Dalton Green Infrastructure Report

Dalton, MA

Created August 2021 by Berkshire Regional Planning Commission
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BRPC
Berkshire Regional Planning Commission

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Cover photo: Green Infrastructure at Greylock Works in North Adams, MA taken by Justin Gilmore, BRPC

Executive Summary

The Dalton Green Infrastructure Report was initially created to in response to repeat flooding in the lower Walker Brook watershed. Walker Brook is a tributary of East Branch Housatonic River located in the town of Dalton, MA. It flows from a steep hill area north of downtown southward where it is buried through the storm sewer system under the developed areas between High Street and Route 8 before converging with the Housatonic.

Rafting during flood event at former High School
Source: Old Dalton High School Advisory Committee

Funded for this study was initially provided by the Massachusetts Executive Office of Energy & Environmental Affairs, and follow-up development was completed through a MassDEP Nutrient and Pathogens Study of the Housatonic along with Town funds via the MS4 budget. The Berkshire Regional Planning Commission (BRPC) worked with the Town of Dalton and engineering consultants, Comprehensive Environmental Inc. and University of New Hampshire Stormwater Center to explore areas where green infrastructure best management practices (BMPs) could be installed both within the Walker Brook watershed as well as throughout developed areas townwide. Outreach through educational flyer mailings and public presentations kept residents and community members notified about study detail and informed them on personal emergency preparedness. The goal was to help Dalton better prepare for the growing likelihood of flood events due to a changing climate and increased precipitation while at the same time mitigate water quality issues caused by municipal stormwater within the MS4 area, particularly nitrogen.

Twenty-five locations were explored as potential sites for green infrastructures BMPs. Of those, pre-conceptual designs were created for 14 sites (see Pre-Conceptual Designs section, p. 12 and Appendix B). The top three site designs were developed further to 30% completion or "Conceptual Design" (see Conceptual BMPs, p. 13, Appendix C). Due to the importance of Walker Brook in this study, the site where the stream is buried near Dalton's Senior Center and Former School was topographically surveyed and site design plans were created to 60% completion (see section on Walker Brook, p. 15 and Appendix D). Design plans at this location include daylighting and restoring an above-ground stream channel of the buried brook.

This plan is broken into four main sections. The first provides general Background (p. 5) information on green infrastructure – what it is, the benefits, and example BMPs. The second section outlines the Potential Green Infrastructure Projects (p. 11) identified throughout Dalton, provides more detailed background information on the proposed site designs, pollutant load reductions, and ongoing maintenance needs. A Policies & Initiatives section (p. 19) provides examples of how green infrastructure can be promoted through Dalton regulation and the Funding & Technical Assistance section (p. 21) lists the funding opportunities and support available in Massachusetts to assist with green infrastructure implementation as well as additional resources on green infrastructure.

A copy of this report is available in Dalton Town Hall and on the Dalton Stormwater Management web page as well as through BRPC. For questions, feedback, or additional information please contact Courteny Morehouse, Energy & Environmental Planner at Berkshire Regional Planning Commission by email at cmorehouse@berkshireplanning.org or phone at (413) 442-1521 x26.

Background

Where does rain go after it hits the ground? Historically, stormwater infrastructure has been designed to funnel stormwater into catch basins that lead to pipes that in turn drain to streams and rivers. This system is sometimes called "gray infrastructure" since it is built primarily with concrete. For many years, this infrastructure proved the most efficient way to remove stormwater from pervious areas – areas where water cannot pass through a surface such as an asphalt road, parking lot, or the roof of a building. However, when the stormwater runs over pervious surfaces, it picks up pollutants that then get funneled directly into rivers and streams. These pollutants can include oil and chemicals from cars, heavy metals from building materials, grass clippings, fertilizers, and pesticides that wash off lawns and landscaping into nearby storm drains. As a result, water quality suffers.

Collectively these pollutants are classified as "non-point source pollution" because they cannot be traced to a single location. The passage of the 1972 Clean Water Act regulated and removed much of the "point source" pollutants, such as site-specific discharge and industrial waste that could be traced back to a single polluter. Today the biggest pollutant of our water bodies is non-point source wastewater.

Another issue that can arise from gray infrastructure systems is increased flooding. Stormwater systems in every town and city are built to accommodate a certain amount of precipitation and runoff both throughout the year and in any given storm. The bigger the storm the more water goes into the system. The amount of impervious area connected to the stormwater system plays a role in how much water is funneled into that system. I.e., the more development, roads, pavement, and buildings there are, the more rainwater is draining into the storm sewer system. Impervious areas in Dalton are located primarily around Route 8 (see the map and section in Appendix A) and much of the stormwater goes into the stream systems of Walker Brook, Unkemet Brook, and East Branch Housatonic River.

If the storm is particularly intense or long in duration, or if most of the water is draining into the system rather than infiltrating into the ground, water can back up and cause flooding. Even when there is not flooding, high volumes of water draining into a single river or stream can overwhelm the stream system. This is especially true if the floodplain surrounding that stream corridor has been developed. The water has only one place to go so it rushes through causing "flashy" flood conditions and sometimes severe erosion of the stream banks. More information on floodplains and a map of the 100-year floodplain in Dalton can be found in Appendix A.

Climate change has changed the equation on how much precipitation we can expect in the coming years. According to climate change modeling, increase in global temperature will lead to more frequent and more intense storms throughout New England. According to NOAA, the Northeast has experienced a 55% increase in precipitation since the 1950s. This is expected to increase an additional 40% by the end of the century.[1]

For these reasons, the state of Massachusetts, cities, towns, and private property owners have started to recognize an alternative to gray infrastructure and are incorporating green infrastructure into site design plans.

[1] Scott, Michon. 2019. *Prepare for more downpours: Heavy rain has increased across most of the United States, and likely to increase further.* Retrieved May 2021 at https://www.climate.gov/news-features/featured-images/prepare-more-downpours-heavy-rain-has-increased-across-most-united-0

What is Green Infrastructure?

In contrast with gray infrastructure, green infrastructure relies on landscaping, soil, plants, and other pervious materials that capture and store stormwater nearer to where rain and snow lands. Green infrastructure relies on man-made structures often in combination with soils and plant vegetation to allow stormwater to seep into the ground (infiltrate), return to the air (evapotranspire), and/or be stored and recycled. Green infrastructure mimics natural systems thereby reducing stormwater flows, replenishing ground water, and treating many of the pollutants before they reach surface waters. In turn, green infrastructure reduces the stress on gray infrastructure systems, restores wildlife habitats, and beautifies the community with natural areas.

A myriad of structures are considered green infrastructure. Below are a few of the more common examples that are proposed at the sites in this plan as well as some that can be implemented on residential properties at a smaller scale.

Green Infrastructure Examples

Bioretention Basin or Pond

Source: UNH Stormwater Center

Bioretention basins and ponds are a classification of green infrastructure that sometimes includes bioswales and rain gardens. All three are landscaped depressions or shallow basins that collect and infiltrate stormwater. Often bioretention basins are created in combination with adjoining grey infrastructure. Storm outfalls may direct stormwater to the basin, and basins are often constructed with an overflow storm drain that allows excess stormwater to reenter the storm sewer system during peak flows of intense storms.

Bioswales

Source: UNH Stormwater Center

Bioswales are shallow linear areas along roadsides, parking areas, or other impervious pavement that collect, slow down, and absorb stormwater from nearby areas. Curbs are removed or cut to allow stormwater to be redirected to the swale. Bioswales can be landscaped with native plants, or simply seeded with grass to reduce maintenance need. At times, rock veins or rip rap is installed along the bioswale to reduce stormwater velocity, allowing more of the water to infiltrate and alleviate flashy flow conditions during high intensity storms.

Rain Gardens

Source: PVPC Green Infrastructure Plan

Perhaps the most well-known form of green infrastructure, rain gardens collect water from nearby areas into an area where plantings and soil absorb and treat the water. Rain gardens can also be installed on residential properties to collect rainwater from downspouts. Depending on the plants selected, rain gardens provide an excellent opportunity to showcase native plants and promote pollinator populations.

Tree or Planter Boxes

Source: EPA

Tree or planter boxes utilize street plantings to allow for stormwater infiltrate in those areas where trees and plantings are installed along sidewalks or medians. Tree or planter boxes include soils, gravel and plants that will encourage infiltrations and treatment. They are typically smaller than rain gardens, bioswales and bioretention basins.

Permeable Pavement

Source: BRPC

Most pavement is impermeable, that is, liquids cannot move through or be absorbed by the material. By contrast, permeable pavement allows water to flow through the pavement while also functioning exactly like traditional asphalt or concrete pavement. Permeable pavement includes grid or
concrete pavers, porous asphalt, or pervious concrete.

Stream Daylighting

Source: EPA

Daylighting resurfaces some or all of a stream that has been buried through
a piped system. Streams can be daylighted by redirecting the stream through an open constructure channel or restoring the natural stream channel. When restored, the stream can mitigate flooding by allowing stormwater overflow to infiltrate and slow in the floodplain area surrounding the stream.

Impervious Disconnection

Source: EPA

Arguably the simplest form of green infrastructure is to disconnect a portion
or all of an impervious area. Curbless roads, driveways, or sidewalks and downspouts that drain to a nearby garden or grassy area function much the same way as a construction bioretention basin or swale.

Rain Barrels

Rain barrels store rainwater and are an easy installation and water storage system for residential homes. Water stored can be used later in gardens thereby reducing the need to use fresh water during drought and other dry times of the year.

Source: EPA

Benefits of Green Infrastructure

Mitigates Flooding & Slows the Flow

Figure 1: Watershed Diagram

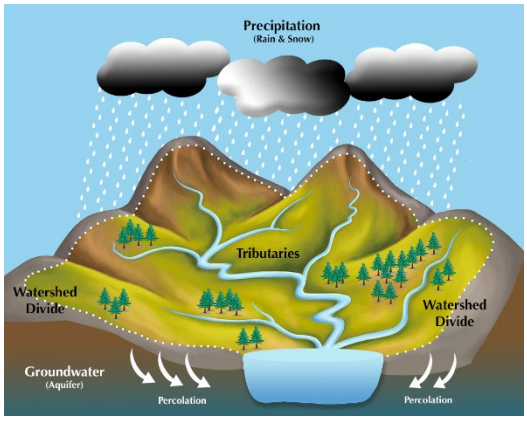


Diagram showing how a watershed works
Source: Center for Watershed Protection

Inland flooding is generally the result of moderate precipitation over several days, intense precipitation over a short period, or melting snowpack. Areas around rivers or streams are particularly prone to flooding since they are the lowest point in their watershed and therefore receive drainage from the rest of the watershed. One of the areas with high flood risk in Dalton is around Walker Brook. Walker Brook flows south toward the developed area of Route 8. The stream is buried where it crosses under High Street and travels underground in a series of undersized pipes and culverts until it reaches the East Branch of the Housatonic River. Existing drainage and storm sewer systems are not sufficient to accommodate waters during heavy rain events and as a result flooding threatens the Dalton Senior Center and adjacent houses. For years, storms caused frequent flooding in the Former Middle/High School basement eventually leading to its closure.

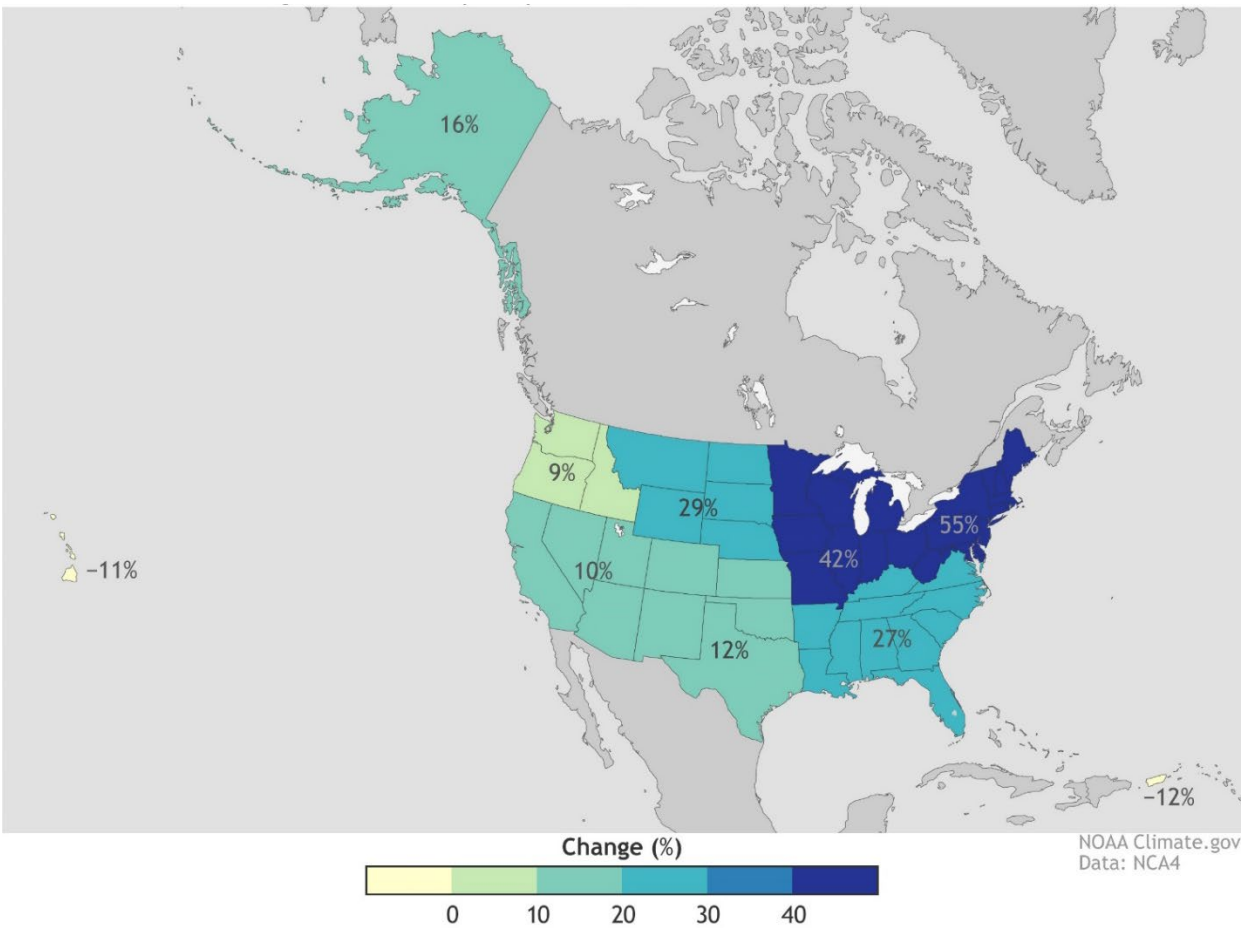
Developed, impervious areas increase surface runoff and can contribute to inland flooding. Impervious cover is any area where rain cannot move through the surface such as roads, sidewalks, roofs, and parking lots. By definition, impervious cover does not allow stormwater to infiltrate and instead redirects runoff to the storm sewer system. The more impervious cover, the more stormwater enters the system, the higher the chance of overwhelming that system and causing backups and flood. Higher percentages of developed land use can in effect increase the likelihood of a 100-year storm event (a storm with a 1% likelihood of occurring in any given year). This is especially true if development is concentrated in a stream floodplain such as Walker Brook. When left undeveloped, floodplains function by allowing excess water to overflow outside the stream channel into the area adjacent. When those areas are developed with impervious cover, stormwater has no place to go and can cause fast flow or "flashy" flood conditions. High velocity in addition to greater volume causes greater damage to traditional grey infrastructure as well as erosion of natural stream channels.

Green infrastructure mitigates flooding impacts of impervious cover by capturing and infiltrating stormwater volume near impervious areas. When distributed throughout a watershed it can store flood waters upstream or higher up in the watershed mitigating flood downstream. Moreover, by capturing flood waters and incorporating natural elements such as vegetation, rip rap, and other mechanisms, runoff flow

is slowed down, thereby decreasing its impact on grey infrastructure and reducing erosion. This in turn, can improve water quality (see more on water quality benefits in the next section).

Mitigating floodwater will become more important for Northeast communities in a warming climate.[2] Warmer air over land brings with it a greater chance for more extreme rain and wind events to occur, which results in greater rain bursts and more flooding. New England and the Northeast are expected to experience this increase the most within the United States. According to NOAA, heavy rain has increased 55% in the Northeast between 1958-2016, and precipitation is expected to increase at least another 40% by the end of the century.[3] Data from USGS streamflow gages across the Northeast show a clear increase in flow since 1940, with an indication that a sharp "stepped" increase occurred in the 1970s.[4] Aging infrastructure that is already undersized will need to be rethought and replaced.

Figure 2: Changes in Extreme Precipitation Across the United States



Observed recent changes in extreme precipitation, 1958-2016
Source: NOAA

[2] Madsen, Travis & Figdor, Emily. 2007. *When It Rains, It Pours: Global Warming and the Frequency of Extreme Precipitation in the United States.* Retrieved May 2021 from https://environmentamerica.org/reports/ame/when-it-rains-it-pours-global-warming-and-rising-frequency-extreme-precipitation-united

[3] Scott, Michon. 2019.

[4] United States Geological Survey. 2021. USGS StreamStats. Retrieved June 2021 from https://streamstats.usgs.gov/ss/

Reduces Runoff of Polluted Stormwater & Recharges Groundwater

In addition to increased flooding, impervious cover impacts water quality. As precipitation flows over hard surfaces it picks up pollutants that sit on those surfaces. This includes oils, grass clippings, fertilizers, pesticides, heavy metals, and more. Center for Watershed Protection modeling in 2003 demonstrated that land use in which impervious area throughout the watershed makes up greater than 10% starts to negatively impact water quality. When impervious area exceeds 25%, water quality deteriorates to the point that it does not support aquatic life.[5]

Figure 3: Rain Gardens on North Street, Pittsfield, MA

The City of Pittsfield installed 10 rain gardens on North Street by 2014.
Source: City of Pittsfield

The passage of the 1972 Clean Water Act improved water quality of streams, rivers, lakes, and ponds throughout the United States significantly by regulating and eliminating point sources of pollution such as those that discharge from industry. Nonpoint source pollution, that is pollutants that cannot be traced back to a specific source, have become the leading impact on water quality. For this reason, the EPA created two programs under the Clean Water Act to address stormwater pollutions: Section 319 of the Clean Water Act and the National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (MS4) Program. More on these programs can be found in the Policies and Initiatives section further on.

Depending on the location, green infrastructure captures impervious cover runoff, infiltrates stormwater and treats pollutants. By infiltrating stormwater green infrastructure recharges groundwater. The Berkshires have historically relied on a combination of precipitation and melting snowpack to recharge groundwaters. Warmer temperatures will reduce the amount of snowpack thereby increasing Dalton's reliance on capturing stormwater to replenish aquifers both above and below ground. Without greater infiltration, Dalton may experience greater periods of drought.

Twenty-four percent of Dalton land use is developed. Just over 9% of developed land is suburban-residential where impervious areas are broken up by green spaces (ex. parks and lawns) where there is more room for green infrastructure to be installed. The remaining 14.7% of developed land is a mix of commercial, institutional, and industrial from the infrastructure built up around the historical mills. Here, development is tighter, impervious cover is greater, and the risks of poor water quality and flooding are higher. Green infrastructure in these more densely developed areas will need to be creative – utilizing best management practices that are smaller but with similar impact such as tree and planter boxes or repurposing existing use such as building a bump-out with a curb cut within the road right-of-way. More urbanized cities such as Philadelphia, New York City, and Portland, OR provide good examples on how to incorporate green infrastructure into more heavily developed areas. One can find examples of their success in the EPA's Green Infrastructure Case Studies.

[5] Center for Watershed Protection. 2003. *Impacts of Impervious Cover on Aquatic Systems* (Watershed Protection Research Monographic No. 1). Retrieved May 2021 from https://clear.uconn.edu/projects/TMDL/library/papers/Schueler_2003.pdf

Potential Green Infrastructure Projects

Site Identification & Prioritization

As part of an existing MA EEA Planning Grant, Berkshire Regional Planning Commission (BRPC) partnered with Comprehensive Environmental Inc. (CEI) to evaluate various Town-owned parcels for implementation of stormwater green infrastructure improvements.

CEI began by completing a desktop review that identified 22 potential BMP locations throughout the Town of Dalton using available GIS information provided by the Town, BRPC, and publicly available through MassGIS (location map of these locations available in Appendix B). The desktop assessment included a review of relevant documentation that includes the following: GIS utilities data from the Town; Multiple site maps of the Walker Brook area for a Hazard Mitigation Grant Program prepared by Hill Engineers; Walker Brook Storm Drainage System Report prepared by Tighe & Bond, Inc.; and the 2019 Municipal Vulnerability Preparedness (MVP) Report. Applicable sites generally consisted of land owned by the Town of Dalton that contained impervious surfaces or were adjacent to impervious surfaces.

Once the potential BMP locations were determined, on-site field investigations were conducted on April 22, 2021 at each location to determine feasibility. CEI documented relevant information such as local topography, available space, expected contributing watershed area, opportunities for public demonstration, potential utility conflicts, etc. using a combination of field notes, sketches, and photographs. Of the sites, 12 sites were selected across 7 Town-owned parcels as having feasible locations for potential BMP design and construction. These 12 sites were selected for pre-conceptual design.

With input from BRPC and the Town of Dalton, 3 locations were chosen for advancement to 30% conceptual design with one of the sites being chosen for a 60% design. These sites are a parking area at Craneville Elementary School, Greenridge Park on South Street, and the Senior Center and Former School site where Walker Brook is buried. An additional 30% conceptual design was also prepared showcasing the feasibility of daylighting Walker Brook, an intermittent stream which is currently culverted below much of downtown Dalton from High Street to a discharge point located south of Main Street (Route 8).

One year later, MassDEP funded a Nutrient and Pathogen Study of the Upper Housatonic watershed. Consultants from University of New Hampshire (UNH) Stormwater Center and Paradigm Consultants reviewed the materials of CEI alongside results from a runoff model called Opti-Tool. With Town input, UNH selected and visited around five additional sites. Of these UNH developed conceptual stormwater management control system designs for two sites – the Dalton Garage and Riverview Dr.

Pre-Conceptual Designs

Based on the results of the field investigations conducted by CEI, the following 12 sites were selected for pre-conceptual BMPs. A locations map of all 22 locations explored and Pre-Conceptual Design plans can be found in Appendix B.

Table 1 – Pre-Conceptual BMP Locations

Site #	Lat.	Lon.	Location	Type of BMP
1*	42.475963	-73.175921	Craneville Elementary School Road	Double Bioretention Basin/Porous Pavement
2	42.475262	-73.178684	Craneville Elementary School Parking Lot	Bioretention/Grassed Swale
3	42.476793	-73.180954	Ashuelot Street Cemetery Access Road	Bioretention Basin
4	42.475892	-73.180937	Ashuelot Street Cemetery	Grassed Water Quality Swale
5*	42.452959	-73.186096	Greenridge Park	Infiltration Basin/Grassed Swale
6	42.452539	-73.190816	South Street – Hubbard Avenue	Infiltration Basin
7	42.478307	-73.170558	Pine Grove Park – West	Rain Garden
8	42.477115	-73.169388	Pine Grove Park – South	Grassed Water Quality Swale
9	42.477536	-73.168440	Pine Grove Park – East	Grassed Water Quality Swale
10	42.474406	-73.167517	View Street – Stockbridge Avenue	Infiltration Basin
11**	42.476158	-73.165811	Senior Center and Former Middle School	Two Infiltration Basins
12*	42.476158	-73.165811	Walker Brook Stream Daylighting	Stream Daylight
13***	42.476244	-73.154761	End of Riverview Dr.	Gravel wetland
14***	42.481180,	-73.175558	Dalton Sewer Dept.	Bioretention Conceptual Design

*Locations selected for advancement to 30% conceptual-level design.
**Locations selected for advancement to 30% conceptual-level and 60% to level design.
***Anayled and developed by UNH Stormwater Center

Conceptual BMPs and 60% Design of Walker Brook Site

Of the Pre-Conceptual locations, four were selected for advancement to 30% conceptual-level BMPs as noted in Table 1 as well as one for advancement to 60% design level. These projects were chosen based on need for flood and water quality mitigation needs, educational opportunity as a demonstration project, and site rehabilitation needs. Conceptual BMPs design drawings developed by CEI can be found in Appendix C. Additional designs (60% complete), survey data, and structure details for the Senior Center/Former School site as well as a StreamStats Report for Walker Brook watershed can be found in Appendix D.

Craneville Elementary School

Site Description

This site is located around the northern unnamed access road for Craneville Elementary School. Current site characteristics consist of a gravel/dirt parking area south of the roadway currently exhibiting erosion and contributing sediment to downstream catch basins, as well as an eroded channel along the edge of pavement north of the roadway. Two catch basins exist just south of the roadway within Park Avenue and John Street that receive untreated stormwater runoff from both the access roadway and Park Avenue. This site was chosen in part due to the parking area need for improvements.

Proposed Stormwater BMPs

The proposed project includes a combination of porous pavement, a grassed water quality swale and a bioretention basin south of the school road. The project also proposes a combination of a riprap swale and bioretention basin north of the school road. Porous pavement will replace the gravel/dirt parking area to limit suspended solids in stormwater runoff and providing infiltration during small storm events. Riprap will also be installed to armor the edge of the roadway on the northern side of the school road to minimize erosion; due to the proximity of trees, excavating and creating a new swale is not recommended in this area as it will disturb root systems. Stormwater will be conveyed east toward the proposed bioretention basins where small storm events will infiltrate into the ground, with nutrient uptake also provided via plantings. Outlet control structures will also be installed in both basins and tied into existing adjacent catch basins to safely handle large storm events.

Table 2 – Craneville Elementary School BMP Pollutant Removal Estimates

Site #	Location	BMP Types	P (lbs)	N (lbs)	TSS (lbs)
1	Craneville Elementary School Road	Porous Pavement	0.2	1.4	87
		Bioretention	0.2	1.4	130
Craneville Elementary School Road Total			0.4	2.8	217

* P = Phosphorus, N = Nitrogen, TSS = Total Suspended Solids

Table 3 – Craneville Elementary School BMP Anticipated Costs

Site #	Location	Final Design	Permitting	Bidding Assistance	Construction
1*	Craneville Elementary School Road	$10,000	$0	$4,000	$100,000 – $125,000

*Locations selected for advancement to 30% conceptual-level design.
**Locations selected for advancement to 30% conceptual-level and 60% to level design

Operation & Maintenance

Bioretention basin inspections and trash removal should be conducted monthly. New mulch, the removal of dead vegetation, replacement of dead vegetation and pruning should be completed annually in either the spring or fall. Plant maintenance within the basin is critical and removing and replacing dead vegetation is a must as elevated salt levels can quickly kill vegetation. It is strongly recommended that snow is not plowed directly into the basin; signs or fences may be put in place to limit the amount of snow impacts from plowed roadways. If the replacement of all media and vegetation is deemed necessary (not expected to occur less than once every 5 years), it is recommended that it be completed in the late spring or early summer. Outlet control structures should also be inspected and maintained to preserve flow capacity.

Quarterly vacuuming of the pavement should be scheduled to reduce clogging. No winter salt/sand should be applied to the porous pavement area. Nearby landscaped areas should be properly maintained to limit soil and mulch transport to the pavement. Structural inspections for cracking should be completed twice a year.

Greenridge Park

Site Description

This site consists of the western end of Greenridge Park parking area, a portion of median directly abutting the parking area and South Street, and a small part along the western perimeter of Greenridge Park. Stormwater runoff within the parking area currently flows from northeast to southwest where it is conveyed to one or more catch basins with no treatment. Additionally, stormwater from within part of Greenridge Park itself flows westerly where it is intercepted by an existing paved swale that runs along the western side of the park, discharging untreated to a catch basin adjacent to South Street. Greenridge Park was chosen because it is one of the more quiet parks in Dalton therefore would be less likely to impede on park use. At the same time, BMPs at this location could serve as an educational exemplar and attraction.

Proposed Stormwater BMPs

The proposed project includes removing part of the existing paved swale and installing a new grassed water quality swale that discharges to a small infiltration basin within the northwestern corner of Greenridge Park where stormwater will infiltrate during small storm events. During large storm events, stormwater will overflow the infiltration basin and flow down the existing paved swale to the existing catch basin. The paved swale will also be stabilized with riprap to reduce stormwater velocity.

The project will also include a subsurface infiltration trench within the western half of the grassed median between the parking lot and South Street. Two new leaching catch basins will be installed to collect the majority of runoff within the parking area via curb cuts. The catch basins will be connected with perforated

pipes surrounded with crushed stone to provided additional subsurface infiltration. Large storm events will flow into the existing catch basins located within South Street.

Table 4 – Greenridge Park BMP Pollutant Removal Estimates

Site #	Location	BMP Types	P (lbs)	N (lbs)	TSS (lbs)
5	Greenridge Park	Infiltration Basin	0.3	2.8	88
		Infiltration Trench	0.6	5.8	180
		Greenridge Park Total	**0.9**	**8.6**	**268**

* P = Phosphorus, N = Nitrogen, TSS = Total Suspended Solids

Table 5 – Greenridge Park BMP Anticipated Costs

Site #	Location	Final Design	Permitting	Bidding Assistance	Construction
5*	Greenridge Park	$8,000	$0	$4,000	$90,000 – $115,000

*Locations selected for advancement to 30% conceptual-level design.
**Locations selected for advancement to 30% conceptual-level and 60% to level design

Operation & Maintenance

Catch basins should be inspected annually and cleaned when the sediment level in the sump reaches one half of the depth from the sump to the lowest pipe invert. It is recommended that additional inspections be scheduled for after the foliage and snow removal seasons to ensure proper function of the catch basin. Clamshell style buckets are typically used to remove sediment from catch basin sumps although, if possible, a vacuum truck is preferred as it can remove more sediment than a traditional clamshell bucket while providing quicker maintenance.

Infiltration basin should be inspected at least twice a year, with preventative maintenance conducted concurrent with each inspection. Items that should be considered during the inspection include the following: erosion, woody vegetation growth on side slopes, sediment accumulation, vegetation health and differential settlement. Preventative maintenance typically consists of erosion repair, vegetation replacement and sediment removal. The basin should also be inspected after water within the basin reaches a level high enough to discharge out through the emergency overflow structure. Once construction of a new basin is complete, inspections should be conducted after every major storm of two or more inches for the first 6 months to ensure proper function and that the side slopes are sufficiently stabilized. Mowing of the side slopes and basin bottom should occur twice a year at a minimum. Grass clippings, organic debris and trash should be removed from the basin after mowing. Remove the sediment deposited on the basin bottom as required.

Stone infiltration trenches should be inspected quarterly to ensure proper function. Items that should be considered during the inspection include the following: erosion, woody vegetation growth, riprap condition, sediment accumulation and differential settlement.

Walker Brook: Senior Center and Former School Site

Site Description

The Walker Brook watershed is of particular concern as this watershed is relatively steep in nature, with an average slope of 12.7% per USGS StreamStats. The StreamStats Report can be found in Appendix D. Much

of the upper undeveloped area of Walker Brook is even steeper, thus the time of concentration of the stream is relatively short. During large rain events, the stream flows to an existing headwall north of High Street where it enters an undersized culvert that has periodically inundated much of downtown Dalton with several feet of water. An assessment completed in 1981 noted that the culvert is approximately 2,300-feet long with at least a dozen different cross-sectional segments that have been installed over the years. Additionally, the report notes that the culvert flows south down Field Street, however, field investigations completed by CEI indicate that the culvert may turn west up High Street before flowing south behind some of the houses along the west side of Field Street Extension before crossing back over between the houses to flow along 1st Street and then south toward the outlet.

The proposed site exists as a grassed field north of the Senior Center with Field Street Ext to the west and High Street to the north. The grassed area is currently used as a small soccer field and exercise equipment is located along the northern and eastern sides of the Senior Center building. A small equipment shed exists near the northeastern corner of the Senior Center parking lot, located only about 30-feet off the adjacent property lines. The area south of the Senior Center and associated parking areas is a large flat grass field. A total of 4 catch basins exist at the intersection of Field Street Ext and High Street with the most western 2 catch basins dropping directly into the Walker Brook culvert, a third basin discharging to a location immediately adjacent to the culverted brook headwall, and the fourth basin discharging to an unknown location. Typical utilities exist within both roadways with the Senior Center gas service running north to south from High Street. An additional site exists as a flat grassed field south of the Senior Center and in the vicinity of the southwest corner of the former middle/high school, just northeast of the intersection at Field Street and 1st Street. Existing drainage infrastructure exists throughout the grassed area and on 1st Street.

Proposed Stormwater BMPs

This location was selected for 60% design, and the following description represents work completed as both the 30% and 60% design effort.

The proposed project includes a large 4-foot-deep infiltration basin and sediment forebay within the grassy area north of the Senior Center. The project also proposes rerouting stormwater flow from the two most eastern catch basins to the infiltration basin via new drainage piping. The area is relatively flat, requiring little grading prior to excavation. This basin also provides an overflow pipe that ties back into the existing culvert in the event that stormwater flows exceed basin capacity. A gravel maintenance access area is proposed to provide easy access to the sediment forebay for cleaning.

The project will also include a large infiltration basin and sediment forebay within the grassy area south of the Senior Center. The project also proposes plugging the downgradient pipe exiting the catch basin north of the basin along Field Street Ext and rerouting flow to the infiltration basin. An existing drainage pipe transecting the proposed basin will also be cut and removed, with a new proposed outfall in the sediment forebay. The downgradient section of the existing pipe should be plugged. A new outlet structure at the southern end of the infiltration basin connecting to a proposed drainage structure that ties in with the existing drainage system. A gravel maintenance access area is proposed to provide easy access to the sediment forebay for cleaning.

The proposed project includes daylighting a portion of Walker Brook within the extents of the Town of Dalton owned parcel(s) that encompass the Senior Center and former Nessacus Middle/High School. A new headwall will be installed north of High Street would direct flow through an upsized culvert to a settling basin in the northern corner of the grassed field. This basin will in part allow for infiltrating small storm events, as well as providing for some flood storage due to the available storage volume. A meandering channel simulating

natural conditions will then convey water behind the senior center and south to an infiltration basin. A second culvert will then connect the infiltration basin to another stretch of designed channel. The designed channel would enter a new headwall near the intersection of 1st Street and Glennon Ave, before being piped within a new culvert to its outfall location south of Main Street.

Note that prior to completing this option, it is highly recommended that the existing Walker Brook culvert between the proposed southerly headwall and the existing daylighting location south of 1st Street be replaced in its entirety with a properly sized culvert capable of conveying large storm events to reduce the potential for flooding.

Table 6 – Walker Brook/Senior Center/Former School BMP Pollutant Removal Estimates

Site #	Location	BMP Types	P (lbs)	N (lbs)	TSS (lbs)
11	Senior Center and Former Middle School	Infiltration Basin (upper)	1.3	12.5	395
		Infiltration Basin (upper)	1.1	7.9	250
Senior Center and Former Middle School Total			2.4	20.4	645
12	Walker Brook Stream Daylighting	N/A			

* P = Phosphorus, N = Nitrogen, TSS = Total Suspended Solids

Table 7 – Walker Brook/Senior Center/Former School BMP Anticipated Costs

Site #	Location	Final Design	Permitting	Bidding Assistance	Construction
11**	Senior Center and Former Middle School	$12,000	$8,000	$6,000	$200,000 – $260,000
12*	Walker Brook Stream Daylighting	Unknown, to be determined			

*Locations selected for advancement to 30% conceptual-level design.
**Locations selected for advancement to 30% conceptual-level and 60% to level design

Operation & Maintenance

Catch basins should be inspected annually and cleaned when the sediment level in the sump reaches one half of the depth from the sump to the lowest pipe invert. It is recommended that additional inspections be scheduled for after the foliage and snow removal seasons to ensure proper function of the catch basin. Clamshell style buckets are typically used to remove sediment from catch basin sumps although, if possible, a vacuum truck is preferred as it can remove more sediment than a traditional clamshell bucket while providing quicker maintenance.

Sediment forebays should be inspected every month for buildup of sediment and organic debris as well as trash. Forebays should be cleaned quarterly and when sediment depth reaches 6 inches to 12 inches. Grassed basins should be mowed to a length no greater than 6 inches and no shorter than 3 inches. Check for signs of erosion and repair accordingly. After the removal of sediment, any damaged or distressed vegetation should be replaced. It is encouraged that reseeding be completed via hydroseeding to limit the disturbance of the forebay.

Infiltration basins should be inspected at least twice a year, with preventative maintenance conducted concurrent with each inspection. Items that should be considered during the inspection include the following:

erosion, woody vegetation growth on side slopes, sediment accumulation, vegetation health and differential settlement. Preventative maintenance typically consists of erosion repair, vegetation replacement and sediment removal. The basin should also be inspected after water within the basin reaches a level high enough to discharge out through the emergency overflow structure. Once construction of a new basin is complete, inspections should be conducted after every major storm of two or more inches for the first 6 months to ensure proper function and that the side slopes are sufficiently stabilized. Mowing of the side slopes and basin bottom should occur twice a year at a minimum. Grass clippings, organic debris and trash should be removed from the basin after mowing. Remove the sediment deposited on the basin bottom as required.

There is little proposed maintenance of the daylighted stream corridor outside of what is normally expected when new plantings are installed. As part of the daylighting project, a riparian buffer should be installed to prevent erosion and provide native habitat. Plantings should be inspected every 6 months to a year and replaced as needed in the spring or fall season. The stream corridor should be inspected periodically for excessive erosion and flow line shift and corrected as needed. Installation of boulders, rock veins, and additional riparian plantings of native vegetation can help slow stream velocity and stabilize banks.

Recommended Next Steps

Prior to finalizing design of the infiltration basins at the Senior Center and Former Middle School site, it is recommended that the following items be completed:

- Complete additional field investigations to fill in any remaining invert elevations that could not be located previously.
- Complete test pits to ascertain seasonal high groundwater and infiltration rates within the footprint of both proposed infiltration basins as noted under the Senior Center and Former Middle School option.
- Conclusively determine the route of the existing culvert.
- As the most up to date study available of the Walker Brook culvert was completed approximately 40 years ago in 1981, it is recommended that a new study be performed to ascertain the current culvert condition, as well as its actual location.
- A comprehensive Hydrology and Hydraulic modeling study should be completed for both the drainage system within downtown Dalton as well as the existing culvert.
- It is recommended that Dalton consider replacing the existing culvert with a properly sized structure.

Riverview Drive

Site Description

Fig. 1: End of road runoff avoids high catch basin and drains to paved swale left of basin. Source: UNH Stormwater Center

At the end of Riverview Drive nearest the water, there is a catch basin and a paved drainage swale that flow directly into the stream untreated (Figure 1). There is undercutting and erosion evident (Figure 2). The untreated stormwater flowing into the stream is the major issue at this site.

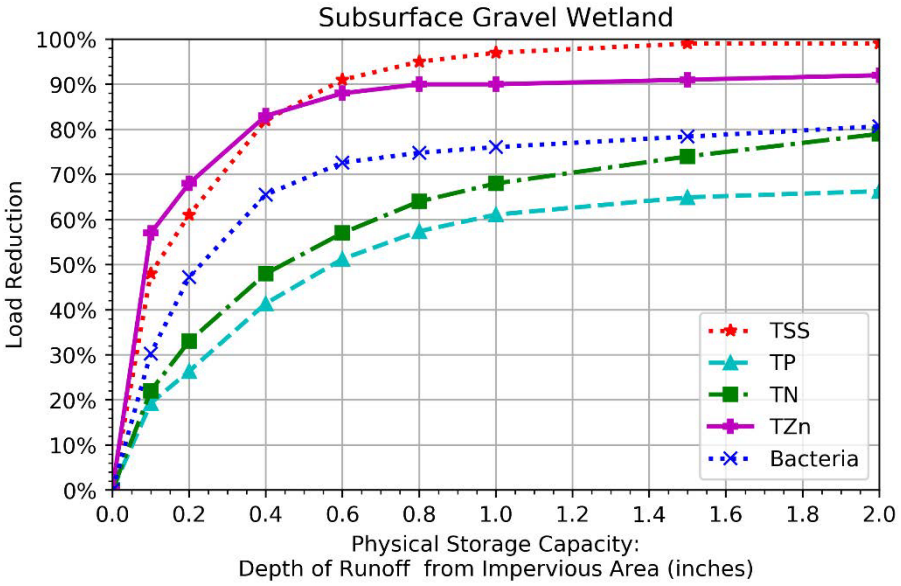
Fig. 2: Surface runoff is conveyed in the paved swale directly to the pond feeding the East Branch Housatonic River. Source: UNH Stormwater Center

Proposed Stormwater BMPs

The proposed stormwater control measure (BMP) designs were developed using the EPA Region I Performance Curves. Generally, the target BMP size of the Physical Storage Capacity (PSC) is greater than 0.1-inch. The cost-optimized PSC is at the "knee" of the curve and generally around the value of 0.4-inch although this varies depending on the BMP and infiltration rate. Figure 3 shows the performance curve for a subsurface gravel wetland (BMP Performance Fact Sheets, UNH Stormwater Center, 2019).

The cost-optimized size would occur at the knee of the line when there are diminishing returns of performance for an increase in PSC. This can be estimated quickly to be about between 0.2-0.6-inch for all parameters. It may also be calculated by finding the root of the second derivative of the line (as done here).

The PSC is the depth of runoff from the impervious drainage area which the BMP hold in the void space. The optimized sizing of 0.4-inch means the BMP is sized to have voids capable of holding 0.4-inches of precipitation on the impervious area. Although the static sizing is 40% of the 1-inch sizing, the load reductions range from 70% to 100% so there is little penalty in performance for building a smaller system. Conversely, there is little performance benefit for building a much larger 1-inch system while the construction and real-estate costs increase substantially. The Load Reduction on the y-axis is the annual reduction modelled using a rainfall record of a couple decades to simulate the full range of typical rainfall events and antecedent conditions.



The proposed designs are undersized to fit within the existing swale currently conveying flow from the large urban drainage area. This is a retrofit targeted at improving water quality treatment for nitrogen, bacteria, and gross solids. These concepts did not investigate site specific geotechnical details such as depth to groundwater or hydrologic soil group that could require design modifications.

The generic design detail found in Appendix C shows the plan view of the existing drainage area and proposed system area and components. There are also associated cross-sections of typical BMP construction and components. These details can change and be customized with advanced site-specific survey and design information.

This leaching catchbasin design has been modified with an expanded stone envelope and a small internal storage reservoir or saturated zone that will mimic the function of a subsurface gravel wetland. The inlet

will be a grated inlet and the outlet will occur over a stabilized internal clay berm. There is no secondary outlet as excess flow will level spread through the stone over the internal berm.

Summary of site parameters, design summary, performance curve efficiencies and load reductions.

	Parameter	Units	SCM 1
Watershed	Impervious Drainage Area	ac	0.59
	Land Use	-	Med Res.
SCM	Stormwater Control Measure	-	Enhanced Leaching Basin
	Applicable Performance Curve	-	Subsurface Gravel Wetland
	Infiltration Rate	in/hr	
Intermediate Calculations	Design Storage Volume	cf	270
	Physical Storage Capacity	in	0.1
Performance Curve Removal Efficiencies	Volume	%	0%
	P	%	22%
	N	%	26%
	TSS	%	54%
	Zn	%	63%
	Bacteria	%	36%
Load Export Rates	Volume	Mgal/yr	0.62
	P	lb/yr	1.2
	N	lb/yr	8.3
	TSS	lb/yr	260
	Bacteria	Billion MPN/yr	4
SCM Annual Performance	Volume	Mgal/yr	0.00
	P	lb/yr	0.3
	N	lb/yr	2.1
	TSS	lb/yr	140
	Bacteria	%/yr	36%
Costs	Total SCM Costs	$	$5,000
	Volume	$/Mgal-yr	N/A
	P	$/lb-yr	$19,600
	N	$/lb-yr	$2,330
	TSS	$/lb-yr	$40
	Bacteria	$/%-yr	$140
O&M	Estimated O&M Hours	hr/yr	13

Operation & Maintenance

Catch basins should be inspected annually and cleaned when the sediment level in the sump reaches one half of the depth from the sump to the lowest pipe invert. It is recommended that additional inspections be scheduled for after the foliage and snow removal seasons to ensure proper function of the catch basin.

Dalton Sewer Department – Dept. Public Works Garage

Site Description

The sewer department site showed considerable deposition of fine sediment, particularly between the two main buildings where water drains slowly after precipitation events (Figure 1). The water flows from a catch basin (Figure 1) into a pipe that leads to the adjacent town-owned property (Figure 3).

Fig. 1: The main catch basin for the Dept. drains half the garage, the lot, and the salt shed. It tends to back up during storms (Site A)
Source: UNH Stormwater Center

Fig. 2: Front of parking lot and half of the garage are all impervious surface with no stormwater treatment. Infiltration near street may be an option.
Source: UNH Stormwater Center

Fig. 3: The outlet of the Dept. drainpipe is submerged and drains to a yard with no outlet. The outlet should be daylighted and treated with a BMP (Site B).
Source: UNH Stormwater Center

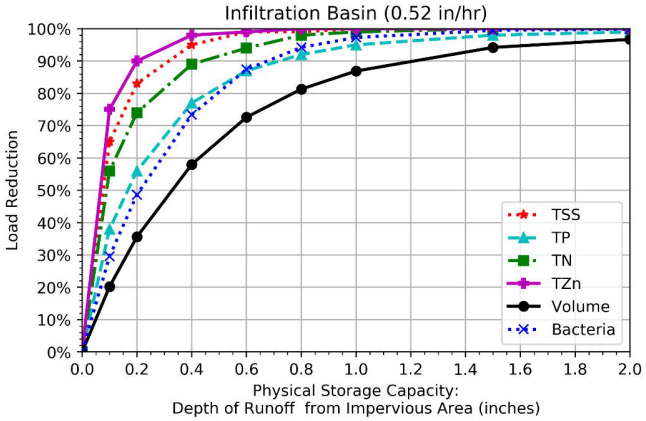
Proposed Stormwater BMPs

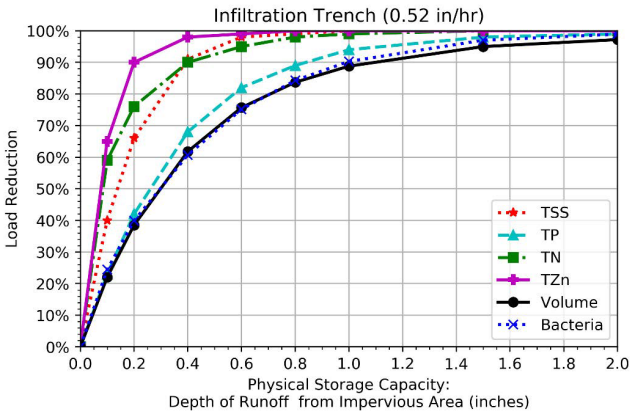
We recommend the installation of a bioretention system with a precast pretreatment system for the collection of sediment/solids from the high-use DPW yard. The bioretention would be located at the existing drain outfall. The pipe would be replaced in the grassed area up to the access road north of Site B.

The proposed stormwater control measure (BMP) designs were developed using the EPA Region I Performance Curves. Generally, the target BMP size of the Physical Storage Capacity (PSC) is greater than 0.1-inch. The cost-optimized PSC is at the "knee" of the curve and generally around the value of 0.4-inch although this varies depending on the BMP and infiltration rate. A conservative infiltration rate of 0.52 in/hr was assumed for this site without having performed in-situ soil tests. Figure 3 shows the performance curve for an infiltration basin and an infiltration trench (BMP Performance Fact Sheets, UNH Stormwater Center, 2019).

The cost-optimized size would occur at the knee of the line when there are diminishing returns of performance for an increase in PSC. This can be estimated quickly to be about between 0.2-0.6-inch for all parameters. It may also be calculated by finding the root of the second derivative of the line (as done here).

The PSC is the depth of runoff from the impervious drainage area which the BMP hold in the void space. The optimized sizing of 0.4-inch means the BMP is sized to have voids capable of holding 0.4-inches of precipitation on the impervious area. Although the static sizing is 40% of the 1-inch sizing, the load reductions range from 70% to 100% so there is little penalty in performance for building a smaller system. Conversely, there is little performance benefit for building a much larger 1-inch system while the construction and real-estate costs increase substantially. The Load Reduction on the y-axis is the annual reduction modelled using a rainfall record of a couple decades to simulate the full range of typical rainfall events and antecedent conditions.





The proposed designs shown in Appendix C are optimized to fit within the site and associated drainage area. This is a retrofit targeted at improving water quality treatment for nitrogen, bacteria, and gross solids. These concepts did not investigate site specific geotechnical details such as depth to groundwater or hydrologic soil group that could require design modifications.

The following generic design detail shows the plan view of the existing drainage area and proposed system area and components. There are also associated cross-sections of typical BMP construction and components. These details can change and be customized with advanced site-specific survey and design information.

This is a combined BMP design consisting of a leaching catch basin to intercept the upland drainage area to a lower bioretention system/infiltration in the adjacent town-owned property. The inlet into the leaching catchbasin will be a grated inlet that discharges to the bioretention system. The overflow will be through an armored spillway over the existing grade.

Table 1: Summary of site parameters, design summary, performance curve efficiencies and load reductions.

	Parameter	Units	SCM 1	SCM 1	Total in Series
Watershed	Impervious Drainage Area	ac	0.98	0.98	0.98
	Land Use	-	Comm. / Ind.	Comm. / Ind.	-
SCM	Stormwater Control Measure	-	4 Leaching Basins	Bio-Filtration	
	Applicable Performance Curve	-	Infiltration Trench	Infiltration Basin	
	Infiltration Rate	in/hr	0.52	0.52	
Intermediate Calculations	Design Storage Volume	cf	1,120	960	
	Physical Storage Capacity	in	0.3	0.3	
Performance Curve Removal Efficiencies	Volume	%	53%	45%	74%
	P	%	59%	65%	86%
	N	%	86%	82%	97%
	TSS	%	84%	90%	98%
	Zn	%	99%	95%	100%
	Bacteria	%	53%	59%	81%
Load Export Rates	Volume	Mgal/yr			1.03
	P	lb/yr			1.7
	N	lb/yr			14.7
	TSS	lb/yr			371
	Bacteria	Billion MPN/yr			6
SCM Annual Performance	Volume	Mgal/yr			0.76
	P	lb/yr			1.5
	N	lb/yr			14.4
	TSS	lb/yr			364
	Bacteria	%/yr			81%
Costs	Total SCM Costs	$	$20,000	$31,000	$51,000
	Volume	$/Mgal-yr		$67,750	$67,001
	P	$/lb-yr		$27,200	$34,089
	N	$/lb-yr		$2,580	$3,551
	TSS	$/lb-yr		$90	$140
	Bacteria	$/%-yr		$530	$63,174
O&M	Estimated O&M Hours	hr/yr	8	20	28

Policies & Initiatives

Clean Water Act Section 319 Non-Point Source Pollution Program

Clean Water Act Section 319 Nonpoint Source Management Program was established in 1987 to address nonpoint source of pollution such as stormwater, that cause poor water quality resulting in impaired water. Under the Clean Water Act Section 305(b), states are required to assess water quality of their streams and rivers. Those waterbodies that do not meet the federal and/or state water quality standards are listed as "impaired" for specific pollutant(s) in the Massachusetts Integrated List of Waters released on a biannual basis as required by Section 303(d) of the Clean Water Act. Lake and pond trophic levels are determined and listed in this same document pursuant with Clean Water Act Section 314. That list of impaired waters sets the stage for local groups, organizations, municipalities, and states to access Section 319 program funding to address pollutant sources. The Massachusetts Department Environmental Protection (MA DEP) 319 Grant program funds implementation projects such as installation of green infrastructure. For more on this program, see the Funding & Technical Assistance section below.

The Map of Impervious Cover (found in Appendix A) displays which streams are impaired according to the 2014 Massachusetts Integrated List of Waters. According to this list there is only one stream in Dalton that does not meet the Water Quality Standards for fishable, swimmable waters – the East Branch Housatonic River. The East Branch Housatonic River is listed as impaired for Polyflourinated biphynals (PCBs), an issue unrelated to stormwater runoff. This is not to say that water quality in all streams is stellar. Indeed, the addition of green infrastructure throughout Dalton will help keep streams off the impaired waters list, even as development continues.

National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) General Permit Program

Dalton is regulated under the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) General Permit as a suburb of Pittsfield. The portion of Dalton located in the MS4 "Urbanized Area" includes the neighborhood around Walker Brook. The MS4 General Permit treats storm sewer systems in urbanized areas as a single "point source" therefore allowing the EPA and state environmental protection agencies to regulate stormwater runoff. The goal of the program is to establish best management practices that will in turn reduce runoff pollutants in the waters of the United States. Green infrastructure is not required under the current Phase II MS4 General Permit. However, towns are required to identify areas where green infrastructure and low impact development can be installed to treat urban runoff.

As part of this plan and in compliance with MS4 requirements, Berkshire Regional Planning Commission worked with Dalton's Stormwater Management Commission to review the existing by-laws and regulations to determine how friendly, prohibitive, or ambivalent Dalton's policies are street design requirements are to Green Infrastructure. A copy of this review along can be found in Appendix E. Recommendations are in the section below. If adopted these updates will incorporate green infrastructure especially at new development sites and strengthen the Dalton's regulatory framework needed to keep waters clean.

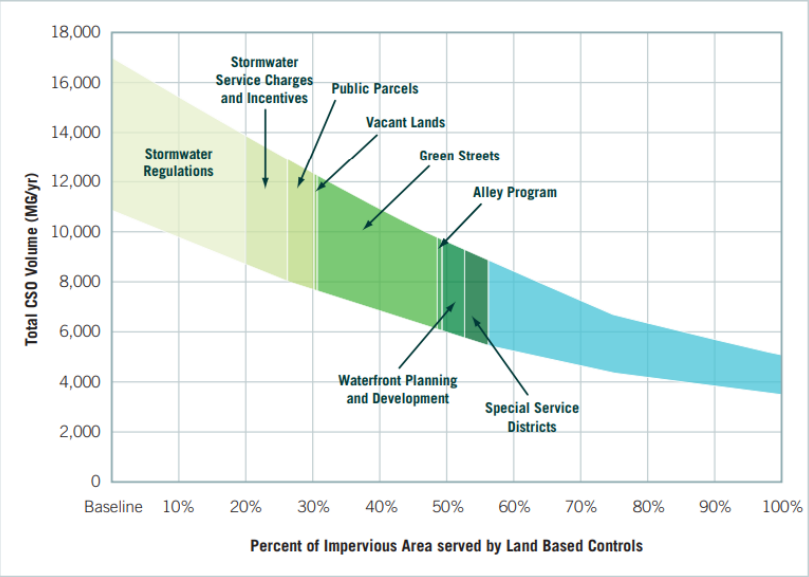
Model By-Laws

Regulation and town by-laws can impact the promote or discourage green infrastructure and reduce flood risk, whether intentional or inadvertent. In addition to an update to Dalton's Stormwater Regulations, adoption of a floodplain by-law would conserve floodplain, reduce flooding, and encourage green infrastructure. Massachusetts has created Model Floodplain By-laws to help towns accomplish this, a copy of which can be found in Appendix F. The next step to encouraging green infrastructure adoption would be to assess Dalton's Zoning, Subdivision of Land and other relevant regulations to identify areas where regulation can be updated to promote green infrastructure, low impact development, and smart growth practices. Resources that can help with this review include the Center for Watershed Protection's Cod and Ordinance Worksheet, the U.S. EPA's Water Quality Scorecard, and the Metropolitan Area Planning Council's Low Impact Development Toolkit Checklist for Regulatory Review.

Green Streets

Green Streets is roadway design and urban planning that incorporates green infrastructure while promoting energy reduction such as renewable energy and alternative transportation to the maximum extent possible. Portland, OR was the first community to fully utilize the green streets design when City Council adopted their Green Street Resolution, Report, and Policy. The resolution required new development, re-development, or enhancement projects funded by the City to incorporate green infrastructure and "green street" elements to the maximum extent possible.[6] An EPA study of green infrastructures projects across the US found that stormwater regulations only impact and treat up to 20% of a community's impervious cover whereas a green streets program, can reach up to 50% (see Figure 4).[7]

Figure 4: Graph of Philadelphia Green Infrastructure Modeled



City of Philadelphia modeled the impact of different approaches to convert land use to include green infrastructure.
Source: Philadelphia Water Dept. found in EPA Green Infrastructure Case Studies

Fifty miles of road connect Dalton, 2.5 miles of which are dirt and 6.6 of which are maintained by MassDOT (Route 8 and Route 9).[8] If Dalton adopted a Green Streets policy, the town could save money on overall project costs for roadway development and enhancement projects by reducing the need for asphalt and concrete especially if supplemented by grant funding.

[6] City of Portland, OR. 2007. *36500 Green Streets Policy & Report Resolution.* Retrieved June 2021 from https://efiles.portlandoregon.gov/Record/2850080/?_ga=2.242033538.1244740509.1624201478-774910026.1624201478
[7] United States Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. 2010. *Green Infrastructure Case Studies: Municipal Policies for Managing Stormwater with Green Infrastructure*. Retrieved June 2021 from https://nepis.epa.gov/Exe/ZyPDF.cgi/P100FTEM.PDF?Dockey=P100FTEM.PDF
[8] Town of Dalton, MA. 2018. *Dalton Multi-Hazard Mitigation Plan Update 2018.* Retrieved June 2021 from https://dalton-ma.gov/wp-content/uploads/2019/08/Dalton-MA-Multi-Hazard-Plan-Adopted.pdf

Funding & Technical Assistance

As more state and federal agencies realize the benefits of green infrastructure, a number of opportunities have been created to fund green infrastructure projects. Where funding comes from is largely dependent on both where the project is located and what the target goals are. Projects located on public roads and sidewalks can often find funding from transportation programs such as Massachusetts Department of Transportation (MassDOT). Projects that reduce pollutant loading and restore habitat can source from funds provided by Massachusetts Dept. Environmental Protection (Mass DEP), EPA, Massachusetts Department of Conservation and Recreation (Mass DCR), and Massachusetts Department of Ecological Restoration. Flood mitigation projects that address climate change impacts may look to several funding sources from Massachusetts Emergency Management Agency (MEMA) as well as the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA) Municipal Vulnerability Preparedness Program.

Hazard Mitigation Grant Program (HMGP) (MEMA)

Hazard Mitigation Grant Program is awarded by the Federal Emergency Management Agency through MEMA to towns, states, and territories after a presidentially declared disaster. Funding goes towards projects to help communities rebuild homes, infrastructure, etc. in a way that also reduces the risk of future disaster losses and impact. Projects covered by this program include stormwater upgrades, drainage and culvert improvements, property acquisition, slope stabilization, infrastructure protection, and structure elevations. Learn more at MEMA's Hazard Mitigation Grant Program website.

Flood Mitigation Assistance (FMA) Grant Program (MEMA)

Flood Mitigation Assistance (FMA) is a category of Hazard Mitigation Assistance Grants specific to the impacts of flooding. To apply for FEMA funding a community must be a part of the National Flood Insurance Program (NFIP), have an up-to-date Hazard Mitigation Plan and have demonstrated risk of repetitive flood damage to buildings, infrastructure, and homes insured by NFIP. Grant funds can be used for projects that will reduce or eliminate risk to those structures through property acquisition, stormwater and drainage infrastructure upgrades, structure elevations, and more. Learn more at FEMA's Flood Mitigation Assistance website.

Building Resilient Infrastructure and Communities (BRIC) Grant Program (MEMA)

The newest grant program in the MEMA toolkit is the Building Resilient Infrastructure and Communities (BRIC) Program. BRIC replaces the Pre-Disaster Mitigation Gran Program to help communities prepare for and reduce the risk of natural disasters prior to impact. In addition to implementation projects, BRIC funds planning projects that increase community capability and capacity-building. This can include updates to building codes, developing new partnerships, project scoping, and mitigation planning. Similar to FEMA, communities applying for BRIC must have an up to date Hazard Mitigation Plan. Learn more at FEMA at the Building Resilient Infrastructure and Communities webpage.

319 Nonpoint Source Grant Program (Mass DEP)

This grant is federally funded by the U.S. Environmental Protection Agency (EPA) via Massachusetts Department of Environmental Protection (Mass DEP) as part of the Clean Water Act Section 319 to address nonpoint sources of pollution that lead to impaired waters. In Massachusetts 319 grants fund implementation projects that reduce listed pollutants to specific water bodies, which can be found in the *Massachusetts Impaired Waters List* (sometimes called the 303d Impaired Waters List). To be awarded 319 funds, projects are required to have an EPA approved 9 Element Watershed-Based Plan that outlines structural and non-structural best management practices, estimated pollutant load reductions, and community engagement. Grant awarded require a 40% nonfederal match. Massachusetts 319 program is open to local governments, regional entities, nonprofits, and for-profit consultants. Funds must only be used on implementation. Planning projects such as creating Watershed-Based Plans can be funded by some entities through a 604b grant described below. Information on grants water quality related (319, 604b, and MS4 Assistance) visit DEP's Grants webpage.

604b Water Quality Management Planning Grant Program (Mass DEP)

The 604b Water Quality Management Planning Grant is another grant administered by Mass DEP through the Clean Water Act. Applications are open only to regional planning agencies, councils of governments, conservation districts, counties, cities and towns, and other state public planning and interstate agencies. Funds can be used for water quality assessment and management planning, including 9 Element Watershed-Based Planning. No local match is required.

Clean Water State Revolving Fund (SRF) Loan Program (Mass DEP)

The State Revolving Fund (SRF) offers low-cost loans (2% interest loans) to Massachusetts municipalities to help them comply with federal and state water quality requirements. In addition to BMP implementation projects, green infrastructure planning projects can receive loan funds as long as the project is consistent with Mass DEP's Nonpoint Source Management Plan. In order to secure SRF Loan funding, towns need to demonstrate how the project is needed to achieve compliance with applicable discharge permit such as MS4 or other NPDES permit, the project should be identified in a watershed management plan and should be consistent with local and regional growth plans. This is ideal for BMPs that also overlap with Dalton's NPDES sewer discharge permit. Learn more about State Revolving Fund Loan Program here.

Municipal Culverts Replacement and Ecological Restoration Grants (Mass DER)

Massachusetts Department of Ecological Restoration (Mass DER) is tasked with restoring rivers, stream, and wetlands throughout the Commonwealth. They often work on these projects directly providing expertise support to on-the-ground local groups, however they also offer a couple of grant programs to help cities and towns restore natural stream and wetlands. The most notable of these is the Culvert Replacement Municipal Assistance Grant Program which provides funds to upsize or replace culverts with bridges that meet the Massachusetts Stream Crossing Standards. Mass DER funds and expertise could be leveraged to fund both replacement of the High Street culvert and daylighting of Walker Brook.

Municipal Vulnerability Preparedness (MVP) Grant Program (EOEEA)

The Municipal Vulnerability Preparedness (MVP) program was created by the Executive Office of Energy and Environmental Affairs specifically to help Massachusetts towns and cities adapt to and mitigate the impacts of climate change locally. The project has two funding programs – planning and action grants. Municipalities that complete the MVP planning process are eligible for action grants that fund the

implementation projects identified in their MVP Plans. Dalton is an MVP Certified community and therefore eligible for Action Grant funding of green infrastructure projects. MVP funds require a 25% match which can sometimes line up well with federal grants requiring match such as the 319-program listed above. For more on MVP Grants go to the Resilient MA website.

Complete Streets (Mass DOT)

Mass DOT's Complete Streets program helps towns and cities create streets that are designed and operated to enable safe access for all users, including pedestrians, bicyclists, motorists, and transit riders of all ages and abilities. Grants awarded through this program fund bike paths, sidewalks, and rethinking traditional street design to incorporate green stormwater infrastructure such as tree boxes, infiltration planters, and more. Dalton is a Tier 3 Complete Streets community with an approved prioritization plan as of 2017. This makes Dalton eligible for project grant funding. Learn more about Complete Streets at MassDOT.

Chapter 90 Funding (MassDOT)

Each municipality in Massachusetts is allocated Chapter 90 state funding program to reimburse for capital improvements made to extend the life of eligible transportation and related roadway infrastructure. Funds may be used for project design, roadways, sidewalks, right-of-way acquisition, landscaping, street lighting, traffic control, and roadside drainage, including green infrastructure solutions. Dalton has 40.36 miles of eligible roadways for which $222,375 was apportioned in fiscal year 2021. For more information on Chapter 90 visit Mass.gov here.

MassWorks Infrastructure Program (EOEEA)

MassWorks Infrastructure provides capital funds to municipalities to create housing, private development, and promote job creation with a particular focus on multi-family development in walkable, mixed-use districts in week or distressed areas. If utilized in conjunction with housing development, Dalton may apply for MassWorks funding to include green spaces and low impact stormwater development in the project design. To learn more about MassWorks and see recently funded projects check out the MassWorks website.

Technical Assistance

Many towns, including Dalton, may not have the staff capacity to hire employees trained to design, install, and maintain green infrastructure. Therefore, many of the above grant programs offer technical assistance in addition to providing funding to contract with a civil engineer with experience in green infrastructure specific designs. Learning from communities that have started implementing green infrastructure in their municipalities can provide a bounty of insight. Fortunately a number of communities in nearby Massachusetts towns and cities have installed green infrastructure including Pittsfield, North Adams, and Deerfield to name a few. For a more national resource, the EPA has dedicated a robust section of their website to green infrastructure information, examples, and technical assistance. A great resource specific to Public Works departments is the Green Infrastructure Guide for Public Works Projects developed by Franklin Regional Council of Governments.

Recommendations

Structural Recommendations

As an MS4 Community, Dalton is required to install at least one Stormwater BMP that targets nitrogen pollutants as per the MS4 General Permit. Any of the suggested BMP designs would accomplish this goal, with some costing more than others. Since there are few funding resources eligible to fund MS4 activities, the recommendation of this report would be to identify the least costly BMP that treats the most nitrogen. It would be especially advantageous if this site were more visible to the public, so that the Town could promote the idea of Green Infrastructure as they seek funding to implement more design plans.

In this report, the least costly design is the Riverview Drive gravel wetlands. Estimated costs for installation and final design creation is $5,000. This structure would remove 25% Nitrogen (2.1 lbs/yr), an average cost of $2,300 per lb/yr.

Non-structural Recommendations

Dalton has been an MS4 community since 2003. In this time, much progress has been made to update the Town's policies and regulations. This includes the formation of an inter-agency Stormwater Commission, the passage of a Stormwater By-law and additional Stormwater Regulations (updated in 2021), and the funding of and/or participation in several stormwater related studies.

While these are important first steps, Dalton could promote Green Infrastructure even more by amending regulations to reduce impervious cover and promote Green Infrastructure. In 2022, BRPC utilized Mass Audubon's Zoning and Bylaw Review Tool to examine Dalton's regulations (see Appendix E). This review looks at 54 policies and planning requirements for impervious cover including sidewalk and street design, parking lot sizes etc.and rates them as Conventional, Better or Best Practices. Of the policies reviewed, under half (41%) were rated as "Conventional," 35% rate as "Better," and nearly a quarter (24%) were "Best Practices."

A review of the tables in Appendix E can provide specific recommendations in regard to zoning requirements, street and sidewalk design and allowable use of space. One area of improvement would be to look at the legacy zoning that make green infrastructure more difficult. Below is a bulleted list of recommendations that would enable more green infrastructure siting and reduce overall imperviousness. It's suggested that these policy changes take place over the next 6 years (FY28).

- Require locating streets to minimize grading and road length, and avoid important natural features
- Reduce the width requirements of roadways and sidewalks according to use.
- Allow alleys and other low traffic or secondary emergency access as well as shoulders to use alternative permeable materials.
- Allow one way loop streets and common drives up to 4 units.
- Allow open drainage with roadside swales and prefer roads without curbs (remove curb requirement).
- Reduce required utility width and allow utilities under roads, sidewalks or immediately adjacent to roads to enable placement of roadside swales.
- Disconnect drainage from road and sidewalk systems during upgrades. Allow or require adjacent green strips
- Allow easy siting of LID and stormwater features, include green infrastructure in the list of requirements regarding stormwater standards for new development under 1 acre.

Additional Resources

An Introduction to Green Infrastructure Practices
Rutgers New Jersey Agricultural Experiment Station, December 2012
Retrieved from https://njaes.rutgers.edu/fs1197/

Enhancing Sustainable Communities with Green Infrastructure: A Guide to Help Communities Better Manage Stormwater While Achieving Other Environmental, Public Health, and Economic Benefits.
US Environmental Protection Agency, October 2014
Retrieved from https://www.epa.gov/sites/production/files/2016-08/documents/green-infrastructure.pdf

Managing Stormwater Runoff Using Green Infrastructure: How To Disconnect a Downspount; Install a Rain Barrel; and Build A Rain Garden.
Stormwater Coalition of Albany County, October 2010
Retrieved from http://www.stormwateralbanycounty.org/wp-content/uploads/2011/12/GuidanceManual_Homeowners_DwnspoutDisc_RainGarden_RainBarrels1.pdf

Daylighting Streams: Breathing Life into Urban Streams and Communities.
American Rivers
Retrieved from https://www.americanrivers.org/conservation-resource/daylighting-streams-breathing-life-urban-streams-communities/

Green Infrastructure Guide for Public Works Projects
Franklin Regional Council of Governments, September 2017
Retrieved from https://frcog.org/wp-content/uploads/2019/01/Green-Infrastructure-Guide-for-Public-Works-Projects-2018.pdf

Green Infrastructure Modeling Toolkit
US Environmental Protection Agency
Retrieved from https://www.epa.gov/water-research/green-infrastructure-modeling-toolkit

Best Management Practices Siting Tool
US Environmental Protection Agency
Retrieved from https://www.epa.gov/water-research/best-management-practices-bmps-siting-tool

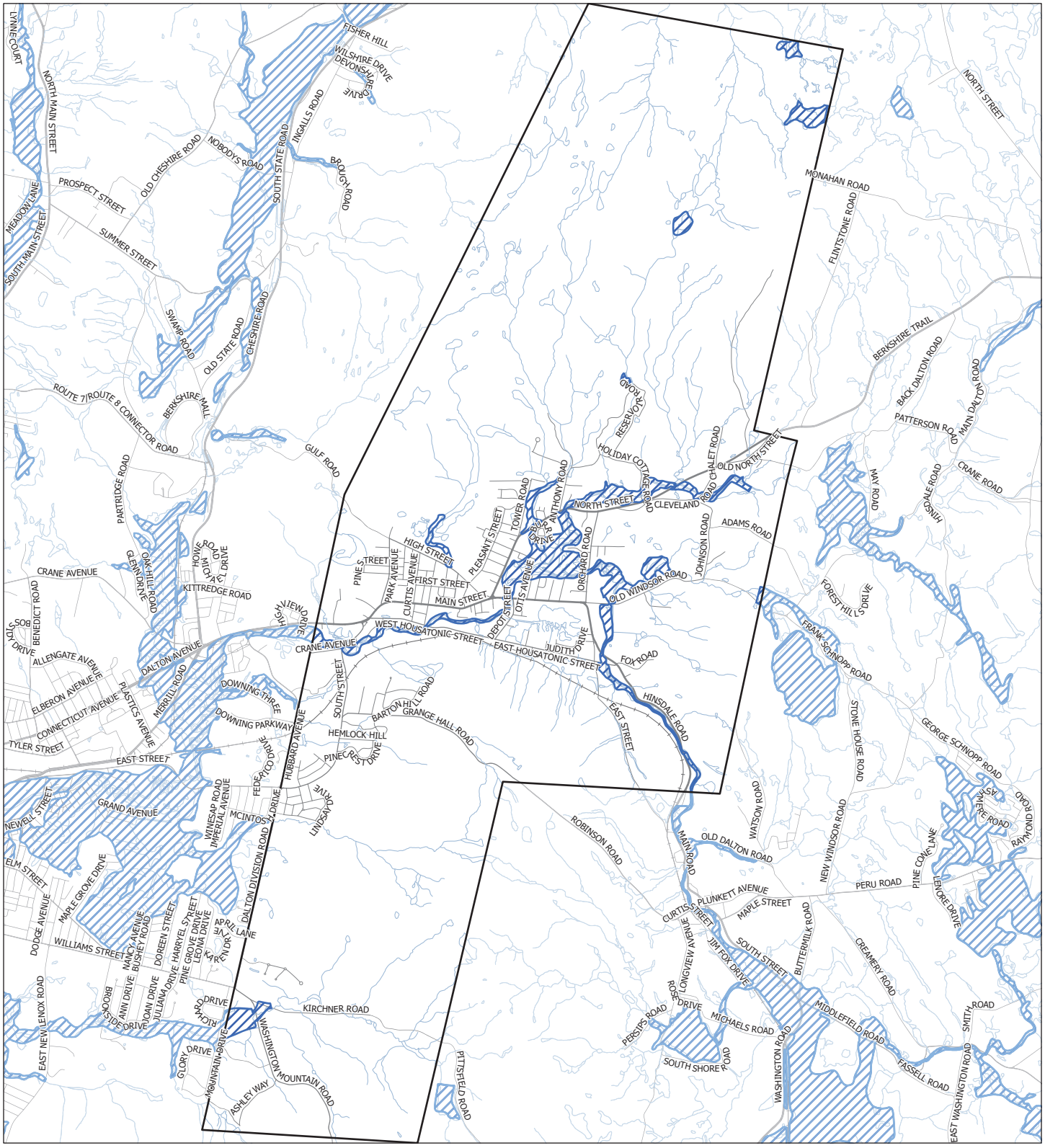
Flood Loss Avoidance Benefits of Green Infrastructure for Stormwater Management
Prepared by Atkins for US Enivornmental Protection Agency
Retrieved from https://www.epa.gov/sites/production/files/2016-05/documents/flood-avoidance-green-infrastructure-12-14-2015.pdf

Code and Ordinance Worksheet for Improving Local Development Regulations
Center for Watershed Protection, December 2017
Retrieved from https://www.cwp.org/updated-code-ordinance-worksheet-improving-local-development-regulations/

Green Infrastructure Opportunities that Arise During Municipal Operations
US Environmental Protection Agency
Retrieved from https://www.epa.gov/sites/production/files/2015-09/documents/green_infrastructure_roadshow.pdf

Appendix A: Maps

Town of Dalton- Floodplain



FEMA 100yr Floodplain
Railroad
Interstate
Major Road
Minor Road
Local Road
Stream
Wetland
Open Water

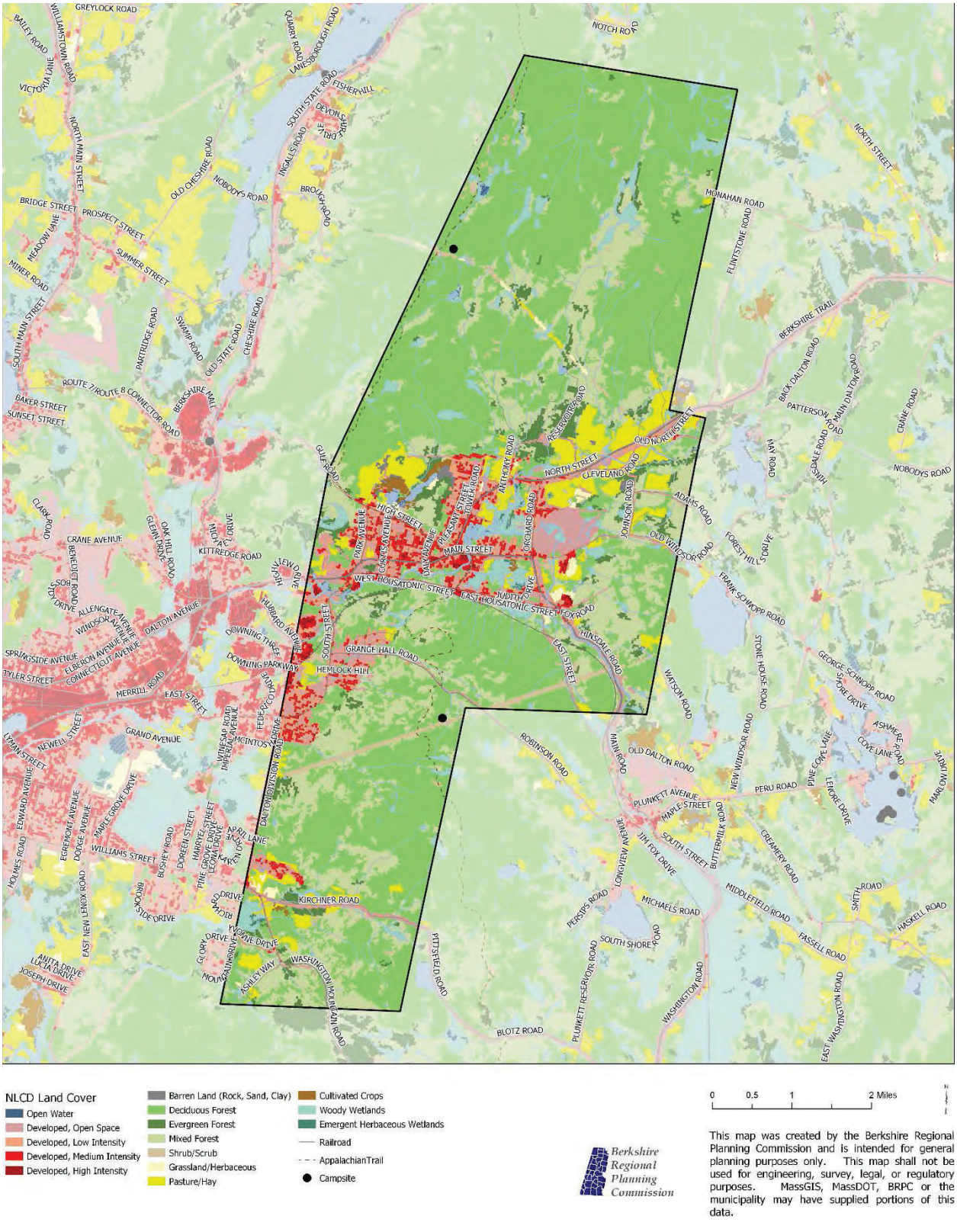
0 0.5 1 2 Miles

N

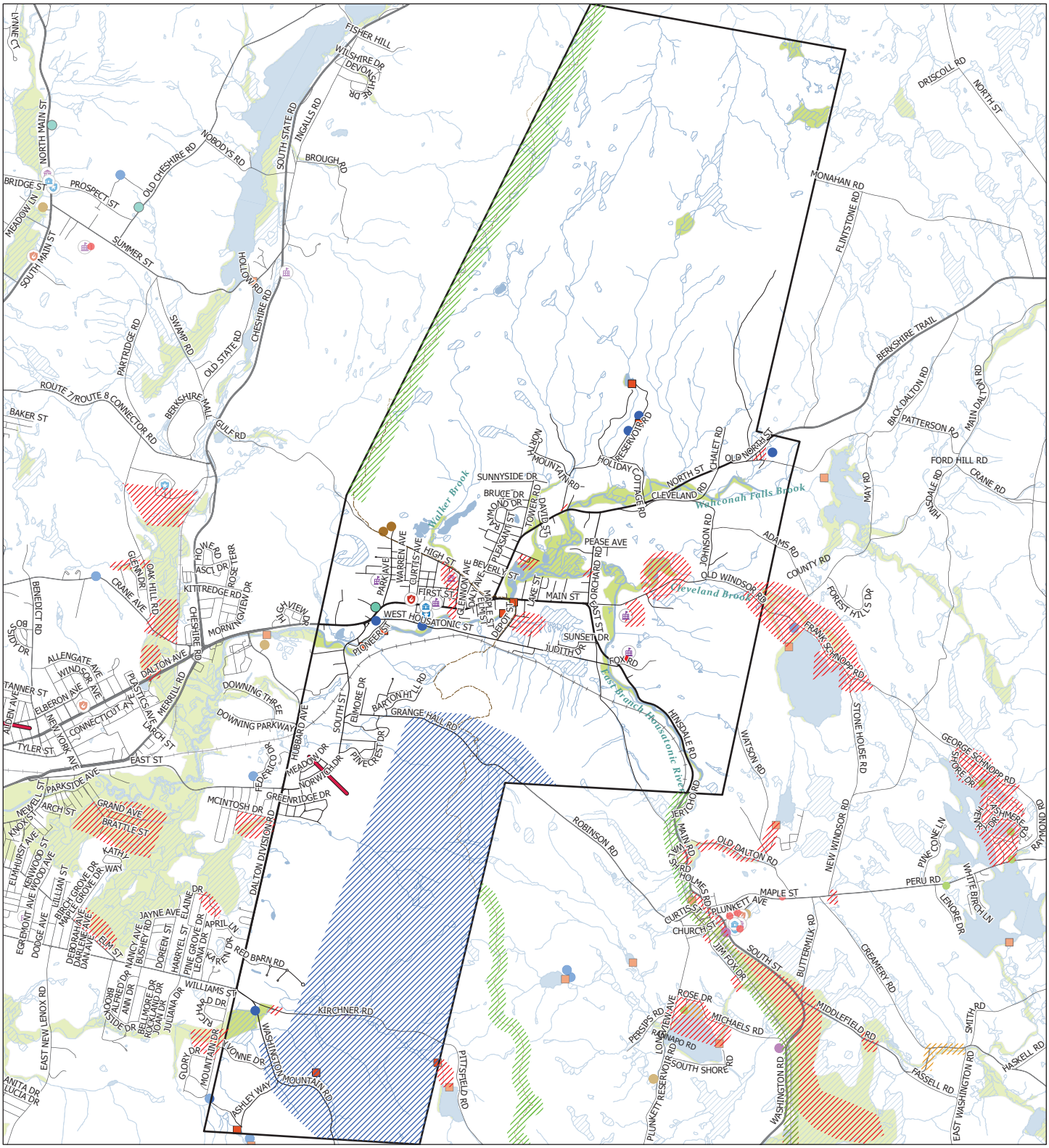
Berkshire Regional Planning Commission

This map was created by the Berkshire Regional Planning Commission and is intended for general planning purposes only. This map shall not be used for engineering, survey, legal, or regulatory purposes. MassGIS, MassDOT, BRPC or the municipality may have supplied portions of this data.

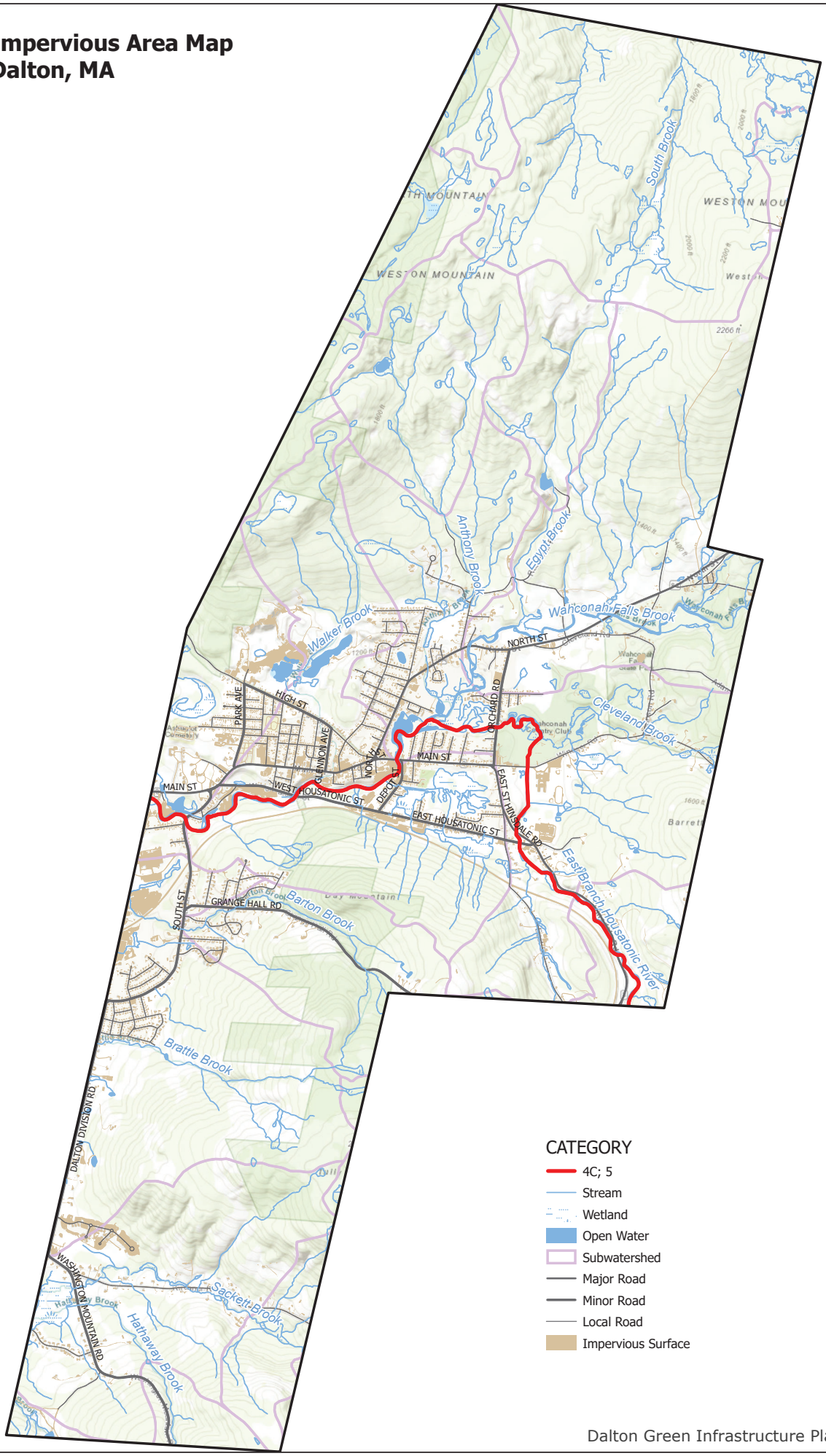
Fig. 3.8.2. National Land Cover Database Map



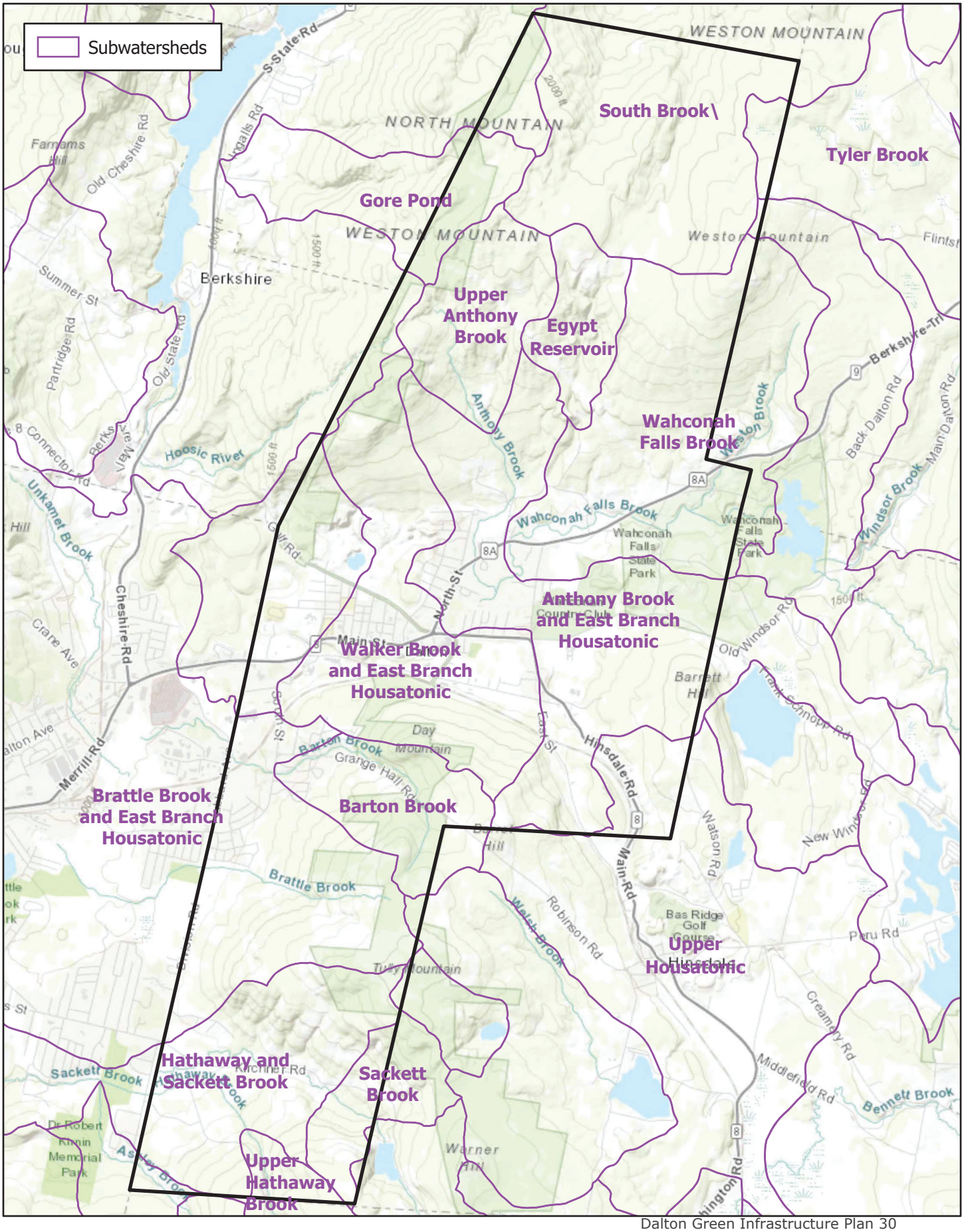
Town of Dalton - Critical Facilities



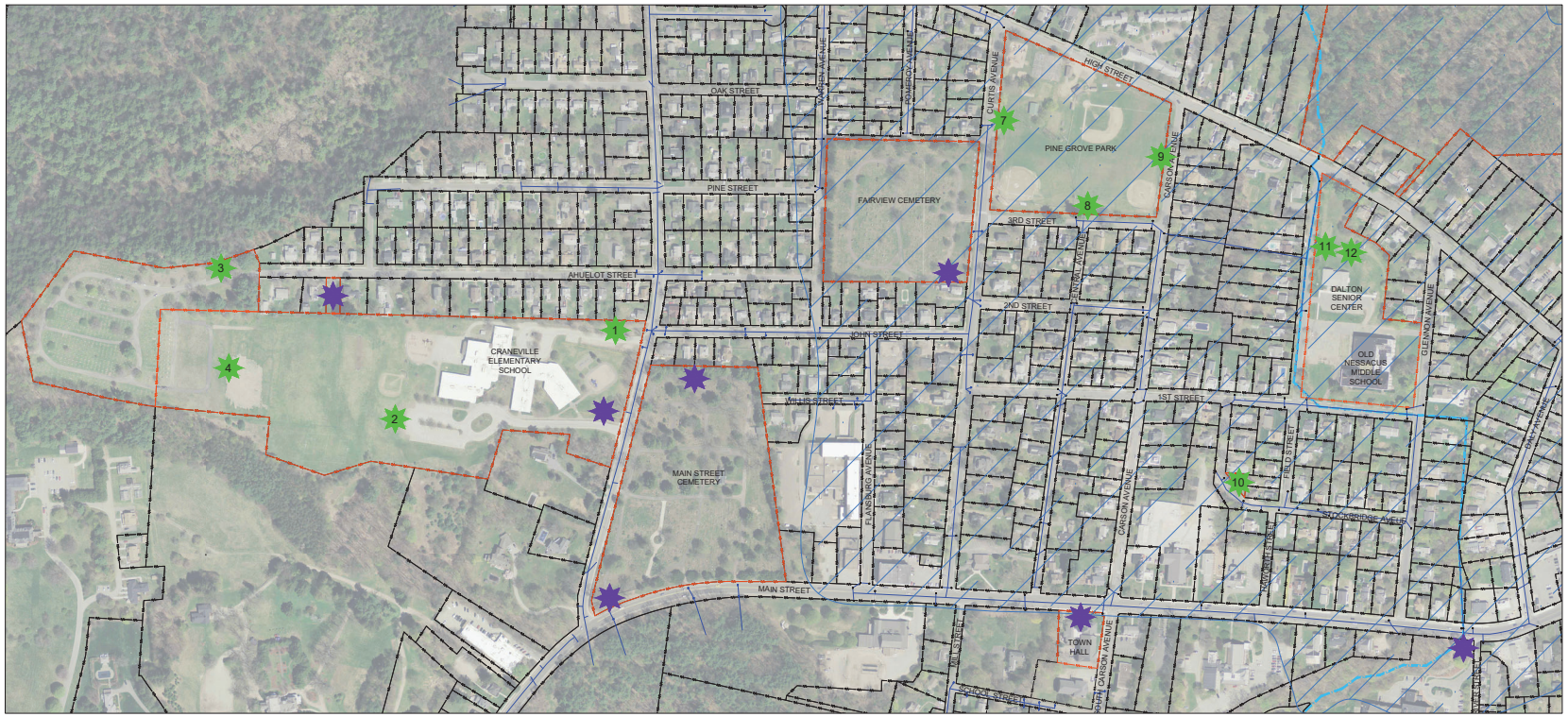
Impervious Area Map
Dalton, MA



Subwatershed Map
Dalton, MA



Appendix B: Pre-Conceptual Designs



LEGEND

- CATCH BASIN
- DRAINAGE PIPE
- PROPERTY LINE
- TOWN OF DALTON
- WALKER BROOK
- POTENTIAL BMP LOCATION
- SELECTED BMP LOCATION
- WATERSHED AREA

N

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

DALTON GREEN INFRASTRUCTURE PLAN

BERKSHIRE REGIONAL PLANNING COMMISSION
1 FENN STREET, SUITE 201
PITTSFIELD, MA 01201

Project: 186-19 Date: May 2021	Sheet:
Drawn by: NP Checked by: NC	
Scale: Not To Scale	

CRANEVILLE ELEMENTARY SCHOOL ROAD

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	1
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	

CRANEVILLE ELEMENTARY SCHOOL PARKING LOT

SCALE 1" = 20'

20 10 0 20 40
Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	2
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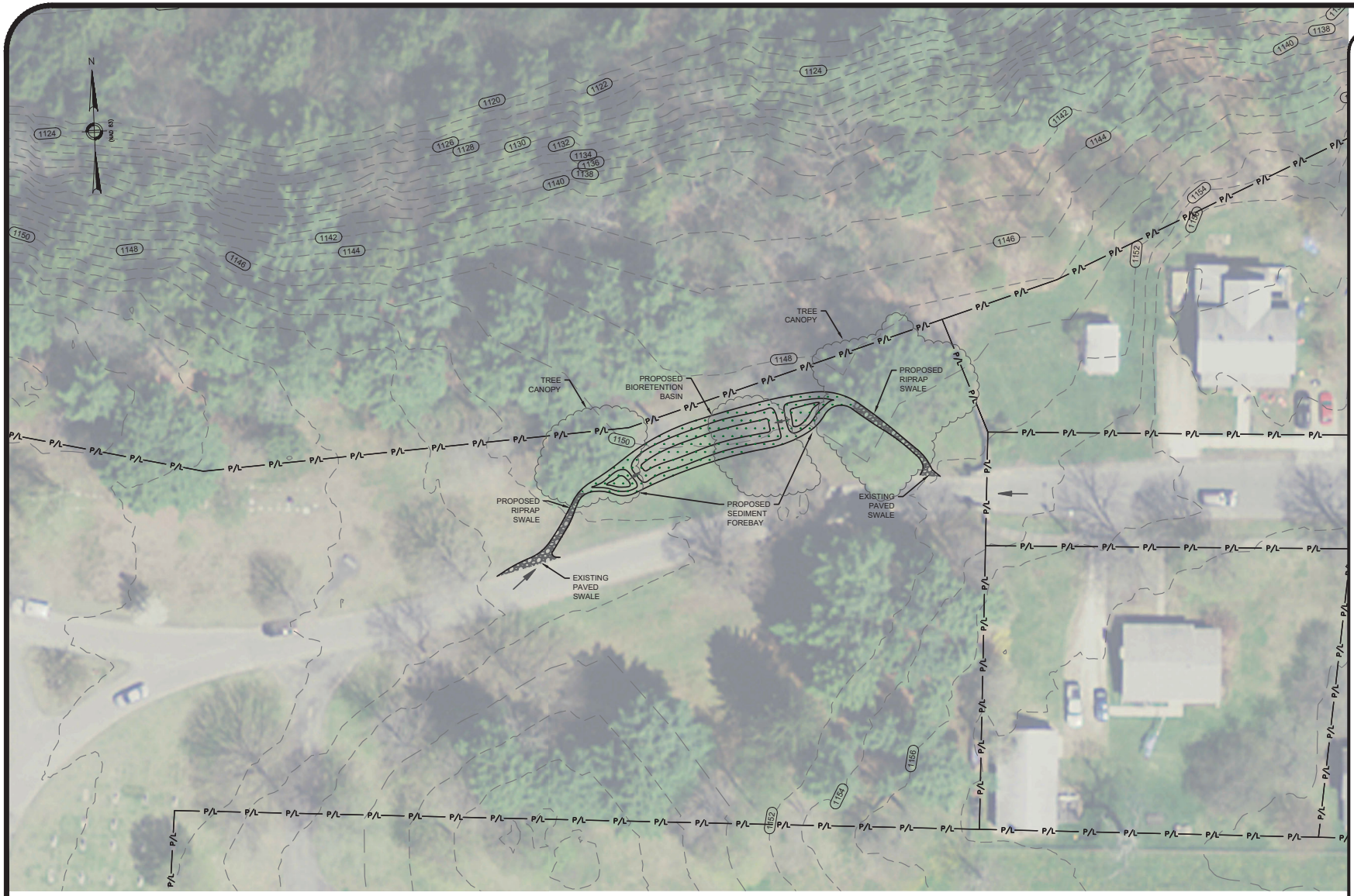

ASHUELOT STREET CEMETERY ACCESS ROAD

SCALE 1" = 20'

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Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	3
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ASHUELOT STREET CEMETERY SWALE

SCALE 1" = 20'

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Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	4
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Scale: 1" = 20'	

GREENRIDGE PARK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	5
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	

SOUTH STREET - HUBBARD AVENUE INTERSECTION

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	6
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	

PINE GROVE PARK - WEST

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	7
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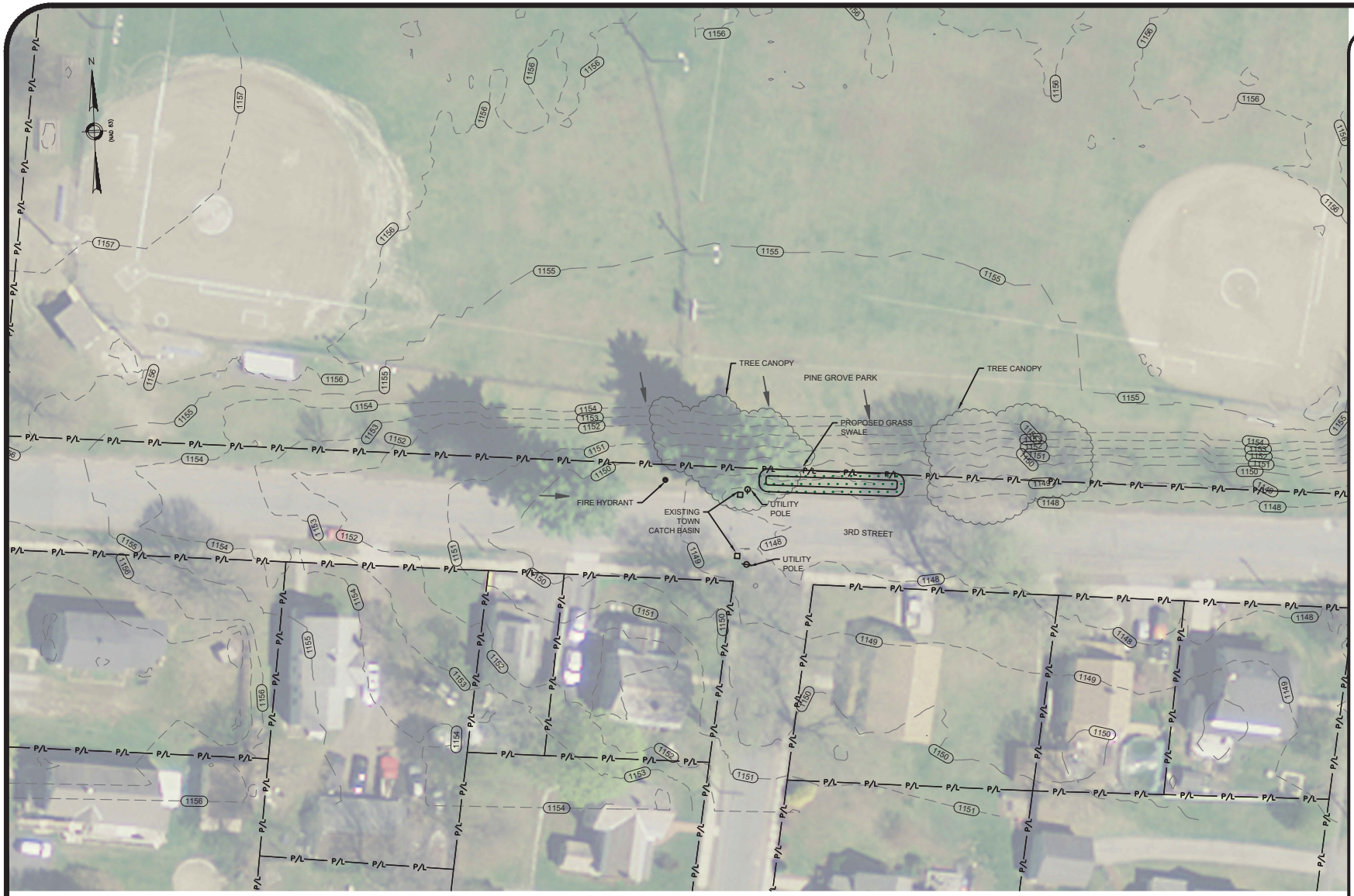

PINE GROVE PARK - SOUTH

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 10'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	8
Drawn By: NP	
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PINE GROVE PARK - EAST

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 4/28/2021	9
Drawn By: NP	
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Scale: 1" = 20'	

VIEW STREET - STOCKBRIDGE AVENUE

SCALE 1" = 20'

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Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
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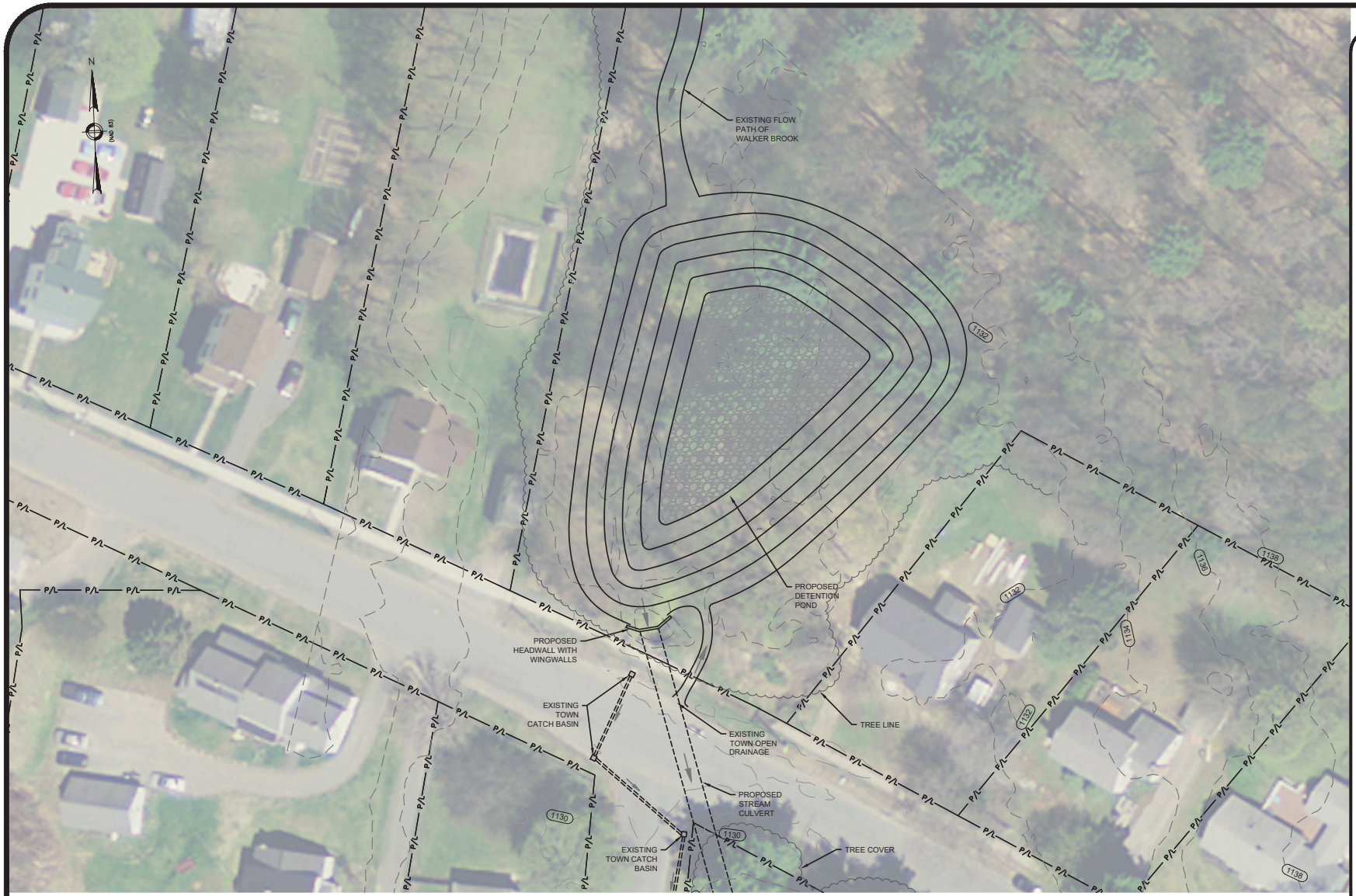

WALKER BROOK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
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WALKER BROOK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/3/2021	11-B
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WALKER BROOK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/3/2021	11 – C
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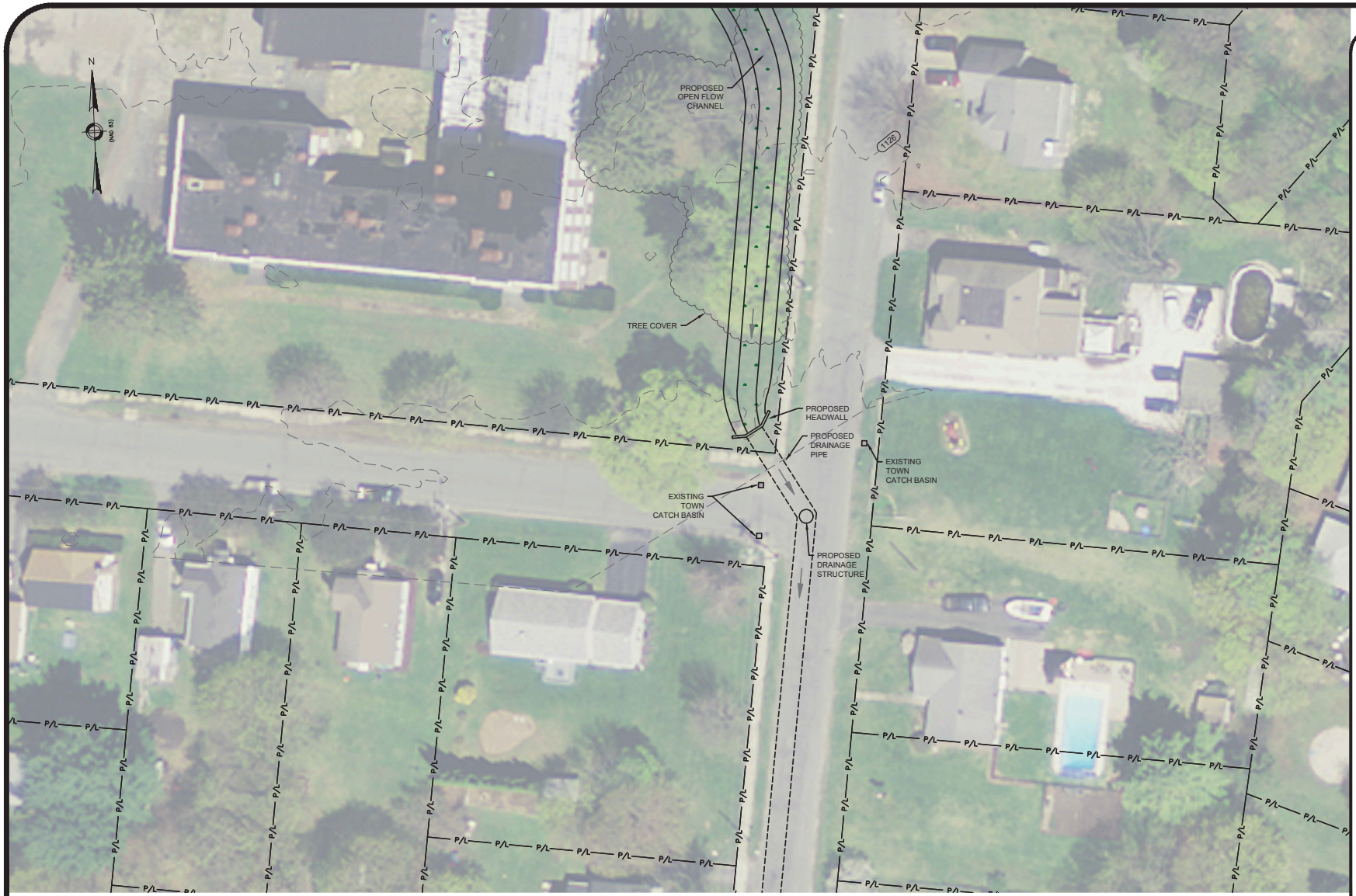

WALKER BROOK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/3/2021	11 – D
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WALKER BROOK

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19
Date: 5/3/2021
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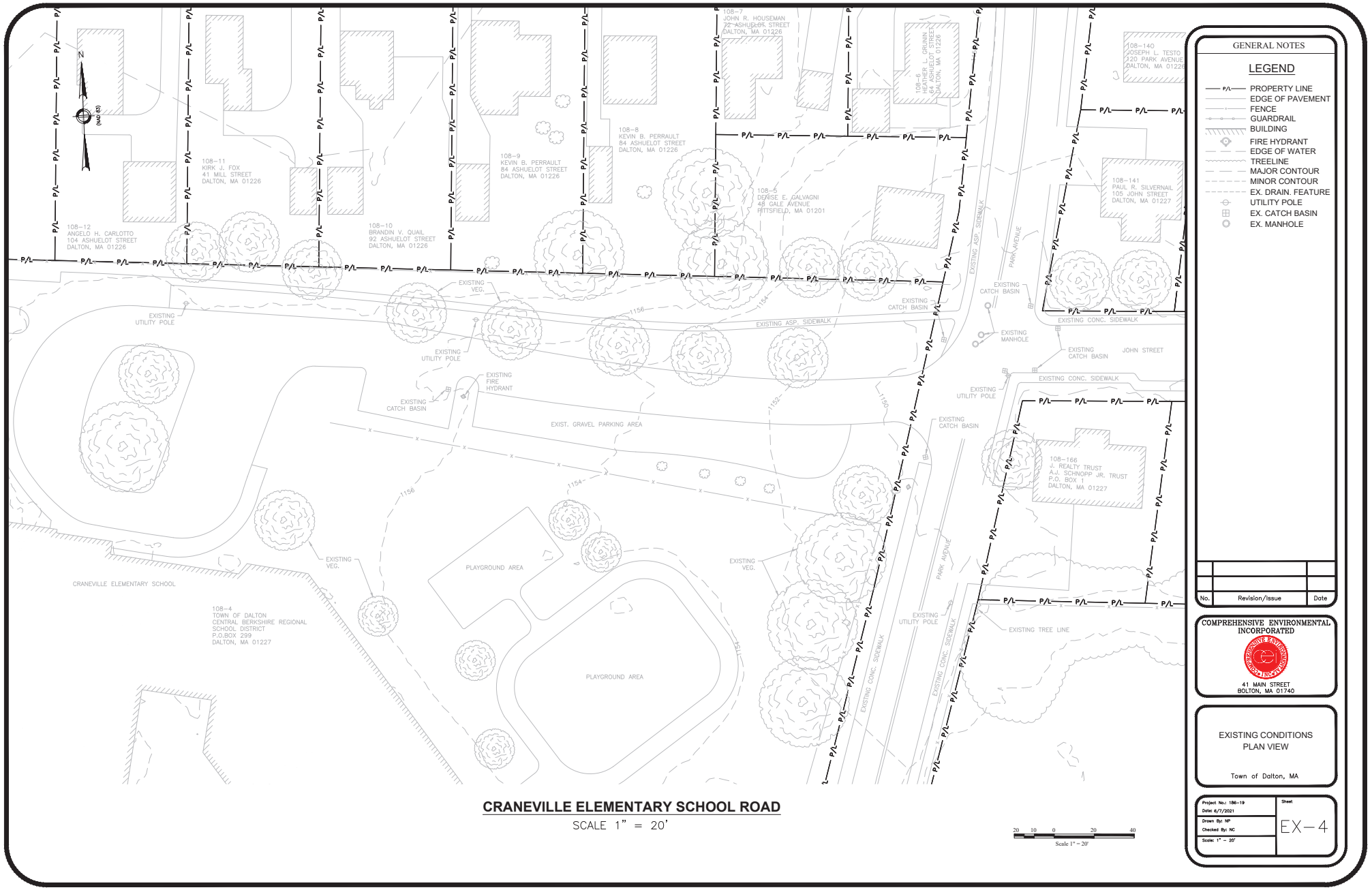
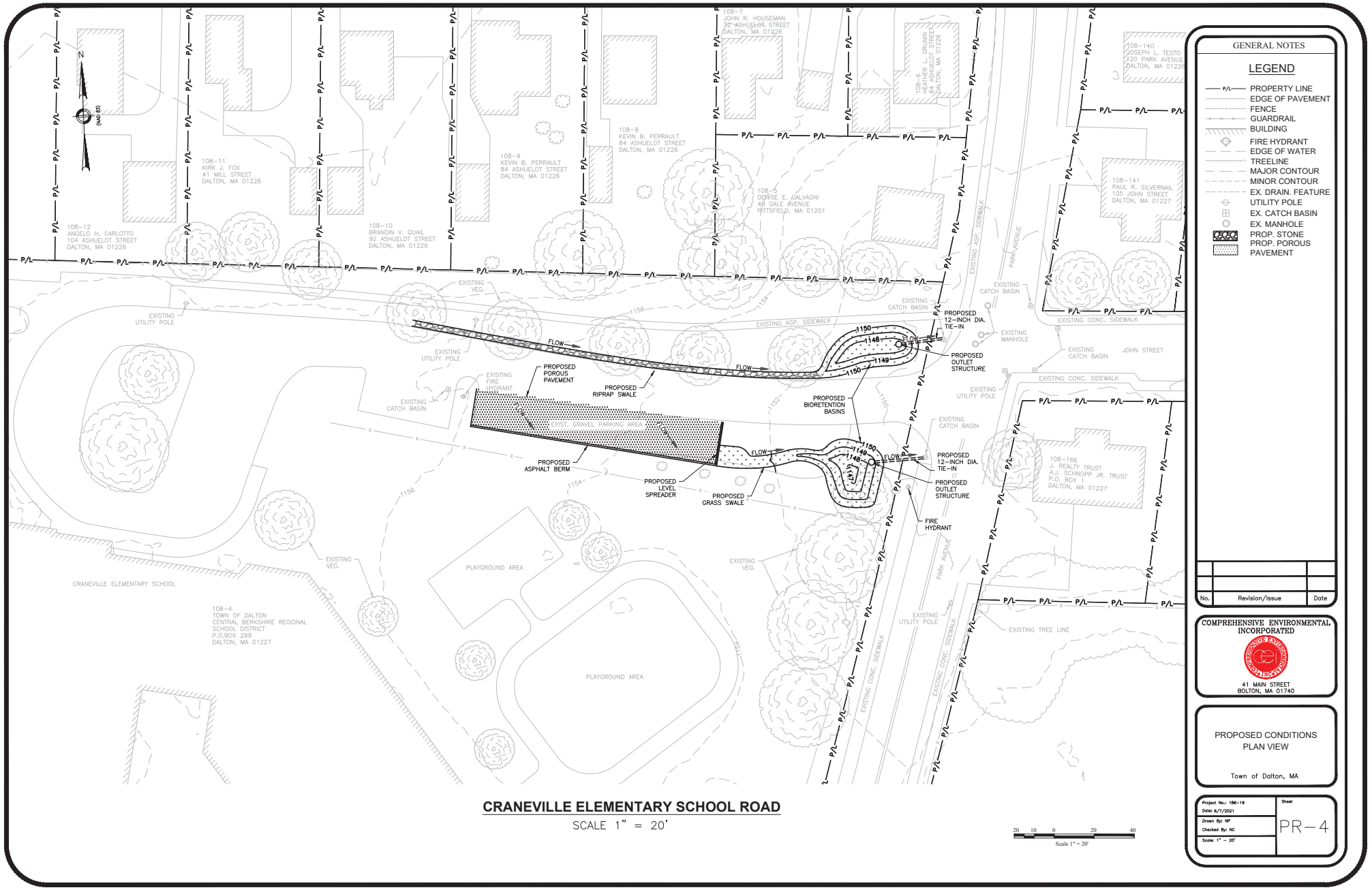
12-B

Appendix C: Conceptual Designs



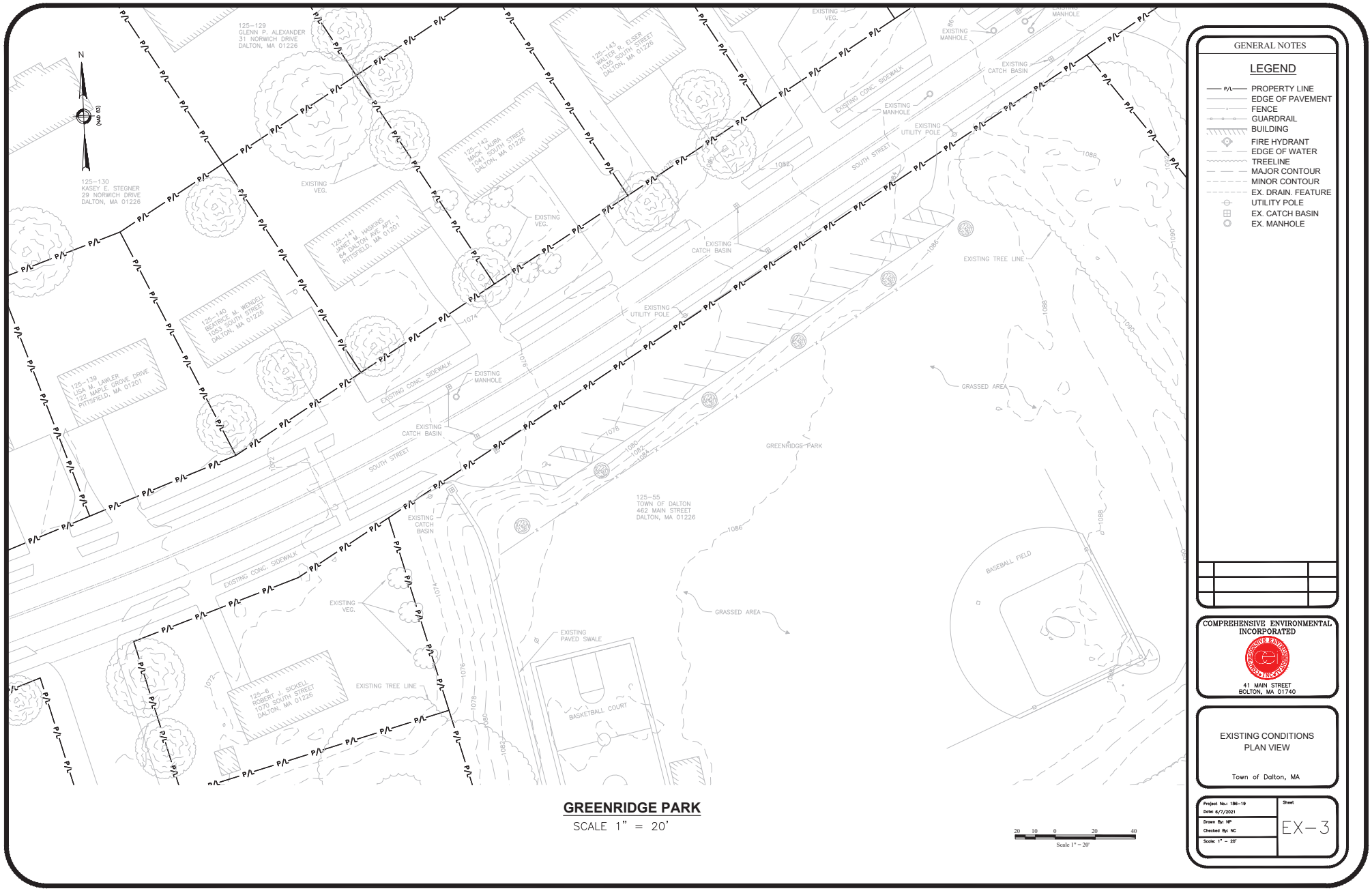
CRANEVILLE ELEMENTARY SCHOOL ROAD

SCALE 1" = 20'



CRANEVILLE ELEMENTARY SCHOOL ROAD

SCALE 1" = 20'



GREENRIDGE PARK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

EXISTING CONDITIONS
PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 6/7/2021	EX-3
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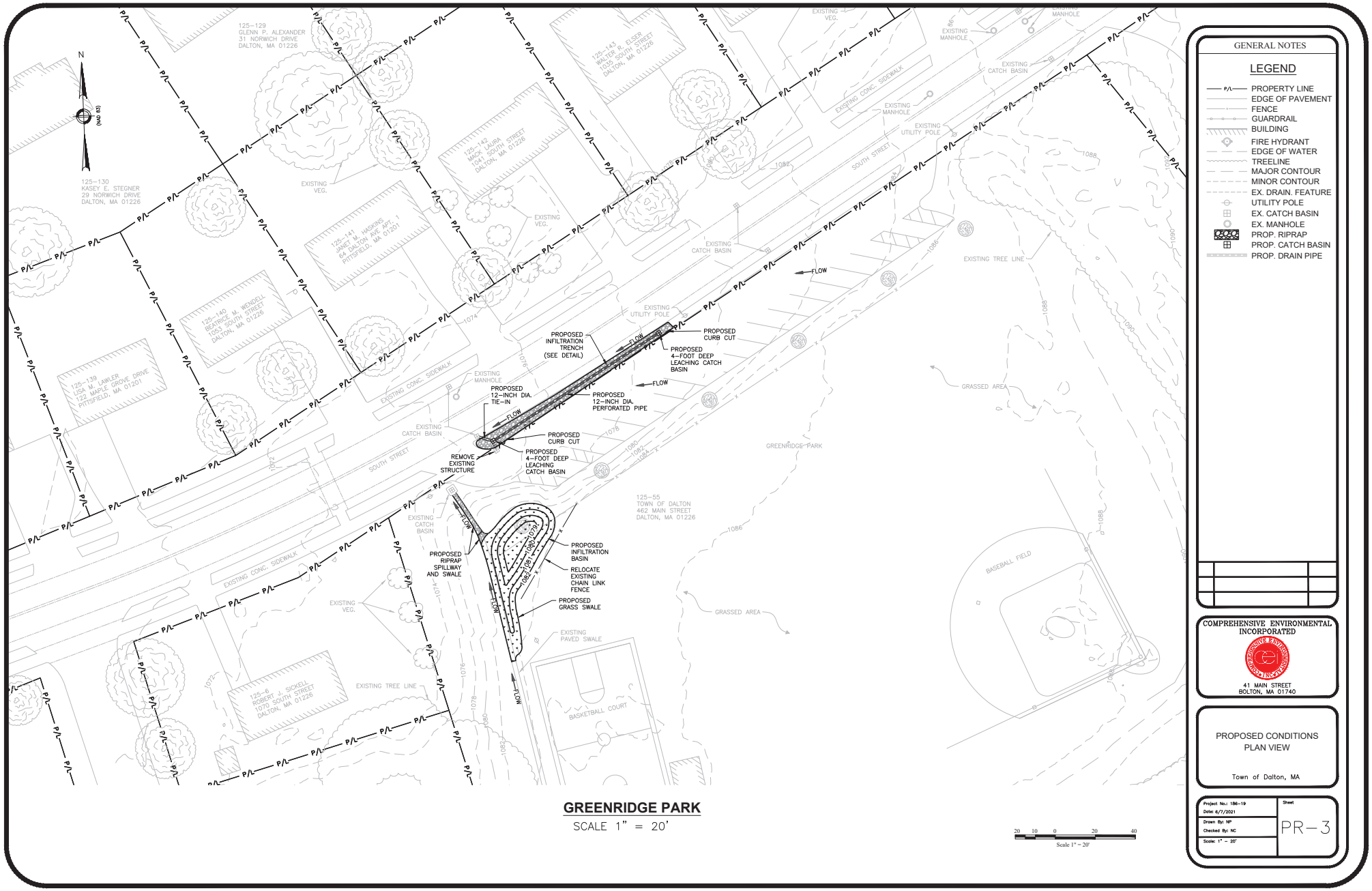

GREENRIDGE PARK

SCALE 1" = 20'

20 10 0 20 40

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- PROP. RIPRAP
- PROP. CATCH BASIN
- PROP. DRAIN PIPE

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of Dalton, MA

Project No.: 186-19	Sheet
Date: 6/7/2021	PR-3
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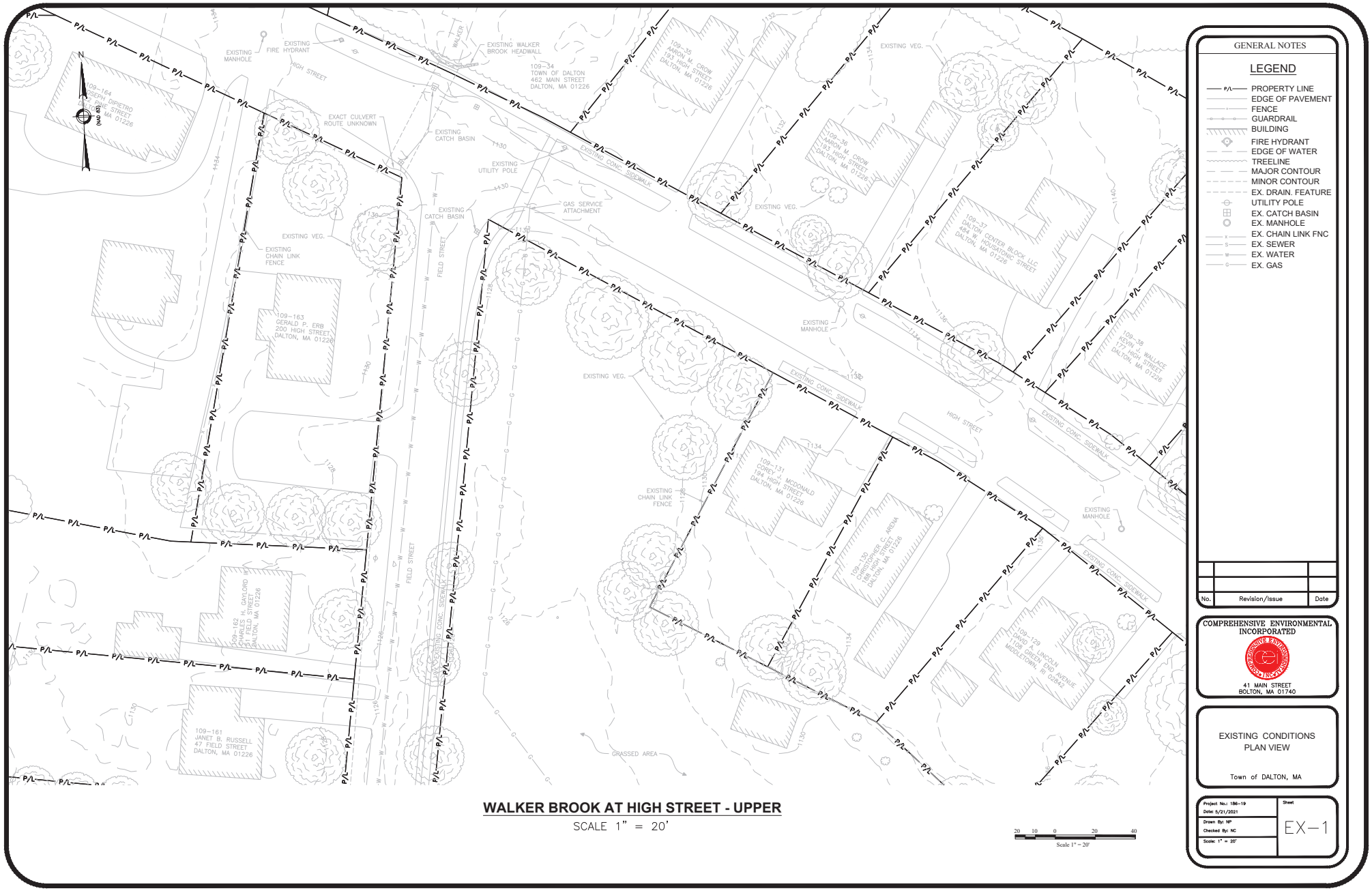
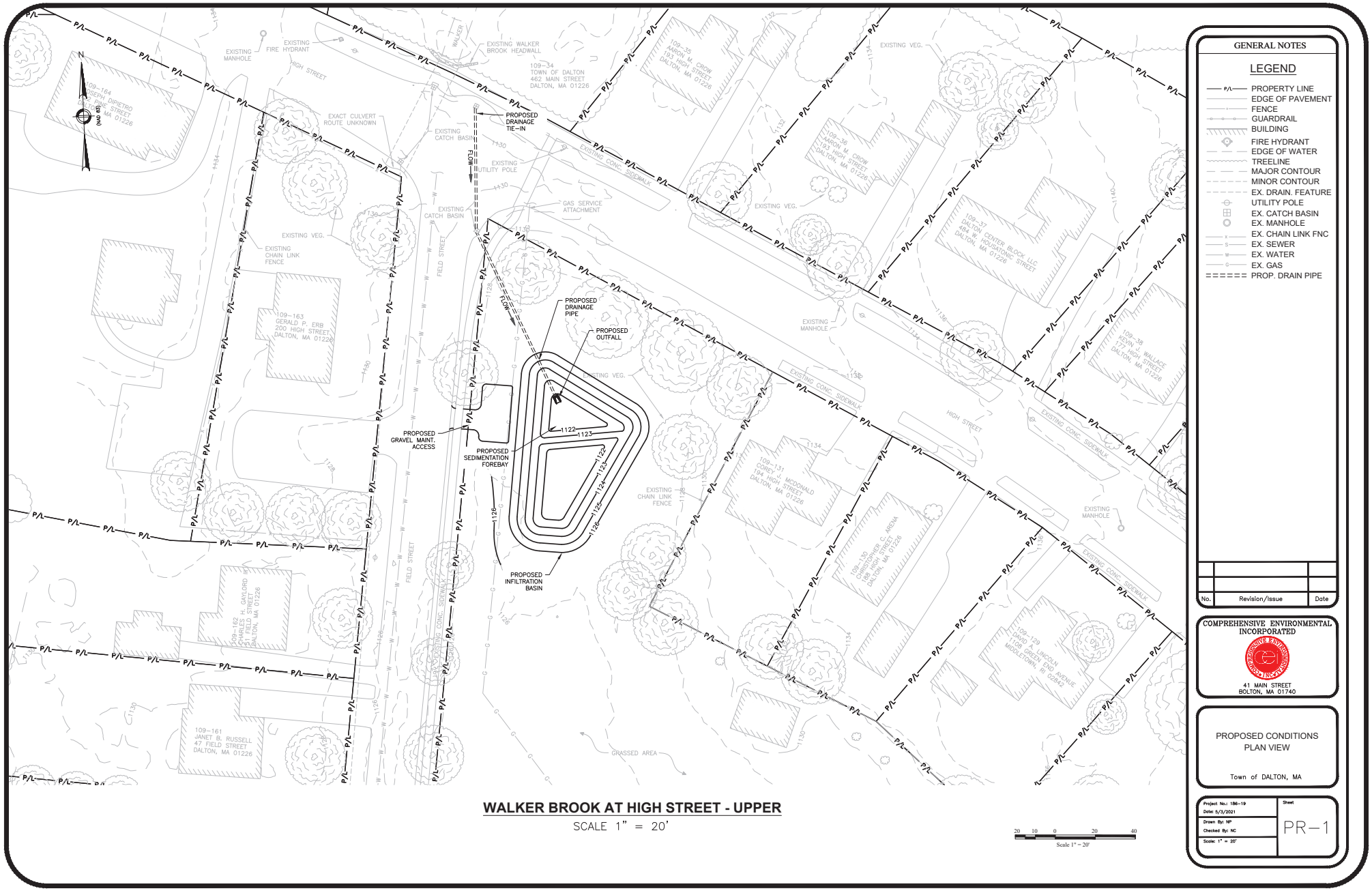


WALKER BROOK AT HIGH STREET - UPPER

SCALE 1" = 20'

WALKER BROOK - SENIOR CENTER - LOWER

SCALE 1" = 20'



WALKER BROOK AT HIGH STREET - UPPER

SCALE 1" = 20'

20 10 0 20 40
Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

No.	Revision/Issue	Date

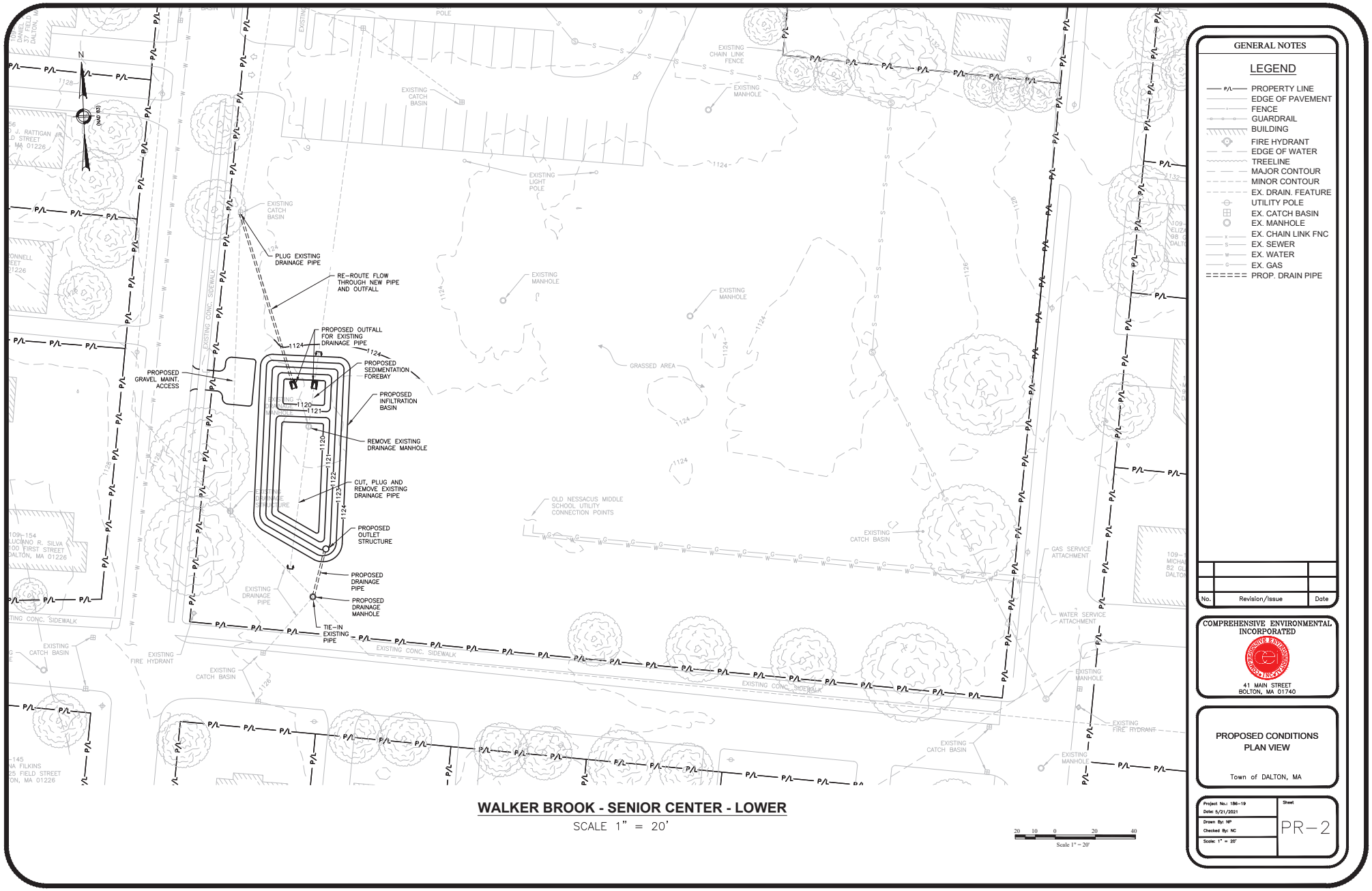
COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/3/2021	PR-1
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	



WALKER BROOK - SENIOR CENTER - LOWER

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	PR-2
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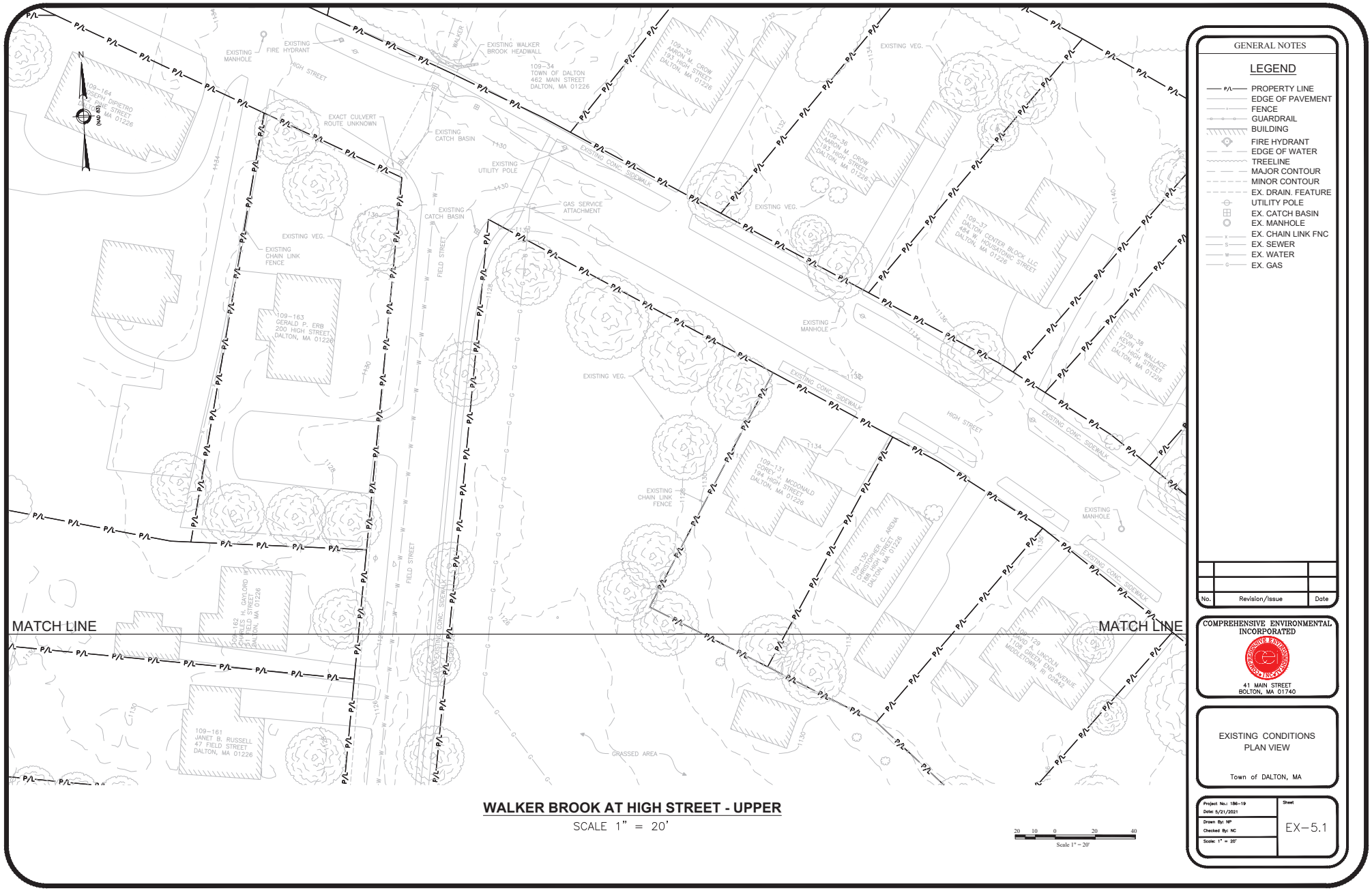
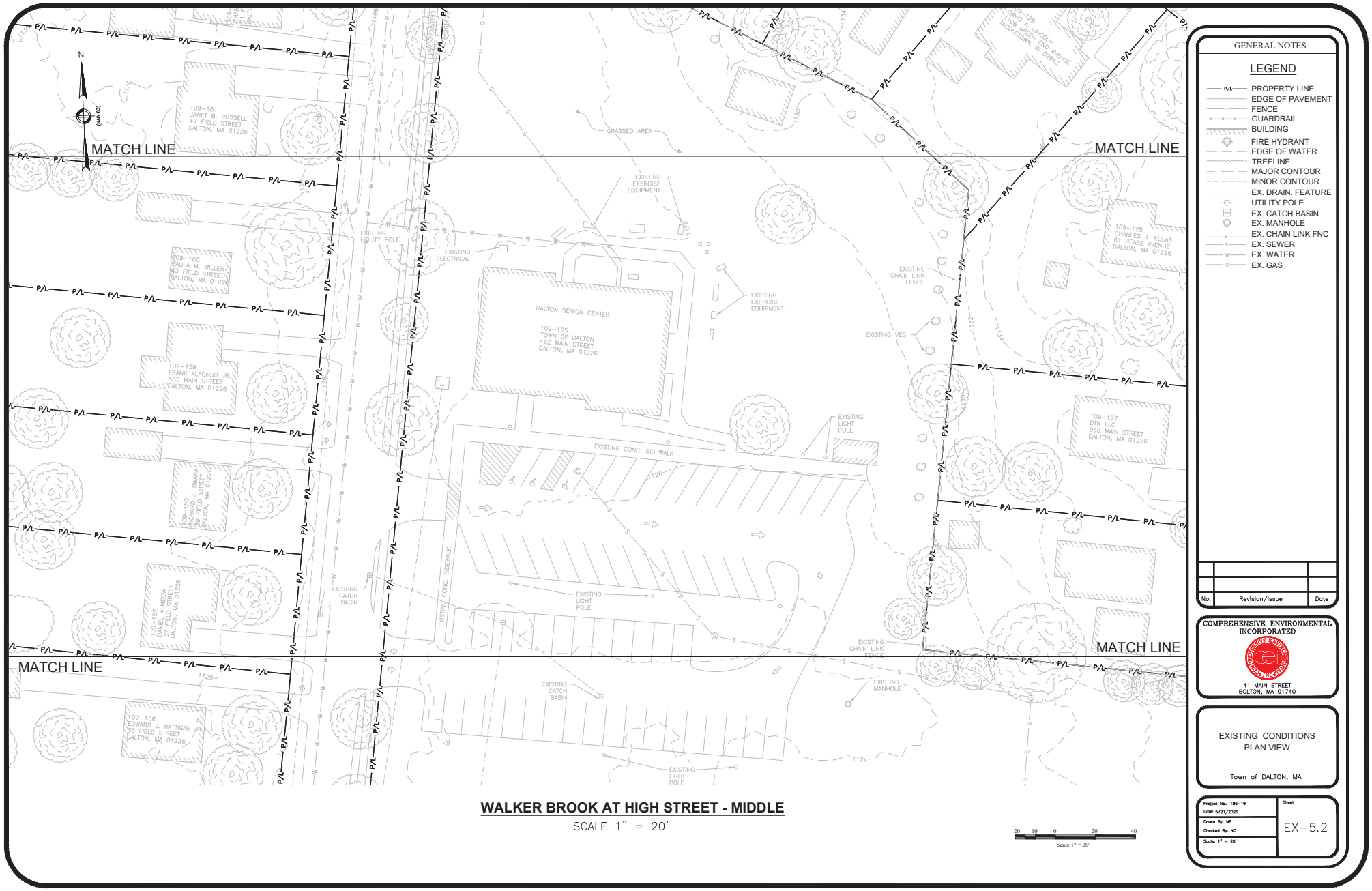


WALKER BROOK AT HIGH STREET - UPPER

SCALE 1" = 20'



WALKER BROOK AT HIGH STREET - MIDDLE

SCALE 1" = 20'

20 10 0 20 40
Scale 1" = 20'

GENERAL NOTES

LEGEND

- P/L — PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

EXISTING CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	
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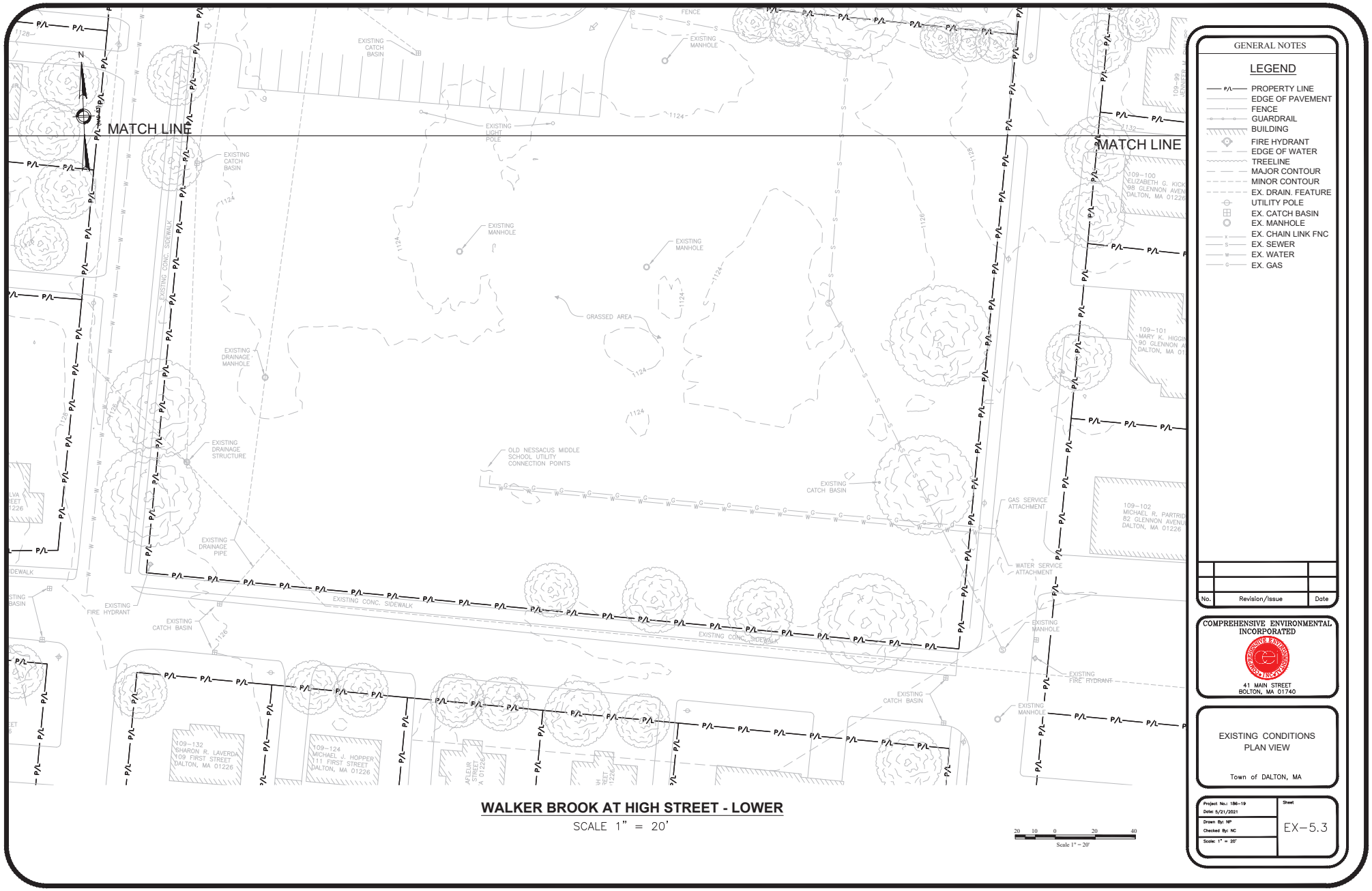


WALKER BROOK AT HIGH STREET - LOWER

SCALE 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS

No.	Revision/Issue	Date

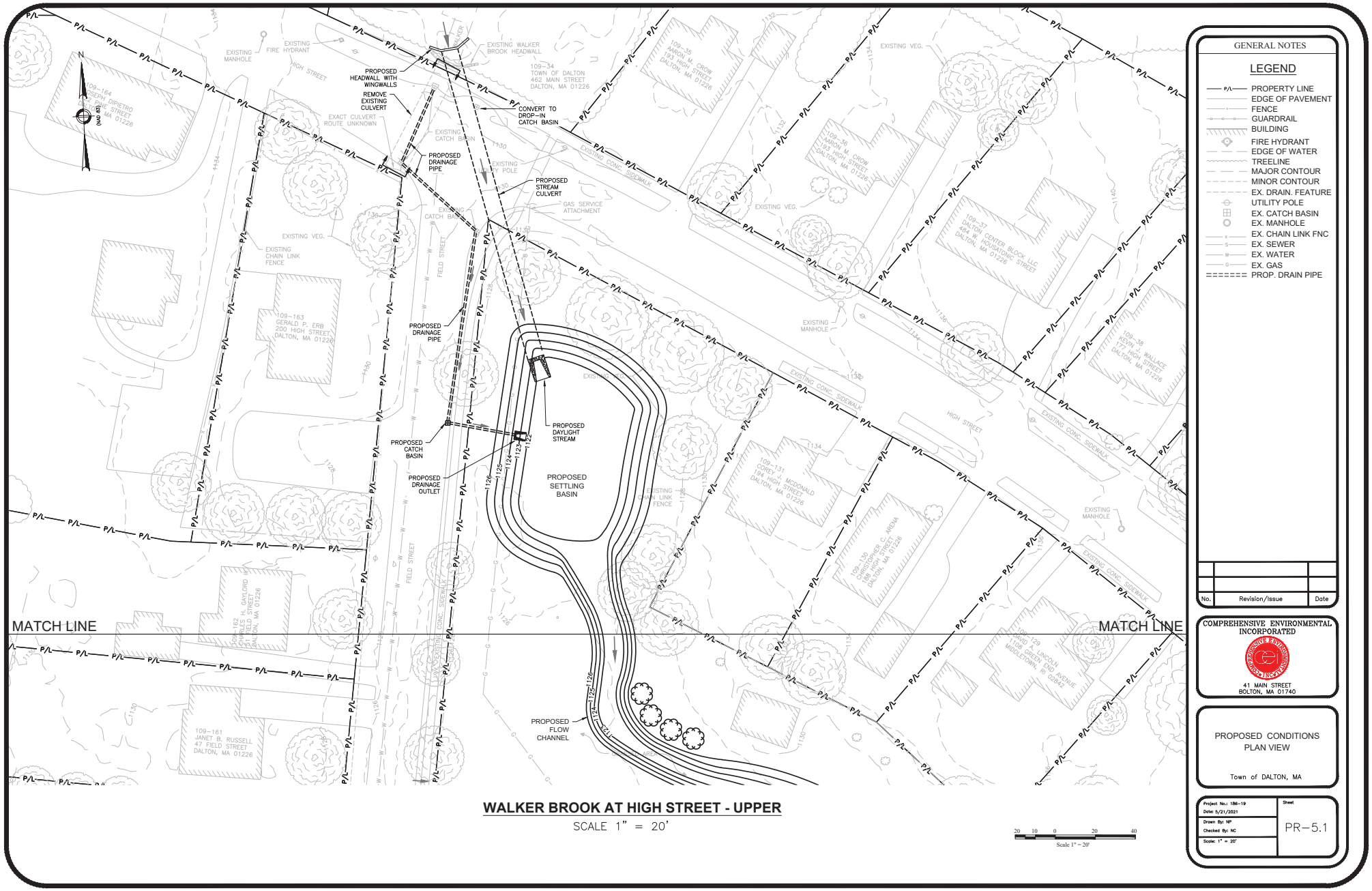
COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

EXISTING CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19 Date: 5/21/2021 Drawn By: NP Checked By: NC Scale: 1" = 20'	Sheet EX-5.3



WALKER BROOK AT HIGH STREET - UPPER

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

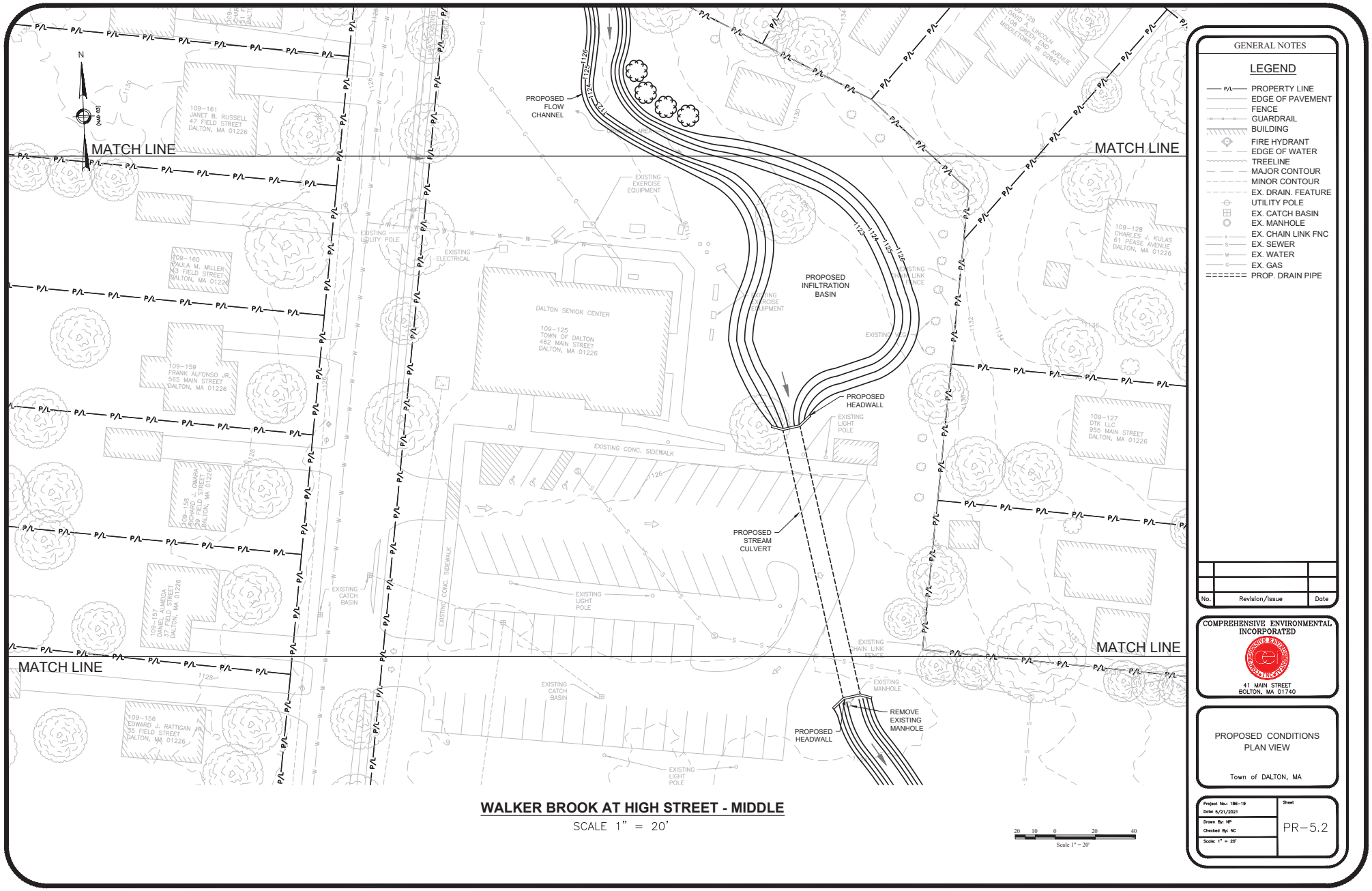
No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	PR-5.1
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	



WALKER BROOK AT HIGH STREET - MIDDLE

SCALE 1" = 20'

20 10 0 20 40
Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	PR-5.2
Drawn By: NP	
Checked By: NC	
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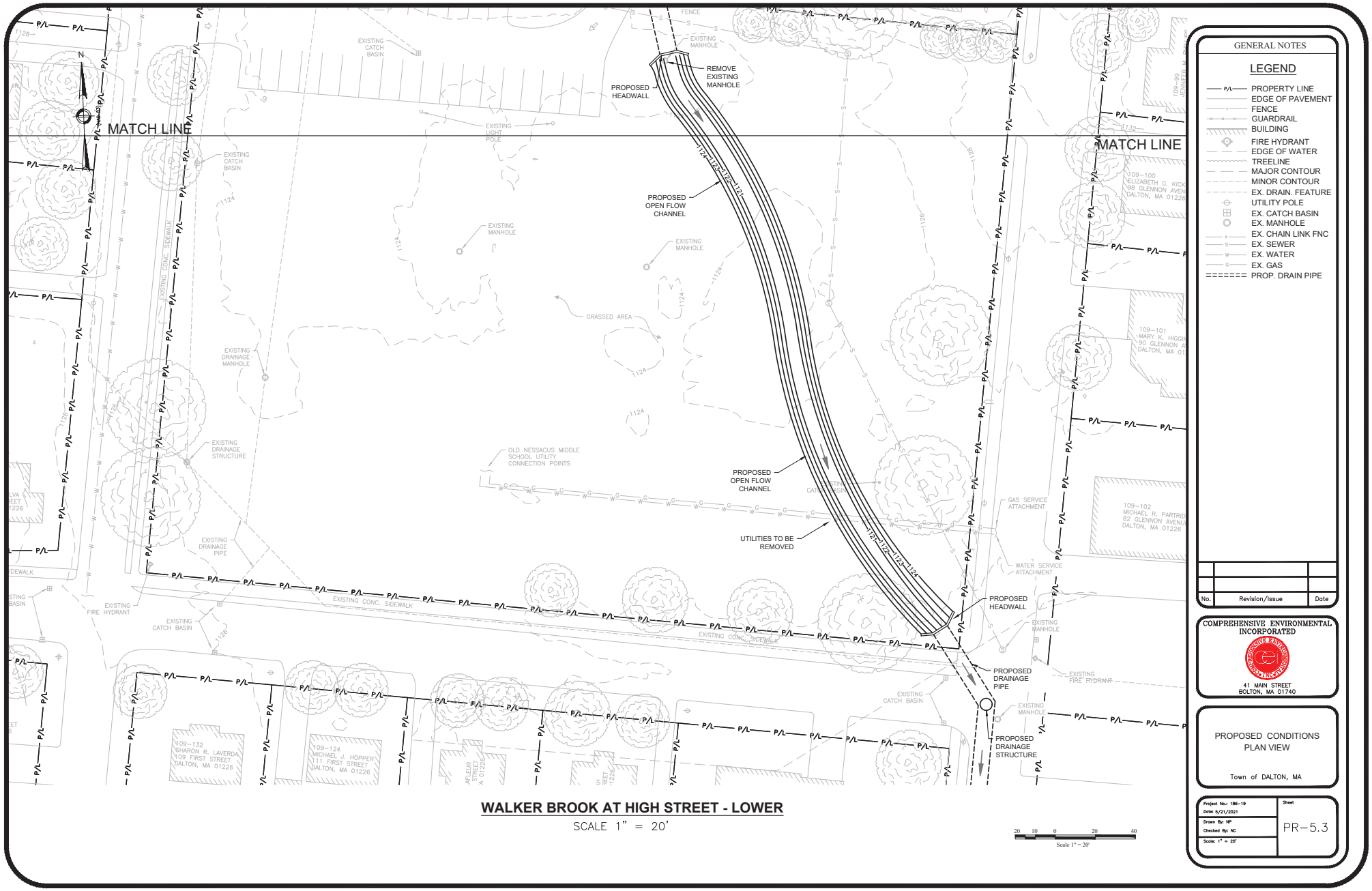


WALKER BROOK AT HIGH STREET - LOWER

SCALE 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	PR-5.3
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	

GRAVEL WETLAND CONCEPT DESIGN
SITE 21: RIVERVIEW DR
VERSION 1
8/19/2022

Prepared for:

Town of Dalton, MA

Prepared by:

University of New Hampshire Stormwater Center

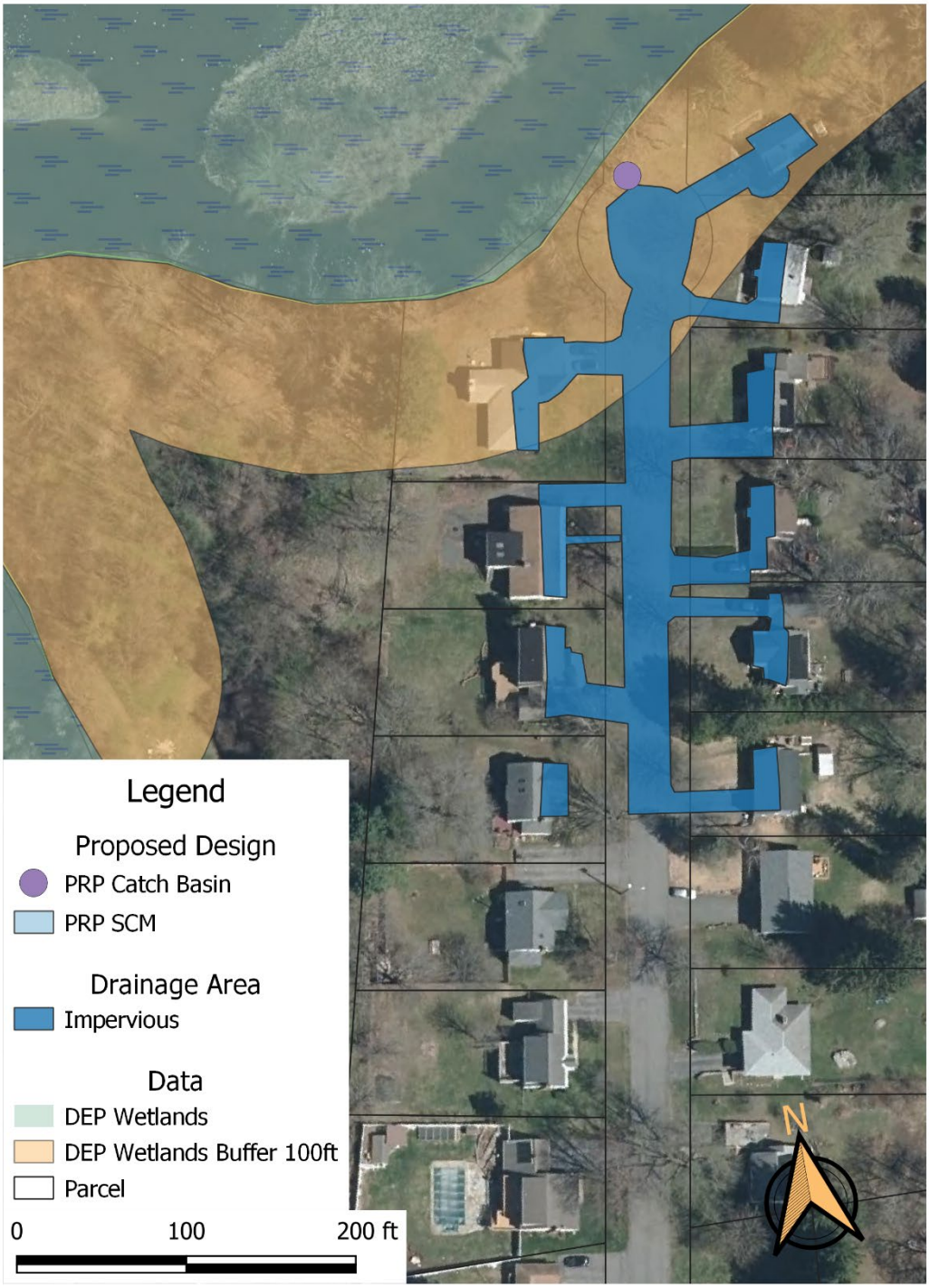


Figure 4: Plan layout

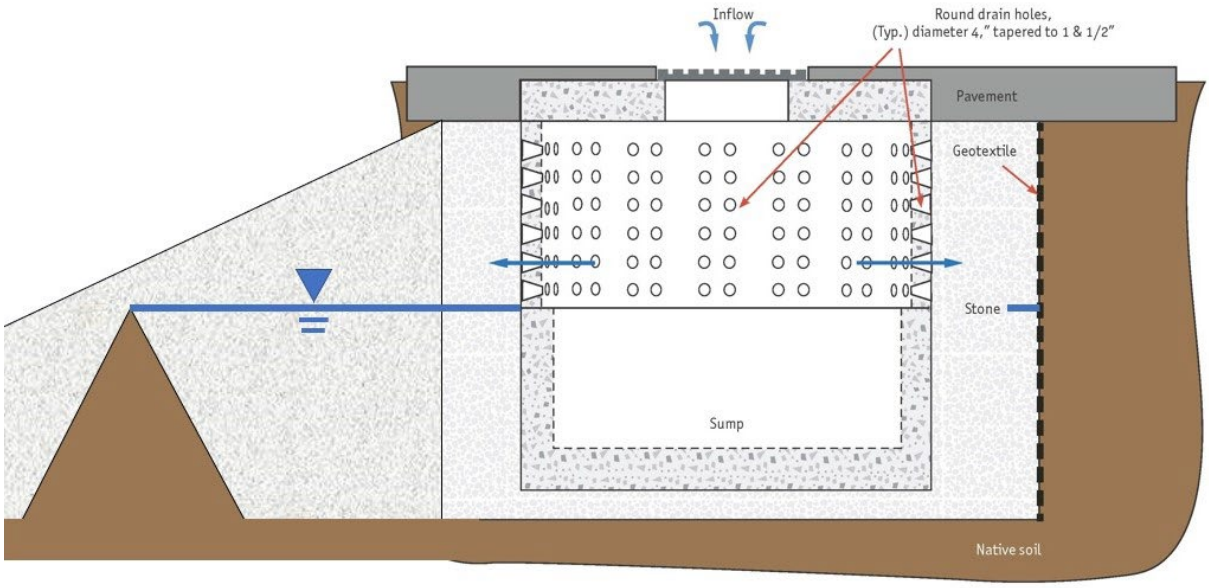


Figure 5: Typical SCM cross-section (not to scale). Source: New England Stormwater Retrofit Manual (VHB, UNHSC 2022)

BIORETENTION CONCEPT DESIGN
SITE 22: DALTON SEWER DEPARTMENT
VERSION 1
8/19/2022

Prepared for:

Town of Dalton, MA

Prepared by:

University of New Hampshire Stormwater Center

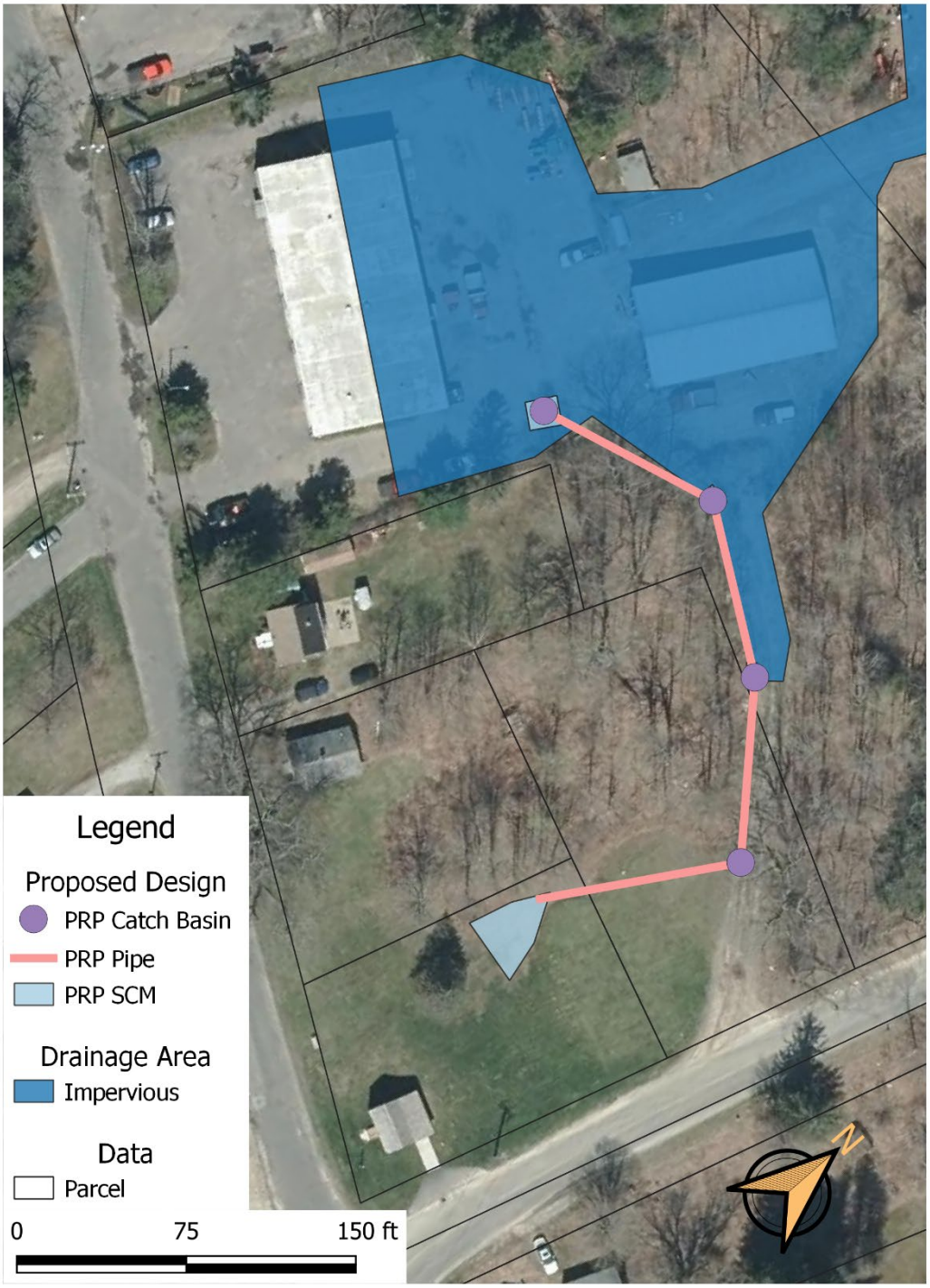
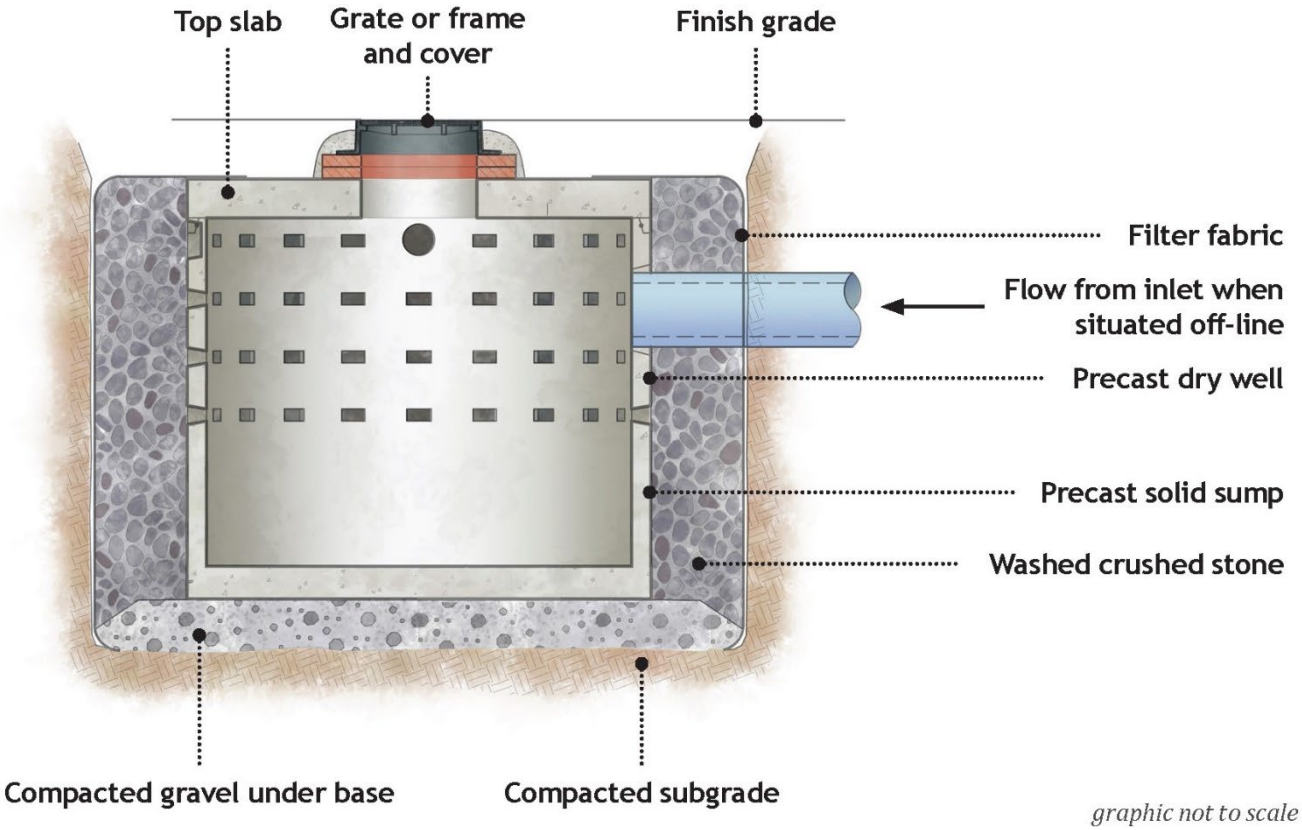
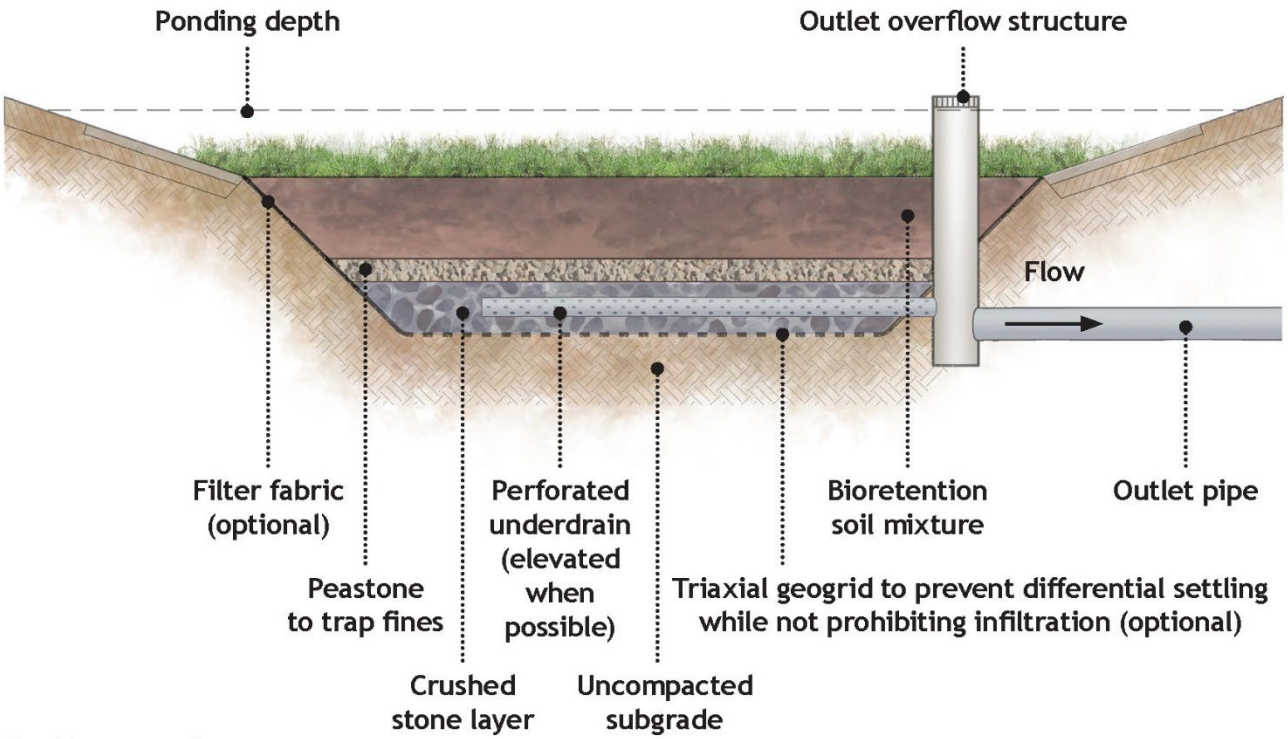


Figure 3: Plan layout



graphic not to scale

Figure 4: Typical Leaching Catch Basin cross-section (not to scale). Source: New England Stormwater Retrofit Manual (VHB, UNHSC 2022)



Graphic not to scale

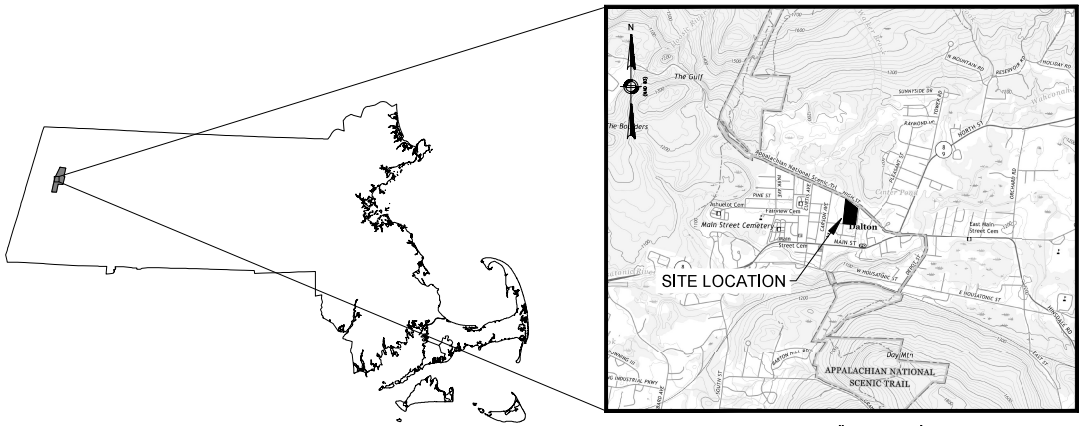
Figure 5: Typical Bio-Filtration cross-section (not to scale). Source: New England Stormwater Retrofit Manual (VHB, UNHSC 2022)

Appendix D: 60% Completed Designs for Walker Brook - Senior Center and Former School Site & StreamStats Report

BERKSHIRE REGIONAL PLANNING COMMISSION

DALTON GREEN INFRASTRUCTURE PLAN
DALTON, MA

June 30, 2021



LOCUS SCALE 1" = 2000'

SHEET	TITLE
C-1	SENIOR CENTER BMP EXISTING CONDITIONS
C-2	FORMER MIDDLE SCHOOL BMP EXISTING CONDITIONS
C-3	SENIOR CENTER BMP PROPOSED CONDITIONS
C-4	FORMER MIDDLE SCHOOL BMP PROPOSED CONDITIONS
D-1	INFILTRATION BASIN DETAILS
D-2	PROJECT DETAILS
D-3	EROSION CONTROL DETAILS

COMPREHENSIVE ENVIRONMENTAL INCORPORATED • BOLTON, MASSACHUSETTS

SENIOR CENTER

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS

NOTES

1. EXISTING CONDITIONS BASED ON AERIAL IMAGES COURTESY OF GOOGLE EARTH ALONG WITH DRONE AND GROUND SURVEY COMPLETED 06/02/2021 BY CEI.
2. LOCATIONS AND ELEVATIONS ARE APPROXIMATE.
3. EXISTING UTILITIES SOURCED FROM HAZARD MITIGATION MAP PREPARED BY HILL ENGINEERS ON 11/12/2015, UTILITY LOCATIONS ARE APPROXIMATE.
4. SEE SHEET D-1 FOR PROPOSED INFILTRATION BASIN DETAILS.
5. SEE SHEET D-2 AND D-3 FOR PROPOSED PROJECT DETAILS AND EROSION CONTROL DETAILS.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

EXISTING CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	C-1
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	

FORMER MIDDLE SCHOOL

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

LEGEND

- P/L — PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS

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No.	Revision/Issue	Date

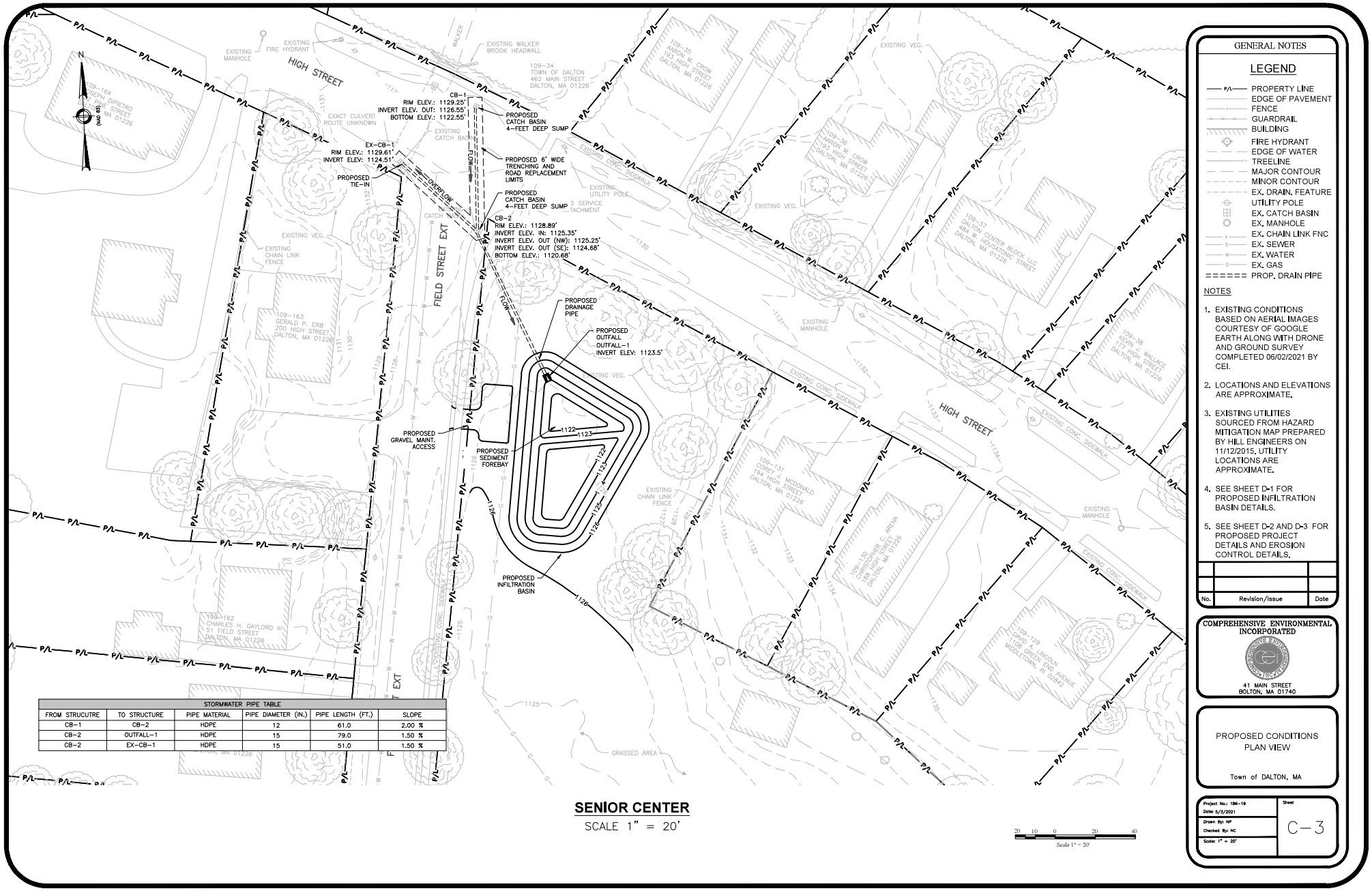
COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

EXISTING CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/3/2021	C-2
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	



STORMWATER PIPE TABLE					
FROM STRUCUTRE	TO STRUCTURE	PIPE MATERIAL	PIPE DIAMETER (IN.)	PIPE LENGTH (FT.)	SLOPE
CB–1	CB–2	HDPE	12	61.0	2.00 %
CB–2	OUTFALL–1	HDPE	15	79.0	1.50 %
CB–2	EX–CB–1	HDPE	15	51.0	1.50 %

SENIOR CENTER

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
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- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

NOTES

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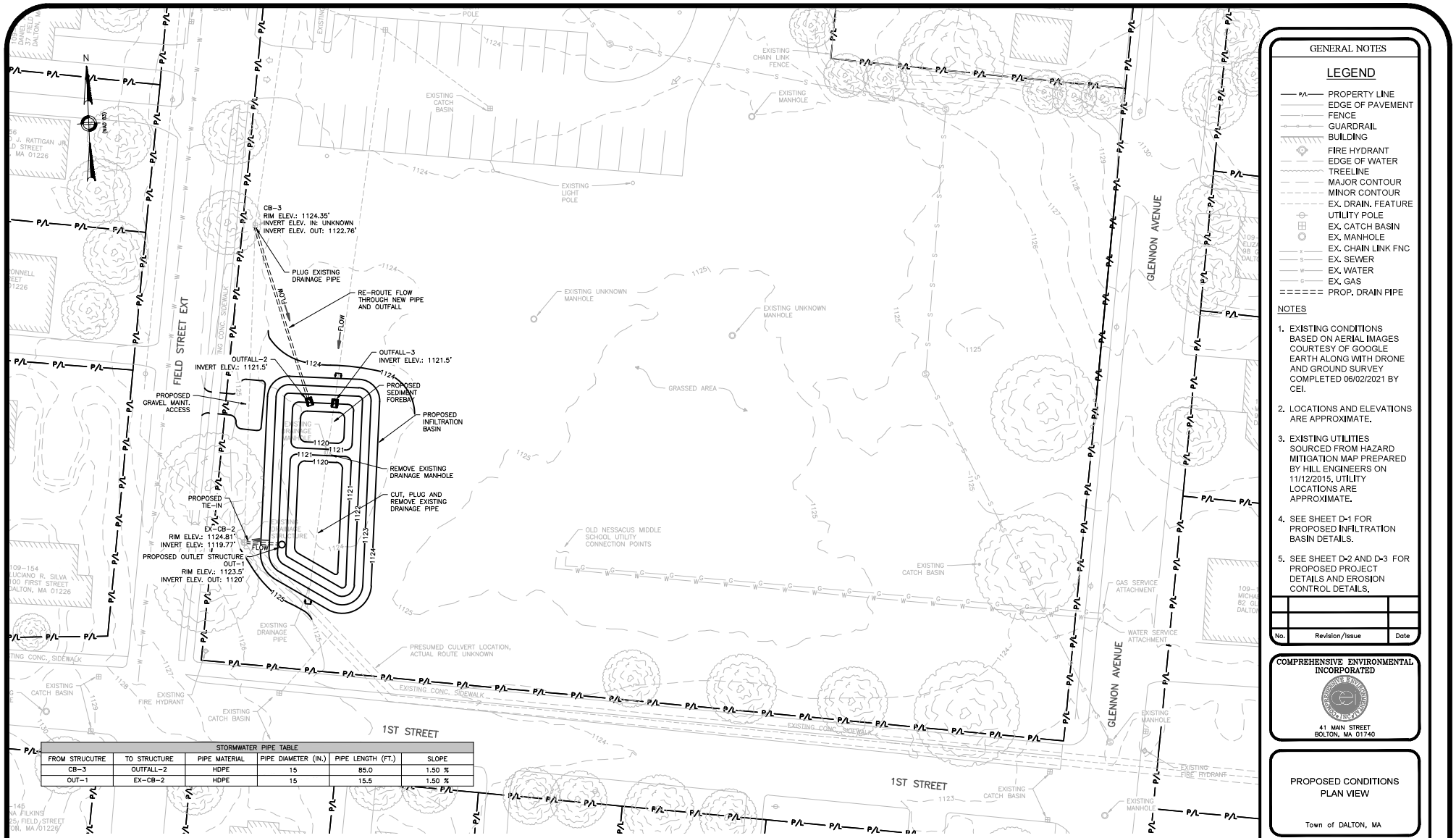
No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS PLAN VIEW

Town of DALTON, MA

Project No.: 186–19	Sheet
Date: 5/3/2021	C–3
Drawn By: NP	
Checked By: NC	
Scale: 1" = 20'	



STORMWATER PIPE TABLE					
FROM STRUCUTRE	TO STRUCTURE	PIPE MATERIAL	PIPE DIAMETER (IN.)	PIPE LENGTH (FT.)	SLOPE
CB-3	OUTFALL-2	HDPE	15	85.0	1.50 %
OUT-1	EX-CB-2	HDPE	15	15.5	1.50 %

FORMER MIDDLE SCHOOL

SCALE 1" = 20'

Scale 1" = 20'

GENERAL NOTES

LEGEND

- PROPERTY LINE
- EDGE OF PAVEMENT
- FENCE
- GUARDRAIL
- BUILDING
- FIRE HYDRANT
- EDGE OF WATER
- TREELINE
- MAJOR CONTOUR
- MINOR CONTOUR
- EX. DRAIN. FEATURE
- UTILITY POLE
- EX. CATCH BASIN
- EX. MANHOLE
- EX. CHAIN LINK FNC
- EX. SEWER
- EX. WATER
- EX. GAS
- PROP. DRAIN PIPE

NOTES

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5. SEE SHEET D-2 AND D-3 FOR PROPOSED PROJECT DETAILS AND EROSION CONTROL DETAILS.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

PROPOSED CONDITIONS
PLAN VIEW

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 5/21/2021	C-4
Drawn By: NP	
Checked By: NC	
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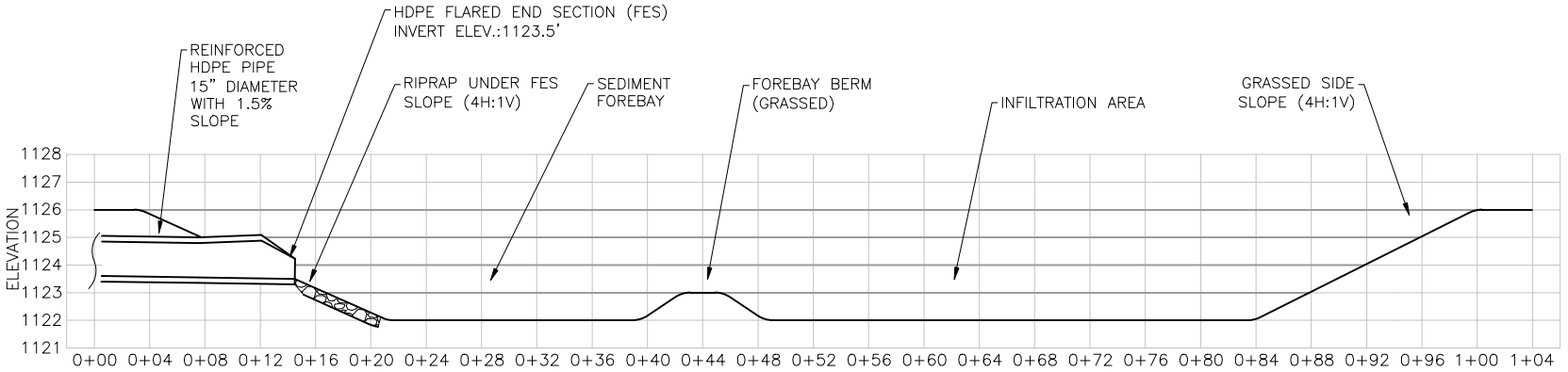
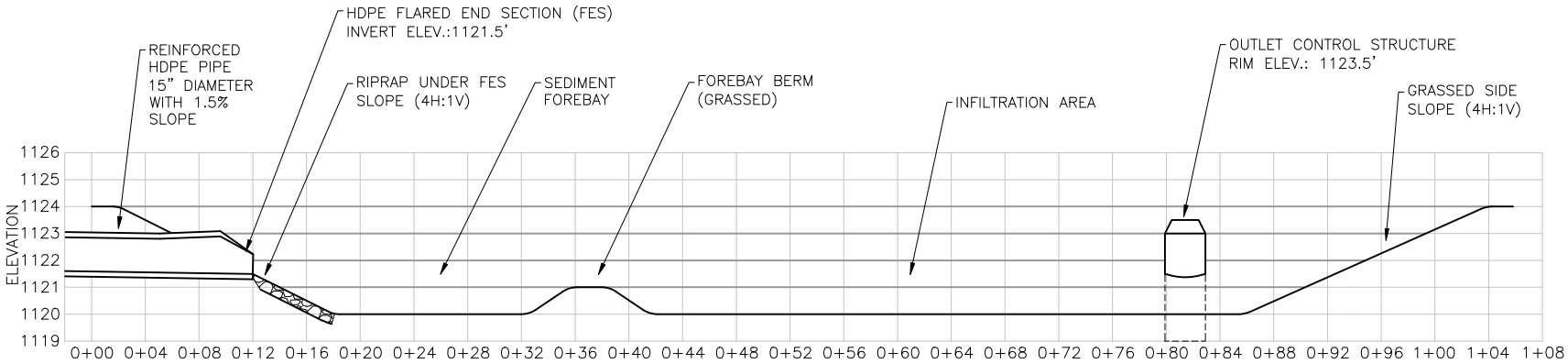


SENIOR CENTER INFILTRATION BASIN DETAIL

SCALE 4H:1V



FORMER MIDDLE SCHOOL INFILTRATION BASIN DETAIL

SCALE 4H:1V

GENERAL NOTES

NOTES

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5. SEE SHEET D-2 AND D-3 FOR PROPOSED PROJECT DETAILS AND EROSION CONTROL DETAILS.

No.	Revision/Issue	Date

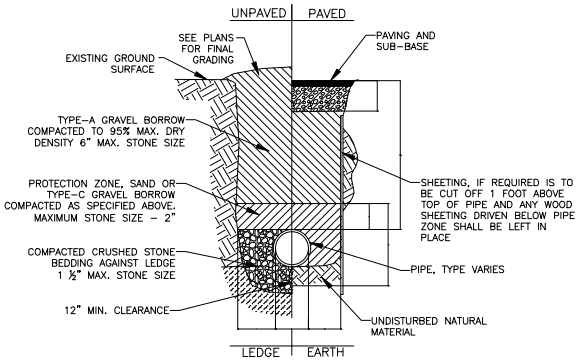
COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

BASIN DETAILS

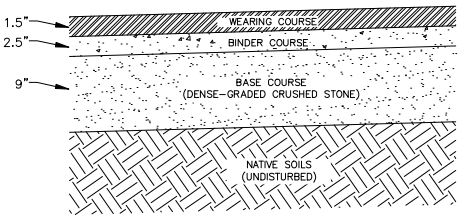
Town of DALTON, MA

Project No.: 186-19
Date: 6/15/2021
Drawn By: NP
Checked By: NC

Sheet
D-1

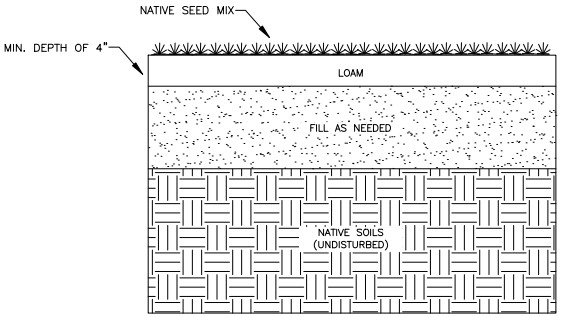


PIPE TRENCHING DETAIL
NOT TO SCALE

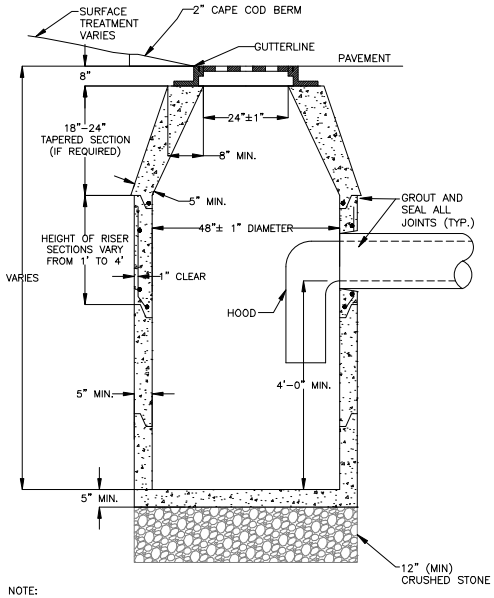


NOTES:
1. PAVEMENT CROSS SECTION IS TYPICAL.

TYPICAL PAVEMENT DETAIL
NOT TO SCALE

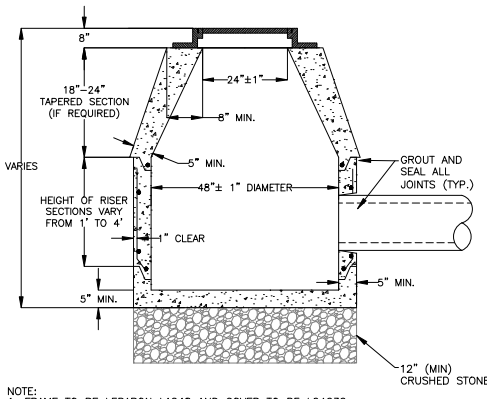


INFILTRATION BASIN SOIL PROFILE
NOT TO SCALE



NOTE:
1. FRAME TO BE LEBARON LF248-5.4 AND GRATE TO BE LEBARON L24SG17
2. CATCH BASIN HOOD TO BE NEENAH R-3705 OR EQUIVALENT
3. SET FRAME IN FULL BED OF MORTAR. BRICKS MAY BE USED FOR GRADE ADJUSTMENTS.
4. MORTAR ALL JOINTS.
5. PROVIDE "V" OPENINGS FOR PIPES WITH 2" CLEARANCE OUTSIDE OF PIPE.
6. PROVIDE MIN. 0.12 SQ. IN. STEEL PER FOOT (VERT) AND PLACE AS PER AASHTO M199.
7. CONSTRUCTION MATERIAL FOR STRUCTURE TO BE PRECAST CONCRETE WITH 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI (MIN).

TYPICAL PRECAST CONCRETE CATCH BASIN
NOT TO SCALE



NOTE:
1. FRAME TO BE LEBARON LA248 AND COVER TO BE L24C32
2. SET FRAME IN FULL BED OF MORTAR. BRICKS MAY BE USED FOR GRADE ADJUSTMENTS.
3. MORTAR ALL JOINTS.
4. PROVIDE "V" OPENINGS FOR PIPES WITH 2" CLEARANCE OUTSIDE OF PIPE.
5. PROVIDE MIN. 0.12 SQ. IN. STEEL PER FOOT (VERT) AND PLACE AS PER AASHTO M199.
6. CONSTRUCTION MATERIAL FOR STRUCTURE TO BE PRECAST CONCRETE WITH 28 DAY COMPRESSIVE STRENGTH OF 3000 PSI (MIN).

TYPICAL PRECAST CONCRETE OUTLET CONTROL STRUCTURE
NOT TO SCALE

GENERAL NOTES

NOTES

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2. LOCATIONS AND ELEVATIONS ARE APPROXIMATE.
3. EXISTING UTILITIES SOURCED FROM HAZARD MITIGATION MAP PREPARED BY HILL ENGINEERS ON 11/12/2015. UTILITY LOCATIONS ARE APPROXIMATE.
4. SEE SHEET D-1 FOR PROPOSED INFILTRATION BASIN DETAILS.
5. SEE SHEET D-2 AND D-3 FOR PROPOSED PROJECT DETAILS AND EROSION CONTROL DETAILS.

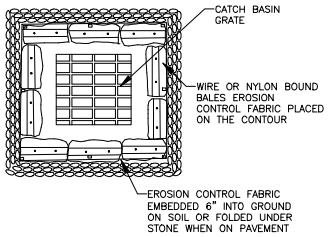
No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

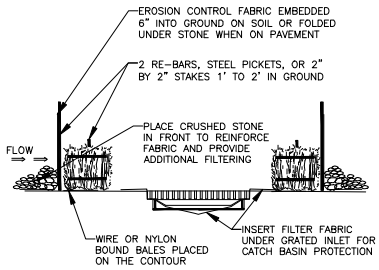
PROJECT DETAILS

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 6/15/2021	D-2
Drawn By: NP	
Checked By: NC	



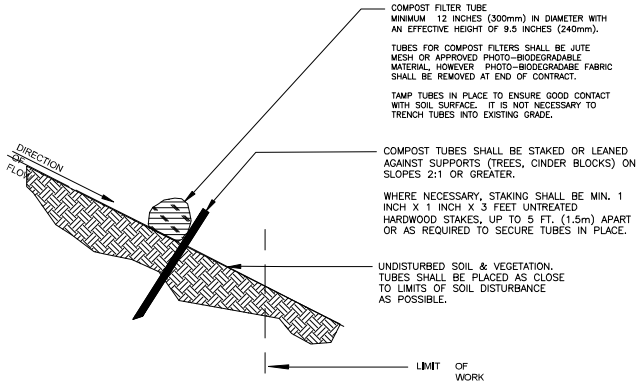
PLAN VIEW



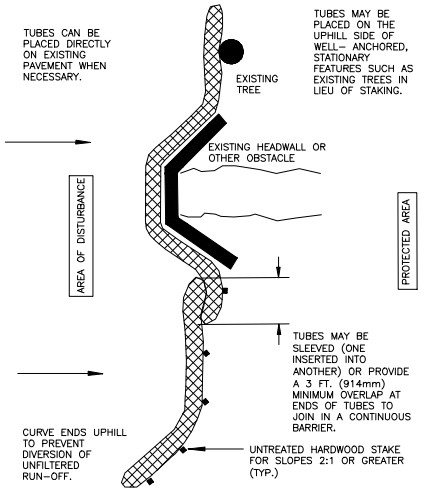
PROFILE VIEW

NOTES
1. SILT FENCE SHALL BE EMBEDDED IN THE SOIL A MINIMUM OF 6"
2. INSPECTION SHALL BE FREQUENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED

CATCH BASIN EROSION CONTROL
NOT TO SCALE



SIDE VIEW



GENERAL NOTES:
1. PROVIDE A MINIMUM TUBE DIAMETER OF 12 INCHES (300mm) FOR SLOPES UP TO 50 FEET (15.24m) IN LENGTH WITH A SLOPE RATIO OF 3H:1V OR STEEPER. LONGER SLOPES OF 3H:1V MAY REQUIRE LARGER TUBE DIAMETER OR ADDITIONAL COURSING OF FILTER TUBES TO CREATE A FILTER BERM. REFER TO MANUFACTURER'S RECOMMENDATIONS FOR SITUATIONS WITH LONGER OR STEEPER SLOPES.
2. INSTALL TUBES ALONG CONTOURS AND PERPENDICULAR TO SHEET OR CONCENTRATED FLOW.
3. TUBE LOCATION MAY BE SHIFTED TO ADJUST TO LANDSCAPE FEATURES, BUT SHALL PROTECT UNDISTURBED AREA AND VEGETATION TO MAXIMUM EXTENT POSSIBLE.
4. DO NOT INSTALL IN PERENNIAL, EPHEMERAL OR INTERMITTENT STREAMS.
5. ADDITIONAL TUBES SHALL BE USED AT THE DIRECTION OF THE ENGINEER.
6. ADDITIONAL STAKING SHALL BE USED AT THE DIRECTION OF THE ENGINEER.

LINEAR SEDIMENT EROSION CONTROL
NOT TO SCALE

GENERAL NOTES

NOTES

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3. EXISTING UTILITIES SOURCED FROM HAZARD MITIGATION MAP PREPARED BY HILL ENGINEERS ON 11/12/2015. UTILITY LOCATIONS ARE APPROXIMATE.
4. SEE SHEET D-1 FOR PROPOSED INFILTRATION BASIN DETAILS.
5. SEE SHEET D-2 AND D-3 FOR PROPOSED PROJECT DETAILS AND EROSION CONTROL DETAILS.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED
41 MAIN STREET
BOLTON, MA 01740

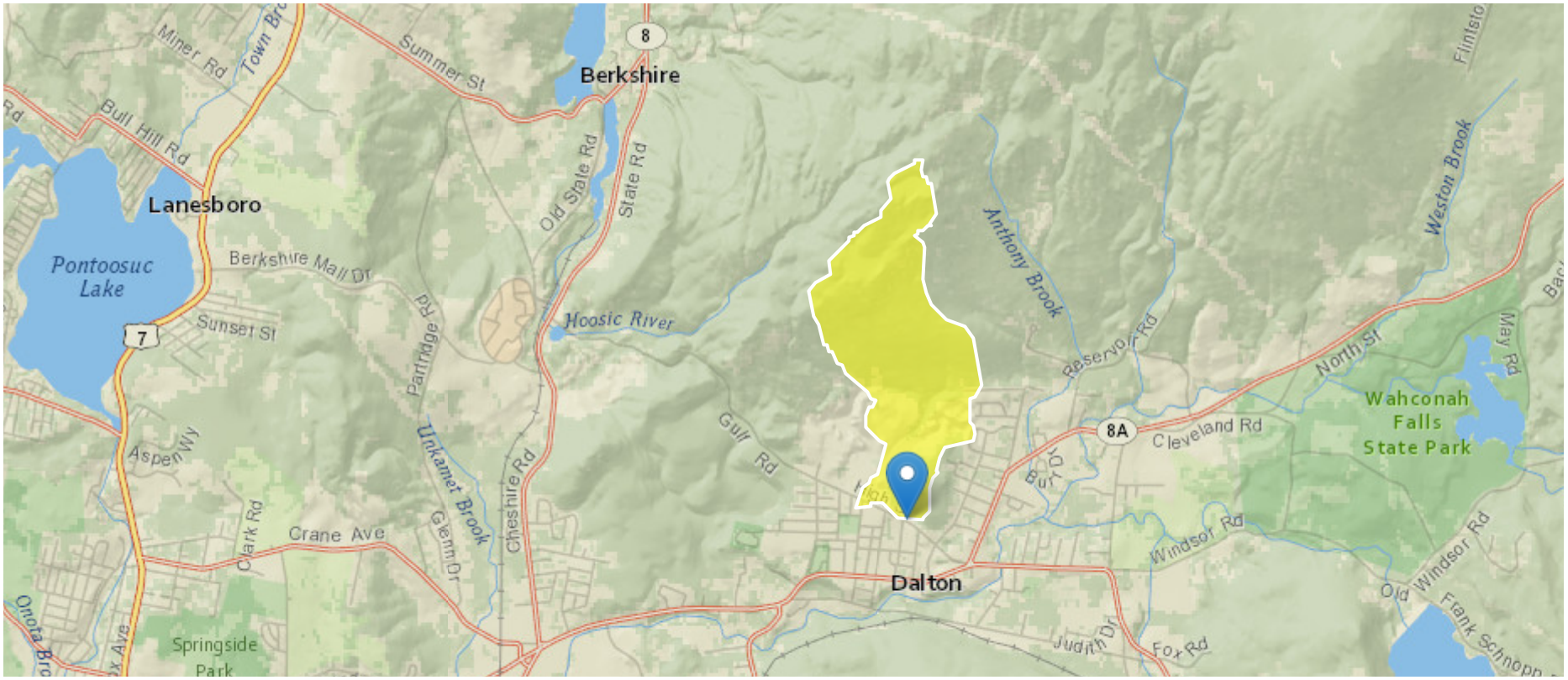
EROSION CONTROL DETAILS

Town of DALTON, MA

Project No.: 186-19	Sheet
Date: 6/15/2021	D-3
Drawn By: NP	
Checked By: NC	

StreamStats Report

Region ID: MA
Workspace ID: MA20210317170528226000
Clicked Point (Latitude, Longitude): 42.47756, -73.16613
Time: 2021-03-17 13:05:47 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.86	square miles
ELEV	Mean Basin Elevation	1440	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	2.31	percent
BSLDEM250	Mean basin slope computed from 1:250K DEM	8.998	percent
DRFTPERSTR	Area of stratified drift per unit of stream length	0.16	square mile per mile
MAREGION	Region of Massachusetts 0 for Eastern 1 for Western	1	dimensionless
BSLDEM10M	Mean basin slope computed from 10 m DEM	12.737	percent
PCTSNDGRV	Percentage of land surface underlain by sand and gravel deposits	27.73	percent
FOREST	Percentage of area covered by forest	81.29	percent

Peak-Flow Statistics Parameters[Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.86	square miles	0.16	512
ELEV	Mean Basin Elevation	1440	feet	80.6	1948
LC06STOR	Percent Storage from NLCD2006	2.31	percent	0	32.3

Peak-Flow Statistics Flow Report[Peak Statewide 2016 5156]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	PIu	SEp
50_percent_AEP_flood	64.7	ft^3/s	30.9	135	42.3
20_percent_AEP_flood	113	ft^3/s	53.1	241	43.4
10_percent_AEP_flood	155	ft^3/s	70.8	339	44.7

Statistic	Value	Unit	PII	PIu	SEp
4_percent_AEP_flood	219	ft^3/s	96	500	47.1
2_percent_AEP_flood	275	ft^3/s	116	651	49.4
1_percent_AEP_flood	336	ft^3/s	137	825	51.8
0_5_percent_AEP_flood	404	ft^3/s	159	1030	54.1
0_2_percent_AEP_flood	506	ft^3/s	188	1360	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (https://dx.doi.org/10.3133/sir20165156)

Low-Flow Statistics Parameters[Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.86	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	8.998	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.16	square mile per mile	0	1.29
MAREGION	Massachusetts Region	1	dimensionless	0	1

Low-Flow Statistics Disclaimers[Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Low-Flow Statistics Flow Report[Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit

Statistic	Value	Unit
7 Day 2 Year Low Flow	0.132	ft^3/s
7 Day 10 Year Low Flow	0.077	ft^3/s

Low-Flow Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Flow-Duration Statistics Parameters[Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.86	square miles	1.61	149
DRFTPERSTR	Stratified Drift per Stream Length	0.16	square mile per mile	0	1.29
MAREGION	Massachusetts Region	1	dimensionless	0	1
BSLDEM250	Mean Basin Slope from 250K DEM	8.998	percent	0.32	24.6

Flow-Duration Statistics Disclaimers[Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Flow-Duration Statistics Flow Report[Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
50 Percent Duration	0.819	ft^3/s
60 Percent Duration	0.552	ft^3/s
70 Percent Duration	0.422	ft^3/s

Statistic	Value	Unit
75 Percent Duration	0.348	ft^3/s
80 Percent Duration	0.361	ft^3/s
85 Percent Duration	0.287	ft^3/s
90 Percent Duration	0.256	ft^3/s
95 Percent Duration	0.159	ft^3/s
98 Percent Duration	0.107	ft^3/s
99 Percent Duration	0.0769	ft^3/s

Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

August Flow-Duration Statistics Parameters[Statewide Low Flow WRIR00 4135]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.86	square miles	1.61	149
BSLDEM250	Mean Basin Slope from 250K DEM	8.998	percent	0.32	24.6
DRFTPERSTR	Stratified Drift per Stream Length	0.16	square mile per mile	0	1.29
MAREGION	Massachusetts Region	1	dimensionless	0	1

August Flow-Duration Statistics Disclaimers[Statewide Low Flow WRIR00 4135]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

August Flow-Duration Statistics Flow Report[Statewide Low Flow WRIR00 4135]

Statistic	Value	Unit
August 50 Percent Duration	0.298	ft^3/s

August Flow-Duration Statistics Citations

Ries, K.G., III,2000, Methods for estimating low-flow statistics for Massachusetts streams: U.S. Geological Survey Water Resources Investigations Report 00-4135, 81 p. (http://pubs.usgs.gov/wri/wri004135/)

Bankfull Statistics Parameters[Bankfull Statewide SIR2013 5155]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.86	square miles	0.6	329
BSLDEM10M	Mean Basin Slope from 10m DEM	12.737	percent	2.2	23.9

Bankfull Statistics Flow Report[Bankfull Statewide SIR2013 5155]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SEp
Bankfull Width	15.7	ft	21.3
Bankfull Depth	0.984	ft	19.8
Bankfull Area	15.2	ft^2	29
Bankfull Streamflow	51.7	ft^3/s	55

Bankfull Statistics Citations

Bent, G.C., and Waite, A.M.,2013, Equations for estimating bankfull channel geometry and discharge for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2013–5155, 62 p., (http://pubs.usgs.gov/sir/2013/5155/)

Probability Statistics Parameters[Perennial Flow Probability]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	0.86	square miles	0.01	1.99
PCTSNDGRV	Percent Underlain By Sand And Gravel	27.73	percent	0	100
FOREST	Percent Forest	81.29	percent	0	100
MAREGION	Massachusetts Region	1	dimensionless	0	1

Probability Statistics Flow Report[Perennial Flow Probability]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PC
Probability Stream Flowing Perennially	0.861	dim	71

Probability Statistics Citations

Bent, G.C., and Steeves, P.A.,2006, A revised logistic regression equation and an automated procedure for mapping the probability of a stream flowing perennially in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2006–5031, 107 p. (http://pubs.usgs.gov/sir/2006/5031/pdfs/SIR_2006-5031rev.pdf)

Appendix E: Open Space Residential Design Overview, Zoning, Subdivision, Site Plan Review, and Stormwater Overview

Supporting LID in Your Community

How to Compare Local Land Use Regulations with Best Practices

Key Areas of Analysis

The following analysis framework is designed to assist communities in Massachusetts in applying cost-effective Low Impact Development (LID) techniques. Specifically, this template enables you to evaluate local land use regulations in relation to models and examples from the Commonwealth of Massachusetts' Smart Growth/Smart Energy Toolkit and other sources in relation to the use of LID and Green Infrastructure (GI) techniques. The focus is primarily on residential development, but the concepts are also applicable to other forms of development and redevelopment.

Best practices minimize the alteration of natural green infrastructure such as forests; reduce creation of impervious surfaces; support retention of naturally vegetated buffers along wetlands and waterways; minimize grading and alterations to natural flow patterns; and support the use of LID techniques as the preferred, most easily permitted methods for managing stormwater.

Get more details on LID's many cost-savings and other benefits at: www.massaudubon.org/LIDCost.

Local coordination across municipal boards and permits is also important for supporting LID. Application of these practices can result in significant savings in infrastructure maintenance costs, as well as improved water quality and protection of water supplies, while supporting property values and overall quality of life. Sustainable development through the application of LID in all aspects of land and water management is a multi-faceted issue that can only successfully be addressed by working together among different departments and perspectives.

Key Areas of Analysis

1. **Overall site design**: Open Space Residential Design (OSRD) vs. conventional subdivisions
2. **Project design and layout standards in relation to LID**: road layout and width, curbing, drainage, sidewalks, parking, landscaping
3. **Maintenance and operations, mechanisms for enforcement**: Who is responsible for maintaining drainage/LID (municipal or homeowner); easements, homeowner association option; municipal inspection and administration systems (this is needed regardless of who is responsible)

Mass Audubon

Open Space Residential Design (OSRD) Overview

This section reviews how local bylaws for cluster, Open Space Residential Design (OSRD), or Natural Resource Protection Zoning (NRPZ) compare to the state's recommended best practices. Communities may currently have multiple bylaws that cover this in different residential areas, in which case they can each be compared to the model regulations. However, in most cases, we would encourage simplification and the use of a single OSRD bylaw with local priorities clearly defined.

Communities may also have no cluster, OSRD, or NRPZ bylaws on the books. In this case, the state's best practice model (see resources below) can be used to create one. If the community closely follows the model, they'll meet the characteristics described within the analysis. However, the analysis still provides a quick checklist.

Some of the most important aspects of OSRD in any community include: the four-step review process that carefully considers the natural landscape before drawing lot lines; the minimum amount of open space protected; the incorporation of LID practices; and allowing this type of development by right instead of special permit.

Zoning, Subdivision, Site Plan Review, and Stormwater Overview

This section reviews not only the individual bylaws and regulations, but also how they work together and how consistent they are. Communities often update portions of bylaws or regulations in a piecemeal way over decades, leading to inconsistencies among various provisions. This color-coded analysis provides a quick overview of not only which rules are out of date and not meeting best practices for LID and preservation of Green Infrastructure, but also how certain topics (such as siting of LID) may be inconsistent between different parts of land use rules.

Not all factors (such as road width, siting of LID, limits on clearing and grading, or allowing common drives) may be addressed in each of the sections considered (Zoning bylaws, Subdivision Rules and Regulations, Site Plan Review (SPR), and Stormwater/LID bylaw). Where that factor is not usually included within a regulation or bylaw, you'll notice that "*(Not Applicable)*" will appear in that box. For example, setbacks and frontage requirements are addressed under Zoning, but often not under other bylaws or regulations. Those boxes are available for editing where desired. The sections identified for review may also need to be adjusted for your analysis, and you may need to add or remove columns to reflect the unique set of bylaws and regulations applicable in your community.

This review may also help towns identify best practices that comply with MS4 permit requirements, issued by EPA and Mass DEP, though it is not comprehensive in relation to the permit requirements and additional actions may be needed. Consultation with EPA and/or DEP is strongly recommended. Visit www.mass.gov/guides/municipal-compliance-fact-sheet-stormwater for more info.

The analysis is broken into five goals, each with factors that address the goal:

Goal 1: Protect Natural Resources and Open Space
The focus of this section is to limit clearing and grading and encourage soil management, the use of native species, and revegetation of disturbed areas. Often, communities have language such as "due regard shall be shown for natural features" without any specific limitations or guidelines that can be used by local boards to ensure developers are following the true intent of the community. The retention of natural vegetation and soils is the single most efficient means of reducing development impacts on water resources, avoiding costs associated with piping and other "grey" stormwater management features as well as the need for irrigation. There are also many other benefits – including habitat for birds and pollinators, trees for shade and clean air, and protection of natural scenery that contributes to property values and a high quality of life.

Goal 2: Promote Efficient, Compact Development Patterns and Infill
Often, making dimensional requirements such as setbacks, lot size, and frontage more flexible as well as allowing common drives will help allow the community to encourage efficient, compact designs. These help to decrease the amount of impervious surfaces and increase infiltration, while still supporting new development.

Goal 3: Smart Designs that Reduce Overall Imperviousness
This section reviews site design such as street location, road width, cul-de-sac design, curbing, roadside swales, and sidewalk design and location. There are many opportunities for communities to minimize impervious surfaces and allow for infiltration through curb cuts, swales, and cul-de-sacs with bioretention, among other things.

Goal 4: Adopt Green Infrastructure Stormwater Management Provisions
This section looks to explicitly discuss LID as a preferred method, such as requiring roof runoff to be directed into vegetated areas, and a preference for infiltration wherever soils allow or can be amended. Bylaws and/or regulations should clearly specify what LID is and which BMPs are preferred or required. Communities should also require an operations and maintenance plan to encourage effective use of LID methods. Adopting a specific LID bylaw can help clearly define and incorporate LID as a preferential stormwater management technique. Defining LID within this bylaw also decreases the need to explain LID throughout each of the Zoning bylaws, SPR, and subdivision rules and regulations and reduce the potential for any conflict between regulations and bylaws. This section also includes additional stormwater management considerations relevant to the MS4 permit.

Goal 5: Encourage Efficient Parking
Parking accounts for a large amount of impervious surface within new and redevelopment projects and offers an enormous opportunity for using LID. By reducing the amount of required parking - or even including parking *maximums* instead of *minimums*, communities can drastically reduce their impervious surfaces and runoff. Many communities already require landscaping in parking areas, which also offers an opportunity to allow curb cuts and infiltration in these areas - improving water quality and reducing the need for irrigation.

Additional Notes and Recommendations

Stormwater Calculations
Ensure your regulations reference the most updated data on storm intensities.
MassDEP Stormwater rules and guidance
https://www.mass.gov/info-details/stormwater-permitting
NOAA14 Atlas https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html
Northeast Climate Center at http://www.nrcc.cornell.edu/

Landscaping and Recommended Trees
Ensure your local landscaping regulations require native, pollinator friendly species such as those here: http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_015043.pdf

Additional Considerations

Funding and Maintenance:

- Ensure sufficient funding for DPW to perform maintenance of stormwater management facilities, whether conventional or LID.
- Consider reduced costs of paving, plowing, salt when comparing LID maintenance costs with conventional designs
- Create mechanisms for enforcement of maintenance agreements; establish regulations/fines for property owners who fail to maintain stormwater facilities.

Training, Demonstration Projects, and Public Education:

- Provide opportunities for and encourage municipal staff and committee/board members to participate in LID workshops or conferences.
- Implement LID demonstration programs at city or town hall, schools, DPW, etc.

Nonpotable Uses of Clean Stormwater:

- Local plumbing codes should allow the use of clean (e.g. rooftop) rainwater for landscape irrigation and interior non-potable uses such as toilet flushing.

MA Open Space Residential Design Best Practices Factors	Conventional	Better	Best Practice	Community's OSRD
Permit Type	Special Permit	By Right	Mandatory	special permit (350-99A)
Land area to which the zoning is applicable	Only a small amount of developable land	Land of particular environmental sensitivity	All developable land zoned residential	any residential development in the R-1 District can apply (350-98)
Minimum Open Space	50-65%	65-75%	≥ 75%	50% (350-103A)
Yield Calculation	Full plan with full percolation tests	Sketch plan with selected percolation test(s)	By formula	by formula (350-101B)
Minimum parcel size	≥ 10 acres	5-10 acres	None	> 10 acres (350-98B)
Review Process	No detailed analysis of site characteristics in relation to design	Cluster layout	Flexible "OSRD" 4 Step	cluster development (350-101)
Ownership of Open Space	Appropriate to the resources present. For example, agricultural land by the farmer, watershed land by a water dept. or district, habitat land by the conservation commission, or recreational open space by a parks and recreation commission or homeowners association.			no mention of appropriate use
Dimensional Standards; area, frontage, etc.	Specified, < than for standard subdivision	Formulaic reduction with specified minimums	None set or small minimums	frontage and setbacks 50% of district (350-102)
Quality of open space conserved: Specificity of local priorities for natural, cultural, and historic resource conservation	No indication of local conservation priorities, or language that refers only to regulated resource areas.	Lack of specificity regarding local conservation priorities; no map of priority locations	Local priorities clearly and unambiguously stated and mapped for use in site design.	vaguely refers to forestry land, wildlife habitats, and natural resources (aquifers, water bodies, wetlands); no map (350-97)
Contiguity of open space; relationship to previously protected open space	No contiguity requirement	Contiguity required within subdivision	Contiguity required; adjacent land considered	contiguity required (350-98C)

Quality of open space conserved: Allowed uses of open space	Allowed use of open space not addressed	Vague language regarding use of conserved open space	Clear list of allowed uses consistent with conservation and recreation goals	long list of allowed uses consistent with recreation and conservation goals (350-103.A.3)
Quality of open space conserved: Submission requirements - GIS maps, data, etc. to inform the review process	Vague or no language regarding submission of information on site resources and no specified process for the use of the data submitted	General non-comprehensive data and mapping requirements; vague process for the application of the data to site design and open space conservation	Specific plans, maps, & comprehensive data regarding natural, cultural, and historic resources required and used as the basis for open space conservation	comprehensive data and mapping requirements that are attentive to natural, cultural, and historical resources (350-99.D)
Relationship to Plans	Relationship to plans not discussed	Optional consideration of open space goals of OSRP, master, and/or regional policy plan	Required consideration of open space goals of OSRP, master, and/or regional policy plan	relationship to master plan one of many factors considered alongside factors such as protection of natural resources and sprawl (350-105.E)
Low Impact Design	Not addressed	Encouraged	Required	not considered
Density bonus for enhanced public benefit(s)	No bonus offered	Bonus by special permit	Automatic or formulaic bonus	no bonus offered
Review Entity	ZBA, council or selectmen as special permit authority	Planning Board	Planning Board	Planning Board

Flexibility re: open space protection to facilitate wastewater treatment facilities	No flexibility provided	Aggregate calculations allowed by board of health	If necessary, required open space may be reduced by < 10% to accommodate; disposal area deed restricted; aggregate calculations allowed by BoH, etc.	surface wastewaster and stormwater management systems do not count towards minimum open space requirements (350-103.A.4)
Monitoring of open space	No specified monitoring requirements and no requirements that would assist the party responsible for monitoring	Loose provisions to facilitate, municipal monitoring, or no specificity regarding monitoring interval	Specific provisions to aid endowed monitoring by a conservation org at stated intervals	no mention of monitoring requirements

Factors	Conventional	Better	Best	Community's Zoning	Community's Subdivision Rules & Regulations	Community's Stormwater/LID Bylaw/Regulations
GOAL 1: PROTECT NATURAL RESOURCES AND OPEN SPACE						
Soils managed for revegetation	Not addressed	Limitations on removal from site, and/or requirements for stabilization and revegetation	Prohibit removal of topsoil from site. Require prep of soils compacted during construction	*(Not applicable)*	*(Not applicable)*	Stormwater Bylaw/ Stormwater Regulations p. 7
Limit clearing, lawn size, require retention or planting of native vegetation/naturalized areas	Not addressed or general qualitative statement not tied to other design standards	Encourage minimization of clearing/ grubbing	Require minimization of clearing/grubbing with specific standards	Earth removal Zoning Bylaw (350-61)	*(Not applicable)*	Stormwater Bylaw/ Stormwater Regulations p. 7
Require native vegetation and trees	Require or recommend invasives	Not addressed, or mixture of required plantings of native and nonnative	Require at least 75% native plantings	*(Not applicable)*	*(Not applicable)*	Not addressed
GOAL 2: PROMOTE EFFICIENT, COMPACT DEVELOPMENT PATTERNS AND INFILL						
Lot size	Required minimum lot sizes	OSRD/NRPZ preferred. Special permit with incentives to utilize	Flexible with OSRD/NRPZ by right, preferred option	required minimum lot size	*(Not applicable)*	*(Not applicable)*
Housing density	Multi-family housing not allowed, or only in/adjacent to commercial and industrial uses	Multi-family and cluster developments allowed by special permit	Multi-family housing allowed by right in most residential areas; cluster developments encouraged with density bonuses for LID features and no maximum lot coverage	multifamily and cluster developments allowed by permit (350-54,55,56)	*(Not applicable)*	*(Not applicable)*
Setbacks	Required minimum front, side, and rear setbacks	Minimize, allow flexibility	Clear standards that minimize and in some instances eliminate setbacks	required minimum setbacks	*(Not applicable)*	*(Not applicable)*
Frontage	Required minimum frontage for each lot/unit	Minimize especially on curved streets and cul-de-sacs	No minimums in some instances, tied into other standards like OSRD design and shared driveways.	required minimum frontage	*(Not applicable)*	*(Not applicable)*

Common driveways	Often not allowed, or strict limitations	Allow for 2-3 residential units	Allow for up to 4 residential units, preferrably constructed with permeable pavers or pavement	common driveways can serve up to 2 units in OSRD (350-104.B.3)	*(Not applicable)*	*(Not applicable)*
GOAL 3: SMART DESIGNS THAT REDUCE OVERALL IMPERVIOUSNESS						
Impervious cover limits and infiltration rates	Not usually addressed in zoning and subdivision regs for rural/suburban residential	Require no net increase in site run-off from pre- to post-development	Impervious cover limits tailored to the commuity and district type (i.e. <10% total impervious cover in rural districts, but higher in urban and redevelopment districts); post-development infiltration should be equal to or greater than pre-development. Following best practice may also help communities comply with MS4 permit requirements	*(Not applicable)*	*(Not applicable)*	regulation of changes to surface of an area equal to or greater than 1 acre that will result in reduced permeability/increased runoff (280-4)
Street location	Numeric and geometric standards based primarily on vehicular travel and safety, with basic pedestrian requirements e.g. sidewalks	Flexibility in applying standards, to reduce area of impact, grading, avoid key natural features	OSRD design preferred by-right. Require locating streets to minimize grading and road length, avoid important natural features	*(Not applicable)*	avoid key natural features (501-13)	*(Not applicable)*
Road width	Major and minor categories, 24-30'	Wide, medium, narrow categories. 22-24' max, plus 2' shoulders	Wide, medium, narrow, and alley categories. 20-24' widest for 2 travel lanes, 18-20' low traffic residential neighborhood, plus 2' shoulders. Allow alleys and other low traffic or secondary emergency access and all shoulders to use alternative, permeable materials.	common driveways can serve up to 2 units in OSRD (350-104.B.3)	*(Not applicable)*	*(Not applicable)*

Road ROW width	50-75', fully cleared and graded	40-50', some flexibility in extent of clearing	20-50'depending on road type	*(Not applicable)*	minimum of 50 feet, fully graded (501-10.B)	*(Not applicable)*
Access Options	No common drives allowed, dead end allowed with limit on length and # of units	Allow dead end with limit on length and # of units. Allow common drives up to 2-3 units	Allow one way loop streets. Allow common drives up to 4 units, and alleys and rear-loading garages where suitable.	common driveways can serve up to 2 units in OSRD (350-104.B.3)	dead ends not permitted unless necessitated by topography (501-10.D)	*(Not applicable)*
Dead Ends/Cul-de-sacs	120 ft or more minimum turnaround	Minimize end radii – 35 ft	Allow hammerhead turnaround	*(Not applicable)*	minimum 100 ft. turnaround	*(Not applicable)*
Cul-de-sacs	Full pavement standard	Encourage center landscaping with bioretention	Require center landscaping with bioretention	Absent/assumed full pavement standard		*(Not applicable)*
Curbing	Curbing required full length both sides of road	Allow curb breaks or curb flush with pavement to enable water to flow to vegetated LID features	Open drainage with roadside swales and no curbs preferred	*(Not applicable)*	required on both sides of the road (501-19)	
Roadside Swales	Allowed as an option	Preferred over closed drainage	Preferred, with criteria for proper design. Adoption of technical specifications and design templates for green infrastructure recommended	Allowed as an option, Drainage ditches wherever possible shall be graded to resemble natural streams (501-23)	#####	
Utilities	Off sets required contributing to wide road ROWs	Not specified, flexible	Allow under road, sidewalks or immediately adjacent to roads to enable placement of roadside swales.	*(Not applicable)*	Shall be buried within the road right-of-way in a strip 4 1/2 feet wide running parallel to the edge of the right-of-way. all overhead wires and related equipment shall be centered as much as possible on rear or side lot lines. (501-16). Easements shall be at least 12ft. wide. (501-11)	*(Not applicable)*
Sidewalks	Concrete or bituminous	Some flexibility in material and design	Prefer permeable pavement or permeable pavers	*(Not applicable)*	Side walk width and design in compliance with Dalton Highway standards, no set material requirement (i.e. flexibility in material and design).	*(Not applicable)*

Sidewalk location	Required both sides of road	Allow on only 1 side of road especially in low density neighborhoods	Prefer siting with land contours and for best pedestrian utility (e.g. connect with common areas and shared open spaces) – not necessarily immediately parallel to road.	*(Not applicable)*	both sides in all zones except for R-1 (501-19)	*(Not applicable)*
Sidewalk drainage	Drains to road closed drainage system	Not addressed	Disconnect drainage from road system – e.g.adjacent green strips or within vegetated areas that can absorb sheet flow	*(Not applicable)*	Not addressed	*(Not applicable)*
GOAL 4: ADOPT GREEN INFRASTRUCTURE STORMWATER MANAGEMENT PROVISIONS						
Rooftop runoff	Prohibit directing clean roof runoff into closed municipal drainage systems.	Allow clean roof runoff to be directed to landscaped or naturally vegetated areas capable of absorbing without erosion, or infiltration	Require directing clean roof runoff to landscaped or naturally vegetated areas capable of absorbing, or infiltration	*(Not applicable)*		Not specified. Clean roof runoff allowed to be directed to landscaped or naturally vegeatated areas.
Overall stormwater design; piping and surficial retention vs. LID	Conventional stormwater system design standards	Encourage LID features and BMPs; design standards often not specified	LID design standard encouraging infiltration, allowing surficial ponding of retained runoff for up to 72 hours; systems designed for larger volume storms, accounting for future precipitation predictions; credit for green roofs towards stormwater requirements. Following best practice may also help communities comply with MS4 permit requirements	*(Not applicable)*		allow green infrastructure practices when appropriate site conditions exist; no specific practices/conditions identified (MCM.5)

Site Plan/Design Requirements	LID not addressed	Encourage use of LID features in site design - such as reduced imperviousness, maintaining natural hydrology, preserving open space, and rainwater reuse	Include bioretention and other vegetated LID features in site landscaping/open space requirements. Following best practice may also help communities comply with MS4 permit requirements. See section 2.3.5 of the MS4 permit for more information	*(Not applicable)*	#####	MS4 Requirements require stormwater treatment in site designs 1 acre or more. (280-4). Does not apply to sites under 1 acre.
Allow easy siting of LID features (bioretention, swales, etc.)	Often not addressed, may require waivers from subdivision standards	Encouraged along road ROW	Allowed on lots, common open space, or road ROW, easement recorded. For commercial development, allow an increase in floor area ratio or other developmental incentives for green roofs		No addressed. Allowed on private lots and within right-of-way if approved by Highway Department and Planning Board.	*(Not applicable)*
Permeable paving	Often not addressed, may require waivers from subdivision standards	Allowed on private residential lots for parking, patios, etc.	Allowed for residential drives, parking stalls, spillover parking spaces, emergency access ways (with proper engineering support for emergency vehicles) Two track design allowed for driveways and secondary emergency access ways (where required)	*(Not applicable)*	Not addressed either way. No special waiver for permeable paving materials.	
Stormwater management O&M plan	Typically only addressed if municipality has a stormwater or LID bylaw, or for areas subject to wetlands permitting	Required	Required, contents specified in alignment with current MassDEP Stormwater Handbook. Following best practice may also help communities comply with MS4 permit requirements	*(Not applicable)*		Stormwater Management O&M for projects 1 acre or more.

Construction Erosion and Sedimentation Plan, and stormwater control	Basic general requirements	Required, contents specified - the site design process should include soil erosion and sedimentation control measures	Goes beyond minimum NPDES requirements. Requires minimization of site disturbance, reduction of construction waste, control measures not removed until proof of soil stabilization or reestablishment of vegetation. Written procedures for site inspection and enforcement included. Following best practice may also help communities comply with MS4 permit requirements. See section 2.3.5 of the MS4 permit for more information	*(Not applicable)*		Required Construction erosion and sediemtn control plan for 1 acre or more under NPDES MS4 General Permit Regulations (280-4)
Stormwater discharge detection & elimination	Not addressed	Discharges and connections noted and/or limits set on quantity and quality	Illicit discharges and connections are probibited and enforced. Following best practice may also help communities comply with MS4 permit requirements. Find more information in section 2.3.4.a of the MS4 permit	*(Not applicable)*	*(Not applicable)*	illicit discharges and connections are prohibited and follow MS4 guildelines (131-12,13)

Post- construction stormwater management and drainage patterns	Not addressed	Allow LID	Resemble pre-existing conditions of volume, velocity, quality and location, as nearly as possible, requiring LID to the max extent feasible. Retain vol of runoff >1in. per sq.ft. of impervious surface and/or remove 90% TSS post-construction & 50% TP generated on the site for new development, or >0.8in. per sq.ft and/or remove 80% TSS and 50% of TP load for redevelopment. Following best practice may also help communities comply with MS4 permit requirements.	*(Not applicable)*		BMPs for redevelopment sites must remove 80% or more of the average annual load of TSS and 50% or more of the average annual load of Total Phosphorus. BMPs for new development must remove 80% or more of the annual average load of total suspended solids and 50% or more of the average annual load of total phosphorous for all post-construction impervious areas on-site. (Stormwater Regulations p. 10)
As-built surveys	Not addressed	Recommended	Required, with written instructions for process; electronic submittal allowed	*(Not applicable)*		As-built required upon completion with written explanation as to differences between as-built and original deisngs in stormwater. (Stormwater Regulations p. 14)
Intra-departmental communication and coordination	Not addressed	Informally or loosely occurring	Required for plan review and/or permit approvals			Stormwater Management Comission, the Board of Health, and the Planning Board share reponsibilities over stormwater management. Plan reviews done by intra-departmental Storwmater Commission
Enforcement	No	Yes	Yes with fines. Same entity should oversee permit approvals and enforcement			Yes; depends on the infraction whether or not fines are used

GOAL 5: ENCOURAGE EFFICIENT PARKING						
Parking	Specific minimums set based on projected maximum use times	Encourage minimum # needed to serve routine use (e.g. 2/residential unit with any additional/visitors parking behind in driveway or on street).	Establish Maximum Parking spaces allowed. Do not require more than 2/residence. Allow tenants separate, optional lease agreements for parking.	minimums set based on maximum use times; has special permit process for minimum # reduction (350-41,42)- also applies to commercial	*(Not applicable)*	*(Not applicable)*
Commercial Parking	Specific minimums set based on projected maximum use times adding all on-site uses together.	Some flexibility to reduce minimums based on street or other available nearby parking or transit.	Allowed shared parking for uses with different peak demand times. Provide model agreements/deed restrictions. Reduce parking requirements near transit. Limit parking stall size (9ftx18ft max), with up to 30% smaller for compact cars		Specific minimums set based on projected use. (350-40, 350-41). Reducttion of minimums allow with special permit (350-42)	*(Not applicable)*
LID in Parking Areas	Often not addressed, may require waivers e.g. for planting islands to drain down rather than built up surrounded by curbs	Allow LID/bioretention within parking areas.	Require landscaping within parking areas, as LID/bioretention, at a minimum of 10% of the interior area landscaped and a minimum of 25 square feet for island planting areas.	parking area for 10 or more cars must be bordered by or contain trees/plantings (350-40.G)		Bioretention allowed/encouraged in new development Stormwater Regulations

Common Acronyms

BoA	Board of Appeals
BoH	Board of Health
BMP	Best Management Practice
CC	Conservation Commission
CR	Conservation Restriction pursuant to MGL 184, S.31-33
DPW	Department of Public Works
GI	Green Infrastructure
HA	Homeowner's Association
LID	Low Impact Development
MS4	Municipal Separate Storm Sewer System
NBS	Nature-based Solutions
NRPD	Natural Resource Protection Development
NRPZ	Natural Resource Protection Zoning
OS	Open Space
OSRD	Open Space Residential Design
PB	Planning Board
ROW	Right of Way
RS	Residential Single
RG	Residential General
SPR	Site Plan Review
SP	Special Permit
SPGA	Special Permit Granting Authority

Resources and Model Bylaws/Regulations

For additional information on best practices, model LID and OSRD bylaws and regulations, case studies, and other related resources see:

www.massaudubon.org/LIDCost
- Five free fact sheets on Cost-Effective LID
- Presentations and other resources

Additional resources
- Massachusetts Smart Growth/Smart Energy Toolkit, including case studies and model bylaws: www.mass.gov/envir/smart_growth_toolkit/

- Massachusetts Smart Growth Model Open Space Design/Natural Resource Protection Zoning: www.mass.gov/files/documents/2017/11/03/Open Space Design (OSD)-Natural Resource Protection Zoning (NRPZ)_0.pdf

- Metropolitan Area Planning Council's (MAPC) LID Toolkit
  www.mapc.org/resource-library/low-impact-development-toolkit/

  MAPC's Climate Resilient Land Use Strategies Toolkit:
  https://www.mapc.org/resource-library/climate-resilient-land-use-strategies/

- MA-APA *Neighborhood Road Design Guidebook*
  https://www.apa-ma.org/wp-content/uploads/2018/12/NRB_Guidebook_2011.pdf

- EPA's Water Quality Scorecard, which was reviewed and incorporated into this analysis framework in July 2017, including using the 5 goals listed:
  www.epa.gov/smartgrowth/water-quality-scorecard

- MassDEP's Stormwater Program and MS4 compliance resources:
  https://www.mass.gov/info-details/stormwater-permitting

Acknowledgements and Disclaimers

The OSRD best practices chart is based on the Massachusetts Executive Office of Energy and Environmental Affairs' Model Open Space Design/Natural Resource Protection Zoning. The zoning, subdivision, site plan, and stormwater regulatory analysis chart is based on a checklist from the MAPC LID Toolkit and other sources.

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NEIWPCC
New England Interstate Water Pollution Control Commission

NARRAGANSETT BAY ESTUARY PROGRAM

This document was funded in part through a technical assistance project, *Empowering MetroWest Communities to Manage Land and Water Resources for a Sustainable Future*, funded by the Foundation for MetroWest. Established in 1995, the Foundation for MetroWest is the only community foundation serving the 33 cities and towns in the region. The Foundation promotes philanthropy in the region, helps donors maximize the impact of their local giving, serve as a resource for local nonprofits and enhance the quality of life for all our residents. Since inception, the Foundation has granted $11.6 million to charitable organizations and currently stewards more than $15 million in charitable assets for current needs and future impact. To learn more, please visit www.foundationformetrowest.org or call 508-647-2260

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MASSACHUSETTS ENVIRONMENTAL TRUST

CAPE COD COMMISSION

SNEP NETWORK

Additions were made to this tool in 2022 to incorporate enhancements from the Cape Cod Commission to assist communities in including stormwater management practices that comply with the MassDEP/US EPA MS4 Permit.

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www.snepnetwork.org

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Contact Us

For questions regarding this analysis or how to implement LID in your community, please feel free to contact u

Mass Audubon
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www.massaudubon.org/advocacy

Appendix F: Massachusetts Model Floodplain By-Law

Massachusetts 2020 Model Floodplain Bylaws

Table of Contents

Section 1. Introduction

After years of devastation from flooding across the nation, Congress created the National Flood Insurance Act of 1968 in an attempt to offer flood disaster relief in the form of insurance. This insurance would be available to residents of communities that voluntarily adopt and enforce floodplain management ordinances that meet at least minimum National Flood Insurance Program (NFIP or the Program) requirements.

According to FEMA's Community Status Book, the first Massachusetts community to officially participate in the NFIP was the Town of Wareham, who joined the NFIP on May 28, 1971. Most other MA communities quickly followed suit in the 1970s and early 1980s. The State NFIP Coordinating Office was created by Executive Order of the Governor in 1978 and is housed under the Water Resources Commission in the Department of Conservation & Recreation's Flood Hazard Management Program.

This document has been prepared in order to assist NFIP communities in Massachusetts to understand the minimum requirements of the NFIP, and to assure that their local bylaws or ordinances contain the necessary and proper language for compliance with the Program.

The local floodplain overlay district is established as an overlay to all other districts. In Massachusetts, the floodplain overlay district bylaw or ordinance is part of a federal requirement for communities that choose to participate in the NFIP. However, the state already administers regulations that take care of many floodplain management requirements and concerns. Referencing existing regulations is important to ensure that projects have been reviewed under the appropriate state regulations and that variances to the conditions of the bylaw do not erroneously allow variances to state requirements.

All development in the floodplain overlay district, including structural and non-structural activities, whether permitted by right or by special permit must be in compliance with the following:

- 780 CMR- Massachusetts Statewide Building Code
- 310 CMR- Department of Environmental Protection Regulations

For those NFIP requirements that are not found in the above state regulations, the community must adopt these requirements in their bylaws (towns) or ordinances (cities.) The following section contains all NFIP requirements that must be adopted as local regulations, since they are not found in the above listed regulations.

Section 3 contains floodplain management definitions that FEMA Region I feels are critical for inclusion in local codes.

Section 4 of this document offers explanations to support local understanding of these requirements.

Section 2. Required Local Bylaws

For those National Flood Insurance Program minimum requirements that are not found in existing state law, the following articles must be adopted by the community as a part of their local bylaws or ordinances, if these are not already adopted. The suggested language in this section is compliant with the federal requirements.

1. Stated local purpose for flood resistant standards

The purpose of the Floodplain Overlay District is to:

1) Ensure public safety through reducing the threats to life and personal injury
2) Eliminate new hazards to emergency response officials
3) Prevent the occurrence of public emergencies resulting from water quality, contamination, and pollution due to flooding
4) Avoid the loss of utility services which if damaged by flooding would disrupt or shut down the utility network and impact regions of the community beyond the site of flooding
5) Eliminate costs associated with the response and cleanup of flooding conditions
6) Reduce damage to public and private property resulting from flooding waters

2. Use of FEMA maps and supporting studies

A community must select the appropriate option as follows:

A. Bylaw text for communities with "Community-Based" FIRMs, FBFM and FIS

The Floodplain District is herein established as an overlay district. The District includes all special flood hazard areas designated on the [Town or City]'s Flood Insurance Rate Map (FIRM) issued by the Federal Emergency Management Agency for the administration of the National Flood Insurance Program, dated [effective map dates on FIRM] and on the Flood Boundary & Floodway Map (if applicable) dated [FBFM effective date.] These maps indicate the 1%-chance regulatory floodplain. The exact boundaries of the District shall be defined by the 1%-chance base flood elevations shown on the FIRM and further defined by the Flood Insurance Study (FIS) report dated [FIS date.] The effective FIRM, FBFM, and FIS report are incorporated herein by reference and are on file with the Town Clerk, Planning Board, Building Official, Conservation Commission and [other.]

OR

B. Bylaw text for communities with "Countywide" FIRMs and FIS

The Floodplain District is herein established as an overlay district. The District includes all special flood hazard areas within [Community Name] designated as Zone A, AE, AH, AO, A99, V, or VE on the [County Name] Flood Insurance Rate Map (FIRM) dated [FIRM date] issued by the Federal Emergency Management Agency (FEMA) for the administration of the National Flood Insurance Program. The exact boundaries of the District shall be defined by the 1%-chance base flood elevations shown on the FIRM and further defined by the [County Name] Flood Insurance Study (FIS) report dated [FIS date]. The FIRM and FIS report are incorporated herein by reference and are on file with the Town Clerk, Planning Board, Building Official, Conservation Commission and [other].

3. Abrogation and greater restriction section

The floodplain management regulations found in this Floodplain Overlay District section shall take precedence over any less restrictive conflicting local laws, ordinances or codes.

4. Disclaimer of liability

The degree of flood protection required by this bylaw [ordinance] is considered reasonable but does not imply total flood protection.

5. Severability section

If any section, provision or portion of this bylaw [ordinance] is deemed to be unconstitutional or invalid by a court, the remainder of the ordinance shall be effective.

6. Designation of community Floodplain Administrator

The Town/City of _____ hereby designates the position of _____ to be the official floodplain administrator for the Town/City.

7. Requirement to submit new technical data

If the Town/City acquires data that changes the base flood elevation in the FEMA mapped Special Flood Hazard Areas, the Town/City will, within 6 months, notify FEMA of these changes by submitting the technical or scientific data that supports the change(s.) Notification shall be submitted to:

FEMA Region I Risk Analysis Branch Chief
99 High St., 6th floor, Boston, MA 02110

And copy of notification to:

Massachusetts NFIP State Coordinator
MA Dept. of Conservation & Recreation, 251 Causeway Street, Boston, MA 02114

8. Variances to building code floodplain standards

CHOOSE THE APPROPRIATE OPTION:

A. If the State issues variances to the flood-resistant standards as found in the state building code, the community will use this text for local adoption:

> The Town/City will request from the State Building Code Appeals Board a written and/or audible copy of the portion of the hearing related to the variance, and will maintain this record in the community's files.
>
> The Town/City shall also issue a letter to the property owner regarding potential impacts to the annual premiums for the flood insurance policy covering that property, in writing over the signature of a community official that (i) the issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage and (ii) such construction below the base flood level increases risks to life and property.
>
> Such notification shall be maintained with the record of all variance actions for the referenced development in the floodplain overlay district.

B. Certain communities have the authority to issue variances to the state building code. If your community has this authority from the BBRS, you will use this text for local adoption:

Variances to floodplain development regulations shall only be issued upon (i) a showing of good and sufficient cause, (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances.

A written justification for the variance will be maintained in the Town's/City's building permit files, delineating the technical reason for the variance, and stating that the variance is the minimum necessary (considering the flood hazard) to afford relief.

The Town/City shall also issue a letter to the property owner regarding potential impacts to the annual premiums for the flood insurance policy covering that property, in writing over the signature of a community official that (i) the issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage and (ii) such construction below the base flood level increases risks to life and property.

Such notification shall be maintained with the record of all variance actions for the referenced development in the floodplain overlay district.

9. Variances to local Zoning Bylaws related to community compliance with the National Flood Insurance Program (NFIP)

A variance from these floodplain bylaws must meet the requirements set out by State law, and may only be granted if: 1) Good and sufficient cause and exceptional non-financial hardship exist; 2) the variance will not result in additional threats to public safety, extraordinary public expense, or fraud or victimization of the public; and 3) the variance is the minimum action necessary to afford relief.

10. Permits are required for all proposed development in the Floodplain Overlay District

The Town/City of _____ requires a permit for all proposed construction or other development in the floodplain overlay district, including new construction or changes to existing buildings, placement of manufactured homes, placement of agricultural facilities, fences, sheds, storage facilities or drilling, mining, paving and

any other development that might increase flooding or adversely impact flood risks to other properties.

11. Assure that all necessary permits are obtained

(Town/City)_____'s permit review process includes the use of a checklist of all local, state and federal permits that will be necessary in order to carry out the proposed development in the floodplain overlay district. The proponent must acquire all necessary permits, and must submit the completed checklist demonstrating that all necessary permits have been acquired.

12. Subdivision proposals

All subdivision proposals and development proposals in the floodplain overlay district shall be reviewed to assure that:

(a) Such proposals minimize flood damage.
(b) Public utilities and facilities are located & constructed so as to minimize flood damage.
(c) Adequate drainage is provided.

13. Base flood elevation data for subdivision proposals

When proposing subdivisions or other developments greater than 50 lots or 5 acres (whichever is less), the proponent must provide technical data to determine base flood elevations for each developable parcel shown on the design plans.

14. Unnumbered A Zones

In A Zones, in the absence of FEMA BFE data and floodway data, the building department will obtain, review and reasonably utilize base flood elevation and floodway data available from a Federal, State, or other source as criteria for requiring new construction, substantial improvements, or other development in Zone A as the basis for elevating residential structures to or above base flood level, for floodproofing or elevating nonresidential structures to or above base flood level, and for prohibiting encroachments in floodways.

15. Floodway encroachment

In Zones A, A1-30, and AE, along watercourses that have not had a regulatory floodway designated, the best available Federal, State, local, or other floodway data shall be used to prohibit encroachments in floodways which would result in any increase in flood levels within the community during the occurrence of the base flood discharge.

In Zones A1-30 and AE, along watercourses that have a regulatory floodway designated on the Town's/City's FIRM or Flood Boundary & Floodway Map (choose map which delineates floodways for your community) encroachments are prohibited in the regulatory floodway which would result in any increase in flood levels within the community during the occurrence of the base flood discharge.

16. Watercourse alterations or relocations in riverine areas

In a riverine situation, the _____ (appropriate official in community) shall notify the following of any alteration or relocation of a watercourse:

- Adjacent Communities, especially upstream and downstream
- Bordering States, if affected
- NFIP State Coordinator
  Massachusetts Department of Conservation and Recreation
  251 Causeway Street, 8th floor
  Boston, MA 02114
- NFIP Program Specialist
  Federal Emergency Management Agency, Region I
  99 High Street, 6th Floor
  Boston, MA 02110

17. AO and AH zones drainage requirements

Within Zones AO and AH on the FIRM, adequate drainage paths must be provided around structures on slopes, to guide floodwaters around and away from proposed structures.

18. Recreational vehicles

In A1-30, AH, AE Zones, V1-30, VE, and V Zones, all recreational vehicles to be placed on a site must be elevated and anchored in accordance with the zone's regulations for

foundation and elevation requirements or be on the site for less than 180 consecutive days or be fully licensed and highway ready.

19. Protection of dunes

Alteration of sand dunes is prohibited when the alteration would increase potential flood damage.

20. Local Enforcement

This is not sample bylaw text, but rather an instruction:

Please read the explanation in Section 4 about the importance of being able to point to specific local enforcement procedures for non-compliant floodplain development.

Section 3. Definitions not found in the State Building Code

National Flood Insurance Program (NFIP) definitions are found in Title 44 of the Code of Federal Regulations, section 59.1. The definitions below refer to their source; if the definition is from the MA building code, it is from the 9th Edition, which meets the minimum standards of the NFIP.

In order for the bylaw or ordinance to be clearly understood, it is necessary to define technical terms or key words. An understanding of these terms is a prerequisite to effective administration of the floodplain management bylaw or ordinance.

Per FEMA Region I, these additional definitions must be included in local bylaws or ordinances.

DEVELOPMENT means any man-made change to improved or unimproved real estate, including but not limited to building or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations or storage of equipment or materials. [US Code of Federal Regulations, Title 44, Part 59]

FLOOD BOUNDARY AND FLOODWAY MAP means an official map of a community issued by FEMA that depicts, based on detailed analyses, the boundaries of the 100-year and 500-year floods and the 100-year floodway. (For maps done in 1987 and later, the floodway designation is included on the FIRM.)

FLOOD HAZARD BOUNDARY MAP (FHBM.) An official map of a community issued by the Federal Insurance Administrator, where the boundaries of the flood and related erosion areas having special hazards have been designated as Zone A or E. [US Code of Federal Regulations, Title 44, Part 59]

FLOODWAY. The channel of the river, creek or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. [Base Code, Chapter 2, Section 202]

FUNCTIONALLY DEPENDENT USE means a use which cannot perform its intended purpose unless it is located or carried out in close proximity to water. The term includes only docking facilities, port facilities that are necessary for the loading and unloading of cargo or passengers, and ship building and ship repair facilities, but does not include long-term storage or related manufacturing facilities. [US Code of Federal Regulations, Title 44, Part 59] Also [Referenced Standard ASCE 24-14]

HIGHEST ADJACENT GRADE means the highest natural elevation of the ground surface prior to construction next to the proposed walls of a structure. [US Code of Federal Regulations, Title 44, Part 59]

HISTORIC STRUCTURE means any structure that is:
(a) Listed individually in the National Register of Historic Places (a listing maintained by the Department of Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register;
(b) Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary to qualify as a registered historic district;
(c) Individually listed on a state inventory of historic places in states with historic preservation programs which have been approved by the Secretary of the Interior; or
(d) Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
(1) By an approved state program as determined by the Secretary of the Interior or
(2) Directly by the Secretary of the Interior in states without approved programs.
[US Code of Federal Regulations, Title 44, Part 59]

NEW CONSTRUCTION. Structures for which the start of construction commenced on or after the effective date of the first floodplain management code, regulation, ordinance, or standard adopted by the authority having jurisdiction, including any subsequent improvements to such structures. *New construction includes work determined to be substantial improvement*. [Referenced Standard ASCE 24-14]

RECREATIONAL VEHICLE means a vehicle which is:
(a) Built on a single chassis;
(b) 400 square feet or less when measured at the largest horizontal projection;
(c) Designed to be self-propelled or permanently towable by a light duty truck; and
(d) Designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use.
[US Code of Federal Regulations, Title 44, Part 59]

REGULATORY FLOODWAY - see FLOODWAY.

SPECIAL FLOOD HAZARD AREA. The land area subject to flood hazards and shown on a Flood Insurance Rate Map or other flood hazard map as Zone A, AE, A1-30, A99, AR, AO, AH, V, VO, VE or V1-30. [Base Code, Chapter 2, Section 202]

START OF CONSTRUCTION. The date of issuance for new construction and substantial improvements to existing structures, provided the actual start of construction, repair, reconstruction, rehabilitation, addition, placement or other improvement is within 180 days after the date of issuance. The actual start of construction means the first placement of permanent construction of a building (including a manufactured home) on a site, such as the pouring of a slab or footings, installation of pilings or construction of columns.

Permanent construction does not include land preparation (such as clearing, excavation, grading or filling), the installation of streets or walkways, excavation for a basement, footings, piers or foundations, the erection of temporary forms or the installation of accessory buildings such as garages or sheds not occupied as dwelling

units or not part of the main building. For a substantial improvement, the actual “start of construction” means the first alteration of any wall, ceiling, floor or other structural part of a building, whether or not that alteration affects the external dimensions of the building. [Base Code, Chapter 2, Section 202]

STRUCTURE means, for floodplain management purposes, a walled and roofed building, including a gas or liquid storage tank, that is principally above ground, as well as a manufactured home. [US Code of Federal Regulations, Title 44, Part 59]

SUBSTANTIAL REPAIR OF A FOUNDATION. When work to repair or replace a foundation results in the repair or replacement of a portion of the foundation with a perimeter along the base of the foundation that equals or exceeds 50% of the perimeter of the base of the foundation measured in linear feet, or repair or replacement of 50% of the piles, columns or piers of a pile, column or pier supported foundation, the building official shall determine it to be substantial repair of a foundation. Applications determined by the building official to constitute substantial repair of a foundation shall require all existing portions of the entire building or structure to meet the requirements of 780 CMR. [As amended by MA in 9th Edition BC]

VARIANCE means a grant of relief by a community from the terms of a flood plain management regulation. [US Code of Federal Regulations, Title 44, Part 59]

VIOLATION means the failure of a structure or other development to be fully compliant with the community's flood plain management regulations. A structure or other development without the elevation certificate, other certifications, or other evidence of compliance required in §60.3(b)(5), (c)(4), (c)(10), (d)(3), (e)(2), (e)(4), or (e)(5) is presumed to be in violation until such time as that documentation is provided. [US Code of Federal Regulations, Title 44, Part 59]

ZONES, FLOOD – *These definitions do not need to be included in local bylaws.*

Definitions of Flood Zones

The community shall use the pertinent definitions for flood zones delineated within the community. All of these terms are defined in the US Code of Federal Regulations, Title 44, Part 64.3.

ZONE A means an area of special flood hazard without water surface elevations determined

ZONE A1-30 and ZONE AE means area of special flood hazard with water surface elevations determined

ZONE AH means areas of special flood hazards having shallow water depths and/or unpredictable flow paths between (1) and (3) feet, and with water surface elevations determined

ZONE AO means area of special flood hazards having shallow water depths and/or unpredictable flow paths between (1) and (3) ft. *(Velocity flow may be evident; such flooding is characterized by ponding or sheet flow.)*

ZONE A99 means area of special flood hazard where enough progress has been made on a protective system, such as dikes, dams, and levees, to consider it complete for insurance rating purposes. (Flood elevations may not be determined.)

ZONES B, C, AND X means areas of minimal or moderate flood hazards or areas of future-conditions flood hazard. *(Zone X replaces Zones B and C on new and revised maps.)*

ZONE V means area of special flood hazards without water surface elevations determined, and with velocity, that is inundated by tidal floods (coastal high hazard area)

ZONE V1-30 and ZONE VE *(for new and revised maps)* means area of special flood hazards, with water surface elevations determined and with velocity, that is inundated by tidal floods (coastal high hazard area)

Section 4. Explanations

The requirements of the NFIP can be found in the US Code of Federal Regulations, Title 44 Emergency Management, generally in sections 59 through 75, although the requirements that most specifically address development in the floodplain are found in section 60.3. The highlighted bold italic type below states the requirement as found in the federal code and is followed by the code citation.

1. Stated local purpose for flood resistant standards

To justify the community's reasoning behind local floodplain overlay district zoning bylaws, the NFIP requires:

> ***A purpose section citing health, safety, and welfare reasons for adoption* [44 CFR 59.22(a)(1)]**

The statement of purpose should set forth the goals and objectives to be achieved through the bylaw or ordinance. In other words, the statement of purpose enumerates what the community intends to accomplish by enacting regulations. The underlying purpose of the floodplain management regulations is to protect the public health, safety, and general welfare and to minimize the harmful impacts of flooding upon the community

These stated purposes will be ever more critical as community liabilities increase due to climate changes and increased flooding/ flood damages. The community is responsible to assure that all development is implemented in a safe, healthy, and socially/economically acceptable manner.

2. Use of FEMA maps and supporting studies

For local adoption of current effective FEMA flood maps and Flood Insurance Studies (FIS), the NFIP requirements state:

> ***Adopt or reference correct Flood Insurance Rate Map (and where applicable, Flood Boundary Floodway Map) and date.* [44CFR 60.2(h)]**
>
> and
>
> ***Adopt or reference correct Flood Insurance Study and date. [44CFR 60.2(h)]***

FEMA guidance (publication #495) states:

"The basis of your community's floodplain management regulations is the flood hazard data FEMA provides. In support of the NFIP, FEMA identifies flood hazards nationwide and publishes and periodically updates flood hazard data. These data are provided to communities in the form of a Flood Insurance Rate Map (FIRM) and Flood Insurance Study (FIS) report…"

and *"Each time FEMA provides your community with new or revised flood hazard data, you must either adopt new floodplain management regulations to incorporate the data into your ordinance or amend the existing ones to reference the new FIRM and FIS report."*

Communities that fail to enact the necessary floodplain management regulations will be suspended from participation in the NFIP and subject to the prohibitions contained in Section 202(a) of the 1973 Act as amended. (Text from actual FEMA Letter of Final Determination.)

3. Abrogation and greater restriction section

The community must provide that floodplain management regulations take precedence over any less restrictive conflicting local laws, ordinances or codes. [44CFR 60.1(b)]

This is a legal provision that specifies that the floodplain management bylaw, ordinance, regulations, and building codes take precedence over less restrictive requirements.

4. Disclaimer of liability

The community must state that the degree of flood protection required by the ordinance is considered reasonable but does not imply total flood protection.

5. Severability section

If any section, provision or portion of the ordinance is deemed unconstitutional or invalid by a court, the remainder of the ordinance shall still be effective.

6. Designation of community Floodplain Administrator

Designate the official responsible to submit a report to the Federal Insurance Administrator concerning the community participation in the Program, including, but not limited to the development and implementation of floodplain management regulations. [44CFR 59.22 (b)]

The community must designate by title one person to act as the community's floodplain administrator (sometimes referred to as the FPA.). This is so that FEMA can use this information in their local contacts database, and so that this person can act on behalf of the community when implementing certain tasks under the National Flood Insurance Program. For example, the local FPA would sign the Community Acknowledgement Form when a property owner wishes to file for a Letter of Map Revision (LOMR).

The designation refers to a local staff position and can be anyone with the local authority to assure that the community is meeting its obligations as a participant in the National Flood Insurance Program. The FPA does not need to be someone who is directly involved in local development, but it should be someone who has at least a general concept of NFIP requirements and of the community's obligations under the Program. Typically, across the nation the FPA can be a building commissioner, town manager, town engineer, director of planning, environmental planner, etc.

Typical duties of an FPA include but are not limited to:

a) Understanding the regulations for development in the floodplain overlay district
b) Ensuring that permits are applied for when development of any kind is proposed in the floodplain overlay district
c) Involvement with the permit process and/or permit application review for development in the floodplain overlay district
d) Coordinating with other local departments such as public works, stormwater/ engineering, planning & zoning, conservation commission, or housing
e) Notifying adjacent communities prior to alteration of a watercourse
f) Dealing with compliance issues and enforcement actions such as correcting violations, or working with the appropriate local staff to correct violations
g) Maintaining records of floodplain development, and keeping FEMA current and historic maps available for public inspection

7. Requirement to submit new technical data

Within 6 months, notify FEMA of changes in the base flood elevation by submitting technical or scientific data so insurance & floodplain management can be based on current data. [44CFR 65.3]

Many development changes to the floodplain will trigger the requirement to file a Letter of Map Revision or other type of Letter of Map Change. When the development does not trigger the LOMC requirement but impacts the heights or extents of the base flood (usually to lower the risk), FEMA should be notified that a change was made so that in future map studies/updates this can be adequately addressed.

8. Variances to building code floodplain standards

44CFR 60.6(a)(3-6):

(3) Variances shall only be issued by a community upon (i) a showing of good and sufficient cause, (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances;

(4) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief;

(5) A community shall notify the applicant in writing over the signature of a community official that (i) the issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage and (ii) such construction below the base flood level increases risks to life and property. Such notification shall be maintained with a record of all variance actions as required in paragraph (a)(6) of this section.

(6) A community shall (i) maintain a record of all variance actions, including justification for their issuance

Because a variance can lead to an increased risk to life and property, variances from flood elevation requirements or other floodplain management requirements should be granted only rarely. Variances for floodplain development regulations must show that:

- Good and sufficient cause and exceptional hardship exist;
- The variance will not result in additional threats to public safety, extraordinary public expense, or fraud or victimization of the public; and
- The variance is the minimum action necessary to afford relief.

In Massachusetts, typically the State Building Code Appeals Board issues a variance to the state building code, unless your community is one of those approved by BBRS for local variance authority. When a local building official's interpretation of the flood-resistant standards under the building code are contested through the appeal process, the community must keep written documentation of both:

a. the justification for local decision to deny the permit, and

b. the results of the state's appeal/variance hearing (either in agreement with the local community, or having granted the variance through appeal.)

The community must also send a letter to the property owner stating that the implications of this variance may adversely impact the cost of the flood insurance policy covering the structure.

A FEMA suggestion for language to be used in such a letter is as follows:

"The granting of this variance may result in increased flood insurance premium rates, up to $25 per $100 of coverage, and such construction below the base flood level increases risks to life and property."

The justification for the variance (or the denial of the variance) and the community letter must be maintained as documentation that these actions were taken.

9. Variances to local Zoning Bylaws related to community compliance with the National Flood Insurance Program (NFIP)

Please note: This section addresses local Zoning Board variances only, and applies only when other variance procedures (such as those under the state building code) do not cover the variance request.

§60.6 Variances and exceptions. Excerpts:

(a) The Federal Insurance Administrator does not set forth absolute criteria for granting variances from the criteria set forth in §§60.3, 60.4, and 60.5. The issuance of a variance is for flood plain management purposes only.

The community, after examining the applicant's hardships, shall approve or disapprove a request.

The Federal Insurance Administrator may review a community's findings justifying the granting of variances, and if that review indicates a pattern inconsistent with the objectives of sound flood plain management, the Federal Insurance Administrator may take appropriate action under §59.24(b) of this subchapter.

Procedures for the granting of variances by a community are as follows:

(1) Variances shall not be issued by a community within any designated regulatory floodway if any increase in flood levels during the base flood discharge would result;

(3) Variances shall only be issued by a community upon (i) a showing of good and sufficient cause, (ii) a determination that failure to grant the variance would result in exceptional hardship to the applicant, and (iii) a determination that the granting of a variance will not result in increased flood heights, additional threats to public safety, extraordinary public expense, create nuisances, cause fraud on or victimization of the public, or conflict with existing local laws or ordinances;

(4) Variances shall only be issued upon a determination that the variance is the minimum necessary, considering the flood hazard, to afford relief;

(5) A community shall notify the applicant in writing over the signature of a community official that (i) the issuance of a variance to construct a structure below the base flood level will result in increased premium rates for flood insurance up to amounts as high as $25 for $100 of insurance coverage and (ii) such construction below the base flood level increases risks to life and property. Such notification shall be maintained with a record of all variance actions as required in paragraph (a)(6) of this section; and

(6) A community shall (i) maintain a record of all variance actions, including justification for their issuance, and (ii) report such variances issued in its annual or biennial report submitted to the Federal Insurance Administrator.

(7) Variances may be issued by a community for new construction and substantial improvements and for other development necessary for the conduct of a functionally dependent use provided that (i) the criteria of paragraphs (a)(1) through (a)(4) of this section are met, and (ii) the structure or other development is protected by methods that minimize

flood damages during the base flood and create no additional threats to public safety.

For further information, see FEMA publication P-993, "Variances & the National Flood Insurance Program."

From the State NFIP Coordinating Office: For all variances to floodplain development regulations, the community must maintain documentation that includes the variance request; determinations made by the entity granting the request that the three criterium listed above have been met; a copy of the letter to the property owner regarding possible insurance premium impacts; and that all appropriate flood protection and hazard mitigation measures were taken where applicable and possible, as specifically described in the variance file.

10. Permits are required for all proposed development in the Floodplain Overlay District

Require permits for all proposed construction and other developments including the placement of manufactured homes [44CFR 60.3(b)(1)]

NFIP requirements are focused on "development" in the floodplain. The NFIP definition of development is *"any manmade change to improved or unimproved real estate, including but not limited to building or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations."* [44CFR 59.1]

Most Massachusetts communities have long used building permits to review construction in their floodplain overlay district, and conservation commissions use several documents for review of other types of development, but the regulation of all development in a floodplain is essential so that flood risks are not increased either on the site or to adjacent or upstream/downstream properties.

Some communities use a 'Floodplain Development Review Form" in addition to the traditional building permit, so they can document the review of all activities in the floodplain such as filling and grading; excavation, mining and drilling, storage of materials or equipment, placement of recreational vehicles or temporary stream crossings, and the review of activities conducted by other agencies such as roads or bridges built by state or federal government.

In Massachusetts, the local conservation commission reviews many of the above-listed activities, but use of a floodplain development review form for all floodplain overlay district proposals ensures that nothing slips through the cracks. This NFIP permitting

requirement is not prescriptive, but the documentation of some kind of permit or review process is mandatory for all floodplain development.

An additional benefit of documenting all floodplain development is that when a violation is discovered, the community can demonstrate that they did not approve the development as constructed, or that the developer did not come in for a full review of the development activity.

11. Assure that all necessary permits are obtained

Assure that all other State and Federal permits are obtained [44CFR 60.3(a)(2)]

While the community does not have to participate in the acquisition or review of all necessary state and federal permits for floodplain development, the community is obligated to assure that all necessary permits have been obtained by the proponent. The use of a checklist facilitates awareness for the proponent of which other permits must be obtained, generally prior to beginning the development project.

12. Subdivision proposals

Review subdivision proposals and development proposals to assure that:

(a) Such proposals minimize flood damage.
(b) Public utilities and facilities are located & constructed so as to minimize flood damage.
(c) Adequate drainage is provided.
[44CFR 60.3(a)(4) (I thru iii)]

13. Base flood elevation data for subdivision proposals

Require base flood elevation data for subdivision proposals or other developments greater than 50 lots or 5 acres. [44CFR 60.3(b)(3)]

If a subdivision fitting this size description is proposed in the floodplain overlay district where there are not already base flood elevations (BFEs) for each parcel, then the developer must provide BFEs for each parcel so that flood-resistant standards can be appropriately applied. The developer is responsible for providing the necessary technical data to support the base flood elevations shown on his/her design drawings.

14. Unnumbered A Zones

In A Zones, in the absence of FEMA BFE data and floodway data, obtain, review and reasonably utilize base flood elevation and floodway data available from available from a Federal, State, or other source as criteria for requiring new construction, substantial improvements, or other development in Zone A as the basis for elevating residential structures to or above base flood level, for floodproofing or elevating nonresidential structures to or above base flood level, and for prohibiting encroachments in floodways. [44CFR 60.3(b)(4)]

If the community has the engineering resources required to determine the base flood elevation in an unnumbered A zone, these resources can be used to meet this requirement. For those communities that do not have these resources, and even in communities that do, the permitting office can require that the proponent pay for resources to determine the base flood elevation when a development is being proposed. Historical records can be used, as well as any other data that reasonably indicates the 1% chance flood event. Two notes about this requirement:

a) FEMA does allow a "defacto" elevation of two (2) feet above the highest adjacent grade in cases where the BFE cannot be reasonably determined, but the 9th Edition of the Massachusetts building code requires an additional foot of freeboard. This means that the top of the lowest floor would have to be three (3) feet above the highest adjacent grade.

b) The 9th Edition of the MA building code allows communities to use preliminary FEMA maps once the Letter of Final Determination has been issued. These maps may indicate a BFE where none existed before, by virtue of the map update process.

15. Floodway encroachment

310 CMR 10.57(4) General Performance Standards.
(a) Bordering Land Subject to Flooding.
1. Compensatory storage shall be provided for all flood storage volume that will be lost as the result of a proposed project within Bordering Land Subject to Flooding, when in the judgment of the issuing authority said loss will cause an increase or will contribute incrementally to an increase in the horizontal extent and level of flood waters during peak flows.

Compensatory storage shall mean a volume not previously used for flood storage and shall be incrementally equal to the theoretical volume of flood water at each elevation, up to and including the 100-year flood elevation, which would be displaced by the proposed project. Such compensatory volume shall have an unrestricted hydraulic connection to the same waterway or water body. Further, with respect to waterways, such compensatory volume shall be provided within the same reach of the river, stream or creek.

2. Work within Bordering Land Subject to Flooding, including that work required to provide the above-specified compensatory storage, shall not restrict flows so as to cause an increase in flood stage or velocity.

This standard is found in the Wetlands Protection Act (WPA), and essentially means that there is no rise allowed in the elevation of the base flood anywhere in the entire floodplain. While an official certification is not required in floodways that are not regulated (shown on the FEMA map), for the intent of the WPA to be fulfilled the community must be sure that there will be no rise in the base flood elevation. If the area is located in an unnumbered A zone, a BFE must be determined before the development is designed, so that the "no rise" standard can be demonstrated.

Prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge. [44CFR 60.3(b)(6)]

Under federal NFIP requirements, the community must require certification from a registered professional that shows there will be no rise in the base flood elevation when development takes place in the regulated floodway. This cannot be accomplished by showing compensatory alone; the documentation must include a hydrologic and hydraulic (H&H) analysis.

16. Watercourse alterations or relocations in riverine areas

In riverine areas, notify neighboring communities of watercourse alterations or relocations. [44CFR 60.3(b)(6)]

Neighboring communities (and possibly a neighboring state) need to know in advance if the alteration or relocation of a watercourse might change their floodplain or flood risk. Send plans for this development to the CEOs of those communities, as well as to the Massachusetts NFIP State Coordinator and to the FEMA Regional Office.

17. AO and AH zones drainage requirements

In Zones AO and AH, require drainage paths around structures on slopes to guide water away from structures. [44CFR 60.3(c)(11)]

Guiding water away from the structure must also consider adjacent properties, where drainage cannot impact those lots or structures.

18. Recreational vehicles

In A1-30, AH, and AE Zones, all recreational vehicles to be placed on a site must be elevated and anchored or be on the site for less than 180 consecutive days or be fully licensed and highway ready. [44CFR 60.3(c)(14)]

In V1-30, VE, and V Zones, all recreational vehicles to be placed on a site must be elevated and anchored or be on the site for less than 180 consecutive days or be fully licensed & highway ready. [44CFR 60.3(e)(9)]

"Fully licensed and highway ready" means that wheels must be inflated; the vehicle must be self-propelled or towable by a light-duty truck; have no attached deck, porch or shed; and have quick-disconnect sewage, water and electrical connections. In other words, the vehicle must be ready to relocate immediately upon notification of the possibility of flooding in the area.

19. Protection of dunes

Prohibit alteration of sand dunes which would increase potential flood damage. [44CFR 60.3(e)(7)]

20. Local Enforcement

The NFIP requires that the floodplain management ordinance be legally enforceable and enforced uniformly throughout the community. [44 CFR 60.1(b)]

Sample bylaw language has not been offered regarding local enforcement of flood-resistant and flood reduction standards because enforcement is typically already addressed elsewhere in codes that are locally enforced.

As a part of implementing the NFIP in a local community, however, FEMA will need to know how the community enforces these regulations and standards. Each NFIP community should be prepared to answer the following questions:

1. How do you enforce the building code in your community? What specific actions are taken, and how are these actions documented? What penalties are specified? *[Definitions and regulations related to building code enforcement are found in CMR 780 Chapter 1 Sections 114 and 115, which refer to M.G.L. c. 143, c. 148, and M.G.L. c. 148A, and specifically M.G.L. c. 143, section 94(a.)]*

2. How do you enforce the Wetlands Protection Act? What actions and documentation exist to prove that enforcement was implemented? *[Enforcement regulations related to the Wetlands Protection Act are found in 310 CMR section 10.08.]*

3. How are other NFIP floodplain development requirements enforced, such as fencing that increases flood risk, the placement of recreational vehicles in the floodplain, re-grading of large commercial properties, construction of agricultural structures, placement of tanks, pools, temporary construction offices, etc.?

FEMA will expect to hear about a rigorous enforcement program that includes specific actions taken by the community for non-compliant floodplain development. Enforcement provisions establish the responsibilities of persons, enforcement authority, what makes a violation, notice of violation, stop work and other orders, and citation and penalties for violations. These penalties may include fines and/or jail sentences.

Explanations for Definitions found in Section 3

Development. FEMA's minimum standards for the NFIP require review of, and possibly permitting for all activities defined as development within the Special Flood Hazard Area (SFHA.) Some of these activities might not normally require permitting under existing state or local regulations, and not all of these activities might be reviewed by the building department in a community.

Flood Boundary & Floodway Map. Some communities with older mapping (typically 1987 and prior) have two sets of flood maps, the familiar Flood Insurance Rate Map (FIRM) and the Flood Boundary & Floodway Map (FBFM). The floodway is delineated only on the FBFM. Communities with a FBFM must include it in the district definition in order to enforce floodway standards.

Flood Hazard Boundary Map. Communities with very old mapping (usually prior to 1980) might have a Flood Hazard Boundary Map (FHBM). This map must be referenced in the community's floodplain district definition. In most cases the FHBM has been converted to a FIRM by letter but the map will still say "Flood Hazard Boundary Map."

Floodway, Regulatory Floodway. The floodway, or regulatory floodway, is established by regulation and through hydraulic analysis. It is not a natural, physical feature of the watercourse. It is part of the 100-year floodplain but has specific requirements that exceed those in the floodplain fringe (the rest of the floodplain). The NFIP standards for floodway encroachments (for example including no-rise analysis) are not in state regulations.

Functionally dependent use. This term is used in the evaluation of variances to floodplain management standards. Sometimes variances can be issued for functionally dependent uses.

Highest adjacent grade. In an AO zone, the base flood elevation is determined by adding the depth indicated on the FIRM to the highest adjacent grade, or two feet if no depth is indicated (and if no alternative floodplain analysis is conducted and applied.)

Historic structure. NFIP standards for substantial improvement include an exception for structures that are identified as historic structures. Only those structures meeting this definition are eligible for this exception.

New construction. NFIP minimum standards apply to all new construction, which includes improvements to structures defined as new construction. as follows: (1) new

construction, including subsequent work to such structures, and (2) work classified as substantial improvement of an existing structure that is not an historic structure. [ASCE 24-14]

Recreational vehicle. NFIP elevation standards can sometimes apply to these vehicles when they are placed in the SFHA.

Special Flood Hazard Area (SFHA). The flood-prone areas on the FEMA maps (and subsequently adopted in a community's Floodplain Overlay District) where NFIP minimum standards apply. within special flood hazard areas.

Start of construction. Knowing the start of construction, as defined, can sometimes determine which version of a FIRM or regulation is used in situations where the FIRM or the regulation has been or is being updated.

Structure. NFIP minimum standards apply to all structures meeting this definition.

Substantial Repair of a Foundation. This is a Massachusetts unique definition included in the 9th Edition Building Code. It is important to be familiar with this definition as Building Code standards will apply.

Variance. It is important to understand the term in order to properly administer, consider and potentially issue variances. Note that variances are not the same as (and shouldn't be confused with) similar terms and/or processes such as special permits, exceptions or exemptions. Variances to standards enforced under state regulations must be administered through the proper state authority.

Violation. Violations can affect the community's standing in the NFIP and will likely result in higher flood insurance premiums. Violations can also prevent a community from entering participating in the Community Rating System.

2020 MA Model Floodplain Bylaw **Frequently Asked Questions**

These questions were posed during the 2020 Model Bylaw training sessions offered by the state and FEMA in early October 2020. To access the Model and the presentation, go to:

https://www.mass.gov/guides/floodplain-management

Adoption deadline

By what date will these bylaws need to be adopted?

If your community will be receiving new maps, then the 2020 Model will be used to review your bylaws (or ordinances) as a part of your map adoption process by the effective date of the new maps.

If the state or FEMA conducts a monitoring visit or interview with your community, the 2020 Model will be used in reviewing your bylaws, and you will need to provide a date by which you will adopt them.

If neither of the above applies to your community within the next year, then we will expect that you will adopt the 2020 Model bylaws at your next earliest convenience.

Location of bylaws in local codes

In what part of the local code should a community place these floodplain bylaws?

This decision is up to the community, but the bylaws need to reside in an adopted and enforceable part of your codes (bylaws or ordinances.) You may gather them together under your Floodplain Overlay District section of your zoning bylaws, put them together in your wetlands bylaws, or other reasonable location where citizens and floodplain developers can find them. Some of these pertain to subdivisions, and may go in that section. Wherever the bylaws reside, we will need you to cite them for us when we review your code if we cannot find them.

What about towns that don't have wetlands bylaws?

Many communities put these bylaws in their zoning regulations, typically under a Floodplain Overlay District section.

If we address subdivisions and flood elevations in the Subdivisions Rules & Regulations, do we also need to include the subdivision language in our Floodplain Overlay District zoning bylaw?

The bylaws do not need to be duplicated in different parts of your local codes, but you will need to enforce them throughout your floodplains, so it would be best to put them where developers can find them for proposed projects.

Map references

How do we know whether to use the community or county map references section?

On your community's flood maps, the name of the community (town, city, or county) is shown on the title panel at the lower right corner. If you need assistance in making this determination, you can contact Eric Carlson at eric.carlson@mass.gov.

Do we still need to insert all the panel numbers and dates as we did before?

FEMA is no longer requiring that each map panel be separately referenced. The date of the Index (of maps) and the Flood Insurance Study must each be referenced. Using the provided bylaw text should make this easy.

Legal purpose bylaws

What if we have these (abrogation/ greater restriction, disclaimer of liability, severability) **in a different part of our local codes? Do we have to move or add them to the Floodplain Overlay District section?**

No. As long as you can cite them from an enforceable part of your adopted code, they can stay right where they are. No need to add to another section.

Floodplain Administrator (FPA)

Can a Floodplain Administrator be designated as more than one position?

No. The purpose of designating an FPA is so that both FEMA and the state will have one contact for the community for communication regarding NFIP and floodplain matters. While we understand that best practice floodplain management means that an integrated team of people will review and enforce floodplain development, we will still need the position (and thereby the name, title, and contact information) of your designated FPA.

For FPA, is it acceptable for a community to designate an entire board or committee?

No, it's not acceptable for an entire board or committee to be the FPA. You may, however, designate the head of that group as the FPA, or perhaps the staff contact for the group.

Does the floodplain administrator need to be a Certified Floodplain Manager (CFM)?

No, but that's a worthy goal as this certification indicates both the person's and the community's desire to put forth the best floodplain management possible. Also, there are additional points for a CRS community that has certified staff.

Can you define the role of the Administrator more specifically?

The role of the FPA is more fully explained in the 2020 Model Bylaw, section 4.

Variances

Which communities have the authority to issue a variance to the state building code? How do we know if we are one of them?

There are very few. These communities have local Building Code Appeals Boards (in contrast to a Zoning Code Appeals Board.) If you aren't sure, you're probably not one of them. To find out, contact the staff at the Board of Building Regulations and Standards: Dan Walsh, Chief of Inspections, 617-826-5236 or dan.p.walsh@mass.gov

If building code variances are issued by the state, why is the town held responsible?

The community is not held responsible for actions by the state. The variance sections found in the 2020 Model Bylaw are there to assure that 1) the community is aware of the request for a variance from floodplain regulations; 2) if the variance is granted, that the community notify the applicant in writing that there may be increased flood risk associated with the variance, and an increase in annual flood insurance premiums; and 3) the community documents the variance and notification in their permit files for future reference.

Would allowing a variance disqualify a community from the Community Rating System?

The allowance of a variance does not disqualify a community from the Community Rating System (CRS.) A pattern of allowing frequent or unjustified variances may impact a community's standing in the NFIP (and therefore CRS), however, and may be investigated in order to find a way to reduce this practice. If the state is approving the variances, the state will be involved in such an inquiry.

Is a variance also required from the ordinance/bylaw itself?

Yes, if the variance is to the floodplain development regulations found in your local code. See the explanation for bylaw #9 in the Model, section 4.

Permit for all development

The suggested bylaw states that the community will require "a permit for all proposed construction or other development in the floodplain…" Does this mean that we have to institute a new permit form and fees for things other than the building code?

Not necessarily. Different communities use different methods to assure that all floodplain development is reviewed. The intention here is to assure that all development in the floodplain is reviewed by the community, using whatever tools the community deems best for this practice. For example, some communities use an integrated online review tool for every activity in their floodplains. Others use a checklist showing that pertinent departments and boards have signed off on the development as proposed. You may develop or use a form if that best fits your needs—whatever assures that appropriate review is being conducted for all development in the floodplain. Please see the NFIP definition of "development" in the Model to understand the reach of this bylaw.

Can things like fences and driveways be permitted through a building permit, rather than a special permit?

Your local building official knows which things can be permitted through the building code. Paving is generally covered under local bylaws; some communities put these in their zoning regulations and some in their stormwater management plans. If the pavement is to be placed where it will impact a resource area, the conservation commission will most likely need to review the proposal to determine its impact on area resources including the floodplain. However your community reviews these development types, the review needs to be documented.

Do solar arrays need to be permitted?

If the development (e.g. proposed solar arrays) is in the floodplain, then yes—it needs to be fully reviewed using some kind of documentable process such as described above.

All permits must be acquired

How do we know what other permits would apply to a particular development?

There is currently no complete checklist for permits required, but relevant state and federal agencies can help you determine what permits might be required. Here are a few suggestions:

MA Office of Coastal Zone Management (CZM) can assist with understanding coastal permits: https://www.mass.gov/orgs/massachusetts-office-of-coastal-zone-management

MA Dept. of Environmental Protection regional coordinators can advise on soil, water and air quality permits: https://www.mass.gov/orgs/massachusetts-department-of-environmental-protection DEP can also advise for mining, dredging and drilling operations, as well as federal permits required by the EPA.

The US Army Corps of Engineers has permits for some work in waterways and tidal wetlands: https://www.usace.army.mil/ CZM will often know about these, too.

Who is responsible to get these permits?

The applicant is responsible to get the permits, but this bylaw states that the community will assure that the necessary permits are obtained for all development in the floodplain.

More restrictive codes—compensatory storage vs. hydrologic & hydraulic study-- Floodway Encroachments

Is the NFIP requirement more restrictive than the MA Wetlands Protection Act for compensatory storage in the floodplain?

Possibly. The Wetlands Protection Act requires that *"Compensatory storage shall be provided for all flood storage volume that will be lost as the result of a proposed project within Bordering Land Subject to Flooding…"* [310 CMR 10.57(4)(a)]

The NFIP requires that the developer prove that a) in floodplains without a regulatory floodway, the development will cause no more than one foot of rise in the base flood, or b) in regulatory floodways the development will cause absolutely no rise in the base flood. This certification needs to be demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice. For more information, see the Model, section 4, item 15, or contact the state or FEMA references at the bottom of this document.

Submitting technical data & watercourse alteration notifications

What's the difference between these two bylaws? (See bylaws #7 and #16 in the Model)

Bylaw #7 regards the submission of new technical data that the community may have about the floodplain maps. This needs to go to FEMA for their files. Bylaw #16 regards changes in a watercourse (if this is allowed to happen in a community)—this information needs to be shared with adjacent communities and FEMA for their awareness. In both cases, the information should be copied to the state NFIP coordinator. See section 4 of the model for further explanation.

How do you define watercourse alteration?

A watercourse is any natural channel conveying water such as a river, stream, or creek. The alteration of this might include such practices as channelization, culverting, diversion or even daylighting a stream that was previously channeled underground.

Does the watercourse alteration bylaw apply when changing a water course in land subject to coastal storm flowage?

This bylaw (#16) is specifically for riverine situations, but if changes will affect up or downstream neighbors, these should still be notified. And of course, if there is new technical data involved, this would be submitted to FEMA under bylaw #7, Requirement to submit new technical data.

Does this only apply to watercourses within the mapped flood zones?

Good question! Most watercourses will be found in the mapped floodplain, but yes, in any case the alteration of a watercourse must be notified as written in the bylaw requirement.

Local Enforcement

Is there model language for bylaws item #20 on local enforcement?

No. A community can describe their process of local enforcement, but many of those "pieces" are found in existing codes such as the building code. Please see the explanation for this in section 4 in the Model.

What about towns that don't have non-criminal disposition to be able to issue fines?

Even if your community has not adopted the provisions of Mass General Law chapter 40, section 21D (non-criminal disposition), you must still be able to levy some type of penalty for non-compliant floodplain development. The NFIP community should work with their attorney to assure that non-compliant floodplain development will be addressed through both violation notifications and penalties. *"The NFIP requires that the floodplain management ordinance be legally enforceable and enforced uniformly throughout the community."* [44 CFR 60.1(b)]

Recreational Vehicles

Is recreational vehicle defined? Would it apply to food trucks?

Yes, the definition for a recreational vehicle is found in section 3 of the Model. Since part of the definition includes *"designed primarily not for use as a permanent dwelling but as temporary living quarters for recreational, camping, travel, or seasonal use,"* a food truck may or may not be considered a recreational vehicle.

Is there a difference between a recreational vehicle and a park model?

Typically a park model is treated like a manufactured home, and would need to be installed on a permanent foundation. The primary concern with a park model is that to fit under the definition of recreational vehicle, it must be self-propelled or towable by a "light-duty truck." A light-duty truck is a United States designation for trucks and vehicles that have a gross vehicle weight of up to 8500 pounds and payload capacities of up to 4000 pounds. [https://www.epa.gov/moves/how-does-moves-define-light-duty-trucks]

Is there a grandfather clause for recreational vehicles?

No. All RVs must be either installed on a permanent foundation (as would a manufactured home), or be highway ready.

What about an RV sales operation?

Great question. In most cases the RV dealership will have temporary tags so they can move the RVs (hopefully all in good operating order!) out of the floodplain should a flood alert be issued. This type of development is storage in the floodplain and should be permitted as such.

Protection of dunes

If we don't have dunes do we have to include the #19 bylaw about dunes?

No.

Definitions

Since these definitions seem to come primarily from the federal code, could we simply reference that code instead of adopting in local bylaw/ordinance?

No. The definitions have been in the federal code for more than four decades, but there have been many instances where local folks don't seem to be aware of them. Many other states require a much longer list of definitions (e.g. Florida), but we've slimmed down the list to those that are critical to compliant floodplain management.

The definition of structure does not appear to include decks or carports because they don't have walls and roofs. Correct?

Correct, although if a deck or carport is attached to a structure then it would be a part of the structure. A self-standing deck or carport would not necessarily be a structure, per this definition, although these are still considered to be development.

If we do not have the Flood Boundary & Floodway Map (FBFM) or the Flood Hazard Boundary Map (FHBM), do we have to include these definitions?

If you do not have these types of map as your current effective maps, then you do not need to include these terms in your list of definitions.

Subdivisions

Please provide some guidance regarding Approval Not Required (ANR) plans, as we have limited control and some can be over 5 acres. Right now we cannot treat these as a subdivision.

Even though you do not treat ANR dispositions as subdivisions, if the structure or other development in the ANR is sited in a regulated floodplain you will need to apply all of the requirements for flood resistant construction and drainage, just as you would for any other development in the floodplain.

Appendix G: Public Feedback

Public Feedback	Responses
By email: Did an alternate for permeable paving get bid at Wahconah? (Because it was near the river I had spoken to Jason Dion about it but I don't know if it ever went anywhere.)	This might be more of a question for the town, but I'd love to find out as well! We concentrated on areas around Walker Brook watershed as that was the original impetus for the plan. We did expand our search outside of that watershed boundary but stuck more or less within adjacent area. We may have missed some opportunities further afield and would love to include those in another iteration if possible.
Dalton will need to build in to the budget the inspection/maintenance costs involved in these mitigation measures.	Agreed, and good point. We looked into including ongoing inspection/maintenance costs but realized that the costs vary greatly depending on the community, capacity of maintenance staff, salaries, etc. We did include a narrative of what maintenance is required for each of the BMPs at each site. This way if any of these projects move forward the town has something to base their maintenance cost estimates on.
Another pitch for Accessory Dwelling Units, as they efficiently use existing infrastructure while providing more housing. (I realize a bylaw is being considered)	Accessory dwelling units can be a great "smart growth" strategy that green infrastructure also falls within. It was outside the scope of the project to look at things like this, but perhaps something to consider incorporating in the Dalton's next Master Plan.
Does Dalton own the properties on p.38 and 42, or will it have to purchase them?	We only looked at town-owned properties for this project. The properties on p. 38 and 42 were explored initially, however we ruled them out in the secondary "priority" screening since they seemed to feel like someone's backyard, and would cause disruption to neighbors. The section demonstrates the properties that we did an initial exploration of. The result was "pre-conceptual" designs that we then talked with the Town about, in order to determine which sites were viable, and which were a no-go.
Where is the area on p.47 located? i.e., how does Walker Brook get back to the river?	The area on p. 47 is just north of the Senior Center. This was a pre-conceptual design to see if there was a green infrastructure solution that helped alleviate Walker Brook flooding without daylighting the stream. In this design, Walker Brook would pass under High St. through a culvert, "daylight" into a large bio-retention basin, and then drain back into the stormwater system at the southern point where it's labeled "outlet structure." Ultimately, we combined this idea into the design that more fully daylights the stream along the east side of the Senior Center and down past the former school site (as seen on p. 60-62). In both designs Walker Brook is partially buried and piped through the stormwater system until it emerges at River Run Apartments just above the confluence with East Branch Housatonic River.
Is the Select Board voting on the portions of the proposed bylaws on Monday? (they're not complete)	The Select Board decided to hold off on the vote to adopt this plan until August to allow for more public comment. By proposed bylaws, do you mean the Model By-laws? If so, the Board would not be voting to adopt these by-laws by adopting the plan. These by-laws are simply an example of regulations that, if adopted, could strengthen floodplain protections, reduce the risk of flooding and support green infrastructure. They aren't a finished product and if the town is interested in adopting they would have to be tailored specifically to Dalton and I believe adopted during Annual Meeting.

I support zoning to reduce development in/near flood plains. I didn't see anything on mitigation for the areas southeast of the Legion or on Pease Ave., but like I said, I just sped through.	That is a good point. We concentrated efforts around Walker Brook, however, it would be great to get more background on the areas you mentioned and include these in a second iteration. Especially if there are water quality benefits and flooding mitigation opportunities. There are several grant opportunities available that BRPC or the Town could apply explore other sites.
By email: I read through much of the plan yesterday and my biggest questions were answered through your discussion. As flooding is the primary natural disaster risk in town, and there are several repetitive loss areas I certainly see this plan as a positive. Filling the MS4 requirements for NPEDS this year is of great help to us, so thank you for essentially taking care of that for us! My primary question was which of the funding and grant opportunities listed would we be most likely to receive for this project? I believe you stated 319 Non-Point Source (MassDEP), and Municipal Voluntary Preparedness (EOEEA) were of interest. I don't see there being many, but what are the potential negatives of green infrastructure (excluding cost)? I imagine implementation of this plan would also help the Town's grey infrastructure in terms of stormwater system build-up.	You are right that green infrastructure is often a boon to gray infrastructure, as it reduces the stormwater load on the system, can prevent backwatering, etc. A few downsides that municipalities may consider: - Upfront installation cost - It's different than simply replacing existing pipes and may require outside contractors rather than in-house public works staff. Although upgrades to any of the aging infrastructure is likely to require some outside contractors and there are situations where green infrastructure can actually reduce costs overall. It's really situation dependent and one would need to get a quote for installation of both a gray infrastructure solution and a green infrastructure solutions as well as consider the long-term and co-benefits obtained. - Ongoing Maintenance - Depending on the best management practice (BMP) ongoing maintenance requires maintenance staff to check on the BMP periodically (sometimes that's twice a year, sometimes just once), and maintain the space, this could include replacing dead plants, gardening, clearing out debris/sediment build up, etc. With porous pavement, the biggest drawback is that it must be vacuumed to keep it functioning optimally - which is additional/different maintenance than a conventional asphalt road. - Proper design - This could apply to gray infrastructure as well, but it should be noted that if the BMP isn't properly designed it can fail. I'm not an engineer, but it seems that the biggest considerations are volume and velocity. Just as when culverts are replaced, the structure should accommodate an accurate accounting of the drainage area it captures and consider the increased volume due to climate change. As far as the most likely grants, any of these would be a good candidate for Municipal Vulnerability Preparedness (MVP). The Walker Brook project is particularly interesting because I think it's a good candidate for MVP, 319, MEMA/FEMA, as well as Dept. of Ecological Restoration, considering that it involves daylighting a stream. BRPC is happy to work with the Town to explore these different grant options. I will also plug that if there are other areas that Dalton thinks are good candidates, let us know. We could explore those, and possibly get 604b grant to fund design work.

From July 12, 2021 Select Board Meeting: Is the Greenridge Park design intended to catch runoff from the field and treat nitrogen and phosphorous. If so, perhaps the town could stop applying those to the field and reduce the need for something there.	The BMPs at Greenridge Park will partially pick up the runoff from the park, yes. They also are designed to treat runoff from the parking area and South St.
Also wanted to note that if the goal is to reduce flooding, it should take into account the stream at the top of the parking area. This stream is intermittent and has a tendency to overflow and run across surrounding streets.	I don't know if the stream was running when the engineers went out and assessed the site, but we would want to note that and consider that in any followup design work should the project move forward.