City of Hudson
Road-Stream Crossing Management Plan

Produced by

Cornell Cooperative Extension of Columbia and Greene Counties

2020

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The City of Hudson Road Stream Crossing Management Plan is designed to improve community and ecosystem resiliency by identifying high priority road stream crossings that reconnect high quality aquatic habitat and improve community flood resiliency and road infrastructure conditions within the City of Hudson. The scope of the project included:

i) an inventory of all state, county, and city road stream crossing,
ii) hydraulic modeling,
iii) evaluation of aquatic organism passage, priotitization of results using multiple objectives

Inadequately sized or incorrectly installed culverts can be a seasonal or year-round barrier to aquatic species, fragmenting habitat and disconnecting the natural flow of organisms, material, nutrients and energy along river systems. This loss of stream connectivity is a critical threat to valuable and already vulnerable species such as the native Eastern brook trout (Salvelinus fontinalis), the American eel (Anguilla rostrata) and river herring (Alosa spp). The Hudson Stream Crossing Project has identified opportunities to reduce habitat fragmentation by prioritizing replacement barrier removal projects that provide the greatest improvement for these vulnerable species as well as other aquatic organisms.

In addition to habitat fragmentation caused by inappropriately sized culverts, flood risks and infrastructure damage are also a concern. Damage caused by flooding can be reduced if local decision-makers are aware of current infrastructure conditions to proactively plan and implement restoration strategies at high priority locations. The Hudson Road Stream Crossing Project has identified at-risk infrastructure, so the City can prioritize their upgrades with hydraulically appropriate and geomorphically compatible designs.

We hope that you find this document useful throughout the prioritization process, and we welcome your feedback. If you have questions about this document or any other aspect of this project, please contact CCE-CG at 518-622-9820 or the following emails:

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NYS DEC Hudson River Estuary Program
NYS Water Resources Institute at Cornell University
Greene County Soil and Water Conservation District

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Acknowledgements

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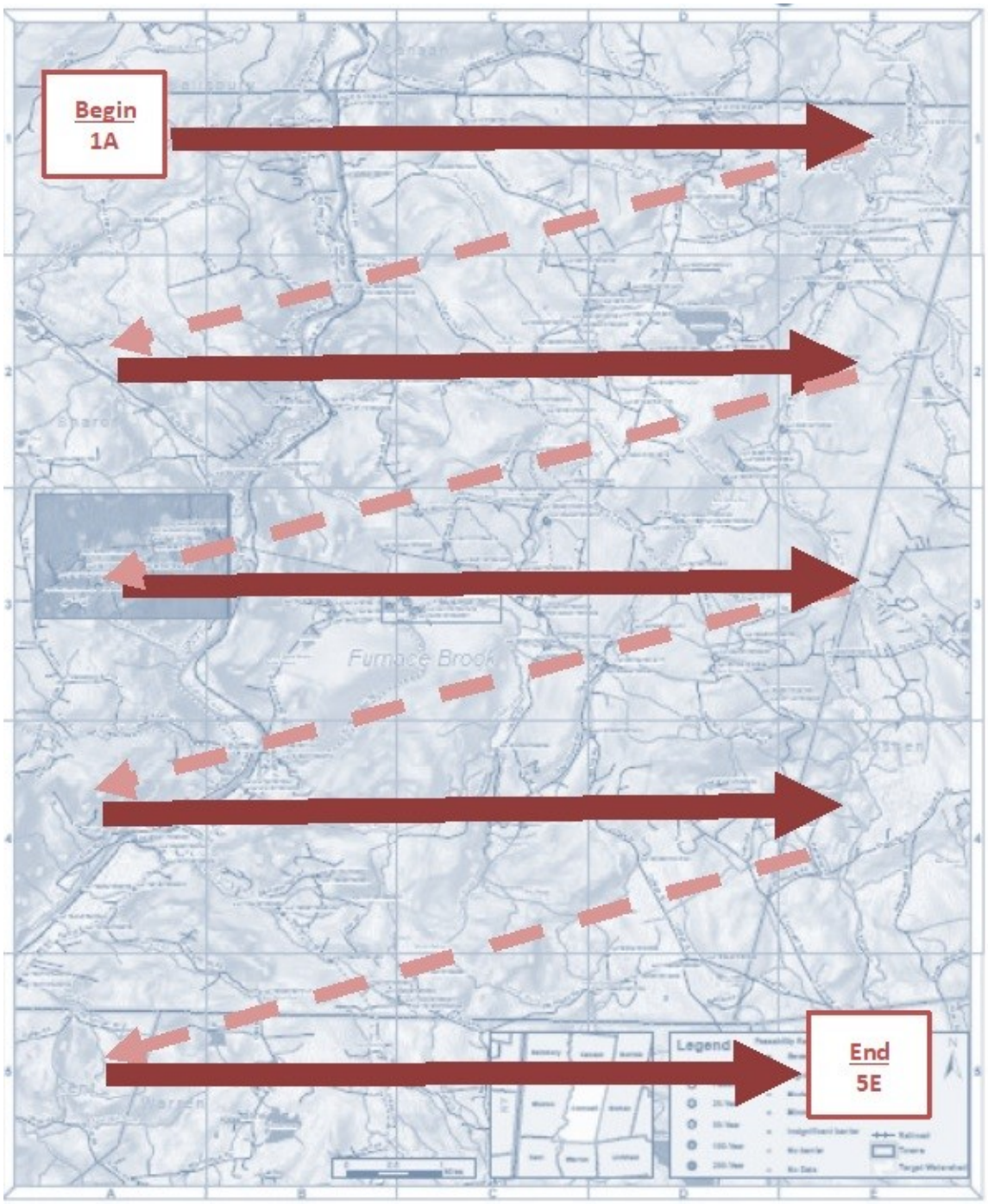
Reference Map(s)

A Note on Organization

In each section of the Inventory (i.e. City, State, Private/Other), crossings are organized based on their location on the Reference Map. Each section begins with crossings in 1A, and ends with 5E. See diagram below:



Interpretive Guide

Road: Pierce Lane

Stream: Unnamed

Results

Barrier Evaluation: Severe barrier
Aquatic Organism Passage Score: 0.74 Condition: OK

Location

Coordinates: 41.84828, -73.34254
Location Description: Telephone pole 4886-4887
Date Observed: 2015-07-30
Survey ID:

Stream and Crossing

Crossing Characteristics

Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Severe
Alignment: Flow –Aligned

Stream Characteristics

Scour Pool: Large
Water Depth/Velocity Matches Stream: Yes Substrate Matches Stream: Yes
Substrate Type: Gravel

Upstream

Downstream

Crossing Comments: Old stonewall/dam impounding channel upstream.

ROAD: The road that the crossing is on. **STREAM:** The waterway that passes through the crossing.

RESULTS

Barrier Evaluation: A description of how severe of a barrier the crossing is to fish and wildlife passage.

Aquatic Organism Passability Score: Descriptions for AOP scores are as follows: Nor barrier 1.0, insignificant barrier 0.80-0.99, minor barrier 0.06-0.79, moderate barrier 0.40-0.59, significant barrier 0.20-0.39, severe barrier 0.00-0.19.

Condition: The overall state of the crossing from a structural perspective, i.e. how likely it is to collapse.

LOCATION

Coordinates: GPS coordinates taken in the field.

Location Description: A brief description of landmarks or other identifying features to help locate the crossing.

Date Observed: The date the crossing was assessed for habitat continuity (format: YYYY-MM-DD).

Survey ID: A unique 5-digit identification code assigned to each crossing based on its coordinates.

STREAM CHARACTERISTICS

Scour Pool: The size of the pool (if there is one) at the crossing outlet. A scour pool is considered "Large" if it is twice the width and/or the depth of an average-sized pool in the stream.

Water Depth/Velocity Matches Stream: A comparison of the water depth/velocity inside of the structure with the stream channel away from the influence of the crossing.

Substrate Matches Stream: A comparison of the substrate inside the structure and the substrate in the stream channel.

Substrate Type: The dominant substrate type inside of the structure.

PHOTOS: Photos taken of the stream above and below the crossing.

CROSSING CHARACTERISTICS:

Crossing Type: This refers to the type of crossing it is, i.e. culvert, bridge, etc.

Number of structures/cells: The number of individual culverts or bridge cells that make up the crossing. Structures are numbered by looking at the inlet and counting from left to right.

Constriction: How far the crossing spans across the stream, and whether or not it constricts the stream flow.

Alignment: The crossing can be flow-aligned or skewed. A crossing is "Skewed" if the stream enters it a 45° angle or more. Angle of skew is included when available.

Crossing Comments: Any additional comments pertaining to the crossing or its surroundings. Additional photos are included in the appendix.

MAP KEY: Code to find the crossing on the Index Maps. "N" & "S"= "North" & "South", followed by the column and row num-

ROAD

Road Photo: Taken of the road surface above the crossing structure.

Road Type/Surface: A description of the type of road and the number of lanes, where applicable.

Road Fill Height: The height (in feet) from the top of the culvert inlet to the surface of the road.

Road Ownership: The entity (city, state, private homeowner, etc.) in charge of road maintenance.

Current/Future Maximum Return Period: The maximum return period in which the culvert is expected to pass (i.e. not ex-ceed its capacity) under current climate conditions and future conditions modeled for the year 2050.

STRUCTURE INFORMATION

Material: The type of material the structure is made out of, e.g. concrete, plastic, stone, etc.

Physical Barriers/Severity: A description of any physical barriers such as debris, grates, etc. and its severity with regards to blocking fish movement (see NAACC protocol for more details).

Internal Features/Structures: Internal structures like baffles and weirs are listed here.

Length (ft): To the nearest foot, measure of the length of the structure at its top.

Structure Comments: Any additional comments about the structure in question.

Outlet Armoring: The material placed below the outlet for the purpose of diffusing flow and minimizing scour.

INLET

Inlet Photo: A photo taken looking at the inlet of the crossing.

Inlet Shape/Type: The shape of the inlet (e.g. round, box) and the style of the inlet that influences how water enters the inlet (e.g. headwall, wingwalls).

Inlet Drop/Grade: Where the inlet is located in relation to the stream bottom (e.g. at stream grade, perched, etc.). For UMASS assessments, this information was only collected if the inlet was perched, in which case the height of the perch is also recorded.

Dimensions: The dimensions of the culvert are given in feet. For details on how these fields were collected for different crossing types, see the NAACC and/or UMASS protocols.

OUTLET

Outlet Photo: A photo taken looking at the outlet of the crossing.

Outlet Shape: The shape of the outlet.

Outlet Drop/Grade: Whether or not an outlet drop is present (UMASS) or the grade in relation to the stream bottom (NAACC).

Drop to Stream Surface/Bottom: The distance (in feet) from the bottom of the structure to the surface of the water, and from the bottom of the structure to the stream bottom. This is particularly applicable to crossings that have an outlet drop.

Dimensions: The dimensions of the culvert are given in feet. For details on how these fields were collected for different crossing types, see the NAACC and/or UMASS protocols.

Map Key: 3C

Road

Road
Road Type/Surface: Paved
Road Fill Height (feet): 4.2
Road Ownership: Town

Predicted Capacity
Current Max Return Period:
Future Max Return Period:

Structure 1 of 1

Material: Metal
Physical Barrier(s)/Severity: None
Internal Features/Structures: None
Slope (%): 3.7%
Structure Comments: None
Outlet Armoring: None

Inlet

Inlet
Inlet Shape/Type: Round Culvert/Headwall and Wingwalls
Inlet Drop/Grade: At Stream Grade
Width: 3.0, Height: 3.0
Substrate/Water Width: 0.5
Water Depth: 0.2
Abutment Height: No data

Outlet

Outlet
Outlet Shape: Round Culvert
Outlet Drop/Grade: Free Fall Onto Cascade
Drop to Stream Surface/Bottom: 5.5/5.8
Width: 3.0, Height: 3.0
Substrate/Water Width: 0.2
Water Depth: 0.2

Map Key: 3C

Road

Road

Road Type/Surface: Paved
Road Fill Height (feet): 4.2
Road Ownership: Town

Predicted Capacity

Current Max Return Period:
Future Max Return Period:

Structure 1 of 1

Material: Metal
Physical Barrier(s)/Severity: None
Internal Features/Structures: None
Slope (%): 3.7%
Structure Comments: None
Outlet Armoring: None

Inlet

Inlet

Inlet Shape/Type: Round Culvert/Headwall and Wingwalls
Inlet Drop/Grade: At Stream Grade
Width: 3.0, Height: 3.0
Substrate/Water Width: 0.5
Water Depth: 0.2
Abutment Height: No data

Outlet

Outlet

Outlet Shape: Round Culvert
Outlet Drop/Grade: Free Fall Onto Cascade
Drop to Stream Surface/Bottom: 5.5/5.8
Width: 3.0, Height: 3.0
Substrate/Water Width: 0.2
Water Depth: 0.2

Priority Crossings

Top Crossings for Flood Risk

This chart is a summary of road-stream crossings with the shortest flood intervals by year (i.e. the most likely to flood roads in smaller storms) and the culvert capacity (i.e. the largest potential of flood water to be released) based on modeling performed by Cornell University. This list only includes City crossings. Note that not all structures in this plan underwent modeling.

Survey ID	Road	Map Key	Max Flood Interval
80063	Power Avenue	B4	25
80062	N 2nd Street	C3	50
80058	S 3rd Street	B5	50
80077	Harry Howard Avenue	C3	200

Additional Flood Risk Information

80077: Despite the predicted 200 year max flood interval, Hudson DPW staff notes that this structure on Harry Howard Avenue has experienced flooding issues. Underhill Pond at the structure's inlet has increased in water level in recent storm events. One of the catch basins was overwhelmed in a recent storm and caused minor flooding at a house downstream.

54945: This structure on N 2nd Street was not modeled for flood risk as the outlet was not found during the NAACC assessment. DPW experiences regular flooding at this structure.

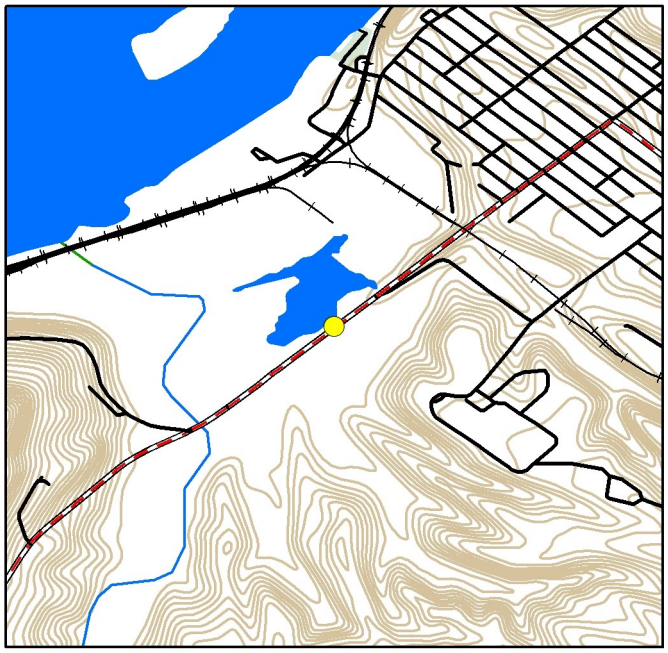
Top Crossings as Barriers to Aquatic Organisms

This chart is a summary of road-stream crossings with the lowest aquatic organism passability (AOP) score (i.e. most likely to be a barrier to organisms looking to travel upstream) based on in-field assessments done according to the NAACC protocol. Note that this list only includes crossings on town-managed roads.

Survey ID	Road	Map Key	Aquatic Passability Score	Physical Barriers
80077	Harry Howard Avenue	C3	0	Fencing, Major Cascade
80059	S 3rd Street	B4	0.61	None
52177	S 3rd Street	B5	0.73	None
80062	N 2nd Street	C3	0.74	None
80060	S 3rd Street	B4	0.82	Debris/Sediment/Rock

City-Managed Crossings

Entries are organized geographically by Map Index Key, beginning with 1A


Crossing Code: xy4224743473798667

Results

Barrier Evaluation: Minor barrier
Aquatic Organism Passage Score: 0.61
Condition: OK

Location

Coordinates: 42.2474, -73.7985
Location Description: 50 yards from Hudson correctional facility sign.
Date Observed: 2020-09-15
Survey ID: 80059

Stream and Crossing

Crossing Characteristics

Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Severe
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: None
Water Depth/Velocity Matches Stream: No-Shallower/No-Faster
Substrate Matches Stream: Comparable
Substrate Type: Silt
Substrate Coverage: 100%

Upstream

Downstream

Crossing Comments: Empties into pond

Road

Road Type/Surface: Paved
Road Fill Height (feet): 2.4
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

Structure 1 of 1

Material: Concrete
Length (ft): 43.5
Outlet Armoring: None
Internal Features/Structures: None

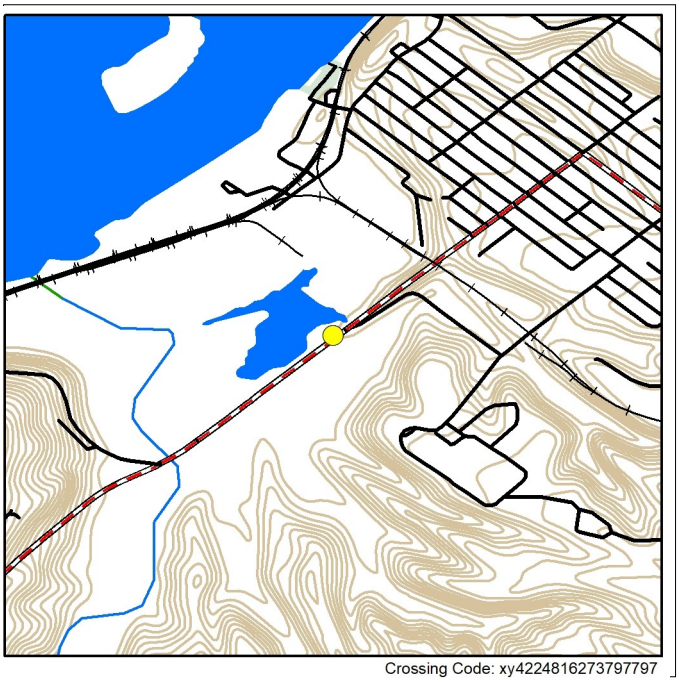
Physical Barrier(s)/Severity: None
Slope (%): 3.3
Structure Comments: Chain fence about 5 feet upstream.

Inlet

Inlet Shape/Type: Headwall and Wingwalls/Box Culvert
Inlet Drop/Grade: Perched
Width: 5, Height: 3
Substrate/Water Width: 5
Water Depth: 0.02
Abutment Height: No data

Outlet

Outlet Shape: Box Culvert
Outlet Drop/Grade: Free Fall
Drop to Stream Surface/Bottom: 0.10/1.00
Width: 5.00, Height:3.10
Substrate/Water Width: 5.00
Water Depth: 0.05



Results

Barrier Evaluation: Insignificant barrier
Aquatic Organism Passage Score: 0.82
Condition: OK

Location

Coordinates: 42.2480, -73.7977
Location Description: 200 yards before Power Road going north.
Date Observed: 2020-09-15
Survey ID: 80060

Stream and Crossing

Crossing Characteristics

Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Moderate
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: None
Water Depth/Velocity Matches Stream: Dry/Dry
Substrate Matches Stream: Contrasting
Substrate Type: Gravel
Substrate Coverage: 100%

Upstream

Downstream

Crossing Comments: Doesnt seem to function as a culvert anymore, dry while all other parallel ones are wet.

Road

Road Type/Surface: Paved
Road Fill Height (feet): 4.4
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

Structure 1 of 1

Material: Concrete
Length (ft): 39.5
Outlet Armoring: None
Internal Features/Structures: None

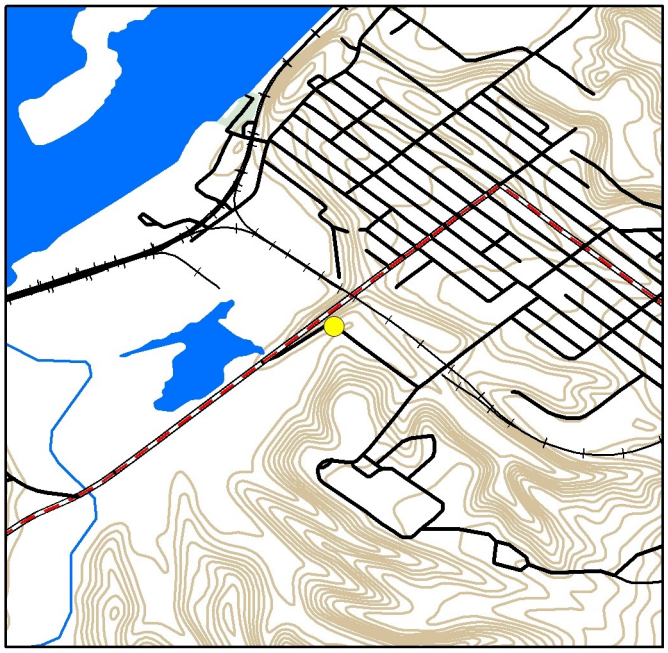
Physical Barrier(s)/Severity: Debris/Sediment/ Rock (Moderate)
Slope (%): 1.2
Structure Comments: Inlet sediment buildup con-

Inlet

Inlet Shape/Type: Headwall and Wingwalls/Box Culvert
Inlet Drop/Grade: At Stream Grade
Width: 5, Height: 0.7
Substrate/Water Width: 5
Water Depth: 0
Abutment Height: No data

Outlet

Outlet Shape: Box Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 5.00, Height:0.80
Substrate/Water Width: 5.00
Water Depth: 0.00



Results

Barrier Evaluation: no score - missing data
Aquatic Organism Passage Score: -1.00
Condition: New

Location

Coordinates: 42.2493, -73.7953
Location Description: Across from stairs
Date Observed: 2020-09-15
Survey ID: 80064

Stream and Crossing

Crossing Characteristics

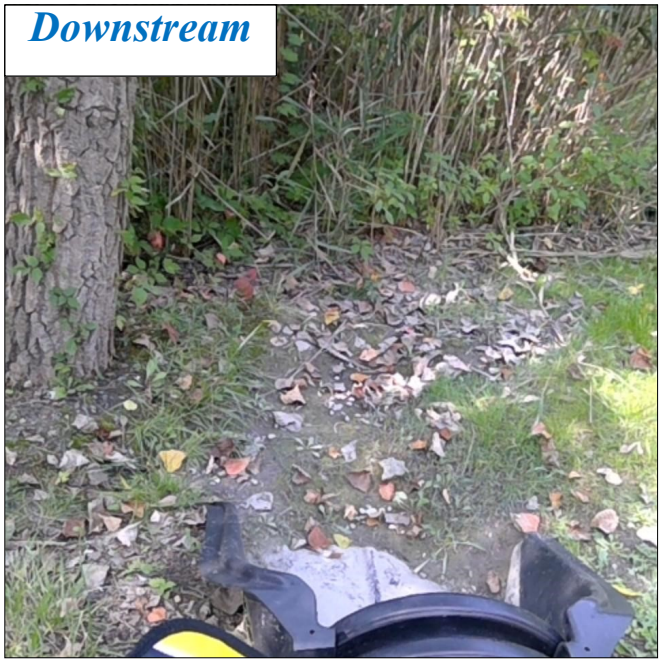
Crossing Type: Partially Inaccessible
Number of structures/cells: 1
Constriction: No data
Alignment: No data

Stream Characteristics

Scour Pool: Small
Water Depth/Velocity Matches Stream: Dry/Dry
Substrate Matches Stream: None
Substrate Type: None
Substrate Coverage: None

Upstream

Downstream



Crossing Comments: Inlet on private property, looks like it extends across private lawn to wetland

Road

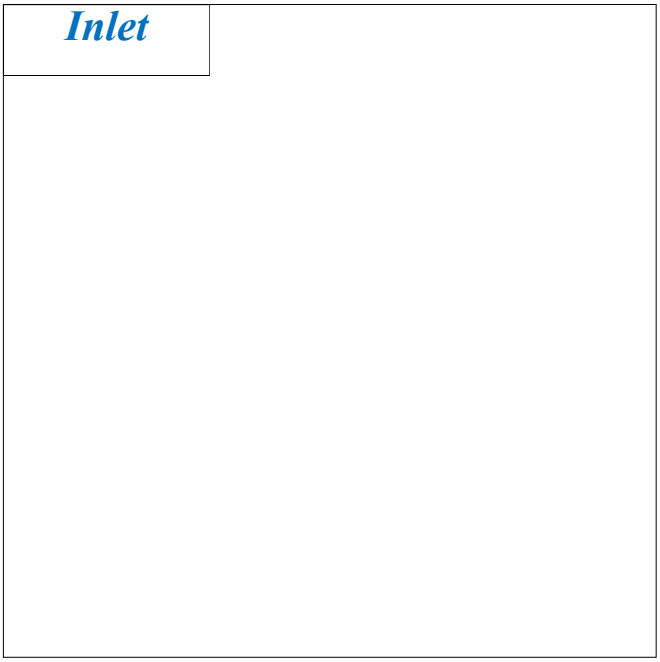
Road Type/Surface: Paved
Road Fill Height (feet): No data
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

Structure 1 of 1

Material: Plastic
Length (ft): No data
Outlet Armoring: None
Internal Features/Structures: No data

Physical Barrier(s)/Severity: None
Slope (%): No data
Structure Comments: No data

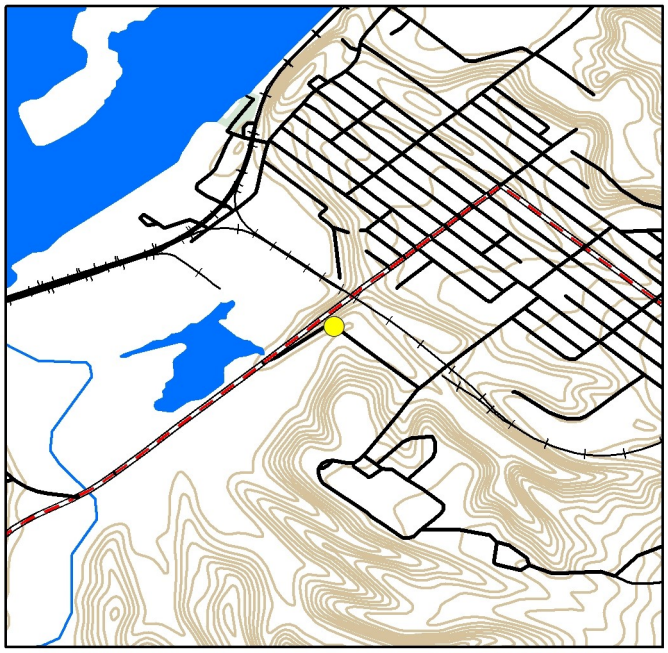


Inlet

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: No data, Height: No data
Substrate/Water Width: No data
Water Depth: No data
Abutment Height: No data

Outlet

Outlet Shape: Round Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 1.30, Height:1.30
Substrate/Water Width: 0.00
Water Depth: 0.00



Results

Barrier Evaluation: Insignificant barrier
Aquatic Organism Passage Score: 0.85
Condition: OK

Location

Coordinates: 42.2493, -73.7952
Location Description: Before Worker's Compensation Board building and brick shed building, at curve in rd.
Date Observed: 2020-09-15
Survey ID: 80063

Stream and Crossing

Crossing Characteristics

Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Moderate
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: None
Water Depth/Velocity Matches Stream: No-Deeper/Yes
Substrate Matches Stream: Comparable
Substrate Type: Silt
Substrate Coverage: 100%

Upstream

Downstream

Crossing Comments: No data

Road

Road Type/Surface: Paved
Road Fill Height (feet): 5.4
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	0.65	3.64	Pass
5	1.38	3.64	Pass
10	2.16	3.64	Pass
25	3.5	3.64	Pass
100	6.19	3.64	Fail

Structure 1 of 1

Material: Metal
Length (ft): 60
Outlet Armoring: None
Internal Features/Structures: None

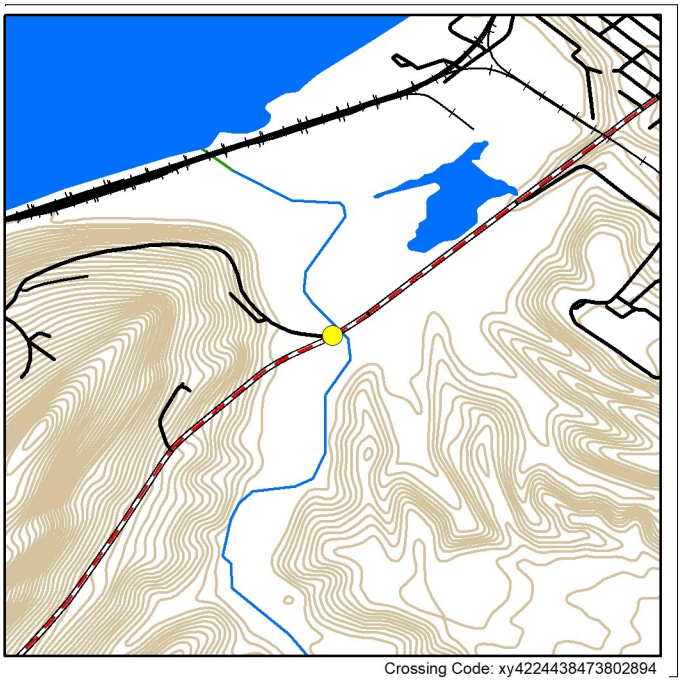
Physical Barrier(s)/Severity: None
Slope (%): 4.8
Structure Comments: No data

Inlet

Inlet Shape/Type: Wingwalls/Round Culvert
Inlet Drop/Grade: At Stream Grade
Width: 5, Height: 3.8
Substrate/Water Width: 4.8
Water Depth: 0.3
Abutment Height: No data

Outlet

Outlet Shape: Pipe Arch/Elliptical Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 5.90, Height:3.10
Substrate/Water Width: 5.70
Water Depth: 0.95


Crossing Code: xy4224438473802894

Results

Barrier Evaluation: Insignificant barrier
Aquatic Organism Passage Score: 0.92
Condition: OK

Location

Coordinates: 42.2443, -73.8028
Location Description: After gravel truck road. Fence at inlet side
Date Observed: 2020-09-15
Survey ID: 80079

Stream and Crossing

Crossing Characteristics

Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Moderate
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: None
Water Depth/Velocity Matches Stream: Yes/Yes
Substrate Matches Stream: Comparable
Substrate Type: Silt
Substrate Coverage: 100%

Upstream

Downstream

Crossing Comments: Fence 10 ft upstream of inlet. Spans entire bankfull.

Road

Road Type/Surface: Paved
Road Fill Height (feet): 2.3
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

Structure 1 of 1

Material: Concrete
Length (ft): 37.2
Outlet Armoring: None
Internal Features/Structures: None

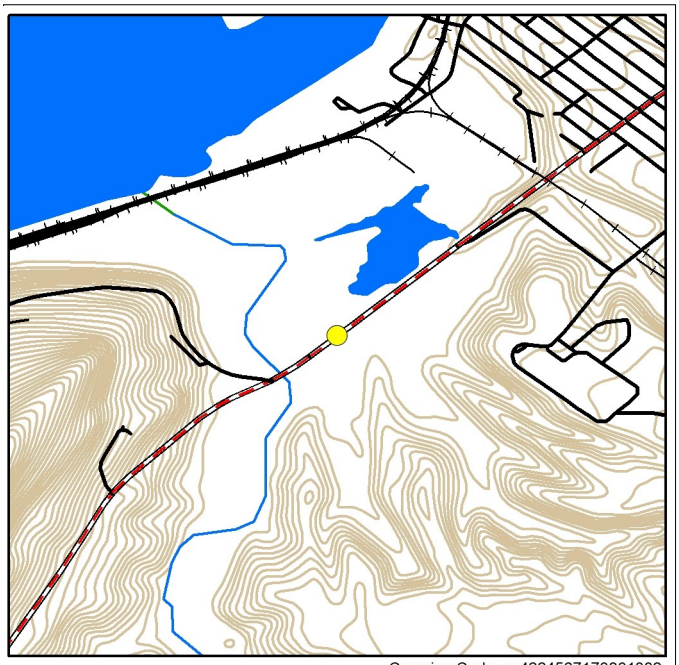
Physical Barrier(s)/Severity: None
Slope (%): 2.3
Structure Comments: No data

Inlet

Inlet Shape/Type: Headwall and Wingwalls/Box Culvert
Inlet Drop/Grade: At Stream Grade
Width: 5, Height: 3.2
Substrate/Water Width: 5
Water Depth: 0.05
Abutment Height: No data

Outlet

Outlet Shape: Box Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 5.00, Height:3.10
Substrate/Water Width: 5.00
Water Depth: 0.10



Results

Barrier Evaluation: Insignificant barrier
Aquatic Organism Passage Score: 0.85
Condition: OK

Location

Coordinates: 42.2456, -73.8009
Location Description: Just after City of Hudson boundary sign
Date Observed: 2020-09-15
Survey ID: 80058

Stream and Crossing

Crossing Characteristics

Crossing Type: Bridge
Number of structures/cells: 1
Constriction: Moderate
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: None
Water Depth/Velocity Matches Stream: No-Shallower/Yes
Substrate Matches Stream: Comparable
Substrate Type: Silt
Substrate Coverage: 100%

Upstream

Downstream

Crossing Comments: Part of wetland

Road

Road Type/Surface: Paved
Road Fill Height (feet): 1.8
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	1.38	10.41	Pass
5	2.92	10.41	Pass
10	4.57	10.41	Pass
25	7.4	10.41	Pass
100	13.1	10.41	Fail

Structure 1 of 1

Material: Concrete
Length (ft): 36.8
Outlet Armoring: None
Internal Features/Structures: None

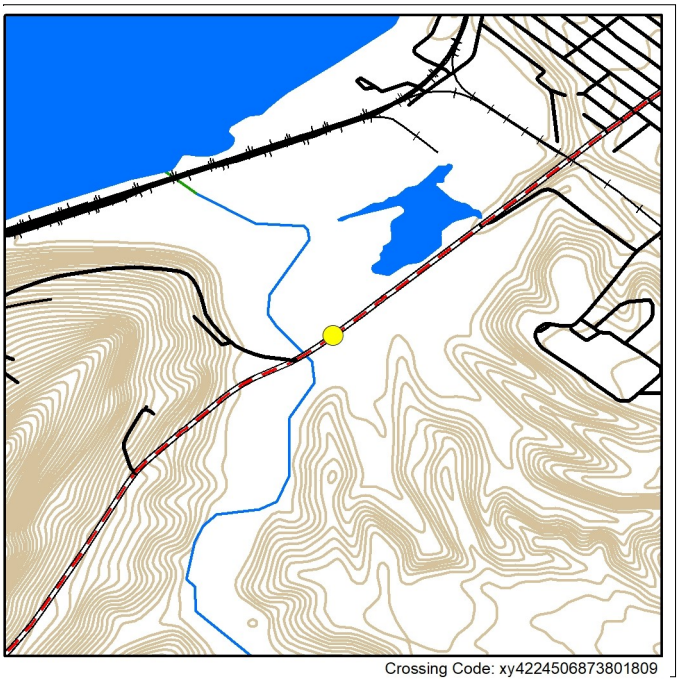
Physical Barrier(s)/Severity: None
Slope (%): 1.5
Structure Comments: Animal tracks through structure

Inlet

Inlet Shape/Type: Headwall and Wingwalls/Box Culvert
Inlet Drop/Grade: At Stream Grade
Width: 10, Height: 3.8
Substrate/Water Width: 10
Water Depth: 0.2
Abutment Height: No data

Outlet

Outlet Shape: Box Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 10.00, Height:3.50
Substrate/Water Width: 10.00
Water Depth: 0.00


Crossing Code: xy4224506873801809

Results

Barrier Evaluation: Minor barrier
Aquatic Organism Passage Score: 0.73
Condition: OK

Location

Coordinates: 42.2453, -73.8014
Location Description: Second guardrail after Merino Road intersection traveling north.
Date Observed: 2017-08-28
Survey ID: 52177

Stream and Crossing

Crossing Characteristics

Crossing Type: Multiple Culvert
Number of structures/cells: 2
Constriction: Severe
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: Large
Water Depth/Velocity Matches Stream: No-Shallower/Yes
Substrate Matches Stream: Comparable
Substrate Type: Silt
Substrate Coverage: 100%

Upstream

Downstream

Crossing Comments: No data

Road

Road Type/Surface: Paved
Road Fill Height (feet): 1.2
Road Ownership:

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	0.08	13.38	Pass
5	0.23	13.38	Pass
10	0.42	13.38	Pass
25	0.76	13.38	Pass
100	1.51	13.38	Pass

Structure 1 of 2

Material: Concrete
Length (ft): 36
Outlet Armoring: None
Internal Features/Structures: None

Physical Barrier(s)/Severity: None
Slope (%): 1.3
Structure Comments: No data

Inlet

Inlet Shape/Type: Other/Box Culvert
Inlet Drop/Grade: At Stream Grade
Width: 10.2, Height: 3.7
Substrate/Water Width: 10.2
Water Depth: 1.3
Abutment Height: No data

Outlet

Outlet Shape: Box Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 10.20, Height:3.00
Substrate/Water Width: 10.20
Water Depth: 1.00

Structure 2 of 2

Material: Concrete
Length (ft): 36.00
Outlet Armoring: None
Internal Features/Structures: None

Physical Barrier(s)/Severity: None
Slope (%): 1.3
Structure Comments: No data

Inlet

Inlet Shape/Type: Headwall/Box Culvert
Inlet Drop/Grade: At Stream Grade
Width: 10.40, Height: 3.20
Substrate/Water Width:
Water Depth: 1.20
Abutment Height: No data

Outlet

Outlet Shape: Box Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 10.40, Height: 2.70
Substrate/Water Width: 10.40
Water Depth: 0.70

Additional Photos

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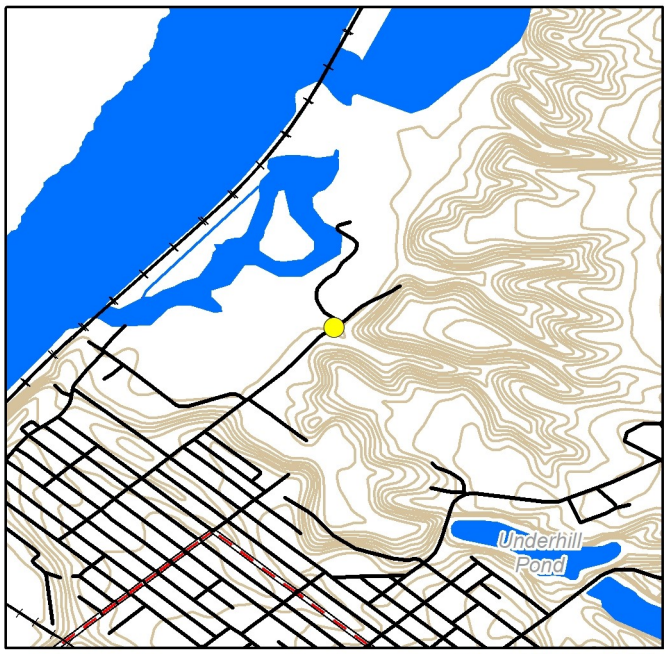


Results

Barrier Evaluation: Minor barrier
Aquatic Organism Passage Score: 0.74
Condition: Poor

Location

Coordinates: 42.2596, -73.7867
Location Description: Just up the road from tea brewing company, just before private property
Date Observed: 2020-09-15
Survey ID: 80062

Stream and Crossing

Crossing Characteristics

Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Spans Only Bankfull/Active Channel
Alignment: Flow-Aligned

Stream Characteristics

Scour Pool: Large
Water Depth/Velocity Matches Stream: No-Shallower/Yes
Substrate Matches Stream: Unknown
Substrate Type: Silt
Substrate Coverage: Unknown

Upstream

Downstream

Crossing Comments: Bottom of pipe is rusted at outlet

Road

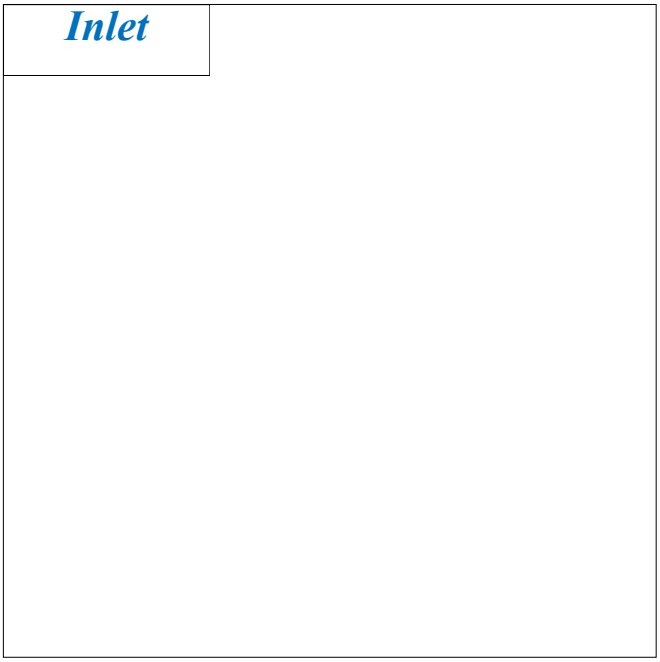
Road Type/Surface: Paved
Road Fill Height (feet): 4.1
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	0.06	1.37	Pass
5	0.21	1.37	Pass
10	0.4	1.37	Pass
25	0.76	1.37	Pass
100	1.57	1.37	Fail

Structure 1 of 1

Material: Metal
Length (ft): 42
Outlet Armoring: None
Internal Features/Structures: None

Physical Barrier(s)/Severity: None
Slope (%): 1.4
Structure Comments: Could not get photo of inlet due to extremely dense thicket

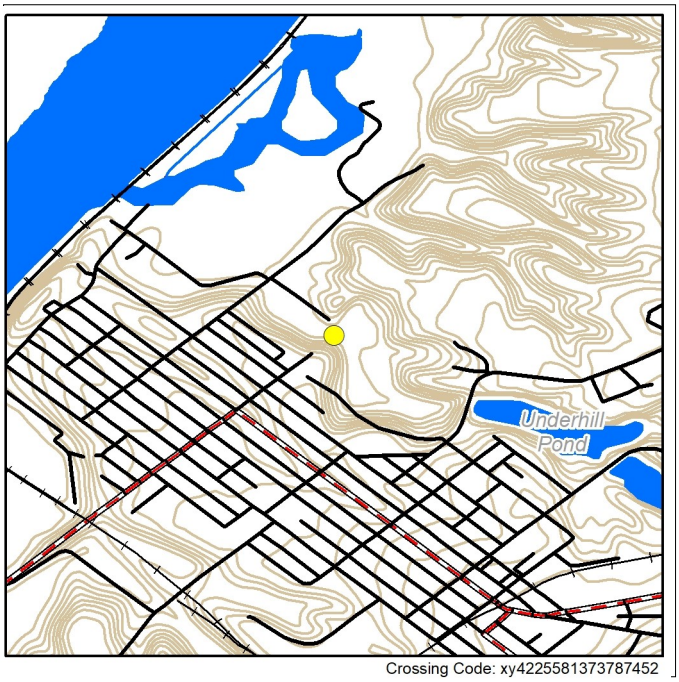


Inlet

Inlet Shape/Type: Projecting/Round Culvert
Inlet Drop/Grade: At Stream Grade
Width: 3, Height: 3
Substrate/Water Width: 1.9
Water Depth: 0.5
Abutment Height: No data

Outlet

Outlet Shape: Round Culvert
Outlet Drop/Grade: At Stream Grade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 3.00, Height:3.00
Substrate/Water Width: 2.70
Water Depth: 1.30



Crossing Code: xy4225581373787452

Results
Barrier Evaluation: no score - missing data
Aquatic Organism Passage Score: -1.00
Condition: OK

Location
Coordinates: 42.2558, -73.7874
Location Description: Right side of Mill Street, gravel pull off.
Date Observed: 2017-10-03
Survey ID: 54945

Stream and Crossing

Crossing Characteristics
Crossing Type: Partially Inaccessible
Number of structures/cells: 1
Constriction: Severe
Alignment: Flow-Aligned

Stream Characteristics
Scour Pool: Unknown
Water Depth/Velocity Matches Stream: Yes/No-Faster
Substrate Matches Stream: None
Substrate Type: None
Substrate Coverage: None

Upstream

Downstream

Crossing Comments: Can't find an outlet, likely a buried stream under N 2nd St

Road

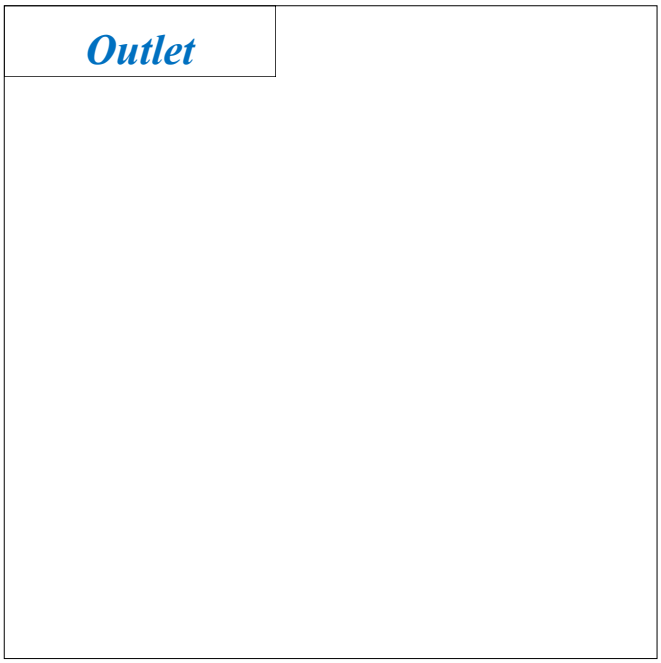
Road Type/Surface: Unpaved
Road Fill Height (feet): 4.6
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

Structure 1 of 1

Material: Plastic
Length (ft): No data
Outlet Armoring:
Internal Features/Structures: None

Physical Barrier(s)/Severity: Fencing (Moderate)
Slope (%): 4.2
Structure Comments: Can't see far down structure but it sounds like there is a free fall within struc-

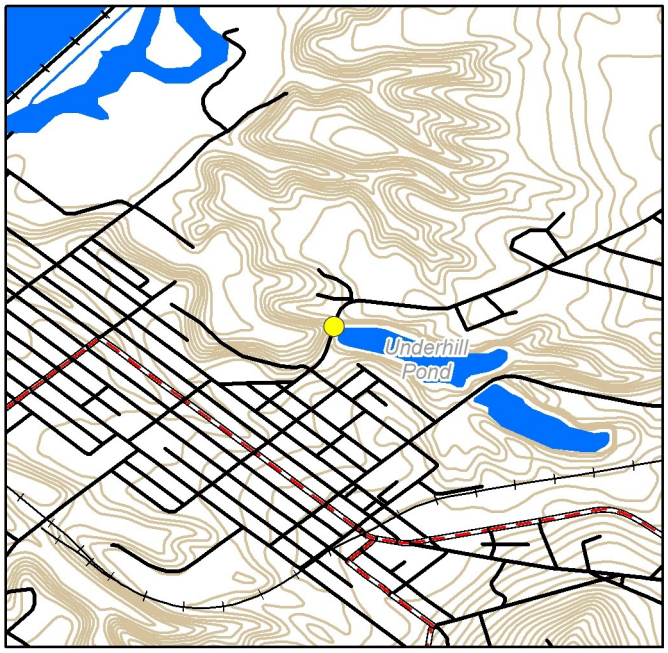


Inlet

Inlet Shape/Type: Projecting/Round Culvert
Inlet Drop/Grade: At Stream Grade
Width: 2.1, Height: 2.2
Substrate/Water Width: 1.3
Water Depth: 0.2
Abutment Height: No data

Outlet

Outlet Shape:
Outlet Drop/Grade:
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 0.00, Height:0.00
Substrate/Water Width: 0.00
Water Depth: 0.00



Crossing Code: xy4225393473783411

Results
Barrier Evaluation: Severe barrier
Aquatic Organism Passage Score: 0.00
Condition: OK

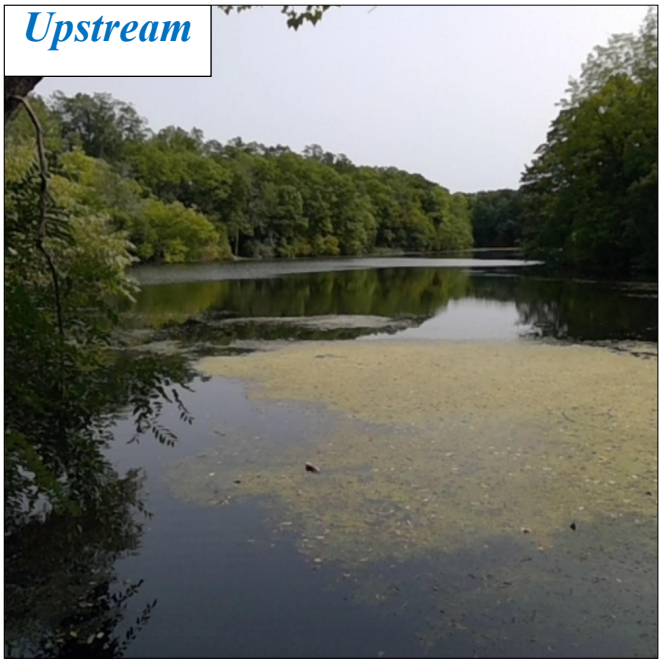
Location
Coordinates: 42.2538, -73.7841
Location Description: Right next to Underhill pond between Mill Street and Washington Street. The outlet is very far down the hill. GPS coordinate for outlet
Date Observed: 2020-09-15
Survey ID: 80077

Stream and Crossing

Crossing Characteristics
Crossing Type: Culvert
Number of structures/cells: 1
Constriction: Severe
Alignment: Flow-Aligned

Stream Characteristics
Scour Pool: Small
Water Depth/Velocity Matches Stream: No-Shallower/No-Faster
Substrate Matches Stream: Comparable
Substrate Type: Silt
Substrate Coverage: 100%

Upstream



Downstream

Crossing Comments: Has removable fence that is attached to ropes to pull up.

Road

Road Type/Surface: Paved
Road Fill Height (feet): 12
Road Ownership: City

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	0.31	6.23	Pass
5	0.74	6.23	Pass
10	1.23	6.23	Pass
25	2.1	6.23	Pass
100	3.93	6.23	Pass

Structure 1 of 1

Material: Combination
Length (ft): 200
Outlet Armoring: Extensive
Internal Features/Structures: None

Physical Barrier(s)/Severity: Fencing (Minor)
Slope (%): 2.4
Structure Comments: Outlet dimensions are solid estimates. Unable to climb stairs or slope.

Inlet

Inlet Shape/Type: Headwall and Wingwalls/Pipe Arch/Elliptical Culvert
Inlet Drop/Grade: At Stream Grade
Width: 6, Height: 3.1
Substrate/Water Width: 3.8
Water Depth: 0.35
Abutment Height: No data

Outlet

Outlet Shape: Round Culvert
Outlet Drop/Grade: Free Fall Onto Cascade
Drop to Stream Surface/Bottom: 16.80/17.00
Width: 2.50, Height:2.50
Substrate/Water Width: 0.60
Water Depth: 0.30

Structure 2 of 1

Material:
Length (ft): 0.00
Outlet Armoring:
Internal Features/Structures:

Physical Barrier(s)/Severity:
Slope (%):
Structure Comments: Outlet dimensions are solid estimates. Unable to climb stairs or slope.

Inlet

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: 0.00, Height: 0.00
Substrate/Water Width:
Water Depth: 0.00
Abutment Height: No data

Outlet

Outlet Shape:
Outlet Drop/Grade: Free Fall Onto Cascade
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 0.00, Height: 0.00
Substrate/Water Width: 0.00
Water Depth: 0.00

Structure 3 of 1

Material:
Length (ft):
Outlet Armoring
Internal Features/Structures:

Physical Barrier(s)/Severity:
Slope (%):
Structure Comments:

Inlet

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: , Height:
Substrate/Water Width:
Water Depth:
Abutment Height:

Outlet

Outlet Shape:
Outlet Drop/Grade:
Drop to Stream Surface/Bottom:
Width: , Height:
Substrate/Water Width:
Water Depth:

Structure 4 of

Material:
Length (ft):
Outlet Armoring
Internal Features/Structures:

Physical Barrier(s)/Severity:
Slope (%):
Structure Comments:

Inlet

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: , Height:
Substrate/Water Width:
Water Depth:
Abutment Height:

Outlet

Outlet Shape:
Outlet Drop/Grade:
Drop to Stream Surface/Bottom:
Width: , Height:
Substrate/Water Width:
Water Depth:

Structure 5 of 1

Material:
Length (ft):
Outlet Armoring
Internal Features/Structures:

Physical Barrier(s)/Severity:
Slope (%):
Structure Comments:

Inlet

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: , Height:
Substrate/Water Width:
Water Depth:
Abutment Height:

Outlet

Outlet Shape:
Outlet Drop/Grade:
Drop to Stream Surface/Bottom:
Width: , Height:
Substrate/Water Width:
Water Depth:

Additional Photos

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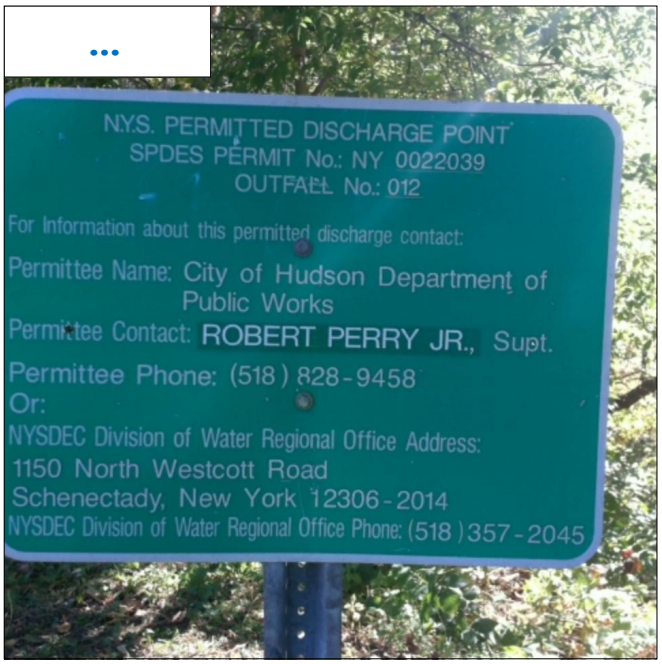

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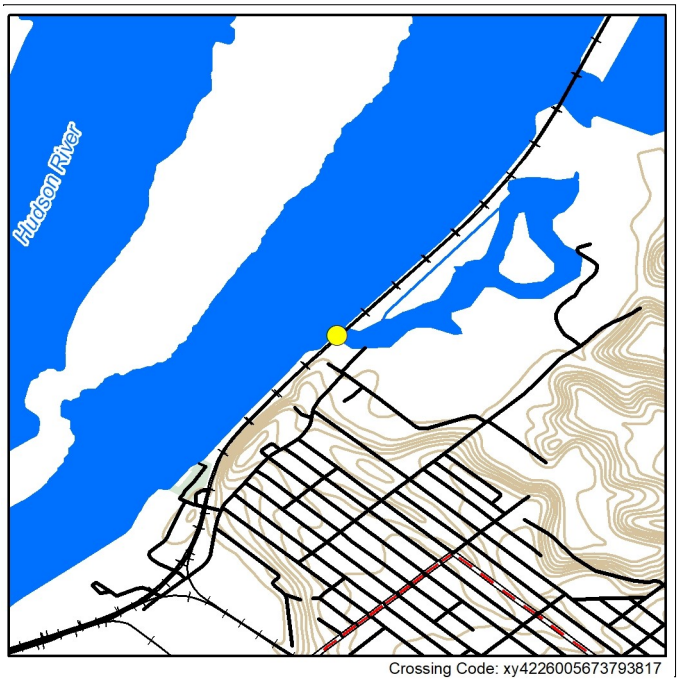
Private and Other Crossings

Entries are organized geographically by Map Index Key, beginning with 1A



Results
Barrier Evaluation: no score - missing data
Aquatic Organism Passage Score: -1.00
Condition: No data

Location
Coordinates: 42.2601, -73.7938
Location Description: Inaccessible
Date Observed: 2017-08-30
Survey ID: 52491

Stream and Crossing

Crossing Characteristics
Crossing Type: Inaccessible
Number of structures/cells: 0
Constriction: No data
Alignment: No data

Stream Characteristics
Scour Pool: No data
Water Depth/Velocity Matches Stream: /
Substrate Matches Stream:
Substrate Type:
Substrate Coverage:

Upstream

Downstream

Crossing Comments: No data

Road

ROAD

Road Type/Surface: Railroad
Road Fill Height (feet): No data
Road Ownership: Private

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

STRUCTURE 1 OF 0

Material:
Length (ft):
Outlet Armoring:
Internal Features/Structures:

Physical Barrier(s)/Severity: No culvert
Slope (%):
Structure Comments:

Inlet

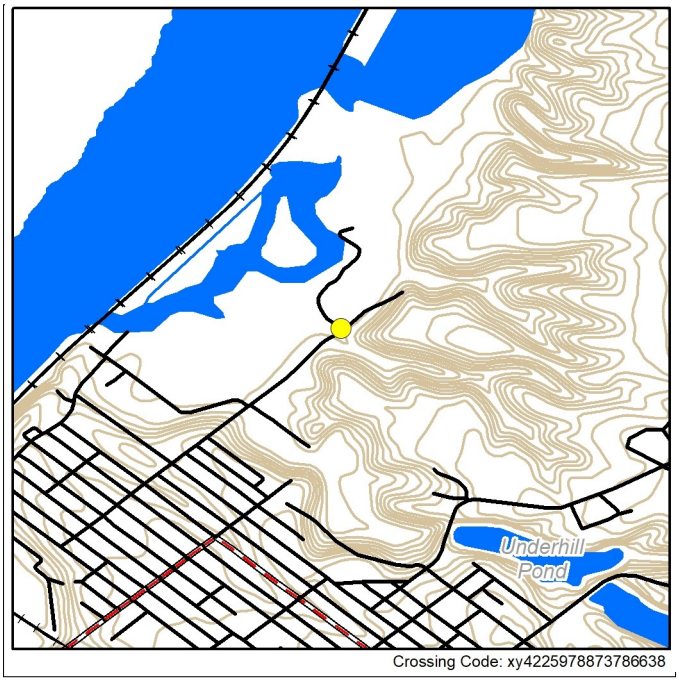
Outlet

INLET

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: , Height:
Substrate/Water Width:
Water Depth:
Abutment Height:

OUTLET

Outlet Shape:
Outlet Drop/Grade:
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 0.00, Height:0.00
Substrate/Water Width: 0.00
Water Depth: 0.00



Crossing Code: xy4225978873786638

Results
Barrier Evaluation: no score - missing data
Aquatic Organism Passage Score: -1.00
Condition: No data

Location
Coordinates: 42.2598, -73.7866
Location Description: Landfill land
Date Observed: 2017-10-03
Survey ID: 54943

Stream and Crossing

Crossing Characteristics
Crossing Type: Inaccessible
Number of structures/cells: 0
Constriction: No data
Alignment: No data

Stream Characteristics
Scour Pool: No data
Water Depth/Velocity Matches Stream: /
Substrate Matches Stream:
Substrate Type:
Substrate Coverage:

Upstream

Downstream

Crossing Comments: Private land

Road

Road

Road Type/Surface: Unpaved
Road Fill Height (feet): No data
Road Ownership: Private

Return Interval (Year)	Peak Flow (cfs)	Culvert Capacity (cfs)	Pass/Fail
2	No data	No data	No data
5	No data	No data	No data
10	No data	No data	No data
25	No data	No data	No data
100	No data	No data	No data

Structure 1 of 0

Material:
Length (ft):
Outlet Armoring:
Internal Features/Structures:

Physical Barrier(s)/Severity: No culvert
Slope (%):
Structure Comments:

Inlet

Outlet

Inlet

Inlet Shape/Type: /
Inlet Drop/Grade:
Width: , Height:
Substrate/Water Width:
Water Depth:
Abutment Height:

Outlet

Outlet Shape:
Outlet Drop/Grade:
Drop to Stream Surface/Bottom: 0.00/0.00
Width: 0.00, Height:0.00
Substrate/Water Width: 0.00
Water Depth: 0.00

Appendix

Project Steps

Step 1: Road Stream Crossing Inventory

North Atlantic Aquatic Continuity Collaborative (NAACC) surveys were completed by project partners.

The NAACC is a participatory network of practitioners united in their efforts to enhance aquatic connectivity. The collaborative efforts of NAACC have so far:

1. developed unified protocols for road-stream crossing assessments that can help identify bridges and culverts that are problematic from an aquatic connectivity perspective,
2. launched an online assessment training program,
3. created an online database that serves as a common repository for crossing assessment data,
4. developed a tool to identify high priority watersheds and crossings for assessment, and are supporting efforts to conduct assessments throughout the region.

The survey includes a variety of measurements that include structure type and condition, flow condition in and out of the structure, structure alignment and many other measurements that will provide the needed data to generate an aquatic passage score for each surveyed crossing. The standardized protocol can be found on the NAACC website.[1]

In the City of Hudson, 31 road stream crossings were identified and 19 were surveyed. The sturcutres that were not surveyed could either not be found, were impossible to access or were not actually located within the city boundary. Only City crossings were included in the prioritization process; however, county, state crossings were surveyed and the data was included in this inventory.

The data from the survey can be accessed by the public through the NAACC online database.[2] In addition, a project specific map with survey, modeling and prioritization data can be accessed by the City and the community.

Step 2: Aquatic Organism Passage Modeling

The survey data is entered into the Aquatic Organism Passage (AOP) model developed by University of Massachusetts at Amherst and other NAACC partners. The model is not species specific but instead uses criteria on a variety of different life forms and life histories to assess the passage potential of each structure. The results from the model classify each structure based on “No AOP”, “Reduced AOP” and “Full AOP”. No AOP means that most species will not be able to pass through the structure. Reduced AOP means that some species may be able to pass under certain flows, but others may or may not be able to pass through the structure. Full AOP means that all species can pass through the structure. Within the No AOP and Reduced AOP category, a severity of the barrier is determined and classified by descriptors for different ranges of aquatic passaibility. These descriptors are displayed in Table 1. The top AOP barriers from the AOP modeling for the City of Hudson are summarized below in Table 2.

Table 1: Description of Barrier Severity Related to AOP Score

Barrier Descriptor	AOP Range
Severe	0.00 – 0.19
Significant	0.20 – 0.39
Moderate	0.40 – 0.59
Insignificant	0.60 – 0.79
Minor	0.80 – 0.99
No Barrier	1.0

[1] http://streamcontinuity.org/

[2] ttps://www.streamcontinuity.org/cdb2/naacc_search_crossing.cfm

Step 3: Hydraulic Capacity Modeling

The survey data is also used to determine the resiliency and flow capacity of each crossing structure. Cornell University Water Resource Institute, in partnership with the Northeast Regional Climate Center and Hudson River Estuary Program, developed the Cornell Resiliency Model to identify undersized culverts vulnerable to flooding under current and future climate conditions. Using a combination of culvert inventory field data and peak discharge predictions for current and future climate scenarios, the model determines culvert flow capacity and highlights the flow event at which the structure will fail.

This model consists of four main components: 1. watershed delineation, 2. peak discharge calculation, 3. capacity calculation, and 4. return period assignment. The watershed component of the model is conducted using ArcGIS, while the peak discharge calculation, capacity calculation and return period assignment are executed using Python scripts.

A detailed description of the steps in the Cornell Resiliency model are as follows:
1. The watershed delineation component of the model is conducted on ArcGIS using custom tools created by Rebecca Marjerison for her PhD dissertation. The tools first delineate the watershed of each culvert. Next, all culvert watersheds being evaluated are aggregated into a single shapefile. Finally, the area, weighted Curve Number (CN) and Time of Concentration (Tc) are computed for each watershed.
2. The second component of the model is the peak discharge calculation. The watershed data compiled in the initial phase of the model is used as the input for this component. The procedure set in the USDA Natural Resources Conservation Service (NRCS) Technical Release 55 (TR-55) graphical method is used to determine peak discharge for various return period storms for each delineated watershed.
3. The third component of the model is the calculation of culvert capacity. Using field data, the capacity of each culvert is modeled using the inlet control equation set forth by the Federal Highway Administration Hydraulic Design Series 5. In this model, the headwater ponding height was assumed to be the height of the road surface above the culvert invert.
The model evaluates flow conditions for the 2, 5, 10, 25, 50 and 100-year storm events. A detailed projection of future climate conditions for Columbia County can be found at the NYS DEC website.

City of Hudson Road-Stream Crossing Management Plan

Draft Review and Crossing Prioritization

December 16rd, 2020

After completion of the City of Hudson Road-Stream Crossing Management Plan, a meeting was held with City staff to gather prioritization information and identify other details that should be included in the management plan. Information could include structures that flood regularly, have frequent debris build up, or require regular maintenance. This meeting also provided an opportunity to compare flood capacity data generated by WRI modeling to the existing field knowledge of staff.

Participants included:

> Department of Public Works Superintendent: Robert Perry Jr.
> Mayoral Aid: Michael Chameides

The following road-stream crossings were discussed with the City of Hudson.

80059- Located on S 3rd Street, also called Bay Road. The state owns and maintains a bridge a little further down the road over the train tracks, so this might be a DOT structure. This is a minor barrier, but doesn't have flood capacity data. Any flooding have to do with tidal influence. The purpose of this structure is to keep stresses off of the embankment for the road. Bay Road most frequently floods at Mount Marino.

80060- Also located on S 3rd Street (Bay Road). Not a significant barrier. This structure also serves to relieve head pressure from tides and heavy rains.

80064- Existing CSO there from a pump station. A pump station upgrade will happen in 2021 and the CSO will be abandoned. There are no flooding or debris issues at this structure.

80063- This structure is also located near the pump station, and DPW does not experience issues with this structure.

80079- Despite its location on S 3rd Street, this structure may be located in Greenport, not the City of Hudson.

80056- Also located on S 3rd Street (Bay Road). This structure also serves to relieve head pressure from tides and heavy rains.

52170- Though this road is marked with "Private, no trespassing" signs, the landfill is actually a County managed and owned property. It used to be owned by the city. Elevations are high so there isn't flooding there, but the outlet leads to Mill Street which does get inundated with waterfrom various structures and floods. This structure was not assessed in 2020 because assessors believed it was private property and that they did not have permission to assess. It will be assessed once conditions allow .

80062- North 2nd Street. This is located at a higher elevation, and has not had any major flooding issues. In the past, the City experiences issues with people dumping garbage near here, but this is less common now.

54945- This structure is located on Mill Street, which does experience flooding. CSO 5. The outlet is behind Craft Tech in the woods and is very difficult to find, but the DPW crew knows where it is. This structure is downstream from Underhill Pond, and captures its overflow water. It is technically a stormwater structure, and water that enters the structure structures doesn't daylight. Where the Charles Mills playground is. In addition to the Pond overflow, it also collects stormwater from the Harry Howard Ave storm lines. New storm lines and discharge points were installed near the bike path as of last month.

80077- This severe barrier is located on Harry Howard Avenue. The major cascading at the outlet, which DPW refers to as "the salmon stairs," causes an extreme aquatic barrier. There is a gate on the inlet which is intended to hold debris back. Recently, there was a rain storm in which two inches of rain fell in half an hour. This caused the level of Underhill Pond to increase. One of the catch basins was overwhelmed and couldn't take rainwater, causing a house downstream to experience minor flooding down on the corner of Washington and Harry Howard. Rob is unsure of how to fix the situation, and is unaware of how often this problem has occurred. Underhill Pond is City owned and managed. This is an important structure to include in the prioritization.

Missing Culvert- There is a structure on Glenwood Blvd that was not predicted by NAACC. It crosses the road and drains into Underhill Pond. This structure does not experience major issues.

CSX Railroad Spur- The City does not own the railroad spur. These structures are private and were not assessed in 2020. DPW has observed some ponding near these structures, which are all located near the Hudson River.

Glossary of Terms

Aquatic organism – An aquatic organism lives in water for at least a portion of their life.

Bankfull– Bankfull is an established height at a given location along a river or stream, above which a rise in water surface will cause the river or stream to overflow the lowest natural stream bank somewhere in the corresponding reach.

Bankfull discharge – Bankfull discharge is the dominant channel forming flow with a recurrence interval seldom outside the 1 to 2-year range.

Bankfull width- The wetted width of the stream occurring at Bankfull.

Clear Span-The maximum inside width of a non-circular pipe or bridge. Cover height - The amount of fill material above a road stream crossing structure.

Design Load- The sum of all vertical forces (i.e. soil weight, passing vehicles, etc.) applied to a buried culverts or bridge.

Flood resiliency – Flood resiliency is the ability for the City to withstand and recover from flood crisis.

Freeboard - The distance between normal water level and the bottom of the road stream crossing structure.

Geomorphic –Response of river and stream channels to various types of natural and human-caused disturbances including floods.

Head cut - A head cut in stream geomorphology, is an area of instream instability and erosional feature of streams with an abrupt vertical drop that can be perpetuated through the river system until equilibrium of channel dimensions and slope is attained.

Hydraulic capacity - The amount of water that can pass through a structure or watercourse.

Intermittent stream – An intermittent stream is a stream which normally ceases to flow for weeks or months each year.

Perennial stream – A perennial stream is a stream or river (channel) that has continuous flow in parts of its stream bed all year round during years of normal rainfall.

Recurrence Interval - Statistical techniques, through a process called frequency analysis, are used to estimate the probability of the occurrence of a given precipitation event. The recurrence interval is based on the probability that the given event will be equaled to or exceeded in any given year. Ten or more years of data are required to perform a frequency analysis for the determination of recurrence intervals. Of course, the more years of historical data the better—a hydrologist will have more confidence on an analysis of a river with 30 years of record than one based on 10 years of record.[1]

[1] https://water.usgs.gov/edu/100yearflood.html

Recurrence Intervals and Probabilities of Occurrences

Recurrence interval, in years	Probability of occurrence in any given year	Percent chance of occurrence in any given year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Regional regression – Regional regression equations are based on statistical relations between (1) streamflow statistics of interest computed from applicable records of the stations and (2) basin and climatic characteristics, for which data are typically readily available.

Road Stream Crossing – Road stream crossings are location where a road, paved or unpaved, crosses over a body of water within the physical extents of all supporting infrastructure (i.e. the proposed crossing infrastructure, wingwalls, etc.)

StreamStats - StreamStats is a USGS Web application that queries an assortment of Geographic Information Systems (GIS) analytical tools to calculate peak discharges for certain recurrence intervals. The calculations were established from publicly available US Geological Service research (USGS SIR 2006-5112 “Magnitude and Frequency of Floods in New York”) which established a relationship between watershed characteristics and peak discharges. StreamStats also is a USGS web application hat calculates bankfull dimensions from publicly available US Geological Service research (USGS SIR 2009-5144 “Bankfull Discharge and Channel Characteristics of Streams in New York State”) which established a relationship between watershed characteristics and bankfull dimensions.

Stormwater - Stormwater is water that originates during precipitation events and snow/ice melt that either soak into the soil (infiltrate), evaporates, or runs off and ends up in nearby streams, rivers, or other water bodies.

Wetland - A wetland is a distinct ecosystem that is inundated by water, either permanently or seasonally, where oxygen- free processes prevail.

NEW YORK STATE OF OPPORTUNITY. | Hudson River Estuary Program

AQUATIC CONNECTIVITY

Identifying Barriers to Organisms and Hazards to Communities

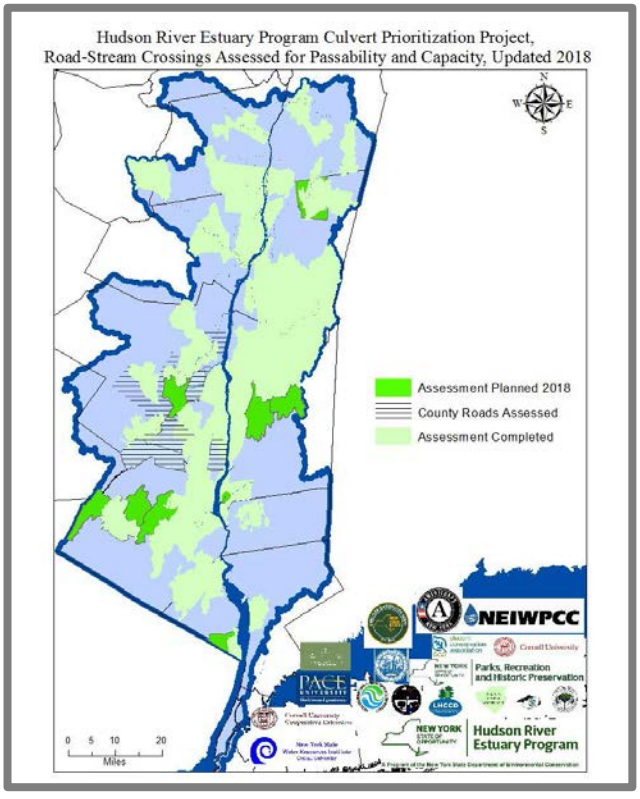
Problem Road Culverts

Poorly designed and undersized culverts are barriers to aquatic organisms and hazards to communities during storms. Streams are linear habitats for aquatic and semi-aquatic species such as American eel, herring, stream salamanders, turtles and crayfish. Road crossings can fragment streams into small pieces, preventing organisms from accessing critical habitats.

Culverts also may be infrastructure liabilities and flooding hazards for communities. During storms, undersized or improperly installed culverts can become clogged with debris or overwhelmed, leading to road flooding, stream bank erosion, or even washout of the whole road.

Culverts such as this one constrict the natural flow of the stream, have a perched outlet that only strong swimmers can jump and contain no natural streambed. Many culverts and dams fragment stream habitats.

Municipalities can receive help prioritizing culverts that could be upgraded, benefitting aquatic organisms and communities' bottom lines.



Culvert assessments have been conducted in approximately 46.9% of the Hudson River Estuary Program boundary.

Studies have found that about two-thirds of crossings are not fully passable to aquatic organisms. The NYSDEC Hudson River Estuary Program, other NYSDEC branches, Soil and Water Conservation Districts, and interested county and local partners are working to reconnect tributaries within the Estuary watershed by surveying and prioritizing impassable and undersized culverts. Road crossings with unnatural stream bottoms, a perched outlet where a culvert adds an unnatural step to the stream, or other conditions are often barriers to organisms that need to go up and down streams.

Cornell University hydrologists model each crossing for the maximum storm interval (return period) the crossing could pass without spilling over the road. Undersized culverts are more likely to flood the road and washout during large storms. Emergency replacement of failed culverts costs more money and disrupts essential services such as hospital access during flood events. **This project connects interested communities with funding sources to replace impassable, undersized culverts with fully passable, properly sized culverts.**

Empowering Communities

After the assessment work, communities have data on each crossing's passability and capacity scoring information. This data is also available on the Cornell WRI Aquatic Connectivity Map and the North Atlantic Aquatic Connectivity Collaborative database. Estuary Program staff are available for technical assistance and presentations to help communities use the information.

To help communities reconnect their streams and proactively remove flooding hazards, Estuary Program grants can fund these planning and mitigation steps.

Scenic Hudson Land Trust received a grant to improve the aquatic organism passability and reduce the flooding hazard of this vital piece of infrastructure.

1.) **Assess Culverts and Bridges** for aquatic organism passability and storm capacity by partner organizations or Estuary Program staff.
2.) **Prioritize Problem Culverts** within a management plan. After the crossings have been assessed and modeled, municipalities can rank crossings by passability, capacity and local needs. This document can be added to a Natural Resource Inventory or Hazard Mitigation Plan.
3.) **Design Replacements** through conceptual or shovel-ready engineering plans. This process also addresses relevant permits required for a construction mitigation project.
4.) **Fix Problem Culverts** by upgrading infrastructure to be fully passable to organisms and reduce flooding hazards.

Removing harmful and unnecessary stream barriers will benefit our resident and migratory fish, as well as all the other organisms that use our streams. New York has seen a dramatic increase in the amount of rain falling during large storms, and climate change projections suggest that will continue. Planning for fully passable crossings for organisms also means planning for structures capable of handling more frequent and intense storm events. This project gives communities a clear understanding of where problem stream barriers are, and provides funding to fix them.

Partners have assessed over 6,600 crossings

- 20% of these are substantial barriers to aquatic organisms
- 71% of crossings are undersized
- Problems are more pronounced for locally owned roads

CONTACT INFORMATION

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www.dec.ny.gov

Planning for the Future: Best Management Practices for Road Stream Crossing Designs

Understanding how best to design and install a flood resilient and wildlife friendly culvert is the ultimate outcome of the road stream crossing management planning exercise. The examples identified and designed during the project highlight the types of structures and design criteria needed to ensure that the structure is meeting these goals.

A well-designed culvert should avoid constricting the stream channel, consider the width and skew of the river as well as be appropriately sized to pass the largest storm feasible - ideally, the 100-year storm. The structure should, maintain the continuity of the natural stream substrate, slope and water velocity through the structure. Non-constricting culverts installed with a similar natural slope will normally provide water depths, velocities, bottom substrates, and channel characteristics that are comparable to the natural stream.[1]

NYS DEC has compiled stream crossing standards that can be used to guide all road stream crossing construction projects.

NYS Stream Crossing Standards

The following recommended standards are provided on the NYS DEC website[2] and are effective for reducing stream barriers and impediments to fish and wildlife.

Structure Type:

A. Bridges and bottomless arches are preferred and should be used whenever possible.

B. Box and Pipe culverts, if used, must be:

- Embedded into the streambed to at least 20 percent of the culvert height at the downstream invert
- Used only on "flat" streambeds (slopes no steeper than 3 percent)
- Installed level

Structure Width:

- The crossing opening (whether open arch, bridge, or culvert) should be at least 1.25 times the width of the stream channel bed. This width is measured bank to bank at the ordinary high-water level (OHW) or edges of terrestrial, rooted vegetation.
- An average of three measurements, (project location and straight sections of the stream upstream and downstream) should be used to determine the channel bed width.

Depth and Velocity:

- At low flows, water depths and velocities should be the same as they are in natural areas upstream and downstream of the crossing.

Substrate:

- Natural substrate should be used within the crossing, and it should match the upstream and downstream substrates. It should resist displacement during floods and should be designed so that appropriate material is maintained during normal flows.

[1] https://www.streamcontinuity.org/aquatic_connectivity/crossing_design/stream_simulation.htm

[2] http://www.dec.ny.gov/permits/49060.html

Additional Design Criteria:

- Size of the structure is large enough to pass a 100-year flow event or the largest storm event feasible considering future climatic conditions.
- Placement of the structure is in line with the stream to reduce skew.
- Instream passable, grade control structures are installed to prevent channel head cuts[9] from causing additional erosion and instability within the stream.

Table 5: Recommended Non-Bridge Culvert Structure

Option 1: Three-Sided Concrete Box

Material – Steel-reinforced concrete, galvanized or aluminum structure.
Usage Summary – Good structure to use if looking for a natural bottom, simple solution; should be considered on perennial streams
Benefits – Open bottom; may require some instream work to ensure stream stability, however this is a good solution for aquatic passage projects; can accommodate minimal road fill over top.
Disadvantages – Can be higher profile; weight of concrete structures may limit installation options and require Town's to contract out work increase cost; required installation of footers.
Life Span – 50-75 years
Cost Comparison – Higher cost depending on the size and weight of the structure.

Option 2: Open-Bottomed Arch Culvert

Material - Galvanized steel, aluminum, steel reinforced concrete
Usage Summary - Good structure to use if looking for a natural bottom, low profile solution; should be considered on perennial streams.
Benefits – Open bottom; low profile; light weight and easy to transport; may require some instream work to ensure stream stability however this is a good solution for aquatic passage projects.
Life Span – 50-75 years
Cost Comparison – May be a less expensive options because of transport and installation savings. City may have the equipment to install these structures in house.

Option 3 - Embedded or at Stream Grade Round Culvert

Material - Galvanized steep, plastic, steel reinforced concrete.
Usage Summary – Low cost solution for small intermittent streams, wetland crossings and stormwater infrastructure.
Benefits – Embedded pipe provided natural bottom
Disadvantages – Depending on size of the pipe it may be difficult to embed pipe and provide natural bottom; in both scenarios the culvert must span creek width, stream grade structure rarely adequate for fish passage at less than stream width.
Life Span – 20-75 years
Cost Comparison – Lower cost solution

Other Design Considerations

The prioritization exercise highlighted in this report is just one way the road stream crossing data can be used to benefit the City. Our example prioritization effort outlined in the report focuses on improving City's natural resources. However, the results from the prioritization effort also demonstrate the benefit of consolidating the large dataset into smaller components to highlight opportunities for other priorities beyond aquatic organism passage.

The dataset can be used in a variety of other ways to benefit the city. Here are a few ways the data can be used:

- Provide specific data for each structure surveyed
- Provide data to help with planning and budgeting
- Prioritize structures based on flood potential
- Identify stormwater infrastructure
- Prioritize structures based on structure condition

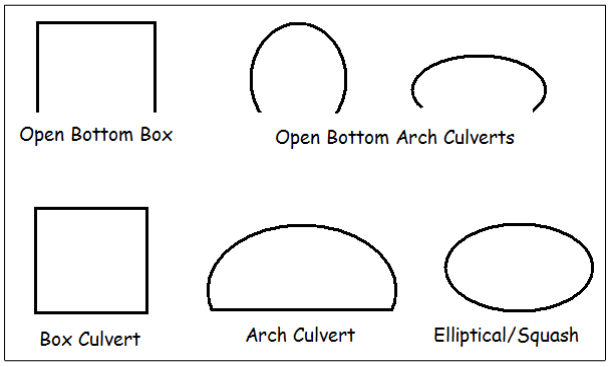
By using the strategies and design examples outlined in the report, the City can ensure that all replacements are adequately sized and designed to pass the 100-year flow, preparing for future extreme weather. Adequately sized and appropriately designed culverts will result in a flood resilient community with connected and healthy aquatic habitat.

Stream Crossings: Guidelines and Best Management Practices

The following recommendations are to assist in designing, installing, and replacing stream crossing structures in small streams, with the goal of protecting stream continuity. Pre-installation stream conditions should be retained to the maximum extent possible. Structures should be designed and installed so that the natural stream flow and bottom substrate are mimicked throughout the crossing and so that the structure does not constrict or fragment the stream. Additional engineering design may be necessary to ensure structural integrity and appropriate hydraulic capacity.

Types of Crossings:

Bridges and open bottom box culverts are the preferred crossing method. Other methods, in descending order of preference, include open-bottom arch culverts (typically installed on concrete footings), box culverts (typically pre-cast concrete), arch or elliptical/squash culverts (metal, concrete, or plastic), and circular culverts (metal, concrete, or plastic).



Location:

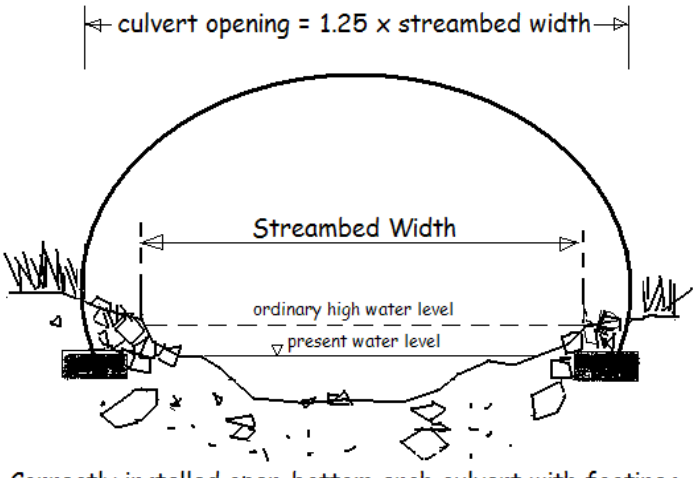
The structure should be located within a stretch of watercourse where the channel is straight, unobstructed, and well defined. When selecting a crossing location, choose a straight, flat area where the streambed/bank characteristics can be easily retained or replicated and erosion potential can be minimized. Areas where wetlands exist along the stream should be avoided when possible.

Length and Side Slopes:

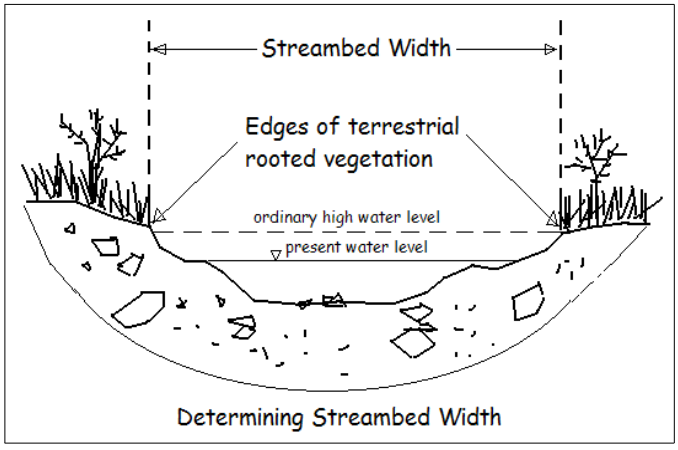
Road and shoulder widths should be the minimum necessary for the crossing and side slopes should be as steep as possible without compromising stability to minimize the length of the culvert. Note: A side slope grade of 2:1 is typically the steepest grade that can be vegetated.

Capacity/Size:

The width of the structure should be 1.25 times the normal width of the streambed. The overall culvert capacity should be able to accommodate expected high flows.



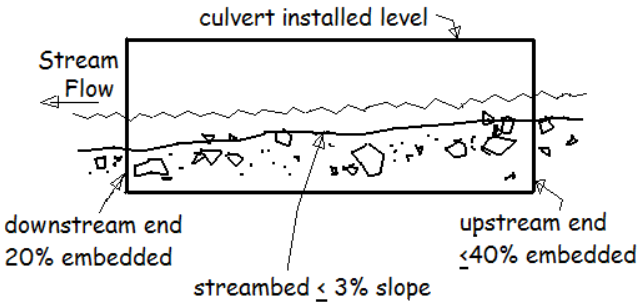
Correctly installed open-bottom arch culvert with footings



Determining Streambed Width

Installation:

For "closed-bottom" culverts, the streambed slope must be less than 3% (3 foot vertical rise in 100 feet of channel length), and the culvert installed level with at least 20% of the vertical rise embedded at the downstream invert.



Culvert installation should take place "in the dry", to facilitate construction and reduce downstream impacts from turbidity and sedimentation. This may require piping or pumping the stream flow around the work area and the use of cofferdams. The duration of dewatering should be kept to a minimum and flows immediately downstream of the worksite should equal flows immediately upstream of the worksite.

Erosion Control:

If necessary, flared ends and/or rip rap should be used to prevent scouring around the inlet and outlet of the culvert. High flows can erode the soil surrounding the inlet and the soil underneath the outlet of a culvert. Both instances can cause culvert undermining and can adversely affect the structural integrity of the road crossing.

Appropriate erosion and sediment controls, including silt fencing and/or straw bales, should be installed parallel to the stream to prevent downstream impacts and should be depicted on project plans.

Disturbance of the streambed and banks should be limited to that necessary to place the culvert. Affected bank and bed areas should be restored to pre-project conditions following installation of the culvert and the banks should be planted with native vegetation, consistent with that which existed prior to the culvert installation. Seeded banks should be covered with mulch to accelerate plant growth.

Timing:

To protect fish spawning, timing restrictions may be imposed for all instream work as well as any adjacent work that may result in suspension of sediment in a stream. In general, instream work should occur during low flow conditions, typically between June and September, to minimize impacts to fisheries and water quality. For additional information on timing restrictions, please contact the regional DEC office for the county in which the project is located.

Maintenance:

It is recommended that stream crossing structures be maintained at least once annually, preferably before high spring flows. Typical maintenance includes checking for structural deficiencies such as undermining and debris buildup.

DEC Permits

Permits are required for streams classified as C(T) or higher quality (ECL Article 15-0501), navigable bodies of water (ECL Article 15-0505), and DEC regulated wetlands (ECL Article 24). For additional information, please contact the regional DEC office for the county in which the project is located or visit our website at http://www.dec.ny.gov/permits/6042.html.

Permits May Also Be Required From Other Agencies, such as

U.S. Army Corps of Engineers
Adirondack Park Agency

Checklist for municipalities preparing for funding opportunities

Info needed for applications to help answer questions such as: Is the project ready to go? Will it have a meaningful impact on the identified problem? Are the costs necessary and logical?

Culvert ID:

Location map included/attached? ☐
Pictures included/attached? ☐

Funding Source(s) sought:

	Topics	Town Answers/Notes
General	Municipality	
	Primary contact person(s)	
	Watershed management plans? (local or regional)	
Culvert/Road-specific	Road crossing/ location description **NAACC**	
	Who owns the road/crossing? *(Does the municipality have permission to work there?)*	
	Owners upstream/downstream? **Parcel Mapper**	
	GPS coordinates **NAACC**	
	NAACC score	
	Current structural condition **Local records, NAACC**	
	When was this culvert replaced/ installed? **Local**	
	Recorded damages to road and/or structure over past 25 years **Local**	
	Flooding history **Local, any disaster declarations?**	
	Community/municipality primarily served by the crossing **Local**	
	Data on traffic density available or needed? **Highway dept.?**	

Stream	Tributary/stream name (if any)	
	State Stream classification **Hudson Valley Natural Resource Mapper**	
	Name of HUC 12 watershed **HVNR Mapper**	
Flooding	RP (Return Period) *[statistical year flood this structure can pass, e.g. 100-year flood]* **WRI**	
	Is the location in a FEMA floodplain? **Columbia County Parcel Mapper**	
	Future flooding model from 2050? **WRI**	
Ecological	Located in important area for rare plants or animals? (Eel – current or historic?) **HVNR mapper, Local**	
	Located within significant natural community? **HVNR mapper**	
	Water quality: Is this an impaired stream? High Quality? **Stream Condition Index**	
	Local land use, zoned uses **Local**	
	Where does this location's watershed fall in regards to HREP priority streams? (Rated 1 thru 20) **NAACC website (not on database): NAACC Watershed Prioritization map**	
	State Stream Standard *(Is this a trout stream/spawning stream?)* **HVNR Mapper**	
	Is this in or near a DEC-regulated/NWI wetland? **HVNR Mapper**	
	Other significant biodiversity or habitat data?	
	Is this a biologically important barrier? **HVNR Mapper**	

Road/Culvert improvements	Designs for improved structure: Describe repairs/improvements needed	
	Improved safety and mobility? *(Improving a sidewalk, sight lines, etc.)*	
	Describe in detail the improvement of route access needs for critical services, other needs for route, etc. *Emergency evacuation route? Will failure strand residents?* **Local**	
	Surveys of structure: Does it exist? If not, who would do it? **Local**	
	How does the improvement fit within zoning and/or comprehensive plan? *(If the town doesn't have a plan, can the grant be used to develop one in part?)*	
	Permits needed/anticipated **DEC Permitting staff**	
	Estimated and itemized structure costs:	
	Engineering costs **Local/Engineering Firm**	
	Equipment / Materials **Local/Hwy dept**	
	Personnel costs **Local/Hwy dept**	
	Road rebuild costs **Local/Hwy dept**	
	Cost/Benefit analysis **Local**	
	Other municipal offices involved and contacted (Planning, Highway, Zoning, etc.) **Local**	
	Are there other properties/structures nearby that will benefit? **Local**	
	Smart Growth law compatible? **(aka. Promotes resilient infrastructure vs. increased suburban/exurban development)** https://www.dot.ny.gov/programs/smart-planning/smartgrowth-law	

FINANCING WATERFRONT RESILIENCE

2019 New York State and federal resources for communities

New York State and federal agencies offer over $150 million in assistance to municipalities and non-profit organizations to build waterfront resilience and adapt to flooding, sea-level rise and other climate risks. This document provides an overview of these assistance programs, how to apply and local examples, ***with a focus on the Hudson Valley region***. Eligible activities include municipal planning, resilient infrastructure and structures, emergency management, economic revitalization, public outreach, and natural solutions like sustainable shorelines, green infrastructure and floodplain protection. A summary table of all resources, organized by agency, areas of assistance, funding amounts and deadlines, can be found at the end of this document. Sign up for our Climate Resilience newsletter to receive the latest funding announcements. Programs covered in this document are:

- **NYS Department of Environmental Conservation (DEC):** Hudson River Estuary Stewardship Planning Grants, River Access and Education Grants, Restoration of Watershed Connectivity RFP, Climate Smart Communities Grants, Water Quality Improvements Program, Non-Agricultural Nonpoint Source Planning Grant and Trees for Tribs
- **Department of State (DOS):** Local Waterfront Revitalization Program and Brownfield Opportunity Area
- **Environmental Facilities Corporation (EFC):** Green Innovation Grant Program, Wastewater Infrastructure Engineering Planning, Clean Water and Drinking Water Revolving State Funds
- **Federal Emergency Management Agency (FEMA):** Hazard Mitigation Assistance, Public Assistance and Community Rating System
- **Additional assistance programs**
    - **New York State Energy Research and Development Authority (NYSERDA):** Clean Energy Communities Program
    - **NYS Office of Parks, Recreation and Historic Preservation (OPRHP):** Parks, Preservation and Heritage Grants and Recreational Trails Grants
    - **US Housing and Urban Development (HUD)** Community Block Grant Program
    - **Empire State Development (ESD)** Grant Program
    - **Hudson River Greenway** Communities Grant Program
    - **Open Space Funding Options**

View of flooded road in Stony Point following Hurricane Sandy in 2012 (L. Konopko)

LOCAL EXAMPLE: CONSOLIDATED FUNDING APPLICATION

Kingston received a $1.2 million grant for a public-private intermunicipal partnership to design and build a one mile promenade along the Hudson River. The promenade will feature green infrastructure and offer public access and recreation and keep open space along the waterfront. The funds were awarded from the Department of State's Local Waterfront Revitalization Program through a CFA application.

NYS Consolidated Funding Application

New York State's Consolidated Funding Application (CFA) allows communities to design comprehensive projects and with one application, apply to multiple state funding sources. Communities may not apply to federal programs such as FEMA through the CFA. You can download the 2019 CFA Available Resources (PDF) online.

Overview of Financial Assistance Programs

Below is a summary of financial assistance programs identified by their funding categories related to flood resilience.

- Municipal planning
- Public outreach
- Resilient infrastructure
- Economic revitalization
- Emergency management
- Natural solutions (e.g., sustainable shorelines, green infrastructure + floodplain protection)

☑CFA = grants included in the NYS Consolidated Funding Application

New York State Department of Environmental Conservation (NYS DEC)

The NYS DEC is a state agency focused on the conservation, enhancement, and enjoyment of environmental resources.

Hudson River Estuary Program Local Stewardship Planning Grant

The Estuary Program provides funding ($350,000) to help communities and local organizations advance four categories of local projects and programs through planning, feasibility studies, and/or design. Award amounts range from $10,500 to $50,000 with 15% match required. All prospective applicants must register in advance in the New York State Grants Gateway where they can also search and download the full RFA by searching for 'Hudson River Estuary.' Funding for the grants is provided by the New York State Environmental Protection Fund (EPF). Eligible planning categories:

- Adapt land uses and decision-making to factor in climate change, flooding, heat, drought, and sea-level rise projections in Hudson River shoreline communities
- Improve water infrastructure to make it more resilient to flooding and/or sea-level rise
- Create a natural resources inventory, open space inventory/index, open space plan, open space funding feasibility study, conservation overlay zone, or connectivity plan
- Develop a watershed and/or source water management plan

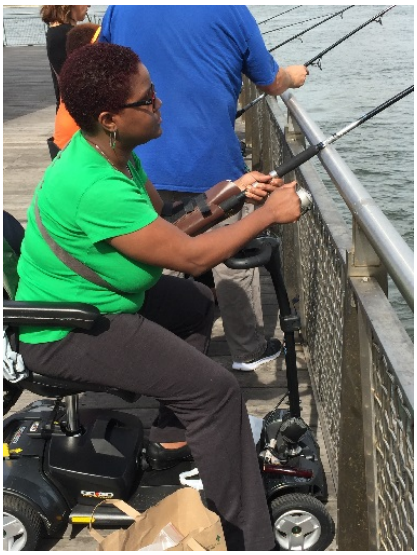
LOCAL EXAMPLE: LOCAL STEWARDSHIP PLANNING GRANT

The Village of Catskill received $68,000 in Local Stewardship grants in 2016 to analyze their wastewater treatment plant and zoning codes to look for opportunities to address flooding and sea-level rise.

Contact: HREPGrants@dec.ny.gov

Deadline: 3:00 pm, July 10, 2019

Hudson River Access and River Education Grant



The Estuary Program provides funding ($400,000) to help communities in the Hudson River Estuary design and improve recreational access and enhance education for people of all ages and abilities. Award amounts range from $10,500 to $50,000 with 15% match required. Approximately $200,000 is available in the River Access Request for Applications (RFA) for projects along the shoreline of the Hudson estuary that provide new or improved accessibility at sites for boating, fishing, swimming, and/or wildlife-dependent recreation. This funding may be used to support plan development, equipment purchases, and/or physical improvements construction. Approximately $200,000 is available in the River Education RFA to support projects and plans to enhance education about the estuary along the tidal waters of the Hudson and make opportunities to learn about the estuary accessible to a wide-range of people. This funding may be used to support plan or curriculum development, equipment purchases, website or mobile phone app development, and/or physical improvements construction.

Contact: HREPGrants@dec.ny.gov

Deadline: 3:00 pm, August 14, 2019

Restoration of Watershed Connectivity: Request for Proposals

The New England Interstate Water Pollution Control Commission, in partnership with the Hudson River Estuary Program, is inviting proposals for projects that will help restore aquatic habitat connectivity for herring and eel, reduce localized flood risks, and improve conditions on Hudson River Estuary tributaries. Approximately $215,000 is available for this Request for Proposals (RFP) is to help municipalities develop municipal management plans and designs to repair or replace inadequate road-stream crossings (culverts and bridges) and to prioritize sites that cause flooding and are barriers to fish movement. Neighboring municipalities are encouraged to work together to plan on a watershed scale, especially if they share a tributary to the Hudson in common. A successful project will engage at least two municipalities. The project will also develop at least two conceptual construction designs, and one final construction design for priority sites for each municipality.

Contact: HREPGrants@dec.ny.gov

Deadline: 12:00 pm, August 2, 2019

Climate Smart Communities (CSC) Grants

The Climate Smart Community (CSC) program offers grants ($11.7M) to support municipal projects that implement certain CSC actions and help them become certified in the program. 50% match required.

Adaptation implementation projects fund $10,000 and $2 million and include, but are not limited to the following:

- Increasing or preserving natural resilience, such as construction of living shorelines and other nature-based landscape features to decrease vulnerability to the effects of climate change and to improve or facilitate conservation, management, and/or restoration of natural floodplain areas and/or wetland systems
- Flood-risk reduction, including, but not limited to, strategic relocation or retrofit of climate-vulnerable critical municipal facilities or infrastructure to reduce future climate-change induced risks to those facilities
- Replacing or right-sizing flow barriers, including, but not limited to, right-sizing bridges or culverts, or improving flow barriers to facilitate emergency response or protection of population centers, critical facilities, infrastructure, and/or natural resources, based on assessment of projected future conditions.
- Extreme-heat preparation, including, but not limited to, establishment of cooling centers, construction of permanent shade structures, and implementation of other cooling features or programs

- Emergency preparedness, including, but not limited to, establishment of emergency warning systems or implementation of emergency preparedness and/or response programs

Certification projects fund $10,000 to $100,000 to complete the following and additional actions:

- PE2 Action: Government Operations Climate Action Plan
- PE6 Action: Comprehensive Plan with Sustainability Elements
- PE6 Action: Complete Streets Policy
- PE6 Action: Planning and Infrastructure for Bicycling and Walking (planning only)
- PE6 Action: Natural Resources Inventory
- PE7 Action: Climate Vulnerability Assessment
- PE7 Action: Climate-Smart Resiliency Planning
- PE7 Action: Climate Adaptation Strategies
- PE7 Action: Heat Emergency Plan

Contact: cscgrants@dec.ny.gov, 518-402-8448

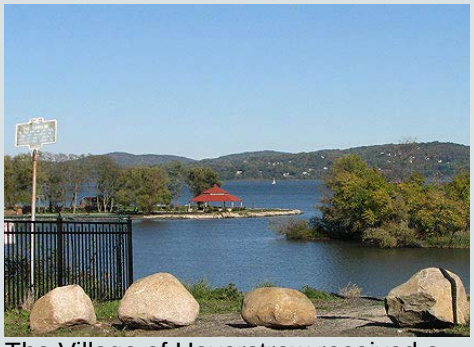
Deadline: 4:00 pm, July 26, 2019, ☑CFA

Water Quality Improvement Project (WQIP)

The WQIP program ($70M) is a competitive, reimbursement grant program that directs funds from the New York State Environmental Protection Fund to projects that reduce polluted runoff, improve water quality and restore habitat in New York's waterbodies. Eligible activities include:

- **Wastewater Treatment Improvement**, $1-10M max award depending on project type, 25% match for high priority projects, or 60% for secondary priority projects, contact Robert Wither, (518) 402-8123, Robert.Wither@dec.ny.gov
    - Wastewater Effluent Disinfection, $1M max award, 25% match
    - Projects to upgrade municipal systems to meet discharge requirements for Combined Sewer Overflow (CSO) or Sanitary Sewer Overflow (SSO), $5-10M max award, 25% match
    - Watershed Plan Implementation, $5-10M max award, 25% match
    - Municipal Systems to Serve Multiple Properties with Inadequate On-site Septic Systems, $5-10M max award, 25% match
    - Other Wastewater Treatment Improvements, $5-10M max award, 60% match
- **Non-Agricultural Nonpoint Source Abatement and Control**, $500,000-$3M max award depending on project type, 25% match, see contacts by project type:
    - Decentralized Wastewater Treatment Facilities for Failing On-Site Treatment Systems, $3M max award, 25% match, contact Ken Kosinski, (518) 402-8086, Ken.Kosinski@dec.ny.gov
    - Green Infrastructure Practice and Stormwater Retrofits, $1M max award, 25% match, contact Ryan Waldron, (518) 402-8244, Ryan.Waldron@dec.ny.gov
    - Streambank Stabilization and Riparian Buffers, $1M max award, 25% match, contact Lauren Townley, (518)402-8283, Lauren.Townley@dec.ny.gov
    - Beach Restoration, $1M max award, 25% match, contact Karen Stainbrook, (518) 402-8095

LOCAL EXAMPLE: CLIMATE SMART COMMUNITIES GRANT



The Village of Haverstraw received a $100,000 Climate Smart Communities grant in 2018 to update and incorporate climate resilience into their Comprehensive Plan.

    - Culvert Repair and Replacement, $1M max award, 25% match, contact Lauren Townley, (518) 402-8283, Lauren.Townley@dec.ny.gov
- **Aquatic Connectivity Restoration**, $250,000 max award, 25% match, contact Corbin Gosier, 518-402-8872, Corbin.Gosier@dec.ny.gov
- **Land Acquisition for Source Water Protection**, $4M max award, 25% match, contact Kristin Martinez, (518) 402-8086, Kristin.Martinez@dec.ny.gov
- **Municipal Separate Storm Sewer Systems (MS4s)**, $500,000-600,000 max award depending on project type, 25% match, contact Ethan Sullivan, (518) 402-1382, Ethan.Sullivan@dec.ny.gov
    - Mapping of stormwater systems, $500,000 max award, 25% match
    - Vacuum truck purchase, $600,000 max award, 25% match

Contact: User.Water@dec.ny.gov

Deadline**:** 4:00 pm, July 26, 2019, ☑CFA

Non-Agricultural Nonpoint Source Planning Grant Program

The DEC will fund planning ($1M) for decentralized wastewater treatment facilities, green infrastructure practice/stormwater retrofits, streambank stabilization, beach restoration and culvert repair and replacement. $30,000 award maximum, 10% match.

Contact: Lauren Townley, 518-402-8283, Lauren.Townley@dec.ny.gov

Deadline**:** 4:00 pm, July 26, 2019, ☑CFA

Trees for Tribs

Do you own or manage land along a stream? You can apply for free native plants to help reduce erosion and improve habitat along your stream! The Hudson Estuary Trees for Tribs Program offers free native trees and shrubs for planting along the tributary streams in the Hudson River Estuary watershed. Our staff can help you with a planting plan and work with your volunteers.

Contact: Beth Roessler, NYS DEC, 845-256-2253, HudsonEstuaryTFT@dec.ny.gov

Deadline: Apply by March 1, 2019 for Spring plantings, August 1, 2019 for Fall plantings

Department of State (DOS)

The DOS is a planning agency that focuses on economic revitalization and resilient, livable communities.

Local Waterfront Revitalization Program (LWRP)

The Local Waterfront Revitalization Program (LWRP) provides technical assistance and grants ($15M) on a reimbursement basis to villages, towns, cities, and counties located along New York's coasts or designated inland waterways, to prepare or implement strategies for community and waterfront revitalization. Funds require a 25% match (15% for environmental justice communities) and the grant categories currently are:

- Preparing or updating a Local Waterfront Revitalization Program (LWRP)
- Preparing an LWRP Component, including a Watershed Management Plan
- Updating an LWRP to Mitigate Future Physical Climate Risks

- Implementing a Local Waterfront Revitalization Program or a completed LWRP Component

Contact: NYS DOS, Office of Planning, Development & Community Infrastructure, opd@dos.ny.gov

Deadline: 4:00 pm, July 26, 2019, ☑CFA

LOCAL EXAMPLE: LOCAL WATERFRONT REVITALIZATION PROGRAM

The Village of Piermont received a $35,000 grant in 2015 to update its Local Waterfront Revitalization Plan, first written in 1992, to include strategies from the Task Force's final Resilience Roadmap Report.

Brownfield Opportunity Area (BOA)

The Brownfield Opportunity Area (BOA) program takes a neighborhood-wide approach to contaminated lands and provides grants ($2M) that support communities to comprehensively assess existing economic and environmental conditions associated with brownfield blight and impacted areas, identify and prioritize community supported redevelopment opportunities, and attract public and private investment. Project awards up to $300,000 with 10% required match, and option to request up to 25% of funds upfront. Eligible activities are:

- BOA nomination: a study that includes a community vision, goals and strategies for revitalization of an area affected by a concentration of known or suspected brownfields
- Pre-development activities in a State-designated BOA:
  - Development and implementation of marketing strategies;
  - Development of plans and specifications;
  - Real estate services;
  - Building conditions studies;
  - Infrastructure analyses;
  - Zoning and regulatory updates;
  - Environmental, housing and economic studies, analyses and reports; and
  - Public outreach.

Contact: NYS DOS, Office of Planning, Development & Community Infrastructure, opd@dos.ny.gov

Deadline: 4:00 pm, July 26, 2019, ☑CFA

Environmental Facility Corporation (EFC)

The EFC is a state agency that assists public and private entities to comply with federal and state environmental quality standards through technical assistance, low cost financing, and green innovation grants.

Green Innovation Grant Program (GIGP)

The Green Innovation Grant Program (GIGP, $15M) funds projects across New York State that utilize unique stormwater infrastructure design and create cutting-edge green technologies. 10% to 60% match required. GIGP funds highly-visible projects that are directly attributable to the improvement or protection of water quality and integral to the success of the following specific green infrastructure practices:

- Bioretention
- Downspout disconnection
- Establishment or Restoration of Floodplains, Riparian buffers, Streams or Wetlands
- Green roofs and green walls

- Permeable pavements
- Stormwater Harvesting and Reuse, *e.g.* Rain Barrel and Cistern Projects
- Stormwater Street Trees / Urban Forestry Programs Designed to Manage Stormwater

Contact: Brian Hahn, 518-402-6924, GIGP@efc.ny.gov

Deadline: 4:00 pm, July 26, 2019, ☑CFA

Wastewater Infrastructure Engineering Planning Grant (WIEP)

The EFC, in cooperation with NYS DEC, offers WIEPG grants ($3 million) for engineering and consulting services to produce engineering reports to construct or improve municipal wastewater systems. Funding level is based on population size and the municipality must provide a 20% match. The final engineering report can be implemented using EFC or other financing sources.

- $30,000 max award for communities with a population of 50,000 or less
- $50,000 max award for communities with a population of 50,000 or more
- $100,000 max award for inflow and infiltration projects based on an Order on Consent or SPDES Permit Compliance Schedule

Contact: Susan Van Patten, NYS DEC, 518-402-8267, CFAWater@gw.dec.state.ny.us

Deadline: 4:00 pm, July 26, 2019, ☑CFA

Clean Water (CWSRF) and Drinking Water State Revolving Funds (DWSRF)

The EFC provides various forms of project finance for water-quality protection projects through the Clean Water State Revolving Fund (CWSRF) and the Drinking Water State Revolving Fund (DWSRF). A variety of publicly-owned water quality improvement projects are eligible for financing, including point source projects such as wastewater treatment facilities, and nonpoint source projects such as stormwater management projects and landfill closures, as well as certain habitat restoration and protection projects in national estuary program areas. Short and long-term loans are available at no interest and low interest rates. Clean Water applicants may apply for Integrated Solutions Construction grant ($8M) to support green infrastructure by funding 50% of construction costs.

Contact for Clean Water: Dwight Brown, EFC, 518-402-7396, CWSRFinfo@efc.ny.gov

Contact for Drinking Water: Michael Montysko, DOH, 518-402-7650, bpwsp@health.ny.gov

Contact for Integrated Solutions Construction grant: Dwight Brown, EFC, 518-402-7396, ISC@efc.ny.gov

Deadline: Open enrollment

LOCAL EXAMPLE: WASTEWATER INFRASTRUCTURE ENGINEERING PLANNING

The City of Kingston received a $25,000 grant to examine long-term adaptive planning for their wastewater treatment plant. They will implement the plan using low interest loans from the CWSRF.

Federal Emergency Management Agency (FEMA)

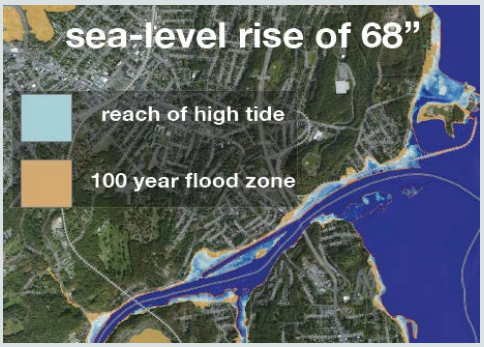
FEMA is a national agency that administers programs providing flood insurance, hazard mitigation assistance, and public assistance grants.

Hazard Mitigation Assistance

FEMA currently provide three types of hazard mitigation assistance (HMA):

- Hazard Mitigation Grant Program (HMGP) assists in implementing long-term hazard mitigation measures. HMGP funds are triggered by a declared disaster and funneled to individual municipalities through the NYS Division of Homeland Security and Emergency Services (DHSES).
- Pre-Disaster Mitigation (PDM) provides funds on an annual basis for hazard mitigation planning and projects.
- Flood Mitigation Assistance (FMA) provides funds on an annual basis for projects to reduce or eliminate risk of flood damage to buildings that are insured under the National Flood Insurance Program (NFIP).

LOCAL EXAMPLE: HAZARD MITIGATION GRANT



Kingston applied for a $5 million grant from Hurricanes Irene and Sandy Relief Funds to implement Task Force recommendations for riparian buffers, buyouts, the adaptation and fortification of infrastructure, and the purchase emergency generators for pumping stations. The City is awaiting notification of the application’s status.

Public Assistance Grant Program

Through the Public Assistance (PA) Program, FEMA provides supplemental Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly-owned facilities, and the facilities of certain private Non-Profit (PNP) organizations. The PA Program also encourages protection of these damaged facilities from future events by providing assistance for hazard mitigation measures during the recovery process. 25% match required.

Contact: FEMA grants are administered by NYS Division of Homeland Security and Emergency Services (DHSES). Visit their website for current grant opportunities: http://www.dhses.ny.gov/grants/

Community Rating System (CRS)

FEMA also administers the National Flood Insurance Program (NFIP) and the related Community Rating System (CRS), which allows municipalities to reduce flood insurance rates for all policyholders by instating community-scale projects and policies regarding flood resilience.

Contact: 317-848-2898, nfipcrs@iso.com

LOCAL EXAMPLE: COMMUNITY RATING SYSTEM

The Village of Scarsdale is Class 8 certified in the Community Rating System (CRS), which means the village residents receive a 10% discount on flood insurance. The Village of Hyde Park is currently seeking CRS certification.

New York State Energy Research and Development Authority (NYSERDA)

NYSERDA is a state authority dedicated to promoting energy efficiency and renewable energy sources.

Clean Energy Communities (CEC) Program

Municipalities that complete four of 10 priority actions will be considered Clean Energy Communities (CEC). Locally based outreach and implementation coordinators will provide free, on-demand technical assistance, including step-by-step guidance, case studies, and template contracts to help municipalities implement the Climate Smart Communities and Clean Energy Communities programs.

Contact: cec@nyserda.ny.gov or Europa McGovern, Mid-Hudson CEC Coordinator, 845-564-4075, emcgovern@hudsonvalleyrc.org

NYS Office of Parks, Recreation & Historic Preservation (OPRHP)

THE NYS OPRHP is a state agency dedicated to preserving and enhancing parks, historic assets and heritage areas.

Grant Program for Parks, Preservation and Heritage

The OPRHP is providing grants ($19.5M) for acquisition, planning, development, and improvement of parks, historic properties, and heritage areas. Project awards up to $600,000 with 50% required match, or 25% match for projects that are in a high-poverty district.

Contact: Erin Drost, (845) 889-3866, erin.drost@parks.ny.gov

Deadline: 4:00 pm, July 26, 2019, ☑CFA

Recreational Trails Program

The OPRHP is providing grants ($1.9M) for design, right-of-way and construction of recreational trails. Project awards up to $250,000 with 20% required match.

Contact: Erin Drost, (845) 889-3866, erin.drost@parks.ny.gov

Deadline: 4:00 pm, July 26, 2019, ☑CFA

LOCAL EXAMPLE: PARK DEVELOPMENT

The Village of Freeport received a $250,000 Parks grant to replace over 1,000 feet of bulkhead at Waterfront Park to reduce soil erosion and improve public safety and recreational access.

US Department of Housing and Urban Development (HUD)

HUD is a federal agency aimed to support sustainable, inclusive and affordable communities.

Community Development Block Grant Program (CDBG)

HUD is offering competitive grants ($20M) for development projects in small communities and counties.

- Resilient drinking water, clean water and stormwater infrastructure projects may be applied for under Category 1: Public Infrastructure, $750,000 max, $900,000 for joint applicants, no match required
- Construction and renovation projects may be applied for under Category 2: Public Facilities, $300,000 max
- Risk assessment and engineering projects may be applied for under Category 4: Community Planning, $50,000 per project, 5% match

Contact: 518-474-2057, HCR_CFA@nyshcr.org

Deadline: 4:00 PM, July 26, 2019, ☑CFA

Empire State Development (ESD)

ESD is the New York state agency focused on economic development.

Empire State Development Grant Funds

The ESD is offering grant funds ($150M) in the 2019 consolidated funding application. Infrastructure investment that can foster new economic development is eligible under Category 1: Strategic Community Development Investment (grant funds cover up to 25% of project soft costs).

Contact: 845-567-4882, nys-midhudson@esd.ny.gov

Deadline: 4:00 pm, July 26, 2019, ☑CFA

LOCAL EXAMPLE: REAL ESTATE TRANSFER TAX

The Town of Warwick passed a 0.75% Real Estate Transfer Tax and the Town of Red Hook a 2% tax to create a conservation fund to help provide financial support for their Open Space Plans.

NYS Hudson River Valley Greenway

The Greenway is state agency focused on using regional collaboration to conserve and enhance the natural, scenic and historic resources of the unique Hudson River Valley.

Greenway Communities Grant Program

Financial assistance for planning ($5,000 to $10,000 per project, more if multiple municipalities involved) is available to designated “Greenway Communities” within the Greenway Area. Projects funded under this program include those that relate to community planning, economic development, natural resource protection, cultural resource protection, scenic resource protection, and open space protection. Greenway Compact communities are eligible for greater funds to develop, approve, and implement a regional compact strategy consistent with the Greenway criteria and the Greenway act.

Contact: 518-473-3835, grants@hudsongreenway.ny.gov

Deadline: September 6 and November 8, 2019

LOCAL EXAMPLE: GREENWAY COMMUNITIES GRANT

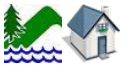
The Village of Ossining received a $15,000 grant to create a Waterfront Recreational Resource Plan to identify ways to promote water-related uses on their 3 miles of Hudson River waterfront, and to outline strategies to increase public access, catalog existing recreational assets, and engage stakeholders to determine demand for possible upgrades.

Open Space Funding Options

Preserving land as open space in floodplains and in coastal areas is an important aspect of flood resilience recommendations. Here are several options for municipalities looking to preserve open space in their community:

- The municipality can advocate to have their land included in the NYS Open Space Plan that is updated every 5 years. This helps the community to show that the land has value outside of traditional development and is a good way to prepare for purchase of the land for open space. The State receives annual funding to purchase lands specifically mentioned in the plan. Municipalities can also seek grant funds to write or update their own Open Space Plan and include floodplain protection as one of the important values that open space provides.
- The municipality can work with a local or regional land trust, like the Wallkill Valley Land Trust or the Open Space Institute to purchase the land using easements if it has scenic, ecological and/or agricultural value. Then, the community may be able to work with the land trust to make the property more valuable as floodplain protection.
- The municipality can purchase the land for open space by taking on debt (bonds) or instigating a tax levy. One example of a relevant tax levy is called a Real Estate Transfer Tax, which has been passable by local law since NYS passed the Hudson Valley Community Preservation Act of 2007. This tax is applied to mortgages on local real estate and is used to create a conservation fund for the community, which can be used to preserve open space.

Summary table of all funding assistance programs

Agency	Assistance Program	Categories	Grant amount, match	Deadline, CFA
DEC	✓ Estuary Program		$10,500-$50,000, 15%	7/10/19 / 8/14/19
	✓ CSC		$10,000-$2M, 50%	7/26/19 ☑CFA
	✓ WQIP		$1-10M, 25-60%	7/26/19 ☑CFA
	✓ NANS Planning		≤$30,000, 10%	7/26/19 ☑CFA
	✓ T4T		N/A	3/1, 8/1/19
DOS	✓ LWRP		No max, 15-25%	7/26/19 ☑CFA
	✓ BOA		≤$300,000, 10%	7/26/19 ☑CFA
EFC	✓ GIGP		No max, 10-60%	7/26/19 ☑CFA
	✓ WIEP		$30,000-100,000, 20%	Open
	✓ CWRSF / DWRSF		N/A	7/26/19 ☑CFA
FEMA	✓ HMA		N/A	Natural disaster trigger
	✓ PA		25%	Open
	✓ CRS		N/A	Open
ADDITIONAL	✓ NYSERDA CEC		N/A	Open
	✓ OPRHP Parks		≤$600,000, 25-50%	7/26/19 ☑CFA
	✓ OPRHP Rec Trails		$250,000, 20%	7/26/19 ☑CFA
	✓ HUD CBDG		$50,000 - $900,000, 0-5%	7/26/19 ☑CFA
	✓ ESD		75% for soft costs	7/26/19 ☑CFA
	✓ Greenway		$5,000 - $10,000+	9/6, 11/8/19
	✓ Open Space		N/A	N/A

CONTACT INFORMATION

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