Allen & Major Associates, Inc. Computation Sheet

Title	***Pipe Sizing Table***	Minimum Slope:	0.50%		By	SJL
Project	Broadstone Bare Cove	Minimum Pipe Size:	12		Chk'd	CMQ
Date	August 12, 2016	Rainfall Intensity (in/hr):	6.00	(25 year storm)	Apprv'd	CMQ
Revised	January 10, 2017	Manning's n:	0.011	HDPE/PVC		
A&M Project Number: 2118-02		Minimum Pipe Cover:	1.34	(AREA DRAIN 1F)		

Broadstone Bare Cove

Line						Req'd. Capac.	Pipe Size	Slope	Design Capacity		Drop	Invert Elevation		Rim Elev.	
From	To	Length	Area	wgt. *C*	*C* A	*Qd*	*D*	*s*	Q_{full}	V_{full}		Upper	Lower	Upper	Cover
Upper	Lower	(feet)	(acres)			(cfs)	(in)	(%)	(cfs)	(fps)	(feet)	(ft)	(ft)	(ft)	(ft)
CB1A	DMH1	95	0.407	0.59	0.240	1.44	12	2.00%	6.0	7.58	1.90	23.25	21.35	26.00	1.63
CB1B	DMH1	15	0.056	0.71	0.040	0.24	12	4.33%	8.8	11.16	0.65	22.00	21.35	26.40	3.28
DMH1	CDS1	60				1.68	12	5.00%	9.4	11.99	3.00	21.25	18.25	26.50	4.13
CDS1	DMH3/UIS1	3				1.68	12	5.00%	9.4	11.99	0.15	18.25	18.10	25.10	5.73
CB2A	DMH2	22	0.302	0.81	0.245	1.47	12	1.00%	4.2	5.36	0.22	18.00	17.78	21.00	1.88
CB2B	DMH2	9	0.302	0.81	0.245	1.47	12	2.44%	6.6	8.38	0.22	18.00	17.78	21.00	1.88
DMH2	CDS2	39				2.94	12	3.85%	8.3	10.51	1.50	17.68	16.18	21.70	2.90
CDS2	UIS1	4				2.94	12	2.00%	6.0	7.58	0.08	16.18	16.10	23.00	5.70
OCS1	DMH11	80	***(From HydroCAD 25-Year Storm)***			**2.30**	12	1.00%	4.2	5.36	0.80	16.75	15.95	23.00	5.13
TRENCH	DRY WELL	13	0.079	0.95	0.075	0.45	12	1.00%	4.2	5.36	0.13	14.30	14.17	16.30	0.88
DRY WELL	DMH9	266				0.45	12	0.84%	3.9	4.92	2.24	15.25	13.01	18.00	1.63
CB4	DMH4/UIS2	32	0.319	0.74	0.236	1.42	12	5.00%	9.4	11.99	1.60	23.00	21.40	27.50	3.38
CB5A	DMH5	90	0.261	0.81	0.212	1.27	12	2.00%	6.0	7.58	1.80	25.70	23.90	29.20	2.38
CB5B	DMH5	6	0.641	0.61	0.390	2.34	12	5.00%	9.4	11.99	0.30	24.00	23.70	27.50	2.38
DMH5	DMH6	34				3.61	12	5.00%	9.4	11.99	1.70	23.25	21.55	27.80	3.43
DMH6	CDS4	37				3.61	15	1.00%	7.7	6.22	0.37	21.45	21.08	28.10	5.28
CB7	CDS4	11	0.185	0.83	0.153	0.92	12	5.00%	9.4	11.99	0.55	21.63	21.08	27.60	4.85
CDS4	UIS2	4				4.53	15	2.00%	10.8	8.80	0.08	21.08	21.00	27.80	5.35
AD1F	DMH7	190	0.166	0.95	0.158	0.95	12	2.00%	6.0	7.58	3.80	25.20	21.40	27.50	1.18
CO1A	DMH7	652	0.498	0.95	0.473	2.84	15	0.50%	5.4	4.40	3.26	24.66	21.40	28.20	2.17
DMH7	OCS2/UIS2	30				3.79	15	1.00%	7.7	6.22	0.30	21.30	21.00	28.30	5.63
OCS2	DMH8	33	***(From HydroCAD 25-Year Storm)***			**1.74**	18	5.00%	27.8	15.71	1.65	22.10	20.45	28.30	4.58
DMH8	DMH9	19				1.74	18	5.00%	27.8	15.71	0.95	19.30	18.35	28.30	7.38
DMH9	DMH10	206				1.74	18	1.00%	12.4	7.03	2.06	12.91	10.85	28.60	14.07
CB13	FES2	19	0.181	0.71	0.128	0.77	12	2.00%	6.0	7.58	0.38	17.10	16.72	20.60	2.38
TRENCH 2	DMH14	68	0.176	0.55	0.097	0.58	8	1.00%	1.4	4.09	0.68	17.80	17.12	19.80	1.21
TRENCH 3	DMH14	12	0.241	0.95	0.229	1.37	8	1.00%	1.4	4.09	0.12	16.80	16.68	18.80	1.21
DMH14	CDS5	3				2.73	15	2.00%	10.8	8.80	0.06	16.58	16.52	19.50	1.55
CDS5	FES1	11				2.73	15	2.00%	10.8	8.80	0.22	16.52	16.30	19.30	1.41
OCS3A	FES3	34	***(From HydroCAD 25-Year Storm)***			**5.63**	15	1.18%	8.3	6.75	0.40	16.40	16.00	21.20	3.43
OCS3B	DMH10	45	***(From HydroCAD 25-Year Storm)***			**4.70**	12	5.00%	9.4	11.99	2.25	15.00	12.75	18.00	1.88
DMH10	DMH11	105				4.70	18	1.00%	12.4	7.03	1.05	10.75	9.70	25.20	12.83
DMH11	HW1	10				8.74	18	1.00%	12.4	7.03	0.10	9.60	9.50	21.80	10.58

Allen & Major Associates, Inc. Computation Sheet

Title	***Pipe Sizing Table***	Minimum Slope:	0.50%	By	SJL
Project	Broadstone Bare Cove	Minimum Pipe Size:	12	Chk'd	CMQ
Date	August 12, 2016	Rainfall Intensity (in/hr):	6.00 (25 year storm)	Apprv'd	CMQ
Revised	January 10, 2017	Manning's n:	0.011 HDPE/PVC		
A&M Project Number: 2118-02		Minimum Pipe Cover:	1.34 (AREA DRAIN 1F)		

Broadstone Bare Cove

Line						Req'd. Capac.	Pipe Size	Slope	Design Capacity		Drop	Invert Elevation		Rim Elev.	
From	To	Length	Area	wgt. *C*	*C* A	*Qd*	*D*	*s*	Q_{full}	V_{full}		Upper	Lower	Upper	Cover
Upper	Lower	(feet)	(acres)			(cfs)	(in)	(%)	(cfs)	(fps)	(feet)	(ft)	(ft)	(ft)	(ft)
CB16	CDS6	122	0.110	0.75	0.083	0.50	12	5.00%	9.4	11.99	6.10	19.30	13.20	30.80	10.38
CB17A	DMH17	86	0.428	0.66	0.283	1.70	12	3.00%	7.3	9.29	2.58	16.68	14.10	21.70	3.90
CB17B	DMH17	12	0.561	0.66	0.368	2.21	12	5.00%	9.4	11.99	0.60	14.70	14.10	25.20	9.38
DMH17	CDS6	16				4.41	12	5.00%	9.4	11.99	0.80	14.00	13.20	24.70	9.58
CDS6	DMH16	7				4.41	12	4.29%	8.7	11.10	0.30	13.20	12.90	24.80	10.48
AD4A	AD4B	12	0.177	0.43	0.077	0.46	12	1.00%	4.2	5.36	0.12	19.00	18.88	21.00	0.88
AD4B	DMH19	75	0.177	0.43	0.077	0.46	12	2.00%	6.0	7.58	1.50	18.88	17.38	21.00	1.00
AD4C	AD4D	39	0.177	0.35	0.062	0.37	12	5.00%	9.4	11.99	1.95	20.00	18.05	22.00	0.88
AD4D	DMH19	19	0.177	0.92	0.163	0.98	12	5.00%	9.4	11.99	0.95	18.05	17.10	22.00	2.83
DMH19	DMH20/UIS4	63				2.27	12	5.00%	9.4	11.99	3.15	17.00	13.85	22.50	4.38
OCS4	DMH21	76	***(From HydroCAD 25-Year Storm)***			**6.13**	18	1.00%	12.4	7.03	0.76	14.90	14.14	22.50	5.98
DMH21	DMH22	75				6.13	18	1.00%	12.4	7.03	0.75	14.04	13.29	21.90	6.24
DMH22	FES4	15				6.13	18	1.00%	12.4	7.03	0.15	13.19	13.04	22.40	7.59

Hingham Fire - Rescue

Fire Prevention & Code Enforcement

210 Central Street, Hingham, MA 02043
*Phone: 781-741-1488 * Fax: 781-741-1460*

To: Carlton Quinn
From: LT Chris DiNapoli, Fire Marshal
Re: 230 Beal St Bldg 1 East Side
Date: 1/17/2017

Mr. Quinn in regards to the e-mail I received from you dated 1/11/2017 advising of the issue with the drive at 230 Beal St Building 1 on the East side. The driveway is 164' long thereby exceeding the NFPA code of 150' that requires a turn around for fire apparatus. I have reviewed the plans and will grant relief from this code for this particular driveway. We will not require you to put a turnaround at the end of this drive. Should you have any further questions or concerns please do not hesitate to contact me. I am also forwarding a copy of this notice to Emily Wentworth to be placed in the file.

Title:	***Hydrant Flow Test Summary***
Project:	***Broadstone Bare Cove, Hingham, MA***
Date:	12/6/2016
Start Time:	10:00 PM
End Time:	10:50 PM
A&M#:	2118-02A
Location:	230 Beal Street, Hingham, MA
Performed By:	Steve Lee & Keven Mulcahy
Witnessed By:	Jason Rodgers (Excel Fire), Keven Mulcahy (A&M), Dave King (Aquarion)
Purpose of test:	Determine static & residual pressure for 8" C.L.D.I. water main in Beal Street.
Pitot Gauge:	2" Pitotless Nozzle + Open Atmosphere
Pressure Gauge:	2-1/2" Static/Residual Pressure Gauge

ALLEN & MAJOR ASSOCIATES, INC.

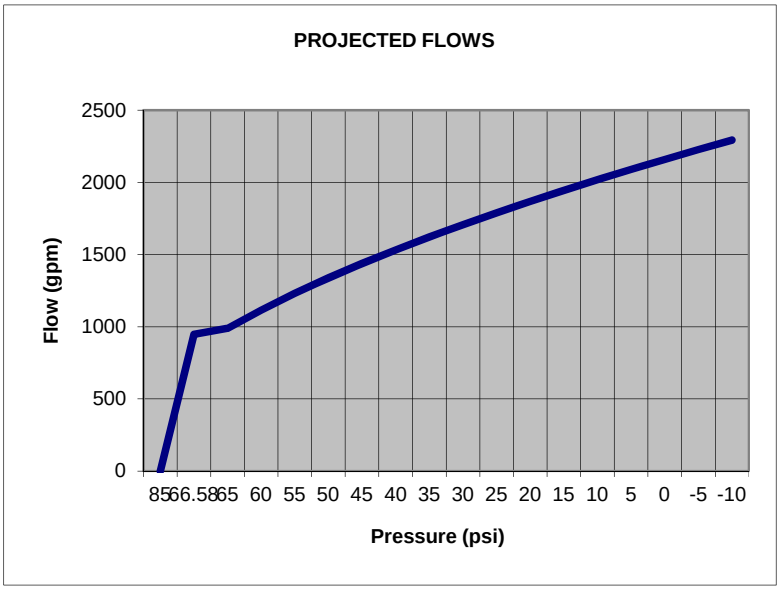
Commerce Way 100
P.O. Box 2118
Woburn, MA 01888-0118
Tel: (781) 935-6889

HYDRANT A (PRESSURE)	***Observed Pressure (psi)***	***Gauge Correction* (psi)***	***Corrected Pressure (psi)***	***Pressure Drop (psi)***	***Elevation (feet)***
STATIC	85	NONE	85.00	0	27.5
RESIDUAL	80	-13.42	66.58	18.42	27.5

HYDRANT B (FLOW)	***Orrifice Diameter***	***Pitot Reading (psi)***	***Hose Monster K Factor***	***Flow Rate (gpm)***	***Elevation (feet)***
OUTLET	2.0	32	167.20	946	58.5

PROJECTED RESULTS

Flow (gpm)	Residual (psi)
0	85
946	66.58
989	65
1115	60
1231	55
1338	50
1438	45
1532	40
1622	35
1707	30
1789	25
1869	20
1945	15
2019	10
2090	5
2160	0



SEE ATTACHED SKETCH FOR HYDRANT LOCATIONS
SEE ATTACHED SHEET FOR FLOW RATE FACTORS AND FORMULA

Equation:

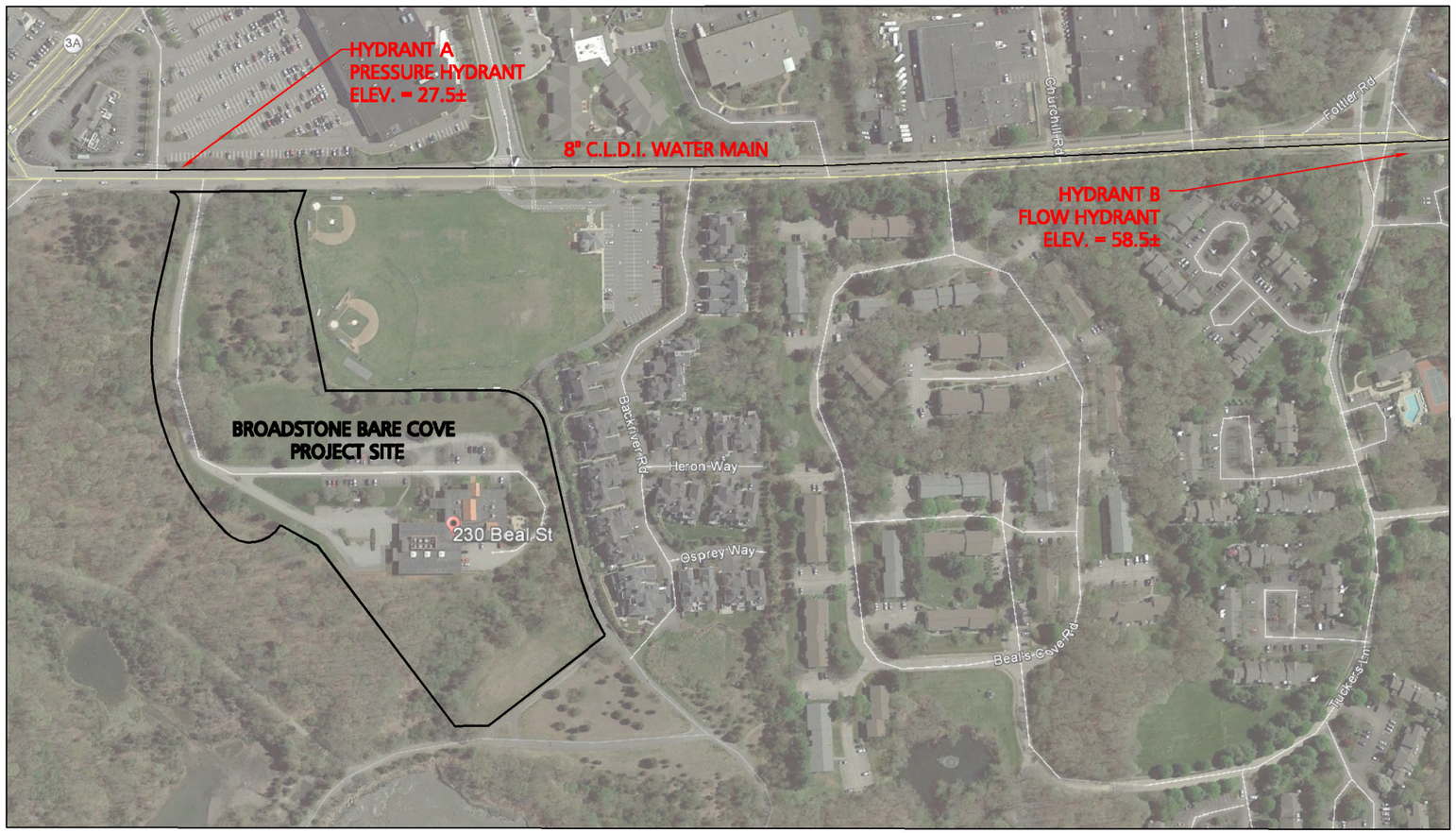
$Q_2 = Q_1*(S-R_2)^{0.54}/(S-R_1)^{0.54}$

Where:

S=Static Pressure R_2=Projected Pressure Q_2=Projected Flow Rate

R_1=Residual Pressure Q_1=Measured Flow Rate

***Gauge correction** - If the static gauge is at a different elevation than the pitot, the gauge reading must be corrected:
For each 12" of elevation that the static gauge is **ABOVE** the pitot, **INCREASE** the gauge reading by 0.433 PSI.
For each 12" of elevation that the static gauge is **BELOW** the pitot, **DECREASE** the gauge reading by 0.433 PSI.



APPLICANT/OWNER:

ALLIANCE RESIDENTIAL COMPANY
184 HIGH STREET, SUITE 401
BOSTON, MA, 02110

PROJECT:

BROADSTONE BARE COVE
HINGHAM, MA

PROJECT NO.	2118-03	DATE:	12-06-2016
SCALE:	NOT TO SCALE	DWG. NAME:	SKETCH
DESIGNED BY:	SJL	CHECKED BY:	CMQ

PREPARED BY:

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DRAWING TITLE:

HYDRANT FLOW SKETCH

SHEET No.

SK

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N:\PROJECTS\2118-02\WP\REPORTS\FIRE FLOW TESTING\2016-12-06 - HYDRANT FLOW TEST\HYDRANT FLOW TEST SKETCH.DWG

Calculating Flow-rates

The flow charts we provide with the Pitotless Nozzle™, Hose Monster® and Nozzle Inserts are correct and should be referred to first. Our flow charts are calculated using K-Factors derived from testing performed at FM Approvals. It is common for third-party software to use the pitot formula to compute flow-rate. The 2½" Hose Monster uses a pitot to measure velocity pressure. The Pitotless Nozzle and 4" and 4½" Hose Monsters do not use a pitot, and the pitot formula has to be tricked into calculating correct flow-rates. Entering the coefficients into a program that uses orifice diameter, coefficient and velocity pressure should give relatively accurate flow-rates. Check results against our flow charts.

Here are the equations used for calculating flow-rates and predicting flow-rates. Use the orifice diameter, coefficient or K-factor found on the next page.

K-factor Formula

Computes a flow-rate in GPM given a psi and a K-factor of the flow device.

$$Q = \sqrt{P} \times K$$

Q = flow-rate in GPM, P = velocity pressure in psi, K = K-factor of flow device

Pitot Formula

Computes a flow-rate in GPM given a psi and coefficient of the flow device.

$$Q = 29.84 \times \sqrt{P} \times D^2 \times C$$

Q = flow-rate in GPM, P = velocity pressure in psi, D = orifice diameter in inches
C = coefficient of flow device

Equation for Determining Rated Capacity

Computes the flow-rate available at a specified residual pressure (a.k.a. Rated Capacity).

The example below enables you to find the predicted flow-rate at 20 psi residual pressure.

$$Q_R = Q_F \times (H_R^{0.54} / H_F^{0.54})$$

Q_R = Flow-rate predicted at the desired residual pressure in GPM

Q_F = Total test flow-rate measured during test in GPM
(GPM measured from Hose Monster or Pitotless Nozzle)

H_R = Pressure drop from static pressure to desired residual pressure
(Static – 20 psi [if 20 psi is the desired residual pressure])

H_F = Actual pressure drop measured during the test (Static – Actual Residual)

(Source: NFPA 291, 2010)

Conversion Factors

Here are some conversion factors for switching between US and metric units:

Flow-rate:

US Gallons per Minute x 3.785 = Liters per Minute
Liters per Minute x 0.264 = US Gallons per Minute

US Gallons per Minute x 0.1337 = Cubic Feet per Minute
Cubic Feet per Minute x 7.481 = US Gallons per Minute

Volume:

US Gallons x 3.785 = Liters
Liters x 0.264 = US Gallons

US Gallons x 0.8327 = Imperial Gallons
Imperial Gallons x 1.201 = US Gallons

Cubic Feet x 7.48051945 = US Gallons
US Gallons x 0.1337 = Cubic Feet

Pressure:

psi x 0.0689 = Bars
Bars x 14.5038 = psi

psi x 6894.757 = Pascals
Pascals x 0.000145 = psi

Bars x 100,000 = Pascals
Pascals x 0.00001 = Bars

Weight of Water:

US Gallons of Water x 8.3454 = Pounds
Cubic Feet of Water x 62.42796 = Pounds

Length:

Meters x 3.2808 = Feet
Feet x 0.3048 = Meters

Coefficient and K-Factor Table for Various Flow Devices

last update: 2/14/2012

Pitotless Nozzle™

Device	K-factor	Coefficient	Orifice Diameter	psi Range	Flow Range (GPM)
2" Pitotless Nozzle + Little Hose Monster™	156.0	1.31	2"	10–70	490–1300
2" Pitotless Nozzle + 2½" Hose Monster Steel	164.8	1.38	2"	10–80	520–1380
2" Pitotless Nozzle + Open Atmosphere	167.2	1.40	2"	10–70	530–1400
1¾" Pitotless Nozzle + Little Hose Monster	104.7	1.15	1.75"	10–90	330–1000
1¾" Pitotless Nozzle + 2½" Hose Monster Steel	106.6	1.17	1.75"	10–90	340–1010
1¾" Pitotless Nozzle + Open Atmosphere	109.7	1.20	1.75"	10–90	350–1040
1⅛" Pitotless Nozzle + Little Hose Monster	37.2	0.98	1.125"	5–90	80–350
1⅛" Pitotless Nozzle + 2½" Hose Monster Steel	37.4	0.99	1.125"	5–90	80–350
1⅛" Pitotless Nozzle + Open Atmosphere	37.0	0.98	1.125"	5–90	80–350
1" Pitotless Nozzle + Little Hose Monster	27.2	0.91	1"	3–90	50–260
1" Pitotless Nozzle + 2½" Hose Monster Steel	27.6	0.93	1"	3–90	50–260
1" Pitotless Nozzle + Open Atmosphere	27.7	0.93	1"	3–90	50–260

In-Line Pitotless Nozzle™

Device	K-factor	Coefficient	Orifice Diameter	psi Range	Flow Range (GPM)
2" In-line Pitotless Nozzle	165.3	1.38	2"	10–75	530–1430
1¾" In-line Pitotless Nozzle	109.9	1.20	1.75"	5–80	250–980
1⅛" In-line Pitotless Nozzle	38.4	1.02	1.125"	5–70	90–320

BigBoy Hose Monster™

Device	K-factor	Coefficient	Orifice Diameter	psi Range	Flow Range (GPM)
4 to 10 psi (BigBoy Hose Monster)	382.9	1.38	3.05"	4–10	766–1211
11 to 36 psi (BigBoy Hose Monster)	376.0	1.35	3.05"	11–36	1247–2256
37 to 53 psi (BigBoy Hose Monster)	372.0	1.34	3.05"	37–53	2263–2708

Note: Due to the shape and size of the BigBoy Pitotless Nozzle, the BigBoy Hose Monster uses three different k-factors over its operating range.

2½" Hose Monster®

Device	K-factor	Coefficient	Orifice Diameter	psi Range	Flow Range (GPM)
2½" Hose Monster	168.67	0.906	2.5"	10–75	530–1460
1¾" Nozzle Insert	89.04	0.975	1.75"	10–75	280–770
1⅛" Nozzle Insert	37.36	0.99	1.125"	10–75	120–320

4" and 4½" Hose Monster®

Device	K-factor	Coefficient	Orifice Diameter	psi Range	Flow Range (GPM)
4½" Hose Monster	331.07	0.548	4.5"	10–75	1050–2870
4" Hose Monster	339.65	0.712	4"	10–75	1070–2940

Using Software

Use the table below if you are using software that requires the coefficient input to be less than '1.0'. Notice that the orifice diameter must be changed from its true diameter in order to accommodate the lower coefficient. This is necessary only for the 2" Pitotless Nozzle and the ¾" Pitotless Nozzle.

Device	Coefficient	Orifice Diameter
2" Pitotless Nozzle + Little Hose Monster	0.99	2.30"
2" Pitotless Nozzle + 2½" Hose Monster Steel	0.99	2.36"
2" Pitotless Nozzle + Open Atmosphere	0.99	2.38"
1¾" Pitotless Nozzle + Little Hose Monster	0.99	1.88"
1¾" Pitotless Nozzle + 2½" Hose Monster Steel	0.99	1.90"
1¾" Pitotless Nozzle + Open Atmosphere	0.99	1.93"

Note: If your software uses the Theoretical Discharge Formula, found in NFPA 291, 4.7.3, the coefficient of discharge can be used to produce flow rates that will match our flow charts.

A hand-held pitot directly at a hydrant outlet

Outlet Type	Coefficient
Outlet smooth and rounded	0.9
Outlet square and sharp	0.8
Outlet square and projecting into barrel	0.7
If a stream straightener is used	0.95

Classifying and Marking of Hydrants

Rated Capacity at 20 psi	Class	Marking Color of Hydrant Tops and Nozzles
≥1500 GPM	AA	Light Blue
1000–1499 GPM	A	Green
500–999 GPM	B	Orange
≤499 GPM	C	Red

The above are the NFPA hydrant classifications and color markings for various rated capacities. Source: NFPA 291, 5.1, 2010.

Garage Floor Plan - Overall

SCALE: 1" = 40'

CUBE 3 STUDIO
architecture interiors planning
360 Merrimack Street Lawrence, MA 01843
phone: 978.989.9900 www.cube3studio.com

project information:

Broadstone Bare Cove

230 Beal Street, Hingham, MA 02043

client information:

Broadstone Bare Cove Alliance, LLC.

C/O Alliance Residential Company
184 High Street
Suite 401
Boston, MA 02110

consultant information:

COMPREHENSIVE PERMIT APPLICATION

drawing information:

drawing by:	BLE
drawing checked by:	AB/JH
drawing scale:	As Noted
drawing date:	12 August 2016
drawing revisions:	
project number:	15122.00

rev.	description	date
1	ZBA RESUBMITTAL	10/25/16
2	ZBA RESUBMITTAL	11/02/16
3	ZBA RESUBMITTAL	01/04/17

registration:

drawing name: Garage Floor Plan

drawing number: A-100

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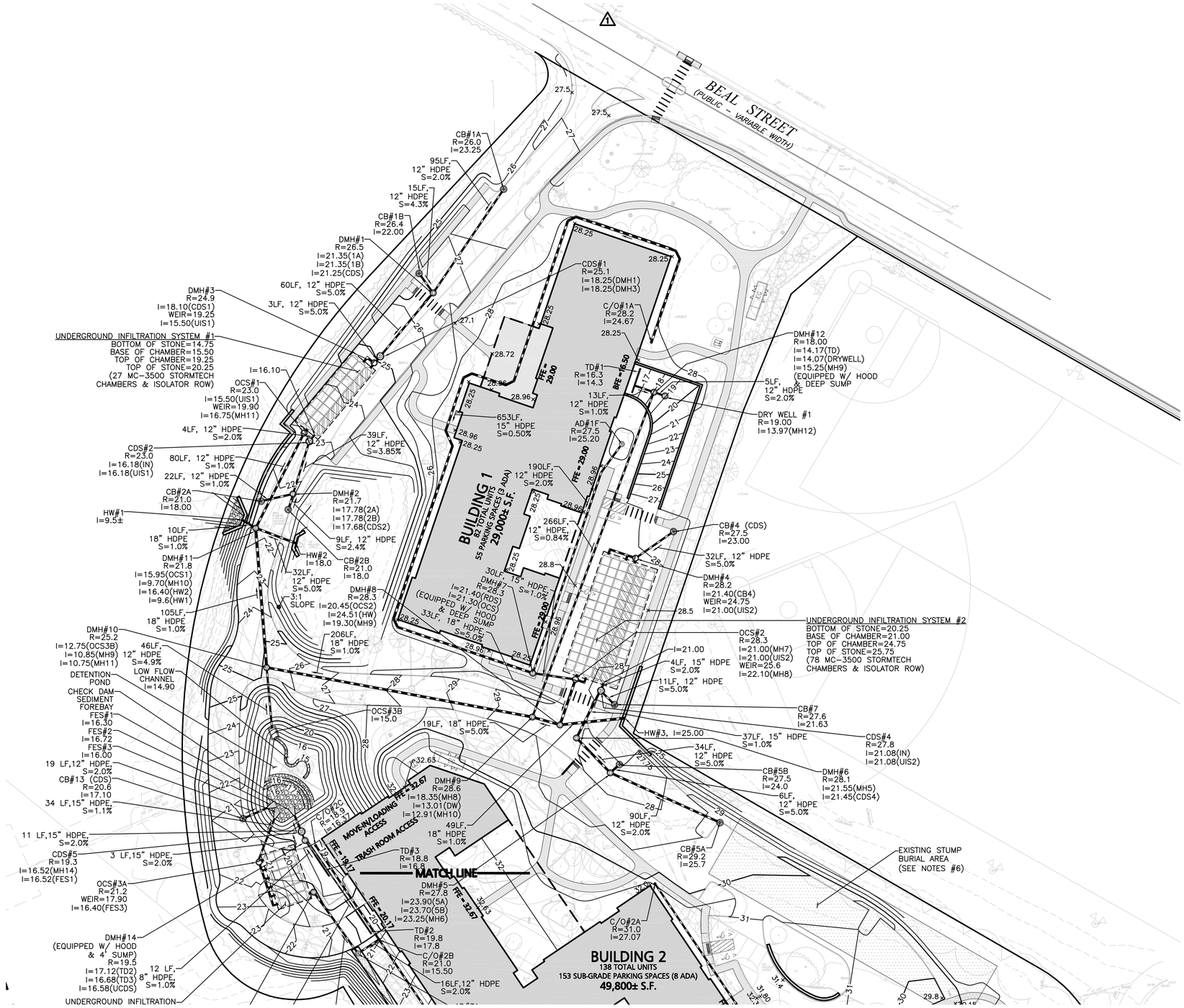

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- HEADWALL
- 5' CONTOUR — 30
- 1' CONTOUR — 31
- SPOT GRADE ×128
- LIMIT OF INFILTRATION STONE
- INFILTRATION CHAMBERS
- ISOLATOR ROW
- DRAINAGE SWALE

NOTES:

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BENCHMARK SUMMARY

TBM #	DESCRIPTION	ELEV.
1	X CUT IN HYDRANT SPINDLE	29.57

GRAPHIC SCALE

40 0 20 40 80 160

(IN FEET)
1 inch = 40 ft.

N:\PROJECTS\2118-02\CIVIL\DRAWINGS\CURRENT\C-2118-02 – GRADING & DRAINAGE.DWG

TOWN OF HINGHAM LIST OF WAIVERS:

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ISSUED FOR REVIEW
JANUARY 18, 2017

PROFESSIONAL ENGINEER FOR
ALLEN & MAJOR ASSOCIATES, INC.

REV	DATE	DESCRIPTION
3.	01/04/2017	ISSUED FOR ZBA RESUBMITTAL
2.	11/2/2016	ISSUED FOR ZBA RESUBMITTAL
1.	10/25/2016	ISSUED FOR ZBA RESUBMITTAL

APPLICANT\OWNER:
BROADSTONE BARE COVE ALLIANCE, LLC. C/O
ALLIANCE RESIDENTIAL COMPANY
184 HIGH STREET, SUITE 401
BOSTON, MA 02110

PROJECT:
BROADSTONE BARE COVE
230 BEAL STREET
HINGHAM, MA

PROJECT NO.	2118-02	DATE:	08-12-2016
SCALE:	1" = 40'	DWG. NAME:	C2118-02
DESIGNED BY:	SJL	CHECKED BY:	CMQ

PREPARED BY:

ALLEN & MAJOR ASSOCIATES, INC.
civil & structural engineering ◆ land surveying
environmental consulting ◆ landscape architecture
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WOBURN, MA ◆ LAKEVILLE, MA ◆ MANCHESTER, NH

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DRAWING TITLE:
GRADING & DRAINAGE PLAN

SHEET No.
C-3A

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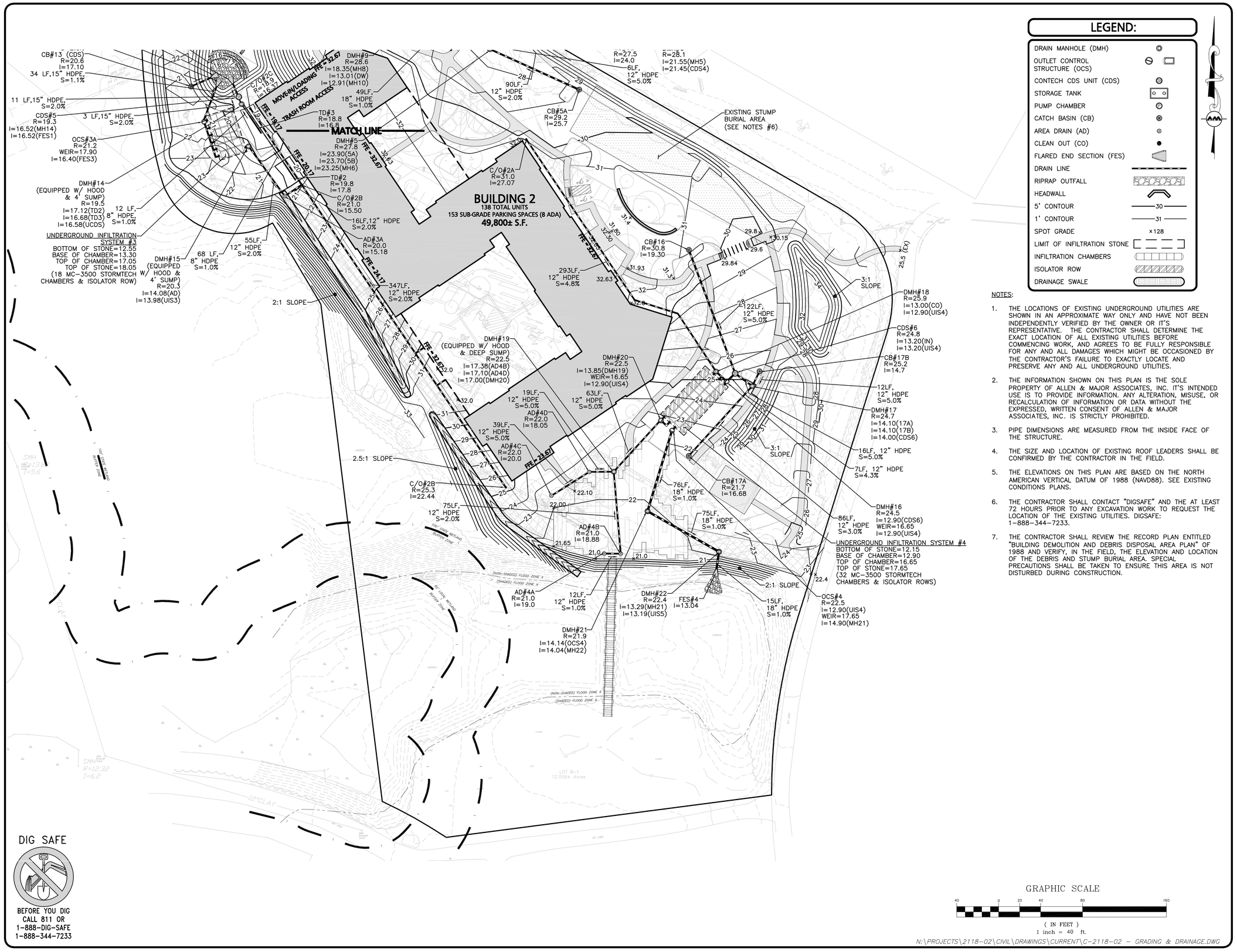

LEGEND:

- DRAIN MANHOLE (DMH)
- OUTLET CONTROL STRUCTURE (OCS)
- CONTECH CDS UNIT (CDS)
- STORAGE TANK
- PUMP CHAMBER
- CATCH BASIN (CB)
- AREA DRAIN (AD)
- CLEAN OUT (CO)
- FLARED END SECTION (FES)
- DRAIN LINE
- RIPRAP OUTFALL
- HEADWALL
- 5' CONTOUR — 30
- 1' CONTOUR — 31
- SPOT GRADE ×128
- LIMIT OF INFILTRATION STONE
- INFILTRATION CHAMBERS
- ISOLATOR ROW
- DRAINAGE SWALE

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PREPARED BY:

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environmental consulting ◆ landscape architecture
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