RANSOM Consulting, Inc.

Consulting Engineers and Scientists

Nordic Aquafarms
Stormwater Management Plan

List of Appendices:

Appendix A: Stormwater Treatment Calculations
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Site Description:

The site (refer to Site Location Map) is an approximately 54-acre development parcel consisting of several parcels under contract with multiple entities including the Belfast Water District (BWD), Mathews Brothers, and Sam Cassida (Refer to the attached Site Location Map). The portion of the site on the Mathews Brothers parcel in the northeast quadrant of the site is primarily grass, with a stand of trees along the drainage channel that defines the eastern boundary of the new parcel. The remainder of the development parcel (from Belfast Water District and Cassida parcels) is primarily vegetated (wooded) with an area in the south currently developed with structures and pavement associated with operations of the BWD. The Belfast Reservoir Number One exists south of the site with a 250-foot strip between the reservoir and the site being retained by the Belfast Water District, within the Resource Protection District, as a buffer to the reservoir.

Portions of the site within the land owned by the Belfast Water District are currently developed with buildings (office building, former filter house, maintenance garages) and associated driveways and parking associated with current BWD operations. A concrete dam controls the water level to the reservoir and piping associated with the former use of the reservoir as the water supply for the City of Belfast still exists adjacent to the dam and office building. Also adjacent to the office building and the dam is a former settling basin previously used in treatment of domestic water supply.

The topography of the undeveloped site slopes generally from north to south/southwest into Reservoir Number One. Groundwater in the area also appears to flow from north to south across the site toward the reservoir. The site slopes steepen within the 250-foot buffer with fingers of notable rivulets, drainage channels, and ravines exiting into the reservoir. The reservoir is controlled by a dam located just west of Route 1 and outlets into Belfast Bay. There is considerable area upgradient of the site which also drains to the reservoir. This Stormwater Management Plan also addresses the offsite areas currently draining onto and through the site.

A Class B high intensity soil survey (HISS) has been performed on this site and is included in *Section 11, Soils* of this Site Location of Development Act permit application. The results of the HISS mapping are included in the stormwater analysis.

Wetland areas and streams are identified on the existing conditions plans included as an attachment in this Section. In addition, these features are shown on the stormwater plans (also included as an attachment) as well as the HISS mapping discussed in the above paragraph.

Development Description:

Nordic Aquafarms proposes the development of a salmon fish growing operation capable of providing 33,000 metric tons per year of seafood to consumers in the northeastern US. While construction is proposed in two phases (see previous sections of this application for additional information on construction phasing), the stormwater management systems have been considered for the complete project build-out.

The salmon growing operation is done indoors and therefore requires a fair number of buildings to perform that function. Buildings proposed on-site consist of:

Building 1 – Consists of 3 grow modules constructed in succession.

Building 2 – Consists of 3 grow modules constructed in succession.

Building 3 – Smolt Building

Building 4 – Fish Processing Facility

Building 5 – Central Utility Plan

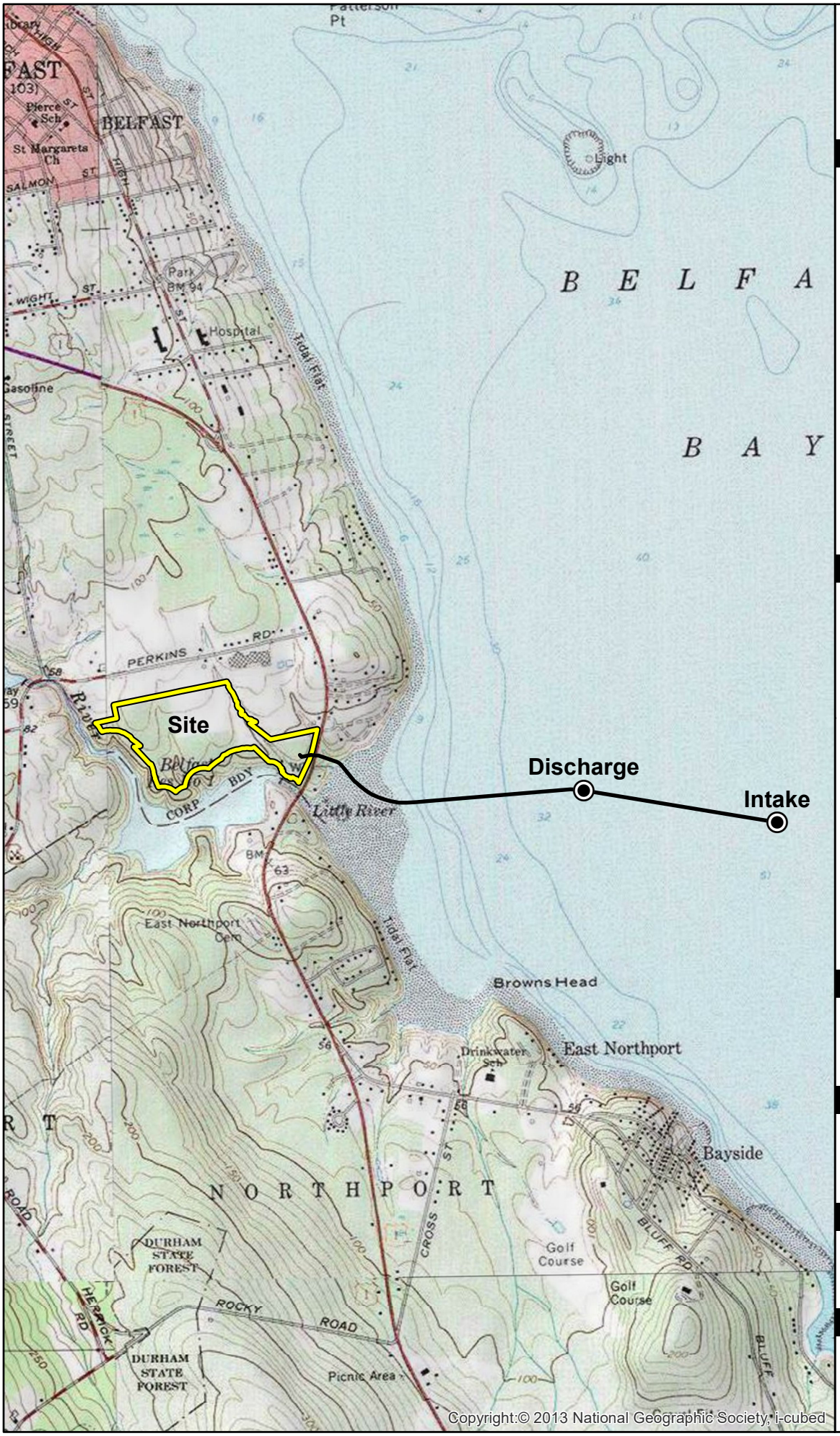
Building 6 – Oxygen generation. This area is currently designated as a building but may be modified based on the requirements of the oxygen generation contractor and their equipment. This may be an outdoor facility that houses generation equipment on a concrete pad. If this is the case, the concrete pad will be surrounded by curbing to collect stormwater runoff.

Building 7 – Office/Maintenance Building

Building 8 – Water/Wastewater Treatment Building

Building 9 – Gate House

The buildings are arranged such that operations central to the needs of the fish growing process will be performed in the middle of the complex, while the larger fish grow module buildings are on the exterior. Water and wastewater treatment will be closer to Route 1 to facilitate intake and discharge of seawater. The building complex will be supported by paved access drives surrounding the facility and between buildings. Efforts were made to group buildings adjacent to one another to minimize the amount of pavement. Loading areas are located adjacent to access drives. Employee parking is scattered throughout the complex in areas that expect to see more employee activity such as the Smolt Building, the processing



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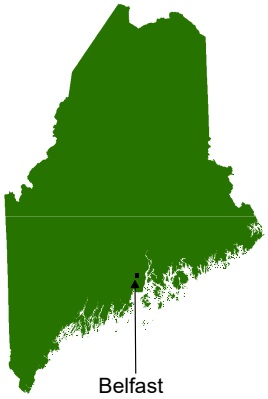
Regional Locator Map



Legend

Site Boundary

Ocean Pipelines

Notes

1. Data Source: USGS National Map Seamless Server, 24K
2. USGS Quad: 7.5 Minute Searsport & Belfast 1976 (revised 1979)
3. Latitude: 44° 23' 43" N
   Longitude: 68° 59' 39" W
   UTM Northing: 4915777 mN
   UTM Easting: 500444 mE

Scale and Orientation

0 1,000 2,000

1 inch = 2,000 feet

Prepared For

Nordic Aquafarms, Inc.
159 High Street
Belfast, Maine

Site Address

Proposed Aquaculture Facility
285 Northport Avenue
Belfast, Maine

171.05027 | Apr 2019

Site Location Map

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facility, the office/maintenance garage, and the water/wastewater treatment facility. Additionally, a small parking area is provided adjacent to the entrance gate to facilitate public use of the existing trail system located on the property within the 250-foot resource protection district being retained by the BWD. Among and adjacent to the paved areas are landscaped islands and grassed areas.

Grading of the site post development still slopes from the north to the south/southwest. To accommodate the function of the buildings and associated access, the center of the site has less significant grade change while the northern and southern portions of the site include steeper slopes to match grading at the 40-foot "no disturbance" buffer at the site boundary.

While existing drainage channels in the center of the site will be filled to accommodate development, the channels to the south and through the 250-foot buffer retained by the BWD will remain. In addition, stormwater from off-site areas to the north will be diverted and underdrain piping will be included around building foundations and during construction to facilitate transport of any groundwater encountered toward the existing drainage channels to the south.

Stormwater Management – Basic Standards:

Erosion and sedimentation control measures during construction are detailed within *Section 14, Basic Standards Submissions* of this Site Location of Development Act Permit. Post-Construction stormwater management practices and good housekeeping practices will be in accordance with Maine DEP Best Management Practices. A post construction stormwater management plan as well as inspection and maintenance requirements and third-party inspection contract are provided in *Appendix C* of this Stormwater Management Plan.

Stormwater Management – Quality (General Standards):

A project must meet Maine's *Chapter 500, Stormwater Management* general standards if the project results in one or more acres of impervious area, or 5 acres or more of developed area for projects that are not within the direct watershed of an urban impaired stream or a lake most at risk (as defined by Chapter 502). To meet the general standards, the project's stormwater management system must include treatment measures that will provide pollutant removal or treatment (or both), mitigate for the increased frequency and duration of channel erosive flows due to runoff from smaller storms, and mitigate potential temperature impacts. To do that a project must provide treatment of 95% of the impervious area and no less than 80% of the developed area. In addition, runoff from upgradient areas must either be redirected away from the project's stormwater treatment measures or that measure must be sized to address the runoff volume of the upgradient area at 50% of the sizing requirements. Although the amount of on-site treatment provided may be reduced by providing treatment on a currently untreated off-site area in the same watershed, this is not proposed for this project at this time.

Treatment of stormwater is addressed using Maine's Best Management Practices (BMPs). These BMPs are focused on meeting the following water quality objectives:

- Effective pollutant removal – removal of fine particles that carry nutrient and heavy metal load as well as dissolved pollutants and hydrocarbons.

- Cooling – to protect aquatic life within a river, stream, or brook watershed discharge must effectively cool down.

- Channel protection – discharge within a river, stream, or brook watershed must be released slowly to avoid destabilization and resulting sedimentation of receiving channels.

- Flood control – detention for large, infrequent storm events to avoid flooding infrastructure.

The water quality volume is the initial depth of runoff that is considered to carry the bulk of pollutants deposited since the last rain event. Studies have indicated that the first inch of runoff distributed over the watershed carries 90% of the pollutant load from a storm event. Maine's BMPs identified in Volume III of the Maine Stormwater Management Design Manual consider this when establishing the treatment volume identified within each BMP. The BMPs chosen for this site to meet the water quality objectives include:

- Subsurface Sand Filters: Filtration BMP discussed in *Maine's Stormwater Management Manual, Volume III, Chapter 7.3, Subsurface Sand Filters.*

- Grassed Underdrained Soil Filters: Filtration BMP discussed in *Maine's Stormwater Management Manual, Volume III, Chapter 7.1, Grassed Underdrained Soil Filters.*

- Manmade Pervious Paver Systems: Filtration BMP discussed in *Maine's Stormwater Management Manual, Volume III, Chapter 7.7, Manmade Pervious Surfaces*.

- Green Roof System: Filtration BMP discussed in *Maine's Stormwater Management Manual, Volume III, Chapter 7.6, Vegetated Roofs.*

Project Specific Water Quality Treatment Measures:

The stormwater management facilities identified above are used throughout the developed site. Calculations detailing the sizing of the treatment facilities are in *Appendix A.* The subcatchment areas being treated by each of the stormwater management facilities are identified on 11 x 17 figures at a scale of 1" = 50' within *Appendix B*. The areas are also included on the Post-Development watershed map, which is included as two 24"x36" drawings at a scale of 1" = 120' within *Appendix E*. Table 1 (at the end of this section) indicates the amount of treatment provided within each subcatchment area as well as for the whole site. The results of calculations indicate that greater than 95% of the new impervious surface and greater than 80% of the new developed area are treated by the stormwater management facilities proposed for this development. In addition, each of the stormwater BMPs are further described below with discussions about how they were used on this site.

- Diversion of Upgradient Runoff. A stormwater channel has been provided within the developed area of the site and downgradient of the 40-foot buffer adjacent to the northern property boundary to divert stormwater from off-site areas. Currently, stormwater from upgradient areas travels south/southwest through the site and toward the stream that defines the eastern boundary of the site (Stream 9). Although the channel is currently not anticipated to provide treatment to runoff from the offsite areas, the channel is designed with a minimal slope of 0.5% to reduce velocity

and erosion potential. Stone check dams are also provided to minimize release of sediment to the stream. Post-development hydraulic modelling is provided in *Appendix D*.

- Subsurface Sand Filters (SSF): Subsurface sand filters are being used exclusively to treat runoff from some of the flat building roofs. The chamber system and stone over the sand filter is designed to store stormwater and discharge it at an attenuated rate to reduce thermal impacts downstream of the system. The subsurface system with detention/retention uses sand and does not provide a source of organic matter for filtration. A pretreatment structure in the form of a fabric wrapped chamber provides the initial settlement and filtration of contaminants, although the intent is to minimize the sediment load (and subsequent maintenance) by using only stormwater runoff from roofs. The roofs of these buildings are an unlikely source of hydrocarbons and therefore hydrocarbon pretreatment is not considered.

  Buildings 1 and 2 are to be built with 3 grow modules each – constructed in succession. Each grow module has an individual subsurface sand filter that can be installed at the time of the construction of the module to treat the runoff from the roof. Building 5 (the Central Utility Plant) uses a SSF as does the roof runoff from Building 6 (or the enclosed concrete equipment pad) for a total of eight SSF systems provided. The SSF systems are located primarily beneath paved surfaces. Each is preceded by an inlet control structure which limits the volume of roof runoff discharged to the filter. A weir in the inlet control structure is provided to allow only the equivalent of the treatment volume (as defined by design guidance per Maine Stormwater Technical Design Manual) through a pipe to the chamber system. Storms with volumes in excess of the treatment volume of 1.0 inches times the subcatchment's impervious area is discharged over the weir to the closed piping network. The treatment volume is filtered through an 18-inch sand filter at a rate no less than 24 and no more than 48 hours and the sand filter is underlain with a drainage layer that collects and transports the treated stormwater to the discharge pipe network. six-inch slotted underdrain pipes are provided in the drainage layer beneath each chamber. A solid discharge collector pipe connects the underdrain pipe every 50 feet along the chamber length and discharges to the pipe network.

- Grassed Soil Filters (GSF): Grassed underdrained soil filters are used primarily for treatment of some paved areas as well as landscaped developed areas. The GSF systems capture and retain runoff and pass it through a soil filter media. The media is a mixture of silty sand and organic matter to remove a range of pollutants including suspended solids, phosphorus, nitrogen, metals, hydrocarbons, and other dissolved pollutants. The filter also provides for attenuation of discharge which provides reduction of thermal impacts to downstream areas as well as minimizing potential channel erosion. The system is sized to store the treatment volume (1.0 inches times the impervious area and 0.4 inches times the landscaped developed area) above the filter with the larger volume storms bypassing the filter through a catch basin and into the closed piping system. The 18-inch thick filter media is underlain with a drainage system and perforated underdrain collection piping which ultimately discharges to the catch basin.

  GSF systems are provided in grassed areas adjacent to pavement throughout the site. The size of the system varies depending on the area draining to it but does not exceed 3,000 sf surface area over the soil filter. Locations where the stormwater is transported to the GSF via a channel or a pipe, a sediment forebay is provided to minimize discharge of sediment to the filter basin. Refer to calculations in *Appendix A*, and stormwater management facility drawings provided in *Appendix B.*

- Manmade Pervious Pavers (MPP): Pervious paver systems are used almost exclusively for the treatment of paved areas on site, though some systems in parking areas may see some runoff from adjacent landscaped area discharging to the system. The MPP system consists of a permeable surface, base, and subbase materials which allow the penetration of runoff into the underlying soil filter. The area of pervious pavers must be no less than 20% of the area being treated and the flow path to the pervious paver section must be no greater than 50 feet. A storage reservoir is provided below the paver bedding material and above the sand filter layer capable of storing the treatment area equivalent to 1.0 inches times the impervious area and 0.4 inches times the landscaped developed area. The 18-inch thick sand filter layer is underlain with a drainage system consisting of R-Tank storage tanks prior to discharge to the closed piping network. Catch basins in the pervious area capture overflow from larger storms and discharge to the R-Tank system. The use of the R-Tank system allows additional storage for attenuation of larger storm events.

  The pervious pavers proposed are H25 loaded so can be used in higher traffic areas, however the paver systems are proposed for parking areas in the center of the site as well as on the outer access drives adjacent to both Building 1 and Building 2. The interior pavers in the parking areas are the full length of the parking spaces and pick up runoff from local paved surfaces. The pavers in the access drives are 6 feet wide and are intended to pick up the runoff from the paved access drive itself.

- Grassed Roof Systems (GRS): The vegetated roofs are limited to those roofs which are technically flat and with limited protrusions or equipment and with minimal anticipated foot traffic. Rooftop vegetation provides advantages beyond stormwater treatment including the reduction in the heat island effect with improvements in building insulation and increases in the life expectancy of the base roof material. The vegetated roof also provides attenuation of stormwater runoff and peak flows as well as treatment under the General Standards of Chapter 500 within a layer of filter media and vegetation. There are two types of vegetated roof systems: extensive and intensive. The extensive roof systems typically provide coverage over the entire roof with a thinner media depth for the growth of sedums or similar arid plants and also provide little treatment. Intensive systems tend to provide access to the roof itself, provide for more open space on the roof and, with a thicker media, provide more nutrient uptake and greater flow attenuation. The containment of the treatment volume within the media provides stormwater treatment and enhances the overall effectiveness of the vegetated roof.

  Buildings on this site will utilize intensive green roof systems. Buildings 3, 4, and 8 will be constructed with green roofs although Building 3 will be constructed in two phases each with a mechanical penthouse extending through the roof system. The design of each green roof system considers up to 20 % of the entire roof area is taken up with the penthouse and/or elevated access pathways to access areas on the roof. The remaining area will utilize an intensive modular pre-grown roof system as manufactured by Firestone. The Firestone Skyscape module platforms are 15” x 20” and, with the number of modules that can fit on the roof, can provide storage and subsequent treatment for a volume equivalent to 1.0 inches x the impervious surface of the entire roof. Although the roof is vegetated, the area is still considered to be impervious. Roof drains will be provided to collect runoff from the larger storm events and any stormwater that is not able to be stored in the filter media prior to evapotranspiration.

Stormwater Management – Quantity (Flooding Standards):

A project must meet Maine's *Chapter 500, Stormwater Management* flooding standards if the project results in three or more acres of impervious area, or 20 acres or more of developed area. To meet the flooding standard, the project's stormwater management systems must:

- detain, retain, or result in the infiltration of stormwater from 24-hour storms of the 2-year, 10-year, and 25-year frequencies such that peak flow of stormwater from the project site do not exceed the peak flows of stormwater prior to undertaking the project;

- design the piped or open channel systems based on a 10-year, 24-hour storm without overloading or flooding beyond channel limits;

- not flood the primary access road to the project and any public roads bordering the project a s a result of a 25-year, 24-hour storm event

A project is eligible for a waiver from the flooding standard for insignificant increases in peak flow rates from a project site. A waiver is also available for a project in the watershed of a coastal wetland, great pond, or major river segment provided the stormwater is conveyed via sheet flow, in a manmade open channel, or in a piped system directly into one of these resources.

As part of this application, Nordic Aquafarms is requesting a waiver from the flooding standard for the portion of the project which is currently in the watershed of a great pond and a coastal wetland and which is discharging directly to the coastal wetland, below the dam of the reservoir (great pond) through the existing on-site settling tank.

Nordic Aquafarms is not requesting a waiver from the flooding standard for the portion of the project which is currently in the watershed of a coastal wetland but is upstream from an existing culvert on US Route 1. The discharge from this culvert is routed through a downstream property on the opposite side of US Route 1 to the coastal wetland. The project does not intend to upgrade the existing culvert or increase the flow to the channel on the downstream property. It is anticipated that the runoff peak flow to the existing culvert after development will be below peak runoff pre- development for the 2-year, 10-year, and 25-year storm events as well as the 100-year frequency storm. Increase in peak runoff at PT6 (refer to tables below) is primarily due to additional area added to the off-site subcatchment OS 9. The stormwater channel located north of Building 1 to divert off-site runoff is included with OS 9 in the post-development condition.

Stormwater runoff in the pre-development condition is evaluated at multiple analysis points. Runoff from off-site subcatchments of 9, 10, and 11 is evaluated at a point where it enters the stream along the eastern boundary (PT6). Runoff is also evaluated at locations of culverts discharging under US Route 1 (PT7, PT8, and PT9). Runoff toward the Little River is evaluated at PT1. There are three separate analysis points (PT2, PT3, and PT4) which are combined as PT5 for runoff headed toward Reservoir Number One. Pre-development stormwater plans, HydroCAD calculations, and backup calculations are included in *Appendix D*.

Subcatchments in the post-development condition were established based on subareas used to define treatment boundaries. The majority of the subcatchments discharge to the closed piping system which

Table 1: Stormwater Treatment

Subcatchment Area #	Total Area (sq.ft)	Developed Area (sq. ft)	New Impervious (sf)	Treated Impervious (sq. ft)	Landscaped (sq. ft)	Treated Landscaped (sq. ft)	Treatment System
1A	17785	17785	6203	6203	11582	11582	GSF 1A
1B	34018	22308	6832	4033	15476	9245	GSF 1B
2	31049	26280	8052	8052	18228	18228	GSF 2
3	36147	28605	13091	13901	15514	15514	GSF 3
4	8448	8448	0	0	9707	9707	GSF 4
5	10807	10807	0	0	10807	10807	GSF 5
6	13985	13985	4484	4484	9501	9501	GSF 6
7	30345	30345	7846	7846	22499	22499	GSF 7
8	45551	45551	25409	25409	20142	20142	GSF 8
9	27099	27099	17996	17996	9103	9103	GSF 9
10	30932	30932	30932	30932	0	0	MPP 10
11	43174	43174	15881	15881	27293	27293	GSF 11
12	12920	12920	7491	7491	5429	5429	GSF 12
13	45163	45163	20981	20981	24182	24182	GSF 13
14	9378	9378	8849	8849	529	529	MPP 14
15	9157	9157	4974	4974	4183	4183	GSF 15/GR 15
16	15110	15110	5161	5161	9949	9949	GSF 16
17	13300	13300	10855	0	2445	0	-
18A	6339	6339	2593	2593	3746	3746	GSF 18A
18B	4023	4023	2348	2348	1675	1675	GSF 18B
19	13711	13711	11210	11210	2501	2501	MPP 19
20	28459	28459	21010	0	7449	0	-
21	9994	9994	8361	7379	1633	1441	MPP 21
22	13511	13511	10326	10326	3185	3185	MPP 22
23	28475	18834	6249	0	12585	0	-
24	18261	18261	12270	12270	5991	5991	GSF 24
25	118223	21818	0	0	21818	0	-
26	3816	3816	3816	3816	0	0	MPP 26
27	4262	4262	0	0	0	0	-
28	79698	9061	2064	1407	2429	2429	GR 28
29	1306	1306	1306	0	0	0	-
30	31472	31472	24541	24541	6931	6931	MPP 30
31	70616	24011	0	0	24011	0	-
32	4677	4677	2826	0	1851	0	-
33	107893	107893	107893	107893	0	0	GR 33
34	24099	24099	24099	24099	0	0	GR 34
35	20997	20997	20997	20997	0	0	GR 35
36	112560	112560	112560	112560	0	0	SSF 36
37	112560	112560	112560	112560	0	0	SSF 37
38	112560	112560	112560	112650	0	0	SSF 38
39	112560	112560	112560	112560	0	0	SSF 39
40	112560	112560	112560	112560	0	0	SSF 40
41	112560	112560	112560	112560	0	0	SSF 41
42	12000	12000	12000	12000	0	0	SSF 42
43	18983	18983	18983	18983	0	0	SSF 43
44	159363	52028	0	0	97156	0	-
45	64440	5799	0	0	5799	0	-
46	14976	0	0	0	0	0	-
47	79187	15454	0	0	10702	0	-
48	40183	305	0	0	305	0	-
49	84173	3471	548	0	2923	0	-
50	30173	30173	30173	30173	0	0	MPP 50
north channel	135154	59131	0	0	0	0	-
Totals	2338192	1649595	1194010	1147678	429259	235792	

% new impervious treated

96.1%

% new developed area treated

83.9%

ultimately discharges through the existing settling basin below the dam at Reservoir Number One. In addition, there are analysis points that mimic the same locations evaluated in the pre-development condition; PT1, PT5, PT6, PT7, PT8 and PT9. Post-development stormwater plans, HydroCAD calculations, and backup calculations are included in *Appendix E*.

Hydraulic Analysis:

Stormwater runoff calculations for quantity were made using the HydroCAD 10.0 computer program, which is based on the Soil Conservation Service's TR-20 methodology. Runoff hydrographs are generated based on a standard Type III 24-hour storm for Waldo County identified in Appendix H of *Maine DEP Chapter 500, Stormwater Management.*

Four storm events were evaluated as follows:

1. 2-year frequency flood event: 2.9" rainfall
2. 10-year frequency flood event: 4.2" rainfall
3. 25-year frequency flood event: 5.2" rainfall
4. 100-year frequency flood event: 7.2" rainfall

Runoff Curve numbers were determined based on land coverage and hydro-geological soil type C. Times of concentration were developed based on runoff flow paths for each subarea and shown on the Pre and Post-Development plans. A minimum Tc of 6 minutes was set in the HydroCAD model.

Peak runoff flow rates and runoff volumes are provided at the analysis points, which are identified on the Pre and Post-Development plans. Comparison of the runoff peak flow rates are provided at each analysis point on Tables 2-5 below

Table 2 – 2-year Storm

Analysis Point	Pre-Development	Post-Development
1	1.9 cfs	0.8 cfs
5	6.2 cfs	1.6 cfs
6	14.9 cfs	15.4 cfs
7	0.6 cfs	0.6 cfs
8	0.1 cfs	0.1 cfs
9	19.6 cfs	17.1 cfs

Table 3 – 10-year Storm

Analysis Point	Pre-Development	Post-Development
1	4.8 cfs	2.0 cfs
5	15.0 cfs	3.7 cfs
6	32.9 cfs	33.7 cfs
7	1.4 cfs	1.4 cfs
8	0.3 cfs	0.3 cfs
9	42.9 cfs	38.9 cfs

Table 4 – 25-year Storm

Analysis Point	Pre-Development	Post-Development
1	7.3 cfs	3.0 cfs
5	22.9 cfs	5.6 cfs
6	48.4 cfs	49.5 cfs
7	2.1 cfs	2.1 cfs
8	0.5 cfs	0.5 cfs
9	63.0 cfs	58.0 cfs

Table 5 – 100-year Storm

Analysis Point	Pre-Development	Post-Development
1	12.9 cfs	5.3 cfs
5	40.2 cfs	9.7 cfs
6	81.4 cfs	84.6 cfs
7	3.7 cfs	3.7 cfs
8	0.8 cfs	0.8 cfs
9	105.9 cfs	98.3 cfs