, Lag= 0.0 min
Primary = 39.16 cfs @ 12.41 hrs, Volume= 4.799 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 23.19' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.06'	**18.0" Round Culvert** L= 55.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.06' / -0.45' S= 0.0071 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=39.08 cfs @ 12.41 hrs HW=23.09' TW=2.00' (Fixed TW Elev= 2.00')
↳**1=Culvert** (Inlet Controls 39.08 cfs @ 22.11 fps)

Pond 18P: DA East Chew Pipe



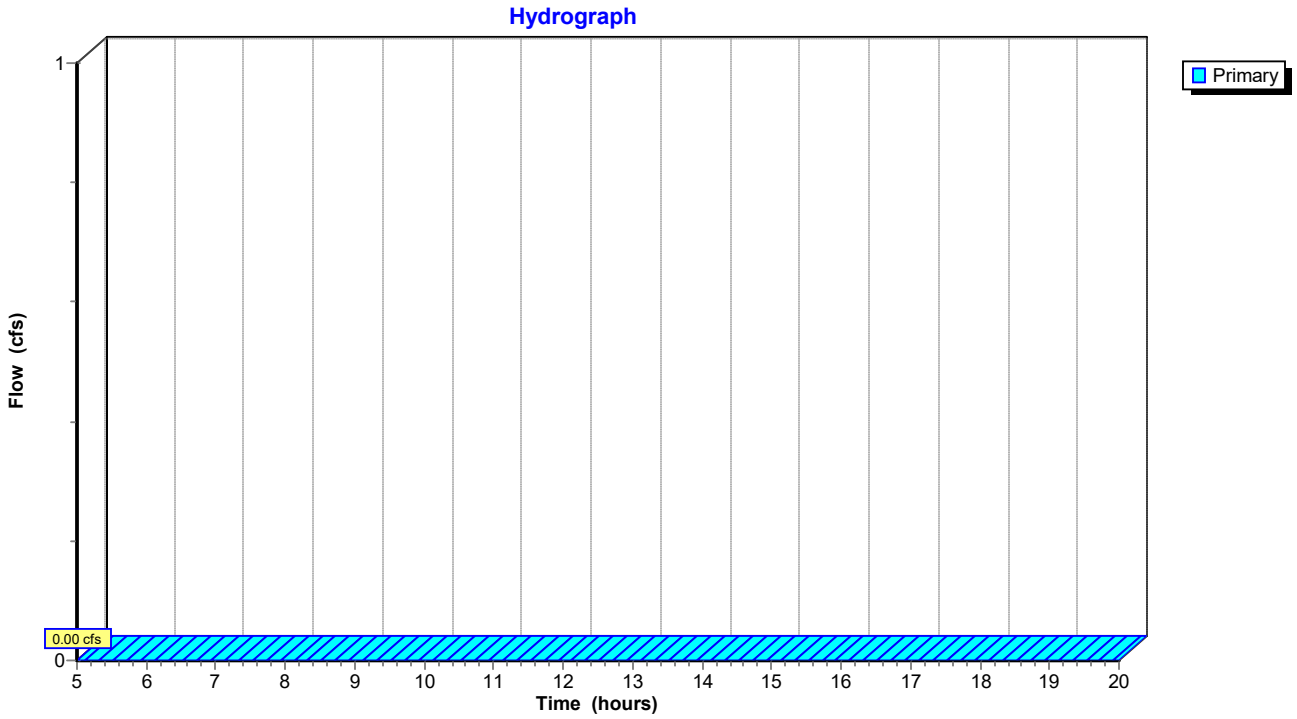
Summary for Link 10L: Harbor

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: Harbor



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DA1 Runoff Area=24.742 ac 65.94% Impervious Runoff Depth>6.17"
Flow Length=990' Tc=45.0 min CN=92 Runoff=102.65 cfs 12.722 af

Subcatchment 4S: DA2 Runoff Area=7.240 ac 50.29% Impervious Runoff Depth>5.85"
Flow Length=649' Tc=43.7 min CN=89 Runoff=29.60 cfs 3.531 af

Subcatchment 5S: DA3 Runoff Area=1.280 ac 59.98% Impervious Runoff Depth>5.84"
Flow Length=849' Tc=51.4 min CN=89 Runoff=4.68 cfs 0.623 af

Subcatchment 6S: DA4 Runoff Area=1.763 ac 53.49% Impervious Runoff Depth>5.86"
Flow Length=289' Tc=41.8 min CN=89 Runoff=7.43 cfs 0.860 af

Subcatchment 7S: DA5 Runoff Area=4.060 ac 49.97% Impervious Runoff Depth>5.65"
Flow Length=235' Slope=0.0010 '/' Tc=34.8 min CN=87 Runoff=18.81 cfs 1.910 af

Subcatchment 8S: DA6 Runoff Area=0.740 ac 60.00% Impervious Runoff Depth>5.87"
Flow Length=237' Tc=34.5 min CN=89 Runoff=3.54 cfs 0.362 af

Subcatchment 9S: East Chew Runoff Area=12.222 ac 65.70% Impervious Runoff Depth>6.17"
Flow Length=990' Tc=45.0 min CN=92 Runoff=50.71 cfs 6.285 af

Pond 12P: DA4 Pipe Peak Elev=5.86' Inflow=7.43 cfs 0.860 af
12.0" Round Culvert n=0.012 L=25.0' S=0.0060 '/' Outflow=7.43 cfs 0.860 af

Pond 13P: DA5 Pipe Peak Elev=26.73' Inflow=18.81 cfs 1.910 af
12.0" Round Culvert n=0.012 L=35.0' S=0.0097 '/' Outflow=18.81 cfs 1.910 af

Pond 14P: DA3 Pipe Peak Elev=3.53' Inflow=4.68 cfs 0.623 af
12.0" Round Culvert n=0.012 L=41.0' S=0.0176 '/' Outflow=4.68 cfs 0.623 af

Pond 15P: DA6 Pipe Peak Elev=2.88' Inflow=3.54 cfs 0.362 af
12.0" Round Culvert n=0.012 L=37.0' S=0.0208 '/' Outflow=3.54 cfs 0.362 af

Pond 16P: DA2 Pipe Peak Elev=4.23' Inflow=29.60 cfs 3.531 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=82.0' S=0.0078 '/' Outflow=29.60 cfs 3.531 af

Pond 17P: DA1 Pipe Peak Elev=28.78' Inflow=102.65 cfs 12.722 af
34.0" x 22.0", R=24.9" Elliptical Culvert n=0.012 L=74.0' S=0.0219 '/' Outflow=102.65 cfs 12.722 af

Pond 18P: DA East Chew Pipe Peak Elev=37.51' Inflow=50.71 cfs 6.285 af
18.0" Round Culvert n=0.012 L=55.0' S=0.0071 '/' Outflow=50.71 cfs 6.285 af

Link 10L: Harbor
Primary=0.00 cfs 0.000 af

Total Runoff Area = 52.047 ac Runoff Volume = 26.294 af Average Runoff Depth = 6.06"
38.19% Pervious = 19.877 ac 61.81% Impervious = 32.170 ac

Summary for Subcatchment 1S: DA1

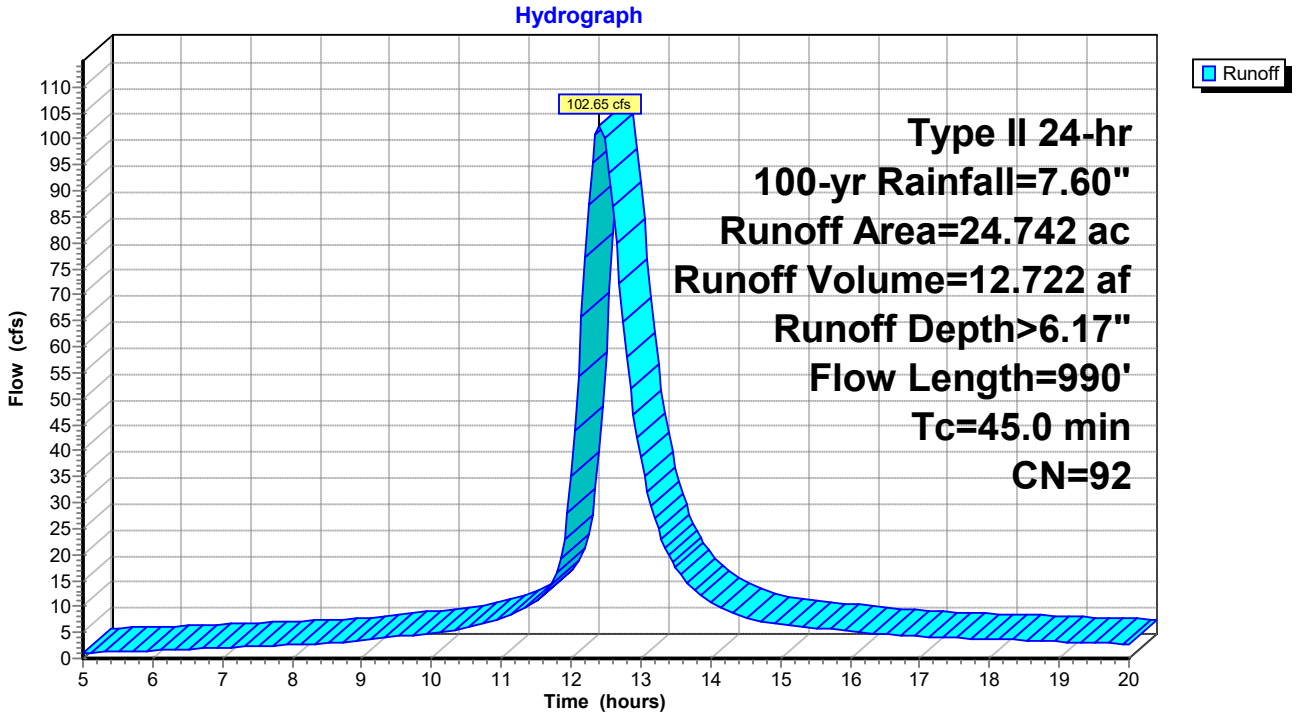
Runoff = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af, Depth> 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
1.000	85	1/2 acre lots, 25% imp, HSG D
0.900	86	1/3 acre lots, 30% imp, HSG D
8.140	87	1/4 acre lots, 38% imp, HSG D
2.002	92	1/8 acre lots, 65% imp, HSG D
8.000	95	Urban commercial, 85% imp, HSG D
4.600	98	Paved parking, HSG D
0.100	80	>75% Grass cover, Good, HSG D
24.742	92	Weighted Average
8.428		34.06% Pervious Area
16.314		65.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 1S: DA1



Summary for Subcatchment 4S: DA2

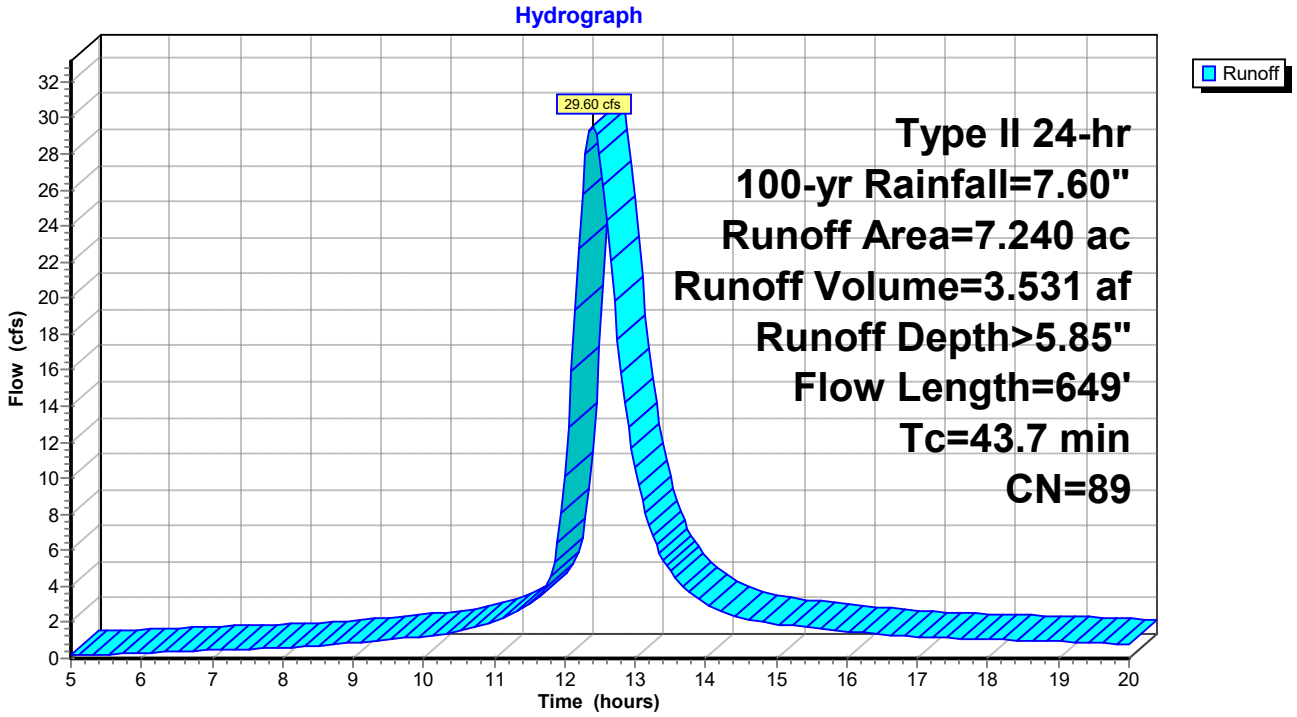
Runoff = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af, Depth> 5.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.200	80	1/2 acre lots, 25% imp, HSG C
0.240	85	1/2 acre lots, 25% imp, HSG D
0.720	81	1/3 acre lots, 30% imp, HSG C
2.320	86	1/3 acre lots, 30% imp, HSG D
0.210	83	1/4 acre lots, 38% imp, HSG C
1.630	87	1/4 acre lots, 38% imp, HSG D
1.920	98	Paved parking, HSG D
7.240	89	Weighted Average
3.599		49.71% Pervious Area
3.641		50.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0080	7.45	30.70	**Pipe Channel, RCP_Elliptical 34x22** 34.0" x 22.0", R=24.9" Elliptical Area= 4.1 sf Perim= 7.5' r= 0.55' n= 0.012 Concrete pipe, finished
2.0	367	0.0012	3.14	15.39	**Pipe Channel, RCP_Round 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
43.7	649	Total			

Subcatchment 4S: DA2



Summary for Subcatchment 5S: DA3

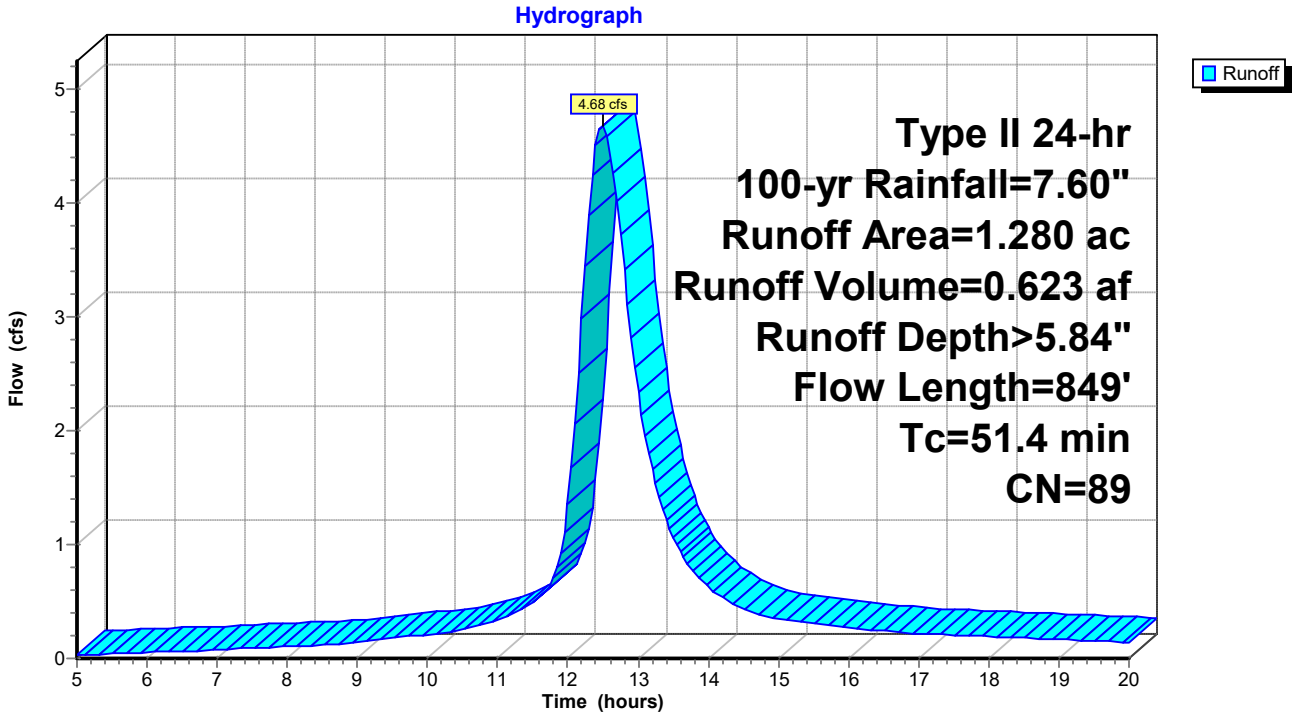
Runoff = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af, Depth> 5.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.110	81	1/3 acre lots, 30% imp, HSG C
0.170	86	1/3 acre lots, 30% imp, HSG D
0.430	83	1/4 acre lots, 38% imp, HSG C
0.080	87	1/4 acre lots, 38% imp, HSG D
0.490	98	Paved parking, HSG D
1.280	89	Weighted Average
0.512		40.02% Pervious Area
0.768		59.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	82	0.0078	7.98	32.34	**Pipe Channel, out** 34.0" x 22.0", R=23.0" Elliptical Area= 4.1 sf Perim= 7.4' r= 0.55' n= 0.011 Concrete pipe, straight & clean
6.8	367	0.0001	0.91	4.44	**Pipe Channel, 30"** 30.0" Round Area= 4.9 sf Perim= 7.9' r= 0.63' n= 0.012 Concrete pipe, finished
2.9	200	0.0010	1.15	5.73	**Channel Flow, ditch** Area= 5.0 sf Perim= 8.0' r= 0.63' n= 0.030 Earth, grassed & winding
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
51.4	849	Total			

Subcatchment 5S: DA3



Summary for Subcatchment 6S: DA4

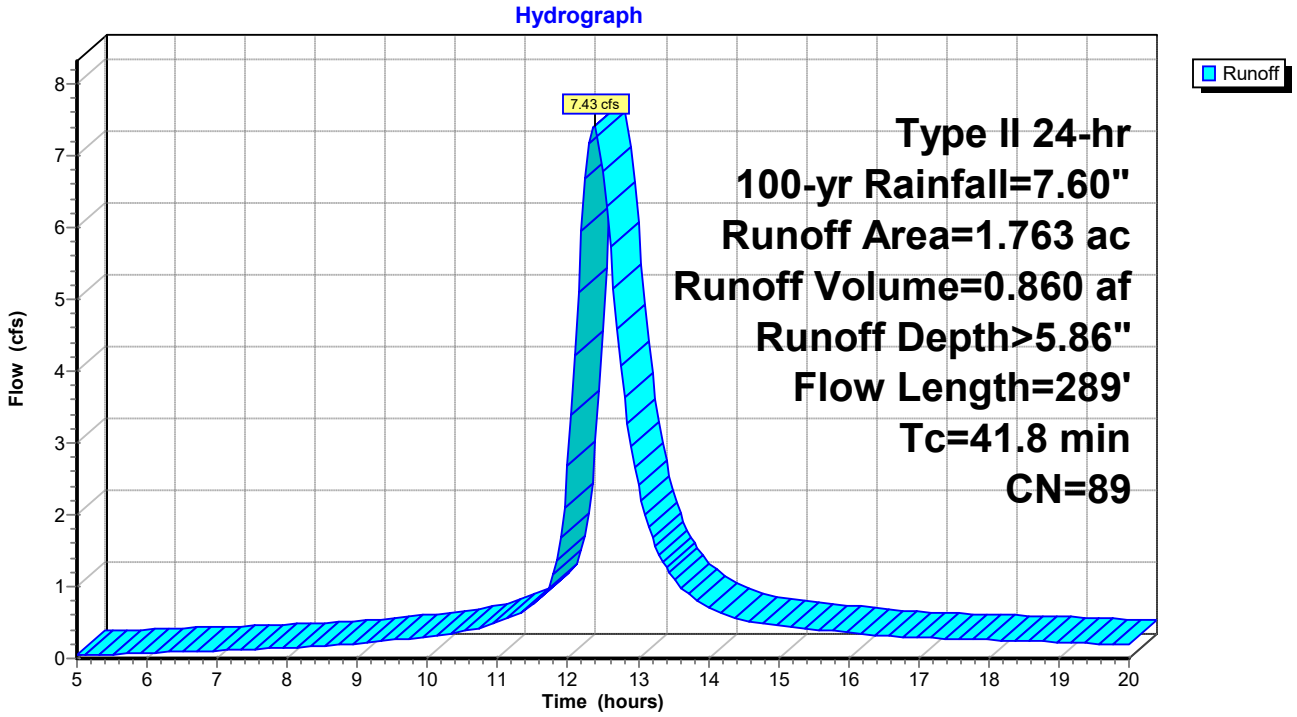
Runoff = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af, Depth> 5.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.040	81	1/3 acre lots, 30% imp, HSG C
0.440	86	1/3 acre lots, 30% imp, HSG D
0.160	83	1/4 acre lots, 38% imp, HSG C
0.423	87	1/4 acre lots, 38% imp, HSG D
0.350	92	1/8 acre lots, 65% imp, HSG D
0.350	98	Paved parking, HSG D
1.763	89	Weighted Average
0.820		46.51% Pervious Area
0.943		53.49% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	25	0.0060	3.81	2.99	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	31	0.0230	7.45	5.85	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
0.1	33	0.0160	6.22	4.88	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
41.8	289	Total			

Subcatchment 6S: DA4



Summary for Subcatchment 7S: DA5

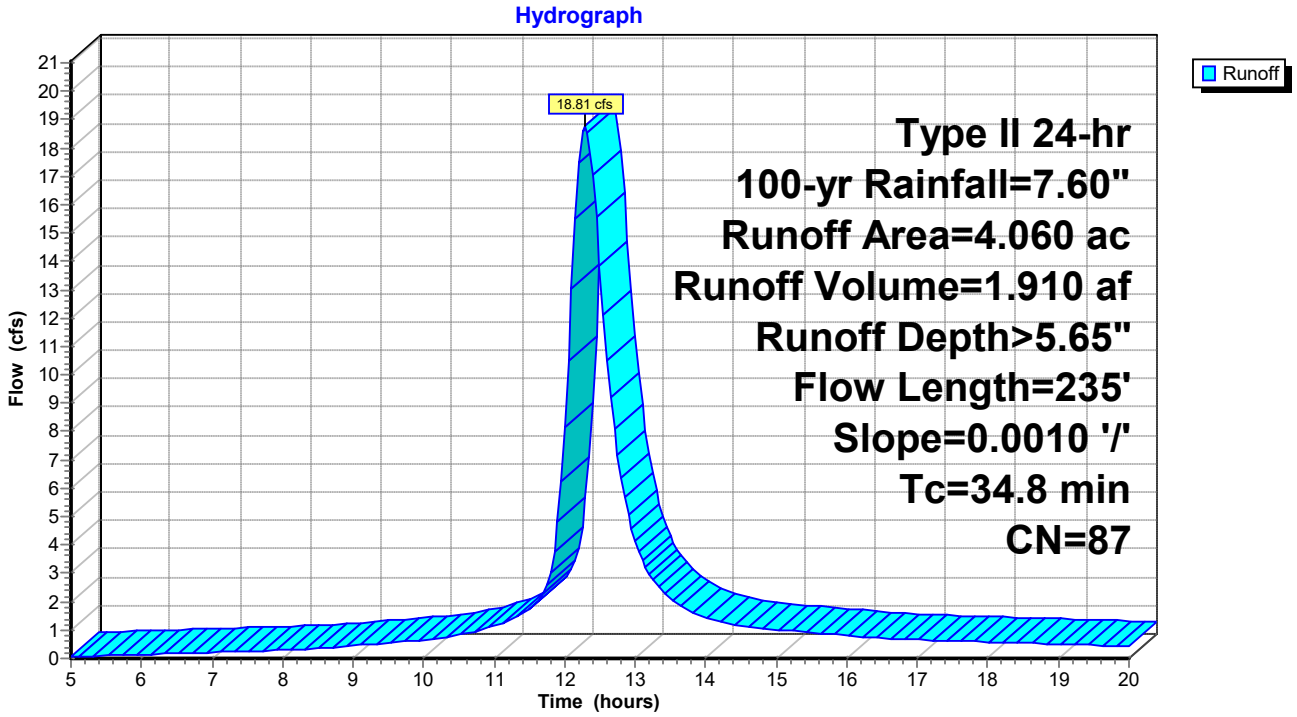
Runoff = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af, Depth> 5.65"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
1.100	79	1 acre lots, 20% imp, HSG C
0.030	80	1/2 acre lots, 25% imp, HSG C
0.180	85	1/2 acre lots, 25% imp, HSG D
0.040	86	1/3 acre lots, 30% imp, HSG D
0.560	83	1/4 acre lots, 38% imp, HSG C
0.930	87	1/4 acre lots, 38% imp, HSG D
0.120	92	1/8 acre lots, 65% imp, HSG D
1.100	98	Paved parking, HSG D
4.060	87	Weighted Average
2.031		50.03% Pervious Area
2.029		49.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.4	35	0.0010	1.55	1.22	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.8	235	Total			

Subcatchment 7S: DA5



Summary for Subcatchment 8S: DA6

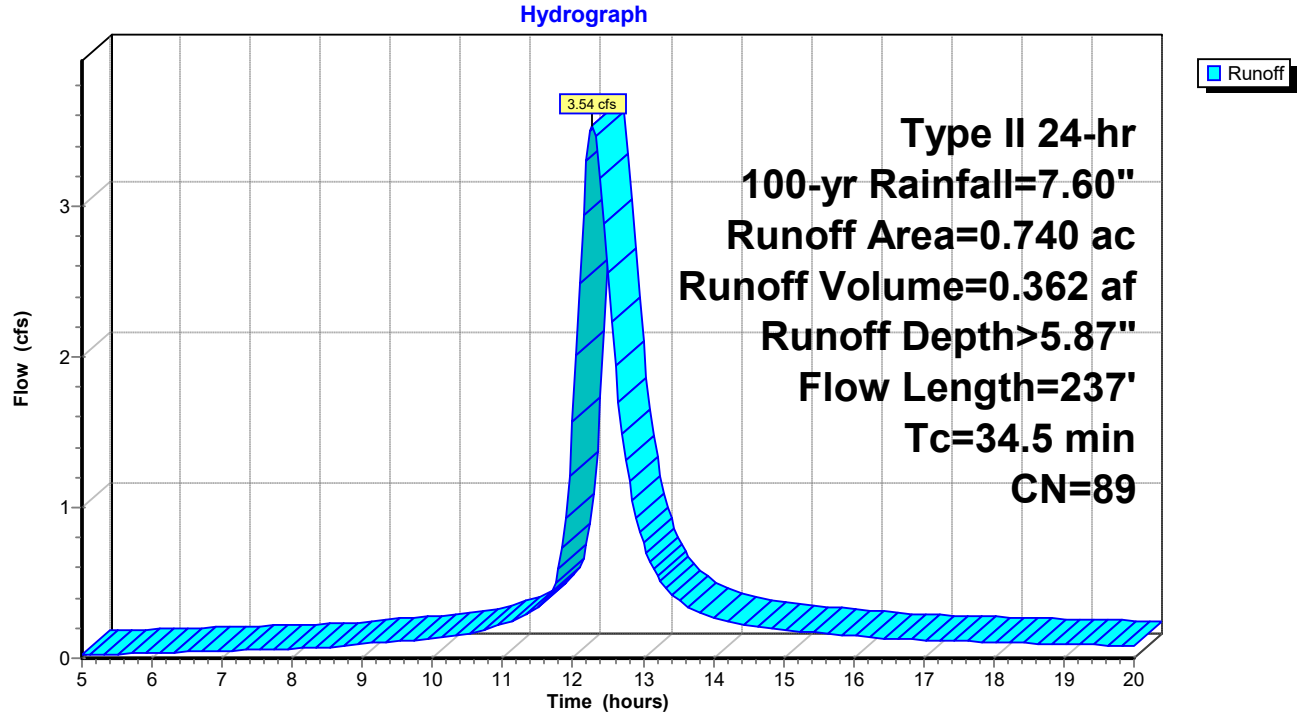
Runoff = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af, Depth> 5.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.370	79	1 acre lots, 20% imp, HSG C
0.370	98	Paved parking, HSG D
0.740	89	Weighted Average
0.296		40.00% Pervious Area
0.444		60.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.1	37	0.0200	6.95	5.46	**Pipe Channel, RCP_Round 12"** 12.0" Round Area= 0.8 sf Perim= 3.1' r= 0.25' n= 0.012 Concrete pipe, finished
3.3	100	0.0010	0.51		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
34.5	237	Total			

Subcatchment 8S: DA6



Summary for Subcatchment 9S: East Chew

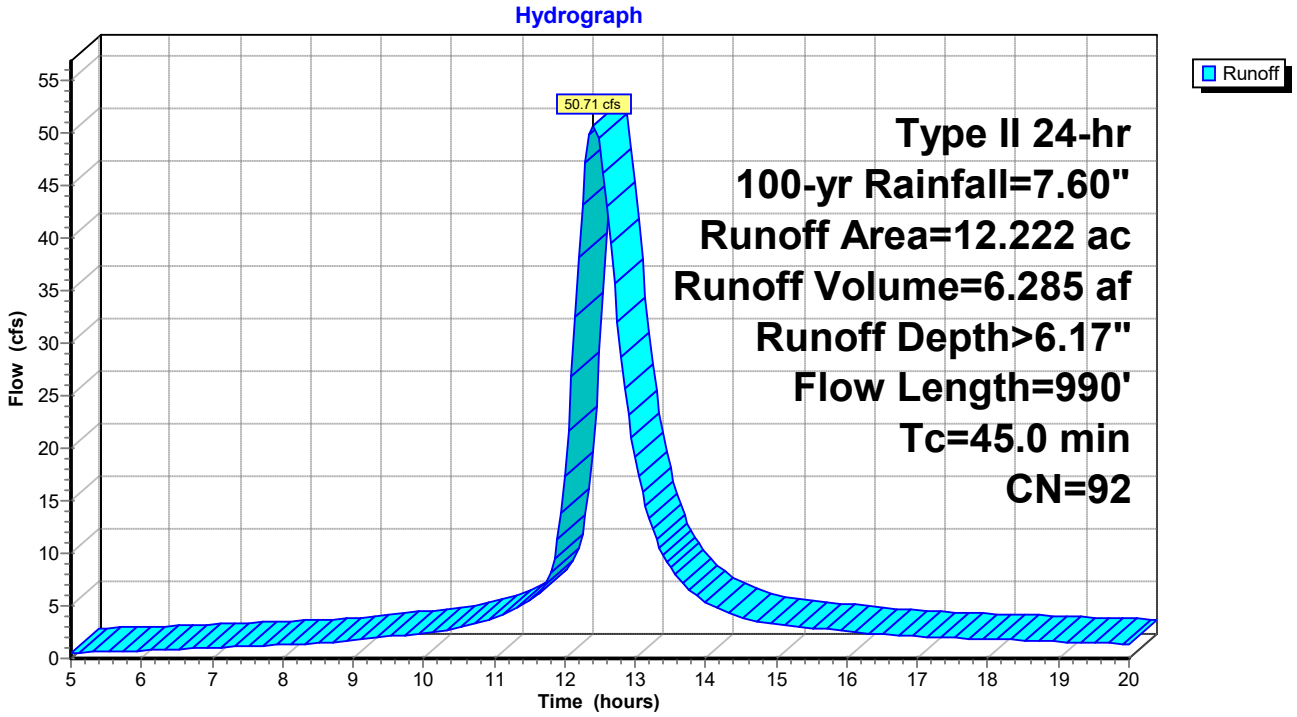
Runoff = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af, Depth> 6.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=7.60"

Area (ac)	CN	Description
0.500	85	1/2 acre lots, 25% imp, HSG D
0.450	86	1/3 acre lots, 30% imp, HSG D
4.070	87	1/4 acre lots, 38% imp, HSG D
1.002	92	1/8 acre lots, 65% imp, HSG D
3.850	95	Urban commercial, 85% imp, HSG D
2.300	98	Paved parking, HSG D
0.050	80	>75% Grass cover, Good, HSG D
12.222	92	Weighted Average
4.192		34.30% Pervious Area
8.030		65.70% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.2	55	0.0071	5.43	9.59	**Pipe Channel,** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.012 Concrete pipe, finished
1.0	235	0.0050	4.03	4.95	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
2.3	500	0.0040	3.61	4.43	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.012 Concrete pipe, finished
10.4	100	0.0001	0.16		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
31.1	100	0.0010	0.05		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
45.0	990	Total			

Subcatchment 9S: East Chew



Summary for Pond 12P: DA4 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 5.86' (Flood elevation advised)

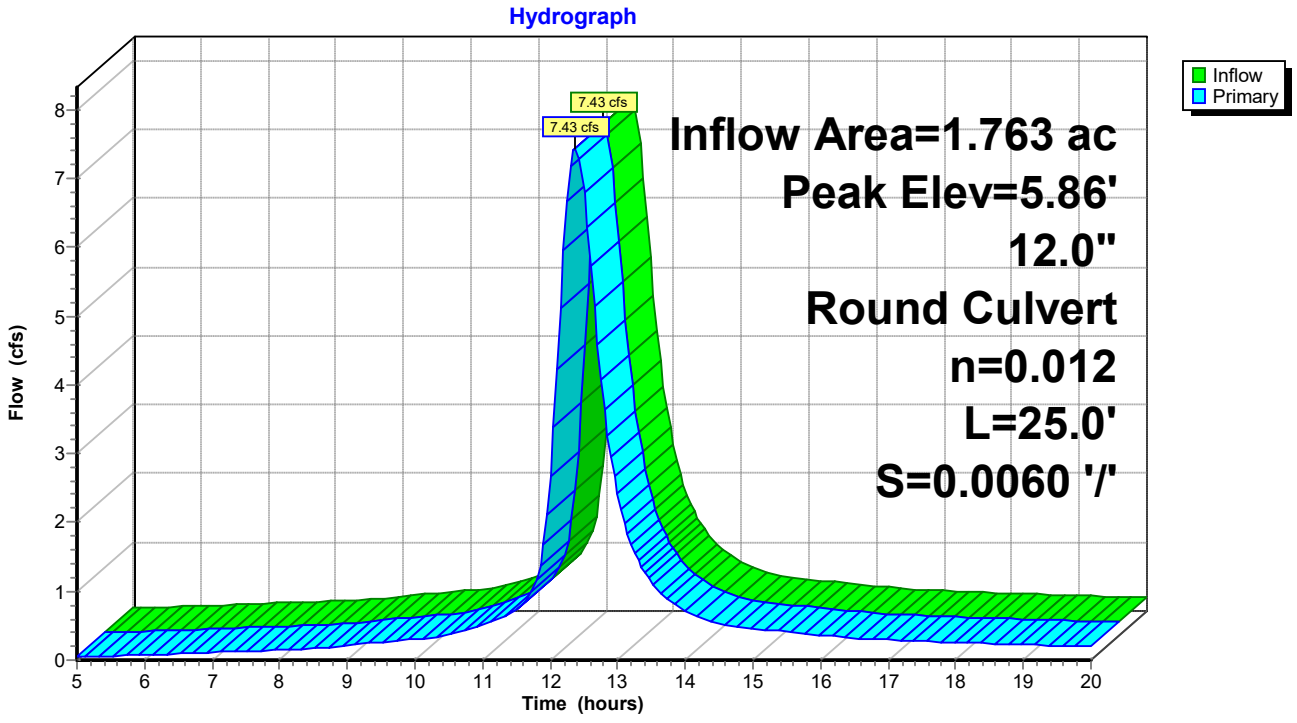
Inflow Area = 1.763 ac, 53.49% Impervious, Inflow Depth > 5.86" for 100-yr event
Inflow = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af
Outflow = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af, Atten= 0%, Lag= 0.0 min
Primary = 7.43 cfs @ 12.37 hrs, Volume= 0.860 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 5.86' @ 12.37 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.05'	**12.0" Round Culvert** L= 25.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.05' / -0.20' S= 0.0060 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=7.40 cfs @ 12.37 hrs HW=5.83' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=Culvert** (Inlet Controls 7.40 cfs @ 9.43 fps)

Pond 12P: DA4 Pipe



Summary for Pond 13P: DA5 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 24.73' above defined flood level

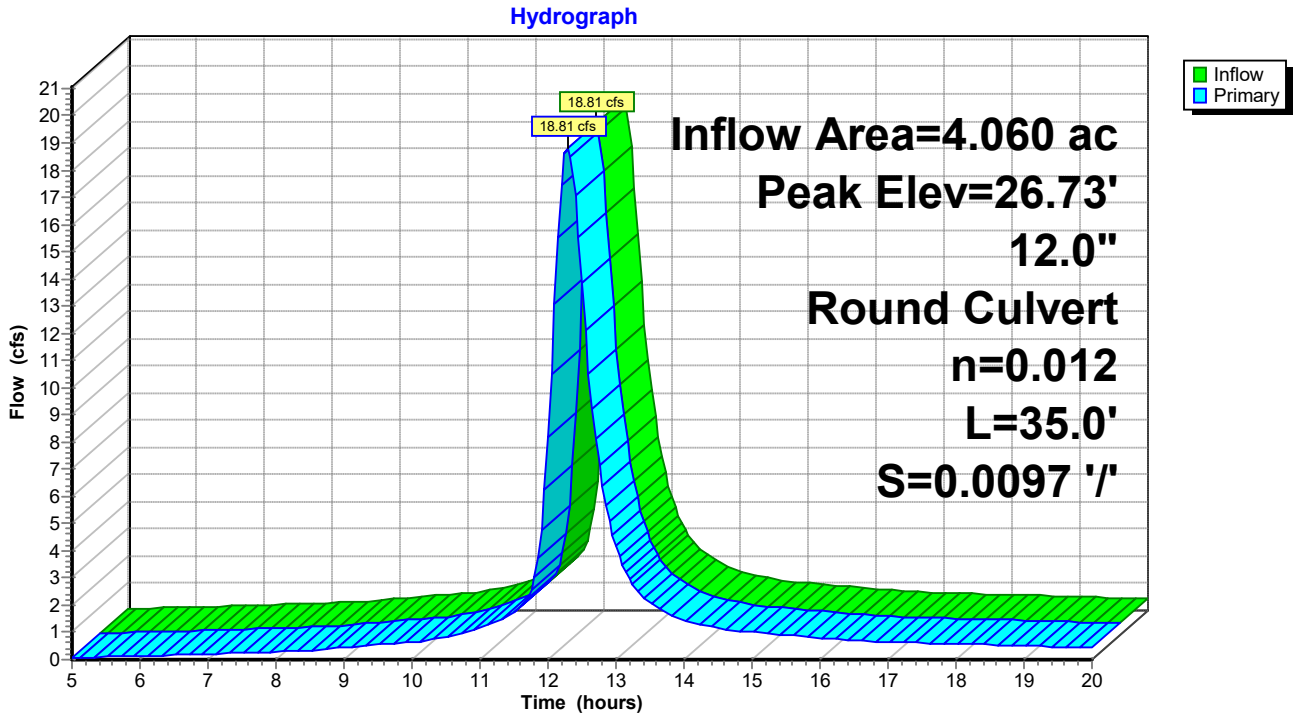
Inflow Area = 4.060 ac, 49.97% Impervious, Inflow Depth > 5.65" for 100-yr event
Inflow = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af
Outflow = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af, Atten= 0%, Lag= 0.0 min
Primary = 18.81 cfs @ 12.29 hrs, Volume= 1.910 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 26.73' @ 12.29 hrs
Flood Elev= 2.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.05'	**12.0" Round CMP_Round 12"** L= 35.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.05' / -0.29' S= 0.0097 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=18.74 cfs @ 12.29 hrs HW=26.55' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=CMP_Round 12"** (Inlet Controls 18.74 cfs @ 23.86 fps)

Pond 13P: DA5 Pipe



Summary for Pond 14P: DA3 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 3.53' (Flood elevation advised)

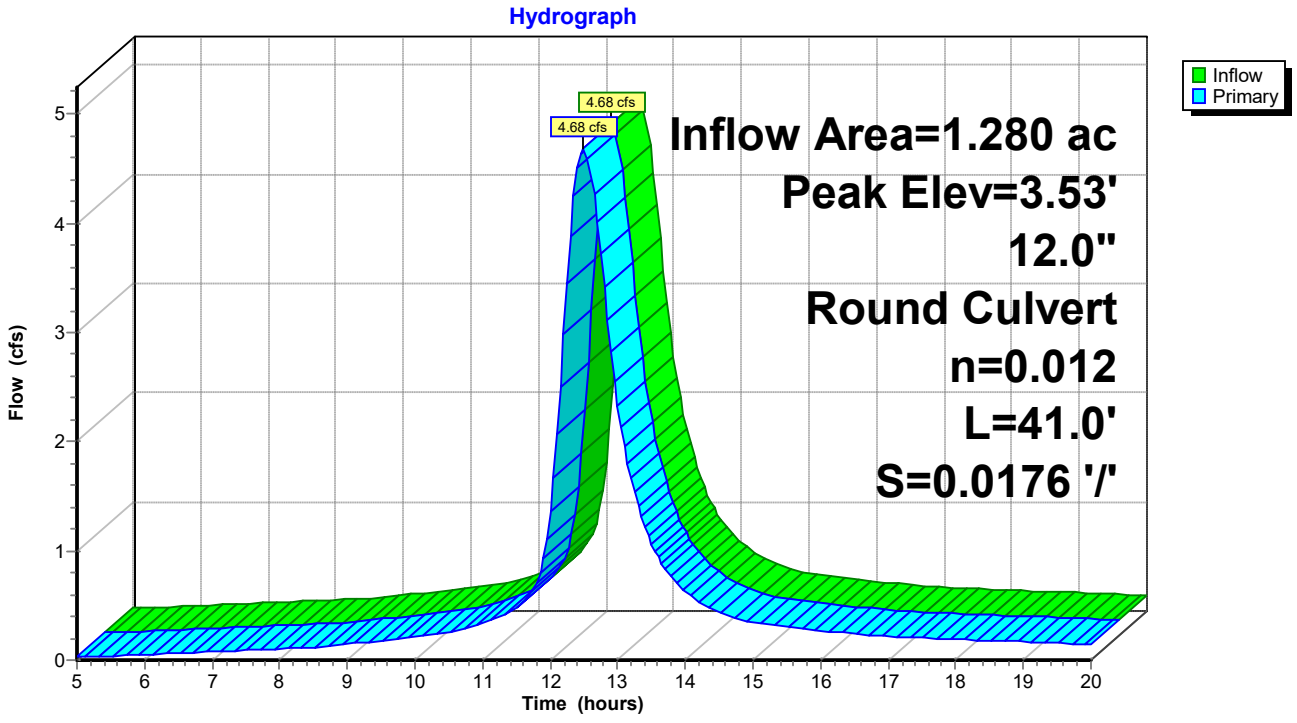
Inflow Area = 1.280 ac, 59.98% Impervious, Inflow Depth > 5.84" for 100-yr event
Inflow = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af
Outflow = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af, Atten= 0%, Lag= 0.0 min
Primary = 4.68 cfs @ 12.49 hrs, Volume= 0.623 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 3.53' @ 12.49 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.16'	**12.0" Round Culvert** L= 41.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.16' / -0.56' S= 0.0176 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=4.67 cfs @ 12.49 hrs HW=3.53' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=Culvert** (Inlet Controls 4.67 cfs @ 5.95 fps)

Pond 14P: DA3 Pipe



Summary for Pond 15P: DA6 Pipe

[82] Warning: Early inflow requires earlier time span
[58] Hint: Peaked 3.88' above defined flood level

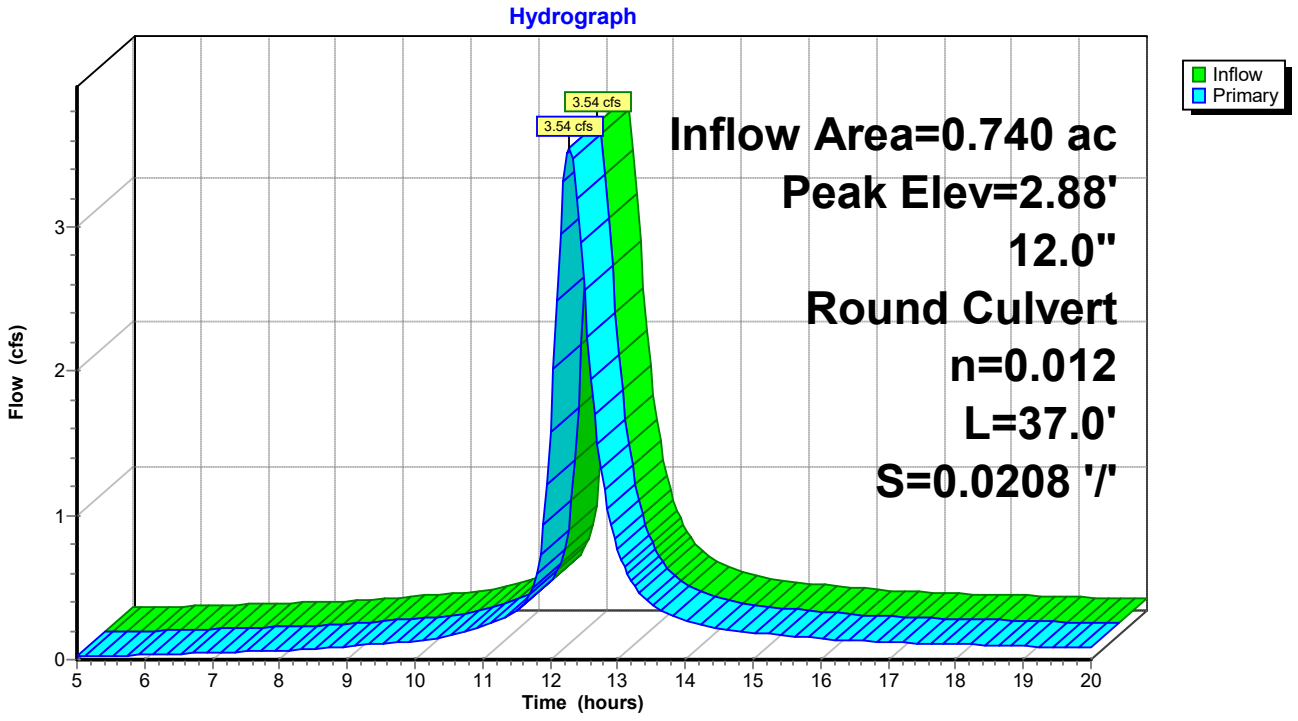
Inflow Area = 0.740 ac, 60.00% Impervious, Inflow Depth > 5.87" for 100-yr event
Inflow = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af
Outflow = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af, Atten= 0%, Lag= 0.0 min
Primary = 3.54 cfs @ 12.28 hrs, Volume= 0.362 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 2.88' @ 12.28 hrs
Flood Elev= -1.00'

Device	Routing	Invert	Outlet Devices
#1	Primary	0.42'	**12.0" Round CMP_Round 12"** L= 37.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.42' / -0.35' S= 0.0208 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 0.79 sf

Primary OutFlow Max=3.53 cfs @ 12.28 hrs HW=2.87' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=CMP_Round 12"** (Inlet Controls 3.53 cfs @ 4.49 fps)

Pond 15P: DA6 Pipe



Summary for Pond 16P: DA2 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 4.23' (Flood elevation advised)

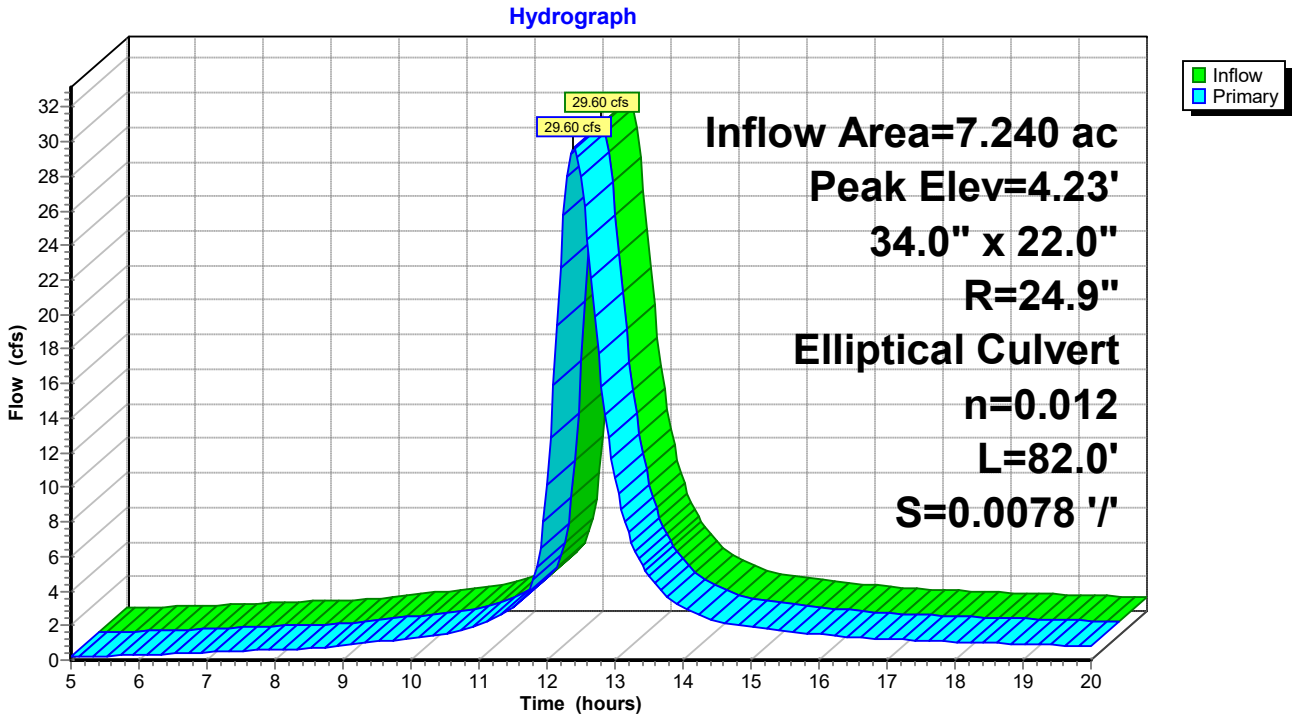
Inflow Area = 7.240 ac, 50.29% Impervious, Inflow Depth > 5.85" for 100-yr event
Inflow = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af
Outflow = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af, Atten= 0%, Lag= 0.0 min
Primary = 29.60 cfs @ 12.40 hrs, Volume= 3.531 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 4.23' @ 12.40 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.36'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 82.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.36' / -1.00' S= 0.0078 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=29.56 cfs @ 12.40 hrs HW=4.22' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 29.56 cfs @ 7.18 fps)

Pond 16P: DA2 Pipe



Summary for Pond 17P: DA1 Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 28.78' (Flood elevation advised)

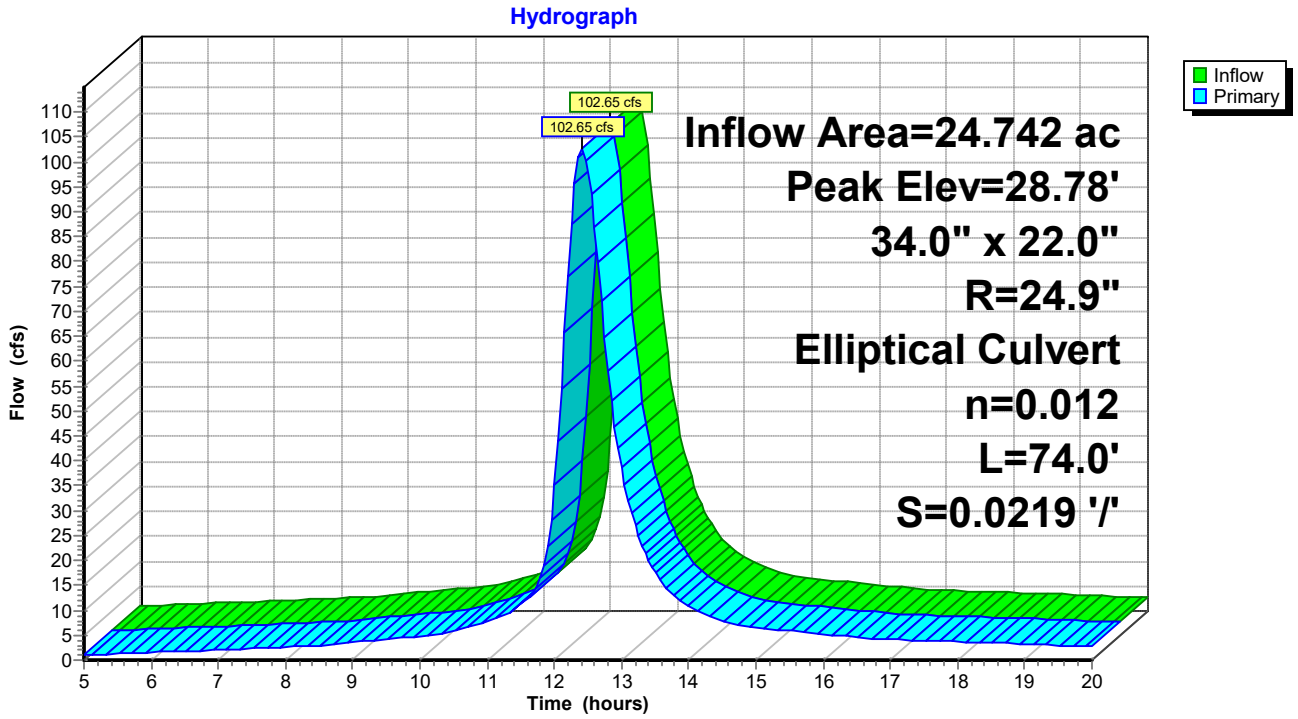
Inflow Area = 24.742 ac, 65.94% Impervious, Inflow Depth > 6.17" for 100-yr event
Inflow = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af
Outflow = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af, Atten= 0%, Lag= 0.0 min
Primary = 102.65 cfs @ 12.41 hrs, Volume= 12.722 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 28.78' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	0.27'	**34.0" W x 22.0" H, R=24.9" Elliptical RCP_Elliptical 34x22** L= 74.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= 0.27' / -1.35' S= 0.0219 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 4.12 sf

Primary OutFlow Max=102.44 cfs @ 12.41 hrs HW=28.68' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=RCP_Elliptical 34x22** (Inlet Controls 102.44 cfs @ 24.87 fps)

Pond 17P: DA1 Pipe



Summary for Pond 18P: DA East Chew Pipe

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 37.51' (Flood elevation advised)

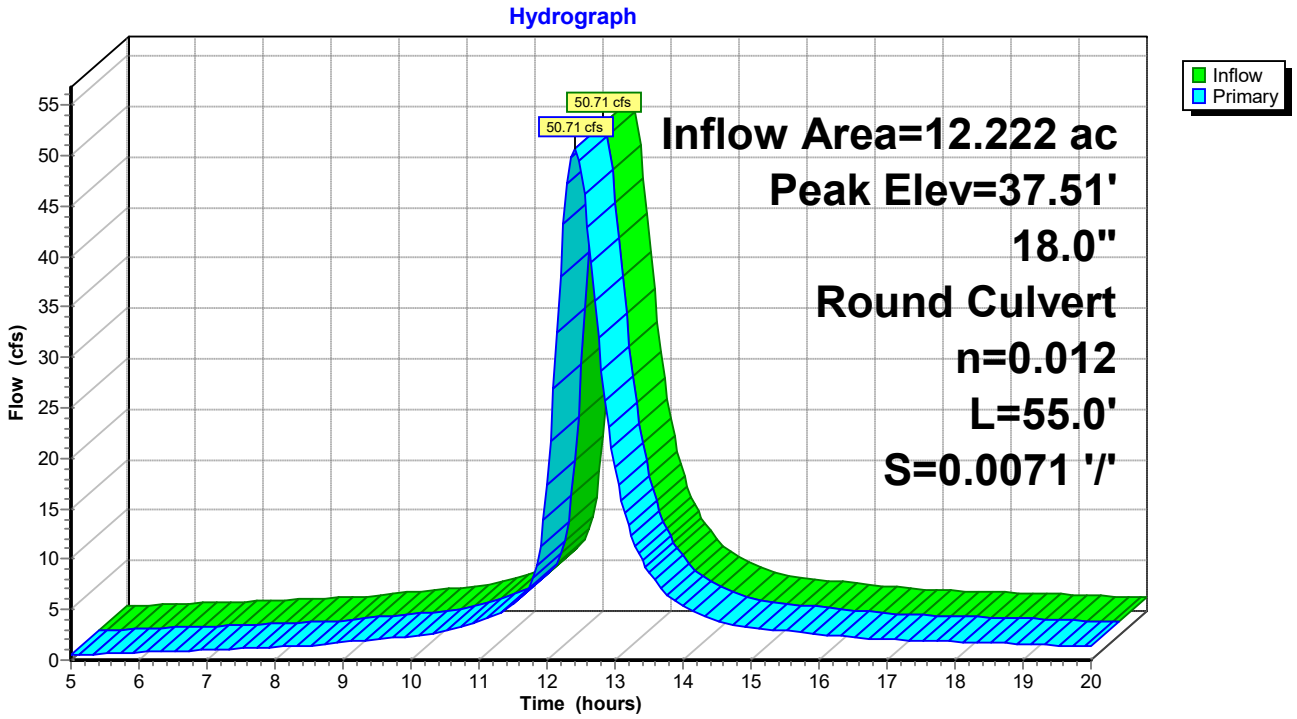
Inflow Area = 12.222 ac, 65.70% Impervious, Inflow Depth > 6.17" for 100-yr event
Inflow = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af
Outflow = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af, Atten= 0%, Lag= 0.0 min
Primary = 50.71 cfs @ 12.41 hrs, Volume= 6.285 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 37.51' @ 12.41 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	-0.06'	**18.0" Round Culvert** L= 55.0' Box, headwall w/3 square edges, Ke= 0.500 Inlet / Outlet Invert= -0.06' / -0.45' S= 0.0071 '/' Cc= 0.900 n= 0.012 Concrete pipe, finished, Flow Area= 1.77 sf

Primary OutFlow Max=50.61 cfs @ 12.41 hrs HW=37.37' TW=2.00' (Fixed TW Elev= 2.00')
↑—**1=Culvert** (Inlet Controls 50.61 cfs @ 28.64 fps)

Pond 18P: DA East Chew Pipe



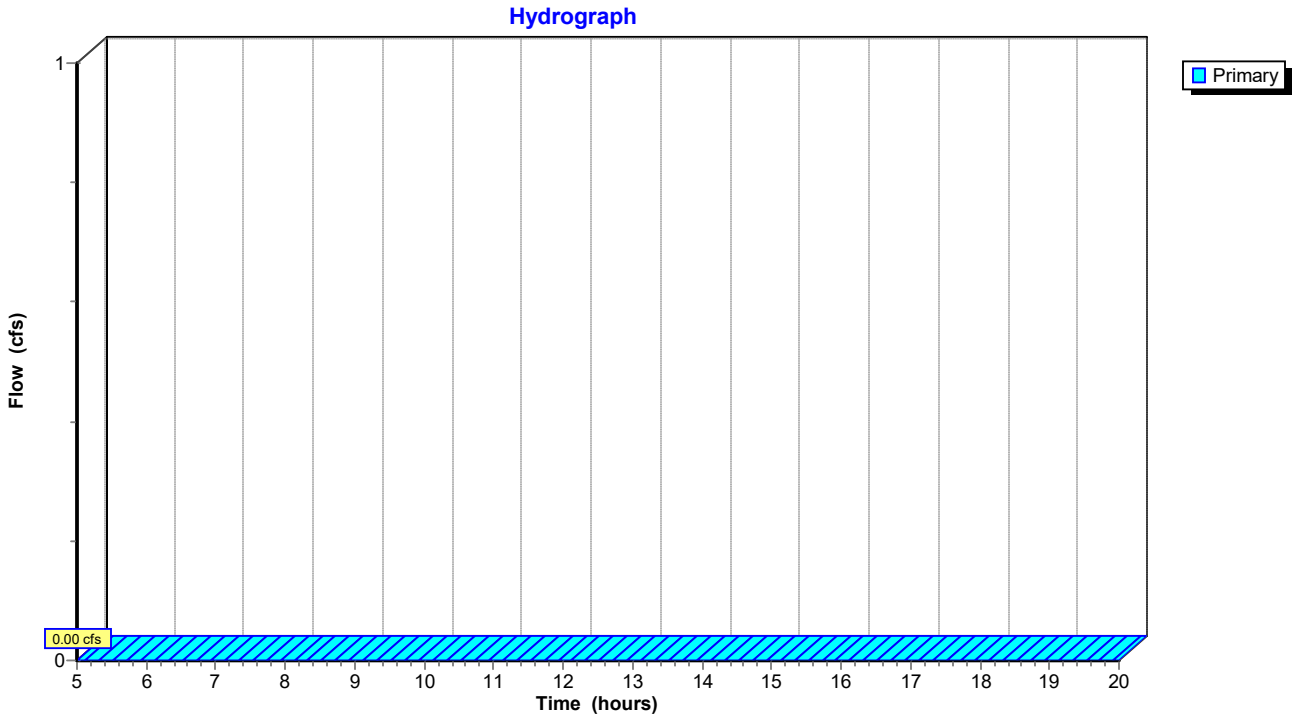
Summary for Link 10L: Harbor

[43] Hint: Has no inflow (Outflow=Zero)

Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Primary outflow = Inflow, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

Link 10L: Harbor



SQUARE FOOT OF AREA

EXISTING CONDITIONS	
IMPERVIOUS AREA	31530SF
TOTAL AREA	32115SF
% IMPERVIOUS	98%
PROPOSED CONDITIONS	
PARKING	21180SF
WALKWAY	3383SF
RAIN GARDEN	890SF
GREEN SPACE	6662SF
% IMPERVIOUS	65%

LEGEND

- 5' PROPOSED WALKWAY
- 20'X9' PARKING SPACE
- 18'X9' PARKING SPACE
- GREEN SPACE
- PUMP VAULT
- NEW PILING
- RAIN GARDEN
- PARK AREA

SECTION A
SCALE: NTS

SECTION B
SCALE: NTS

SECTION C
SCALE: NTS

SECTION D
SCALE: NTS

PLOT CODE
PEN1-RED .007 INCHES (1.4mm)
PEN2-YELLOW .007 INCHES (1.4mm)
PEN3-GREEN .010 INCHES (2.5mm)
PEN4-CYAN .014 INCHES (3.6mm)
PEN5-BLUE .020 INCHES (5.0mm)
PEN6-MAGENTA .027 INCHES (7.0mm)
PEN7-WHITE .039 INCHES (10.0mm)

GENERAL NOTES

1. NEW BULKHEAD TO BE CONSTRUCTED IN SAME LOCATION AS EXISTING, AND RAISED WITH TOP ELEVATION AT 5.0'.
2. 5' WIDE BOARDWALK/PEDESTRIAN PROMENADE TO BE CONSTRUCTED IN CONJUNCTION WITH NEW BULKHEAD THAT WILL BE RAISED TO ELEVATION 5'.
3. SLIP LAYOUT TO REMAIN AS-IS. FINGER PIERS TO BE REBUILT IN SAME LOCATION AT TOP ELEVATION 3.8'
4. SMALL BOAT RAMP TO BE CLOSED WITH BULKHEAD ACROSS, AS SHOWN, GREEN SPACE TO BE PROVIDED IN ITS PLACE BEHIND BULKHEAD
5. LARGE BOAT RAMP TO BE RECONSTRUCTED SO TOP ELEVATION OF RAMP IS 5.0'. 2 TRAILER SPACES TO REMAIN ON AREA NORTH OF BOAT RAMP.
6. PARKING TO BE REVISED AS SHOWN, 42 SPACED PROPOSED
7. PROPOSED KAYAK LAUNCH TO BE PLACED AT HEAD OF HARBOR ALONG EAST CHEW AVE.
8. ALL WATERMEN TO BE DOCKED TOGETHER ALONG NORTHERN END OF WEST HARBOR ROAD,
9. TWO RAIN GARDENS ARE PROPOSED TO MEET REQUIREMENTS OF CRITICAL AREA REDEVELOPMENT AND NUTRIENT REDUCTION REQUIREMENTS.
10. GREEN SPACE/PLANTING AREAS SHOWN FOR SOFTENING OF CURRENT GREY-SCAPE AND BEAUTIFICATION OF AREA.
11. NEW PUMP VAULT BOXES SHALL BE CONSTRUCTED OVER EXISTING STORM WATER OUTFALL PIPES. 8'X8' BOXES WITH ACCESS HATCH AT GRADE WITH SMALL DIAMETER DISCHARGE PIPING ARE SHOWN. PUMPS WILL BE SIZED FOR EACH DISCHARGE TO DRAW DOWN RUNOFF QUICKER.
12. TIDE GATES/BACKFLOW PREVENTERS TO BE INSTALLED ON EACH OF THE 7 CULVERTS DISCHARGING INTO THE HARBOR.
13. A PARK APPROXIMATELY 3285SF (SCALE, FINISH IMPROVEMENTS TO BE DETERMINED) PROVIDED ALONG EAST CHEW AVE.
14. LOW-LEVEL BOLLARD-STYLE LIGHTING SHOWN FOR PROPOSED WALKWAY TO SOFTEN LIGHT POLLUTION AND BRIGHTNESS OF EXISTING LIGHTING FOR RESIDENTS IN VICINITY.
15. OPTION TO BURY EXISTING OVERHEAD ELECTRIC SERVICES IS BEING INVESTIGATED.
16. PROVIDE WING WALL TO TIE ELEVATION 5..0' FROM NEW BULKHEAD TO NEW TOP OF BOAT RAMP
17. REGRADE AREA TO TRAILER PARKING BY THE INN TO ENSURE TOP ELEVATION 5.0'. COORDINATE WITH INN TO ENSURE PROPER DRAINAGE, TIE-IN CONDITIONS, AND BULKHEAD IMPROVEMENTS ON THEIR PROPERTY TO AVOID UNINTENDED CONSEQUENCES AND UNNECESSARY HOLDING OF RUNOFF.
18. NEW PILES TO BE INSTALLED WITH A CAP ADDED. ELEVATION TO BE DETERMINED.

PRINTS ISSUED FOR: REVIEW

NO.	REVISIONS	DATE

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WEST HARBOR AND EAST CHEW FEASIBILITY

ST. MICHAELS, MARYLAND

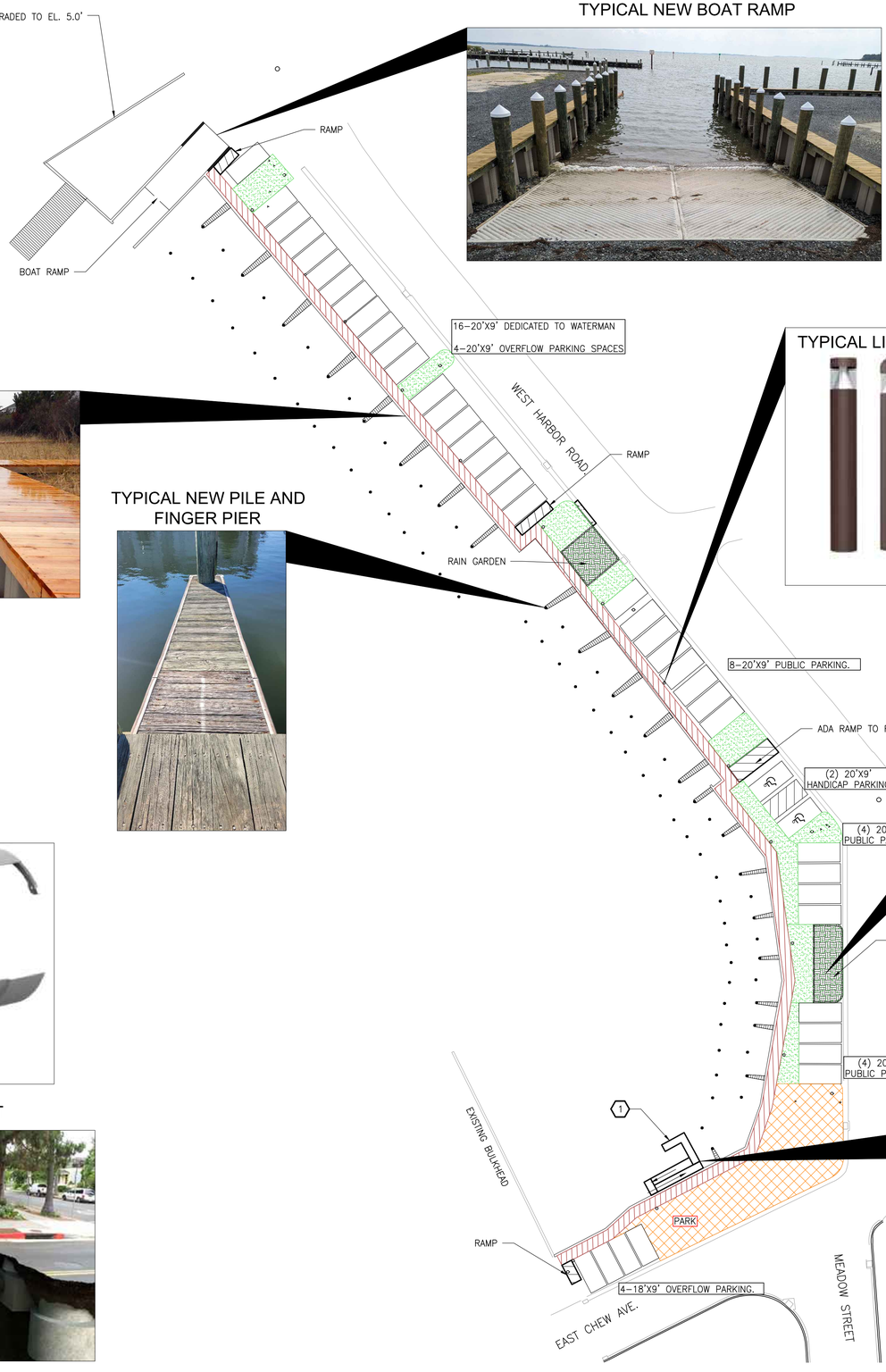
PROPOSED IMPROVEMENTS

SCALE	: AS NOTED
DESIGN BY	: BRJ
DRAWN BY	: CMB
CHECKED BY	:
GMB FILE	: 220279
DATE	: JUN. 2023

SHEET NO.
C1.1

LEGEND

- 5' PROPOSED WALKWAY ABOVE BULKHEAD
- 20'X9' PARKING SPACE
- 18'X9' PARKING SPACE
- GREEN SPACE
- PUMP VAULT
- NEW PILING
- KAYAK BOAT LAUNCH
- RAIN GARDEN
- PARK AREA



TYPICAL NEW BOAT RAMP

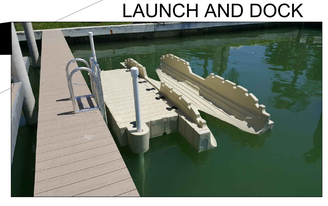
TYPICAL NEW WALKWAY ABOVE NEW BULKHEAD

TYPICAL NEW PILE AND FINGER PIER

TYPICAL LIGHT BOLLARD

TYPICAL RAIN GARDEN

EXAMPLE OF KAYAK LAUNCH AND DOCK



RECOMMENDED FLOOD GATE PROTECTION ON ALL STORM DRAIN LINES

TYPICAL PUMP VAULT LAYOUT

GENERAL NOTES

1. NEW BULKHEAD TO BE CONSTRUCTED IN SAME LOCATION AS EXISTING, AND RAISED WITH TOP ELEVATION AT 5.0'.
2. 5' WIDE BOARDWALK/PEDESTRIAN PROMENADE TO BE CONSTRUCTED IN CONJUNCTION WITH NEW BULKHEAD THAT WILL BE RAISED TO ELEVATION 5'.
3. SLIP LAYOUT TO REMAIN AS-IS. FINGER PIERS TO BE REBUILT IN SAME LOCATION AT TOP ELEVATION 3.8'
4. SMALL BOAT RAMP TO BE CLOSED WITH BULKHEAD ACROSS, AS SHOWN, GREEN SPACE TO BE PROVIDED IN ITS PLACE BEHIND BULKHEAD
5. LARGE BOAT RAMP TO BE RECONSTRUCTED SO TOP ELEVATION OF RAMP IS 5.0'. 2 TRAILER SPACES TO REMAIN ON AREA NORTH OF BOAT RAMP.
6. PARKING TO BE REVISED AS SHOWN, 42 SPACED PROPOSED
7. PROPOSED KAYAK LAUNCH TO BE PLACED AT HEAD OF HARBOR ALONG EAST CHEW AVE.
8. ALL WATERMEN TO BE DOCKED TOGETHER ALONG NORTHERN END OF WEST HARBOR ROAD,
9. TWO RAIN GARDENS ARE PROPOSED TO MEET REQUIREMENTS OF CRITICAL AREA REDEVELOPMENT AND NUTRIENT REDUCTION REQUIREMENTS.
10. GREEN SPACE/PLANTING AREAS SHOWN FOR SOFTENING OF CURRENT GREY-SCAPE AND BEAUTIFICATION OF AREA.
11. NEW PUMP VAULT BOXES SHALL BE CONSTRUCTED OVER EXISTING STORM WATER OUTFALL PIPES. 8'X8' BOXES WITH ACCESS HATCH AT GRADE WITH SMALL DIAMETER DISCHARGE PIPING. PUMPS WILL BE SIZED FOR EACH DISCHARGE TO DRAW DOWN RUNOFF QUICKER.
12. TIDE GATES/BACKFLOW PREVENTERS TO BE INSTALLED ON EACH OF THE 7 CULVERTS DISCHARGING INTO THE HARBOR.
13. A PARK APPROXIMATELY 3285SF (SCALE, FINISH IMPROVEMENTS TO BE DETERMINED) PROVIDED ALONG EAST CHEW AVE.
14. LOW-LEVEL BOLLARD-STYLE LIGHTING SHOWN FOR PROPOSED WALKWAY TO SOFTEN LIGHT POLLUTION AND BRIGHTNESS OF EXISTING LIGHTING FOR RESIDENTS IN VICINITY.
15. OPTION TO BURY EXISTING OVERHEAD ELECTRIC SERVICES IS BEING INVESTIGATED.
16. PROVIDE WING WALL TO TIE ELEVATION 5..0' FROM NEW BULKHEAD TO NEW TOP OF BOAT RAMP
17. REGRADE AREA TO TRAILER PARKING BY THE INN TO ENSURE TOP ELEVATION 5.0'. COORDINATE WITH INN TO ENSURE PROPER DRAINAGE, TIE-IN CONDITIONS, AND BULKHEAD IMPROVEMENTS ON THEIR PROPERTY TO AVOID UNINTENDED CONSEQUENCES AND UNNECESSARY HOLDING OF RUNOFF.

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WEST HARBOR AND EAST CHEW FEASIBILITY

ST. MICHAELS, MARYLAND

PROPOSED SITE

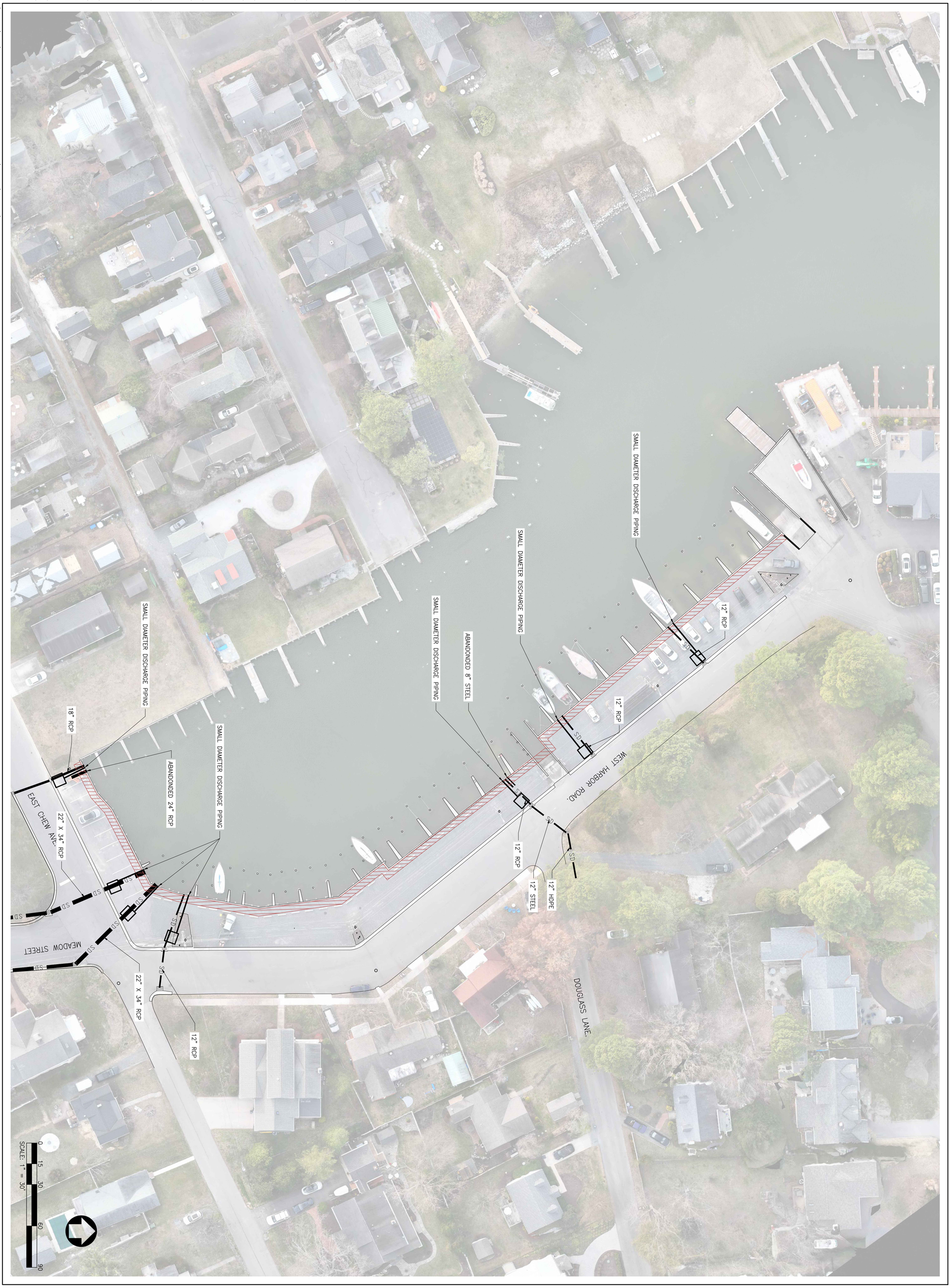
SCALE	: AS NOTED
DESIGN BY	: BRJ
DRAWN BY	: CMB
CHECKED BY	:
GMB FILE	: 220279
DATE	: JUN. 2023

SHEET NO. C1.2

PLOT CODE
PEN1-RED 006 INCHES (.15mm)
PEN2-YELLOW 007 INCHES (.18mm)
PEN3-GREEN 010 INCHES (.25mm)
PEN4-CYAN 014 INCHES (.35mm)
PEN5-BLUE 020 INCHES (.50mm)
PEN6-MAGENTA 027 INCHES (.70mm)
PEN7-WHITE 039 INCHES (1.00mm)

H:\Projects\2022\220279 west harbor & east chew feasibility\Drawings\sheet set\C1.0 BULKHEAD OPTION B.dwg, 11/1/2023 2:10:32 PM, cBevenour, AutoCAD PDF (General Documentation).pc3

H:\Projects\2022\220279 west harbor & east chew feasibility\Drawings\sheet set\C1.0 BULKHEAD OPTION B.dwg Nov 01, 2023 - 2:10pm



PROPOSED STORMWATER

SHEET NO. C1.3

SCALE: AS NOTED
DESIGN BY: GMB
DRAWN BY: GMB
CHECKED BY: GMB
DWG FILE: 220279
DATE: JUN. 2023

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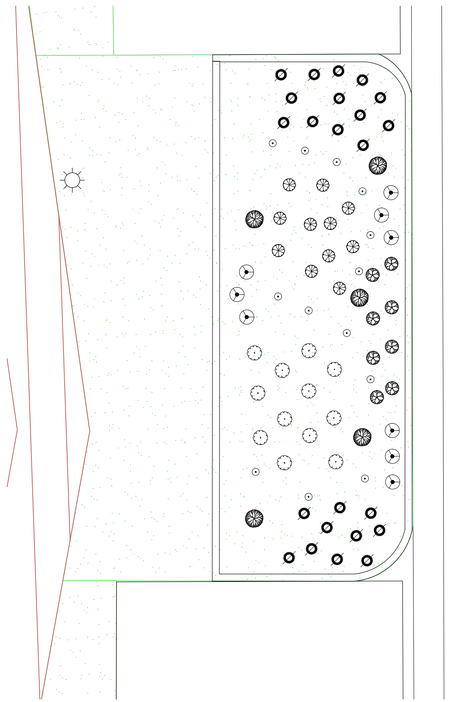
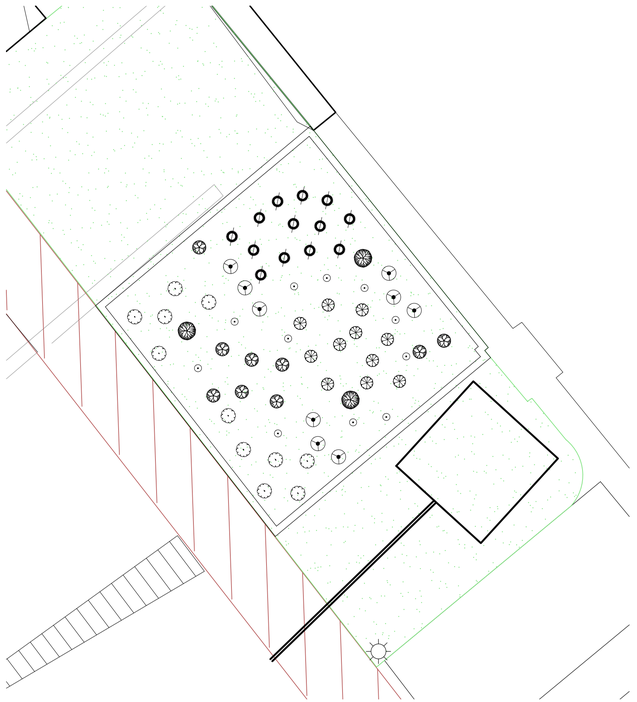
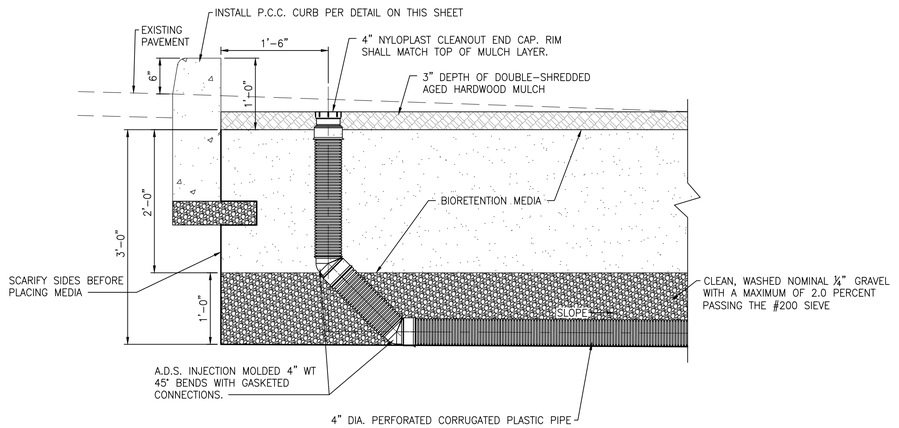




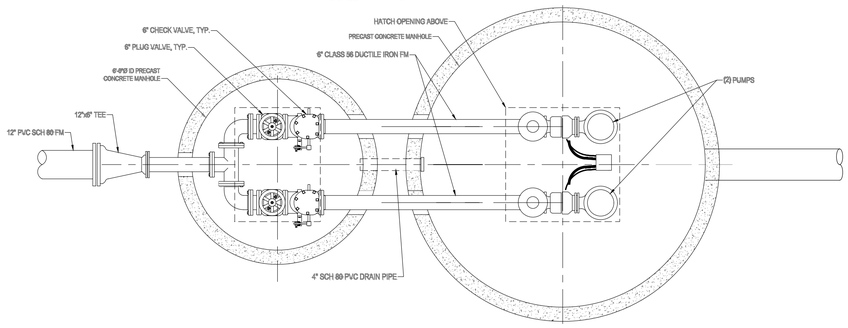


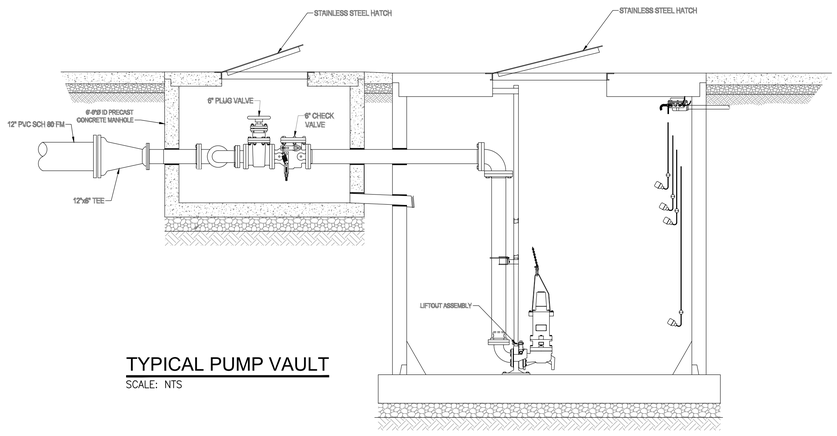
BIO AREA "B" SECTION
NO SCALE

PLANTING LEGEND

SYM.	QTY.	BOTANICAL NAME	SIZE	SPACING
IV	36	IRIS VERSICOLOR	3 GALLON CONTAINER	AS SHOWN
LS	22	LOBELIA SIPHILITICA	3 GALLON CONTAINER	AS SHOWN
AM	23	ARONIA MELANOCARPA	3 GALLON CONTAINER	AS SHOWN
VV	18	VACCINIUM VACILLANS	3-5 GALLON CONTAINER	AS SHOWN
RH	17	RUDBECKIA HIRTA	3-5 GALLON CONTAINER	AS SHOWN
IG	8	ILEX GLABRA	15 GALLON CONTAINER	AS SHOWN
AG	24	ANDROPOGON GERADI	1 GALLON CONTAINER	AS SHOWN

0 2.5 5 10 15
SCALE: 1" = 5'

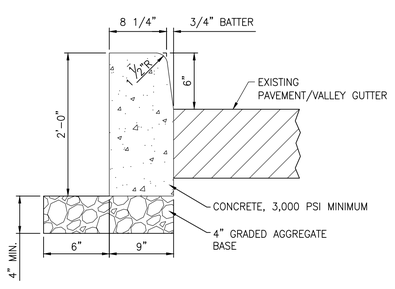




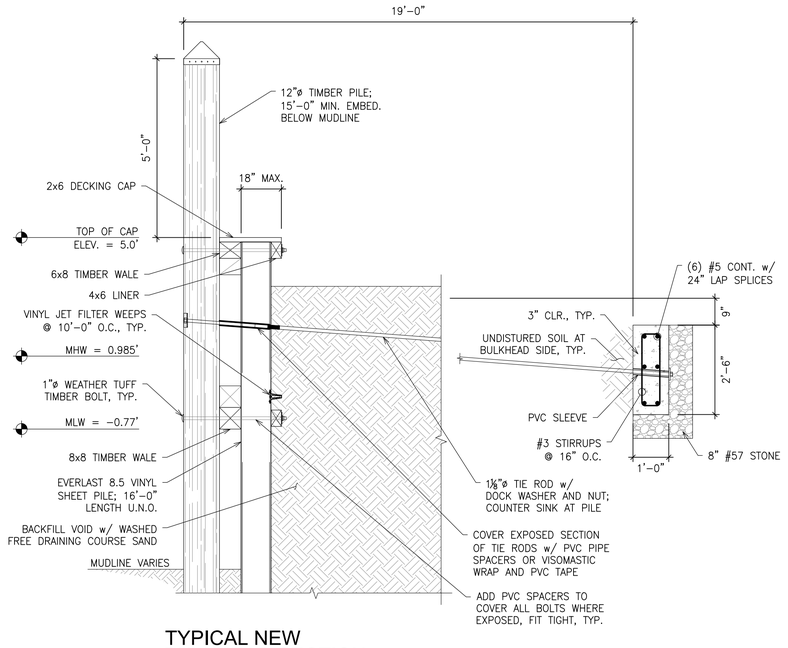
TYPICAL PUMP VAULT
SCALE: NTS

MAINTENANCE SCHEDULE

1. DURING THE FIRST YEAR OF OPERATION, THE OWNER SHALL INSPECT THE FACILITY AFTER EVERY HEAVY STORM AND REPLACE VEGETATION AS NEEDED.
2. THE OWNER SHALL REMOVE SEDIMENT ACCUMULATED IN THE PRETREATMENT AREAS AS NECESSARY.
3. SIGNS OF UNEVEN FLOW WITHIN THE MEDIA MAY MEAN THAT THE GRAVEL OR UNDERDRAIN IS CLOGGED. THE GRAVEL OR UNDERDRAIN SHALL BE REMOVED, CLEANED, AND REPLACED, AS NEEDED.
4. THE OWNER SHALL ENSURE THE INLETS AND OUTLETS TO EACH BIORETENTION CELL ARE FREE FROM DEBRIS.
5. THE OWNER SHALL REPAIR EROSION AT INFLOW POINTS AND ENSURE FLOW SPLITTERS ARE FUNCTIONAL TO PREVENT STORM WATER FROM BYPASSING THE FACILITY.



P.C.C. CURB DETAIL TYPE 1 MODIFIED
NO SCALE



TYPICAL NEW BULKHEAD SECTION
NO SCALE

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ST. MICHAELS, MARYLAND

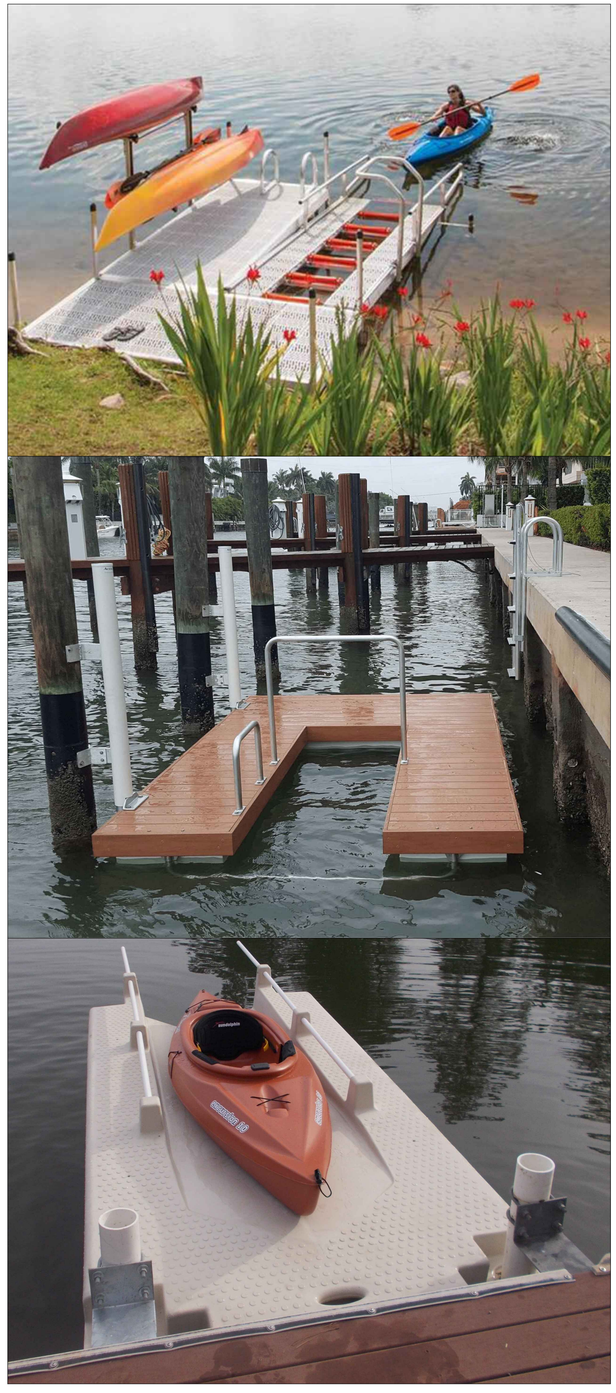
RAIN GARDEN AND DETAILS

SCALE	: AS NOTED
DESIGN BY	: BRJ
DRAWN BY	: CMB
CHECKED BY	:
GMB FILE	: 220279
DATE	: JUN. 2023

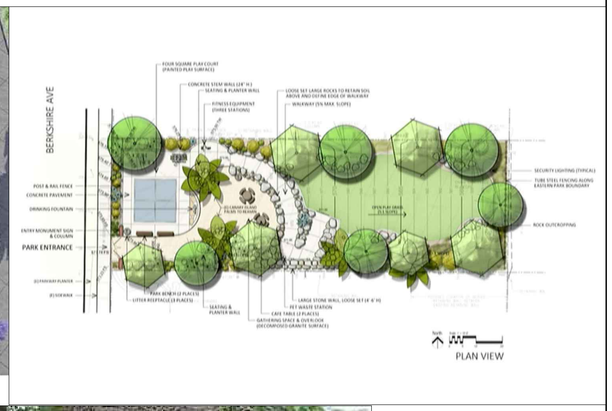
SHEET NO. C1.4

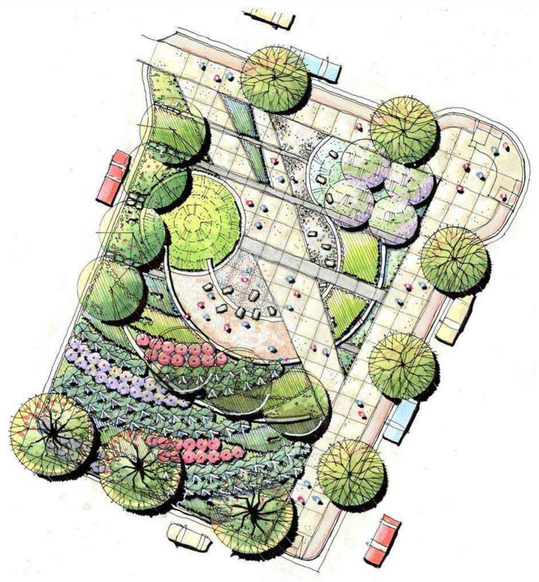
PLOT CODE
PEN1-WHITE 039 INCHES (1.00mm)
PEN2-MAGENTA 027 INCHES (.70mm)
PEN3-BLUE 020 INCHES (.50mm)
PEN4-CYAN 014 INCHES (.35mm)
PEN5-GREEN 010 INCHES (.25mm)
PEN7-YELLOW 007 INCHES (.18mm)
PEN1-RED 005 INCHES (.13mm)

KAYAK BOAT LAUNCH OPTIONS



PARK AREA OPTIONS AND IDEAS





PLOT CODE
PEN-RED .008 INCHES (0.2mm)
PEN-YELLOW .007 INCHES (0.18mm)
PEN-GREEN .010 INCHES (0.25mm)
PEN-CYAN .014 INCHES (0.35mm)
PEN-BLUE .020 INCHES (0.50mm)
PEN-MAGENTA .007 INCHES (0.18mm)
PEN-WHITE .039 INCHES (1.00mm)

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WEST HARBOR AND EAST CHEW FEASIBILITY

ST. MICHAELS, MARYLAND

DETAILS

SCALE	: AS NOTED
DESIGN BY	: BRJ
DRAWN BY	: CMB
CHECKED BY	:
GMB FILE	: 220279
DATE	: JUN. 2023

SHEET NO.
C1.5

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PEN1-RED .006 INCHES (.15mm)
PEN2-YELLOW .007 INCHES (.18mm)
PEN3-GREEN .010 INCHES (.25mm)
PLOT CODE
PEN4-CYAN .014 INCHES (.35mm)
PEN5-BLUE .020 INCHES (.50mm)
PEN6-MAGENTA .027 INCHES (.70mm)
PEN7-WHITE .039 INCHES (1.00mm)

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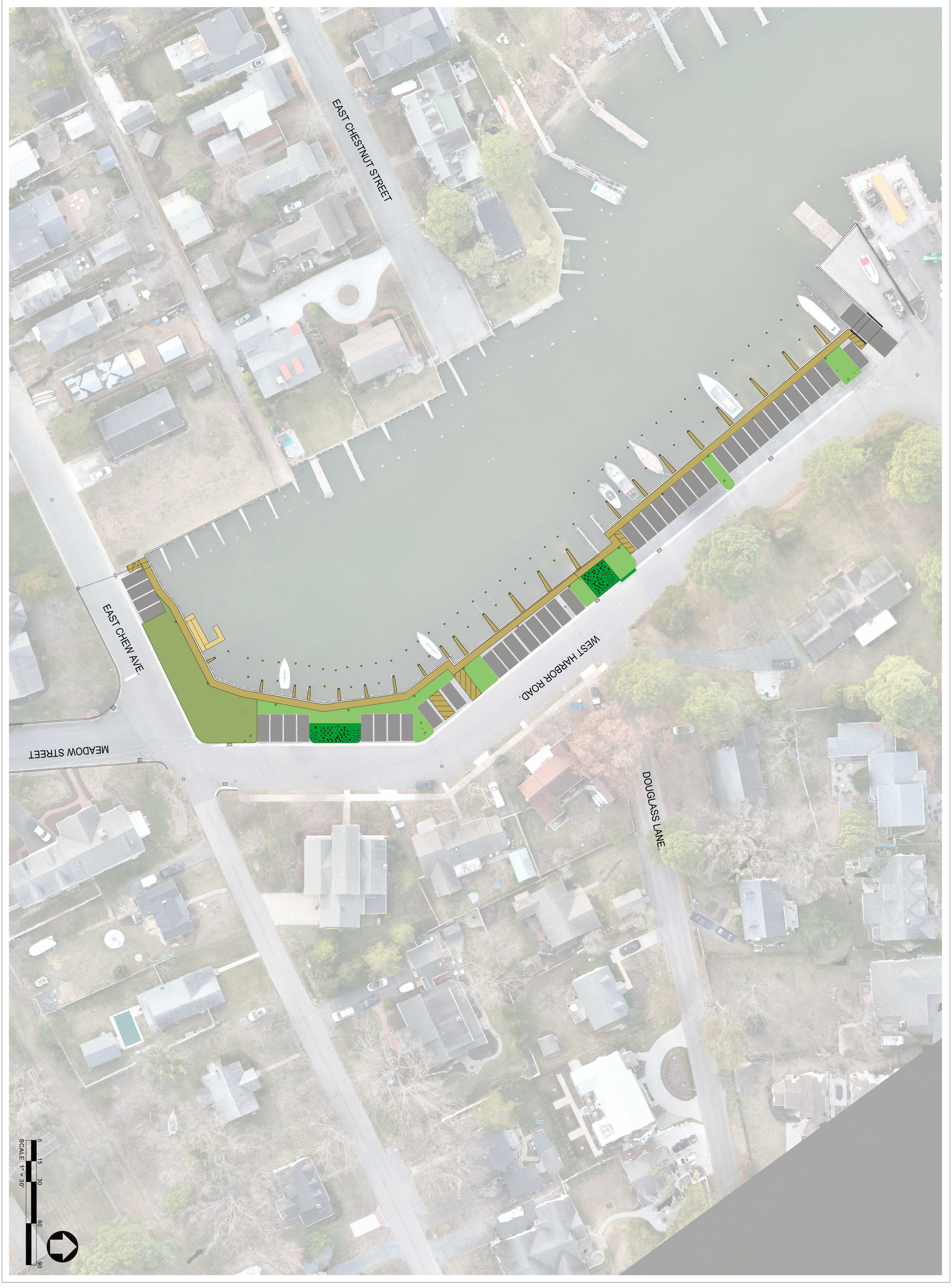

PROPOSED SITE PLAN RENDERING

SCALE: AS NOTED
DESIGN BY: DAD
DRAWN BY: DAB
CHECKED BY:
DATE: NOV 2023
SHEET NO: C1.1

WEST HARBOR AND EAST CHEW FEASIBILITY

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