CITY OF NEWBURYPORT
DEPARTMENT OF PUBLIC SERVICES
16A PERRY WAY
NEWBURYPORT, MA 01950

Phillips Drive Neighborhood Drainage and Flooding Problems
Evaluation Report and Recommended Solutions

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I. Purpose:

The purpose of this Evaluation Report and Recommended Solutions (hereinafter the "Report") is to summarize the drainage and flooding problems that exist in the Phillips Drive neighborhood, which includes, Phillips Drive, Drew Street, Sullivan Drive, and Ryan Road and to recommend improvements to resolve these problems. This renewed effort to resolve the neighborhood's drainage problems began when some of the neighbors raised concerns that a housing project for military veterans was being proposed in late 2016 on the adjacent land off Hoyt's Lane and that the development would exacerbate the drainage and flooding problems in the neighborhood.

Mayor Holaday met with residents and requested that they submit their concerns in writing so that the City could begin addressing the problems. This Report is largely based on those efforts and the residents' 54-page report titled *Phillips Drive Neighborhood Water Drainage Issues, Report to Mayor Donna Holaday, June 2017,* by *Homeowners of Phillips Dr. Neighborhood*. Our work performed to-date implies work performed since this renewed effort in 2017.

The City Engineering Department prepared this Report and the evaluation and solutions provided are based upon their decades of design and construction experience in general civil engineering, site development, stormwater management, hydrology, and hydraulics. Our solutions to the problems encountered in this neighborhood are based on conventional, industry-standard roadway and drainage design and construction.

II. Executive Summary

The Phillips Drive neighborhood has experienced some form of flooding and drainage problems since it was originally built 50+ years ago. In late 2016, the neighborhood voiced their opposition to a new development on abutting land to the north of Phillips Drive currently owned by the city. The main concern was the potential for increased flooding onto Phillips Drive. Since early 2017, the City has met with residents on multiple occasions, held a public meeting, collected comments and feedback, inspected the conditions of the roads and drainage pipes and structures, performed some limited field survey, cleaned out drainage pipes, reviewed historic and record data, performed hydrologic and hydraulic modeling, and came up with the most logical solutions to mitigate the damage being caused by said flooding.

The entire development was built on poorly draining soils, including wetlands, at the base of a hill to the north which has added to the groundwater problems for those homes abutting the hill. The poor soils throughout the neighborhood have forced many homeowners to install sump pumps in their basements to battle the high groundwater. Some residents also installed perimeter drains around their foundations.

The flooding and drainage problems fall into three main categories: 1) high groundwater issues; 2) surface flooding issues, and; 3) deteriorating roads. We have concluded that while the Cherry Hill development has likely increased the groundwater flows into the neighborhood, groundwater was and always will be a problem. It is not practical to perform any additional analyses to determine for certain the exact amounts of flow that the development has added. Rather, we propose some solutions to help mitigate the groundwater problems that continue to plague some homes along Phillips Drive. We also provide solutions to alleviate the damage caused by surface flooding during major storm events. Lastly, the roads have passed their life expectancy and are in very poor shape and must be reconstructed.

It is our opinion that performing any type of hydrogeologic analysis (i.e. underground hydrology) is unnecessary at this time. The proposed solutions provided herein should resolve the vast majority, if not all, of the drainage and flooding problems in the neighborhood. We will continue working on these problems and will continue looking into new solutions if or when they arise.

III. Simplified definitions as they relate to Phillips Drive flooding problems:

The following definitions – *albeit simplified* – are necessary in understanding the findings in this Report:

Hydrology: The science of water and its characteristics on the surface of the earth. First we quantify how much rainfall hits the earth, then how much evaporates, then how much infiltrates, then how much runs off downhill. Once enough is collected in a definitive shaped structure (stream, ditch, swale, pipe) then the science switches to hydraulics.

Hydrologic calculations are made assuming certain runoff coefficients for the material on the earth's surface. Pavement has a high runoff coefficient while forests have a low coefficient.

Runoff Rate: Runoff rate is the rate of flow, in cubic feet per second, that results after rain has traveled over the land area being calculated. Runoff rates are then directly transferred into the conveyance (stream, swale, channel, pipe, etc.) downstream of the land area. Runoff rates vary with the intensity of the storm being evaluated.

Runoff Volume: The total volume of runoff, in cubic feet or acre-feet, being discharged from the land area being calculated.

Hydraulics: The physics of flow in an underground drainage pipe (i.e. closed system) or in a swale or ditch at the surface (i.e. open channel flow). We look at the shape and type of conveyance in order to calculate the hydraulic characteristics.

Groundwater: Water underground that travels in the pores of the soil and cracks in rock. Groundwater will move just like water in a stream. The more porous the soils underground, the more it's likely to move, from a higher elevation to a lower elevation. Groundwater moves thru cracks in bedrock but also flows on top of the rock especially if the rock is tight. Clay is relatively impermeable so groundwater will sit on top of clay layers for weeks and months, depending on the type of clay.

Pipe trench: The 3-dimensional area created when an underground pipe is installed. For most pipes under 2-feet in diameter, the trench is 4'wide by depth of pipe by the length of the pipe. The ground is excavated to the depth the pipe needs to go, bedding soil is sometimes installed along the bottom of the trench for the pipe to sit on, pipe is installed, and the trench is then backfilled with soil around and above the pipe all the way to the surface. Most of the time the backfill soil is the same soil that was removed to install the pipe but sometimes it's imported material that is of a better material (i.e. more gravelly, sandy, etc.). Therefore, groundwater can travel within pipe trenches if the trench soils are more permeable than the adjacent soils.

Detention vs.
Retention: Detention ponds detain stormwater runoff. They're sized to control the rate of water being sent downstream. They typically have outlet pipes sized accordingly to prevent more flows from running downstream after a development is constructed compared to before. Detention ponds do retain some flows but are primarily to keep the peak rates of discharge under control.

Retention ponds are similar but they do not attenuate the rate of flow being sent downstream. They simply stop the flow and retain it until it recharges into the groundwater. There are no outlet pipes from a retention pond.

Cherry Hill development designed and constructed detention ponds, not retention ponds. These ponds were designed to hold water for no more than 72 hours, but in most cases will be dry in about a day. Lower detention times for the less-intense storms and greater detention times for the more-intense storms.

IV. Work Completed To-Date

1. DPS has cleared debris from the main drainage channel that runs from the end of Ryan Road to the Hoyt's Lane culvert.

2. DPS staff with assistance of a contractor inspected approximately 80% of the existing drainage lines with a camera and cleaned pipes with any obstructions. See Appendix E for Existing Conditions Plans.

3. Engineering Division has reviewed the Drainage Report from the Cherry Hill Subdivision project and other record information.

4. Engineering Department began a hydrologic and hydraulic analysis of both neighborhoods to determine if there are areas that are exacerbating the groundwater problems or to see where any problems may exist.

V. Summary of findings to the most critical and common drainage problems:

The following is a summary of the most critical and common problems along with our responses. Responses to the remaining comments not addressed in this section are provided in the subsequent section further below.

Common Problem 1: *Groundwater has infiltrated our basements ever since the Cherry Hill subdivision was constructed and some homes have sump pumps running constantly. Many residents theorize* *that the removal of the tree farm that previously existed on the Cherry Hill site is the main cause of the groundwater problems in the Phillips Drive neighborhood.*

Response 1: In general, this theory has merit – removing a natural vegetated sponge will result in more runoff and more groundwater because the plants are not there to soak up the water and evaporate it into the air (i.e. evapotranspiration).

To determine if this theory is correct, we reviewed the Drainage Report prepared by the engineering firm that designed the Cherry Hill subdivision to see if their calculations were performed properly. Our findings are as follows:

- The engineer used industry-standard hydrologic and hydraulic models (TR-20, Manning's, etc.) to perform their drainage calculations. These models are used by virtually every engineer needing to perform these types of analyses. We did not see any substantial errors in their calculations. In general, their interpretation of pre-development and post-development conditions and their overall hydrologic and hydraulic design was performed according to the applicable industry and regulatory standards.

- As best as we can tell, they used proper runoff coefficients in their calculations. The old tree farm doesn't exist today so we cannot go out and see the condition of the vegetation and ground surface. However, we referred to historic aerial photos provided by Google Earth® and pictures of the plants grown on the farm (see Appendix A).

  For the existing conditions (pre-development conditions) the engineer used runoff coefficient factors of 44, 49, and 54 for two largest watershed areas (Be upland, De upland, and Ee, as shown on Existing Watershed plan in Appendix B). These numbers are composite (weighted average) runoff coefficient factors because the areas include both the tree farm and wooded areas. The range of coefficient factors used by engineers performing TR-20 hydrologic models starts on the low end with 30 for forests in healthy condition (i.e. thick vegetated sponge) and tops off at 98 for pavement (i.e. nearly 100% runoff).

  As the aerial and plant photo in Appendix B reveal, the tree farm was not as heavily vegetated as the native forest elsewhere in the area so we suspect that the true runoff coefficient for the farm was actually higher than what the engineers used. In other words, the tree farm was not as much of a 'sponge' as many suspected.

  In addition, according to one resident, there used to be a natural spring coming from the Cherry Hill area before it was developed. This suggests that before the development was constructed, enough groundwater was being recharged and sent down towards the Phillips Drive neighborhood that it actually daylighted (surfaced). The actual amount of transpiration from the tree farm and woods was very likely much less than the perceived amount of transpiration.

  We find the runoff coefficient numbers used by the engineers to be acceptable.

- We did not find any substantial errors in their calculations (measurements of land areas, improper use of hydrologic formulas, etc.).

- The engineer released the runoff from the development towards three separate discharge points – all of them discharging into Phillips Drive and are labeled as "RES-#". The ***rate of runoff*** from the three discharge points under post-development conditions were greatly reduced when compared to pre-development conditions. See attached summaries in Appendix B.

  The percent reduction of the entire development (as a *weighted average* of all three discharge (i.e. 'RES' points) for each storm event evaluated is as follows:

Storm Event:	Change in Rate of Runoff (cfs) (project-wide weighted average):
2 yr (3.1"/24 hr)	-19%
10 yr (4.6"/24 hr)	-30%
25 yr (5.4"/24 hr)	-49%
100 yr (7.0"/24 hr)	-54%

  The Department of Environmental Protection's Stormwater Policy states that the post-development runoff rates must be *less than or equal to* the pre-development runoff rates.

- We walked the Cherry Hill site and determined that, in general, the development was constructed as designed. We did not observe any significant changes between the design and as-built development. Therefore, we can assume that their hydrologic and hydraulic calculations reflect the as-built conditions.

- **Conclusion:**

  TR-20 is not an *exact* representation of what occurs in nature. However, it has been used for decades by engineers and it provides an approximate representation of the natural processes. The model's results tend to be conservative relative to the amount of runoff and evapotranspiration that actually exist. Fully understanding the actual amount of runoff and groundwater recharge during pre-development conditions and then again for post-development conditions is impossible. Furthermore, TR-20 models the hydrologic cycle aboveground and does not model the water once it enters into the ground.

  DEP and our local regulations require that groundwater be recharged as part of the post-development design. It is generally preferred to recharge as much as possible into the ground and there are no requirements to evaluate the potential changes to groundwater conditions downstream of a development. This would result in an exhaustive and extremely expensive effort.

  There are an infinite number of variables that come into play when analyzing groundwater characteristics – soil type, soil profile, soil depth, soil compaction, ledge, porosity of ledge, quality of vegetation, type and maturity of vegetation, watering methods for the tree farm, use of on-site wells, etc. Removal of impervious layers of soil, adding pervious layers, and mixing of soil layers will also impact the flow of groundwater. It is impossible to fully understand the changes a development has made on groundwater conditions.

Therefore, we base our evaluation herein on empirical data – real experience and observations from people who have lived through the change. We do not recommend performing any more studies or hydrologic evaluations.

The Phillips Drive neighborhood was built on a 'swamp' according to residents. This supports the record soil data that states that the underlying soils are poorly draining and very tight soils, like clays and silts. These are classified as Soil Types C and D. (Soil types range from "A", which are well draining sands and gravels, to "D", which are poorly draining clays, silts, and high bedrock.) We cannot discount this fact because these underlying soils are the main reason that the majority of homes in the area have sump pumps in their basements. The problem we've heard is that these sump pumps have been turned on more frequently and some are not keeping up with the apparent increase in flows.

We agree that that more groundwater is likely being sent towards Phillips Drive as a result of the Cherry Hill development. The development reduced the peak flow *runoff rate* (in cubic feet per second) leaving the site which means that more rainfall is being held back as a result of the new development and less is being sent directly overland towards Phillips Drive. Also, our site inspections revealed that the outlet control structures of the detention ponds are clogged and not draining properly. Retaining more runoff will result in more groundwater being recharged than before the development.

In addition, all the homes in the development have drywells to collect the runoff from their rooftops.

Fortunately, it also appears that this groundwater is only impacting a handful of residents in the Phillips Drive neighborhood and not the majority of the homes nearest to Cherry Hill. The Flooding Assessment map in Appendix C shows the homes that we are aware of as having a *chronic* groundwater problem. Those most impacted are 23 and 25 Phillips Drive, which makes sense because they are at the base of the cemetery hill and are also at the lowest point in the neighborhood so they will be most impacted regardless of where the groundwater comes from.

The best solution we see for residents experiencing excessive basement flooding (more flows than sump pumps can handle and/or flows that result in high electrical bills from pump usage) would be to install perimeter drains around their homes and discharge the flows via gravity to our city drainage system or to a stream or drainage channel. A new roadway drainage system can be designed and built so the main trunk line is deeper than typically necessary in order to collect perimeter drains via gravity.

Common Problem 2: *No provision is set forth for the drainage, or plans for the groundwater flow via the sewer easement [from Cherry Hill Subdivision], thus creating increased water table down gradient towards Phillips Drive homes.*

Response 2: Transporting groundwater from one area to another does occur via underground utility pipes and conduits. The soil material within the pipe trench is commonly more porous and provides better drainage than the soils surrounding the trench. Groundwater does commonly follow the gravel bedding of pipe trenches until the groundwater reaches a low point.

While this problem may exist, the pipe trench in question runs from Cherry Hill all the way down Phillips and next to the stream at the bottom of the hill and continues alongside the stream until it reaches the Storey Ave pump station. We suspect that any groundwater that gets transported via this pipe trench will likely continue past the homes along Phillips Drive and not add much to the groundwater in that area of the Phillips. We suspect that it is not the root cause of the problem.

Common Problem 3: *Properties are being flooded after heavy rains and some homes have experienced basement flooding as a result.*

Response 3: This problem is quite evident. A number of past storms have resulted in yards being inundated with runoff which also resulted in many basements being flooded. We have seen pictures of past storm events, received numerous comments from residents, and observed the runoff entering properties after rainfall events. The Flooding Assessment map in Appendix C shows the properties that we understand have been impacted the most by surface flooding.

In general, the neighborhood's drainage system is substandard and improvements are necessary. There are not enough catch basins to capture all of the runoff, the roadway edges do not have a well-defined gutter to keep the runoff in the streets, and there were no apparent provisions for any secondary drainage system(s) to redirect the flows that spill over from the roadway's drainage system away from the homes. In addition, during heavy storm events, the roadway culvert next to 23 Phillips Drive gets inundated and the roadway overtops.

Installing curbing and more catch basins are the best means of keeping the runoff in the street and off private properties. Roadway drainage systems are typically designed to handle the 10-year or 25-year storm events. For storms more intense than those, such as the 100-year storm, roadways should be designed so that the flooding caused by these storms is directed out of harm's way and into the area's drainage channels, streams, or rivers. Simple grassed swales are effective at sending these floodwaters downstream.

The culvert next to 23 Phillips Drive carries overland flows from the entire watershed and this culvert has experienced backup during heavy storm events. The topography upstream of this culvert is sloped, has ample storage away from homes, and has adequate freeboard (vertical clearance between the water's surface and people's homes) so the backup doesn't end up in nearby basements. The backup is problematic in that it overtops the road, makes the road impassable, and causes flooding onto 23 Phillips Drive – which is downstream of the culvert. This culvert should be upgraded to handle the 100-year storm.

Problem 4: *The roads are in bad shape and groundwater is coming out of the middle of the road on Phillips Drive in front of #'s 14, 19, and 21 causing an ice flow during the winter.*

Response 4: The roads have not been repaved since they were first built but the City has made spot repairs since. These roads have exceeded their service life and need to be reconstructed.

Some areas, such as the one causing the ice flow, will need roadway subdrains to be installed to capture the groundwater and send it downstream to an open channel. Subdrains are the best solution to keeping groundwater out of the roadway gravel base, where problems occur. Constant groundwater in the gravel base results in degradation of the base and the pavement mostly due to the freeze-thaw cycle, which causes pavement cracking and potholes.

VI. <u>Responses to Remaining Comments:</u>

The above-mentioned *Responses to Common Problems* address most problems raised by the residents. The following responses address the remaining concerns of the residents:

Goulet Statement, 25 Phillips Drive:

Comments #4 - *The Orangeburg clay pipe that was used has now deteriorated and is no longer functional.*

Response #4 - Orangeburg pipe is a solid pipe (not perforated) so it appears that the previous contractor installed it to collect flows from upstream and send them past your house in order to lower the groundwater table in that area. Orangeburg pipe is bituminized (asphalt) fiber pipe. It was an inexpensive pipe material used to convey water, sewage, and drainage but has since been replaced by other materials because it has been known to degrade, soften, and collapse and is generally no longer used.

Replacing this pipe is not recommended. Installing a perimeter drain around the house will capture groundwater from the cemetery hill as well as the flows uphill from Phillips Drive.

Comments #10 - *Kindly advise the status of the FEMA Grant Funding Application.*

Response #10 - The City will consider seeking FEMA grant monies to fund the capital improvement projects as well as all other available funding programs. Large-scale projects like this are typically funded by State and/or Federal sources via the issuance of bonds, which are loans provided to municipalities from which they pay off with local tax revenue.

Atanasoff Statement, 37 Phillips:

Main Comment - *Our basement has flooded 4 times over this timeframe due to primarily the "manmade water culvert" the town has put in my backyard… It cannot handle all the water coming from Cherry Hill when it rains for more than 3-4 days straight.*

Response - See Response to Common Problem #3 above. In addition, there are three drain lines installed between the homes on Phillips Drive directly abutting Cherry Hill. It is highly recommended to replace these lines with larger-diameter pipes to help alleviate overland flooding onto their backyards and to construct grassed swales sized to handle the more intense storms.

Palladino Statement, 23 Phillips Drive:

Comment - *The previous owner installed a French drain on three sides of the house which is not handling the amount of water flowing into our yard and basement.*

Response - Reconstructing the roads with new curbing and a fully functioning drainage system should solve the problem but the possibility remains that the French drain may not have been constructed properly or has since been clogged. There are a number of explanations: silts and fines have clogged the inside of the pipe, clogged stone around the pipe, pipe was not installed deep enough to lower the groundwater table, outlet location is blocked, etc. The City may be able to inspect the French drain and see what improvements can be made.

The pipe could be working properly but the groundwater has found its way to the foundation walls before the drain or the drain's trench could capture the flow. If the groundwater flows down the outside face of the foundation wall, it typically enters the basement at the joint between the foundation's footing and the foundation walls. The concrete for these were poured separately and if a waterstop wasn't installed (typically not decades ago) then water will seep thru the joint. Rainfall that ponds on the ground directly surrounding the home is usually the culprit for how water flows down the foundation wall.

Lastly, the basement floor elevation could be lower than the adjacent stream bed elevation. If this is the case, then the basement flooding will persist until drier periods.*Weber Statement, 4 Drew Street:*

Response - We assume that the work that Ted Norton did in Oct/Nov 2014 has been successful. If basement flooding still exists, we recommend inspecting the various pipes and drywell to see if they were installed properly and are functioning well. The deeper the perimeter drain, the better the chance of stopping the groundwater from entering the basement.

Installing curbing on the roadways should address the other water runoff problems.

Welch Statement, 6 Drew Street:

Response - Cracked driveway (and roadway) pavements are common when the underlying soils are poorly draining like those in the area. In addition, the gravel base below the pavement may not be think enough or porous enough to provide a solid base. It's important to have the pavement base soils drain properly to prevent cracking, especially during the freeze-thaw cycle, and be thick enough to provide the structural support that the pavement needs.

VII. Proposed Solutions:

We arrived at four possible solutions to alleviate the drainage and flooding problems, as follows:

Solution No. 1. Complete New Roadway Construction

Description: As shown on Conceptual Design Plans in Appendix E, construct new roadways with curbing, drainage systems, swales, and culverts. Curbing is recommended to ensure that the runoff in the roadways remain in the roadways. Any solution less than this, such as installing a new drainage system only, would only be partially effective and will not solve all the problems. The problems stem from both an insufficient drainage system and the lack of curbing and fixing one without the other is not advisable. Therefore, a complete roadway improvement project with curbing is recommended.

Benefits:

a. New curbing keeps roadway runoff within the roads and away from private properties.
b. Upgraded drainage system will handle storm events better than the existing drainage system.
c. Increase the size of the roadway culvert next to 23 Phillips Drive.
d. Install the drainage trunk lines deep enough to allow for connections to perimeter drains via gravity (no pumping necessary). **It is recommended that homeowners with chronic basement flooding problems install perimeter drains around their homes. The best and most cost-effective time to install these would be during the roadway construction project.**
e. Install subdrains beneath roads to improve pavement longevity and alleviate groundwater problems.
f. Eliminates erosion along roadway edges.
g. Repairs damaged and aging pavement.
h. Reduces most problems associated with high groundwater.
i. Construction can be phased to spread out the costs over multiple years and to fix the most problematic areas first, as follows:

    Conceptual Improvements Phase I (see Sheet 3 in Appendix E):

    - Install curbing, drainage, culverts and swales in the northern-most section of the neighborhood.

- This section must be constructed first before any upstream drainage systems are installed in order to properly receive the flows from upstream piping systems.

Conceptual Improvements Phase II (see Sheet 4 in Appendix E):

- Install curbing, drainage, culverts and swales in the southern-most section of the neighborhood.
- Connect to the drainage systems installed under Phase I.

Solution No. 2: Cleanout Cherry Hill's detention pond outlets – RES 10, 12, and 13

Description: Unclog the outlet pipes from Cherry Hill's detention ponds. See Appendix D.

Benefits:

a. Allow the ponds to operate as intended.
b. Low cost.

Solution No. 3. Install Subdrain to Eliminate Icing on Phillips Drive

Description: Install perforated pipe subdrains under Phillips Drive from 19 Phillips down to the stream.

Benefits:

a. Improves the roadway base and prevents damage to pavement during freeze-thaw cycles.
b. Eliminates groundwater from seeping through the pavement causing ice flow.
c. Can be installed with minimal cost and independent of other solutions or as part of Solution 1 above.

Solution No. 4. Increase sizes of outlet pipes from Cherry Hill's detention ponds – RES 10 and RES 12.

Description: The theory is to send more runoff downstream during storm events in order to reduce the amount of flow being infiltrated into the ground. The pipes will need to be sized so that they do not send more runoff downstream than the amount of runoff that used to come from the previous tree farm.

Benefits:

a. Similar to Solution 3 above, this will send more flow overland and less into the ground during storm events.

VIII. <u>Conclusion:</u>

To completely resolve the drainage and flooding problems, we recommend that Solutions 1, 2, and 3 as outlined above be implemented as soon as possible. Solution 4 should be not be implemented until it has been proven or it is clear that Solutions 1-3 have not met expectations. Some grading will be necessary on private properties in order to build grassed swales to direct flows away from homes and some fill may be needed to regrade yards in order to make sure the runoff from the yards are directed into the swales.

In order to accomplish these improvements, the following construction phasing is recommended and the approximate costs to implement are provided for budgeting purposes:

Phase I – Test Pits, Solution 2, and Solution 3:

1. Excavate or drill to determine soil type and depth to ledge. High ledge will impact drainage and roadway design and construction.
2. Clean out outlet pipes (Solution 2).
3. Install subdrain (Solution 3).

Timeframe: TBD

Approx. cost: <$5k

Phase II – Detailed Topographic Survey:

A detailed topographic survey is needed to assist in the design, regardless of which roadway and drainage improvements will be implemented. If funds can be acquired this fiscal year, the work can begin as soon as the snow is gone.

Timeframe: July/August 2018

Approx. cost: $50,000

Phase III – Design:

The capital improvement projects resulting from this effort will need to be designed by a professional civil engineer. The City's Engineering Division is qualified but it is not staffed to complete the design in a timely manner. Therefore, we recommend hiring an engineering firm to perform this work.

Complete roadway and drainage system design timeframe: Approx. 6 months

Approx. cost: $200,000

Phase IV – Construction:

Construction cost will vary depending on which improvements will be implemented.

Complete roadway and drainage system timeframe: Calendar Years 2019-2021

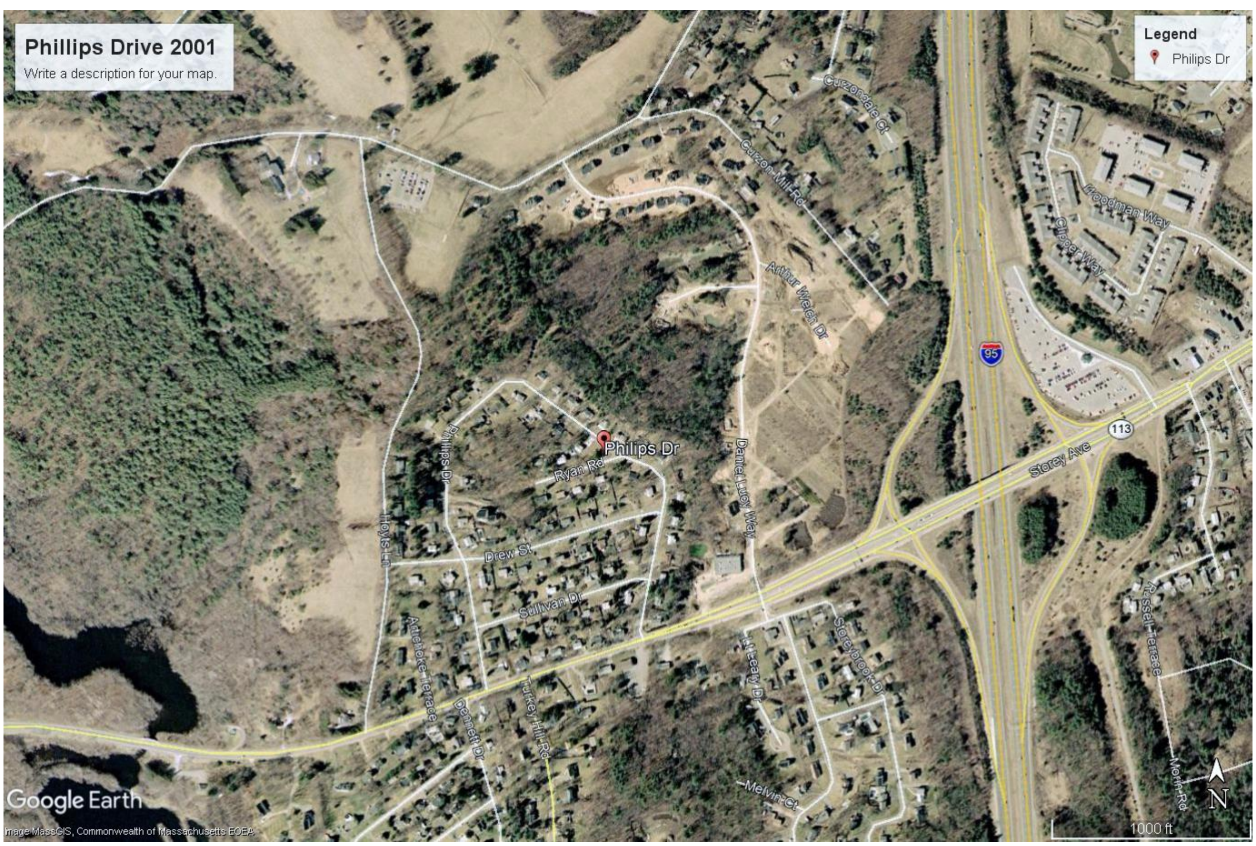
Approx. cost: $4 million - $5million

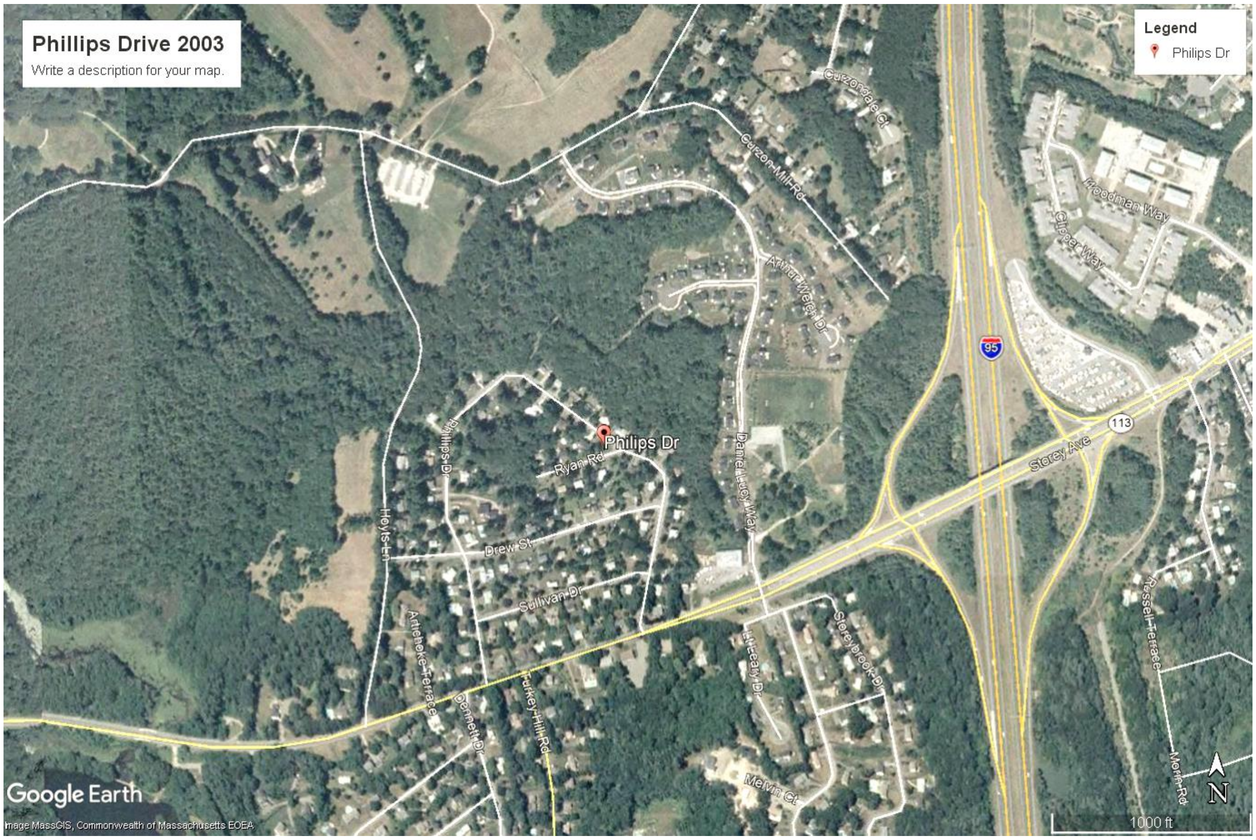
APPENDIX A

Aerial Photos 1998-2016

Cherry Hill Nurseries Catalogue

Historic aerial photographs courtesy of Google Earth. Notice that current roadways are overlaid on top of historic aerials (even though they didn't exist yet).





Phillips Drive 2003
Write a description for your map.
Legend
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Sullivan Dr
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Arthur Welch Dr
Daniel Lucey Way
Storey Ave
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95
Freedman Way
Turkey Hill Rd
Merrimac Terrace
Dermott Dr
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Melvin Ct
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Turkey Hill Rd
Dermott Dr
Steeplebrook Dr
Melvin Ct
Russell Terrace
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Hybrid Rhododendrons (see page 8)

Colorado Blue Spruce (see page 4)

Hemlock Spruce (see page 6)

Rhododendrons, continued

be taken not to plant tender varieties, nor those grafted on any but Catawbiense stock, as our rigorous winters prove too much save for the hardiest varieties.

Rhododendrons should not be planted where lime has been scattered, unless the soil is removed and fresh soil is put in to replace it. They grow best in a mixture of leaf mold and sandy loam. A deep mulch of leaves may be given them in the fall, and a protection from the sun's rays in winter until they are well established, this being done by placing pine or spruce boughs around them.

Rhododendron Catawbiense. A native variety bearing round clusters of lilac flowers. 75 cts. each, $6 for 10.

R. maximum. Great Laurel. A very broad-leaved native variety. A vigorous grower and perfectly hardy; bears large trusses of rosy white flowers in late June. 2 feet, $1 each, $8 for 10; larger, $1.50 each, $12.50 for 10.

Rhododendron Catawbiense

Catawbiense Hybrids

We offer a list of hardy varieties which we consider most desirable.

Abraham Lincoln. Rosy crimson.

Album elegans. Blush, changing to white; free flowering.

Atrosanguineum. Blood-red; early.

Blandyanum. Crimson.

Boule de Neige. Pure white; very handsome.

Caractacus. Rich, dark crimson; has a fine truss.

Charles Dickens. Bright scarlet; fine habit.

Everestianum. One of the hardiest and best Rhododendrons for New England. Compact trusses of rosy lilac, slightly spotted yellow.

General Grant. Rosy pink.

Giganteum. Bright rose.

H. W. Sargent. Crimson; very large truss.

Lady Armstrong. Pale rose; one of the best of the pink varieties.

Lady Clermont. Deep red, shaded lighter.

Mrs. Milner. Rich crimson; excellent foliage.

Old Port. Rich plum color; very distinct.

Purpureum Grandiflorum. Purple; very hardy and floriferous.

Roseum elegans. Bright deep rose; excellent foliage.

18 to 24 inches, $1.50 each, $12 for 10; 2 to 2½ feet, $2 each, $17.50 for 10

Yucca · Adam's Needle

Yucca filamentosa. A very unique evergreen plant, with sharp sword-shaped leaves, bearing creamy white, bell-shaped flowers on stems 5 or 6 feet tall. Unexcelled for borders or mass planting. Strong plants, 25 cts. each, $2 for 10.

Ornamental Deciduous Trees

We have included in this list not only upright deciduous trees but also weeping forms. In most cases we have quoted on medium-sized trees, the size usually planted. We can, however, furnish larger specimen trees in many of these varieties, and shall be glad to quote prices to any one interested. We can also quote on larger quantities than those mentioned.

Ash. See Fraxinus

Acer · Maple

Acer dasycarpum. White or Silver-leaved Maple. A native Maple, one of the fastest-growing of the species. Foliage light green above and silvery white beneath. One of the most useful trees where a quick growth is desired. 50 cts.

var. Wierii laciniatum. Wier's Cut-leaved Silver Maple. A variety of the Silver Maple having graceful, drooping branches and deeply cut foliage. Very ornamental for individual planting. 6 to 8 feet, 75 cts.

A. Pennsylvanicum. Striped-bark Maple. A beautiful tree with the bark striped white and green. Very pretty in winter. 6 to 8 feet, bushy, $1 each, $8 for 10.

A. platanoides. Norway Maple. A large tree with spreading, rounded growth and dark green leaves. Hardy and vigorous, and well adapted for seashore and street planting. 6 to 8 feet, 60 cts. each, $5 for 10; 10 to 12 feet, $1.50 each, $12 for 10.

var. Geneva. A variety of the Norway Maple. Foliage bright green in the spring, changes to a darker shade, becoming a rich coppery purple in late summer, giving an appearance of having been touched by frost. Large specimens, $2 to $5.

var. Schwedlerii. Schwedler's Maple. Very handsome, the young growth and foliage being of a deep red, fading to green as it matures. 5 to 6 feet, 75c. each, $6 for 10; large specimens, $2 to $5.

A. pseudoplatanus. Sycamore Maple. A rapid-growing tree with smooth, grayish bark and striking leaves. 8 to 10 feet, $1.25.

APPENDIX B

Cherry Hill Subdivision Drainage Report Excerpts:

- Existing and Proposed Watershed Maps
- Pre- versus post-development runoff comparisons

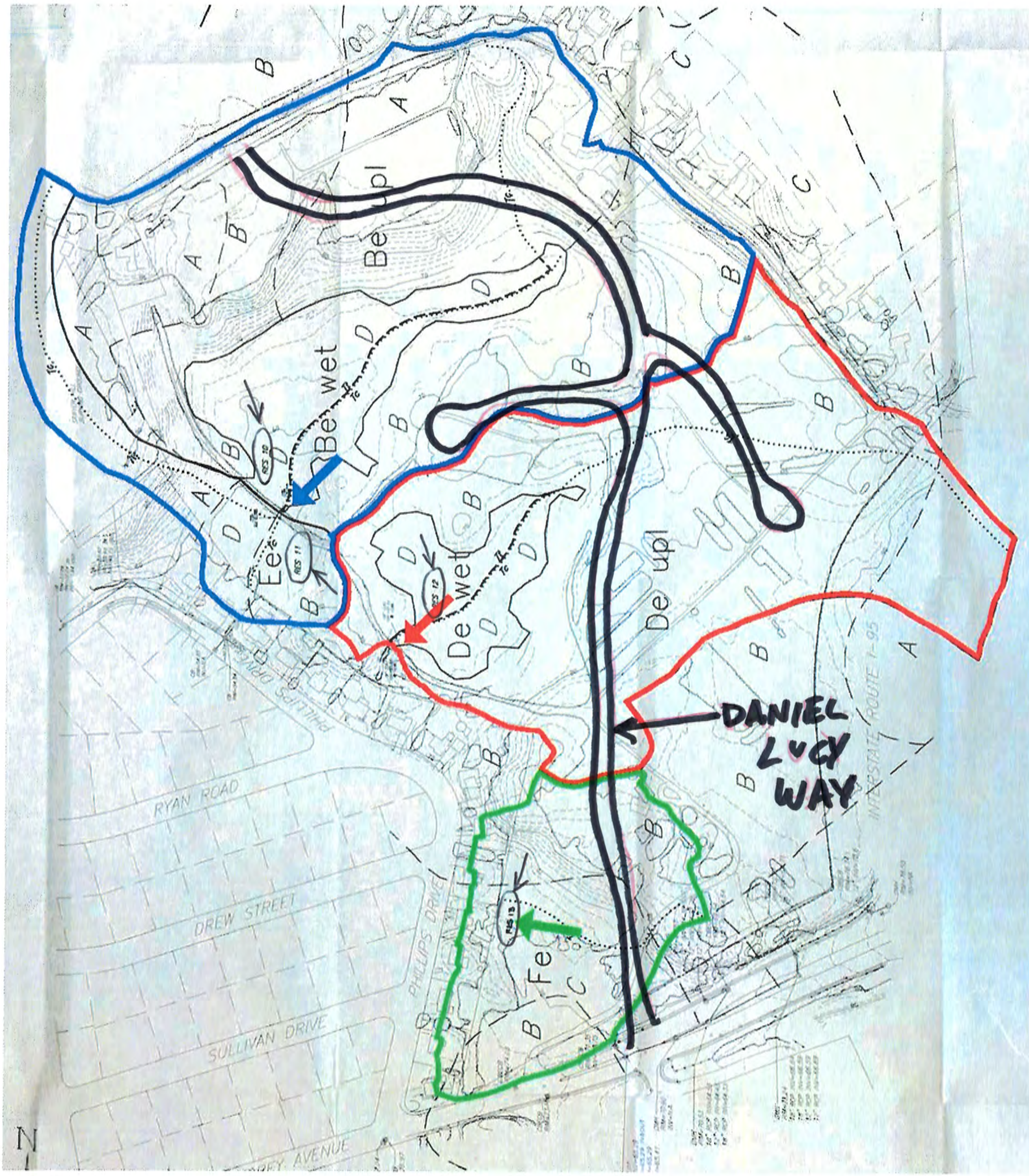
JOB FILE
NBT-0015

Revised Mitigative Drainage Study

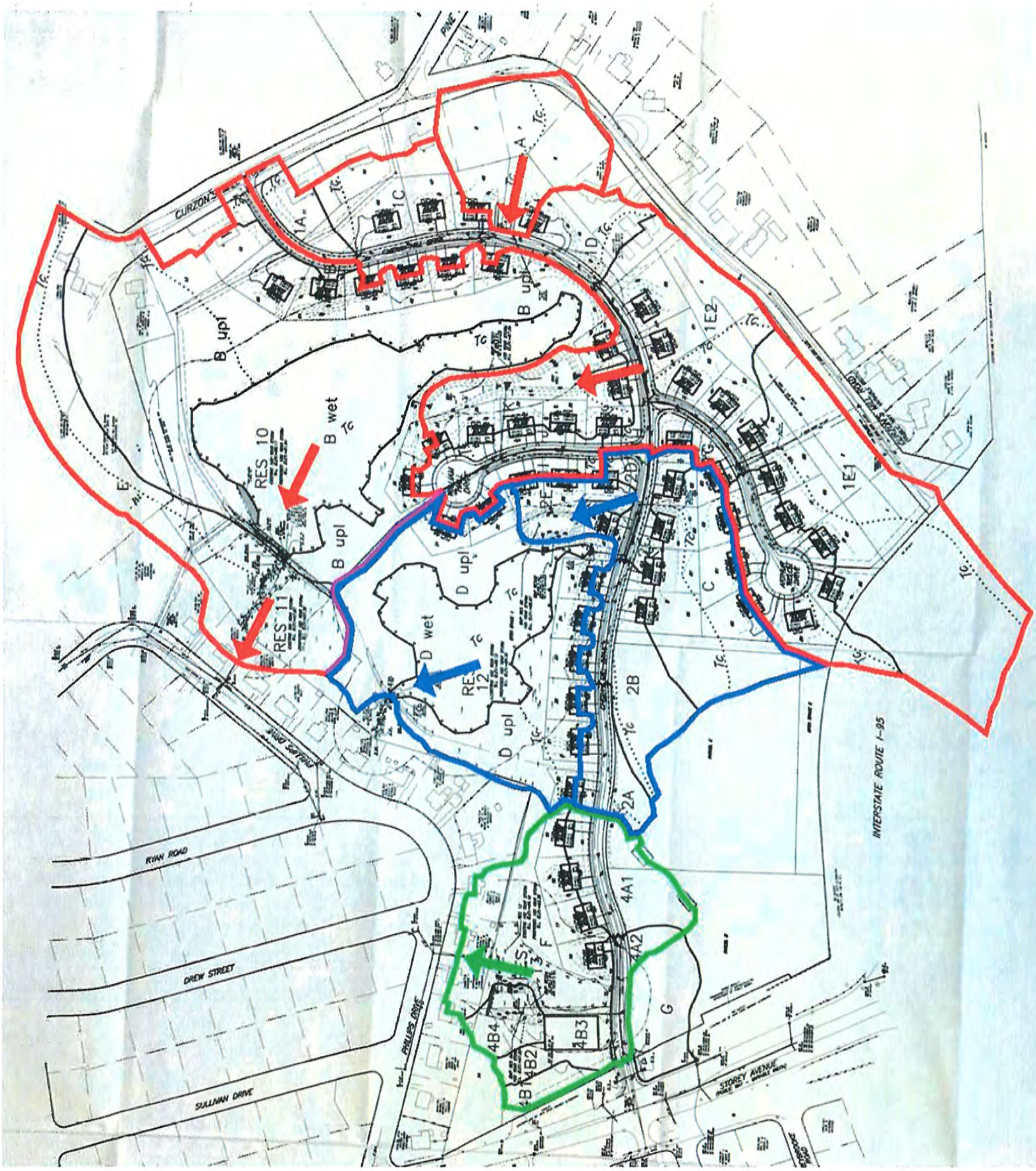
Cherry Hill Estates
Newburyport, Massachusetts

February 16, 2000

Hayes Engineering, Inc.
Civil Engineers & Land Surveyors
603 Salem Street
Wakefield, MA 01880



CHERRY HILL DRAINAGE REPORT - EXISTING WATERSHED



CHERRY HILL DRAINAGE REPORT
PROPOSED WATERSHED

February 8, 2000

OUTLET — 32.95 Acres or 52% of DEVELOPMENT

RES 11
PEAK FLOW RATE
SUMMARY
TO DOWNSTREAM

Storm Event	Existing Condition cfs	Proposed Condition cfs	Change cfs	% change
2 yr. 3.1"/24 hr.	2.4	1.6	- 0.8	33%
10 yr. 4.6"/24 hr.	3.4	3.1	- 0.3	9%
25 yr. 5.4"/24 hr.	9.8	5.3	- 4.5	46%
100 yr. 7.0"/24 hr.	26.1	9.9	- 16.1	62%

February 8, 2000

OUTLET
RES 12
PEAK FLOW RATE
SUMMARY
TO DOWNSTREAM

22.55 Acres
or
36 % OF DEVELOPMENT

Storm Event	Existing Condition cfs	Proposed Condition cfs	Change cfs	% Change
2 yr. 3.1"/24 hr.	2.3	2.3	0	—
10 yr. 4.6"/24 hr.	10.1	3.6	- 6.5	64%
25 yr. 5.4"/24 hr.	11.7	4.5	- 7.2	62%
100 yr. 7.0"/24 hr.	13.0	6.2	- 6.8	52%

February 8, 2000

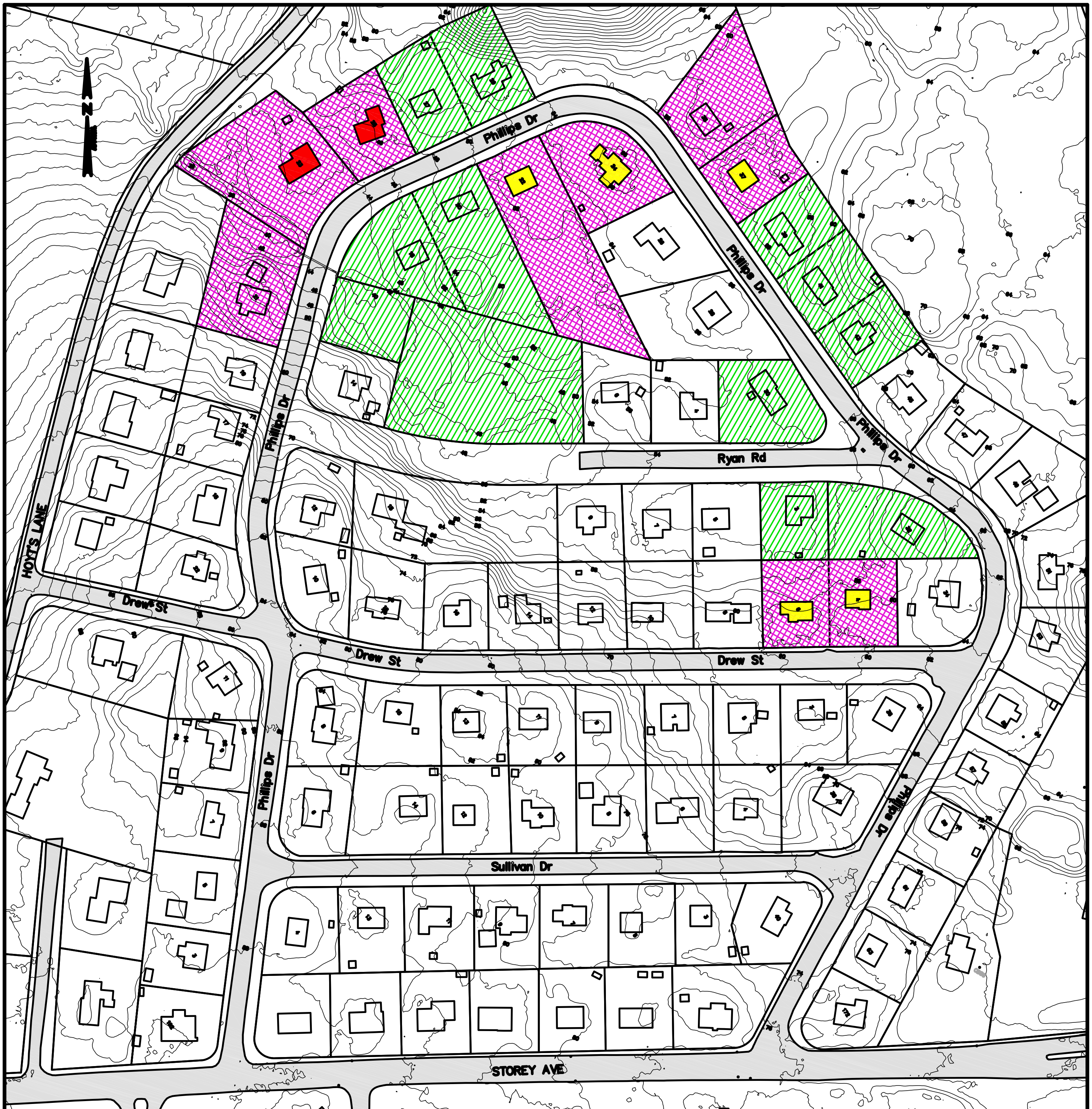
OUTLET — 7.67 Acres
RES 13
PEAK FLOW RATE
SUMMARY
TO DOWNSTREAM

of
12 % of DEVELOPMENT

Storm Event	Existing Condition cfs	Proposed Condition cfs	Change cfs	% change
2 yr. 3.1"/24 hr.	2.5	2.2	- 0.3	12%
10 yr. 4.6"/24 hr.	4.3	3.5	- 0.8	19%
25 yr. 5.4"/24 hr.	5.5	4.1	- 1.4	25%
100 yr. 7.0"/24 hr.	6.9	5.3	- 1.6	23%

APPENDIX C

Flooding Assessment Map



LEGEND

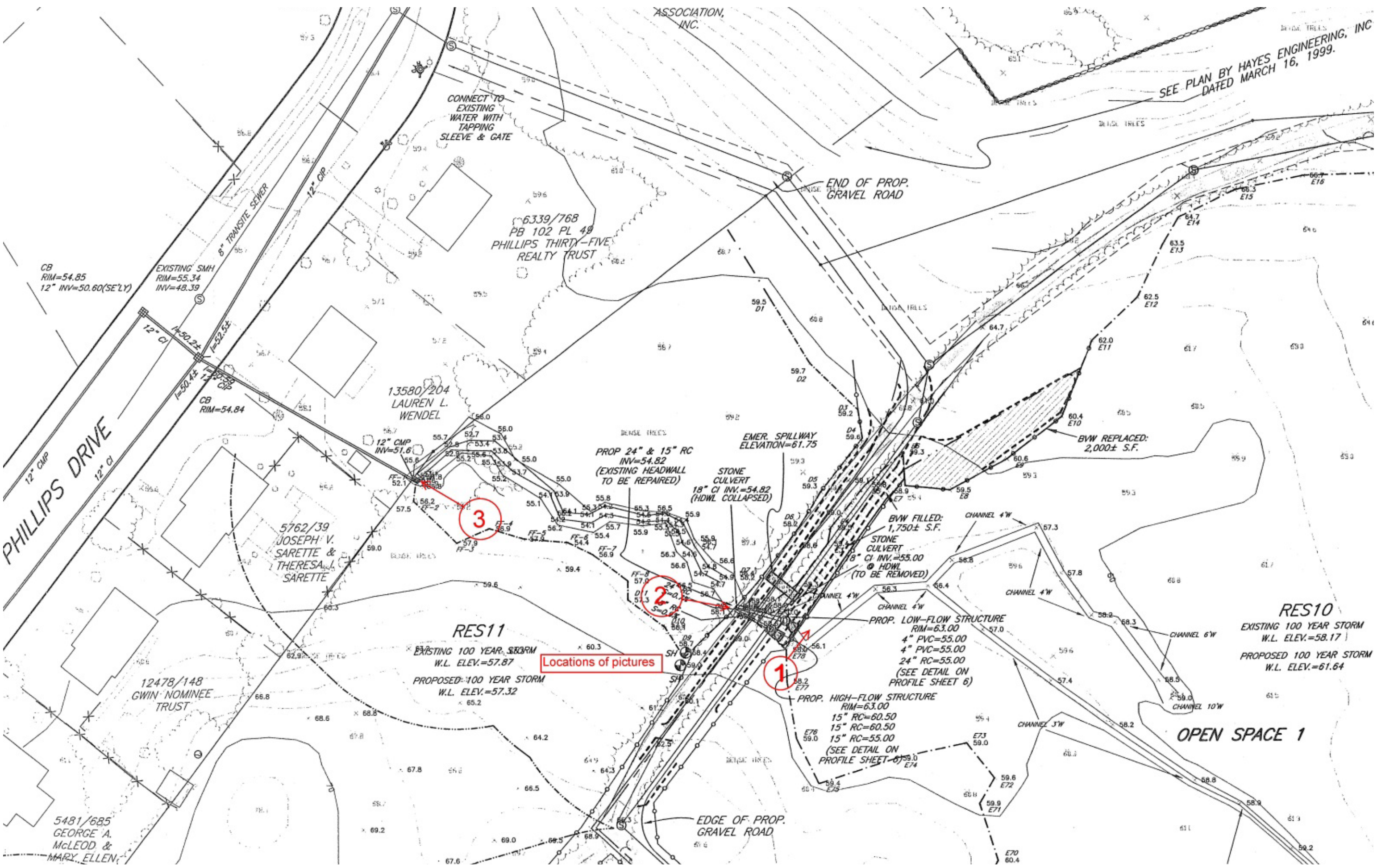
(red)	CHRONIC GROUNDWATER INFILTRATION	(magenta crosshatch)	REPORTED YARD FLOODING (PER JUNE 2017 DRAINAGE ISSUES REPORT)
(yellow)	BASEMENT FLOODING DURING SIGNIFICANT RAINFALL EVENTS	(green hatch)	ADDITIONAL NOTED YARD FLOODING

CITY OF NEWBURYPORT DEPARTMENT OF PUBLIC SERVICES 16A PERRY WAY NEWBURYPORT, MA 01950	PHILLIPS DRIVE NEIGHBORHOOD ROADWAY & DRAINAGE IMPROVEMENTS	DATE ISSUED: 01-24-2018
	FLOODING ASSESSMENT	SCALE: 1"=200'

APPENDIX D

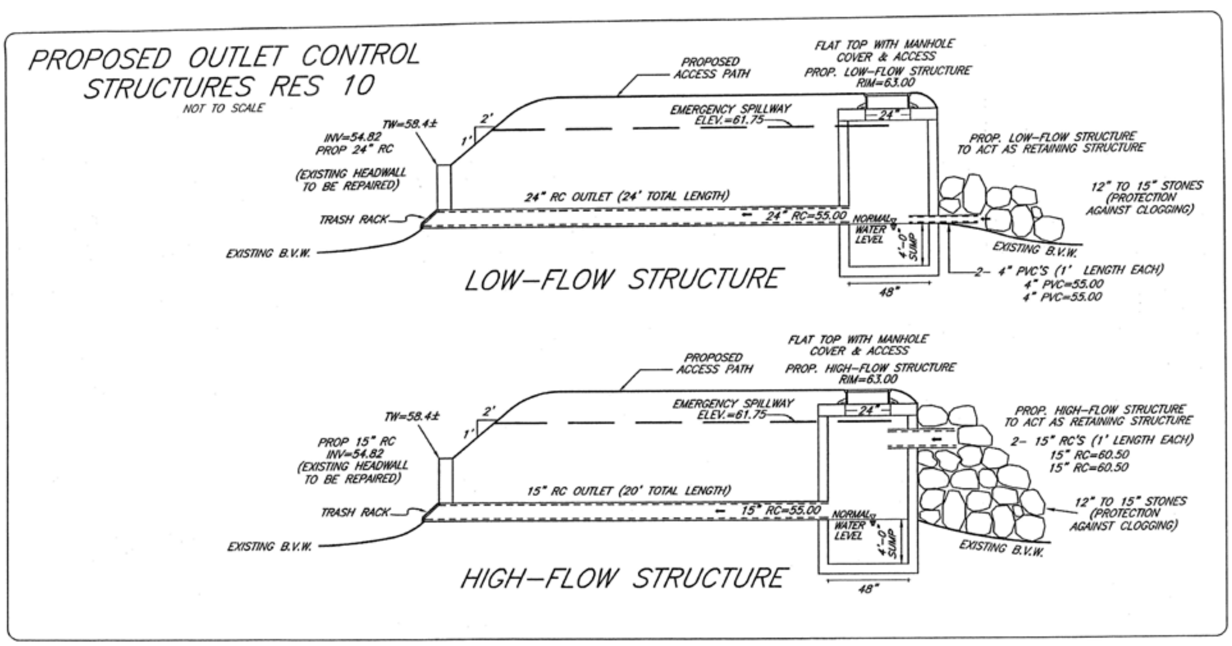
Pictures:

- Cherry Hill Detention Pond Outlet – RES 10
- Culvert inlet behind 37 Phillips



From Cherry Hill Subdivision Plans. Shows locations of where the following pictures were taken.

Picture 1: Fall 2017. Standing at the base of the berm/road looking northwest – road on left, detention pond on right. Notice drain manhole structure top left and stone in front of it.



Design sketch from Cherry Hill Subdivision Plans. The outlet control structure is a drain manhole with two pipes collecting flow from the pond.

The top picture shows that the inlet pipes are completely buried and are not functioning as designed (the bottom sketch). The stone is too small and the voids have since clogged preventing direct flow of runoff to pass downstream.

Picture 2: Two outlet pipes downstream of the road/berm. Pipe to right completely clogged.

Picture 3: Inlet of 12” pipe behind 37 Phillips Drive. This pipe collects all the discharge flows from Cherry Hill’s detention pond RES 10.

APPENDIX E

Phillips Drive Neighborhood Existing Conditions Plans and Conceptual Improvements Plans

CITY OF NEWBURYPORT
DEPARTMENT OF PUBLIC SERVICES
16A PERRY WAY
NEWBURYPORT, MA 01950

Rev No	Date	Drawn	Chkd	Description
				Revisions

Designed By:

Checked By:

Date: JANUARY 10, 2018

SCALE:
1" = 50'
0 25 50 100 FEET

PHILLIPS DRIVE NEIGHBORHOOD FLOODING EVALUATION REPORT

EXISTING CONDITIONS PLAN I

Sheet No.
1 OF 4

C-1

CITY OF NEWBURYPORT DEPARTMENT OF PUBLIC SERVICES 16A PERRY WAY NEWBURYPORT, MA 01950	Rev No / Date / Drawn / Chkd / Description Revisions	Designed By: Checked By: Date: JANUARY 10, 2018	SCALE: 1" = 50' 0 25 50 100 FEET	PHILLIPS DRIVE NEIGHBORHOOD FLOODING EVALUATION REPORT EXISTING CONDITIONS PLAN II	Sheet No. 2 OF 4 C-2

CITY OF NEWBURYPORT
DEPARTMENT OF PUBLIC SERVICES
16A PERRY WAY
NEWBURYPORT, MA 01950

Rev No	Date	Drawn	Chkd	Description

Revisions

Designed By:

Checked By:

Date: JANUARY 10, 2018

SCALE: 1" = 50'

0 25 50 100 FEET

PHILLIPS DRIVE NEIGHBORHOOD FLOODING EVALUATION REPORT

CONCEPTUAL IMPROVEMENTS PHASE I

Sheet No. 3 OF 4

C-3

CITY OF NEWBURYPORT DEPARTMENT OF PUBLIC SERVICES 16A PERRY WAY NEWBURYPORT, MA 01950	Rev No / Date / Drawn / Chkd / Description Revisions	Designed By: Checked By: Date: JANUARY 10, 2018	SCALE: 1" = 50' 0 25 50 100 FEET

PHILLIPS DRIVE NEIGHBORHOOD FLOODING EVALUATION REPORT

CONCEPTUAL IMPROVEMENTS PHASE II

Sheet No. 4 OF 4

C-4