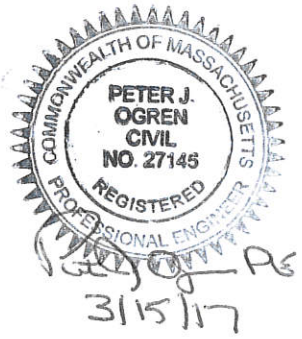
Project File: BEV-0007C

# UTILITIES REPORT

## Definitive Subdivision Plan
## Trask Lane Extension
## Beverly, MA

## March 2017




Hayes Engineering, Inc.

603 Salem Street
Wakefield, MA 01880
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BEV-0007C

# UTILITIES REPORT

Definitive Subdivision Plan
Trask Lane Extension - Assessor's Map 28, Lot 126
Beverly, MA

March 15, 2017

## INTRODUCTION

The purpose of this utility report is to provide the required information on drainage, water and sewer in accordance with the requirements of Section 3.c(2)w of the definitive plan requirements of the Beverly Planning Board. The subdivision proposal calls for the elimination of two Planning Board ways previously laid out by a definitive plan dated April 24, 1981, and also the shortening of the proposed Trask Lane, as shown on that definitive plan. The proposal to eliminate and shorten the proposed ways is to allow for a different vocabulary of construction than might have been originally anticipated on the tract of land owned by the Reeve family off Trask Lane. While alternative proposals called for multi-storied brick buildings, at least to a mid-rise level, current thinking is that 4 and 5-story wood frame podium construction would be utilized. Where it is anticipated that all of the proposed units are to be apartments and owned by a single entity, the additional roadways and frontages are not needed to support individual lots of ownership.

While no definitive site plan currently exists for the approximately 80 acres of undeveloped property, it is expected that no more than 700 units, averaging 2 bedrooms or less, are to be constructed on the premises. (See plan of Study Area and Remaining Land in the Appendix.)

## DRAINAGE

Due to the fact that no definitive site plan is available for the proposed apartment complex construction on the remaining Reeve land off Trask Lane, no definitive drainage plans have been established. The proposed definitive subdivision plan actually eliminates Planning Board approved roadways within the tract to accommodate future construction. It is clear, however, that any apartment complex developed on the subject parcel would require approval under the Wetlands Protection Act of the Commonwealth of Massachusetts, as well as the City of Beverly Non-Zoning Wetlands Ordinance, and would require a Land Disturbance and Drainage Permit from the Beverly City Engineer. It, consequently, is appropriate to leave the issue of final drainage design to be completed in conjunction with that site development plan (also subject to Site Plan Review under the City of Beverly Ordinance). It is noted, however, that the subject property exists at a high point in the watershed, and that the land, in general, slopes from an elevation of 143 feet in the area of the City of Beverly water tower, to elevation 42 at the adjacent golf course land. Where the Beverly Golf and Tennis Center was once owned by HDC, Inc., the predecessor in title, Folly Hill Associates Trust, the subject land benefits from a reservations of right to discharge across the once-owned golf course lands. As a result, it is believed that the proposed level of development on the subject property can be accommodated within the drainage requirements of State regulation and City of Beverly Ordinance.

WATER SUPPLY AND SEWAGE DISPOSAL

The issues of water supply and sewage disposal have long been under study for the subject tract. In 1971, agreement was reached with the City of Beverly for the provision of the necessary water and sewer services to support the construction of 1,400 apartment units. The necessary services were to be provided at the boundary of the subject property. The plans progressed to construct a one million gallon water tank on the top of Folly Hill (on the subject property) and, in cooperation with Folly Hill, a comprehensive sewer plan, including the construction of the Bass River Interceptor, was to proceed as part of the City's work.

In spite of the historic agreements relative to the infrastructure to support the proposed projects, additional investigation as to water supply and sewage disposal has been completed, as follows:

Water Supply

As previously stated, the one million gallon water tank was constructed at the top of Folly Hill as planned. In order to verify flow available, Hayes Engineering, Inc. conducted a flow test on March 2, 2017 at approximately 10:30 AM with the Beverly Water Department. The flow was taken at the existing hydrant approximately 40 feet southerly of the proposed cul-de-sac terminus, with residual pressure taken at a hydrant approximately 220 feet northerly of that location. Actual discharge at the test was 1,186 gallons per minute, with a calculated discharge of 20 psi residual, or 5,750 gallons per minute. (See Sketch Plan of Land in Beverly, Mass. by Hayes Engineering, Inc., dated March 6, 2017 and fire flow calculations included in the Appendix of this report.)

Based on this flow test and ignoring losses of future piping to service the proposed complex, a minimum domestic pressure at the faucet of 20 psi would be reached at approximately elevation 178 (the expected highest floor), and adequate fire flows would be available to approximately elevation 158 (the highest expected foundation grade).

It, consequently, is our conclusion that adequate flow and pressure exists in the water supply line running through the subject site and that, while the highest buildings could require a boost in domestic pressure, adequate fire flow exists throughout the site.

Sewer

In order to determine the geometry of the sewers servicing the existing Folly Hill site, Hayes Engineering, Inc. met with Greg St. Louis, P.E., City Engineer, to review the route of sewer discharge from the site. In discussions with Roland Adams, GIS Manager for the City of Beverly, the sewer route servicing the Folly Hill area was as shown on Sewer Trace PID 28-126, downstream, dated February 21, 2017 (copy included in the Appendix of this report). Sewage from the existing apartment and condo complexes discharges down Colgate Road, through a trunk sewer which passes Shoe Pond, goes down Balch Street, entering the Bass River Interceptor.

While, apparently, there are not capacity concerns for the Bass River Interceptor and final pumping station to South Essex Sewer District, there is concern as to the capacity of the 8-inch pipe from manhole 25a to 25b, and the somewhat odd piping configuration of manholes 25a, 25b and 25c on Colgate Road (see Location Plan II, Phase 2, Infiltration Inflow Reduction by Camp Dresser & McKee, dated June 1996, in Appendix). This report further investigates the 8-inch sewer capacity and piping configuration.

The entire Folly Hill area, including 252 Folly Hill apartments, 70 condominiums and 232 Apple Village units, as well as approximately 70 single-family residences, all discharge towards this single, 8-inch sewer in Colgate Road. The final reach of this sewer before it enters the 18-inch trunk pipe, which ultimately runs through Beverly Golf and Tennis, is at approximately a 3% grade.

Sewer capacities for the 8-inch pipe were calculated at both .3 depth and .67 depth, and compared to the observed flow mid-morning on March 7, 2017 (at or near peak flow time). In addition, flow calculations were computed for the currently anticipated build-out of an additional 700 units. The results are shown in the following table.

| | | |
|---|---|---|
| **Existing Flow at Peak** | Observed 3/07/2017<br>.3 Depth<br><br>170 gpm | Calculated at Peak<br><br>249 gpm |
| **Proposed Flow** | Available Calculated at<br>.67 Depth<br><br>585 gpm | Calculated at Peak<br><br>563 gpm |

The conclusion is that adequate capacity is available in the existing 8-inch pipe for both the existing and proposed anticipated sewer flows in the location of the 8-inch pipe on Colgate Road.

In order to determine if the configurations of manholes 25a, 25b, 25c and 25, due to their odd geometry, create a backwater effect, turbulence or other flow-reducing characteristics, those manholes were observed, as well, on March 7, 2017. The photograph of manhole 25a, (see Appendix), shows the sewage flowing smoothly at an approximated .3 depth at the downstream end of the manhole. Photograph of 25b is at an angle point prior to entry to manhole 25c and the trunk sewer. That manhole shows some evidence of solids stranding in the invert, which appears to be due, not to the change in direction, but perhaps due to irregularities in the manhole invert.

The flow in manhole 25c shows that there is a drop from the 8-inch pipe flowing in an easterly direction down Colgate Road and into the trunk line. The 8-inch pipe comes in above the invert of the trunk and, as such, there are no backwatering effects. The photograph at manhole 25 shows a smooth flow and transition down the cross-country sewer across Beverly Golf and Tennis.

It is consequently our conclusion that while some improvement might be made in manhole 25b, the configuration of the sewers entering the cross-country trunk in this area does not create backwater, turbulent flow or other flow restriction.

## CONCLUSION

It is our conclusion, as a result of the previous analysis, that adequate capacity for the anticipated build-out of the subject development exists in both the sewer and water systems as originally anticipated in the Folly Hill Utility Agreement. In addition, it appears that our conclusions are much the same as the conclusions of Camp Dresser & McKee when writing Edgar G. Mitchell on November 19, 1973, indicating how sewer and water utilities are to be provided to the parcel. (See letter in the Appendix.)

# Sewer Trace PID 28-126 Downstream

Study Area

Remaing Land

1 inch = 1,000 feet



Map17-033
February 21, 2017
Roland Adams

# Sketch Plan of Land in BEVERLY, MASS.

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Civil Engineers & Land Surveyors
603 Salem Street
Wakefield, MA 01880

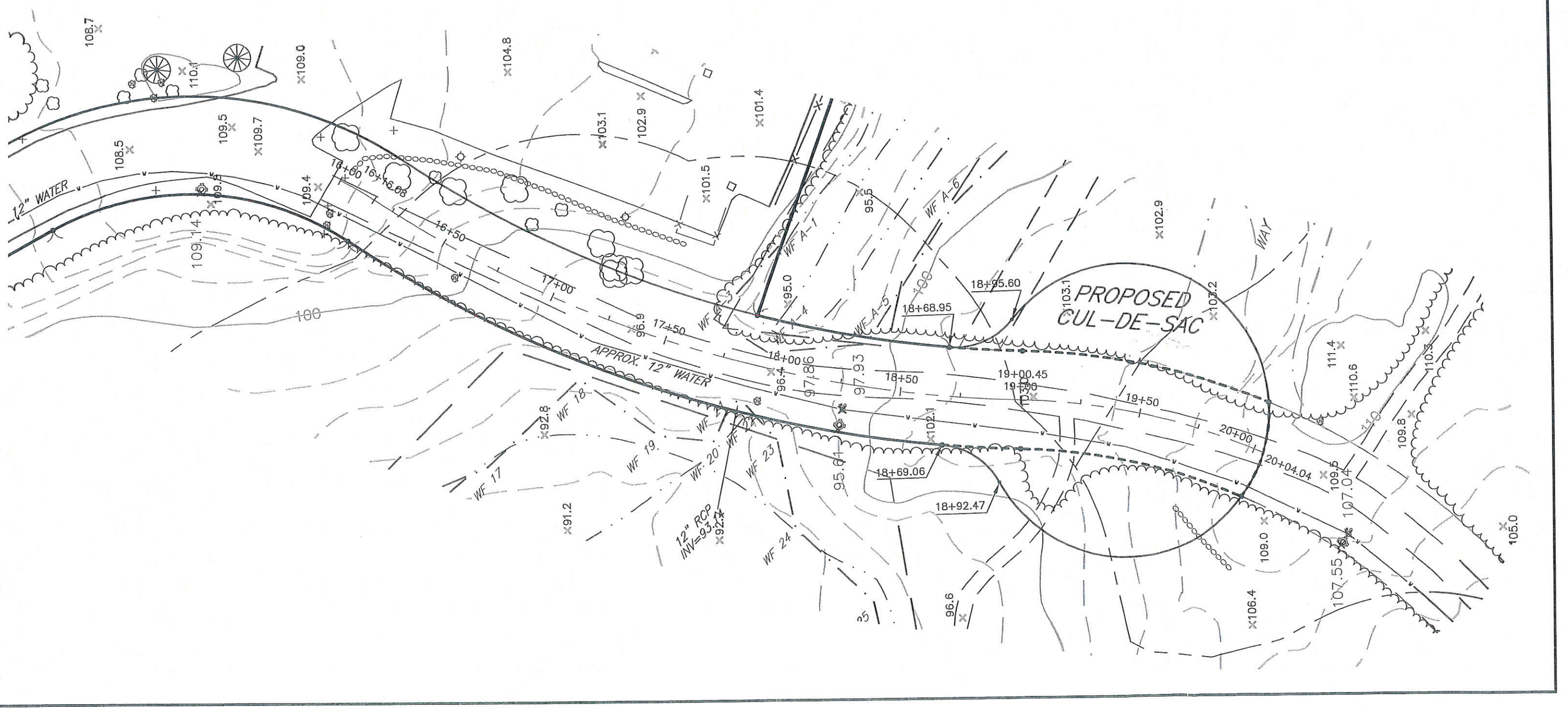
Telephone: 781.246.2800
Facsimile: 781.246.7596
www.hayeseng.com

Scale: 1" = 40'

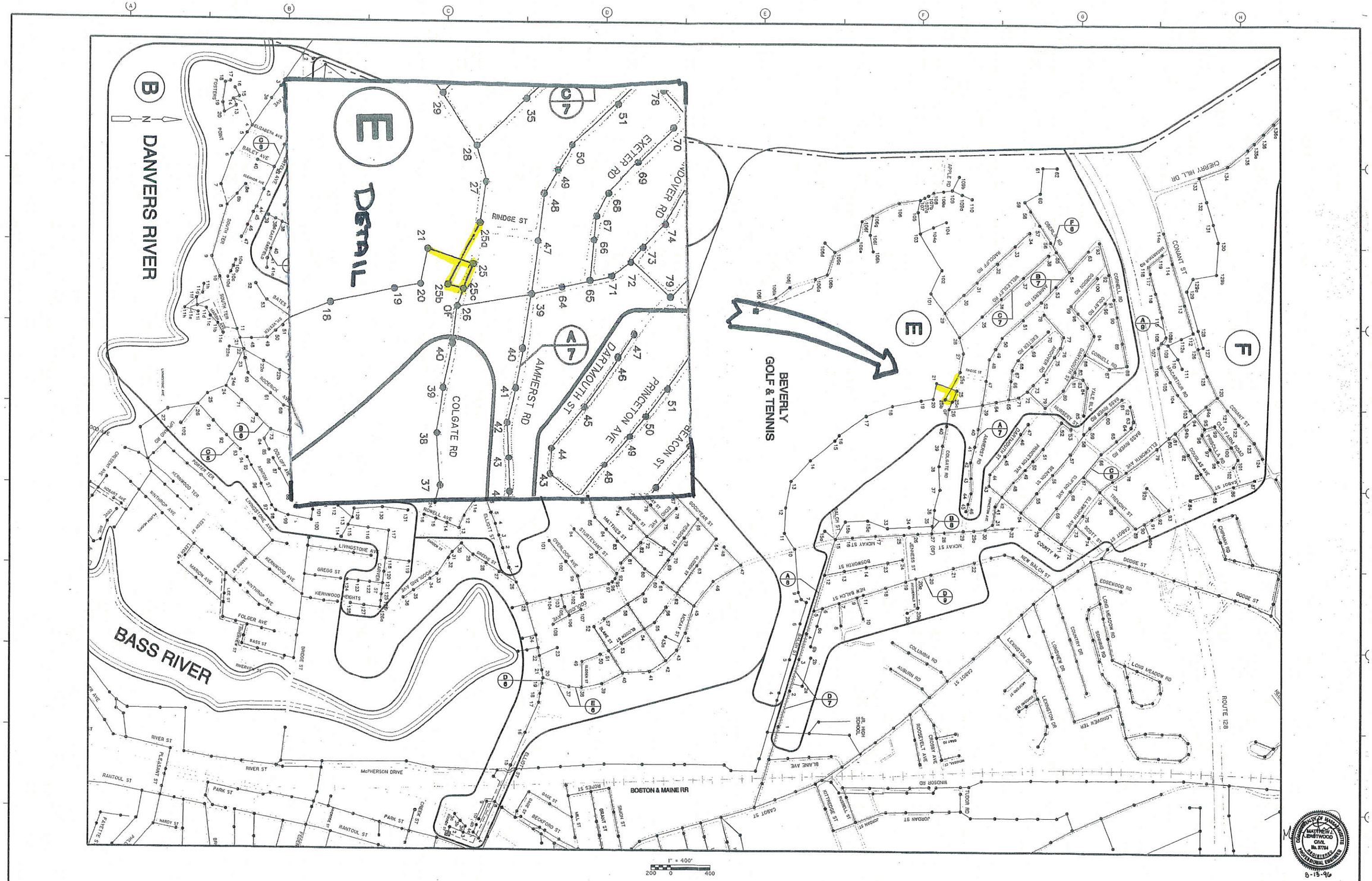
0' 20' 40' 80'

March 6, 2017

## Showing Existing Hydrant Locations




M:\Box\Dtrack.dwg, 3/6/2017 8:46:05 AM, TEW




| REV. NO. | DATE | DRWN | CHKD | REMARKS |
|---|---|---|---|---|
| | | | | |

DESIGNED BY: M. EASTWOOD
DRAWN BY: M. EASTWOOD
SHEET CHK'D BY: M. EASTWOOD
CROSS CHK'D BY: W. MACKEY
APPROVED BY: W. MACKEY
DATE: JUNE 1996

CAMP DRESSER & McKEE INC.
environmental engineers, scientists, planners, & management consultants
CDM

SOUTH ESSEX SEWERAGE DISTRICT
CONTRACT No. CB-95-2A
CITY OF BEVERLY, MASSACHUSETTS
PHASE II INFILTRATION/INFLOW REDUCTION

# LOCATION PLAN II

PROJECT NO. 142-42-DN
FILE NAME: SHEET_2
SHEET NO. 2

COMMONWEALTH OF MASSACHUSETTS
MATTHEW L. EASTWOOD
CIVIL
No. 27764
REGISTERED
PROFESSIONAL ENGINEER
8-13-96

142-54568


4
#259


A1
3
#25b


3
#256

2 *75c


#25

# HYDRANT FLOW CALCULATIONS

# WATER FLOW TEST SUMMARY SHEET

| Hydrant Nos. | Hydrant Type | Outlet Diameter (inches) | Pitot Pressures (psi) | Discharge (gpm) |
|---|---|---|---|---|
| 1 | F | 2.5 | 50 | 1186 |
| 2 | | | | |
| 3 | | | | |

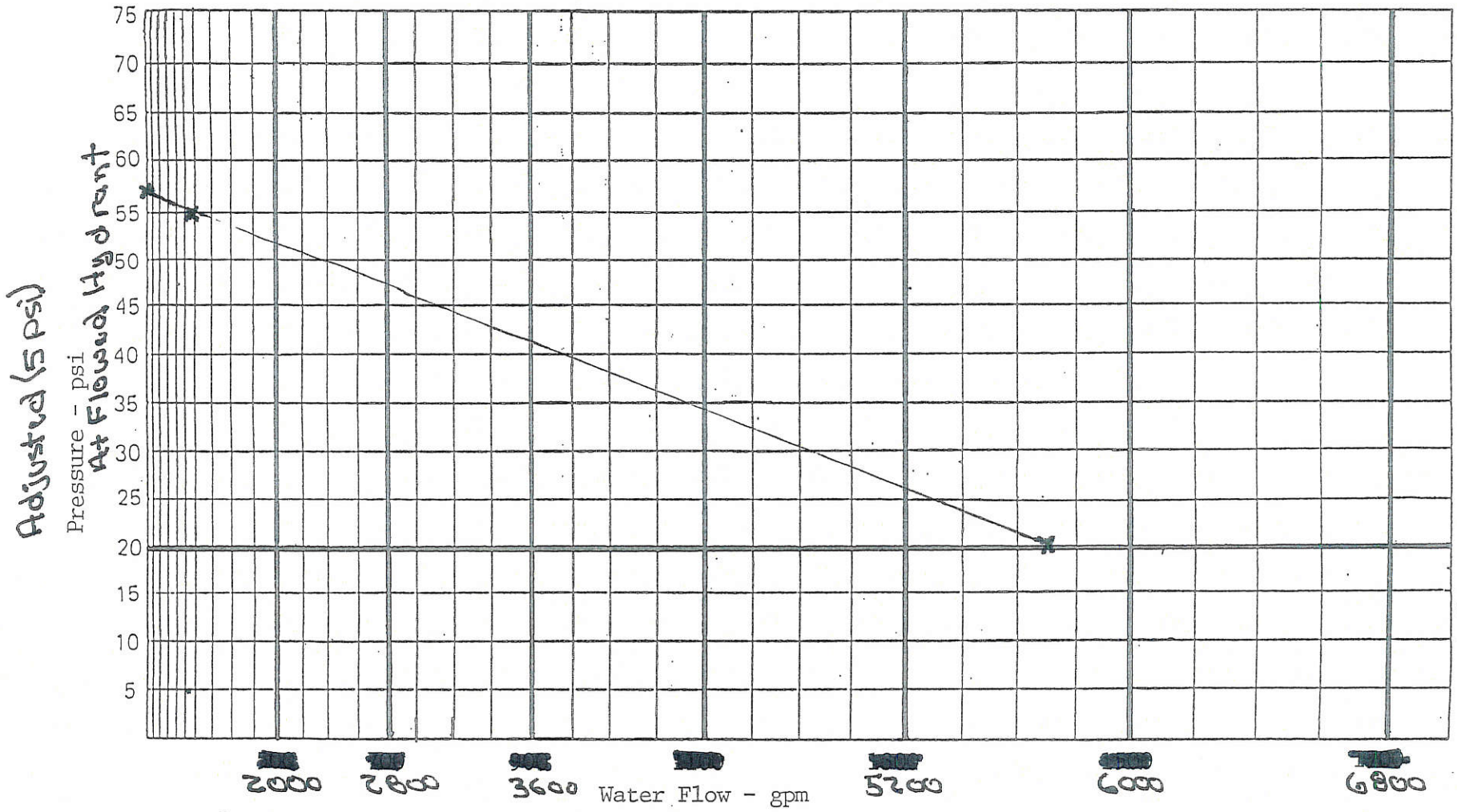
Project Location: Folley Hill Track, Ln
Location of Hydrant Tested: 450' South of Permit
Tested By: PJO
Observed By: Beverly Water Dept
Location of Hydrant Observed: 250' South of Permit

Date: 3/2/17
Time: 10:30
Static psi 62
Residual psi: 60

Total Discharge During Test: 1186 gpm

| Available gpm | |
|---|---|
| at 20 psi | at 0 psi |
| 5750 | N/A |

## WATER FLOW CHART



HAYES ENGINEERING, INC.
603 SALEM STREET
WAKEFIELD, MA 01880
TEL.: (781) 246-2800
FAX: (781) 246-7596

JOB FILE #: BEV-0007C
NAME:
DATE: 3/6/17
MADE BY: PJO

☐ MEMO
☑ CALCULATION

# Fire Flow Folly Hill Beverly

$Q = 29.83(d)^2\sqrt{P}\,Cd$

d = Outlet Dia.
P = Pitot Pressure
Cd = Coef of Discharge

$Q = 29.83(2.5)^2\sqrt{50}(.9)$

$= 29.83(6.25)\ 7.07(.9) = 1186\text{gpm}$

## Flow Test
3/2/17 10:30 Am
P = 50
Cd = .9

## Flow @ 20 psi
Static = 62 psi
Residual = 60 psi
Elev Adjustment

107.55 − 95.61 = 11.94

$\frac{11.94}{2.308} = 5.18\text{psi}$

$\Delta P = 60.62 - 25 = 37\text{psi}$

$Q_2 = Q_1 \times \frac{PD_2}{PD_1}$

$= 1186\text{gpm}\left(\frac{7.03}{1.45}\right) = 5750\text{gpm}$

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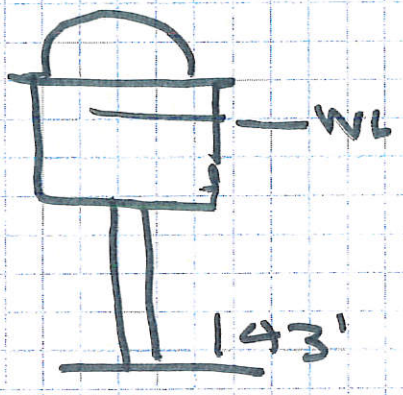
JOB FILE #: _____
NAME: _____
DATE: _____
MADE BY: _____

☐ MEMO
☐ CALCULATION





178' Highest Floor

62(2.308) = 143'

95.61 Hydt 300' Sky of Pmt on

~~238.61~~

238.61 Water Tank Water Level

238
- 178
50

50 / 2.308 = 21 PSI Domestic Pressure at Floor Elev 178

Fire Flow @ 3000 gpm for Headloss

22 ~~x~~ x 2.308 = ~~x~~ 50

108 + ~~x~~ 50 = 158'

# SEWER CAPACITY CALCULATIONS

HAYES ENGINEERING, INC.
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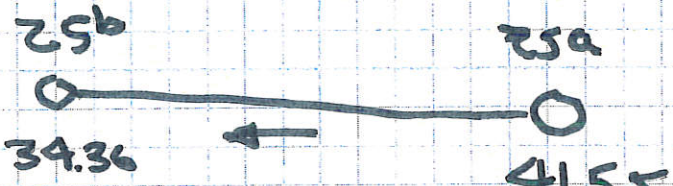
FAX: (781) 246-7596

JOB FILE #: _____
NAME: _____
DATE: _____
MADE BY: _____

☐ MEMO
☐ CALCULATION

# 8" Colgate Rd Sewer Capacity

8" VC Sewer
244' Long




$\frac{7.19}{244} \approx 3\%$

$41.55 - 34.36 = 7.19$

## Peak Sewer Flows

252 Folly Hill Apartments
70 Condo's
232 Apple Village Apts
70 Single Family Homes

554 Units x 2.5 Bd/Unit. (110 gal/Bdrm) = 152,350

70 SFH x 3.5 Bd/Unit (110 gal/Bdrm) = 26,950

179,300 gpd

$\frac{179,300}{1440} = 124.51$ gpm Tidal Flow

Peaking Factor of 2

249 gpm

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TEL.: (781) 246-2800
FAX: (781) 246-7596

JOB FILE #: _____
NAME: _____
DATE: _____
MADE BY: _____

☐ MEMO
☐ CALCULATION

## Future Flows

700 Units 2 Bd Rm (110 gal/bd Rm) = 154,000 gal/day

$\frac{154,000}{1440} = 107$ gpm

Peaking Factor of 2

214 gpm

Total Flow

214
249
463 gpm

# Free Online Manning Pipe Flow Calculator

## Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate, program, or host these calculators? (../contact.php) [Hide this request]

### Colgate Rd

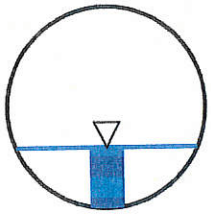
Beverly MA

Set units: m | mm | ft | in

| | |
|---|---|
| **Pipe diameter, $d_0$** | 8 in |
| **Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)** | .014 |
| **Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), $S_0$** | 3 % rise/run |
| **Percent of (or ratio to) full depth (100% or 1 if flowing full)** | 30 % |

Results

| | | |
|---|---|---|
| **Flow, Q** | 170.8041 | gpm |
| **Velocity, v** | 4.3211 | ft/sec |
| **Velocity head, $h_v$** | 3.4823 | in |
| **Flow area** | 12.6828 | sq. in. |
| **Wetted perimeter** | 9.2742 | in |
| **Hydraulic radius** | 1.3675 | in |
| **Top width, T** | 7.3321 | in |
| **Froude number, F** | 2.01 | |
| **Shear stress (tractive force), tau** | 0.3746 | psf |



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# Free Online Manning Pipe Flow Calculator

## Manning Formula Uniform Pipe Flow at Given Slope and Depth

Can you help me translate, program, or host these calculators? (../contact.php) [Hide this request]

### Colgate Rd

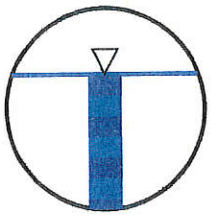
Beverly MA

Set units: m | mm | ft | in

| | |
|---|---|
| **Pipe diameter, $d_0$** | 8 in |
| **Manning roughness, n ? (http://www.engineeringtoolbox.com/mannings-roughness-d_799.html)** | .014 |
| **Pressure slope (possibly ? (../pressureslope.php) equal to pipe slope), $S_0$** | 3 % rise/run |
| **Percent of (or ratio to) full depth (100% or 1 if flowing full)** | 67 % |

Results

| | | |
|---|---|---|
| **Flow, Q** | 688.4446 | gpm |
| **Velocity, v** | 6.1703 | ft/sec |
| **Velocity head, $h_v$** | 7.1005 | in |
| **Flow area** | 35.7994 | sq. in. |
| **Wetted perimeter** | 15.3417 | in |
| **Hydraulic radius** | 2.3335 | in |
| **Top width, T** | 7.5234 | in |
| **Froude number, F** | 1.73 | |
| **Shear stress (tractive force), tau** | 0.8367 | psf |



Please give us your valued words of suggestion or praise. Did this free calculator exceed your expectations

CAMP DRESSER & McKEE
Inc.
CONSULTING ENGINEERS
ONE CENTER PLAZA BOSTON, MASS. 02108 TEL. 617 742-5151 CABLE: CAMDRES
ROBERT C. MARINI
SENIOR VICE PRESIDENT

November 19, 1973

Mr. Edgar G. Mitchell
Commissioner of Public Works
City Hall
Beverly, MA 01915

Beverly, Mass.
Folly Hill
Water and Sewerage Facilities

Dear Mr. Mitchell:

In a letter dated November 1, 1973, you requested that we evaluate the effect of an additional 100 housing units within the Folly Hill Complex (Village "B") on the water and sewerage facilities of the City of Beverly. The comprehensive plan for this development previously submitted to our office by Fay Spofford and Thorndike, Inc. was referred to as the proposed plan of water and sewerage facilities in the project. This letter report consists of our review of this request to specifically evaluate the effect of additional development on these facilities in the City.

Water Supply and Fire Protection

In 1961 Camp Dresser and McKee submitted a report to the City entitled "Report on Improvements to the Water Distribution System". A second report prepared for HDC, Inc. outlined the initial requirements for providing water and sewerage facilities for the Folly Hill development. The recommendations in this latter report are being implemented at the present time to serve not only Village "A", but also provide sufficient storage for the entire 1430 units planned in the development until the year 2000.

A one million gallon elevated storage tank (Contract No. 1) is presently under construction with an estimated completion date of late summer 1974. The water main and booster station (Contract No. 2) bids have been received and are awaiting execution of the contract documents. This latter contract will be completed prior to the completion of the elevated storage tank. These waterworks improvements will provide sufficient water for fire protection and domestic consumption for this area of the City.

Presently the 250 housing units of Village "A" are supplied with water for domestic usage from a 12-in. connection to the City water main at the end of Colgate Road. The developer has installed a 500 gpm pump at this location to

increase the pressure in this line. This pump is rated for continuous operation and is satisfactorily providing sufficient water for domestic consumption in the development. At the request of Beverly Fire Chief, Dean Palmer, the developer is removing the temporary overland fire connection to the Town of Danvers at the Kings Grant Motel. A permanent 8-in. connection will be installed from Upland Road in Danvers to Trask Lane where a post indicator valve will be installed. This will provide sufficient water for fire protection in the development until the waterworks improvements previously mentioned are completed next year. At that time this connection will remain as an emergency fire connection between the two communities.

The water improvements recommended in the Fay Spofford and Thorndike, Inc. report have been revised in a series of meetings since receipt of the report by Camp Dresser & McKee and therefore only general comments will apply. The intent of installing these improvements is to provide sufficient water supply in quantity and pressure for fire protection and domestic consumption throughout the development. Where possible these water mains should be looped and of sufficient size to provide the fire requirement in the development. We have based the design of the waterworks improvements on a fire requirement of 3,500 gpm for three hours at a residual pressure of 20 psi. The comprehensive report is based upon a fire requirement of 2,500 gpm which may be adequate for some sections of the development. The domestic water usage projected for the development is identical to that proposed in the entire Camp Dresser & McKee report.

Therefore, the waterworks improvements proposed for this development will provide sufficient water for fire protection and domestic consumption for the entire development including the additional 100 housing units in Village "B". The revisions to the comprehensive report should be reviewed by the City for approval prior to implementation.

Sewerage Facilities

"Report of Sewerage" was prepared by Camp Dresser & McKee in October 1965 for the entire City of Beverly. Extensive improvements were recommended and several of these improvements have been completed or are presently under construction. The 1971 report for HDC, Inc. previously mentioned, evaluated the effect of the initial stage of development on the sewerage facilities of the City. This initial stage consisted of 250 housing units in Village "A".

Two areas were indicated when the 1985 flows from Folly Hill would increase the flow from the presently sewered area above the capacity of the system. Both of these areas will be relieved by construction of a section of the Bass River Interceptor along the River Street extension between Elliot Street and Federal Street (Contract No. 4). This project is presently being completed and will relieve the surcharged conditions on Rantoul and West Federal Streets. Several other areas were indicated where the sewage flows will increase to the capacity of the system but will not cause serious surcharging. However, these flows were based on the addition of wastewater flows from Village "A" alone.

The 1971 report also indicated that a second stage construction will be required prior to 1985 to relieve the newly surcharged sewers in the following areas:

Balch Street, from McKay Street to New Balch Street
Beckford Street, from Cabot Street to Elliot Street
River Street, from West Federal Street to Pleasant Street

As indicated in this report, the Bass River Interceptor could be extended north from Elliot Street to McKay Street with 36-in. pipe and south from Federal Street to Pleasant Street with 42-in. pipe. This will relieve the newly surcharged conditions in these three areas. The Bass River Interceptor would be complete from McKay Street to Pleasant Street and then discharge into the existing conduit in Pleasant Street. This latter sewer is presently surcharged and any large increase beyond Village "A" will aggravate an already critical situation. This situation cannot be relieved until the Bass River Interceptor is extended to the end of Linden Avenue where it will discharge into the South Essex Sewerage District (SESD) intercepting sewer from the Rial Side to the Beverly Pumping Station at the end of Water Street. This latter project is in the initial design stage and will not be completed for at least two years.

We have also reviewed the sewerage portion of the Fay Spofford and Thorndike, Inc. report on the Folly Hill Development. This portion of the comprehensive report concentrated solely on a determination of the ability of the existing City sewerage system to receive the wastewater flow from an additional 100 housing units in this development. The peak sewage flow used in this report is similar to the 1985 peak sewage flows projected in the CDM report for Village "A". Consequently, the effects of sewering the 100 additional housing units will be compared on a similar basis.

The tabulation of the flow data in the comprehensive report for the 100 additional units indicates that the sewage flow will increase to the capacity of the existing system in several areas north of Elliot Street, but will not cause surcharging at the present time. The area immediately south of Elliot Street will be relieved by the new 42-in. interceptor under construction. Further downstream, the Pleasant Street sewer may not be adversely affected by the additional 100 housing units. However, any expansion beyond the first stage construction for Village "B" will probably adversely affect the existing sewerage system unless the Bass River Interceptor and the SESD improvements are completed.

In summary, there is absolutely no problem with water supply for domestic consumption or fire protection for the additional 100 housing units in Village "B" provided the waterworks improvements under construction are completed. The upper portions of the sewer interceptor system can accommodate the additional 100 housing units provided the sewerage facilities presently under construction are completed. The lower portions of the sewer interceptor system is already operating at capacity and surcharging occurs during extreme use conditions. The addition of wastewater flow from these 100 housing units may tend to aggravate the situation slightly more than at present, but we believe that this will be within tolerable limits. It is recommended that the City proceed with the design of and construction of the remainder of the Bass River Interceptor so that it will be completed in a timely manner to continue meeting the sewerage needs of this area of the City. This project is dependent upon the sewerage works improvements to the SESD facilities which are needed immediately. The timely completion of these projects will be mutually beneficial for all.

We will be pleased to meet with you and discuss the overall project if you desire. Please notify us if you have any questions.

Very truly yours,

CAMP DRESSER & McKEE Inc.

Robert C. Marini

CDM 227-18-GS
RCM/emc

cc: Mayor Herbert F. Grimes