

MEMORANDUM

DATE: December 6, 2019

TO: Woodland, LLC
66 Main Street
Millis, MA 02054

FROM: Robert J. Michaud, P.E. – Managing Principal
Daniel A. Dumais, P.E. – Senior Project Manager

RE: **Proposed Woodlands Open Space – Secondary Roadway Evaluation**
Main Street – Millis, Massachusetts



MDM Transportation Consultants, Inc. (MDM) has prepared this secondary roadway evaluation for the proposed Woodland Open Space residential development to be located along Main Street in Millis, Massachusetts. The project will include 44 single-family homes with primary access/egress via a direct connection to the northern side of Main Street approximately 400 feet east of Village Street. The Town's subdivision regulations have a 500-foot dead-end limitation which requires that a secondary access point be provided for the project in order to develop the Site in a meaningful way. This memorandum describes the projected trip generation, trip distribution patterns, and a review of the secondary roadway alternatives for the project. The property has access to four adjacent public ways for the purpose of a secondary roadway as follows:

- North Street
- Dale Avenue
- Railroad Avenue
- Island Road

In summary, notwithstanding any potential civil design issues including environmental issues, grading issues, emergency access requirements, and/or right of way limitations three secondary roadway alternatives (North Street, Dale Avenue, and Railroad Avenue) with the *Recommended Improvements* outlined above in place would provide adequate secondary roadway connections for the project. The majority of the project traffic will use the primary roadway connection to Main Street and the secondary access point will accommodate approximately 20% of the total trips while also providing a secondary means of access for emergency personnel.

Existing Roadway Characteristics

North Street

North Street is generally a north-south roadway that is classified as a Local roadway that provides a connection between Main Street to the south and Cottage Avenue to the north. North Street provides one travel lane in each direction with no pavement markings. A marked “STOP” line and “STOP” sign is provided on the North Street approach to Main Street. The total pavement width along North Street is approximal 18 feet. Land uses include several residential homes.

Dale Avenue

Dale Avenue is generally an east-west roadway that is classified as a Private roadway between Winter Street and its termination point at the Site. Dale Avenue is currently a driveway providing access/egress for two residential homes with no pavement markings. There are no traffic controls (signs or markings) provided on the Dale Avenue approach to Winter Street. The total pavement width along Dale Avenue varies and is generally limited to 12 – 14 feet. Land uses include two residential homes and the undeveloped Site.

Railroad Avenue

Railroad Avenue is generally a north-south roadway that is classified as a Local roadway with the section between Union Street and Buddy Kearney Lane under Town jurisdiction and the terminal section between Buddy Kearney Lane and the Site under private jurisdiction. Railroad Avenue provides one travel lane in each direction with no pavement markings. The roadway is a relatively undefined between Union Street and Howie Oil Company with an unprotected grade change (retaining wall) provided at the Howie Oil Company property. The roadway also provides a 190-foot-wide curb opening along Union Street with no traffic controls (signs or markings). The total pavement width along Railroad Avenue varies but is generally limited to 18 feet or less. Land uses include several residential homes, an oil company, and an autobody/sign company at its intersection with Union Street.

Site Generated Traffic

The trip generation estimates for the proposed residential use are provided for the weekday morning weekday periods, which correspond to the critical analysis and periods for the proposed uses and adjacent street traffic flow. New traffic generated by the project was estimated using trip rates published in ITE's *Trip Generation*¹ for the Land Use Code (LUC) 210 – Single Family Detached Housing.

¹*Trip Generation*, 10th Edition; Institute of Transportation Engineers; Washington, DC; 2017.

Table 1 presents the trip-generation estimate for the proposed development based on ITE methodology.

**TABLE 1
TRIP-GENERATION SUMMARY**

Period/Direction	Singe Family Homes (44-Units) ¹
<i>Weekday Morning Peak Hour</i>	
Entering	8
<u>Exiting</u>	<u>25</u>
Total	33
<i>Weekday Evening Peak Hour</i>	
Entering	28
<u>Exiting</u>	<u>16</u>
Total	44
<i>Weekday Daily</i>	418

¹Based on ITE LUC 710 trip rates applied to 44 Units.

As summarized in **Table 1**, the development is estimated to generate approximately 33 vehicle trips (8 entering and 25 exiting) during the weekday morning peak hour and 44 vehicle trips (28 entering and 16 exiting) during the weekday evening peak hour. On a daily basis, the development is estimated to generate approximately 418 vehicle trips on a weekday with 50 percent entering and exiting. Trip generation calculations are provided in the **Attachments**.

Trip Distribution

The distribution for projected traffic for the proposed development is based primarily on Journey to Work Census data for persons living within the Town of Millis. Trip distribution calculations are provided in the **Attachments**. The trip distribution patterns indicate the following:

- Main Street to/from the east: 55%
- Main Street to/from the west: 20%
- Union Street to/from the north: 20%
- Village Street to/from the south: 5%

Subdivision Roadway Design

This section addresses the minimal recommended dimensioning (width) of the subdivision roadway connections relative to guidelines published by the American Association of State Highway and Transportation Officials (AASHTO). Road "A" will serve as the primary means of access/egress for the proposed subdivision with a direct connection to Main Street.

A preliminary review of the roadways indicates that the connection to Island Road would connect the project to an unpaved roadway with minimal roadway width. Therefore, this roadway in its current state was deemed the least desirable connections from a transportation prospective. Therefore, this memorandum focused on the three secondary access points; North Street, Dale Avenue and Railroad Avenue which all appear to provide a more desirable secondary connection point for the project. For reference, preliminary site layout plans for the three alternatives prepared by Legacy Engineering are provided in the **Attachments**. Based on the projected trip distribution patterns for the Site, the majority of the project traffic will use the primary roadway connection to Main Street and the secondary access roadway will accommodate approximately 20% of the total trips (to/from Union Street) while also provide a secondary means of access for emergency personnel.

Roadway Classification and Design Criteria

The Urban Land Institute (ULI), American Society of Civil Engineers (ASCE) and Institute of Transportation Engineers (ITE) together have developed residential street design criteria as published in *Residential Streets, Third Edition*². *Residential Streets* recommends that local streets, regardless of their average daily traffic volume, be designed for low vehicle speeds, that is, a speed of 15 to 20 miles per hour. *Residential Streets* acknowledges that overly designed streets with an undue concern with geometry more appropriate for highways encourages greater travel speeds and therefore, should be avoided. The American Association of State Highway and Transportation Officials' (AASHTO) "Green Book"³ also provides specific design criteria for local low volume roads. Evaluation of the subdivision roadway's alignment was applied in accordance with AASHTO guidelines for this roadway type, specifically roadway width.

²*Residential Streets, Third Edition*, published by Urban Land Institute; Washington, D.C., 2001.

³*A Policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2018.

Minimum Roadway Width

AASHTO guidance suggests various roadway and a graded shoulder width for new construction of local roads based on design speed and design volume (vehicles per day). The minimum recommended roadway design widths for the local roadways are summarized in **Table 2**. The estimated ADT's are based on the trip distribution pattern and daily trip estimates shown in **Table 1** with calculations provided in the **Attachments**.

TABLE 2
SUMMARY OF ROADWAY DESIGN WIDTHS

Roadway Segment	Estimated ADT ¹	AASHTO Recommended	
		Travel Width ²	Shoulder Width ³
<i>Road "A" – Main Street Connection</i>	350±	18	2
<u>Secondary Roadway Alternatives</u>			
<i>Railroad Avenue</i>	100±	18	2
<i>Dale Avenue Connection</i>	100±	18	2
<i>North Street Connection</i>	100±	18	2

Source: AASHTO 2018

¹Estimated average daily traffic in vehicles per day (vpd) based on average trip distribution patterns.

²Minimum width of traveled way (feet) for specific design volume (vehicles/day) and design speed ≤40 mph.

³Width of graded shoulder on each side of the road (feet).

As summarized in **Table 2**, the subdivision roadways will have projected roadway volumes that classify these roadways as very low volume local roadways following AASHTO guidance (ADT ≤400 vehicle per day). Under this classification, minimum recommended roadway width is 18 feet and a graded shoulder width of 2 feet on each side of the roadway. These minimum roadway widths encourage lower travel speeds that are in keeping with the residential nature of the proposed subdivision and local roadway systems and is consistent with AASHTO recommended roadway widths for very low volume local roadways.

Conclusions and Recommendations

The Town's subdivision regulations have a 500-foot dead-end limitation which requires that a secondary access point be provided for the project in order to develop the Site in a meaningful way. Development of the site will generate modest traffic increases of up to 44 vehicular trips during peak hours and 418 vehicular trips on a daily basis. The majority of the project traffic will use the primary roadway connection to Main Street and the secondary access point will accommodate approximately 20% of the total trips while also provide a secondary means of access for emergency personnel. MDM recommends the following improvements for the secondary roadway alternatives.

North Street

Under the North Street alternative, 20% of the project traffic would likely use the North Street extension from the Site to connect to Union Street via Cottage Street and Winter Street. This alternative would also provide the ability for right turning vehicles out of the Site and left turning vehicles into the Site to use North Street as a secondary access point for destinations along Main Street to/from the West. Improvements for this alternative should include:

- *Signage and Markings.* A STOP sign (R1-1) and STOP line pavement markings are provided at the Main Street intersection with North Street. As part of this alternative a STOP sign and STOP line pavement markings should be provided on the Cottage Avenue approach to North Street. The sign and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD).
- *Roadway Design.* Under this alternative the secondary roadway would extend North Street into the Site. The roadway should (a) extend North Street into the property as straight as possible; (b) widths and curb radii should be designed to achieve approximate perpendicular orientation at Cottage Avenue; (c) total minimum width between the Site and Cottage Street to facilitate full access/egress; and (d) minimum curb radii as required to accommodate the largest design vehicle (delivery truck) and the Town's largest fire apparatus (ladder truck).

Dale Avenue

Under the Dale Avenue alternative, 20% of the project traffic would likely use Dale Avenue from the Site to connect to Union Street via Winter Street. Under this alternative the remaining traffic would likely use the Main Street roadway. Improvements for this alternative should include:

- *Signage and Markings.* As part of this alternative a STOP sign and STOP line pavement markings should be provide on the Winter Street approach to Dale Avenue. The sign and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD).
- *Roadway Design.* Under this alternative the secondary roadway would extend Dale Avenue into the Site. The roadway should (a) extend Dale Avenue into the property at as straight as possible; (b) widths and curb radii should be designed to achieve approximate perpendicular orientation at Winter Street (c) total minimum width between the Site and Winter Street to facilitate full access/egress; and (d) minimum curb radii as required to accommodate the largest design vehicle (delivery truck) and the Town's largest fire apparatus (ladder truck).

Railroad Avenue

Under the Railroad Avenue alternative, 20% of the project traffic would likely use the Railroad Avenue extension from the Site to connect to Union Street. Under this alternative the remaining traffic would likely use the Main Street roadway. MDM notes that Railroad Avenue generally lack definition through the Howie Oil property and has a wide open (190'±) curb opening at its intersection with Union Street. Improvements for this alternative should include:

- *Signage and Markings.* As part of this alternative a STOP sign and STOP line pavement markings should be provided on the Railroad Avenue approach to Union Street. The sign and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD).
- *Roadway Design.* Under this alternative the secondary roadway would extend Railroad Avenue Street into the Site. The roadway should (a) extend Railroad Avenue into the property at as straight as possible; (b) widths and curb radii should be designed to achieve approximate perpendicular orientation at Buddy Kearny Lane; (c) total minimum width between the Site and Buddy Kearny Lane to facilitate full access/egress; and (d) minimum curb radii as required to accommodate the largest design vehicle (delivery truck) and the Town's largest fire apparatus (ladder truck).
- *Railroad Avenue Improvements.* The roadway between the Howie Oil property and Union Street should be enhanced to at a minimum include a double yellow centerline and marked edge lines to provide driver guidance. Physical improvements including curbing and landscaping is recommended at the Railroad Avenue intersection with Union Street to provide a defined roadway with respect to the commercial property and for the ability to provide the STOP sign, a street name sign, and a STOP bar location. The intersection should be designed to provide (a) widths and curb radii should be

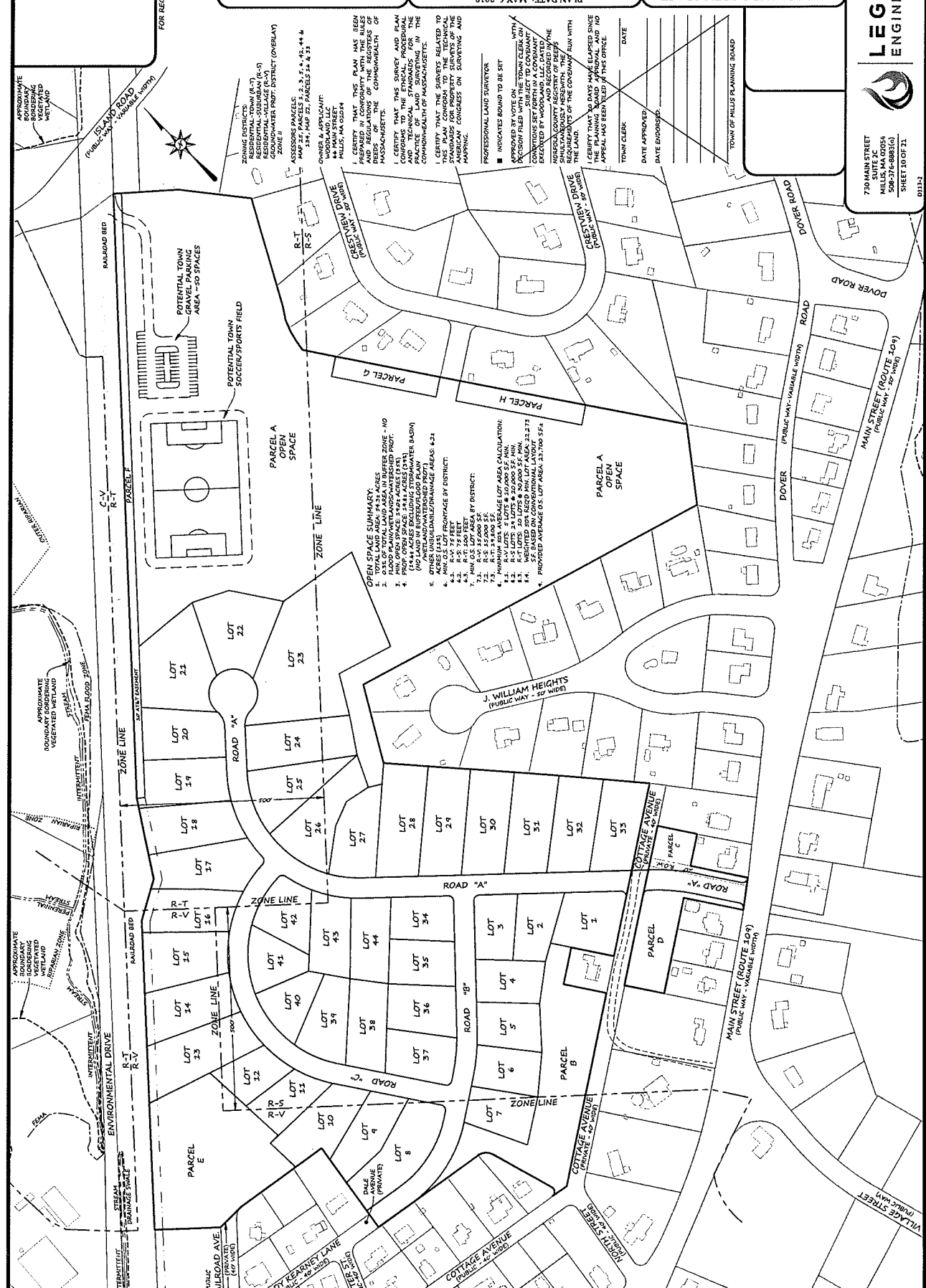
designed to achieve approximate perpendicular orientation at Union Street ; (b) total minimum width to provide full access/egress; and (c) minimum curb radii as required to accommodate the largest design vehicle (delivery truck) and the Town's largest fire apparatus (ladder truck). The roadway should consider if appropriate a guard rail section near the unprotected grade change (retaining wall) provided at the Howie Oil Company property.

In summary, notwithstanding any potential civil design issues including environmental issues, grading issues, emergency access requirements, and/or right of way limitations three secondary roadway alternatives (North Street, Dale Avenue, and Railroad Avenue) with the *Recommended Improvements* outlined above in place would provide adequate secondary roadway connections for the project. The majority of the project traffic will use the primary roadway connection to Main Street and the secondary access point will accommodate approximately 20% of the total trips while also providing a secondary means of access for emergency personnel.

ATTACHMENTS

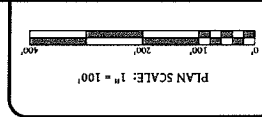
- Preliminary Site Layout Plans
- Trip Generation
- Trip Distribution Calculations
- Roadway Design Criteria

□ Preliminary Site Layout Plans



**WOODLANDS OPEN SPACE
PRELIMINARY SUBDIVISION
OPEN SPACE OVERALL LAYOUT
PLAN OF LAND IN
MILLS, MA**

REVISIONS PER TOWN COMMENTS
DATE BY
PLAN DATE: MAY 6, 2019



**LEGACY
ENGINEERING**

730 MAIN STREET
SUITE 2C
MILLS, MA 01928
508-376-8830
SHEET 10 OF 21

011313

FOR REGISTRY USE

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

APPROXIMATE
BOUNDARY
BORDERING
VEGETATED
WETLAND

ZONING DISTRICTS (R-3)
RESIDENTIAL-SUBURBAN (R-3)
RESIDENTIAL-VILLAGE (R-4)
RESIDENTIAL-OPEN SPACE (R-5)
OPEN SPACE DISTRICT (OVERLAY)

ASSESSING PARCELS
MAP 22 PARCELS 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44

OWNERS: 1. JAMES E. HARRIS, JR. & 2. JAMES E. HARRIS, JR. & 3. JAMES E. HARRIS, JR. & 4. JAMES E. HARRIS, JR. & 5. JAMES E. HARRIS, JR. & 6. JAMES E. HARRIS, JR. & 7. JAMES E. HARRIS, JR. & 8. JAMES E. HARRIS, JR. & 9. JAMES E. HARRIS, JR. & 10. JAMES E. HARRIS, JR. & 11. JAMES E. HARRIS, JR. & 12. JAMES E. HARRIS, JR. & 13. JAMES E. HARRIS, JR. & 14. JAMES E. HARRIS, JR. & 15. JAMES E. HARRIS, JR. & 16. JAMES E. HARRIS, JR. & 17. JAMES E. HARRIS, JR. & 18. JAMES E. HARRIS, JR. & 19. JAMES E. HARRIS, JR. & 20. JAMES E. HARRIS, JR. & 21. JAMES E. HARRIS, JR. & 22. JAMES E. HARRIS, JR. & 23. JAMES E. HARRIS, JR. & 24. JAMES E. HARRIS, JR. & 25. JAMES E. HARRIS, JR. & 26. JAMES E. HARRIS, JR. & 27. JAMES E. HARRIS, JR. & 28. JAMES E. HARRIS, JR. & 29. JAMES E. HARRIS, JR. & 30. JAMES E. HARRIS, JR. & 31. JAMES E. HARRIS, JR. & 32. JAMES E. HARRIS, JR. & 33. JAMES E. HARRIS, JR. & 34. JAMES E. HARRIS, JR. & 35. JAMES E. HARRIS, JR. & 36. JAMES E. HARRIS, JR. & 37. JAMES E. HARRIS, JR. & 38. JAMES E. HARRIS, JR. & 39. JAMES E. HARRIS, JR. & 40. JAMES E. HARRIS, JR. & 41. JAMES E. HARRIS, JR. & 42. JAMES E. HARRIS, JR. & 43. JAMES E. HARRIS, JR. & 44. JAMES E. HARRIS, JR.

I CERTIFY THAT THIS PLAN WAS PREPARED IN CONFORMITY WITH THE RULES AND REGULATIONS OF THE REGISTER OF DEEDS AND THE COMMISSIONERS OF MASSACHUSETTS.

I CERTIFY THAT THE SURVEY AND PLAN CONFORMS WITH THE STANDARDS AND PRACTICE OF LAND SURVEYING IN THE COMMONWEALTH OF MASSACHUSETTS.

I CERTIFY THAT THE SURVEYS RELATED TO THIS PLAN COMPLY WITH THE STANDARDS FOR PROFESSIONAL SURVEYING AND MAPPING.

PROFESSIONAL LAND SURVEYOR

INDICATES BOUNDARY TO BE SET APPROVED BY VOTE ON DECISION FILED WITH THE TOWN CLERK ON DATE BY

POTENTIAL TOWN SOCCER SPORTS FIELD

POTENTIAL TOWN GRAVEL PARKING AREA - 50 SPACES

OPEN SPACE SUMMARY:
1. 0.31% OF TOTAL LAND AREA IN BUFFER ZONE - NO OPEN SPACE.
2. MIN. OPEN SPACE: 1.01 ACRES (0.043)
3. PROP. OPEN SPACE: 3.41 ACRES (0.148)
4. MIN. OPEN SPACE: 1.01 ACRES (0.043)
5. OTHER UNDESIRABLE/UNWANTED AREAS: 4.21 ACRES (0.174)
6. ACRES (1.13) FRONTAGE BY DISTRICT:
7. MIN. 0.5 LOT AREA BY DISTRICT:
8. R-3: 25 FEET
9. R-4: 25 FEET
10. R-5: 25 FEET
11. R-6: 25 FEET
12. R-7: 25 FEET
13. R-8: 25 FEET
14. R-9: 25 FEET
15. R-10: 25 FEET
16. R-11: 25 FEET
17. R-12: 25 FEET
18. R-13: 25 FEET
19. R-14: 25 FEET
20. R-15: 25 FEET
21. R-16: 25 FEET
22. R-17: 25 FEET
23. R-18: 25 FEET
24. R-19: 25 FEET
25. R-20: 25 FEET
26. R-21: 25 FEET
27. R-22: 25 FEET
28. R-23: 25 FEET
29. R-24: 25 FEET
30. R-25: 25 FEET
31. R-26: 25 FEET
32. R-27: 25 FEET
33. R-28: 25 FEET
34. R-29: 25 FEET
35. R-30: 25 FEET
36. R-31: 25 FEET
37. R-32: 25 FEET
38. R-33: 25 FEET
39. R-34: 25 FEET
40. R-35: 25 FEET
41. R-36: 25 FEET
42. R-37: 25 FEET
43. R-38: 25 FEET
44. R-39: 25 FEET
45. R-40: 25 FEET
46. R-41: 25 FEET
47. R-42: 25 FEET
48. R-43: 25 FEET
49. R-44: 25 FEET
50. R-45: 25 FEET
51. R-46: 25 FEET
52. R-47: 25 FEET
53. R-48: 25 FEET
54. R-49: 25 FEET
55. R-50: 25 FEET
56. R-51: 25 FEET
57. R-52: 25 FEET
58. R-53: 25 FEET
59. R-54: 25 FEET
60. R-55: 25 FEET
61. R-56: 25 FEET
62. R-57: 25 FEET
63. R-58: 25 FEET
64. R-59: 25 FEET
65. R-60: 25 FEET
66. R-61: 25 FEET
67. R-62: 25 FEET
68. R-63: 25 FEET
69. R-64: 25 FEET
70. R-65: 25 FEET
71. R-66: 25 FEET
72. R-67: 25 FEET
73. R-68: 25 FEET
74. R-69: 25 FEET
75. R-70: 25 FEET
76. R-71: 25 FEET
77. R-72: 25 FEET
78. R-73: 25 FEET
79. R-74: 25 FEET
80. R-75: 25 FEET
81. R-76: 25 FEET
82. R-77: 25 FEET
83. R-78: 25 FEET
84. R-79: 25 FEET
85. R-80: 25 FEET
86. R-81: 25 FEET
87. R-82: 25 FEET
88. R-83: 25 FEET
89. R-84: 25 FEET
90. R-85: 25 FEET
91. R-86: 25 FEET
92. R-87: 25 FEET
93. R-88: 25 FEET
94. R-89: 25 FEET
95. R-90: 25 FEET
96. R-91: 25 FEET
97. R-92: 25 FEET
98. R-93: 25 FEET
99. R-94: 25 FEET
100. R-95: 25 FEET
101. R-96: 25 FEET
102. R-97: 25 FEET
103. R-98: 25 FEET
104. R-99: 25 FEET
105. R-100: 25 FEET

J. WILLIAM HEIGHTS
(PUBLIC WAY - 50' WIDE)

ROAD "A"

ROAD "B"

ROAD "C"

ROAD "D"

ROAD "E"

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

CRESTVIEW DRIVE
(PUBLIC WAY - 50' WIDE)

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

DOVER ROAD

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

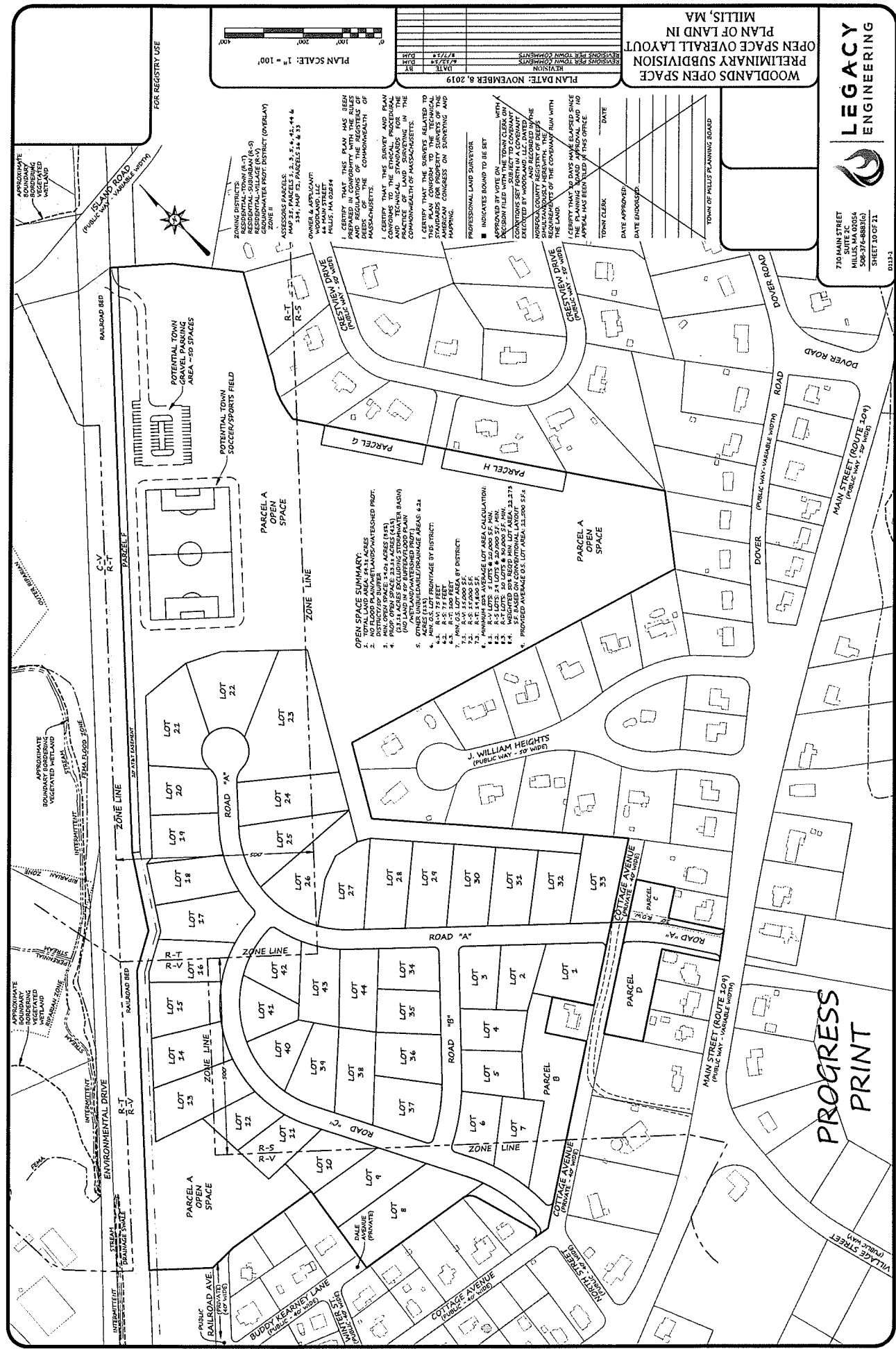
RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED

RAILROAD BED



PLAN DATE: NOVEMBER 8, 2019

DATE	BY	REVISIONS PER TOWN COMMENTS
6/12/19	DJM	
8/1/19	DJM	

WOODLANS OPEN SPACE
 PRELIMINARY SUBDIVISION
 OPEN SPACE OVERALL LAYOUT
 PLAN OF LAND IN
 MILLIS, MA

LEGACY ENGINEERING

730 MAIN STREET
 SUITE 2C
 MILLIS, MA 01946
 508-336-8883
 SHEET 10 OF 21



PLAN SCALE: 1" = 100'

FOR REGISTRY USE

PROFESSIONAL LAND SURVEYOR

INDICATES SOUND TO BE SET

APPROVED BY TOWN CLERK ON

DECISION FILED WITH THE TOWN CLERK ON

DATE: _____

TOWN CLERK: _____

DATE APPROVED: _____

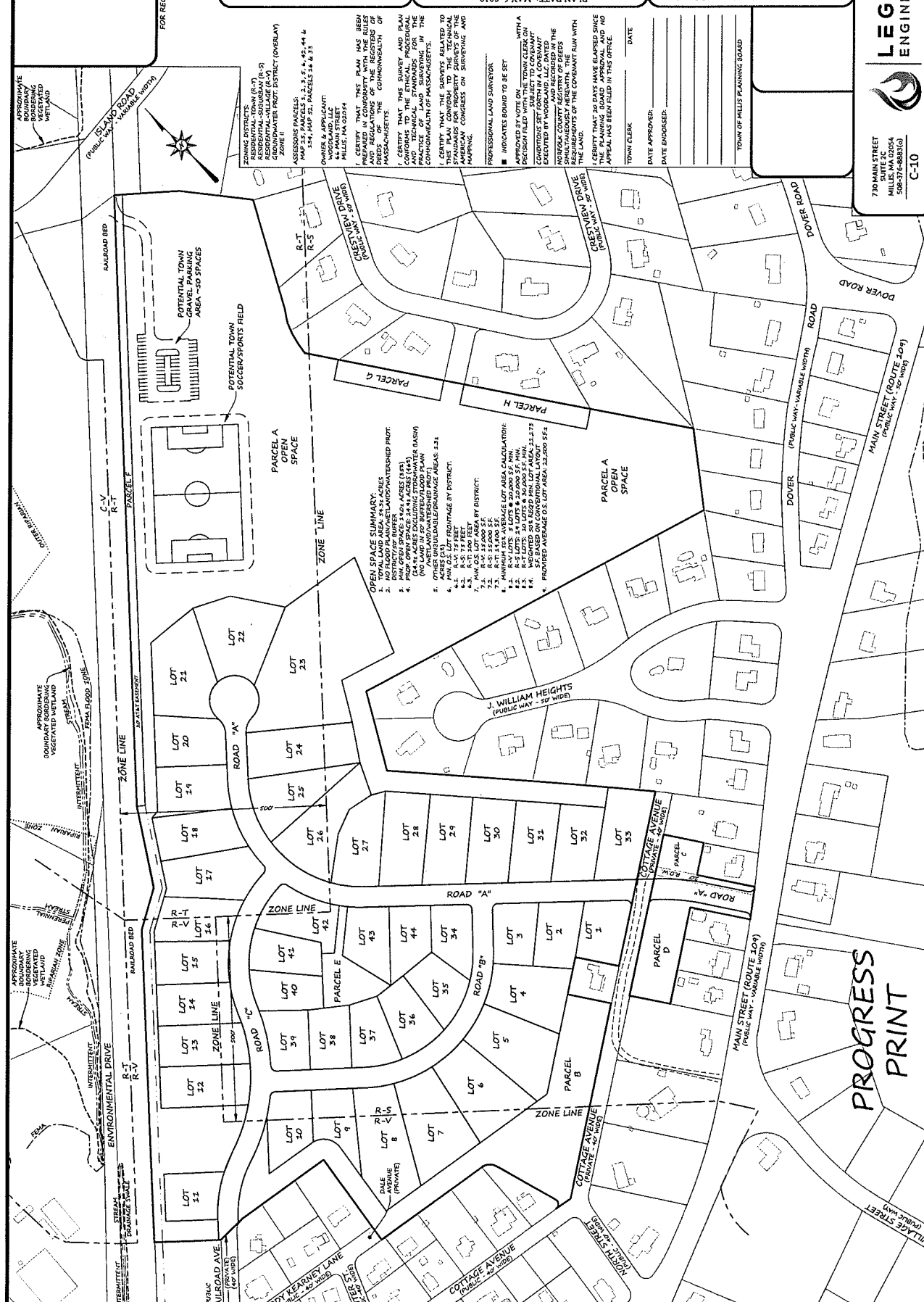
DATE ENDORSED: _____

TOWN OF MILLIS PLANNING BOARD

OPEN SPACE SUMMARY:

- NO FLOOD PLAIN/WETLANDS/WATERBODIED PROT.
- MIN. OPEN SPACE: 3.31 ACRES (41%)
- MIN. OPEN SPACE: 3.31 ACRES (41%)
- MIN. OPEN SPACE: 3.31 ACRES (41%)
- OTHER UNDESIRABLE/UNDESIRABLE AREAS: 4.21
- ACRES (1.14) PRORATED BY DISTRICT:
- R-1: 1.14 / 2.5 FEET
- R-2: 1.14 / 2.5 FEET
- R-3: 1.14 / 2.5 FEET
- R-4: 1.14 / 2.5 FEET
- R-5: 1.14 / 2.5 FEET
- R-6: 1.14 / 2.5 FEET
- R-7: 1.14 / 2.5 FEET
- R-8: 1.14 / 2.5 FEET
- R-9: 1.14 / 2.5 FEET
- R-10: 1.14 / 2.5 FEET
- R-11: 1.14 / 2.5 FEET
- R-12: 1.14 / 2.5 FEET
- R-13: 1.14 / 2.5 FEET
- R-14: 1.14 / 2.5 FEET
- R-15: 1.14 / 2.5 FEET
- R-16: 1.14 / 2.5 FEET
- R-17: 1.14 / 2.5 FEET
- R-18: 1.14 / 2.5 FEET
- R-19: 1.14 / 2.5 FEET
- R-20: 1.14 / 2.5 FEET
- R-21: 1.14 / 2.5 FEET
- R-22: 1.14 / 2.5 FEET
- R-23: 1.14 / 2.5 FEET
- R-24: 1.14 / 2.5 FEET
- R-25: 1.14 / 2.5 FEET
- R-26: 1.14 / 2.5 FEET
- R-27: 1.14 / 2.5 FEET
- R-28: 1.14 / 2.5 FEET
- R-29: 1.14 / 2.5 FEET
- R-30: 1.14 / 2.5 FEET
- R-31: 1.14 / 2.5 FEET
- R-32: 1.14 / 2.5 FEET
- R-33: 1.14 / 2.5 FEET
- R-34: 1.14 / 2.5 FEET
- R-35: 1.14 / 2.5 FEET
- R-36: 1.14 / 2.5 FEET
- R-37: 1.14 / 2.5 FEET
- R-38: 1.14 / 2.5 FEET
- R-39: 1.14 / 2.5 FEET
- R-40: 1.14 / 2.5 FEET
- R-41: 1.14 / 2.5 FEET
- R-42: 1.14 / 2.5 FEET
- R-43: 1.14 / 2.5 FEET
- R-44: 1.14 / 2.5 FEET
- R-45: 1.14 / 2.5 FEET
- R-46: 1.14 / 2.5 FEET
- R-47: 1.14 / 2.5 FEET
- R-48: 1.14 / 2.5 FEET
- R-49: 1.14 / 2.5 FEET
- R-50: 1.14 / 2.5 FEET
- R-51: 1.14 / 2.5 FEET
- R-52: 1.14 / 2.5 FEET
- R-53: 1.14 / 2.5 FEET
- R-54: 1.14 / 2.5 FEET
- R-55: 1.14 / 2.5 FEET
- R-56: 1.14 / 2.5 FEET
- R-57: 1.14 / 2.5 FEET
- R-58: 1.14 / 2.5 FEET
- R-59: 1.14 / 2.5 FEET
- R-60: 1.14 / 2.5 FEET
- R-61: 1.14 / 2.5 FEET
- R-62: 1.14 / 2.5 FEET
- R-63: 1.14 / 2.5 FEET
- R-64: 1.14 / 2.5 FEET
- R-65: 1.14 / 2.5 FEET
- R-66: 1.14 / 2.5 FEET
- R-67: 1.14 / 2.5 FEET
- R-68: 1.14 / 2.5 FEET
- R-69: 1.14 / 2.5 FEET
- R-70: 1.14 / 2.5 FEET
- R-71: 1.14 / 2.5 FEET
- R-72: 1.14 / 2.5 FEET
- R-73: 1.14 / 2.5 FEET
- R-74: 1.14 / 2.5 FEET
- R-75: 1.14 / 2.5 FEET
- R-76: 1.14 / 2.5 FEET
- R-77: 1.14 / 2.5 FEET
- R-78: 1.14 / 2.5 FEET
- R-79: 1.14 / 2.5 FEET
- R-80: 1.14 / 2.5 FEET
- R-81: 1.14 / 2.5 FEET
- R-82: 1.14 / 2.5 FEET
- R-83: 1.14 / 2.5 FEET
- R-84: 1.14 / 2.5 FEET
- R-85: 1.14 / 2.5 FEET
- R-86: 1.14 / 2.5 FEET
- R-87: 1.14 / 2.5 FEET
- R-88: 1.14 / 2.5 FEET
- R-89: 1.14 / 2.5 FEET
- R-90: 1.14 / 2.5 FEET
- R-91: 1.14 / 2.5 FEET
- R-92: 1.14 / 2.5 FEET
- R-93: 1.14 / 2.5 FEET
- R-94: 1.14 / 2.5 FEET
- R-95: 1.14 / 2.5 FEET
- R-96: 1.14 / 2.5 FEET
- R-97: 1.14 / 2.5 FEET
- R-98: 1.14 / 2.5 FEET
- R-99: 1.14 / 2.5 FEET
- R-100: 1.14 / 2.5 FEET

PROGRESS PRINT



**WOODLANDS OPEN SPACE
DEFINITIVE SUBDIVISION
OPEN SPACE OVERALL LAYOUT
PLAN OF LAND IN
MILLS, MA**

REVISIONS FOR TOWN COMMENTS

NO.	DATE	DESCRIPTION
1	05/12/19	INITIAL PLAN
2	05/14/19	REVISED PLAN
3	05/16/19	REVISED PLAN
4	05/18/19	REVISED PLAN
5	05/20/19	REVISED PLAN
6	05/22/19	REVISED PLAN
7	05/24/19	REVISED PLAN
8	05/26/19	REVISED PLAN
9	05/28/19	REVISED PLAN
10	05/30/19	REVISED PLAN

MEASUREMENTS: 1" = 100'

PLAN DATE: MAY 6, 2019

**LEGACY
ENGINEERING**

730 MAIN STREET
SUITE 2C
MILLS, MA 01938
508-376-8830

C-10

01153

APPROVED BY VOTE ON _____ DATE _____

APPROVED BY TOWN CLERK _____ DATE _____

APPROVED BY TOWN PLANNING BOARD _____ DATE _____

TOWN CLERK _____ DATE _____

DATE APPROVED: _____ DATE ENDORSED: _____

TOWN OF MILLS PLANNING BOARD

FOR REGISTRY USE

ZONING DISTRICTS: (R-1) RESIDENTIAL-SUBSIBAN (R-2) RESIDENTIAL-SUBSIBAN (R-3) RESIDENTIAL-SUBSIBAN (R-4) RESIDENTIAL-SUBSIBAN (R-5) RESIDENTIAL-SUBSIBAN (R-6) RESIDENTIAL-SUBSIBAN (R-7) RESIDENTIAL-SUBSIBAN (R-8) RESIDENTIAL-SUBSIBAN (R-9) RESIDENTIAL-SUBSIBAN (R-10) RESIDENTIAL-SUBSIBAN (R-11) RESIDENTIAL-SUBSIBAN (R-12) RESIDENTIAL-SUBSIBAN (R-13) RESIDENTIAL-SUBSIBAN (R-14) RESIDENTIAL-SUBSIBAN (R-15) RESIDENTIAL-SUBSIBAN (R-16) RESIDENTIAL-SUBSIBAN (R-17) RESIDENTIAL-SUBSIBAN (R-18) RESIDENTIAL-SUBSIBAN (R-19) RESIDENTIAL-SUBSIBAN (R-20) RESIDENTIAL-SUBSIBAN (R-21) RESIDENTIAL-SUBSIBAN (R-22) RESIDENTIAL-SUBSIBAN (R-23) RESIDENTIAL-SUBSIBAN (R-24) RESIDENTIAL-SUBSIBAN (R-25) RESIDENTIAL-SUBSIBAN (R-26) RESIDENTIAL-SUBSIBAN (R-27) RESIDENTIAL-SUBSIBAN (R-28) RESIDENTIAL-SUBSIBAN (R-29) RESIDENTIAL-SUBSIBAN (R-30) RESIDENTIAL-SUBSIBAN (R-31) RESIDENTIAL-SUBSIBAN (R-32) RESIDENTIAL-SUBSIBAN (R-33) RESIDENTIAL-SUBSIBAN (R-34) RESIDENTIAL-SUBSIBAN (R-35) RESIDENTIAL-SUBSIBAN (R-36) RESIDENTIAL-SUBSIBAN (R-37) RESIDENTIAL-SUBSIBAN (R-38) RESIDENTIAL-SUBSIBAN (R-39) RESIDENTIAL-SUBSIBAN (R-40) RESIDENTIAL-SUBSIBAN (R-41) RESIDENTIAL-SUBSIBAN (R-42) RESIDENTIAL-SUBSIBAN (R-43) RESIDENTIAL-SUBSIBAN (R-44) RESIDENTIAL-SUBSIBAN (R-45) RESIDENTIAL-SUBSIBAN (R-46) RESIDENTIAL-SUBSIBAN (R-47) RESIDENTIAL-SUBSIBAN (R-48) RESIDENTIAL-SUBSIBAN (R-49) RESIDENTIAL-SUBSIBAN (R-50) RESIDENTIAL-SUBSIBAN (R-51) RESIDENTIAL-SUBSIBAN (R-52) RESIDENTIAL-SUBSIBAN (R-53) RESIDENTIAL-SUBSIBAN (R-54) RESIDENTIAL-SUBSIBAN (R-55) RESIDENTIAL-SUBSIBAN (R-56) RESIDENTIAL-SUBSIBAN (R-57) RESIDENTIAL-SUBSIBAN (R-58) RESIDENTIAL-SUBSIBAN (R-59) RESIDENTIAL-SUBSIBAN (R-60) RESIDENTIAL-SUBSIBAN (R-61) RESIDENTIAL-SUBSIBAN (R-62) RESIDENTIAL-SUBSIBAN (R-63) RESIDENTIAL-SUBSIBAN (R-64) RESIDENTIAL-SUBSIBAN (R-65) RESIDENTIAL-SUBSIBAN (R-66) RESIDENTIAL-SUBSIBAN (R-67) RESIDENTIAL-SUBSIBAN (R-68) RESIDENTIAL-SUBSIBAN (R-69) RESIDENTIAL-SUBSIBAN (R-70) RESIDENTIAL-SUBSIBAN (R-71) RESIDENTIAL-SUBSIBAN (R-72) RESIDENTIAL-SUBSIBAN (R-73) RESIDENTIAL-SUBSIBAN (R-74) RESIDENTIAL-SUBSIBAN (R-75) RESIDENTIAL-SUBSIBAN (R-76) RESIDENTIAL-SUBSIBAN (R-77) RESIDENTIAL-SUBSIBAN (R-78) RESIDENTIAL-SUBSIBAN (R-79) RESIDENTIAL-SUBSIBAN (R-80) RESIDENTIAL-SUBSIBAN (R-81) RESIDENTIAL-SUBSIBAN (R-82) RESIDENTIAL-SUBSIBAN (R-83) RESIDENTIAL-SUBSIBAN (R-84) RESIDENTIAL-SUBSIBAN (R-85) RESIDENTIAL-SUBSIBAN (R-86) RESIDENTIAL-SUBSIBAN (R-87) RESIDENTIAL-SUBSIBAN (R-88) RESIDENTIAL-SUBSIBAN (R-89) RESIDENTIAL-SUBSIBAN (R-90) RESIDENTIAL-SUBSIBAN (R-91) RESIDENTIAL-SUBSIBAN (R-92) RESIDENTIAL-SUBSIBAN (R-93) RESIDENTIAL-SUBSIBAN (R-94) RESIDENTIAL-SUBSIBAN (R-95) RESIDENTIAL-SUBSIBAN (R-96) RESIDENTIAL-SUBSIBAN (R-97) RESIDENTIAL-SUBSIBAN (R-98) RESIDENTIAL-SUBSIBAN (R-99) RESIDENTIAL-SUBSIBAN (R-100)

ASSESSORS PARCELS: MAP 22, MAP CELLS 2, 4, 10, 14, 44 & 11

OWNER & DEVELOPER: WOODLAND, LLC MILLS, MA 01938

I CERTIFY THAT THE PLAN HAS BEEN PREPARED IN CONFORMANCE WITH THE RULES AND REGULATIONS OF THE REGISTER OF DEEDS AND THE COMMISSIONERS OF REVENUE OF THE COMMONWEALTH OF MASSACHUSETTS.

I CERTIFY THAT THIS SURVEY AND PLAN AND THE INFORMATION HEREON IS A TRUE AND CORRECT STATEMENT OF THE FACTS AND IS ACCURATE AND TRULY REPRESENTS THE PRACTICE OF LAND SURVEYING IN THE COMMONWEALTH OF MASSACHUSETTS.

THIS PLAN AND THE SURVEY RELATE TO THE STANDARDS FOR PROFESSIONAL SURVEYING AND MAPPING CONDUCTED BY THE PROFESSIONAL LAND SURVEYOR.

INDICATES BOUND TO BE SET APPROVED BY VOTE ON _____ WITH A DECISION FILED WITH THE TOWN CLERK ON _____ (DATE) AND THE TOWN CLERK'S OFFICE IS LOCATED AT _____ (ADDRESS) AND THE TOWN CLERK'S OFFICE IS OPEN FOR BUSINESS ON _____ (DATE) AND THE TOWN CLERK'S OFFICE IS OPEN FOR BUSINESS ON _____ (DATE).

I CERTIFY THAT 30 DAYS HAVE ELAPSED SINCE THE PLAN WAS FILED WITH THE TOWN CLERK AND NO APPEAL HAS BEEN FILED IN THIS OFFICE.

TOWN CLERK _____ DATE _____

DATE APPROVED: _____ DATE ENDORSED: _____

TOWN OF MILLS PLANNING BOARD

**PROGRESS
PRINT**

□ Trip Generation

**Institute of Transportation Engineers (ITE) 10th Edition
Land Use Code (LUC) 210 - Single-Family Detached Housing**

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 44

AVERAGE WEEKDAY DAILY

$T = 9.5^* (X)$
 $T = 9.5^* \quad 44$
 $T = 418.00$
 $T = 418$ vehicle trips
with 50% (209 vpd) entering and 50% (209 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.74^* (X)$
 $T = 0.74^* \quad 44$
 $T = 32.56$
 $T = 33$ vehicle trips
with 25% (8 vph) entering and 75% (25 vph) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.99^* (X)$
 $T = 0.99^* \quad 44$
 $T = 43.56$
 $T = 44$ vehicle trips
with 63% (28 vph) entering and 37% (16 vph) exiting.

SATURDAY DAILY

$T = 9.54^* (X)$
 $T = 9.54^* \quad 44$
 $T = 419.76$
 $T = 420$ vehicle trips
with 50% (210 vph) entering and 50% (210 vph) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$T = 0.93^* (X)$
 $T = 0.93^* \quad 44$
 $T = 40.92$
 $T = 41$ vehicle trips
with 54% (22 vph) entering and 46% (19 vph) exiting.

□ Trip Distribution Calculations

Journey-to-Work Distribution
US Census Journey-to-Work Data

Residence Town Name	Workplace Town Name	All Workers	% of Total Rounded
Millis town	Millis town	642	16.7%
Millis town	Boston city	408	10.6%
Millis town	Natick town	251	6.5%
Millis town	Newton city	250	6.5%
Millis town	Frammingham town	239	6.2%
Millis town	Medfield town	129	3.3%
Millis town	Wellesley town	98	2.5%
Millis town	Medway town	94	2.4%
Millis town	Needham town	92	2.4%
Millis town	Waltham city	89	2.3%
Millis town	Cambridge city	88	2.3%
Millis town	Walpole town	86	2.2%
Millis town	Canton town	84	2.2%
Millis town	Norwood town	84	2.2%
Millis town	Norfolk town	77	2.0%
Millis town	Weston town	71	1.8%
Millis town	Franklin Town city	66	1.7%
Millis town	Stoughton town	66	1.7%
Millis town	Holliston town	60	1.6%
Millis town	Dover town	53	1.4%
Millis town	Westwood town	53	1.4%
Millis town	Weymouth Town city	47	1.2%
Millis town	Marborough city	40	1.0%
Millis town	Dedham town	28	0.7%
Millis town	Worcester city	26	0.7%
Millis town	Andover town	25	0.6%
Millis town	Hartford town	21	0.5%
Millis town	Somerville city	20	0.5%
Millis town	Watertown Town city	20	0.5%
Millis town	Holden town	20	0.5%
Millis town	Concord town	19	0.5%
Millis town	Avon town	19	0.5%
Millis town	Blackstone town	19	0.5%
Millis town	North Attleborough town	18	0.5%
Millis town	Nashua city	18	0.5%
Sub-Total		3,448	89.5%
Other		403	10.5%
Total		3,851	100%

Workplace	To/From Routes					Total
	Main Street (East)	Main Street (West)	Union Street (North)	Village Street (South)	Total	
Millis town	5%	0.8%	10.8%	4.2%	0.8%	16.7%
Boston city	100%	10.6%	0.0%	0.0%	0.0%	10.6%
Natick town	20%	1.3%	0.0%	5.2%	0.0%	6.5%
Newton city	100%	6.5%	0.0%	0.0%	0.0%	6.5%
Frammingham town	100%	0.0%	100%	6.2%	0.0%	6.2%
Medfield town	100%	3.3%	0.0%	0.0%	0.0%	3.3%
Wellesley town	100%	2.5%	0.0%	0.0%	0.0%	2.5%
Medway town	100%	0.0%	1.5%	40%	1.0%	2.4%
Needham town	100%	2.4%	0.0%	0.0%	0.0%	2.4%
Waltham city	100%	2.3%	0.0%	0.0%	0.0%	2.3%
Cambridge city	100%	2.3%	0.0%	0.0%	0.0%	2.3%
Walpole town	80%	1.8%	0.0%	0.0%	0.4%	2.2%
Canton town	100%	2.2%	0.0%	0.0%	0.0%	2.2%
Norwood town	100%	2.2%	0.0%	0.0%	0.0%	2.2%
Norfolk town	70%	0.0%	0.0%	0.0%	0.0%	2.0%
Weston town	100%	1.3%	0.0%	0.0%	0.0%	1.8%
Franklin Town city	100%	1.7%	1.2%	0.0%	0.0%	1.7%
Stoughton town	100%	0.0%	0.0%	0.0%	0.0%	1.6%
Holliston town	100%	1.4%	0.0%	0.0%	0.0%	1.4%
Dover town	100%	1.4%	0.0%	0.0%	0.0%	1.4%
Westwood town	100%	1.2%	0.0%	0.0%	0.0%	1.2%
Weymouth Town city	100%	0.0%	0.6%	0.4%	0.0%	1.0%
Marborough city	100%	0.7%	0.0%	0.0%	0.0%	0.7%
Dedham town	100%	0.0%	0.6%	0.0%	0.0%	0.6%
Worcester city	50%	0.3%	0.7%	0.0%	0.0%	0.8%
Andover town	100%	0.5%	0.0%	0.0%	0.0%	0.5%
Hartford town	100%	0.0%	0.5%	0.0%	0.0%	0.5%
Somerville city	100%	0.4%	0.0%	0.0%	0.0%	0.4%
Watertown Town city	100%	0.0%	0.0%	0.0%	0.0%	0.5%
Holden town	100%	0.0%	0.5%	0.1%	0.0%	0.5%
Concord town	100%	0.0%	0.0%	0.5%	0.0%	0.5%
Avon town	100%	0.0%	0.0%	0.0%	0.0%	0.5%
Blackstone town	100%	0.0%	0.3%	0.0%	0.2%	0.5%
North Attleborough town	100%	0.0%	0.0%	100%	0.5%	0.5%
Nashua city	100%	0.0%	0.5%	0.0%	0.0%	0.5%
Sub-Total	47.7%	17.5%	18.9%	5.4%	89.5%	
Other						
Total	SAY	53.3%	21.1%	6.1%	100.0%	100%

□ Roadway Design Criteria

Table 5-5. Minimum Width of Traveled Way and Shoulders for Two-Lane Local Roads in Rural Areas

U.S. Customary				Metric			
Design Speed (mph)	Minimum Width of Traveled Way (ft) for Specified Design Volume (veh/day)			Design Speed (km/h)	Minimum Width of Traveled Way (m) for Specified Design Volume (veh/day)		
	under 400	400 to 2000	over 2000		under 400	400 to 2000	over 2000
15	18	20 ^a	22	20	5.4	6.0 ^a	6.6
20	18	20 ^a	22	30	5.4	6.0 ^a	6.6
25	18	20 ^a	22	40	5.4	6.0 ^a	6.6
30	18	20 ^a	22	50	5.4	6.0 ^a	6.6
35	18	20 ^a	22	60	5.4	6.0 ^a	6.6
40	18	20 ^a	22	70	6.0	6.6	6.6
45	20	22	22	80	6.0	6.6	6.6
50	20	22	22	90	6.6	6.6	6.6 ^b
55	22	22	22b	100	6.6	6.6	6.6 ^b
60	22	22	22b	All speeds	Width of graded shoulder on each side of the road (m)		
65	22	22	22b		0.6	1.0	1.8
All speeds	Width of graded shoulder on each side of the road (ft)						
	2	3	6				

^a For roads in mountainous terrain with design volume of 400 to 600 veh/day, an 18-ft [5.4-m] traveled-way width may be used.

^b Consider using traveled-way width of 24 ft [7.2 m] where substantial truck volumes are present or agricultural equipment frequently uses the road

5.2.2.3 Right-of-Way Width

Providing right-of-way widths that accommodate construction, adequate drainage, and proper maintenance of a highway is a very important part of the overall design. Wide rights-of-way permit the construction of gentle slopes, resulting in reduced crash severity potential and providing for easier and more economical maintenance. The procurement of sufficient right-of-way at the time of the initial construction permits the widening of the roadway and the widening and strengthening of the pavement at a reasonable cost as traffic volumes increase.

In developed areas, it may be necessary to limit the right-of-way width. However, the right-of-way width should not be less than that needed to accommodate all the elements of the design cross sections, utilities, and appropriate border areas.

5.2.2.4 Medians

Medians are generally not provided for local roads in rural areas. For additional information on medians, see Section 5.3, "Local Streets in Urban Areas."

Estimated ADT Calculations

	Total Daily Trips	ADT	SAY
Road "A" - Main Street Connection Assumes 80% Daily Trips	418	334	350
Secondary Driveway Alternatoves Assumes 20% Daily Trips			
Railroad Avenue	418	84	100
Dale Avenue Connection	418	84	100
North Street Connection	418	84	100



December 16, 2019

Mr. Nichols, Chairman of Planning Board
Town of Millis
900 Main St.
Millis, MA 02054

Re: Millis – Woodlands Open Space Preservation Subdivision Application
Traffic Peer Review

Dear Mr. Nichols:

BETA Group, Inc. (BETA) has completed our review and analysis of traffic and access-related documents submitted to the Planning Board for the proposed 44 lot open space preservation development to be known as Woodlands. This letter is provided to outline BETA's findings and recommendations.

BASIS OF REVIEW

BETA received the following items:

- Secondary Roadway Evaluation Memorandum, dated December 6, 2019, prepared by MDM Transportation Consultants, Inc, Marlborough, MA
- Secondary Roadway Alternative Plans (3 sheets), as appended to the December 6th memorandum, prepared by Legacy Engineering, Millis, MA

INTRODUCTION

The project site includes the development of ten parcels on the southeastern side of Environmental Drive and railroad track, between Crestview Drive and Cottage Avenue. The proposed project intends to create a 44 lot open space development. Special permit review has been completed by BETA under separate cover in letters dated May 30, 2019 and July 8, 2019.

The site as proposed in the Special Permit Application identifies primary access for the 44-lot residential development via a direct connection to Main Street (Route 109) approximately 400 feet east of Village Street. The Planning Board has requested evaluation of secondary roadway alternatives.

SITE GENERATED TRAFFIC

The memorandum identifies that the proposed development will generate approximately 33 vehicle trips (8 entering and 25 exiting) during the weekday morning peak hour and 44 vehicle trips (28 entering and 16 exiting) during the weekday evening peak hour, with 418 total daily trips with 50 percent entering and exiting. Trip generation was estimated using the Institute of Transportation Engineers (ITE)'s Trip Generation Manual (10th Edition) for Land Use Code (LUC) 210 – Single Family Detached Housing. BETA finds the trip generation to be accurately estimated and consistent with industry standards.

Trip distribution is based on Journey to Work Census data for residents of Millis. This is an accurate method consistent with industry standards. Data indicates distribution patterns of 55% percent to/from

the east via Main Street, 20% to/from the west via Main Street, 20% to/from to west via Union Street, and 5% to/from the south via Village Street.

The memorandum assumes the 20% distribution to/from Union Street would utilize the secondary site access. BETA concurs with this assumption, but cautions that slight variances may exist depending upon the secondary access route chosen. It should be noted that 20% of the total site generated traffic equals seven trips in the weekday morning peak hour and nine trips in the weekday evening peak hour.

SUBDIVISION ROADWAY DESIGN

The memorandum presents criteria from the American Association of State Highway and Transportation Officials (AASHTO) for local roads with an average daily traffic (ADT) under 400 vehicles per day (vpd). The primary development access route as well as the alternate access routes being considered all fall under this threshold. AASHTO recommends a roadway width of 18 feet with a graded shoulder of 2 feet on each side of the roadway. BETA finds these criteria to be appropriate and agrees that these minimum widths encourage reduced speeds and are in keeping with the residential nature of the proposed development.

SECONDARY ACCESS ALTERNATIVES

The memorandum accurately states that the development parcel has access to four adjacent public ways that could be utilized for the purpose of a secondary roadway, as follows:

- North Street
- Dale Avenue
- Railroad Avenue
- Island Road

The memorandum states that North Street, Dale Avenue, and Railroad Avenue would provide adequate secondary roadway connections for the project and presents plans showing site layout revisions utilizing each of these access points. For the purpose of this review, all four adjacent public ways have been evaluated.

ISLAND ROAD

Island Road is a local road of varying width extending from Exchange Street (Route 115) to the west to Dover Road to the east. Environmental Drive runs parallel to the railroad track abutting the development site to the north, and ends at an intersection with Island Road at an uncontrolled railroad crossing without warning lights or crossing gates. Although Island Road is paved at its ends, it is primarily a dirt roadway.

NORTH STREET

North Street is approximately 18 feet in width and provides connection between Main Street to the south and Cottage Avenue to the north. Land use includes two residential homes and the undeveloped site.

DALE AVENUE

Dale Avenue is an east-west roadway between Winter Street and its termination point at the site parcel. Dale Avenue is essentially a driveway providing access to two residential homes. Pavement width varies but is typically between 12 and 14 feet. Although the memorandum states that Dale Avenue is a private roadway, it is an accepted public way.

RAILROAD AVENUE

Railroad Avenue is generally a north-south roadway running parallel to the railroad track between Union Street and a dead end terminus at the site parcel. Pavement width varies but is generally 18 feet or less. Segments of Railroad Avenue are relatively undefined, including along the Howie Oil Company property where a concrete slab abutting oil tanks and a retaining wall are unprotected and undivided from the roadway. Railroad Avenue is also undefined at its intersection with Union Street, with a 190-foot curb cut encompassing a parking area, Railroad Avenue and an adjacent industrial garage/office housing multiple business.

SECONDARY ACCESS RECOMMENDATIONS

Secondary access alternatives were reviewed for access, impacts to abutting land and neighboring streets, and potential for cut-through traffic.

ACCESS

New trips created by the proposed development are most easily accommodated by arterial and collector roads abutting the parcel. For this reason, it is prudent to provide primary access to Main Street (Route 109). The site layout provides this access at the easternmost portion of the parcel abutting Main Street, maximizing the distance from the Village Street intersection.

Although a plan was not provided showing secondary access via Island Road, access is feasible by reconfiguring the site to relocate the open space parcels. However, Island Road is not suitable for repeated daily residential traffic due to its narrow width and dirt surface. Widening and full depth pavement construction would be required to meet the minimum 18 foot width and 2 foot graded shoulders recommended by AASHTO.

Access via Railroad Avenue would require extending Railroad Avenue to the site, and reconstructing portions of Railroad Avenue to provide roadway definition with a consistent 18 foot width with 2 foot graded shoulders. This includes potential impacts to the presently unprotected retaining wall, where the adjacent roadway is less than 18 feet wide.

Access via Dale Avenue also requires extending the street to the site, with a steep uphill grade to meet the existing elevation of Dale Avenue. This would also require significant widening of Dale Avenue, which at present varies between 12 and 14 feet. Access via both Dale Avenue and Railroad Avenue would send vehicles to Union Street via Railroad Avenue, which may promote intersection improvements to provide definition of Railroad Avenue at Union Street.

Access via North Street is most feasible, and presents the most direct secondary access to an arterial roadway. Access via North Street also would not require widening of the existing roadway, which is typically 18 feet in width.

IMPACTS

The Island Road alternative would impact the existing sand dunes currently designated as open space in the proposed site layout. It should be noted that this area has been identified as a potential town recreational area, with a sports field and adjacent parking. The Island Road alternative would require site-generated traffic to traverse Island Road to reach either Dover Road to the east or Exchange Street (Route 115) to the west, creating increased traffic traveling on a local road potentially impacting residential homes clustered at either end of Island Road.

The Railroad Avenue alternative impacts three residential homes at the northern dead end of Railroad Avenue, and creates conflicts between site generated traffic and truck traffic generated by industrial uses along Railroad Avenue.

The Dale Avenue alternative creates impacts to two residential homes along Dale Avenue, and also encourages site-generated traffic utilizing the secondary access to follow Winter Street to access Union Street. This would in turn also increase traffic along Winter Street, impacting seven additional residential homes along Winter Street.

The North Street alternative creates impacts to two residential homes along North Street, and may also potentially encourage site-generated traffic to use Cottage Avenue to Winter Street for access to Union Street. This in turn would impact eight residential homes on Cottage Avenue, and four on Winter Street between Cottage Avenue and Union Street.

CUT-THROUGH TRAFFIC

Existing delays along Main Street (Route 109) and the desire to turn onto Union Street from Main Street may encourage more aggressive drivers to find a potential cut-through route to bypass Main Street.

The Island Street alternative would not encourage cut-through traffic to Union Street, as no connection would exist between the proposed development and the residential streets to the west of the development abutting Union Street.

The Railroad Avenue and Dale Avenue alternatives would potentially encourage cut-through traffic to Union Street via Railroad Avenue. The secondary site access plan alternatives provided for review most directly encourage cut-through traffic for the Dale Avenue alternative, which introduces a 90 degree angle between the primary site access road and the road connecting to Dale Avenue, which is a more direct alignment along the site road to Dale Avenue compared to the Railroad Avenue alternative.

The North Street alternative has less potential for cut-through traffic because both the primary and secondary access intersect Main Street.

There is potential for cut-through traffic to use Cottage Avenue from the primary site access roadway to Union Street via Winter Street. This potential exists in all alternatives.

CONCLUSION

Of the four secondary access alternatives, North Street provides the most feasible option for secondary access, with the most minor impacts to abutting streets.

- North Street is of an adequate width to accommodate subdivision traffic, and is the only option that does not require modification and/or reconstruction of an existing street.
- The North Street alternative may encourage site-generated traffic to use the secondary access to North Street in order to cut through on Cottage Avenue to Union Street via Winter Street. It should be noted that this potential cut-through option exists today for non-site generated traffic.
- The North Street alternative encourages less external (non-site generated) traffic to cut through the proposed development, since the development's primary and secondary access both intersect Main Street.

If we can be of any further assistance regarding this matter, please contact us at our office.

Woodlands Preliminary Subdivision Plan, Millis

December 16, 2019

Page 5 of 5

Very truly yours,
BETA Group, Inc.



Greg E. Lucas, PE, PTOE, RSP
Associate/Senior Traffic Engineer

cc: Camille Standley- Planning Board

Job No: [6605]