# GLOVSKY

*Counselors-at-Law*

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**Direct Dial (978) 720-3122**

October 11, 2016

**BY HAND DELIVERY**

Planning Board
Beverly City Hall
191 Cabot Street
Beverly, MA 01915

***Re: Applications for Site Plan Review and Special Permit***
***50 Dunham Road / Vitality Senior Living, LLC***

Dear Board Members:

On behalf of Vitality Senior Living, LLC, I enclose for the Board's consideration the following materials in connection with a proposed assisted living residential project at 50 Dunham Road:

1. Site Plan Review and Special Permit Applications with accompanying Addendum and Owner's Authorization (12 copies);

2. Vitality Senior Living – Boardwalk Beverly, Plans prepared by Levi+Wong Design Associates dated October 11, 2016 for Site Preparation, Parking, Utilities, and Landscape (11 Sheets)(12sets 24x36, 12 sets 11x17);

3. Storm Water Report prepared by Samiotes Consultants, Inc. dated October 11, 2016 (12 copies);

4. Traffic Technical Memorandum prepared by Jacobs Engineering Group, Inc., dated October 5, 2016 (12 copies);

5. Parties in Interest List (1 copy); and

6. Applicant's Checks (2) for Filing Fees – Site Plan Review $5,000; Special Permit $400.

Architectural floor plans and elevations for the project will be provided under separate cover with the Design Review Board application to follow on or before October 26, 2016.

Please schedule the public hearing for these applications for the Board's regularly scheduled meeting in November.

Sincerely,

Miranda P. Gooding

MPG/
Enclosures

**CITY OF BEVERLY**

**SITE PLAN REVIEW APPLICATION**, *or*
**MODIFICATION OF SITE PLAN REVIEW APPLICATION**
*(please type or print clearly)*

October 11, 2016 _____, 20____
(date) (date received)

Name of owner (*please print*): Anderson Clark, LLP

Address of owner: c/o Cummings Properties, 200 W. Cummings Park, Woburn 01801

Telephone number (H): Attn: Dennis Clarke (W): 781-932-7019

Name of applicant (*please print*): Vitality Senior Living, LLC

Address of applicant: c/o Glovsky & Glovsky, LLC, 8 Washington St., Beverly 01915

Telephone number (H): _____ (W): 978-720-3122

Address of property: 50 Dunham Road

Assessors' Map #: 69 lot#: 2 zoning district: IR

Total Area of Land: Approximately 5 acre portion of 54 acre property.

Description of project: See Addendum attached.

The deed for this property is recorded in Essex South District Registry of Deeds

Registry of Deeds, Book # 30948, Page # 212.

See attached authorization
(signature of property owner)

(signature of applicant if not owner)
Miranda P. Gooding, Attorney for Applicant

** See attached copy of zoning ordinance for plan and filing requirements and procedure**

CITY OF BEVERLY PLANNING BOARD
SPECIAL PERMIT APPLICATION FORM

Date: October 11, 2016 Received by: _____

1. Name & Mailing address of petitioner: Vitality Senior Living, LLC
c/o Glovsky & Glovsky, LLC, 8 Washington Street, Beverly, MA 01915

2. Name & Mailing address of property owner: Anderson Clark, LLC
c/o Cummings Properties, LLC, 200 West Cummings Park, Woburn, MA 01801

3. Petitioner's telephone number: 978-720-3122 Fax number: 978-720-3181

4. Property owner's telephone number: 781-932-7019 email dac@cummings.com

5. Street address of subject property: 50 Dunham Road
Assessors Map/Lot Numbers: Map 69 / Lot 2

6. If petitioner is the owner, state date of acquisition and the name of the person from whom title was acquired: N/A

7. If petitioner is not the owner, state interest or status of petitioner in land: Agreement to Purchase.

8. Specific provision(s) of the zoning ordinance involved in this application: Sections 300-59.D and 300-91 reduction in parking for elderly housing. See attached Addendum.

9. State the use for which permission is being sought: Senior Assisted Living Residence. See attached Addendum.

10. Is the property which is the subject of this application contiguous to other land held in common ownership? No

The successors agree for themselves, their successors in title, and assigns to comply continuously with such conditions, limitations, and safeguards as may be specified by the Planning Board and that failure to so comply or failure to use said lot or building (if any) for the purpose above specified shall constitute a violation of and make void any special permit issued pursuant hereto.

Signature of petitioner attorney for Petitioner
Miranda P. Gooding

See attached authorization
Signature of property owner

**REQUIRED ATTACHMENTS**

- Copy of current property deed
- Evidence of petitioner's right to file application if applicable (e.g. purchase and sale agreement, signed and notarized statement from property owner)
- Copy of most current record plan
- Twelve (12) copies of plan(s) drawn in accordance with the Board's requirements for said plans, and ten (10) additional copies of plans, size 11" x 17"
- $400.00 filing fee (cash or check made payable to the City of Beverly)
- List of names and addresses of parties in interest as defined by M.G.L. Chapter 40A, Section 9

*Addendum to Applications for Site Plan Review and Special Permit*
*50 Dunham Road (Vitality Senior Living, LLC)*

## Requested Relief

Vitality Senior Living, LLC ("Vitality"), seeks the following relief for its proposed assisted living facility to be developed at 50 Dunham Road:

1. Site Plan Review under Section 300-98 of the Zoning Ordinance; and

2. Special Permit under Section 300-59.D of the Ordinance to allow 52 off-street parking spaces for the proposed use.

## Project Summary

The Project includes the development of a four story, mixed use building on a 5-acre development parcel located in the Dunham Road office park operated by Cummings Properties. The 135,000 square foot building will house an assisted living facility for seniors, along with approximately 6000 square feet of ground floor commercial space, and a 52-car garage.

The assisted living facility will consist of 118 private residence suites with associated common areas. The residence facility is designed for seniors who are still ambulatory but in need of non-medical support with their daily housekeeping and other responsibilities. 28 of the suites will be operated as a specialized memory care wing with appropriate supportive and cognitive learning services. On-site services will include meal service in common dining areas disbursed throughout the building, along with housekeeping, laundry, private shuttle transportation and various recreational activities including exercise facilities. It is anticipated that the average age of new residents will be 75-85. A 52-car parking garage located on the ground floor will provide parking for the facility staff and residents. The use for the ground floor commercial space has not been fully determined, but potential uses include a café and/or day care facility.

## Existing Conditions; Permitting Considerations

The project is proposed to be built on an undeveloped portion of the 54 acre property at 50 Dunham Road (Map 69, Lot 2). 50 Dunham Road is entirely located in an IR Zoning District, and abuts the R10 and RHD residential districts as well as the Municipal Open Space and Recreational District. The site is currently improved with a 4-story mixed office and industrial building (#50 Dunham Road) and a 5-story parking garage and several surface parking areas. Two other mixed use buildings (#48 and #52), recently reviewed by the Planning Board, are in various stages of construction. The development parcel for this new building is an approximately 5 acre unimproved portion of the site, which Vitality will be purchasing from the current owner as a commercial condominium unit. The new building will conform to all dimensional requirements in the IR Zoning District.

As detailed below, relief is required from the Planning Board with respect to parking and from the ZBA with respect to use/affordability requirements. In addition, the Conservation Commission will review storm water and wetlands impacts associated with the project.

*Zoning Board of Appeals.* Vitality has filed an application to the ZBA for a special permit to authorize "subsidized elderly housing use" in the IR District. However, since the application was filed, Vitality has determined that it is not feasible to privately develop an assisted living facility which permanently restricts 15% of the units as affordable, within the framework provided by the Zoning Ordinance.

Therefore, Vitality will be amending its pending application with the ZBA to request a variance to permit the affordability requirements to be satisfied by a reduced percentage of affordable units and/or a payment in lieu of providing units. In the meantime, Vitality wishes to proceed with Site Plan Review and other permitting requirements for the building.

*Parking.* On-site garage parking for 52 vehicles will be provided in the building and reserved exclusively for the assisted living facility. As set forth above, Vitality seeks a special permit to authorize the proposed parking. Vitality intends to demonstrate that 52 spaces is adequate to provide on-site parking for staff and for residents, assuming that 25% of the residents in the 90 assisted living units will require vehicle parking (residents in the memory care wing will not be permitted to have vehicles), and will demonstrate that the special permit criteria for this request will be satisfied. Parking for the building's commercial space(s) will be provided in surface parking areas adjacent to the building. Though the use for the commercial space is still undetermined, we have assumed that approximately 22 additional spaces will be required, based upon the parking ratio of 1 space per 275 square foot/area, which is the parking ratio for retail trade establishments. Accordingly, no special permit relief is sought with respect to the commercial space.

*Conservation Commission.* The property contains areas of bordering vegetated wetlands, ponds and respective buffer and no disturb areas, as determined by an ORAD issued by the City of Beverly Conservation Commission dated June 10, 2012. The building has been sited and engineered to minimize impacts to these resource areas. A Notice of Intent for the project is currently pending before the Conservation Commission.

***Special Permit Criteria.*** The proposed project complies with the conditions for the issuance of a special permit under Section 300-91.B of the Ordinance:

a. ***That the specific site is an appropriate location for the proposed use, and that the character of adjoining uses will not be adversely affected.***

The proposed senior living facility is appropriate for the commercially zoned site. Adding this low-impact residential use to the office/industrial campus will provide a diversity of uses on the site and will produce far less adverse traffic impacts on nearby properties and roadways than another office building. For comparison, the average daily trips generated by the proposed project is 312, compared to an estimated 1300 average daily trips that would be generated by the development of the building for office use which is allowed as of right on the site.

The site offers rich natural resources for residents to enjoy, including access to walking paths and recreational property at Norwood Pond. The site also offers proximity to the North Shore Music Theater, which will provide nearby entertainment for residents and a steady audience for the theater.

b. ***That no factual evidence is found that property values in the district will be adversely affected by such use.***

Vitality anticipates that the site will be fully integrated into the Dunham Road campus and that the diversity of uses in the building – including potential services/retail uses for the commercial space, will increase property values and rents within the office park.

c. ***That no undue traffic and no nuisance or unreasonable hazard will result.***

As indicated in the traffic assessment report prepared by Jacobs Engineering Group, Inc., and submitted with this application, the additional daily trips generated by this project will not cause a decrease in the level of service at adjacent intersections (Brimbal Avenue and Dunham Road/Brimbal Avenue at Route 128 on/off ramps), even when taking into account other approved projects in the area.

d. ***That adequate and appropriate facilities will be provided for the proper operation and maintenance of the proposed use.***

All applicable fire and safety codes will be observed in the construction of the project, and there will be ample access for public safety and emergency vehicles. The site is presently served by municipal water and sewer, natural gas, cable, electricity and telephone service. To address storm water drainage, Vitality has proposed adequate and appropriate infrastructure to manage storm water as outlined in the Storm Water Report included with this application.

e. ***That there are no valid objections from abutting property owners based on demonstrable fact.***

Vitality will endeavor to address valid objections or concerns raised by abutters during the Site Plan Review process.

f. ***That adequate and appropriate City services are or will be available for the proposed use.***

The preliminary project review for this building did not reveal any deficiencies in City services available for the building. Vitality will endeavor to address concerns that are raised during the Site Plan Review process.

Based on the foregoing, Vitality respectfully requests approval of the Site Plan and the granting of this Special Permit request.

# AUTHORIZATION

**RE: Owner Assent to Submit Applications – 50 Dunham Road (Vitality Senior Living, LLC)**

To whom it may concern:

The undersigned, being the owner of the premises commonly known as 50 Dunham Road, Beverly, MA (being shown Assessor's Map 69, Parcel 2), hereby authorize **Vitality Senior Living, LLC** to submit applications to various Boards and Commissions of the City of Beverly, including without limitation, the Zoning Board of Appeal, Conservation Commission, Planning Board, Engineering Department and Building Department, for review and permitting of a proposed mixed use building and associated site improvements.

**Anderson Clarke, LLP**

By: _____
Dennis Clarke, Partner

August 18, 2016

# JACOBS

## *Technical Memorandum*

**Date:** October 5, 2016

**To:** Vitality Senior living, LLC, Jerry Pucillo,

**From:** Rodney C. Emery, P.E., PTOE

**Subject:** Proposed Assisted Living Facility Development (50 Dunham Road), Beverly, MA

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Jacobs Engineering Group Inc. has prepared this traffic assessment for the intersections of Brimbal Avenue and Dunham Road and Brimbal Avenue and the Route 128 on/off ramps ( Study Area Intersections) in conjunction with Vitality Senior living, LLC's request for a special permit approval for an assisted living facility consisting of 118 residential suites and associated common use space for dining and recreation as well as a small commercial/office space and parking garage. The project is proposed to be built on an undeveloped portion of the 54 acre property at 50 Dunham Road. The development parcel is an approximately 5 acre parcel that will be purchased from Cummings Properties.

Trip Generation

The traffic to be generated by the proposed assisted living development was estimated using the Institute of Transportation Engineers (ITE) *Trip generation Manual*. The following ITE Land Use Codes[1] will be used to generate the volume of new trips. For the 118 residential suites we utilized ITE Land Use code 253, *Congregate Care Facility*. For the office/commercial space we utilized ITE land use code 750, *Office Park*. The following table shows the trip generation values, % of trips entering and exiting the site and summarizes the proposed trip generation values of the new mixed-use development.

Table 1 **Trip Generation** Summary

| | Congregate Care (253) | | Office park 750) | | New Trips |
|---|---|---|---|---|---|
| | Trip Rates/Trips | | Trip Rates/Trips | | |
| **Weekday Daily** | 2.02 | 238 | 11.42 | 74 | 312 |
| **Weekday AM Peak** | 0.06 | 7 | 1.71 | 11 | 18 |
| **Enter** | 59% | 4 | 89% | 10 | 14 |
| **Exit** | 41% | 3 | 11% | 1 | 4 |
| **Weekday PM Peak** | 0.17 | 20 | 1.48 | 10 | 30 |
| **Enter** | 55% | 11 | 14% | 1 | 12 |
| **Exit** | 45% | 9 | 86% | 9 | 18 |

[1] Using the 9 th edition of the ITE trip Generation Manual

Trip Distribution

The distribution of proposed new site traffic on area roadways is based on existing travel patterns at the study area intersections and expected travel routes to the site. The assignment of traffic is summarized in Figures 1 & 2 for the weekday AM and weekday PM peak hours respectively.

No Build Conditions

Base traffic conditions for the two study area intersections were developed by utilizing the proposed 2021 Build conditions for the proposed North Shore Crossing Shopping Center project.[2] The original TIAS prepared for this project received a peer review on behalf of the City of Beverly and revisions were made to the 2023 ***No Build*** traffic conditions (Figures 3 & 4) to reflect the following assumptions for background growth:

- 0.5 percent annual growth
- 48 Dunham road development
- 52 Dunham road development
- 100 additional employees at Cell Signaling

Additional traffic was estimated to be generated by the proposed North Shore Shopping Center Project and distributed to the interchange area around Brimbal Avenue. Again, these values of new trips and traffic assignments were developed and agreed to in consultation with the city's peer review consultant. The 2023 no build traffic volumes were added to the new site traffic volumes to form the 2023 ***Build*** traffic volumes (Figures 5 & 6) in the North Shore Shopping Center Project. These build traffic volumes will be used form the 2023 ***No Build*** traffic volumes for this study. Since TIAS guidelines recommend a 7 year build out analysis period an additional 0.5 percent annual growth factor was applied to the 2023 ***No Build*** volumes to create a 2023 ***No Build*** volumes.

[2] Letter to Beverly Planning board, Response to Traffic Peer Review Comments, North Shore Crossing, Beverly, MA prepared by Ron Muller & Associates, dated December 10, 2014.

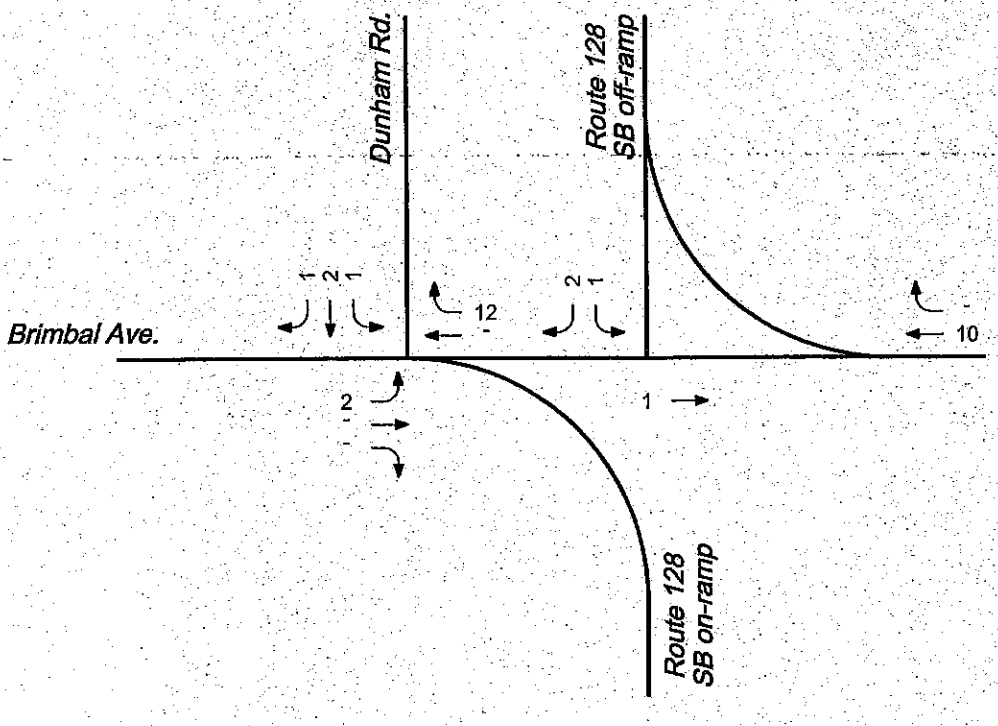


**FIGURE 1** **SITE GENERATED TRIPS - AM**

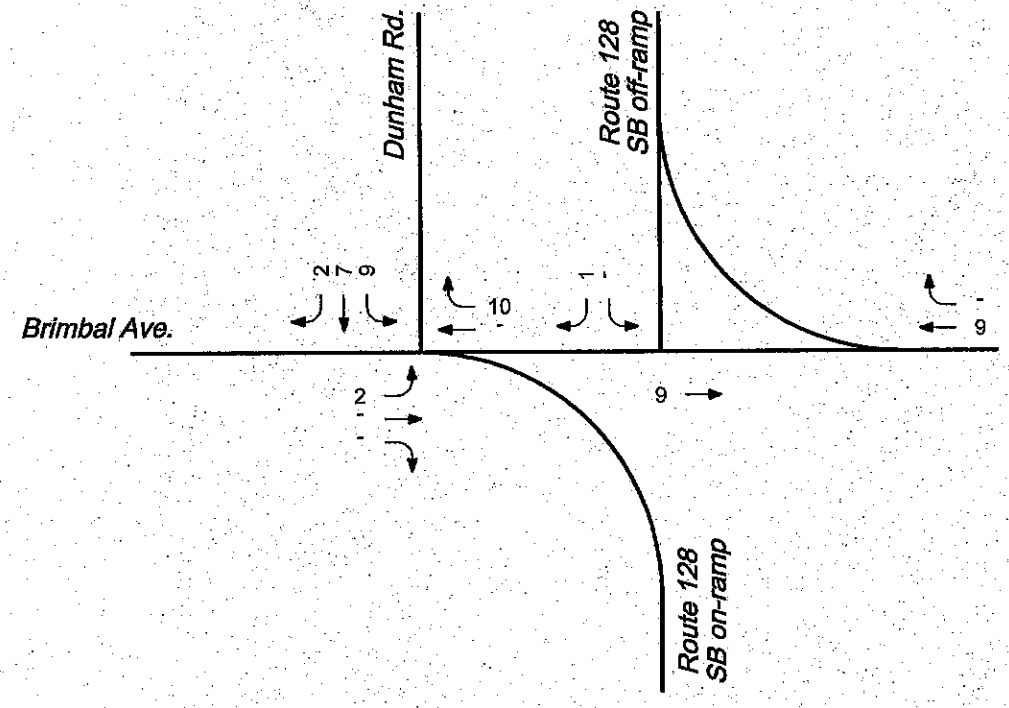


**FIGURE 2** **SITE GENERATED TRIPS - PM**

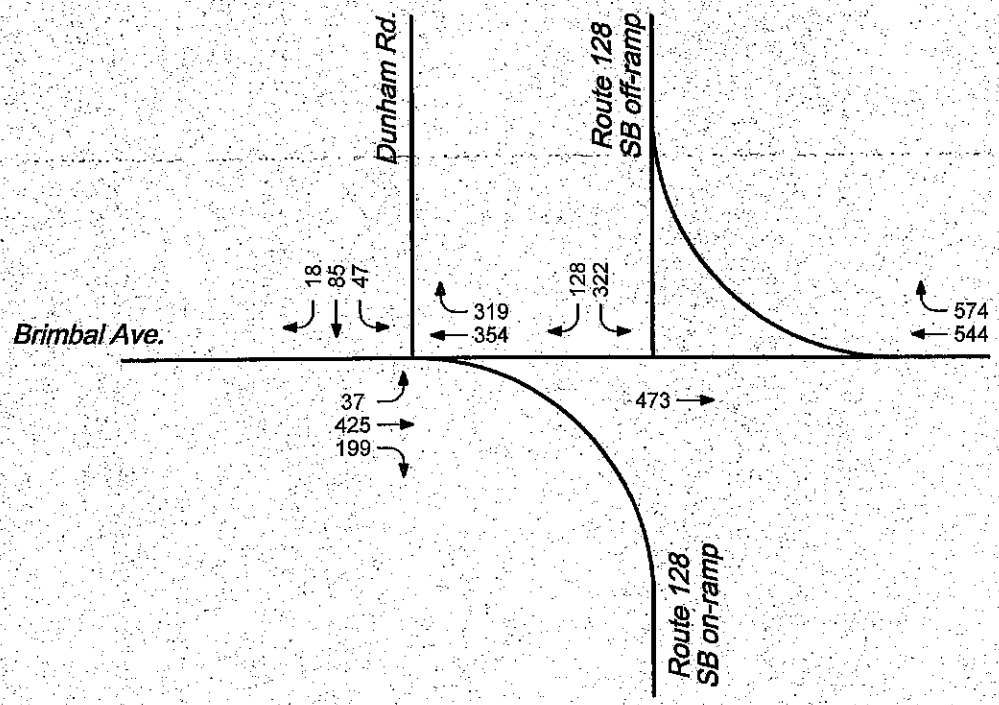


**FIGURE 3** **2023 - NO BUILD - AM**

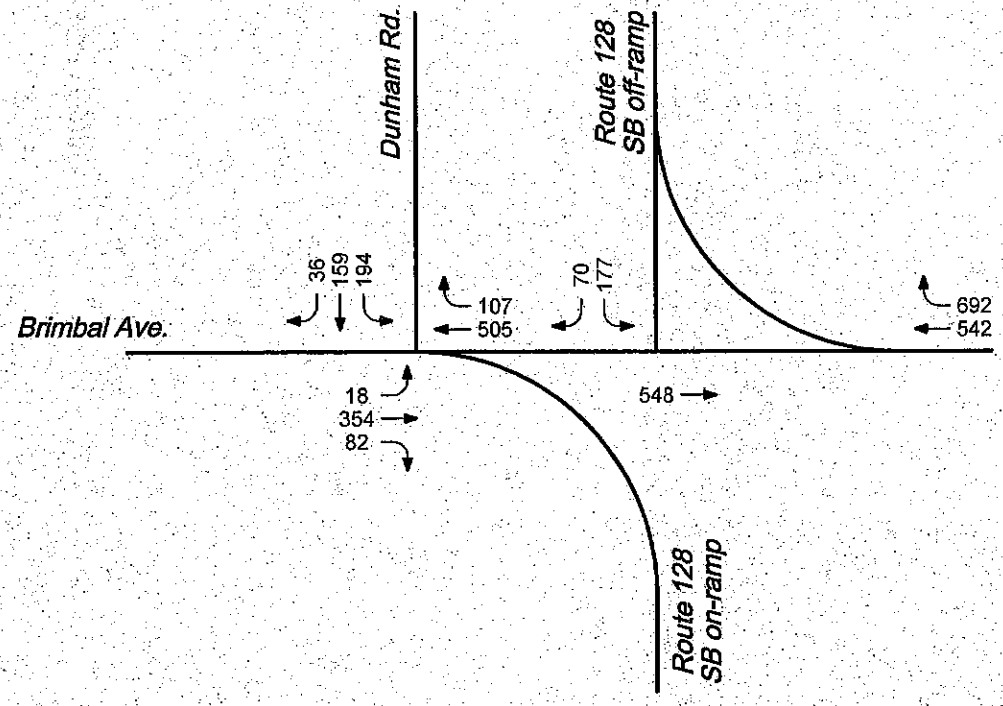


**FIGURE 4** **2023 - NO BUILD - PM**

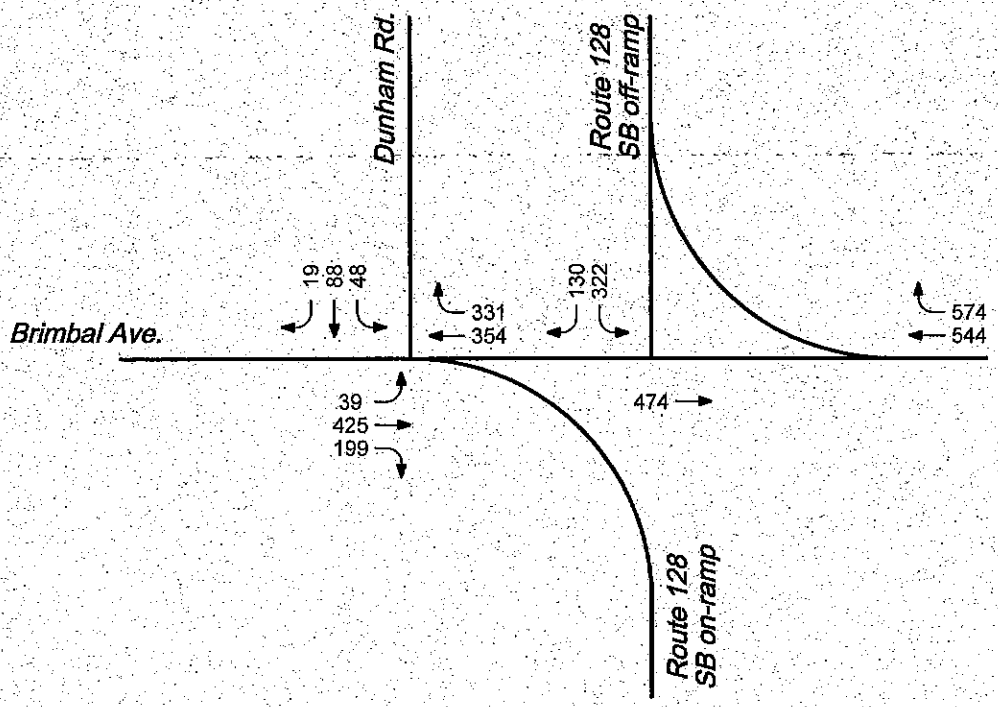


**FIGURE 5** **2023 - BUILD - AM**

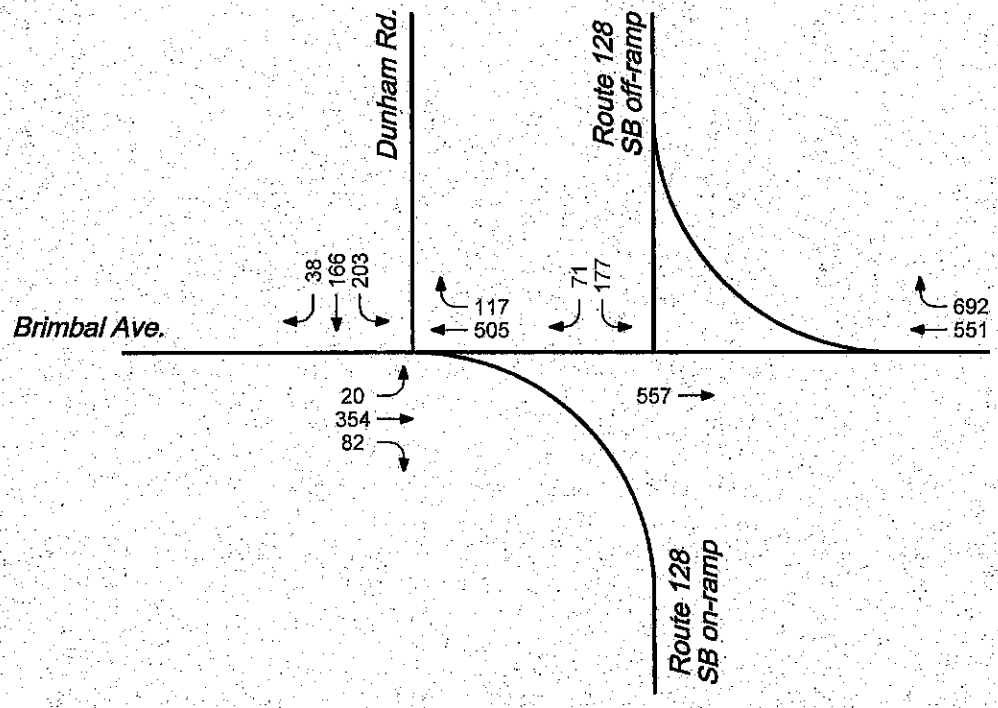


**FIGURE 6** **2023 - BUILD - PM**

# JACOBS

Traffic operations Analysis

The Highway Capacity Manual (HCM) from the Federal Highway Administration (FHWA) provides guidance and analysis methodologies that are used to calculate and measure performance levels for freeway sections, ramp junctions, weave sections and intersections (signalized and unsignalized).

Level of Service (LOS) is a term used to denote different operating conditions that occur under various traffic volume loads. It is a qualitative measure of the effect of a number of factors including geometrics, speed, travel delay, freedom to maneuver, and safety. The LOS is divided into a range of six letter grades, ranging from A to F, with A being the best and F the worst. LOS E or F is generally considered inadequate traffic operations in suburban and urban areas.

The MassDOT Highway Design Manual indicates a minimum overall LOS D. MassDOT strives for the best LOS wherever possible, and indicates overall LOS D can be acceptable for urban areas, in accordance with AASHTO guidelines.

Intersection performance measures can be calculated in the form of volume to capacity (v/c) ratio, average vehicular delay, average and 95th percentile queue lengths, and level-of-service (LOS). *Synchro 8.0 was the software used to execute the intersection analysis*. Synchro 8.0, a software program from Trafficware, uses the methodologies and thresholds contained within the HCM. This is the preferred/recommended software of MassDOT. Traffic volume represents the travel demand observed and capacity represents the amount of traffic the intersection can accommodate under prevailing conditions. Volume to capacity ratio that approaches or exceeds 1.0 indicates traffic congestion or poor operating conditions.

LOS designation is reported differently for signalized and unsignalized intersections. For signalized intersections, it is defined in terms of delay, which is a measure of driver discomfort and frustration, fuel consumption, and lost travel time. Specifically, LOS criteria are quantified in terms of average control delay per vehicle for the peak hour, which is reported for the entire intersection and by lane or lane group approach.

For unsignalized intersections, the analysis assumes that the traffic on the mainline is not affected by traffic on the side street. The LOS for each movement is calculated by determining the length of gaps that are available in the conflicting traffic stream. Based upon the length of the gaps between vehicles, the capacity of the movement can be calculated. The demand of the movement is then compared to the capacity and utilized to determine the average control delay for the movement.

For unsignalized intersections, an overall intersection LOS is not determined. It is generally reported in terms of delay for left-turns on the mainline and all side street movements. The delay ranges differ slightly between unsignalized and signalized intersections due to driver expectations and behavior for each LOS. Table 2 summarizes the LOS criteria.

*Table 2: Intersection LOS Thresholds*

| LOS | Signalized Control Delay | Unsignalized Control Delay |
|---|---|---|
| A | 0-10 | 0-10 |
| B | >10-20 | > 10-15 |
| C | >20-35 | >15-25 |
| D | >35-55 | >25-35 |
| E | >55-80 | >35-50 |
| F | >80 | >50 |

Source: 2010 Highway Capacity Manual

Traffic operations analyses for the proposed project were limited to the study area intersections of Brimbal Avenue and Dunham Road and Brimbal Avenue and Route 128 on/off ramps for both the morning and the afternoon peak hour conditions. The newly completed Brimbal Avenue and Sohier Road roundabouts were not included in our study area because they were analyzed as part of the North Shore Crossing Project TIAS and found to be operating at an A level of service under ***No Build*** conditions. The small amount of traffic to be generated by the new assisted living development would not affect the LOS at these roundabouts.

A previous analysis was performed for a mixed use expansion on the Cummings Campus along Dunham Road for two mixed use projects. These projects were called 48 and 52 Dunham Road developments and are included in our calculations of the ***No Build*** traffic volume networks. A mitigation plan was developed for these study area intersections which consisted of the widening of Dunham Road to provide a southbound left turn lane and the signalization of the intersections of Brimbal Avenue and Dunham Road and Brimbal Avenue and the Route 128 on/off Ramps. The ***No Build*** traffic operations analyses assumed these improvements were operational. Tables 3 and 5 summarize the impacts at the study area intersections without this this new development project, the ***No Build*** condition.

A second set of traffic operations analysis was performed at the intersections of Brimbal Avenue and Dunham Road and Brimbal Avenue and the Route 128 on/off ramps to see what changes in level of traffic operations would occur if a new assisted living facility development were constructed. Tables 4 and 6 summarize the impacts at the intersection of Brimbal Avenue and Dunham Road with the addition of this new development, the ***Build*** condition. As you can see from the attached tables only

minor differences in delays, queue lengths and V/C ratios were found between ***No Build*** and ***Build*** conditions. The LOS for each movement at each intersection remained unchanged.

Table 3- (No Build Analysis)[3]

| | 2023 No Build AM Peak | | | | | 2023 No Build PM Peak | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Intersection** | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS |
| **Brimbal @ Dunham** | Brimbal NB-TR | 17.3 | 668 | 0.87 | B | Brimbal NB-TR | 6.5 | 61 | 0.66 | A |
| | Brimbal SB-LT | 26.7 | 57 | 0.37 | C | Brimbal SB-LT | 15.6 | 19 | 0.08 | B |
| | Brimbal SB-TR | 30.9 | 631 | 0.80 | C | Brimbal SB-TR | 13.9 | 267 | 0.47 | B |
| | Dunham WB-LT | 41.4 | 63 | 0.26 | D | Dunham WB-LT | 61.7 | 296 | 0.83 | E |
| | Dunham WB-TR | 44.2 | 113 | 0.52 | D | Dunham WB-TR | 55.7 | 286 | 0.79 | E |

Table 4-(Build Analysis)[4]

| | 2023 Build AM Peak | | | | | 2023 Build PM Peak | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Intersection** | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS |
| **Brimbal @ Dunham** | Brimbal NB-TR | 12.5 | 633 | 0.80 | B | Brimbal NB-TR | 7.8 | 599 | 0.72 | A |
| | Brimbal SB-LT | 17.6 | 45 | 0.26 | B | Brimbal SB-LT | 13.6 | 27 | 0.11 | B |
| | Brimbal SB-TR | 23.7 | 501 | 0.72 | C | Brimbal SB-TR | 17.9 | 345 | 0.50 | B |
| | Dunham WB-LT | 42.9 | 68 | 0.30 | D | Dunham WB-LT | 44.9 | 196 | 0.69 | D |
| | Dunham WB-TR | 49.5 | 125 | 0.62 | D | Dunham WB-TR | 42.7 | 188 | 0.65 | D |

[3] Assumes traffic signal control and widening of Dunham Road
[4] Assumes traffic signal control and widening of Dunham Road

Table 5-(No Build analysis)

| | 2023 No Build AM Peak | | | | | 2023 No Build PM Peak | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Intersection** | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS |
| **Brimbal @ SB on/Off Ramps** | Brimbal NB-TH | 25.2 | 472 | 0.68 | C | Brimbal NB-TH | 17.6 | 364 | 0.58 | B |
| | Brimbal SB-TH | 8.6 | 81 | 0.59 | A | Brimbal SB-TH | 19.7 | 420 | 0.59 | B |
| | On/Off Ramps WB-LT | 38.3 | 297 | 0.72 | D | On/OFF Ramps WB-LT | 45.7 | 178 | 0.68 | D |
| | On/Off WB-TR | 28.5 | 90 | 0.23 | C | Dunham WB-TR | 36.0 | 46 | 0.10 | D |

Table 6 -(Build Analysis)

| | 2023 Build AM Peak | | | | | 2023 Build PM Peak | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Intersection** | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS | Movement | Delay (Sec) | 95% Queue (ft.) | V/C | LOS |
| **Brimbal @ SB on/Off Ramps** | Brimbal NB-TH | 20.4 | 419 | 0.63 | C | Brimbal NB-TH | 20.6 | 531 | 0.63 | C |
| | Brimbal SB-TH | 7.2 | 79 | 0.54 | A | Brimbal SB-TH | 20.6 | 491 | 0.63 | C |
| | On/Off Ramps WB-LT | 50.2 | 312 | 0.84 | D | On/OFF Ramps WB-LT | 47.2 | 182 | 0.69 | D |
| | On/Off WB-TR | 31.4 | 91 | 0.26 | C | On/Off WB-TR | 36.5 | 51 | 0.13 | D |

## Summary

The proposed development will consist of approximately 118 new residential suites and associated common use space for dining and recreation as well as a small commercial/office space and parking garage. The project is projected to add 312 weekday daily trips and 18 morning peak hour and 30 afternoon peak hour trips to the roadway network. The study area

intersections were analyzed using 2023 ***No Build*** traffic volumes, which included annual background growth, 100 additional employees at Cell Signaling previously approved traffic for 48 and 52 Dunham Road and the North Shore Crossing Center project. The analyses prepared assumed the intersection improvements at the study area intersections developed and funded by Cummings Properties were included in both the ***No Build*** and ***Build*** analyses. The LOS for the study area intersections are expected to operate at an adequate LOS and average delays for the overall intersection operation is projected to decrease slightly or in one case increase by a few seconds due to the additional traffic generated by the proposed project. Individual movements within the intersections vary more widely, but at least a D LOS is maintained for all approaches to the two intersections.

Intersection LOS
Brimbal Ave at Dunham Road

| Overall Intersection | LOS | Delay |
|---|---|---|
| No Build-AM Peak | C | 25.9 |
| Build-AM Peak | C | 20.9 |
| No Build-PM Peak | C | 23.2 |
| Build-PM Peak | C | 20.7 |

Intersection LOS
Brimbal Ave at Route 128 on/off Ramps

| Overall Intersection | LOS | Delay |
|---|---|---|
| No Build-AM Peak | C | 23.7 |
| Build-AM Peak | C | 22.7 |
| No Build-PM Peak | C | 22.4 |
| Build-PM Peak | C | 25.1 |

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# Level of Service Analyses

**JACOBS**

No Build AM Peak

| Lane Group | WBL | WBT | NBT | SBL | SBT |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 51 | 113 | 732 | 40 | 678 |
| v/c Ratio | 0.26 | 0.54 | 0.87 | 0.37 | 0.81 |
| Control Delay | 42.6 | 47.2 | 20.3 | 32.8 | 32.5 |
| Queue Delay | 0.2 | 0.0 | 0.2 | 0.0 | 0.6 |
| Total Delay | 42.8 | 47.2 | 20.5 | 32.8 | 33.1 |
| Queue Length 50th (ft) | 30 | 63 | 71 | 16 | 348 |
| Queue Length 95th (ft) | 63 | 113 | #668 | 57 | #631 |
| Internal Link Dist (ft) | | 155 | 65 | | 330 |
| Turn Bay Length (ft) | | | | | |
| Base Capacity (vph) | 442 | 460 | 841 | 108 | 841 |
| Starvation Cap Reductn | 0 | 0 | 6 | 0 | 0 |
| Spillback Cap Reductn | 133 | 0 | 0 | 0 | 26 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.17 | 0.25 | 0.88 | 0.37 | 0.83 |

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 0 | 0 | 47 | 86 | 18 | 0 | 354 | 319 | 37 | 425 | 199 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | | | 1.00 | 1.00 | | | 1.00 | | 1.00 | 1.00 | |
| Frt | | | | 1.00 | 0.97 | | | 0.94 | | 1.00 | 0.95 | |
| Flt Protected | | | | 0.95 | 1.00 | | | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | | | 1770 | 1813 | | | 1744 | | 1770 | 1774 | |
| Flt Permitted | | | | 0.95 | 1.00 | | | 1.00 | | 0.12 | 1.00 | |
| Satd. Flow (perm) | | | | 1770 | 1813 | | | 1744 | | 232 | 1774 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 0 | 0 | 51 | 93 | 20 | 0 | 385 | 347 | 40 | 462 | 216 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 29 | 0 | 0 | 15 | 0 |
| Lane Group Flow (vph) | 0 | 0 | 0 | 51 | 104 | 0 | 0 | 703 | 0 | 40 | 663 | 0 |
| Turn Type | | | | Split | NA | | | NA | | Perm | NA | |
| Protected Phases | | | | 3 | 3 | | | 2 | | | 6 | |
| Permitted Phases | | | | | | | | | | 6 | | |
| Actuated Green, G (s) | | | | 11.1 | 11.1 | | | 46.6 | | 46.6 | 46.6 | |
| Effective Green, g (s) | | | | 11.1 | 11.1 | | | 46.6 | | 46.6 | 46.6 | |
| Actuated g/C Ratio | | | | 0.11 | 0.11 | | | 0.47 | | 0.47 | 0.47 | |
| Clearance Time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | | | 3.0 | 3.0 | | | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | | | 196 | 201 | | | 812 | | 108 | 826 | |
| v/s Ratio Prot | | | | 0.03 | c0.06 | | | c0.40 | | | 0.37 | |
| v/s Ratio Perm | | | | | | | | | | 0.17 | | |
| v/c Ratio | | | | 0.26 | 0.52 | | | 0.87 | | 0.37 | 0.80 | |
| Uniform Delay, d1 | | | | 40.7 | 41.9 | | | 23.9 | | 17.2 | 22.8 | |
| Progression Factor | | | | 1.00 | 1.00 | | | 0.31 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | | | 0.7 | 2.2 | | | 9.8 | | 9.5 | 8.1 | |
| Delay (s) | | | | 41.4 | 44.2 | | | 17.3 | | 26.7 | 30.9 | |
| Level of Service | | | | D | D | | | B | | C | C | |
| Approach Delay (s) | | 0.0 | | | 43.3 | | | 17.3 | | | 30.7 | |
| Approach LOS | | A | | | D | | | B | | | C | |

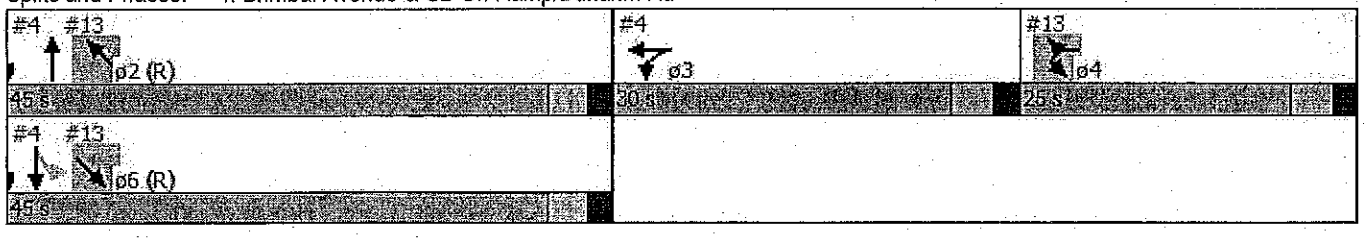
| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 25.9 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.54 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 52.1% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Phase Number | 2 | 3 | 4 | 6 |
|---|---|---|---|---|
| Node Number | 4 | 4 | 13 | 4 |
| Movement | NBT | WBTL | WBL | SBTL |
| Lead/Lag | | Lead | Lag | |
| Lead-Lag Optimize | | Yes | Yes | |
| Recall Mode | C-Min | None | None | C-Min |
| Maximum Split (s) | 45 | 30 | 25 | 45 |
| Maximum Split (%) | 45.0% | 30.0% | 25.0% | 45.0% |
| Minimum Split (s) | 15 | 10 | 10 | 15 |
| Yellow Time (s) | 3 | 3 | 3 | 3 |
| All-Red Time (s) | 2 | 2 | 2 | 2 |
| Minimum Initial (s) | 10 | 5 | 5 | 10 |
| Vehicle Extension (s) | 3 | 3 | 3 | 3 |
| Minimum Gap (s) | 3 | 3 | 3 | 3 |
| Time Before Reduce (s) | 0 | 0 | 0 | 0 |
| Time To Reduce (s) | 0 | 0 | 0 | 0 |
| Walk Time (s) | | | | |
| Flash Dont Walk (s) | | | | |
| Dual Entry | Yes | No | Yes | Yes |
| Inhibit Max | Yes | Yes | Yes | Yes |
| Start Time (s) | 0 | 45 | 75 | 0 |
| End Time (s) | 45 | 75 | 0 | 45 |
| Yield/Force Off (s) | 40 | 70 | 95 | 40 |
| Yield/Force Off 170(s) | 40 | 70 | 95 | 40 |
| Local Start Time (s) | 0 | 45 | 75 | 0 |
| Local Yield (s) | 40 | 70 | 95 | 40 |
| Local Yield 170(s) | 40 | 70 | 95 | 40 |

| Intersection Summary | |
|---|---|
| Cycle Length | 100 |
| Control Type | Actuated-Coordinated |
| Natural Cycle | 60 |

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Splits and Phases: 4: Brimbal Avenue & SB On Ramp/Dunahm Rd



| Lane Group | WBL | WBR | SET | NWT | NWR |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 350 | 139 | 514 | 591 | 624 |
| v/c Ratio | 0.72 | 0.29 | 0.59 | 0.68 | 0.72 |
| Control Delay | 42.2 | 18.8 | 9.3 | 27.4 | 18.8 |
| Queue Delay | 0.0 | 4.4 | 3.5 | 0.1 | 0.0 |
| Total Delay | 42.2 | 23.2 | 12.8 | 27.5 | 18.8 |
| Queue Length 50th (ft) | 200 | 41 | 52 | 288 | 187 |
| Queue Length 95th (ft) | 297 | 90 | m81 | #472 | 374 |
| Internal Link Dist (ft) | 134 | | 65 | 543 | |
| Turn Bay Length (ft) | | 50 | | | 75 |
| Base Capacity (vph) | 484 | 472 | 868 | 868 | 872 |
| Starvation Cap Reductn | 0 | 0 | 257 | 0 | 0 |
| Spillback Cap Reductn | 0 | 262 | 0 | 16 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.72 | 0.66 | 0.84 | 0.69 | 0.72 |

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

| Movement | WBL | WBR | SEL | SET | NWT | NWR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 322 | 128 | 0 | 473 | 544 | 574 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Lane Util. Factor | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.85 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 350 | 139 | 0 | 514 | 591 | 624 |
| RTOR Reduction (vph) | 0 | 39 | 0 | 0 | 0 | 135 |
| Lane Group Flow (vph) | 350 | 100 | 0 | 514 | 591 | 489 |
| Turn Type | Prot | Prot | | NA | NA | Perm |
| Protected Phases | 4 | 4 | | 6 | 2 | |
| Permitted Phases | | | | | | 2 |
| Actuated Green, G (s) | 27.3 | 27.3 | | 46.6 | 46.6 | 46.6 |
| Effective Green, g (s) | 27.3 | 27.3 | | 46.6 | 46.6 | 46.6 |
| Actuated g/C Ratio | 0.27 | 0.27 | | 0.47 | 0.47 | 0.47 |
| Clearance Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 483 | 432 | | 868 | 868 | 737 |
| v/s Ratio Prot | c0.20 | 0.06 | | 0.28 | c0.32 | |
| v/s Ratio Perm | | | | | | 0.31 |
| v/c Ratio | 0.72 | 0.23 | | 0.59 | 0.68 | 0.66 |
| Uniform Delay, d1 | 32.9 | 28.2 | | 19.7 | 20.9 | 20.6 |
| Progression Factor | 1.00 | 1.00 | | 0.34 | 1.00 | 1.00 |
| Incremental Delay, d2 | 5.3 | 0.3 | | 2.0 | 4.3 | 4.7 |
| Delay (s) | 38.3 | 28.5 | | 8.6 | 25.2 | 25.3 |
| Level of Service | D | C | | A | C | C |
| Approach Delay (s) | 35.5 | | | 8.6 | 25.2 | |
| Approach LOS | D | | | A | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 23.7 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.61 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 54.8% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

JACOBS

No Build PM Peak

| Lane Group | WBL | WBT | NBT | SBL | SBT |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 211 | 212 | 665 | 20 | 474 |
| v/c Ratio | 0.83 | 0.79 | 0.67 | 0.08 | 0.48 |
| Control Delay | 70.8 | 63.5 | 6.6 | 12.2 | 15.6 |
| Queue Delay | 67.4 | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Delay | 138.2 | 63.5 | 6.6 | 12.2 | 15.7 |
| Queue Length 50th (ft) | ~152 | ~136 | 35 | 5 | 155 |
| Queue Length 95th (ft) | #296 | #286 | 61 | 19 | 267 |
| Internal Link Dist (ft) | | 155 | 65 | | 330 |
| Turn Bay Length (ft) | 140 | | | | |
| Base Capacity (vph) | 255 | 269 | 995 | 251 | 992 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 144 | 0 | 0 | 0 | 25 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 1.90 | 0.79 | 0.67 | 0.08 | 0.49 |

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 0 | 0 | 194 | 159 | 36 | 0 | 505 | 107 | 18 | 354 | 82 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | | | 1.00 | 1.00 | | | 1.00 | | 1.00 | 1.00 | |
| Frt | | | | 1.00 | 0.97 | | | 0.98 | | 1.00 | 0.97 | |
| Flt Protected | | | | 0.95 | 1.00 | | | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | | | 1770 | 1811 | | | 1819 | | 1770 | 1810 | |
| Flt Permitted | | | | 0.95 | 1.00 | | | 1.00 | | 0.25 | 1.00 | |
| Satd. Flow (perm) | | | | 1770 | 1811 | | | 1819 | | 463 | 1810 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 0 | 0 | 211 | 173 | 39 | 0 | 549 | 116 | 20 | 385 | 89 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 6 | 0 | 0 | 7 | 0 |
| Lane Group Flow (vph) | 0 | 0 | 0 | 211 | 204 | 0 | 0 | 659 | 0 | 20 | 467 | 0 |
| Turn Type | | | | Split | NA | | | NA | | Perm | NA | |
| Protected Phases | | | | 3 | 3 | | | 2 | | | 6 | |
| Permitted Phases | | | | | | | | | | 6 | | |
| Actuated Green, G (s) | | | | 14.4 | 14.4 | | | 54.5 | | 54.5 | 54.5 | |
| Effective Green, g (s) | | | | 14.4 | 14.4 | | | 54.5 | | 54.5 | 54.5 | |
| Actuated g/C Ratio | | | | 0.14 | 0.14 | | | 0.54 | | 0.54 | 0.54 | |
| Clearance Time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | | | 3.0 | 3.0 | | | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | | | 254 | 260 | | | 991 | | 252 | 986 | |
| v/s Ratio Prot | | | | c0.12 | 0.11 | | | c0.36 | | | 0.26 | |
| v/s Ratio Perm | | | | | | | | | | 0.04 | | |
| v/c Ratio | | | | 0.83 | 0.79 | | | 0.66 | | 0.08 | 0.47 | |
| Uniform Delay, d1 | | | | 41.6 | 41.3 | | | 16.2 | | 10.8 | 13.9 | |
| Progression Factor | | | | 1.00 | 1.00 | | | 0.21 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | | | 20.0 | 14.4 | | | 3.0 | | 0.6 | 1.6 | |
| Delay (s) | | | | 61.7 | 55.7 | | | 6.5 | | 11.4 | 15.6 | |
| Level of Service | | | | E | E | | | A | | B | B | |
| Approach Delay (s) | | 0.0 | | | 58.7 | | | 6.5 | | | 15.4 | |
| Approach LOS | | A | | | E | | | A | | | B | |

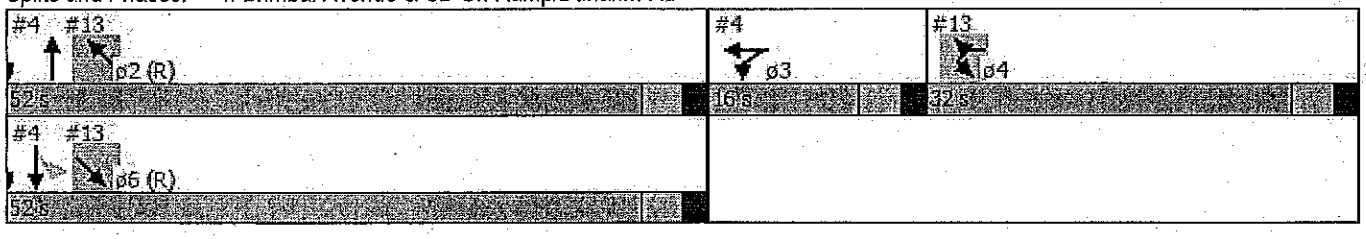
| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 23.2 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.57 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 52.2% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Phase Number | 2 | 3 | 4 | 6 |
|---|---|---|---|---|
| Node Number | 4 | 4 | 13 | 4 |
| Movement | NBT | WBTL | WBL | SBTL |
| Lead/Lag | | Lead | Lag | |
| Lead-Lag Optimize | | Yes | Yes | |
| Recall Mode | C-Min | None | None | C-Min |
| Maximum Split (s) | 52 | 16 | 32 | 52 |
| Maximum Split (%) | 52.0% | 16.0% | 32.0% | 52.0% |
| Minimum Split (s) | 15 | 10 | 10 | 15 |
| Yellow Time (s) | 3 | 3 | 3 | 3 |
| All-Red Time (s) | 2 | 2 | 2 | 2 |
| Minimum Initial (s) | 10 | 5 | 5 | 10 |
| Vehicle Extension (s) | 3 | 3 | 3 | 3 |
| Minimum Gap (s) | 3 | 3 | 3 | 3 |
| Time Before Reduce (s) | 0 | 0 | 0 | 0 |
| Time To Reduce (s) | 0 | 0 | 0 | 0 |
| Walk Time (s) | | | | |
| Flash Dont Walk (s) | | | | |
| Dual Entry | Yes | No | Yes | Yes |
| Inhibit Max | Yes | Yes | Yes | Yes |
| Start Time (s) | 0 | 52 | 68 | 0 |
| End Time (s) | 52 | 68 | 0 | 52 |
| Yield/Force Off (s) | 47 | 63 | 95 | 47 |
| Yield/Force Off 170(s) | 47 | 63 | 95 | 47 |
| Local Start Time (s) | 0 | 52 | 68 | 0 |
| Local Yield (s) | 47 | 63 | 95 | 47 |
| Local Yield 170(s) | 47 | 63 | 95 | 47 |

| Intersection Summary | |
|---|---|
| Cycle Length | 100 |
| Control Type | Actuated-Coordinated |
| Natural Cycle | 55 |

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

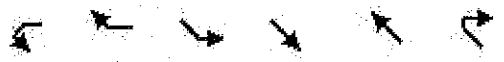
Splits and Phases: 4: Brimbal Avenue & SB On Ramp/Dunahm Rd



| Lane Group | WBL | WBR | SET | NWT | NWR |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 192 | 76 | 596 | 589 | 752 |
| v/c Ratio | 0.67 | 0.25 | 0.59 | 0.58 | 0.74 |
| Control Delay | 50.7 | 14.6 | 20.5 | 18.2 | 14.0 |
| Queue Delay | 0.0 | 0.2 | 2.0 | 0.0 | 0.0 |
| Total Delay | 50.7 | 14.8 | 22.5 | 18.3 | 14.0 |
| Queue Length 50th (ft) | 117 | 9 | 307 | 216 | 166 |
| Queue Length 95th (ft) | 178 | 46 | m420 | 364 | 368 |
| Internal Link Dist (ft) | 134 | | 65 | 543 | |
| Turn Bay Length (ft) | | 50 | | | 75 |
| Base Capacity (vph) | 477 | 470 | 1013 | 1013 | 1019 |
| Starvation Cap Reductn | 0 | 0 | 264 | 0 | 0 |
| Spillback Cap Reductn | 0 | 106 | 0 | 10 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.40 | 0.21 | 0.80 | 0.59 | 0.74 |

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.



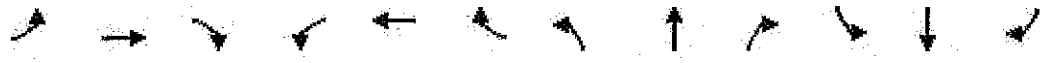
| Movement | WBL | WBR | SEL | SET | NWT | NWR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 177 | 70 | 0 | 548 | 542 | 692 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Lane Util. Factor | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.85 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 192 | 76 | 0 | 596 | 589 | 752 |
| RTOR Reduction (vph) | 0 | 50 | 0 | 0 | 0 | 158 |
| Lane Group Flow (vph) | 192 | 26 | 0 | 596 | 589 | 594 |
| Turn Type | Prot | Prot | | NA | NA | Perm |
| Protected Phases | 4 | 4 | | 6 | 2 | |
| Permitted Phases | | | | | | 2 |
| Actuated Green, G (s) | 16.1 | 16.1 | | 54.5 | 54.5 | 54.5 |
| Effective Green, g (s) | 16.1 | 16.1 | | 54.5 | 54.5 | 54.5 |
| Actuated g/C Ratio | 0.16 | 0.16 | | 0.54 | 0.54 | 0.54 |
| Clearance Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 284 | 254 | | 1015 | 1015 | 862 |
| v/s Ratio Prot | c0.11 | 0.02 | | 0.32 | 0.32 | |
| v/s Ratio Perm | | | | | | c0.38 |
| v/c Ratio | 0.68 | 0.10 | | 0.59 | 0.58 | 0.69 |
| Uniform Delay, d1 | 39.5 | 35.8 | | 15.2 | 15.1 | 16.6 |
| Progression Factor | 1.00 | 1.00 | | 1.16 | 1.00 | 1.00 |
| Incremental Delay, d2 | 6.2 | 0.2 | | 2.0 | 2.4 | 4.5 |
| Delay (s) | 45.7 | 36.0 | | 19.7 | 17.6 | 21.1 |
| Level of Service | D | D | | B | B | C |
| Approach Delay (s) | 43.0 | | | 19.7 | 19.5 | |
| Approach LOS | D | | | B | B | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 22.4 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.57 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 47.0% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Lane Group | WBL | WBT | NBT | SBL | SBT |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 52 | 117 | 745 | 42 | 678 |
| v/c Ratio | 0.30 | 0.63 | 0.80 | 0.26 | 0.73 |
| Control Delay | 46.0 | 55.0 | 13.9 | 21.5 | 25.0 |
| Queue Delay | 1.0 | 0.0 | 0.1 | 0.0 | 0.2 |
| Total Delay | 47.0 | 55.0 | 14.0 | 21.5 | 25.2 |
| Queue Length 50th (ft) | 31 | 66 | 68 | 15 | 325 |
| Queue Length 95th (ft) | 68 | 125 | #633 | 45 | 501 |
| Internal Link Dist (ft) | | 155 | 65 | | 330 |
| Turn Bay Length (ft) | | | | 50 | |
| Base Capacity (vph) | 194 | 207 | 928 | 159 | 929 |
| Starvation Cap Reductn | 0 | 0 | 6 | 0 | 0 |
| Spillback Cap Reductn | 47 | 0 | 0 | 0 | 28 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.35 | 0.57 | 0.81 | 0.26 | 0.75 |

Intersection Summary

#. 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.



| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 0 | 0 | 48 | 88 | 19 | 0 | 354 | 331 | 39 | 425 | 199 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | | | 1.00 | 1.00 | | | 1.00 | | 1.00 | 1.00 | |
| Frt | | | | 1.00 | 0.97 | | | 0.93 | | 1.00 | 0.95 | |
| Flt Protected | | | | 0.95 | 1.00 | | | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | | | 1770 | 1813 | | | 1741 | | 1770 | 1774 | |
| Flt Permitted | | | | 0.95 | 1.00 | | | 1.00 | | 0.17 | 1.00 | |
| Satd. Flow (perm) | | | | 1770 | 1813 | | | 1741 | | 310 | 1774 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 0 | 0 | 52 | 96 | 21 | 0 | 385 | 360 | 42 | 462 | 216 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 31 | 0 | 0 | 15 | 0 |
| Lane Group Flow (vph) | 0 | 0 | 0 | 52 | 109 | 0 | 0 | 714 | 0 | 42 | 663 | 0 |
| Turn Type | | | | Split | NA | | | NA | | Perm | NA | |
| Protected Phases | | | | 3 | 3 | | | 2 | | | 6 | |
| Permitted Phases | | | | | | | | | | 6 | | |
| Actuated Green, G (s) | | | | 9.8 | 9.8 | | | 51.6 | | 51.6 | 51.6 | |
| Effective Green, g (s) | | | | 9.8 | 9.8 | | | 51.6 | | 51.6 | 51.6 | |
| Actuated g/C Ratio | | | | 0.10 | 0.10 | | | 0.52 | | 0.52 | 0.52 | |
| Clearance Time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | | | 3.0 | 3.0 | | | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | | | 173 | 177 | | | 898 | | 159 | 915 | |
| v/s Ratio Prot | | | | 0.03 | c0.06 | | | c0.41 | | | 0.37 | |
| v/s Ratio Perm | | | | | | | | | | 0.14 | | |
| v/c Ratio | | | | 0.30 | 0.62 | | | 0.80 | | 0.26 | 0.72 | |
| Uniform Delay, d1 | | | | 41.9 | 43.3 | | | 19.9 | | 13.6 | 18.7 | |
| Progression Factor | | | | 1.00 | 1.00 | | | 0.32 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | | | 1.0 | 6.2 | | | 6.1 | | 4.0 | 5.0 | |
| Delay (s) | | | | 42.9 | 49.5 | | | 12.5 | | 17.6 | 23.7 | |
| Level of Service | | | | D | D | | | B | | B | C | |
| Approach Delay (s) | | 0.0 | | | 47.5 | | | 12.5 | | | 23.3 | |
| Approach LOS | | A | | | D | | | B | | | C | |

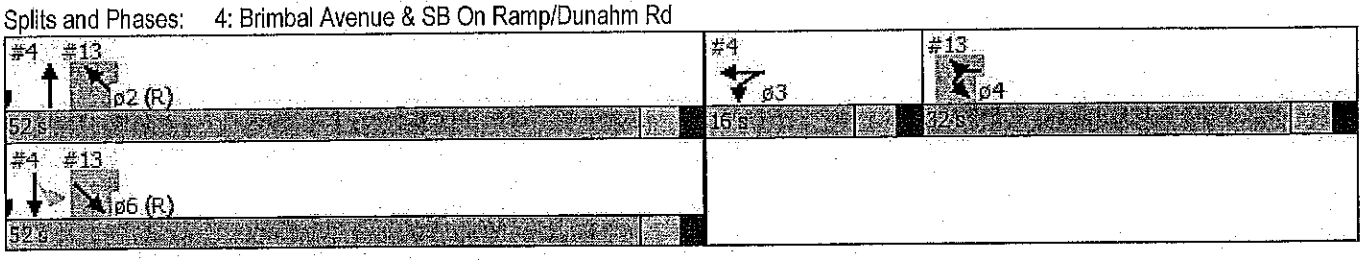
| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 20.9 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.55 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 53.0% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Phase Number | 2 | 3 | 4 | 6 |
|---|---|---|---|---|
| Node Number | 4 | 4 | 13 | 4 |
| Movement | NBT | WBTL | WBL | SBTL |
| Lead/Lag | | Lead | Lag | |
| Lead-Lag Optimize | | | | |
| Recall Mode | C-Min | None | None | C-Min |
| Maximum Split (s) | 52 | 16 | 32 | 52 |
| Maximum Split (%) | 52.0% | 16.0% | 32.0% | 52.0% |
| Minimum Split (s) | 15 | 10 | 10 | 15 |
| Yellow Time (s) | 3 | 3 | 3 | 3 |
| All-Red Time (s) | 2 | 2 | 2 | 2 |
| Minimum Initial (s) | 10 | 5 | 5 | 10 |
| Vehicle Extension (s) | 3 | 3 | 3 | 3 |
| Minimum Gap (s) | 3 | 3 | 3 | 3 |
| Time Before Reduce (s) | 0 | 0 | 0 | 0 |
| Time To Reduce (s) | 0 | 0 | 0 | 0 |
| Walk Time (s) | | | | |
| Flash Dont Walk (s) | | | | |
| Dual Entry | Yes | Yes | Yes | Yes |
| Inhibit Max | Yes | Yes | Yes | Yes |
| Start Time (s) | 0 | 52 | 68 | 0 |
| End Time (s) | 52 | 68 | 0 | 52 |
| Yield/Force Off (s) | 47 | 63 | 95 | 47 |
| Yield/Force Off 170(s) | 47 | 63 | 95 | 47 |
| Local Start Time (s) | 0 | 52 | 68 | 0 |
| Local Yield (s) | 47 | 63 | 95 | 47 |
| Local Yield 170(s) | 47 | 63 | 95 | 47 |

| Intersection Summary | |
|---|---|
| Cycle Length | 100 |
| Control Type | Actuated-Coordinated |
| Natural Cycle | 60 |

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Splits and Phases: 4: Brimbal Avenue & SB On Ramp/Dunahm Rd



| Lane Group | WBL | WBR | SET | NWT | NWR |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 350 | 141 | 515 | 602 | 624 |
| v/c Ratio | 0.84 | 0.34 | 0.54 | 0.63 | 0.66 |
| Control Delay | 54.2 | 19.7 | 7.8 | 22.3 | 13.9 |
| Queue Delay | 0.0 | 2.6 | 1.8 | 0.0 | 0.0 |
| Total Delay | 54.2 | 22.3 | 9.7 | 22.3 | 13.9 |
| Queue Length 50th (ft) | 209 | 41 | 53 | 278 | 157 |
| Queue Length 95th (ft) | #312 | 91 | 79 | 419 | 302 |
| Internal Link Dist (ft) | 134 | | 65 | 543 | |
| Turn Bay Length (ft) | | 50 | | | 75 |
| Base Capacity (vph) | 477 | 471 | 960 | 960 | 952 |
| Starvation Cap Reductn | 0 | 0 | 284 | 0 | 0 |
| Spillback Cap Reductn | 0 | 230 | 0 | 0 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.73 | 0.59 | 0.76 | 0.63 | 0.66 |

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

| Movement | WBL | WBR | SEL | SET | NWT | NWR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 322 | 130 | 0 | 474 | 554 | 574 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Lane Util. Factor | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.85 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 350 | 141 | 0 | 515 | 602 | 624 |
| RTOR Reduction (vph) | 0 | 46 | 0 | 0 | 0 | 136 |
| Lane Group Flow (vph) | 350 | 95 | 0 | 515 | 602 | 488 |
| Turn Type | Prot | Prot | | NA | NA | Perm |
| Protected Phases | 4 | 4 | | 6 | 2 | |
| Permitted Phases | | | | | | 2 |
| Actuated Green, G (s) | 23.6 | 23.6 | | 51.6 | 51.6 | 51.6 |
| Effective Green, g (s) | 23.6 | 23.6 | | 51.6 | 51.6 | 51.6 |
| Actuated g/C Ratio | 0.24 | 0.24 | | 0.52 | 0.52 | 0.52 |
| Clearance Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 417 | 373 | | 961 | 961 | 816 |
| v/s Ratio Prot | c0.20 | 0.06 | | 0.28 | c0.32 | |
| v/s Ratio Perm | | | | | | 0.31 |
| v/c Ratio | 0.84 | 0.26 | | 0.54 | 0.63 | 0.60 |
| Uniform Delay, d1 | 36.4 | 31.1 | | 16.2 | 17.3 | 16.9 |
| Progression Factor | 1.00 | 1.00 | | 0.35 | 1.00 | 1.00 |
| Incremental Delay, d2 | 13.8 | 0.4 | | 1.5 | 3.1 | 3.2 |
| Delay (s) | 50.2 | 31.4 | | 7.2 | 20.4 | 20.1 |
| Level of Service | D | C | | A | C | C |
| Approach Delay (s) | 44.8 | | | 7.2 | 20.3 | |
| Approach LOS | D | | | A | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 22.7 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.61 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 55.3% | ICU Level of Service | B |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

JACOBS

Build PM Peak

| Lane Group | WBL | WBT | NBT | SBL | SBT |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 221 | 221 | 676 | 22 | 474 |
| v/c Ratio | 0.69 | 0.66 | 0.72 | 0.11 | 0.51 |
| Control Delay | 49.4 | 45.2 | 10.4 | 18.6 | 20.1 |
| Queue Delay | 90.7 | 0.0 | 0.0 | 0.0 | 0.1 |
| Total Delay | 140.1 | 45.2 | 10.4 | 18.6 | 20.1 |
| Queue Length 50th (ft) | 134 | 126 | 40 | 7 | 184 |
| Queue Length 95th (ft) | 196 | 188 | #599 | 27 | 345 |
| Internal Link Dist (ft) | | 155 | 65 | | 330 |
| Turn Bay Length (ft) | 140 | | | | |
| Base Capacity (vph) | 442 | 461 | 938 | 205 | 936 |
| Starvation Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Spillback Cap Reductn | 380 | 0 | 0 | 0 | 25 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 3.56 | 0.48 | 0.72 | 0.11 | 0.52 |

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

| Movement | EBL | EBT | EBR | WBL | WBT | WBR | NBL | NBT | NBR | SBL | SBT | SBR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | | | | | | | |
| Volume (vph) | 0 | 0 | 0 | 203 | 166 | 38 | 0 | 505 | 117 | 20 | 354 | 82 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Lane Util. Factor | | | | 1.00 | 1.00 | | | 1.00 | | 1.00 | 1.00 | |
| Frt | | | | 1.00 | 0.97 | | | 0.97 | | 1.00 | 0.97 | |
| Flt Protected | | | | 0.95 | 1.00 | | | 1.00 | | 0.95 | 1.00 | |
| Satd. Flow (prot) | | | | 1770 | 1811 | | | 1816 | | 1770 | 1810 | |
| Flt Permitted | | | | 0.95 | 1.00 | | | 1.00 | | 0.21 | 1.00 | |
| Satd. Flow (perm) | | | | 1770 | 1811 | | | 1816 | | 400 | 1810 | |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 0 | 0 | 0 | 221 | 180 | 41 | 0 | 549 | 127 | 22 | 385 | 89 |
| RTOR Reduction (vph) | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 7 | 0 | 0 | 7 | 0 |
| Lane Group Flow (vph) | 0 | 0 | 0 | 221 | 212 | 0 | 0 | 669 | 0 | 22 | 467 | 0 |
| Turn Type | | | | Split | NA | | | NA | | Perm | NA | |
| Protected Phases | | | | 3 | 3 | | | 2 | | | 6 | |
| Permitted Phases | | | | | | | | | | 6 | | |
| Actuated Green, G (s) | | | | 18.0 | 18.0 | | | 51.3 | | 51.3 | 51.3 | |
| Effective Green, g (s) | | | | 18.0 | 18.0 | | | 51.3 | | 51.3 | 51.3 | |
| Actuated g/C Ratio | | | | 0.18 | 0.18 | | | 0.51 | | 0.51 | 0.51 | |
| Clearance Time (s) | | | | 5.0 | 5.0 | | | 5.0 | | 5.0 | 5.0 | |
| Vehicle Extension (s) | | | | 3.0 | 3.0 | | | 3.0 | | 3.0 | 3.0 | |
| Lane Grp Cap (vph) | | | | 318 | 325 | | | 931 | | 205 | 928 | |
| v/s Ratio Prot | | | | c0.12 | 0.12 | | | c0.37 | | | 0.26 | |
| v/s Ratio Perm | | | | | | | | | | 0.05 | | |
| v/c Ratio | | | | 0.69 | 0.65 | | | 0.72 | | 0.11 | 0.50 | |
| Uniform Delay, d1 | | | | 38.4 | 38.1 | | | 18.8 | | 12.5 | 16.0 | |
| Progression Factor | | | | 1.00 | 1.00 | | | 0.21 | | 1.00 | 1.00 | |
| Incremental Delay, d2 | | | | 6.5 | 4.6 | | | 3.9 | | 1.1 | 1.9 | |
| Delay (s) | | | | 44.9 | 42.7 | | | 7.8 | | 13.6 | 17.9 | |
| Level of Service | | | | D | D | | | A | | B | B | |
| Approach Delay (s) | | 0.0 | | | 43.8 | | | 7.8 | | | 17.7 | |
| Approach LOS | | A | | | D | | | A | | | B | |

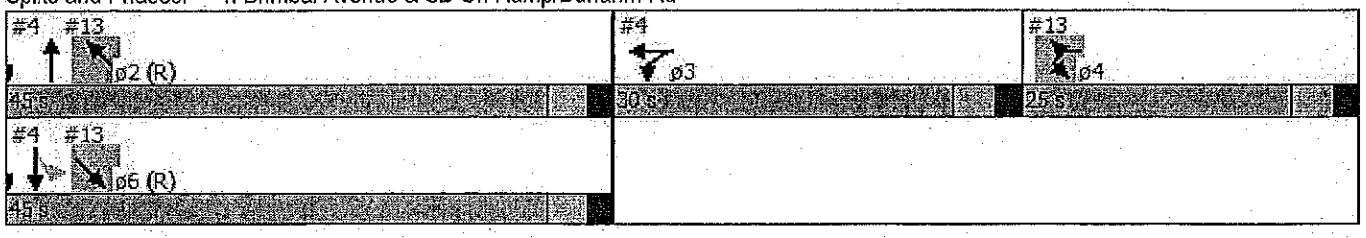
| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 20.7 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.58 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 53.3% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

| Phase Number | 2 | 3 | 4 | 6 |
|---|---|---|---|---|
| Node Number | 4 | 4 | 13 | 4 |
| Movement | NBT | WBTL | WBL | SBTL |
| Lead/Lag | | Lead | Lag | |
| Lead-Lag Optimize | | | | |
| Recall Mode | C-Min | None | None | C-Min |
| Maximum Split (s) | 45 | 30 | 25 | 45 |
| Maximum Split (%) | 45.0% | 30.0% | 25.0% | 45.0% |
| Minimum Split (s) | 15 | 10 | 10 | 15 |
| Yellow Time (s) | 3 | 3 | 3 | 3 |
| All-Red Time (s) | 2 | 2 | 2 | 2 |
| Minimum Initial (s) | 10 | 5 | 5 | 10 |
| Vehicle Extension (s) | 3 | 3 | 3 | 3 |
| Minimum Gap (s) | 3 | 3 | 3 | 3 |
| Time Before Reduce (s) | 0 | 0 | 0 | 0 |
| Time To Reduce (s) | 0 | 0 | 0 | 0 |
| Walk Time (s) | | | | |
| Flash Dont Walk (s) | | | | |
| Dual Entry | Yes | No | Yes | Yes |
| Inhibit Max | Yes | Yes | Yes | Yes |
| Start Time (s) | 0 | 45 | 75 | 0 |
| End Time (s) | 45 | 75 | 0 | 45 |
| Yield/Force Off (s) | 40 | 70 | 95 | 40 |
| Yield/Force Off 170(s) | 40 | 70 | 95 | 40 |
| Local Start Time (s) | 0 | 45 | 75 | 0 |
| Local Yield (s) | 40 | 70 | 95 | 40 |
| Local Yield 170(s) | 40 | 70 | 95 | 40 |

| Intersection Summary | |
|---|---|
| Cycle Length | 100 |
| Control Type | Actuated-Coordinated |
| Natural Cycle | 55 |

Offset: 0 (0%), Referenced to phase 2:NBT and 6:SBTL, Start of Green

Splits and Phases: 4: Brimbal Avenue & SB On Ramp/Dunahm Rd



| Lane Group | WBL | WBR | SET | NWT | NWR |
|---|---|---|---|---|---|
| Lane Group Flow (vph) | 192 | 77 | 605 | 599 | 752 |
| v/c Ratio | 0.69 | 0.26 | 0.63 | 0.63 | 0.78 |
| Control Delay | 52.7 | 16.7 | 23.7 | 23.6 | 20.5 |
| Queue Delay | 0.0 | 0.4 | 1.4 | 0.1 | 0.0 |
| Total Delay | 52.7 | 17.1 | 25.1 | 23.7 | 20.5 |
| Queue Length 50th (ft) | 117 | 13 | 337 | 262 | 231 |
| Queue Length 95th (ft) | 182 | 51 | #531 | #491 | #563 |
| Internal Link Dist (ft) | 134 | | 65 | 543 | |
| Turn Bay Length (ft) | | 50 | | | 75 |
| Base Capacity (vph) | 355 | 360 | 956 | 956 | 958 |
| Starvation Cap Reductn | 0 | 0 | 177 | 0 | 0 |
| Spillback Cap Reductn | 0 | 91 | 0 | 14 | 0 |
| Storage Cap Reductn | 0 | 0 | 0 | 0 | 0 |
| Reduced v/c Ratio | 0.54 | 0.29 | 0.78 | 0.64 | 0.78 |

Intersection Summary

# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

| Movement | WBL | WBR | SEL | SET | NWT | NWR |
|---|---|---|---|---|---|---|
| Lane Configurations | | | | | | |
| Volume (vph) | 177 | 71 | 0 | 557 | 551 | 692 |
| Ideal Flow (vphpl) | 1900 | 1900 | 1900 | 1900 | 1900 | 1900 |
| Total Lost time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Lane Util. Factor | 1.00 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Frt | 1.00 | 0.85 | | 1.00 | 1.00 | 0.85 |
| Flt Protected | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (prot) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Flt Permitted | 0.95 | 1.00 | | 1.00 | 1.00 | 1.00 |
| Satd. Flow (perm) | 1770 | 1583 | | 1863 | 1863 | 1583 |
| Peak-hour factor, PHF | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 | 0.92 |
| Adj. Flow (vph) | 192 | 77 | 0 | 605 | 599 | 752 |
| RTOR Reduction (vph) | 0 | 46 | 0 | 0 | 0 | 147 |
| Lane Group Flow (vph) | 192 | 31 | 0 | 605 | 599 | 605 |
| Turn Type | Prot | Prot | | NA | NA | Perm |
| Protected Phases | 4 | 4 | | 6 | 2 | |
| Permitted Phases | | | | | | 2 |
| Actuated Green, G (s) | 15.7 | 15.7 | | 51.3 | 51.3 | 51.3 |
| Effective Green, g (s) | 15.7 | 15.7 | | 51.3 | 51.3 | 51.3 |
| Actuated g/C Ratio | 0.16 | 0.16 | | 0.51 | 0.51 | 0.51 |
| Clearance Time (s) | 5.0 | 5.0 | | 5.0 | 5.0 | 5.0 |
| Vehicle Extension (s) | 3.0 | 3.0 | | 3.0 | 3.0 | 3.0 |
| Lane Grp Cap (vph) | 277 | 248 | | 955 | 955 | 812 |
| v/s Ratio Prot | c0.11 | 0.02 | | 0.32 | 0.32 | |
| v/s Ratio Perm | | | | | | c0.38 |
| v/c Ratio | 0.69 | 0.13 | | 0.63 | 0.63 | 0.75 |
| Uniform Delay, d1 | 39.9 | 36.3 | | 17.6 | 17.5 | 19.2 |
| Progression Factor | 1.00 | 1.00 | | 1.01 | 1.00 | 1.00 |
| Incremental Delay, d2 | 7.3 | 0.2 | | 2.8 | 3.1 | 6.2 |
| Delay (s) | 47.2 | 36.5 | | 20.6 | 20.6 | 25.4 |
| Level of Service | D | D | | C | C | C |
| Approach Delay (s) | 44.1 | | | 20.6 | 23.3 | |
| Approach LOS | D | | | C | C | |

| Intersection Summary | | | |
|---|---|---|---|
| HCM 2000 Control Delay | 25.1 | HCM 2000 Level of Service | C |
| HCM 2000 Volume to Capacity ratio | 0.58 | | |
| Actuated Cycle Length (s) | 100.0 | Sum of lost time (s) | 15.0 |
| Intersection Capacity Utilization | 47.5% | ICU Level of Service | A |
| Analysis Period (min) | 15 | | |
| c Critical Lane Group | | | |

# VITALITY BOARDWALK ASSISTED LIVING DEVELOPMENT
## 50 DUNHAM ROAD
## BEVERLY, MASSACHUSETTS

# STORMWATER REPORT

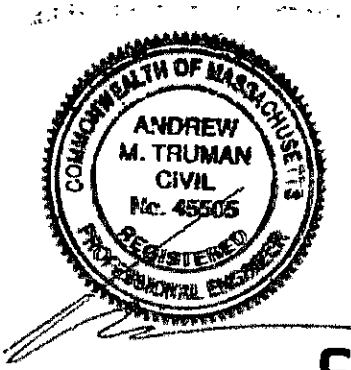

*Submitted to:*
City of Beverly Planning Board

*Applicant:*
Vitality Senior Living
227 Mallory Station Road, Suite 126-B
Franklin, TN 37067

*Architect:*
Levi+Wong Design Associates
45 Walden Street
Concord, MA 01742

*Landscape Architect:*
Dirtworks Landscape Architecture, PC
315 West 39th Street, Studio 910
New York, NY 10018

*Civil Engineer:*
Samiotes Consultants, Inc.
20 A Street
Framingham, Massachusetts 01701




samiotes

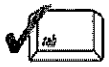
**11 October 2016**

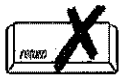
**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## A. Introduction

**Important:** When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.




A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

**Massachusetts Department of Environmental Protection**
Bureau of Resource Protection - Wetlands Program

# Checklist for Stormwater Report

## B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

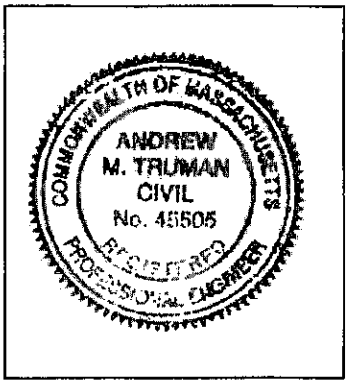
*Note:* Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

## Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature




9/20/16
Signature and Date

## Checklist

**Project Type:** Is the application for new development, redevelopment, or a mix of new and redevelopment?

☐ New development

☐ Redevelopment

☒ Mix of New Development and Redevelopment

# Checklist for Stormwater Report

## Checklist (continued)

**LID Measures:** Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

**Standard 1: No New Untreated Discharges**

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☐ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 2: Peak Rate Attenuation**

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

**Standard 3: Recharge**

☒ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☒ Static ☐ Simple Dynamic ☐ Dynamic Field[1]

☐ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☒ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☒ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

☒ Site is comprised solely of C and D soils and/or bedrock at the land surface

☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000

☐ Solid Waste Landfill pursuant to 310 CMR 19.000

☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 3: Recharge** (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

**Standard 4: Water Quality**

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 4: Water Quality** (continued)

☐ The BMP is sized (and calculations provided) based on:

☒ The ½" or 1" Water Quality Volume or

☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

**Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)**

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP will be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

**Standard 6: Critical Areas**

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable**

☒ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☒ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control**

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☒ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

# Checklist for Stormwater Report

## Checklist (continued)

**Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control** (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

**Standard 9: Operation and Maintenance Plan**

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☐ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

**Standard 10: Prohibition of Illicit Discharges**

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

# VITALITY BOARDWALK ASSISTED LIVING DEVELOPMENT
# STORMWATER MANAGEMENT NARRATIVE

## SEPTEMBER 2016

### 1.0 Introduction:

Project Description:
The stormwater management for this project is designed to mitigate the peak stormwater rate of runoff resulting from the construction of the proposed assisted living development at 50 Dunham Road, Beverly, MA. The proposed assisted living facility will include 118 residential suites, together with associated common dining, learning and recreational facilities, and a parking garage. This development is designed for seniors who are still ambulatory but in need of nonmedical support with their daily housekeeping and other responsibilities.

Existing Conditions:
The project is proposed to be built on a partially developed portion of the 54 acre property at 50 Dunham Road. The proposed assisted living development parcel is approximately 5 acre portion of the site. Because of the presence of ledge on the site there is no dedicated stormwater system in the existing parking area. A series of leaching catch basins were installed at some point during the development of the site.

In the current conditions, the site currently sheets towards the leaching catch basins or off site via existing catch basins. The existing two (2) buildings and surrounding area have been designed & permitted with their own stormwater detention system, and have not been modeled as part of this hydrologic analysis.

Soils:
Soils on the site consist of hydrological "D" soils.

### 2.0 Methodology/ Procedure

Objective:
The objective of the stormwater management for the site was to mitigate any increase in peak storm runoff rates due to the construction of the proposed project. The existing driveway area was not considered as part of the analysis or water quality review.

Proposed Stormwater Control Systems:
The following are the proposed stormwater control systems to be used on the site to mitigate an increase in peak stormwater runoff:

Catch Basins/ Drywell combo: A drywell is pre-cast concrete barrel and riser with an open bottom that permits runoff to infiltrate into the ground. The drywell is combined with a deep sump catch basins that provides pretreatment. 80% TSS removal is awarded to the deep sump catch basin/leaching drywell pretreatment combination provided the system is off-line. The drywell have grates on them to provide for the safe overflow from these devices in severe storm events.

Subsurface Structures (Brentwood- Stormtanks SD-36 units): Subsurface structures are underground systems that capture runoff, and gradually infiltrate it into the groundwater through rock and gravel. There are a number of underground infiltration systems that can be installed to enhance groundwater recharge. Subsurface structures are constructed to store stormwater temporarily and let it percolate into the underlying soil. These structures are used for small drainage areas (typically less than 2 acres). They are feasible only where the soil is adequately permeable and the maximum water table and/or elevation is sufficiently low. They can be used to control the quantity as well as quality of stormwater

runoff, if properly designed and constructed. The structures serve as storage chambers for captured stormwater, while the soil matrix provides treatment.

Proposed Stormwater Management System:
The proposed system will consist of catch basins, area drains, drywells, and, infiltration systems.

Watershed Routing:
Below is a summary of the various existing and proposed watersheds with a brief narrative describing the routing:

Existing Watersheds:

Ex-Watershed-1: This watershed consists of majority of the site, consisting of the existing driveway, parking lot, wooded and landscaped areas. The runoff from this watershed goes partially into existing leaching basins, with the remainder sheeting into the wetlands.

Ex-Watershed-2: This watershed consists of a small portion of the existing driveway/ access road. The runoff from this watershed sheets south off site towards Dunham Road.

Proposed Watersheds:

P-BLDG: This watershed consist of the proposed building. Runoff from the roof is routed to infiltration tanks (Brentwood- Stormtanks) located north of the building, under the landscaped garden(s)/ walking areas. The stormwater that does not infiltrate, outlets from the stormtanks and is routed through an outlet control structure and then daylights near the edge of the existing drive (west of the proposed building) where is will sheet across the road and into the wetlands.

P-Watershed-1: This watershed consists of the wooded area around the vernal pool (north of the building) that is not being disturbed as a result of the proposed project. The stormwater from this watershed sheets to the vernal pool.

P-Watershed-2: This watershed consists of a small portion of the existing driveway/ access road. The runoff from this watershed sheets south off site towards Dunham Road. This watershed is not being developed.

P-Watershed-3: This watershed consists of the landscaped gardens and paved walking paths located north of the building. Runoff from this watershed sheets into area drains located in several low spots throughout this watershed and routs the stormwater to the infiltration tanks (Brentwood- Stormtanks). The stormwater that does not infiltrate, outlets from the stormtanks and is routed through an outlet control structure and then daylights near the edge of the existing drive (west of the proposed building) where is will sheet across the road and into the wetlands.

P-Watershed-4: This watershed consist of a small paved patio (at the northwest corner of the building). Stormwater from this watershed sheets off the patio and to a landscaped low spot. The patio will likely consist of some form of porous paver.

P-watershed-5: This watershed consists of portions of the existing road/ parking lot, proposed landscaped areas, and walkways (west and south of the proposed building). The stormwater from this watershed sheets into an existing leaching catch basin located in the existing paved.

P-watershed-5A: This watershed consists of portion of the proposed paved driveway, handicap parking near the entrance, sections of walkway, and the paved entrance to the building. Stormwater from this watershed sheets into a catch basin and then routed to a drywell. Stormwater that does not infiltrate from the drywell, will bubble up from the drywell grate, and sheet down the existing drive to the wetlands.

P-watershed-5B: This watershed consists of the paved ramp entrance into the parking garage. The stormwater from this watershed sheets into a catch basin and then routed to a drywell. Stormwater that does not infiltrate from the drywell, will bubble up from the drywell grate, and sheet down the existing drive to the wetlands.

P-watershed-6: This watershed consists of portions of the existing road/ parking lot, proposed landscaped areas. The stormwater from this watershed sheets into an existing catch basin located in the existing paved area that outlets to the wetlands.

P-watershed-6A: This watershed consists of the paved ramp entrance into the parking garage. The stormwater from this watershed sheets into a catch basin and then routed to a drywell. Stormwater that does not infiltrate from the drywell, will bubble up from the drywell grate, and sheet down the existing drive to the wetlands.

## 3.0 Stormwater Management Standards

The Department of Environmental Protection has implemented the Stormwater Management Standards as of November 18, 1996 and updated them in February 2008. The standards met are described below and in the Stormwater Management Form as provided by DEP.

### 3.1 Standard #1: Untreated Stormwater

The project is designed so that new stormwater conveyances (outfalls/discharges) do not discharge untreated stormwater into, or cause erosion to, wetlands or waters.

### 3.2 Standard #2: Post-development peak discharge rates

The proposed project will result in an increase in impervious area. The proposed stormwater management system has been designed so that there is no increase in post construction discharge rates from the site. Standard #2 is met.

**Table 1: Analysis Point Peak Rate of Runoff (cubic feet per second, cfs)**

| Analysis Period | 2-year | 10-year | 100-year |
|---|---|---|---|
| **Existing** | 11.72 | 17.98 | 29.92 |
| **Proposed** | 9.38 | 15.08 | 28.08 |

### 3.3 Standard #3: Recharge to groundwater

Loss of annual recharge to groundwater shall be eliminated or minimized through the use of environmentally sensitive site design, low impact development techniques, stormwater best management practices, and good operation and maintenance. At a minimum, the annual recharge from the post- development site shall approximate the annual recharge from pre-development conditions based on soil type. This Standard is met when the stormwater management system is

designed to infiltrate the required recharge volume as determined in accordance with the Massachusetts Stormwater Handbook.

Soil types have been identified based on the information contained in the Soil Report. We have determined that the soils are consistent with Hydrologic soil type "D" which requires runoff to be infiltrated (as listed in the table below) from new impervious areas.

The proposed development will result in an increase in impervious area in the "D" soil areas. Therefore, 0.10 inches of runoff will be required to be infiltrated for the new impervious areas.

| Hydrologic Group Volume to Recharge (x Total Impervious Area) | |
|---|---|
| Hydrologic Group | Volume to Recharge x Total Impervious Area |
| A | 0.60 inches of runoff |
| B | 0.35 inches of runoff |
| C | 0.25 inches of runoff |
| D | 0.10 inches of runoff |

Required Recharge Volumes:

"D" Soils

Infiltration Rate: 0.10 inches of runoff
Proposed Site New Impervious Area: 52,726 sf
52,726 sf x 0.10 x (1/12) =366 cf

Total required recharge volume: 439 cf

The volume of water contained below the outlet in the infiltration system below the outlet is 1,621 cf.

Therefore Standard #3 is met.

**3.4 Standard #4: TSS removal**

The BMP's selected to remove TSS from all new impervious areas for this project include: Deep Sump Catch Basin (pre-treatment), Drywells and Infiltration Basins. The estimate for the BMP's are based on guides outlined in the SMP. Four of the proposed watershed will result in discharge to the wetlands and have been reviewed for TSS removal.

Watersheds requiring TSS removal:

P-watershed-3:
Initial TSS = 1.00
Catch Basin: (1.00)(1.00-0.25*) = 0.75 TSS
Infiltration Tanks: (0.75)(1.00-0.80) = 0.15 TSS

Total TSS Removal = 1.0-0.15 = 85%

Volume to be treated = 45,740sf x 0.5"/12" =1,906 cuft

Volume below outlet to infiltration system = 1,991 cuft.

P-watershed-5A:
Initial TSS = 1.00
Catch Basin: (1.00)(1.00-0.25*) = 0.75 TSS
Drywell: (0.75)(1.00-0.80) = 0.15 TSS

Total TSS Removal = 1.0-0.15 = 85%

Volume to be treated = 5,712sf x 0.5"/12" =238 cuft
Volume below outlet to drywell = 359 cuft.

P-watershed-5B:
Initial TSS = 1.00
Catch Basin: (1.00)(1.00-0.25*) = 0.75 TSS
Drywell: (0.75)(1.00-0.80) = 0.15 TSS

Total TSS Removal = 1.0-0.15 = 85%

Volume to be treated = 1,393sf x 0.5"/12" =588 cuft
Volume below outlet to drywell = 311 cuft.

P-watershed-6A:
Initial TSS = 1.00
Catch Basin: (1.00)(1.00-0.25*) = 0.75 TSS
Infiltration Tanks: (0.75)(1.00-0.80) = 0.15 TSS

Total TSS Removal = 1.0-0.15 = 85%

Volume to be treated = 1,774sf x 0.5"/12" =74 cuft
Volume below outlet to drywell = 363 cuft.

Therefore Standard #4 is met.

Therefore, 15% of the initial 100% (1.00) of the total suspended solids from the paved areas will outlet into the Resource Areas. The combination of the BMP's selected for this site will result in 85% removal rate. The requirement by DEP is 80% TSS removal.

### 3.5 Standard #5: Higher potential pollutant loads

The project site does not contain Land Uses with Higher Potential Pollutant Loads.

### 3.6 Standard #6: Protection of critical areas

The site is not located within critical areas as defined by Critical areas are Outstanding Resource Waters (ORW) as designated in 314 CMR 4.00, Special Resource Waters as designated in 314 CMR 4.00, recharge areas for public water supplies as defined in 310 CMR 22.02 (Zone Is, Zone IIs and Interim Wellhead Protection Areas for groundwater sources and Zone As for surface water sources), bathing beaches as defined in 105 CMR 445.000, cold-water fisheries as defined in 314 CMR 9.02 and 310 CMR 10.04, and shellfish growing areas as defined in 314 CMR 9.02 and 310 CMR 10.04.

Therefore Standard #6 is met.

### 3.7 Standard #7: Redevelopment projects

Due to the increase in impervious area the project is considered New Construction and all of the Standards will be met. However portions of the site are already developed and only new point source discharges have been reviewed for compliance with the SWMP.

### 3.8 Standard #8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

The erosion and sediment control plan to be in place during the construction phase is detailed in section 4 of this narrative. A copy of the pollution prevent ion plan is included in the Appendix.

### 3.9 Standard #9: Operation/maintenance plan

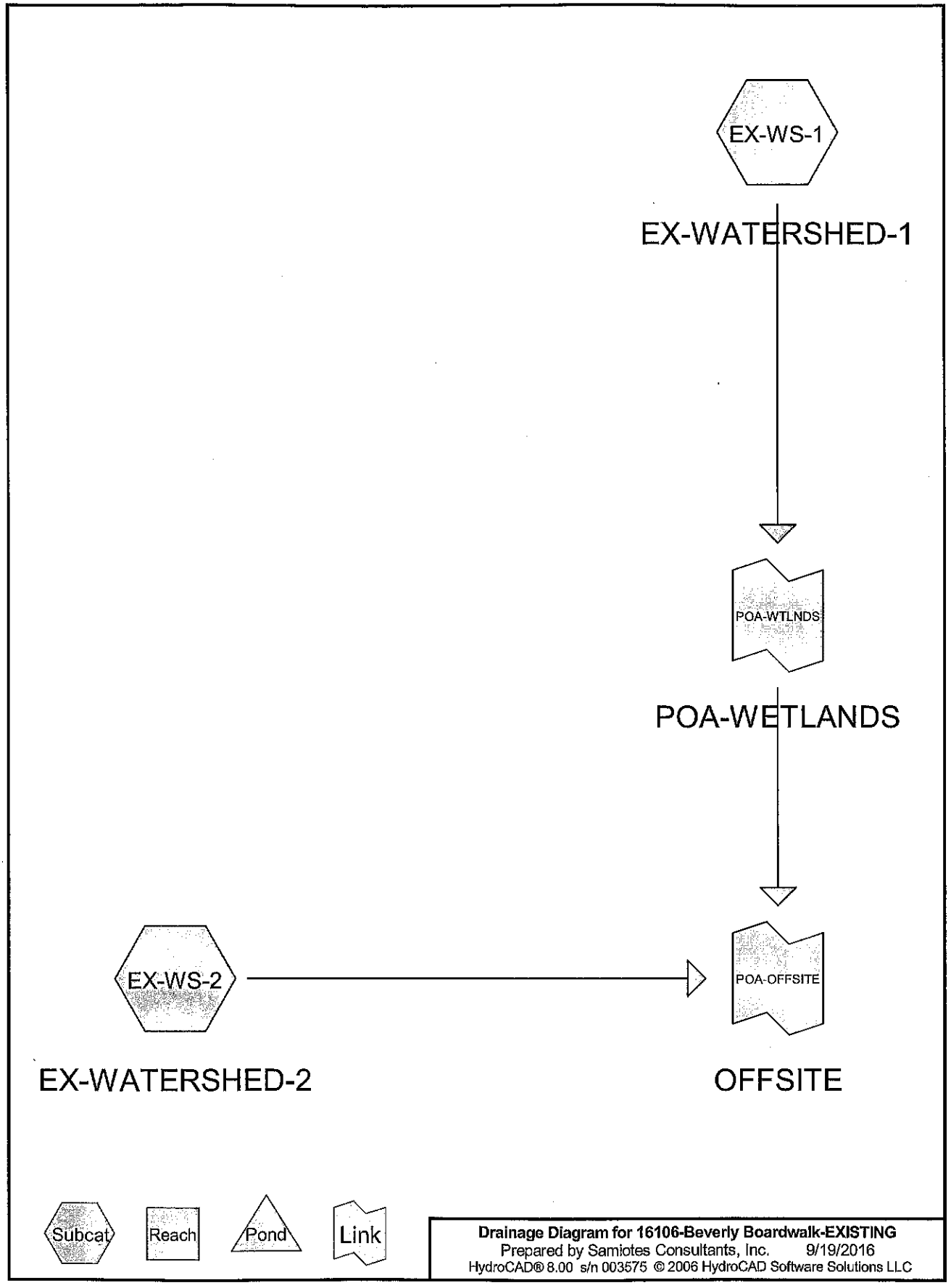
An operation and maintenance plan for both construction and post-development stormwater controls has been developed. The plan includes owner(s); parties responsible for operation and maintenance; schedule for inspection and maintenance; routine and non-routine maintenance tasks. A copy of the O&M is included in the Appendix.

### 3.10 Standard #10: All illicit discharges to the stormwater management system are prohibited

It is not anticipated that there will be any Illicit discharges.

## TABLE OF CONTENTS FOR APPENDIX

# APPENDIX 1:
## EXISTING HYDROLOGICAL CALCULATIONS




**Drainage Diagram for 16106-Beverly Boardwalk-EXISTING**
Prepared by Samiotes Consultants, Inc. 9/19/2016

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcats) |
|---|---|---|
| 24,898 | 77 | Woods, Good, HSG D (EX-WS-1) |
| 9,112 | 79 | Woods, Fair, HSG D (EX-WS-1) |
| 110,130 | 89 | <50% Grass cover, Poor, HSG D (EX-WS-1) |
| 8,758 | 98 | PAVED (EX-WS-2) |
| 80,517 | 98 | Paved parking & roofs (EX-WS-1,EX-WS-1) |
| 233,415 | | |

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-WS-1: EX-WATERSHED-1** Runoff Area=224,657 sf Runoff Depth=2.17"
Flow Length=91' Tc=10.3 min CN=90 Runoff=11.25 cfs 40,599 cf

**Subcatchment EX-WS-2: EX-WATERSHED-2** Runoff Area=8,758 sf Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.65 cfs 2,166 cf

**Link POA-OFFSITE: OFFSITE** Inflow=11.72 cfs 42,765 cf
Primary=11.72 cfs 42,765 cf

**Link POA-WTLNDS: POA-WETLANDS** Inflow=11.25 cfs 40,599 cf
Primary=11.25 cfs 40,599 cf

**Total Runoff Area = 233,415 sf Runoff Volume = 42,765 cf Average Runoff Depth = 2.20"**
**61.75% Pervious Area = 144,140 sf 38.25% Impervious Area = 89,275 sf**

## Subcatchment EX-WS-1: EX-WATERSHED-1

Runoff = 11.25 cfs @ 12.14 hrs, Volume= 40,599 cf, Depth= 2.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 75,311 | 98 | Paved parking & roofs |
| 5,206 | 98 | Paved parking & roofs |
| 24,898 | 77 | Woods, Good, HSG D |
| 110,130 | 89 | <50% Grass cover, Poor, HSG D |
| 9,112 | 79 | Woods, Fair, HSG D |
| 224,657 | 90 | Weighted Average |
| 144,140 | | Pervious Area |
| 80,517 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | 50 | 0.1350 | 0.08 | | **Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.20" |
| 0.1 | 6 | 0.1350 | 1.84 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.2 | 35 | 0.2600 | 2.55 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 91 | Total | | | |

## Subcatchment EX-WS-2: EX-WATERSHED-2

Runoff = 0.65 cfs @ 12.07 hrs, Volume= 2,166 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 8,758 | 98 | PAVED |
| 8,758 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Link POA-OFFSITE: OFFSITE

Inflow Area = 233,415 sf, Inflow Depth = 2.20" for 2-yr event
Inflow = 11.72 cfs @ 12.14 hrs, Volume= 42,765 cf
Primary = 11.72 cfs @ 12.14 hrs, Volume= 42,765 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

## Link POA-WTLNDS: POA-WETLANDS

Inflow Area = 224,657 sf, Inflow Depth = 2.17" for 2-yr event
Inflow = 11.25 cfs @ 12.14 hrs, Volume= 40,599 cf
Primary = 11.25 cfs @ 12.14 hrs, Volume= 40,599 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-WS-1: EX-WATERSHED-1** Runoff Area=224,657 sf Runoff Depth=3.40"
Flow Length=91' Tc=10.3 min CN=90 Runoff=17.31 cfs 63,573 cf

**Subcatchment EX-WS-2: EX-WATERSHED-2** Runoff Area=8,758 sf Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.92 cfs 3,112 cf

**Link POA-OFFSITE: OFFSITE** Inflow=17.98 cfs 66,686 cf
Primary=17.98 cfs 66,686 cf

**Link POA-WTLNDS: POA-WETLANDS** Inflow=17.31 cfs 63,573 cf
Primary=17.31 cfs 63,573 cf

**Total Runoff Area = 233,415 sf Runoff Volume = 66,686 cf Average Runoff Depth = 3.43"**
**61.75% Pervious Area = 144,140 sf 38.25% Impervious Area = 89,275 sf**

## Subcatchment EX-WS-1: EX-WATERSHED-1

Runoff = 17.31 cfs @ 12.14 hrs, Volume= 63,573 cf, Depth= 3.40"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 75,311 | 98 | Paved parking & roofs |
| 5,206 | 98 | Paved parking & roofs |
| 24,898 | 77 | Woods, Good, HSG D |
| 110,130 | 89 | <50% Grass cover, Poor, HSG D |
| 9,112 | 79 | Woods, Fair, HSG D |
| 224,657 | 90 | Weighted Average |
| 144,140 | | Pervious Area |
| 80,517 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | 50 | 0.1350 | 0.08 | | **Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.20" |
| 0.1 | 6 | 0.1350 | 1.84 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.2 | 35 | 0.2600 | 2.55 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 91 | Total | | | |

## Subcatchment EX-WS-2: EX-WATERSHED-2

Runoff = 0.92 cfs @ 12.07 hrs, Volume= 3,112 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 8,758 | 98 | PAVED |
| 8,758 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Link POA-OFFSITE: OFFSITE

Inflow Area = 233,415 sf, Inflow Depth = 3.43" for 10-yr event
Inflow = 17.98 cfs @ 12.14 hrs, Volume= 66,686 cf
Primary = 17.98 cfs @ 12.14 hrs, Volume= 66,686 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

## Link POA-WTLNDS: POA-WETLANDS

Inflow Area = 224,657 sf, Inflow Depth = 3.40" for 10-yr event
Inflow = 17.31 cfs @ 12.14 hrs, Volume= 63,573 cf
Primary = 17.31 cfs @ 12.14 hrs, Volume= 63,573 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-WS-1: EX-WATERSHED-1** Runoff Area=224,657 sf Runoff Depth=5.82"
Flow Length=91' Tc=10.3 min CN=90 Runoff=28.87 cfs 109,018 cf

**Subcatchment EX-WS-2: EX-WATERSHED-2** Runoff Area=8,758 sf Runoff Depth=6.76"
Tc=5.0 min CN=98 Runoff=1.43 cfs 4,934 cf

**Link POA-OFFSITE: OFFSITE** Inflow=29.92 cfs 113,952 cf
Primary=29.92 cfs 113,952 cf

**Link POA-WTLNDS: POA-WETLANDS** Inflow=28.87 cfs 109,018 cf
Primary=28.87 cfs 109,018 cf

**Total Runoff Area = 233,415 sf Runoff Volume = 113,952 cf Average Runoff Depth = 5.86"**
**61.75% Pervious Area = 144,140 sf 38.25% Impervious Area = 89,275 sf**

## Subcatchment EX-WS-1: EX-WATERSHED-1

Runoff = 28.87 cfs @ 12.14 hrs, Volume= 109,018 cf, Depth= 5.82"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 75,311 | 98 | Paved parking & roofs |
| 5,206 | 98 | Paved parking & roofs |
| 24,898 | 77 | Woods, Good, HSG D |
| 110,130 | 89 | <50% Grass cover, Poor, HSG D |
| 9,112 | 79 | Woods, Fair, HSG D |
| 224,657 | 90 | Weighted Average |
| 144,140 | | Pervious Area |
| 80,517 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.0 | 50 | 0.1350 | 0.08 | | **Sheet Flow,** Woods: Dense underbrush n= 0.800 P2= 3.20" |
| 0.1 | 6 | 0.1350 | 1.84 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 0.2 | 35 | 0.2600 | 2.55 | | **Shallow Concentrated Flow,** Woodland Kv= 5.0 fps |
| 10.3 | 91 | Total | | | |

## Subcatchment EX-WS-2: EX-WATERSHED-2

Runoff = 1.43 cfs @ 12.07 hrs, Volume= 4,934 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 8,758 | 98 | PAVED |
| 8,758 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Link POA-OFFSITE: OFFSITE

Inflow Area = 233,415 sf, Inflow Depth = 5.86" for 100-yr event
Inflow = 29.92 cfs @ 12.14 hrs, Volume= 113,952 cf
Primary = 29.92 cfs @ 12.14 hrs, Volume= 113,952 cf, Atten= 0%, Lag= 0.0 min

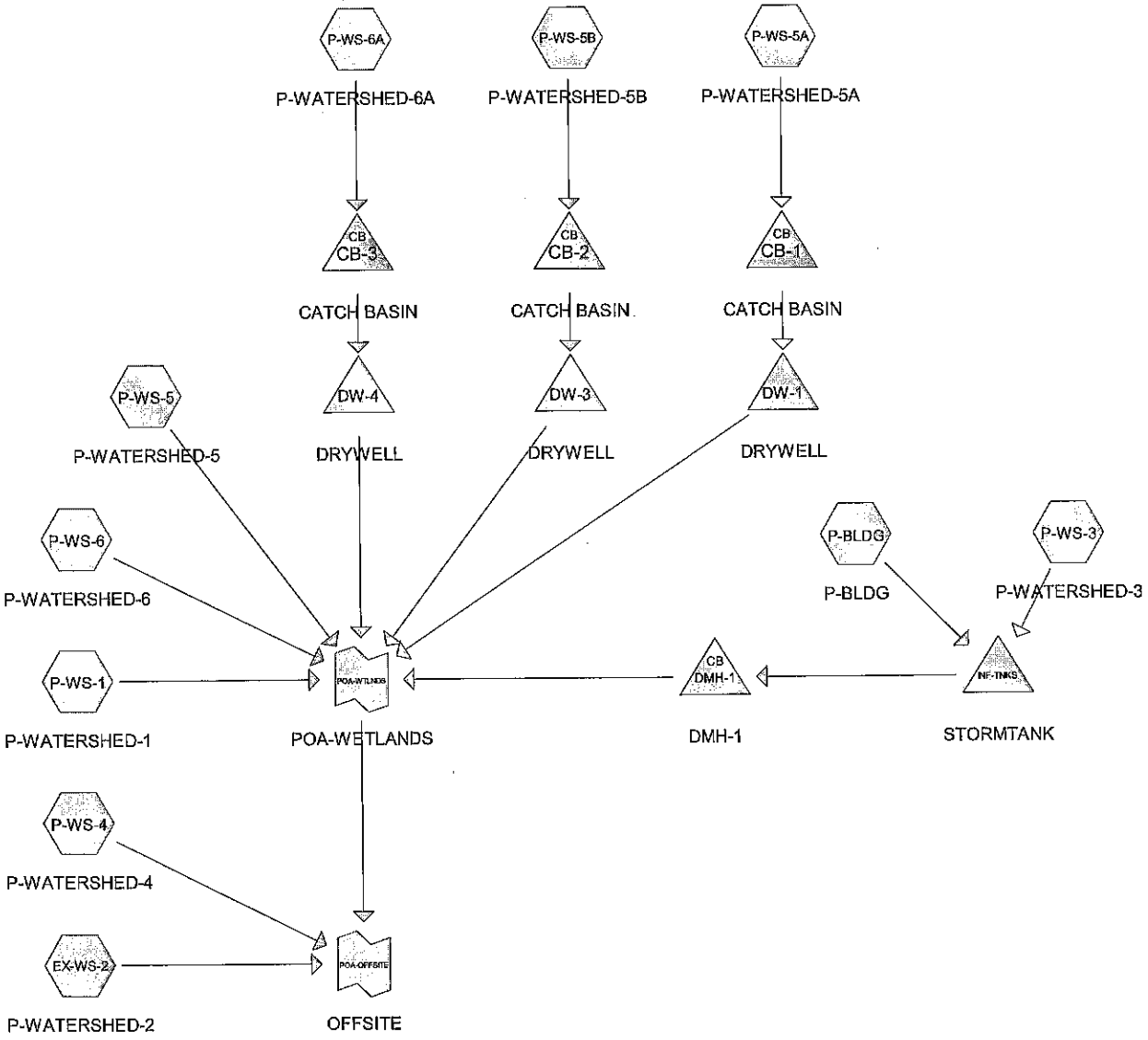
Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

## Link POA-WTLNDS: POA-WETLANDS

Inflow Area = 224,657 sf, Inflow Depth = 5.82" for 100-yr event
Inflow = 28.87 cfs @ 12.14 hrs, Volume= 109,018 cf
Primary = 28.87 cfs @ 12.14 hrs, Volume= 109,018 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

# APPENDIX 2:
## PROPOSED HYDROLOGICAL CALCULATIONS




**Drainage Diagram for 16106-Beverly Boardwalk-PROPOSED**
Prepared by Samiotes Consultants, Inc. 9/19/2016

## Area Listing (all nodes)

| Area (sq-ft) | CN | Description (subcats) |
|---|---|---|
| 23,947 | 77 | Woods, Good, HSG D (P-WS-1,P-WS-3,P-WS-5) |
| 84,641 | 80 | >75% Grass cover, Good, HSG D (P-WS-1,P-WS-3,P-WS-5,P-WS-5,P-WS-5A,P-WS-6,P-WS |
| 342 | 91 | Gravel roads, HSG D (P-WS-4) |
| 124,485 | 98 | Paved parking & roofs (EX-WS-2,P-BLDG,P-WS-1,P-WS-3,P-WS-3,P-WS-3,P-WS-4,P-WS-5 |
| 233,415 | | |

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-WS-2: P-WATERSHED-2** Runoff Area=8,758 sf Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.65 cfs 2,166 cf

**Subcatchment P-BLDG: P-BLDG** Runoff Area=42,517 sf Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=3.14 cfs 10,514 cf

**Subcatchment P-WS-1: P-WATERSHED-1** Runoff Area=22,811 sf Runoff Depth=1.27"
Tc=10.3 min CN=78 Runoff=0.66 cfs 2,421 cf

**Subcatchment P-WS-3: P-WATERSHED-3** Runoff Area=45,740 sf Runoff Depth=1.76"
Flow Length=57' Tc=10.3 min CN=85 Runoff=1.87 cfs 6,699 cf

**Subcatchment P-WS-4: P-WATERSHED-4** Runoff Area=378 sf Runoff Depth=2.35"
Tc=5.0 min CN=92 Runoff=0.02 cfs 74 cf

**Subcatchment P-WS-5: P-WATERSHED-5** Runoff Area=68,184 sf Runoff Depth=1.91"
Flow Length=355' Tc=6.8 min CN=87 Runoff=3.41 cfs 10,880 cf

**Subcatchment P-WS-5A: P-WATERSHED-5A** Runoff Area=5,712 sf Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.42 cfs 1,413 cf

**Subcatchment P-WS-5B: P-WATERSHED-5B** Runoff Area=1,393 sf Runoff Depth=2.97"
Tc=5.0 min CN=98 Runoff=0.10 cfs 344 cf

**Subcatchment P-WS-6: P-WATERSHED-6** Runoff Area=36,148 sf Runoff Depth=2.26"
Flow Length=163' Tc=6.0 min CN=91 Runoff=2.16 cfs 6,803 cf

**Subcatchment P-WS-6A: P-WATERSHED-6A** Runoff Area=1,774 sf Runoff Depth=2.45"
Tc=5.0 min CN=93 Runoff=0.12 cfs 362 cf

**Pond CB-1: CATCH BASIN** Peak Elev=83.26' Inflow=0.42 cfs 1,413 cf
Outflow=0.42 cfs 1,413 cf

**Pond CB-2: CATCH BASIN** Peak Elev=67.67' Inflow=0.10 cfs 344 cf
Outflow=0.10 cfs 344 cf

**Pond CB-3: CATCH BASIN** Peak Elev=61.31' Inflow=0.12 cfs 362 cf
Outflow=0.12 cfs 362 cf

**Pond DMH-1: DMH-1** Peak Elev=83.73' Inflow=2.51 cfs 14,526 cf
15.0" x 67.0' Culvert Outflow=2.51 cfs 14,526 cf

**Pond DW-1: DRYWELL** Peak Elev=85.76' Storage=335 cf Inflow=0.42 cfs 1,413 cf
Discarded=0.00 cfs 37 cf Primary=0.42 cfs 1,080 cf Outflow=0.42 cfs 1,117 cf

**Pond DW-3: DRYWELL** Peak Elev=70.81' Storage=311 cf Inflow=0.10 cfs 344 cf
Discarded=0.00 cfs 26 cf Primary=0.00 cfs 8 cf Outflow=0.00 cfs 34 cf

**Pond DW-4: DRYWELL** Peak Elev=58.62' Storage=136 cf Inflow=0.12 cfs 362 cf
Discarded=0.00 cfs 25 cf Primary=0.11 cfs 220 cf Outflow=0.11 cfs 245 cf

**Pond INF-TNKS: STORMTANK** Peak Elev=85.88' Storage=5,038 cf Inflow=4.66 cfs 17,214 cf
Discarded=0.01 cfs 1,292 cf Primary=2.51 cfs 14,526 cf Outflow=2.52 cfs 15,818 cf

**Link POA-OFFSITE: OFFSITE** Inflow=9.38 cfs 38,178 cf
Primary=9.38 cfs 38,178 cf

**Link POA-WTLNDS: POA-WETLANDS** Inflow=8.76 cfs 35,938 cf
Primary=8.76 cfs 35,938 cf

**Total Runoff Area = 233,415 sf Runoff Volume = 41,675 cf Average Runoff Depth = 2.14"**
**46.67% Pervious Area = 108,930 sf 53.33% Impervious Area = 124,485 sf**

## Subcatchment EX-WS-2: P-WATERSHED-2

Runoff = 0.65 cfs @ 12.07 hrs, Volume= 2,166 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 8,758 | 98 | Paved parking & roofs |
| 8,758 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-BLDG: P-BLDG

Runoff = 3.14 cfs @ 12.07 hrs, Volume= 10,514 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 42,517 | 98 | Paved parking & roofs |
| 42,517 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-1: P-WATERSHED-1

Runoff = 0.66 cfs @ 12.15 hrs, Volume= 2,421 cf, Depth= 1.27"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 315 | 98 | Paved parking & roofs |
| 20,100 | 77 | Woods, Good, HSG D |
| 2,396 | 80 | >75% Grass cover, Good, HSG D |
| 22,811 | 78 | Weighted Average |
| 22,496 | | Pervious Area |
| 315 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.3 | | | | | **Direct Entry,** |

## Subcatchment P-WS-3: P-WATERSHED-3

Runoff = 1.87 cfs @ 12.14 hrs, Volume= 6,699 cf, Depth= 1.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 468 | 98 | Paved parking & roofs |
| 2,089 | 77 | Woods, Good, HSG D |
| 29,848 | 80 | >75% Grass cover, Good, HSG D |
| 3,401 | 98 | Paved parking & roofs |
| 9,934 | 98 | Paved parking & roofs |
| 45,740 | 85 | Weighted Average |
| 31,937 | | Pervious Area |
| 13,803 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.4 | 36 | 0.0135 | 0.08 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.2 | 6 | 0.0050 | 0.45 | | **Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20" |
| 2.6 | 10 | 0.0135 | 0.06 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.1 | 5 | 0.0135 | 0.81 | | **Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps |
| 10.3 | 57 | Total | | | |

## Subcatchment P-WS-4: P-WATERSHED-4

Runoff = 0.02 cfs @ 12.07 hrs, Volume= 74 cf, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 36 | 98 | Paved parking & roofs |
| 342 | 91 | Gravel roads, HSG D |
| 378 | 92 | Weighted Average |
| 342 | | Pervious Area |
| 36 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-5: P-WATERSHED-5

Runoff = 3.41 cfs @ 12.10 hrs, Volume= 10,880 cf, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 28,300 | 98 | Paved parking & roofs |
| 1,758 | 77 | Woods, Good, HSG D |
| 36,107 | 80 | >75% Grass cover, Good, HSG D |
| 2,019 | 80 | >75% Grass cover, Good, HSG D |
| 68,184 | 87 | Weighted Average |
| 39,884 | | Pervious Area |
| 28,300 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 4.3 | 37 | 0.0540 | 0.14 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 1.4 | 13 | 0.1200 | 0.16 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.2 | 38 | 0.1315 | 2.54 | | **Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps |
| 0.9 | 267 | 0.0600 | 4.97 | | **Shallow Concentrated Flow,** Paved Kv= 20.3 fps |
| 6.8 | 355 | Total | | | |

## Subcatchment P-WS-5A: P-WATERSHED-5A

Runoff = 0.42 cfs @ 12.07 hrs, Volume= 1,413 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 77 | 80 | >75% Grass cover, Good, HSG D |
| 5,635 | 98 | Paved parking & roofs |
| 5,712 | 98 | Weighted Average |
| 77 | | Pervious Area |
| 5,635 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-5B: P-WATERSHED-5B

Runoff = 0.10 cfs @ 12.07 hrs, Volume= 344 cf, Depth= 2.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 1,393 | 98 | Paved parking & roofs |
| 1,393 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-6: P-WATERSHED-6

Runoff = 2.16 cfs @ 12.09 hrs, Volume= 6,803 cf, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 22,427 | 98 | Paved parking & roofs |
| 13,721 | 80 | >75% Grass cover, Good, HSG D |
| 36,148 | 91 | Weighted Average |
| 13,721 | | Pervious Area |
| 22,427 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.3 | 50 | 0.0600 | 0.16 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.7 | 113 | 0.0200 | 2.87 | | **Shallow Concentrated Flow,** Paved Kv= 20.3 fps |
| 6.0 | 163 | Total | | | |

## Subcatchment P-WS-6A: P-WATERSHED-6A

Runoff = 0.12 cfs @ 12.07 hrs, Volume= 362 cf, Depth= 2.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-yr Rainfall=3.20"

| Area (sf) | CN | Description |
|---|---|---|
| 473 | 80 | >75% Grass cover, Good, HSG D |
| 1,301 | 98 | Paved parking & roofs |
| 1,774 | 93 | Weighted Average |
| 473 | | Pervious Area |
| 1,301 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Pond CB-1: CATCH BASIN

Inflow Area = 5,712 sf, Inflow Depth = 2.97" for 2-yr event
Inflow = 0.42 cfs @ 12.07 hrs, Volume= 1,413 cf
Outflow = 0.42 cfs @ 12.07 hrs, Volume= 1,413 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.42 cfs @ 12.07 hrs, Volume= 1,413 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.26' @ 12.07 hrs
Flood Elev= 86.40'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 86.40' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 82.90' | **12.0" x 38.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 82.10' S= 0.0211 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.42 cfs @ 12.07 hrs HW=83.26' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.42 cfs @ 1.62 fps)

## Pond CB-2: CATCH BASIN

Inflow Area = 1,393 sf, Inflow Depth = 2.97" for 2-yr event
Inflow = 0.10 cfs @ 12.07 hrs, Volume= 344 cf
Outflow = 0.10 cfs @ 12.07 hrs, Volume= 344 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.10 cfs @ 12.07 hrs, Volume= 344 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 67.67' @ 12.07 hrs
Flood Elev= 71.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 71.00' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 67.50' | **12.0" x 24.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 66.90' S= 0.0250 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.10 cfs @ 12.07 hrs HW=67.67' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.10 cfs @ 1.12 fps)

## Pond CB-3: CATCH BASIN

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1,774 sf, | Inflow Depth = | 2.45" | for 2-yr event |
| Inflow = | 0.12 cfs @ | 12.07 hrs, | Volume= | 362 cf |
| Outflow = | 0.12 cfs @ | 12.07 hrs, | Volume= | 362 cf, Atten= 0%, Lag= 0.0 min |
| Primary = | 0.12 cfs @ | 12.07 hrs, | Volume= | 362 cf |

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 61.31' @ 12.07 hrs
Flood Elev= 64.60'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 64.60' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 61.10' | **8.0" x 5.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 61.00' S= 0.0200 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.12 cfs @ 12.07 hrs HW=61.31' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.12 cfs @ 1.23 fps)

## Pond DMH-1: DMH-1

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 88,257 sf, | Inflow Depth = | 1.98" | for 2-yr event |
| Inflow = | 2.51 cfs @ | 12.27 hrs, | Volume= | 14,526 cf |
| Outflow = | 2.51 cfs @ | 12.27 hrs, | Volume= | 14,526 cf, Atten= 0%, Lag= 0.0 min |
| Primary = | 2.51 cfs @ | 12.27 hrs, | Volume= | 14,526 cf |

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.73' @ 12.27 hrs
Flood Elev= 92.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 82.81' | **15.0" x 67.0' long 15" CI PIPE**<br>CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 69.00' S= 0.2061 '/' Cc= 0.900<br>n= 0.013 Cast iron, coated |

**Primary OutFlow** Max=2.51 cfs @ 12.27 hrs HW=83.73' (Free Discharge)
↑—**1=15" CI PIPE** (Inlet Controls 2.51 cfs @ 2.58 fps)

## Pond DW-1: DRYWELL

Inflow Area = 5,712 sf, Inflow Depth = 2.97" for 2-yr event
Inflow = 0.42 cfs @ 12.07 hrs, Volume= 1,413 cf
Outflow = 0.42 cfs @ 12.08 hrs, Volume= 1,117 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.00 cfs @ 11.33 hrs, Volume= 37 cf
Primary = 0.42 cfs @ 12.08 hrs, Volume= 1,080 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 85.76' @ 12.08 hrs Surf.Area= 179 sf Storage= 335 cf

Plug-Flow detention time= 160.3 min calculated for 1,117 cf (79% of inflow)
Center-of-Mass det. time= 82.0 min ( 837.5 - 755.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 76.35' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 77.35' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 83.35' | 7 cf | **2.00'D x 2.15'H RISER** -Impervious |
| #4 | 85.50' | 50 cf | **SURFACE AREA (Prismatic)** Listed below (Recalc) |
| | | 359 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 85.50 | 100 | 0 | 0 |
| 86.00 | 100 | 50 | 50 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 85.50' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 11.33 hrs HW=85.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.40 cfs @ 12.08 hrs HW=85.76' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.40 cfs @ 1.72 fps)

## Pond DW-3: DRYWELL

Inflow Area = 1,393 sf, Inflow Depth = 2.97" for 2-yr event
Inflow = 0.10 cfs @ 12.07 hrs, Volume= 344 cf
Outflow = 0.00 cfs @ 18.46 hrs, Volume= 34 cf, Atten= 99%, Lag= 383.4 min
Discarded = 0.00 cfs @ 4.15 hrs, Volume= 26 cf
Primary = 0.00 cfs @ 18.46 hrs, Volume= 8 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 70.81' @ 18.46 hrs Surf.Area= 79 sf Storage= 311 cf

Plug-Flow detention time= 1,053.3 min calculated for 34 cf (10% of inflow)
Center-of-Mass det. time= 707.9 min ( 1,463.3 - 755.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 61.15' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 62.15' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 68.15' | 8 cf | **2.00'D x 2.65'H RISER** -Impervious |
| | | 311 cf | Total Available Storage |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 70.80' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 4.15 hrs HW=61.27' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.00 cfs @ 18.46 hrs HW=70.81' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.00 cfs @ 0.27 fps)

## Pond DW-4: DRYWELL

| | | | | |
|---|---|---|---|---|
| Inflow Area = | 1,774 sf, | Inflow Depth = | 2.45" | for 2-yr event |
| Inflow = | 0.12 cfs @ | 12.07 hrs, | Volume= | 362 cf |
| Outflow = | 0.11 cfs @ | 12.10 hrs, | Volume= | 245 cf, Atten= 5%, Lag= 1.5 min |
| Discarded = | 0.00 cfs @ | 7.17 hrs, | Volume= | 25 cf |
| Primary = | 0.11 cfs @ | 12.10 hrs, | Volume= | 220 cf |

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 58.62' @ 12.10 hrs Surf.Area= 79 sf Storage= 136 cf

Plug-Flow detention time= 242.8 min calculated for 245 cf (68% of inflow)
Center-of-Mass det. time= 148.0 min ( 939.8 - 791.7 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 55.25' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 56.25' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 62.25' | 10 cf | **2.00'D x 3.25'H RISER** -Impervious |
| #4 | 65.50' | 50 cf | **SURFACE AREA (Prismatic)** Listed below (Recalc) |
| | | 363 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 65.50 | 100 | 0 | 0 |
| 66.00 | 100 | 50 | 50 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 58.50' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 7.17 hrs HW=55.36' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.09 cfs @ 12.10 hrs HW=58.62' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.09 cfs @ 1.19 fps)

## Pond INF-TNKS: STORMTANK

| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 88,257 sf, | Inflow Depth = | 2.34" | for | 2-yr event |
| Inflow = | 4.66 cfs @ | 12.09 hrs, | Volume= | 17,214 cf | |
| Outflow = | 2.52 cfs @ | 12.27 hrs, | Volume= | 15,818 cf, | Atten= 46%, Lag= 11.0 min |
| Discarded = | 0.01 cfs @ | 6.95 hrs, | Volume= | 1,292 cf | |
| Primary = | 2.51 cfs @ | 12.27 hrs, | Volume= | 14,526 cf | |

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 85.88' @ 12.27 hrs Surf.Area= 3,956 sf Storage= 5,038 cf

Plug-Flow detention time= 159.9 min calculated for 15,815 cf (92% of inflow)
Center-of-Mass det. time= 117.7 min ( 902.2 - 784.5 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 84.00' | 5,094 cf | **1.50'W x 3.00'L x 3.00'H Brentwood ST-36** x 389<br>5,252 cf Overall x 97.0% Voids |
| #2 | 83.50' | 3,473 cf | **STONE SURROUND (Prismatic)** Listed below (Recalc)<br>9,923 cf Overall x 35.0% Voids |
| | | 8,567 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 83.50 | 2,205 | 0 | 0 |
| 87.00 | 2,205 | 7,718 | 7,718 |
| 88.00 | 2,205 | 2,205 | 9,923 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |
| #2 | Device 4 | 84.65' | **6.0" Vert. 6" ORIFICE** X 2 rows with 18.0" cc spacing C= 0.600 |
| #3 | Primary | 84.67' | **8.0" Vert. 8" ORIFICE** C= 0.600 |
| #4 | Primary | 84.23' | **15.0" x 40.0' long 15" HDPE** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 82.81' S= 0.0355 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior |
| #5 | Device 4 | 86.00' | **5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 6.95 hrs HW=84.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=2.51 cfs @ 12.27 hrs HW=85.88' (Free Discharge)
├**3=8" ORIFICE** (Orifice Controls 1.58 cfs @ 4.52 fps)
└**4=15" HDPE** (Passes 0.94 cfs of 4.73 cfs potential flow)
  ├**2=6" ORIFICE** (Orifice Controls 0.94 cfs @ 4.78 fps)
  └**5=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

## Link POA-OFFSITE: OFFSITE

Inflow Area = 233,415 sf, Inflow Depth = 1.96" for 2-yr event
Inflow = 9.38 cfs @ 12.10 hrs, Volume= 38,178 cf
Primary = 9.38 cfs @ 12.10 hrs, Volume= 38,178 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

## Link POA-WTLNDS: POA-WETLANDS

Inflow Area = 224,279 sf, Inflow Depth = 1.92" for 2-yr event
Inflow = 8.76 cfs @ 12.10 hrs, Volume= 35,938 cf
Primary = 8.76 cfs @ 12.10 hrs, Volume= 35,938 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-WS-2: P-WATERSHED-2** Runoff Area=8,758 sf Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.92 cfs 3,112 cf

**Subcatchment P-BLDG: P-BLDG** Runoff Area=42,517 sf Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=4.45 cfs 15,108 cf

**Subcatchment P-WS-1: P-WATERSHED-1** Runoff Area=22,811 sf Runoff Depth=2.29"
Tc=10.3 min CN=78 Runoff=1.22 cfs 4,358 cf

**Subcatchment P-WS-3: P-WATERSHED-3** Runoff Area=45,740 sf Runoff Depth=2.91"
Flow Length=57' Tc=10.3 min CN=85 Runoff=3.09 cfs 11,089 cf

**Subcatchment P-WS-4: P-WATERSHED-4** Runoff Area=378 sf Runoff Depth=3.60"
Tc=5.0 min CN=92 Runoff=0.04 cfs 113 cf

**Subcatchment P-WS-5: P-WATERSHED-5** Runoff Area=68,184 sf Runoff Depth=3.10"
Flow Length=355' Tc=6.8 min CN=87 Runoff=5.46 cfs 17,608 cf

**Subcatchment P-WS-5A: P-WATERSHED-5A** Runoff Area=5,712 sf Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.60 cfs 2,030 cf

**Subcatchment P-WS-5B: P-WATERSHED-5B** Runoff Area=1,393 sf Runoff Depth=4.26"
Tc=5.0 min CN=98 Runoff=0.15 cfs 495 cf

**Subcatchment P-WS-6: P-WATERSHED-6** Runoff Area=36,148 sf Runoff Depth=3.50"
Flow Length=163' Tc=6.0 min CN=91 Runoff=3.28 cfs 10,537 cf

**Subcatchment P-WS-6A: P-WATERSHED-6A** Runoff Area=1,774 sf Runoff Depth=3.71"
Tc=5.0 min CN=93 Runoff=0.17 cfs 548 cf

**Pond CB-1: CATCH BASIN** Peak Elev=83.34' Inflow=0.60 cfs 2,030 cf
Outflow=0.60 cfs 2,030 cf

**Pond CB-2: CATCH BASIN** Peak Elev=67.71' Inflow=0.15 cfs 495 cf
Outflow=0.15 cfs 495 cf

**Pond CB-3: CATCH BASIN** Peak Elev=61.36' Inflow=0.17 cfs 548 cf
Outflow=0.17 cfs 548 cf

**Pond DMH-1: DMH-1** Peak Elev=84.73' Inflow=5.31 cfs 23,470 cf
15.0" x 67.0' Culvert Outflow=5.31 cfs 23,470 cf

**Pond DW-1: DRYWELL** Peak Elev=85.81' Storage=340 cf Inflow=0.60 cfs 2,030 cf
Discarded=0.00 cfs 38 cf Primary=0.59 cfs 1,696 cf Outflow=0.59 cfs 1,734 cf

**Pond DW-3: DRYWELL** Peak Elev=70.86' Storage=311 cf Inflow=0.15 cfs 495 cf
Discarded=0.00 cfs 27 cf Primary=0.05 cfs 169 cf Outflow=0.05 cfs 196 cf

**Pond DW-4: DRYWELL** Peak Elev=58.66' Storage=138 cf Inflow=0.17 cfs 548 cf
Discarded=0.00 cfs 25 cf Primary=0.17 cfs 406 cf Outflow=0.17 cfs 432 cf

**Pond INF-TNKS: STORMTANK** Peak Elev=86.29' Storage=6,042 cf Inflow=7.01 cfs 26,196 cf
Discarded=0.01 cfs 1,324 cf Primary=5.31 cfs 23,470 cf Outflow=5.32 cfs 24,794 cf

**Link POA-OFFSITE: OFFSITE** Inflow=15.08 cfs 61,471 cf
Primary=15.08 cfs 61,471 cf

**Link POA-WTLNDS: POA-WETLANDS** Inflow=14.32 cfs 58,246 cf
Primary=14.32 cfs 58,246 cf

**Total Runoff Area = 233,415 sf Runoff Volume = 64,999 cf Average Runoff Depth = 3.34"**
**46.67% Pervious Area = 108,930 sf 53.33% Impervious Area = 124,485 sf**

## Subcatchment EX-WS-2: P-WATERSHED-2

Runoff = 0.92 cfs @ 12.07 hrs, Volume= 3,112 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 8,758 | 98 | Paved parking & roofs |
| 8,758 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-BLDG: P-BLDG

Runoff = 4.45 cfs @ 12.07 hrs, Volume= 15,108 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 42,517 | 98 | Paved parking & roofs |
| 42,517 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-1: P-WATERSHED-1

Runoff = 1.22 cfs @ 12.14 hrs, Volume= 4,358 cf, Depth= 2.29"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 315 | 98 | Paved parking & roofs |
| 20,100 | 77 | Woods, Good, HSG D |
| 2,396 | 80 | >75% Grass cover, Good, HSG D |
| 22,811 | 78 | Weighted Average |
| 22,496 | | Pervious Area |
| 315 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.3 | | | | | **Direct Entry,** |

## Subcatchment P-WS-3: P-WATERSHED-3

Runoff = 3.09 cfs @ 12.14 hrs, Volume= 11,089 cf, Depth= 2.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 468 | 98 | Paved parking & roofs |
| 2,089 | 77 | Woods, Good, HSG D |
| 29,848 | 80 | >75% Grass cover, Good, HSG D |
| 3,401 | 98 | Paved parking & roofs |
| 9,934 | 98 | Paved parking & roofs |
| 45,740 | 85 | Weighted Average |
| 31,937 | | Pervious Area |
| 13,803 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.4 | 36 | 0.0135 | 0.08 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.2 | 6 | 0.0050 | 0.45 | | **Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20" |
| 2.6 | 10 | 0.0135 | 0.06 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.1 | 5 | 0.0135 | 0.81 | | **Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps |
| 10.3 | 57 | Total | | | |

## Subcatchment P-WS-4: P-WATERSHED-4

Runoff = 0.04 cfs @ 12.07 hrs, Volume= 113 cf, Depth= 3.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 36 | 98 | Paved parking & roofs |
| 342 | 91 | Gravel roads, HSG D |
| 378 | 92 | Weighted Average |
| 342 | | Pervious Area |
| 36 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-5: P-WATERSHED-5

Runoff = 5.46 cfs @ 12.10 hrs, Volume= 17,608 cf, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 28,300 | 98 | Paved parking & roofs |
| 1,758 | 77 | Woods, Good, HSG D |
| 36,107 | 80 | >75% Grass cover, Good, HSG D |
| 2,019 | 80 | >75% Grass cover, Good, HSG D |
| 68,184 | 87 | Weighted Average |
| 39,884 | | Pervious Area |
| 28,300 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 4.3 | 37 | 0.0540 | 0.14 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 1.4 | 13 | 0.1200 | 0.16 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.2 | 38 | 0.1315 | 2.54 | | **Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps |
| 0.9 | 267 | 0.0600 | 4.97 | | **Shallow Concentrated Flow,** Paved Kv= 20.3 fps |
| 6.8 | 355 | Total | | | |

## Subcatchment P-WS-5A: P-WATERSHED-5A

Runoff = 0.60 cfs @ 12.07 hrs, Volume= 2,030 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 77 | 80 | >75% Grass cover, Good, HSG D |
| 5,635 | 98 | Paved parking & roofs |
| 5,712 | 98 | Weighted Average |
| 77 | | Pervious Area |
| 5,635 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-5B: P-WATERSHED-5B

Runoff = 0.15 cfs @ 12.07 hrs, Volume= 495 cf, Depth= 4.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 1,393 | 98 | Paved parking & roofs |
| 1,393 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-6: P-WATERSHED-6

Runoff = 3.28 cfs @ 12.09 hrs, Volume= 10,537 cf, Depth= 3.50"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 22,427 | 98 | Paved parking & roofs |
| 13,721 | 80 | >75% Grass cover, Good, HSG D |
| 36,148 | 91 | Weighted Average |
| 13,721 | | Pervious Area |
| 22,427 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.3 | 50 | 0.0600 | 0.16 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.7 | 113 | 0.0200 | 2.87 | | **Shallow Concentrated Flow,** Paved Kv= 20.3 fps |
| 6.0 | 163 | Total | | | |

## Subcatchment P-WS-6A: P-WATERSHED-6A

Runoff = 0.17 cfs @ 12.07 hrs, Volume= 548 cf, Depth= 3.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-yr Rainfall=4.50"

| Area (sf) | CN | Description |
|---|---|---|
| 473 | 80 | >75% Grass cover, Good, HSG D |
| 1,301 | 98 | Paved parking & roofs |
| 1,774 | 93 | Weighted Average |
| 473 | | Pervious Area |
| 1,301 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Pond CB-1: CATCH BASIN

Inflow Area = 5,712 sf, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.60 cfs @ 12.07 hrs, Volume= 2,030 cf
Outflow = 0.60 cfs @ 12.07 hrs, Volume= 2,030 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.60 cfs @ 12.07 hrs, Volume= 2,030 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.34' @ 12.07 hrs
Flood Elev= 86.40'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 86.40' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 82.90' | **12.0" x 38.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 82.10' S= 0.0211 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.60 cfs @ 12.07 hrs HW=83.34' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.60 cfs @ 1.79 fps)

## Pond CB-2: CATCH BASIN

Inflow Area = 1,393 sf, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.15 cfs @ 12.07 hrs, Volume= 495 cf
Outflow = 0.15 cfs @ 12.07 hrs, Volume= 495 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.15 cfs @ 12.07 hrs, Volume= 495 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 67.71' @ 12.07 hrs
Flood Elev= 71.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 71.00' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 67.50' | **12.0" x 24.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 66.90' S= 0.0250 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.14 cfs @ 12.07 hrs HW=67.71' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.14 cfs @ 1.22 fps)

## Pond CB-3: CATCH BASIN

Inflow Area = 1,774 sf, Inflow Depth = 3.71" for 10-yr event
Inflow = 0.17 cfs @ 12.07 hrs, Volume= 548 cf
Outflow = 0.17 cfs @ 12.07 hrs, Volume= 548 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.17 cfs @ 12.07 hrs, Volume= 548 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 61.36' @ 12.07 hrs
Flood Elev= 64.60'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 64.60' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 61.10' | **8.0" x 5.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 61.00' S= 0.0200 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.17 cfs @ 12.07 hrs HW=61.36' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.17 cfs @ 1.37 fps)

## Pond DMH-1: DMH-1

Inflow Area = 88,257 sf, Inflow Depth = 3.19" for 10-yr event
Inflow = 5.31 cfs @ 12.18 hrs, Volume= 23,470 cf
Outflow = 5.31 cfs @ 12.18 hrs, Volume= 23,470 cf, Atten= 0%, Lag= 0.0 min
Primary = 5.31 cfs @ 12.18 hrs, Volume= 23,470 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 84.73' @ 12.18 hrs
Flood Elev= 92.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 82.81' | **15.0" x 67.0' long 15" CI PIPE**<br>CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 69.00' S= 0.2061 '/' Cc= 0.900<br>n= 0.013 Cast iron, coated |

**Primary OutFlow** Max=5.31 cfs @ 12.18 hrs HW=84.73' (Free Discharge)
↑—**1=15" CI PIPE** (Inlet Controls 5.31 cfs @ 4.33 fps)

## Pond DW-1: DRYWELL

Inflow Area = 5,712 sf, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.60 cfs @ 12.07 hrs, Volume= 2,030 cf
Outflow = 0.59 cfs @ 12.08 hrs, Volume= 1,734 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.00 cfs @ 10.15 hrs, Volume= 38 cf
Primary = 0.59 cfs @ 12.08 hrs, Volume= 1,696 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 85.81' @ 12.08 hrs Surf.Area= 179 sf Storage= 340 cf

Plug-Flow detention time= 130.4 min calculated for 1,734 cf (85% of inflow)
Center-of-Mass det. time= 66.5 min ( 815.4 - 748.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 76.35' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 77.35' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 83.35' | 7 cf | **2.00'D x 2.15'H RISER** -Impervious |
| #4 | 85.50' | 50 cf | **SURFACE AREA (Prismatic)** Listed below (Recalc) |
| | | 359 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 85.50 | 100 | 0 | 0 |
| 86.00 | 100 | 50 | 50 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 85.50' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 10.15 hrs HW=85.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.58 cfs @ 12.08 hrs HW=85.81' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.58 cfs @ 1.89 fps)

## Pond DW-3: DRYWELL

Inflow Area = 1,393 sf, Inflow Depth = 4.26" for 10-yr event
Inflow = 0.15 cfs @ 12.07 hrs, Volume= 495 cf
Outflow = 0.05 cfs @ 12.38 hrs, Volume= 196 cf, Atten= 68%, Lag= 18.9 min
Discarded = 0.00 cfs @ 3.08 hrs, Volume= 27 cf
Primary = 0.05 cfs @ 12.38 hrs, Volume= 169 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 70.86' @ 12.38 hrs Surf.Area= 79 sf Storage= 311 cf

Plug-Flow detention time= 413.1 min calculated for 196 cf (40% of inflow)
Center-of-Mass det. time= 257.7 min ( 1,006.6 - 748.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 61.15' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 62.15' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 68.15' | 8 cf | **2.00'D x 2.65'H RISER** -Impervious |
| | | 311 cf | Total Available Storage |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 70.80' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 3.08 hrs HW=61.27' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.02 cfs @ 12.38 hrs HW=70.86' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.02 cfs @ 0.83 fps)

## Pond DW-4: DRYWELL

Inflow Area = 1,774 sf, Inflow Depth = 3.71" for 10-yr event
Inflow = 0.17 cfs @ 12.07 hrs, Volume= 548 cf
Outflow = 0.17 cfs @ 12.08 hrs, Volume= 432 cf, Atten= 1%, Lag= 0.5 min
Discarded = 0.00 cfs @ 5.67 hrs, Volume= 25 cf
Primary = 0.17 cfs @ 12.08 hrs, Volume= 406 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 58.66' @ 12.08 hrs Surf.Area= 79 sf Storage= 138 cf

Plug-Flow detention time= 175.0 min calculated for 431 cf (79% of inflow)
Center-of-Mass det. time= 97.4 min ( 878.0 - 780.6 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 55.25' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 56.25' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 62.25' | 10 cf | **2.00'D x 3.25'H RISER** -Impervious |
| #4 | 65.50' | 50 cf | **SURFACE AREA (Prismatic)** Listed below (Recalc) |
| | | 363 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 65.50 | 100 | 0 | 0 |
| 66.00 | 100 | 50 | 50 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 58.50' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 5.67 hrs HW=55.36' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.16 cfs @ 12.08 hrs HW=58.66' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.16 cfs @ 1.36 fps)

## Pond INF-TNKS: STORMTANK

Inflow Area = 88,257 sf, Inflow Depth = 3.56" for 10-yr event
Inflow = 7.01 cfs @ 12.09 hrs, Volume= 26,196 cf
Outflow = 5.32 cfs @ 12.18 hrs, Volume= 24,794 cf, Atten= 24%, Lag= 5.4 min
Discarded = 0.01 cfs @ 5.39 hrs, Volume= 1,324 cf
Primary = 5.31 cfs @ 12.18 hrs, Volume= 23,470 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 86.29' @ 12.18 hrs Surf.Area= 3,956 sf Storage= 6,042 cf

Plug-Flow detention time= 117.9 min calculated for 24,789 cf (95% of inflow)
Center-of-Mass det. time= 87.8 min ( 865.0 - 777.2 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 84.00' | 5,094 cf | **1.50'W x 3.00'L x 3.00'H Brentwood ST-36** x 389<br>5,252 cf Overall x 97.0% Voids |
| #2 | 83.50' | 3,473 cf | **STONE SURROUND (Prismatic)** Listed below (Recalc)<br>9,923 cf Overall x 35.0% Voids |
| | | 8,567 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 83.50 | 2,205 | 0 | 0 |
| 87.00 | 2,205 | 7,718 | 7,718 |
| 88.00 | 2,205 | 2,205 | 9,923 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |
| #2 | Device 4 | 84.65' | **6.0" Vert. 6" ORIFICE** X 2 rows with 18.0" cc spacing C= 0.600 |
| #3 | Primary | 84.67' | **8.0" Vert. 8" ORIFICE** C= 0.600 |
| #4 | Primary | 84.23' | **15.0" x 40.0' long 15" HDPE** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 82.81' S= 0.0355 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior |
| #5 | Device 4 | 86.00' | **5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 5.39 hrs HW=84.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=5.31 cfs @ 12.18 hrs HW=86.29' (Free Discharge)
├**3=8" ORIFICE** (Orifice Controls 1.91 cfs @ 5.46 fps)
└**4=15" HDPE** (Passes 3.40 cfs of 5.59 cfs potential flow)
  ├**2=6" ORIFICE** (Orifice Controls 1.17 cfs @ 4.85 fps)
  └**5=Broad-Crested Rectangular Weir** (Weir Controls 2.23 cfs @ 1.54 fps)

## Link POA-OFFSITE: OFFSITE

Inflow Area = 233,415 sf, Inflow Depth = 3.16" for 10-yr event
Inflow = 15.08 cfs @ 12.12 hrs, Volume= 61,471 cf
Primary = 15.08 cfs @ 12.12 hrs, Volume= 61,471 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

## Link POA-WTLNDS: POA-WETLANDS

Inflow Area = 224,279 sf, Inflow Depth = 3.12" for 10-yr event
Inflow = 14.32 cfs @ 12.13 hrs, Volume= 58,246 cf
Primary = 14.32 cfs @ 12.13 hrs, Volume= 58,246 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment EX-WS-2: P-WATERSHED-2** Runoff Area=8,758 sf Runoff Depth=6.76"
Tc=5.0 min CN=98 Runoff=1.43 cfs 4,934 cf

**Subcatchment P-BLDG: P-BLDG** Runoff Area=42,517 sf Runoff Depth=6.76"
Tc=5.0 min CN=98 Runoff=6.94 cfs 23,954 cf

**Subcatchment P-WS-1: P-WATERSHED-1** Runoff Area=22,811 sf Runoff Depth=4.47"
Tc=10.3 min CN=78 Runoff=2.37 cfs 8,506 cf

**Subcatchment P-WS-3: P-WATERSHED-3** Runoff Area=45,740 sf Runoff Depth=5.25"
Flow Length=57' Tc=10.3 min CN=85 Runoff=5.46 cfs 20,021 cf

**Subcatchment P-WS-4: P-WATERSHED-4** Runoff Area=378 sf Runoff Depth=6.05"
Tc=5.0 min CN=92 Runoff=0.06 cfs 191 cf

**Subcatchment P-WS-5: P-WATERSHED-5** Runoff Area=68,184 sf Runoff Depth=5.48"
Flow Length=355' Tc=6.8 min CN=87 Runoff=9.41 cfs 31,134 cf

**Subcatchment P-WS-5A: P-WATERSHED-5A** Runoff Area=5,712 sf Runoff Depth=6.76"
Tc=5.0 min CN=98 Runoff=0.93 cfs 3,218 cf

**Subcatchment P-WS-5B: P-WATERSHED-5B** Runoff Area=1,393 sf Runoff Depth=6.76"
Tc=5.0 min CN=98 Runoff=0.23 cfs 785 cf

**Subcatchment P-WS-6: P-WATERSHED-6** Runoff Area=36,148 sf Runoff Depth=5.94"
Flow Length=163' Tc=6.0 min CN=91 Runoff=5.41 cfs 17,889 cf

**Subcatchment P-WS-6A: P-WATERSHED-6A** Runoff Area=1,774 sf Runoff Depth=6.17"
Tc=5.0 min CN=93 Runoff=0.28 cfs 912 cf

**Pond CB-1: CATCH BASIN** Peak Elev=83.47' Inflow=0.93 cfs 3,218 cf
Outflow=0.93 cfs 3,218 cf

**Pond CB-2: CATCH BASIN** Peak Elev=67.76' Inflow=0.23 cfs 785 cf
Outflow=0.23 cfs 785 cf

**Pond CB-3: CATCH BASIN** Peak Elev=61.44' Inflow=0.28 cfs 912 cf
Outflow=0.28 cfs 912 cf

**Pond DMH-1: DMH-1** Peak Elev=87.05' Inflow=8.87 cfs 41,212 cf
15.0" x 67.0' Culvert Outflow=8.87 cfs 41,212 cf

**Pond DW-1: DRYWELL** Peak Elev=85.89' Storage=348 cf Inflow=0.93 cfs 3,218 cf
Discarded=0.00 cfs 40 cf Primary=0.93 cfs 2,883 cf Outflow=0.93 cfs 2,923 cf

**Pond DW-3: DRYWELL** Peak Elev=70.98' Storage=311 cf Inflow=0.23 cfs 785 cf
Discarded=0.00 cfs 27 cf Primary=0.23 cfs 421 cf Outflow=0.23 cfs 449 cf

**Pond DW-4: DRYWELL** Peak Elev=58.71' Storage=140 cf Inflow=0.28 cfs 912 cf
Discarded=0.00 cfs 26 cf Primary=0.28 cfs 769 cf Outflow=0.28 cfs 796 cf

**Pond INF-TNKS: STORMTANK** Peak Elev=86.85' Storage=7,419 cf Inflow=11.56 cfs 43,976 cf
Discarded=0.01 cfs 1,356 cf Primary=8.87 cfs 41,212 cf Outflow=8.88 cfs 42,569 cf

**Link POA-OFFSITE: OFFSITE** Inflow=28.08 cfs 107,941 cf
Primary=28.08 cfs 107,941 cf

**Link POA-WTLNDS: POA-WETLANDS** Inflow=26.68 cfs 102,816 cf
Primary=26.68 cfs 102,816 cf

**Total Runoff Area = 233,415 sf Runoff Volume = 111,545 cf Average Runoff Depth = 5.73"**
**46.67% Pervious Area = 108,930 sf 53.33% Impervious Area = 124,485 sf**

## Subcatchment EX-WS-2: P-WATERSHED-2

Runoff = 1.43 cfs @ 12.07 hrs, Volume= 4,934 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 8,758 | 98 | Paved parking & roofs |
| 8,758 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-BLDG: P-BLDG

Runoff = 6.94 cfs @ 12.07 hrs, Volume= 23,954 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 42,517 | 98 | Paved parking & roofs |
| 42,517 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-1: P-WATERSHED-1

Runoff = 2.37 cfs @ 12.14 hrs, Volume= 8,506 cf, Depth= 4.47"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 315 | 98 | Paved parking & roofs |
| 20,100 | 77 | Woods, Good, HSG D |
| 2,396 | 80 | >75% Grass cover, Good, HSG D |
| 22,811 | 78 | Weighted Average |
| 22,496 | | Pervious Area |
| 315 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 10.3 | | | | | **Direct Entry,** |

## Subcatchment P-WS-3: P-WATERSHED-3

Runoff = 5.46 cfs @ 12.14 hrs, Volume= 20,021 cf, Depth= 5.25"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 468 | 98 | Paved parking & roofs |
| 2,089 | 77 | Woods, Good, HSG D |
| 29,848 | 80 | >75% Grass cover, Good, HSG D |
| 3,401 | 98 | Paved parking & roofs |
| 9,934 | 98 | Paved parking & roofs |
| 45,740 | 85 | Weighted Average |
| 31,937 | | Pervious Area |
| 13,803 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 7.4 | 36 | 0.0135 | 0.08 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.2 | 6 | 0.0050 | 0.45 | | **Sheet Flow,** Smooth surfaces n= 0.011 P2= 3.20" |
| 2.6 | 10 | 0.0135 | 0.06 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.1 | 5 | 0.0135 | 0.81 | | **Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps |
| 10.3 | 57 | Total | | | |

## Subcatchment P-WS-4: P-WATERSHED-4

Runoff = 0.06 cfs @ 12.07 hrs, Volume= 191 cf, Depth= 6.05"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 36 | 98 | Paved parking & roofs |
| 342 | 91 | Gravel roads, HSG D |
| 378 | 92 | Weighted Average |
| 342 | | Pervious Area |
| 36 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-5: P-WATERSHED-5

Runoff = 9.41 cfs @ 12.10 hrs, Volume= 31,134 cf, Depth= 5.48"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 28,300 | 98 | Paved parking & roofs |
| 1,758 | 77 | Woods, Good, HSG D |
| 36,107 | 80 | >75% Grass cover, Good, HSG D |
| 2,019 | 80 | >75% Grass cover, Good, HSG D |
| 68,184 | 87 | Weighted Average |
| 39,884 | | Pervious Area |
| 28,300 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 4.3 | 37 | 0.0540 | 0.14 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 1.4 | 13 | 0.1200 | 0.16 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.2 | 38 | 0.1315 | 2.54 | | **Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps |
| 0.9 | 267 | 0.0600 | 4.97 | | **Shallow Concentrated Flow,** Paved Kv= 20.3 fps |
| 6.8 | 355 | Total | | | |

## Subcatchment P-WS-5A: P-WATERSHED-5A

Runoff = 0.93 cfs @ 12.07 hrs, Volume= 3,218 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 77 | 80 | >75% Grass cover, Good, HSG D |
| 5,635 | 98 | Paved parking & roofs |
| 5,712 | 98 | Weighted Average |
| 77 | | Pervious Area |
| 5,635 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-5B: P-WATERSHED-5B

Runoff = 0.23 cfs @ 12.07 hrs, Volume= 785 cf, Depth= 6.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 1,393 | 98 | Paved parking & roofs |
| 1,393 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Subcatchment P-WS-6: P-WATERSHED-6

Runoff = 5.41 cfs @ 12.08 hrs, Volume= 17,889 cf, Depth= 5.94"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 22,427 | 98 | Paved parking & roofs |
| 13,721 | 80 | >75% Grass cover, Good, HSG D |
| 36,148 | 91 | Weighted Average |
| 13,721 | | Pervious Area |
| 22,427 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.3 | 50 | 0.0600 | 0.16 | | **Sheet Flow,** Grass: Dense n= 0.240 P2= 3.20" |
| 0.7 | 113 | 0.0200 | 2.87 | | **Shallow Concentrated Flow,** Paved Kv= 20.3 fps |
| 6.0 | 163 | Total | | | |

## Subcatchment P-WS-6A: P-WATERSHED-6A

Runoff = 0.28 cfs @ 12.07 hrs, Volume= 912 cf, Depth= 6.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-yr Rainfall=7.00"

| Area (sf) | CN | Description |
|---|---|---|
| 473 | 80 | >75% Grass cover, Good, HSG D |
| 1,301 | 98 | Paved parking & roofs |
| 1,774 | 93 | Weighted Average |
| 473 | | Pervious Area |
| 1,301 | | Impervious Area |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description |
|---|---|---|---|---|---|
| 5.0 | | | | | **Direct Entry,** |

## Pond CB-1: CATCH BASIN

Inflow Area = 5,712 sf, Inflow Depth = 6.76" for 100-yr event
Inflow = 0.93 cfs @ 12.07 hrs, Volume= 3,218 cf
Outflow = 0.93 cfs @ 12.07 hrs, Volume= 3,218 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.93 cfs @ 12.07 hrs, Volume= 3,218 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 83.47' @ 12.07 hrs
Flood Elev= 86.40'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 86.40' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 82.90' | **12.0" x 38.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 82.10' S= 0.0211 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.93 cfs @ 12.07 hrs HW=83.47' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.93 cfs @ 2.03 fps)

## Pond CB-2: CATCH BASIN

Inflow Area = 1,393 sf, Inflow Depth = 6.76" for 100-yr event
Inflow = 0.23 cfs @ 12.07 hrs, Volume= 785 cf
Outflow = 0.23 cfs @ 12.07 hrs, Volume= 785 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.23 cfs @ 12.07 hrs, Volume= 785 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 67.76' @ 12.07 hrs
Flood Elev= 71.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 71.00' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 67.50' | **12.0" x 24.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 66.90' S= 0.0250 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.23 cfs @ 12.07 hrs HW=67.76' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.23 cfs @ 1.38 fps)

## Pond CB-3: CATCH BASIN

Inflow Area = 1,774 sf, Inflow Depth = 6.17" for 100-yr event
Inflow = 0.28 cfs @ 12.07 hrs, Volume= 912 cf
Outflow = 0.28 cfs @ 12.07 hrs, Volume= 912 cf, Atten= 0%, Lag= 0.0 min
Primary = 0.28 cfs @ 12.07 hrs, Volume= 912 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 61.44' @ 12.07 hrs
Flood Elev= 64.60'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 64.60' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Primary | 61.10' | **8.0" x 5.0' long Culvert** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 61.00' S= 0.0200 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.28 cfs @ 12.07 hrs HW=61.44' (Free Discharge)
↑—**1=Orifice/Grate** ( Controls 0.00 cfs)
└—**2=Culvert** (Inlet Controls 0.28 cfs @ 1.57 fps)

## Pond DMH-1: DMH-1

Inflow Area = 88,257 sf, Inflow Depth = 5.60" for 100-yr event
Inflow = 8.87 cfs @ 12.18 hrs, Volume= 41,212 cf
Outflow = 8.87 cfs @ 12.18 hrs, Volume= 41,212 cf, Atten= 0%, Lag= 0.0 min
Primary = 8.87 cfs @ 12.18 hrs, Volume= 41,212 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Peak Elev= 87.05' @ 12.18 hrs
Flood Elev= 92.00'

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 82.81' | **15.0" x 67.0' long 15" CI PIPE**<br>CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 69.00' S= 0.2061 '/' Cc= 0.900<br>n= 0.013 Cast iron, coated |

**Primary OutFlow** Max=8.87 cfs @ 12.18 hrs HW=87.05' (Free Discharge)
↑—**1=15" CI PIPE** (Inlet Controls 8.87 cfs @ 7.23 fps)

## Pond DW-1: DRYWELL

Inflow Area = 5,712 sf, Inflow Depth = 6.76" for 100-yr event
Inflow = 0.93 cfs @ 12.07 hrs, Volume= 3,218 cf
Outflow = 0.93 cfs @ 12.08 hrs, Volume= 2,923 cf, Atten= 0%, Lag= 0.4 min
Discarded = 0.00 cfs @ 8.42 hrs, Volume= 40 cf
Primary = 0.93 cfs @ 12.08 hrs, Volume= 2,883 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 85.89' @ 12.08 hrs Surf.Area= 179 sf Storage= 348 cf

Plug-Flow detention time= 97.8 min calculated for 2,923 cf (91% of inflow)
Center-of-Mass det. time= 50.4 min ( 792.5 - 742.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 76.35' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 77.35' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 83.35' | 7 cf | **2.00'D x 2.15'H RISER** -Impervious |
| #4 | 85.50' | 50 cf | **SURFACE AREA (Prismatic)** Listed below (Recalc) |
| | | 359 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 85.50 | 100 | 0 | 0 |
| 86.00 | 100 | 50 | 50 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 85.50' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 8.42 hrs HW=85.51' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.91 cfs @ 12.08 hrs HW=85.89' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.91 cfs @ 2.12 fps)

## Pond DW-3: DRYWELL

Inflow Area = 1,393 sf, Inflow Depth = 6.76" for 100-yr event
Inflow = 0.23 cfs @ 12.07 hrs, Volume= 785 cf
Outflow = 0.23 cfs @ 12.07 hrs, Volume= 449 cf, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 2.02 hrs, Volume= 27 cf
Primary = 0.23 cfs @ 12.07 hrs, Volume= 421 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 70.98' @ 12.07 hrs Surf.Area= 79 sf Storage= 311 cf

Plug-Flow detention time= 239.9 min calculated for 449 cf (57% of inflow)
Center-of-Mass det. time= 122.5 min ( 864.5 - 742.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 61.15' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 62.15' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 68.15' | 8 cf | **2.00'D x 2.65'H RISER** -Impervious |
| | | 311 cf | Total Available Storage |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 70.80' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 2.02 hrs HW=61.27' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.21 cfs @ 12.07 hrs HW=70.98' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.21 cfs @ 1.45 fps)

## Pond DW-4: DRYWELL

Inflow Area = 1,774 sf, Inflow Depth = 6.17" for 100-yr event
Inflow = 0.28 cfs @ 12.07 hrs, Volume= 912 cf
Outflow = 0.28 cfs @ 12.07 hrs, Volume= 796 cf, Atten= 0%, Lag= 0.3 min
Discarded = 0.00 cfs @ 3.98 hrs, Volume= 26 cf
Primary = 0.28 cfs @ 12.07 hrs, Volume= 769 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 4
Peak Elev= 58.71' @ 12.07 hrs Surf.Area= 79 sf Storage= 140 cf

Plug-Flow detention time= 125.1 min calculated for 795 cf (87% of inflow)
Center-of-Mass det. time= 67.5 min ( 835.4 - 767.9 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 55.25' | 133 cf | **10.00'D x 7.00'H STONE** |
| | | | 550 cf Overall - 170 cf Embedded = 380 cf x 35.0% Voids |
| #2 | 56.25' | 170 cf | **6.00'D x 6.00'H DRYWELL** Inside #1 |
| #3 | 62.25' | 10 cf | **2.00'D x 3.25'H RISER** -Impervious |
| #4 | 65.50' | 50 cf | **SURFACE AREA (Prismatic)** Listed below (Recalc) |
| | | 363 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 65.50 | 100 | 0 | 0 |
| 66.00 | 100 | 50 | 50 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 58.50' | **24.0" Vert. Orifice/Grate** C= 0.600 |
| #2 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |

**Discarded OutFlow** Max=0.00 cfs @ 3.98 hrs HW=55.36' (Free Discharge)
↑—**2=Exfiltration** (Exfiltration Controls 0.00 cfs)

**Primary OutFlow** Max=0.27 cfs @ 12.07 hrs HW=58.71' (Free Discharge)
↑—**1=Orifice/Grate** (Orifice Controls 0.27 cfs @ 1.55 fps)

## Pond INF-TNKS: STORMTANK

Inflow Area = 88,257 sf, Inflow Depth = 5.98" for 100-yr event
Inflow = 11.56 cfs @ 12.09 hrs, Volume= 43,976 cf
Outflow = 8.88 cfs @ 12.18 hrs, Volume= 42,569 cf, Atten= 23%, Lag= 5.3 min
Discarded = 0.01 cfs @ 3.73 hrs, Volume= 1,356 cf
Primary = 8.87 cfs @ 12.18 hrs, Volume= 41,212 cf

Routing by Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs / 6
Peak Elev= 86.85' @ 12.18 hrs Surf.Area= 3,956 sf Storage= 7,419 cf

Plug-Flow detention time= 81.0 min calculated for 42,560 cf (97% of inflow)
Center-of-Mass det. time= 61.8 min ( 829.8 - 768.0 )

| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 84.00' | 5,094 cf | **1.50'W x 3.00'L x 3.00'H Brentwood ST-36** x 389<br>5,252 cf Overall x 97.0% Voids |
| #2 | 83.50' | 3,473 cf | **STONE SURROUND (Prismatic)** Listed below (Recalc)<br>9,923 cf Overall x 35.0% Voids |
| | | 8,567 cf | Total Available Storage |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 83.50 | 2,205 | 0 | 0 |
| 87.00 | 2,205 | 7,718 | 7,718 |
| 88.00 | 2,205 | 2,205 | 9,923 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Discarded | 0.00' | **0.090 in/hr Exfiltration over Surface area** |
| #2 | Device 4 | 84.65' | **6.0" Vert. 6" ORIFICE** X 2 rows with 18.0" cc spacing C= 0.600 |
| #3 | Primary | 84.67' | **8.0" Vert. 8" ORIFICE** C= 0.600 |
| #4 | Primary | 84.23' | **15.0" x 40.0' long 15" HDPE** CMP, projecting, no headwall, Ke= 0.900<br>Outlet Invert= 82.81' S= 0.0355 '/' Cc= 0.900<br>n= 0.013 Corrugated PE, smooth interior |
| #5 | Device 4 | 86.00' | **5.0' long x 0.5' breadth Broad-Crested Rectangular Weir**<br>Head (feet) 0.20 0.40 0.60 0.80 1.00<br>Coef. (English) 2.80 2.92 3.08 3.30 3.32 |

**Discarded OutFlow** Max=0.01 cfs @ 3.73 hrs HW=84.00' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.01 cfs)

**Primary OutFlow** Max=8.87 cfs @ 12.18 hrs HW=86.85' (Free Discharge)
├**3=8" ORIFICE** (Orifice Controls 2.28 cfs @ 6.54 fps)
└**4=15" HDPE** (Inlet Controls 6.59 cfs @ 5.37 fps)
  ├**2=6" ORIFICE** (Passes < 1.95 cfs potential flow)
  └**5=Broad-Crested Rectangular Weir** (Passes < 12.90 cfs potential flow)

## Link POA-OFFSITE: OFFSITE

Inflow Area = 233,415 sf, Inflow Depth = 5.55" for 100-yr event
Inflow = 28.08 cfs @ 12.10 hrs, Volume= 107,941 cf
Primary = 28.08 cfs @ 12.10 hrs, Volume= 107,941 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

## Link POA-WTLNDS: POA-WETLANDS

Inflow Area = 224,279 sf, Inflow Depth = 5.50" for 100-yr event
Inflow = 26.68 cfs @ 12.10 hrs, Volume= 102,816 cf
Primary = 26.68 cfs @ 12.10 hrs, Volume= 102,816 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

# APPENDIX 3:

## CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN AND EROSION CONTROL OPERATION AND MAINTENANCE PLAN

# VITALITY BOARDWALK ASSISTED LIVING DEVELOPMENT
# CONSTRUCTION PERIOD POLLUTION PREVENTION PLAN AND EROSION CONTROL OPERATION AND MAINTENANCE PLAN

**Submitted: September 2016**

## During The Construction Period the General Contractor shall be responsible for the following:

1. **Erosion Control**

   Erosion control barriers will be placed along down-gradient portion of the site as indicated on the project plans. Additional erosion control barriers will be placed at the limit of work as needed and in any sensitive areas as work progresses.

   A stockpile of additional erosion control barriers shall be kept on site at all times

2. **Site Access**

   Site access, for construction equipment will be from the Main Driveway as shown on the Site Preparation Plan CD-1.1, and a construction entrance will be installed at the onset of the project as shown.

3. **Construction Staging**

   A construction staging area will be established on the existing parking area. All construction materials, supplies, trailers and offices, portable toilets, and equipment shall be stored within the limits of the staging area. Temporary trailers and offices may also be located within the staging area. All temporary stockpiles will be surrounded with straw wattles and silt fencing as required.

4. **Site Grading/Site Work**

   The site activities may only commence when the site is stable from erosion and all required control measures are in place and functional.

5. **Slope Stabilization**

   All surfaces and slopes shall be checked after each major storm event and at *least once every 7 calendar days or once every 14 calendar days and within 24 hours of the occurrence of a storm event 0.25 inches or greater* to see that vegetation is in good condition. Any rills or damage from erosion shall be repaired immediately to avoid further damage. If seeps develop on the slopes, the area will be evaluated to determine if the seep will cause an unstable condition and shall be stabilized immediately if necessary. Problems found during the inspections by the General Contractor shall be repaired promptly. Areas requiring re-vegetation shall be replanted immediately or stabilized in a manner acceptable to the Conservation Commission if it is outside of the growing season. Slopes and other exposed surfaces receiving vegetation will be maintained as necessary to support healthy vegetation. If stabilization is required during the non-growing season, straw mulch, or a commercially manufactured blanket must be employed to prevent erosion

6. **Permanent Stabilization**

Disturbed portions of the site where construction activities permanently cease shall be stabilized with permanent seed no later than 14 days after the last construction activity. The permanent seed mix, fertilizer, and mulch shall be specified on the project plans. Permanent seeding shall occur in the Spring between 3/15 to 5/20 or Fall between 8/15 to 10/15.

7. **Drainage Structures (Catch Basins, Area Drains and existing Leaching Catch basin)**

All structures shall be inspected on a bi-weekly basis and/or after every rain storm and repairs made as necessary. Sediment shall be removed from the sump after the sediment has reached a maximum of one half the depth of the sump. The sediment shall be removed from the site and properly disposed of. Drainage structures/sumps shall be cleaned completely at the end of construction. .

8. **Dust and Sediment Control**

**Siltsacks:**
Catch basin / area drain filters shall be placed at all inlets to drainage structures as structures are installed and prior to pavement removal. Outlet protection work shall be constructed before runoff is allowed to enter the drainage system. Construction and location of catch basin filters shall be as indicated on the Drawings.

**Wattles:**
Wattles shall be installed as indicated on the Drawings.

Wattles shall be placed in a row with ends overlapping the adjacent row by a minimum of 24". Each wattle shall be securely anchored in place by 2 stakes driven downstream the wattles.

**Construction Entrance:**
The area of the construction entrance should be cleared of all pavement, and other objectionable material. The filter fabric should be placed on the subgrade prior to the gravel placement. The gravel shall be placed to the specified dimensions depicted on the plans.

The Construction entrance shall be a minimum of 50-feet in length and 20-feet wide.

**Dust Control:**
A mechanical street sweeper shall be utilized to clean the existing paved areas on an as-needed basis.

For emergency control of dust apply water to affected areas. The source of supply and the method of application for water are the responsibility of the contractor.

**Pollution Prevention Measures**

1. Before, during, and after construction, functional erosion and sedimentation controls shall be implemented to prevent the silting of the wetland areas down-gradient of the site. Wattles crushed stone, temporary stabilization and other controls shall be properly maintained and are not to be removed until the site is permanently stabilized. Other controls shall be added as warranted during construction to protect environmentally-sensitive areas. Sufficient extra materials (e.g. wattles and other control materials) shall be stored on site for emergencies.

2. Silt sacks and wattles check dams shall be installed at all existing and proposed infiltration areas to protect from soils and sediment.

2. Casting of excavated materials shall be stored away from wetland areas and sensitive land areas.

3. Any stockpiling of loose materials shall be properly stabilized to prevent erosion and siltation. Preventative controls such as straw bales, temporary seeding/mulching and jute covering shall be implemented to prevent such an occurrence.

4. There shall be no flooding, ponding, or flood related damage caused by the project or surface run-off emanating from the project on lands of an abutter, nearby or down-gradient of the site.

5. There shall be no contaminant migration caused by the project to nearby and down-gradient properties, nearby aquifers, and nearby resource areas.

6. The contractor shall make sufficient provisions to control any unexpected drainage and erosion conditions that may arise during construction that may create damage on abutting properties. Said control measures are to be implemented at once.

7. During construction flood prevention, erosion, and sedimentation controls shall be in place before the natural ground cover is disturbed. Said controls shall be in place prior to other construction work and shall be monitored and approved by the Contractor. They shall be properly maintained and are not to be removed until the site is stabilized.

8. The Contractor shall designate a person or persons to inspect and supervise the erosion controls for the project. The Conservation Commission shall be notified as to the means to contact said individual or individuals on a 24-hour basis on all working and non-working days of the project. Said means of contact shall include at least 2 separate telephone number of said designated person or persons.

9. There shall be periodic inspection of straw bales, and other erosion controls by the Contractor's Designee to assure their continued effectiveness.

10. The Contractor shall make adequate provisions for controlling erosion and sediment from activities that might yield water at high volumes with high suspended solid contents, such as dewatering excavations.

11. Street sweeping shall be used to keep public ways free and clear of sediment and dirt from the site activities.

**Other Control Measures**

Waste Materials. All trash and construction debris from the site will be hauled to an approved landfill or recycling facility. No construction waste material will be buried on the site. All personnel will receive instructions regarding the correct procedure for waste disposal. Notices describing these practices will be posted in the construction office. The site superintendent will be responsible for seeing that these procedures are followed. Employee waste and other loose materials will be collected so as to prevent the release of floatables during rainfall events.

Hazardous Waste. No Hazardous materials are expected to be encountered. The mandated State and Local permits for removal of such materials, if located, will be implemented when such materials are encountered.

## After Construction Vitality Assisted Living (the Owner) shall be responsible for the following:

## General Land Grading and Slopes Stabilization

All surfaces and slopes shall be checked bi-annually to see that vegetation is in good condition. Any rills or damage from erosion shall be repaired immediately to avoid further damage. If seeps develop on the slopes, the area will be evaluated to determine if the seep will cause an unstable condition and shall be stabilized immediately if necessary. Problems found during the inspections by the Owner shall be repaired promptly. Areas requiring re-vegetation shall be replanted immediately. Slopes and other exposed surfaces receiving vegetation will be maintained as necessary to support healthy vegetation.

Areas of steep slopes (2.5:1 or greater) shall be stabilized using jute mesh or a similar approved erosion blanket.

## Street Sweeping

It is proposed that the parking and drive areas be swept with a wet brush street sweeper on a semi-annual basis, with at least two sweepings per year. One sweep shall be done at the end of the winter season (prior to the heavy rains), and the other sweep at the end of autumn (prior to snowfall).

## Rip Rap

Bi-annually and after large storms, the rip-rap rock at the stormwater outlet shall be inspected to ensure that the stones is maintained in-place. Lost or dislocated rocks shall be replaced as soon as possible.

## Stormwater Management System

**Catch Basins/Area Drains:**
The drains shall be inspected annually, and cleaned out when sumps are approximately one foot full. The use of "clam shells" for sediment removal shall not be allowed; a vacuum truck shall be the approved method of cleaning. Integrity and functionality of oil hoods shall also be checked at the time of the inspection. A record of cleaning shall be recorded in the Maintenance Log

**Infiltration System**
The infiltration shall be inspected after major storms for the first year after installation. Inspection ports shall be viewed to ensure no standing water remains after 72 hours. After the first year the system shall be inspected on an annual bases and notes on the repost logged.

INSPECTION REPORT FORM FOR STORM WATER SYSTEM

**Project: Vitality Boardwalk Assisted Living Development -Beverly MA**
**50 Dunham Road**

**INSPECTOR:**_____ **DATE:**_____

**Regular Inspection:** ☐
**Inspection after Rainfall:** ☐ **Amount of Rainfall:**_____**inches**

| BMP | Functioning Correctly | Notes/Action Taken |
|---|---|---|
| | **Y/N** | |
| | **Y/N** | |
| | **Y/N** | |
| | **Y/N** | |
| | **Y/N** | |
| | **Y/N** | |
| | **Y/N** | |

**Additional Observations:** _____

_____

_____

**Action Required:** _____

_____

_____

**To be performed by:**_____ **On or Before:**_____

# APPENDIX 4:
## CALCULATIONS

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

*Version 1, Automated: Mar. 4, 2008*

Location: P-WATERSHED-3

## TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump and Hooded Catch Basin** | **0.25** | **1.00** | **0.25** | **0.75** |
| **Subsurface Infiltration Structure** | **0.80** | **0.75** | **0.60** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |

**Total TSS Removal =** **85%**

**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project: 16106.00- VITALITY BOARDWALK

Prepared By: MEK

Date: 9.20.16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

*Version 1, Automated: Mar. 4, 2008*

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Location: P-WATERSHED-5A

## TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump and Hooded Catch Basin** | **0.25** | **1.00** | **0.25** | **0.75** |
| **Dry Well** | **0.80** | **0.75** | **0.60** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |

**Total TSS Removal =** **85%**

**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project: 16106.00- VITALITY BOARDWALK

Prepared By: MEK

Date: 9.20.16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:

1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

*Version 1, Automated: Mar. 4, 2008*

Location: P-WATERSHED-5B

## TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| **Deep Sump and Hooded Catch Basin** | **0.25** | **1.00** | **0.25** | **0.75** |
| **Dry Well** | **0.80** | **0.75** | **0.60** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |
| | **0.00** | **0.15** | **0.00** | **0.15** |

**Total TSS Removal =** **85%**

**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project: 16106.00- VITALITY BOARDWALK

Prepared By: MEK

Date: 9.20.16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed

1. From MassDEP Stormwater Handbook Vol. 1

INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
2. Select BMP from Drop Down Menu
3. After BMP is selected, TSS Removal and other Columns are automatically completed.

*Version 1, Automated: Mar. 4, 2008*

Location: P-WATERSHED-6A

## TSS Removal Calculation Worksheet

| B<br>BMP[1] | C<br>TSS Removal Rate[1] | D<br>Starting TSS Load* | E<br>Amount Removed (C*D) | F<br>Remaining Load (D-E) |
|---|---|---|---|---|
| Deep Sump and Hooded Catch Basin | 0.25 | 1.00 | 0.25 | 0.75 |
| Dry Well | 0.80 | 0.75 | 0.60 | 0.15 |
| | 0.00 | 0.15 | 0.00 | 0.15 |
| | 0.00 | 0.15 | 0.00 | 0.15 |
| | 0.00 | 0.15 | 0.00 | 0.15 |

**Total TSS Removal =** 85%

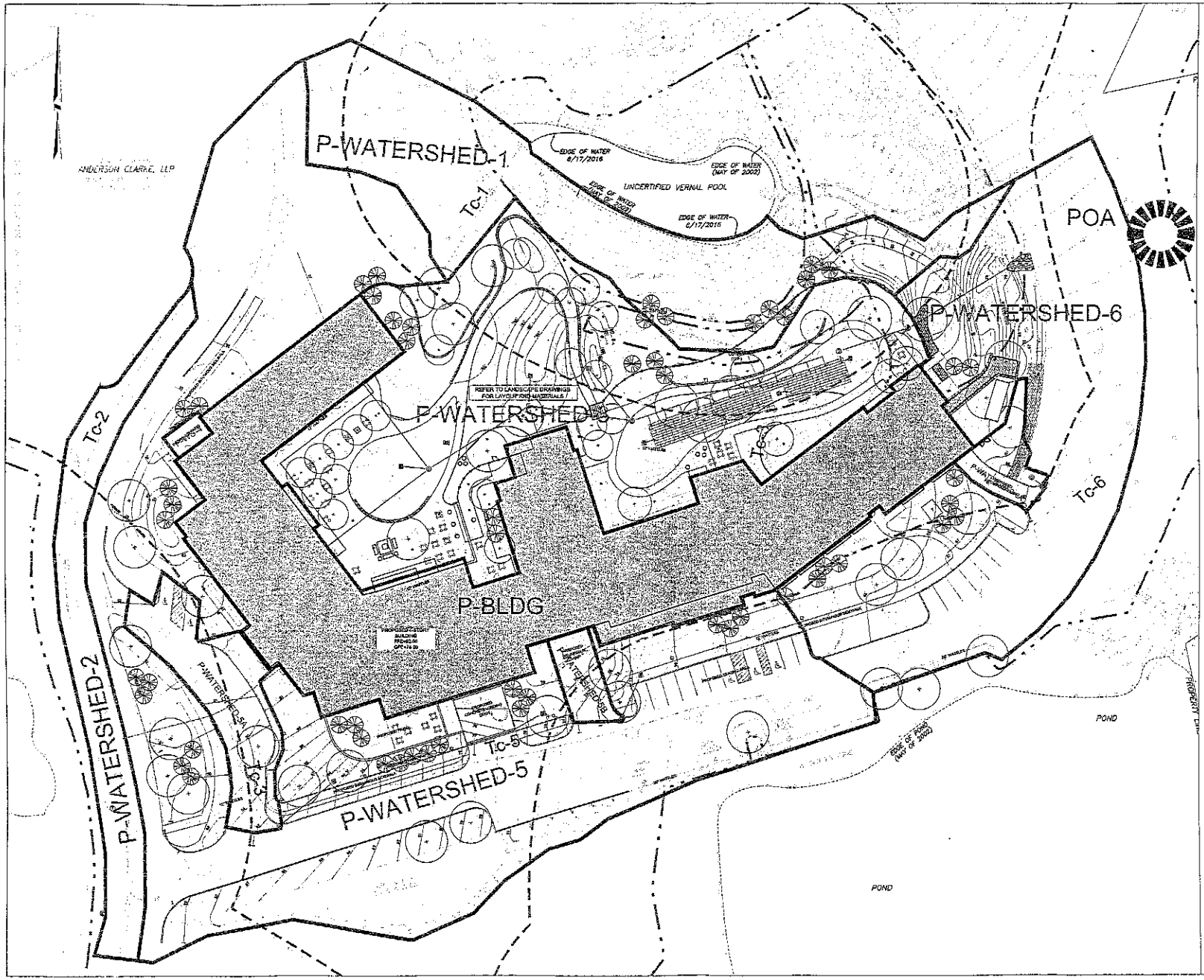
**Separate Form Needs to be Completed for Each Outlet or BMP Train**

Project: 16106.00- VITALITY BOARDWALK
Prepared By: MEK
Date: 9.20.16

*Equals remaining load from previous BMP (E) which enters the BMP

Non-automated TSS Calculation Sheet must be used if Proprietary BMP Proposed
1. From MassDEP Stormwater Handbook Vol. 1

# APPENDIX 5:
## SKETCHES




Boardwalk Beverly

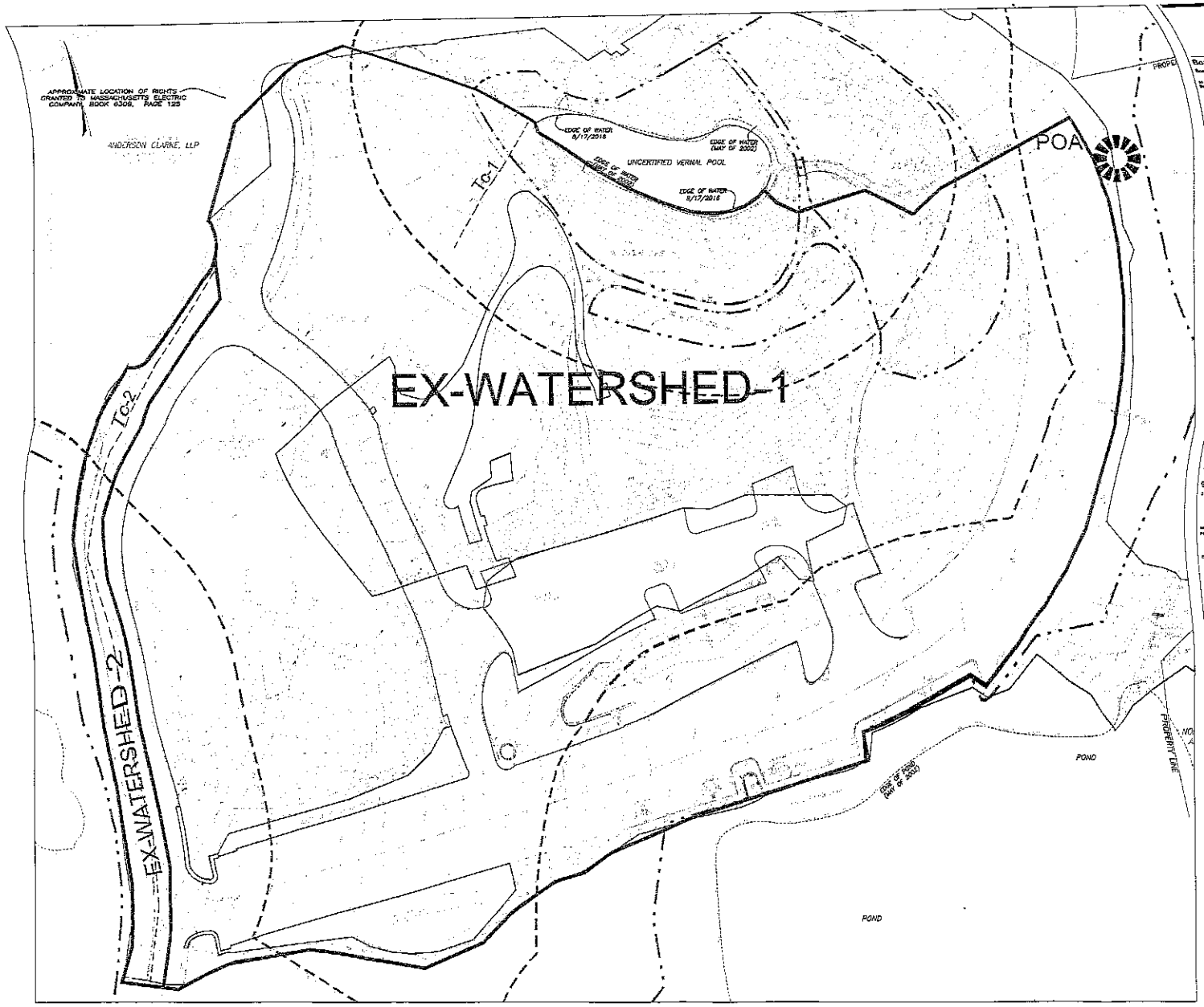
Boardwalk Beverly

LEVI+WONG DESIGN ASSOCIATES LWDA

NOT FOR CONSTRUCTION

PROPOSED WATERSHED

PW-1.1




Boardwalk Beverly

LEVI+WONG DESIGN ASSOCIATES LWDA

NOT FOR CONSTRUCTION

EXISTING WATERSHED

EX-1.1