



HAJEC ASSOCIATES
Transportation Engineering
and Planning

TRAFFIC IMPACT AND ACCESS STUDY

BAYBERRY ENTERPRISE REALTY TRUST RESIDENTIAL DEVELOPMENT

BAYBERRY ROAD

PEPPERELL, MASSACHUSETTS

(JUNE 2006)

PROJECT DESCRIPTION

Hajec Associates has conducted a Traffic Impact and Access Study (TIAS) for the above-referenced project, consisting of construction and occupancy of 44 townhouse dwelling units in 22 duplex-type buildings.

The development parcel is located on the west side of Bayberry Road, in the west-central section of the Town of Pepperell, MA. It consists of approximately 19.85 acres of currently undeveloped land.

Primary access/egress between the site and the existing public street system will be provided via a single full-movement (with both left and right turns to and from the project permitted) driveway connection with Bayberry Road. This roadway will be located on the eastern side of the development parcel, between the existing #20 and #24 Bayberry Road (just north of #20 and just south of #24 Bayberry Road). It will intersect Bayberry Road in an approximate "T" (90 degree angle) configuration. Internal to the subject site, the driveway will provide a 24-foot wide pavement width encompassing two travel lanes (one lane in each direction).

There will also be a 20-foot wide gravel roadway for emergency access/egress at the site. This emergency roadway will be approximately 1300 feet long and connect directly to Ashley Street on the western side of the development. For the majority of its length (about 1000 feet), it will traverse a 40-foot wide easement area connecting the western project boundary with Ashley Street. The remaining length of this roadway (about 300 feet) will travel within the project limits until connecting with the primary paved internal roadway.

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STUDY AREA DEFINITION

The study area for this report for which detailed operations analysis (evaluation of both potential project-related traffic volume increases and intersection service levels) was conducted includes the following intersections and connecting roadway segments:

- * Bayberry Road at Chestnut Street;
- * Bayberry Road at Heald Street; and
- * Bayberry Road at Site Drive.

This study area was defined through field reconnaissance as well as the use of professional judgment, based primarily on experience from work on hundreds of similar previous projects.

The selected intersections and roadways are critical, from an analysis standpoint, in that they, as a whole, will accommodate all traffic generated by the subject project.

There are no known improvements imminent for study area roadways and intersections, independent of any mitigation that would occur as a result of the proposed project.

METHODOLOGY AND REFERENCES

This TIAS was prepared in accordance with the "Supplemental Requirements" of the Town's Comprehensive Permit Application as well as the traffic analysis guidelines of the Massachusetts Highway Department (MHD). The latter (MHD guidelines) are also espoused by several communities in the Commonwealth (and thus typically adhered to in the preparation of municipally-based studies).

Reference publications and other material reviewed for this study are as follows:

- * Trip Generation, Institute of Transportation Engineers (ITE), Seventh Edition, Volume 2 of 3, Land Use Code 230 ("Residential Condominium/Townhouse"), 2003;
- * Highway Capacity Software 2000, Transportation Research Board;
- * A Policy on the Geometric Design of Highways and Streets, Fifth Edition, American Association of State Highway and Transportation Officials (AASHTO), 2003;
- * Highway Design Manual, Massachusetts Highway Department (as amended through December 2005);

- * Traffic Engineering Handbook, by Prentice Hall for the Institute of Transportation Engineers, Fourth Edition, 1992;
- * Manual on Uniform Traffic Control Devices for Streets and Highways, 2003 Edition, U.S. Department of Transportation Federal Highway Administration (FHA), 2003;
- * Bayberry Enterprise Realty Trust Site Plan, prepared by Griffin Engineering Group, LLC of Beverly, MA, dated March 3, 2006;
- * Automatic Traffic Recorder (ATR) weekday count and speed survey on Bayberry Road (just south of the site at #20 Bayberry Road), collected by Accurate Counts under the direction of Hajec Associates during April 2006 (included as Attachment 1); and
- * Peak period (7:00AM-9:00AM and 4:00PM-6:00PM) weekday turning movement counts (TMC'S) at Bayberry Road/Chestnut Street and Bayberry Road/Heald Street, collected by Accurate Counts under the direction of Hajec Associates during April 2006 (included as Attachment 2).

Field reconnaissance beyond that required for the traffic counts was conducted to perform the various additional measurements and observations needed to complete a professionally acceptable TIAS.

In order to assess traffic volume and operational levels, weekday morning and evening commuter periods were considered, and the associated peak one hour periods were ultimately analyzed. These time intervals represent the expected peak generating periods of the site, based on residential townhouse/condominium trip rates from the Institute of Transportation Engineers. The weekday daily (24-hour) traffic flow condition was also evaluated.

EXISTING CONDITIONS

Roadway Section Volumes

- * Daily (24-hour) weekday traffic along Bayberry Road near the development area was 156 vehicles per day (vpd).
- * The existing weekday AM peak hour on Bayberry Road near the site included 11 vehicles (4 northbound and 7 southbound) and occurred between 7:15AM and 8:15AM. The weekday PM peak hour consisted of 19 vehicles (13 northbound and 6 southbound) and occurred between 5:00PM and 6:00PM.
- * The observed weekday AM peak hour truck volume on Bayberry Road included only 2 vehicles. There was not any truck traffic observed during the weekday PM peak hour.

* The existing weekday AM peak hour on Chestnut Street east of Bayberry Road included 30 vehicles and occurred between 7:45AM and 8:45AM. The weekday PM peak hour on this section of Chestnut Street included 31 vehicles and occurred between 4:15PM and 5:15PM.

* The existing weekday AM peak hour on Chestnut Street west of Bayberry Road included 28 vehicles between 7:45AM and 8:45AM. The weekday PM peak hour on this section of Chestnut Street included 29 vehicles between 4:15PM and 5:15PM.

* Heald Street is the most heavily travelled roadway among those considered in the study area.

* The existing AM peak hour volume on Heald Street east of Bayberry Road consisted of 67 vehicles between 7:00AM and 8:00AM, while the PM peak hour volume consisted of 81 vehicles between 4:30PM and 5:30PM.

* The existing weekday AM peak hour on Heald Street west of Bayberry Road included 64 vehicles between 7:00AM and 8:00AM. The weekday PM peak hour on this section of Heald Street included 69 vehicles between 4:30PM and 5:30PM.

* The observed peak hour volume as a percentage of average daily traffic is also known as the "K Factor." On Bayberry Road just south of the site (in front of #20 Bayberry Road), the K Factor was 7.1% during the AM peak hour and 12.2% during the PM hourly analysis period, on a weekday. These K Factor values are within the range of that accepted as typical for roadways used, to a large extent, for work-related trips.

Intersection Volumes

* The Bayberry Road/Chestnut Street intersection approach volume was 32 vehicles during the weekday AM peak hour and 34 vehicles during the weekday PM peak hour. The heaviest approach volume during the AM period was 22 vehicles, along Chestnut Street eastbound. The heaviest approach volume during the PM period was 23 vehicles, along Chestnut Street westbound.

* The Bayberry Road/Heald Street intersection approach volume was 77 vehicles during the weekday AM peak hour and 88 vehicles during the PM peak hour. The heaviest approach volume during the AM hourly period was 32 vehicles, along Heald Street eastbound. The heaviest approach volume during this PM peak hour period was 51 vehicles, along Heald Street westbound.

* The peak hours at each study area intersection and along study roadway sections may vary (each location may have different peak hours). In order to obtain a representation of "worst-case" conditions, the individual peak hours for each location were used in the operations analysis. The peak hour volumes for the Bayberry Road/Chestnut Street and Bayberry Road/Heald Street intersections are presented as Attachment 3.

Vehicle Speeds

* The 85th percentile speed (85% of recorded vehicles were travelling at or below this speed) on Bayberry Road southbound was 36 miles per hour (mph). The mean (average) speed was 27 mph. The 85th percentile speed is the value typically used to establish intersection sight distance requirements.

* The 85th percentile speed on Bayberry Road northbound was 38 mph. The mean speed was 28 mph.

* The 85th percentile speed for all traffic (both directions) on Bayberry Road was 37 mph. The mean speed of all traffic was 27 mph.

FUTURE VOLUMES - NO-BUILD CONDITION

* Traffic volume projections were developed for a 2011 design, or planning horizon, year, to be consistent with aforementioned professional standards. It is expected, however, that the subject project will be constructed and occupied prior to that time.

* A 2.0% per year growth rate was assumed for the general background component of 2011 No-Build traffic. This growth rate was based on information obtained from the Metropolitan Planning Organization (MPO) regional planning agency having the Town of Pepperell within its jurisdiction. The application of this rate (compounded annually) resulted in an increase of just over 10.0% in study area traffic volumes, compared to existing conditions. The traffic volume increases associated with this growth factor were superimposed on the existing (year 2006) volumes to simulate 2011 No-Build conditions.

* In addition to the future traffic increases resulting from the aforementioned 2.0% annual growth rate, the potential for project-specific vehicular traffic that would be generated by planned developments in and immediately adjacent to the study area was also researched, for inclusion in the No-Build analysis.

FUTURE VOLUMES - BUILD CONDITION

* Vehicle trip generation estimates for the proposed development were made using fitted-curve equations presented in the Institute of Transportation Engineers (ITE) Trip Generation, 7th Edition, Volume 2 of 3, Land Use Code 230 ("Residential Condominium/Townhouse"), published in 2003. This report contains predictive equations and trip rates for various land use types, with these rates currently the accepted standard. This ITE publication and the trip-making information contained therein is based on empirical data collected at sites throughout the country.

* The proposed project of 44 residential units will generate a total of 27 vehicle trips (5 inbound and 22 outbound) during the weekday AM peak one hour and 31 trips (21 inbound and 10 outbound) during the PM peak one hour of study area traffic. On an average daily (24-hour) weekday basis, the proposed project will generate a total of 320 trips (160 inbound and 160 outbound). These trips consist of all traffic expected to be generated by the development, including (in addition to those by residents) trips made by service/delivery vehicles (such as those associated with visits made by friends and family, landscaping services, mail delivery, appliance repair, furniture delivery, etc.). The pertinent sections of Trip Generation are contained as Attachment 4.

* Due to the trip-making characteristics of residential projects, and in accordance with professional guidelines, it was assumed that 100% of the traffic generated by the proposed development will be new trips to the study area (there will be no pass-by trips).

* The distribution of these new trips along the study area roadway network was determined primarily according to: (1) minimum path routings between the site and surrounding regional roadways; and (2) patterns identified in the ATR and TMC counts conducted specifically for this TIAS. Accordingly, it is expected that the allocation of project-generated vehicular trips will be as follows:

- Bayberry Road to/from north of site	35%
- Bayberry Road to/from south of site	65%
- Chestnut Street to/from east	25%
- Chestnut Street to/from west	10%
- Heald Street to/from east	45%
- Heald Street to/from west	20%

* Traffic increases resulting from the project will not be critical or significant, from a net vehicle or average arrival rate standpoint. Specifically, the volume increases on study area roadway sections resulting from the proposed residential development will be as follows:

Bayberry Road North of Site Drive

AM Peak Hour = 9 Vehicles (1 Vehicle Per 6.7 Minutes)
PM Peak Hour = 11 Vehicles (1 Vehicle Per 5.5 Minutes)

Bayberry Road South of Site Drive

AM Peak Hour = 18 Vehicles (1 Vehicle Per 3.3 Minutes)
PM Peak Hour = 20 Vehicles (1 Vehicle Per 3.0 Minutes)

Chestnut Street To/From the East

AM Peak Hour = 7 Vehicles (1 Vehicle Per 8.6 Minutes)
PM Peak Hour = 8 Vehicles (1 Vehicle Per 7.5 Minutes)

Chestnut Street To/From the West

AM Peak Hour = 2 Vehicles (1 Vehicle Per 30.0 Minutes)
PM Peak Hour = 3 Vehicles (1 Vehicle Per 20.0 Minutes)

Heald Street To/From the East

AM Peak Hour = 12 Vehicles (1 Vehicle Per 5.0 Minutes)
PM Peak Hour = 14 Vehicles (1 Vehicle Per 4.3 Minutes)

Heald Street To/From the West

AM Peak Hour = 6 Vehicles (1 Vehicle Per 10.0 Minutes)
PM Peak Hour = 6 Vehicles (1 Vehicle Per 10.0 Minutes)

TRAFFIC OPERATIONS

* Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, intersection capacity analyses were conducted for 2006 Existing, 2011 No-Build, and 2011 Build peak hour traffic conditions. These analyses provide an indication of how well roadway facilities serve the traffic demands placed upon them. The evaluation criteria contained in the 2000 Highway Capacity Software were used to analyze the study area intersections.

* Level of Service (LOS) is the term used to define the various operating conditions which occur on a given roadway segment or intersection under different traffic volume loading conditions. LOS is a qualitative measure of the effect of several factors, including roadway geometrics, speed, travel delay, freedom to maneuver, and safety. Levels of service are represented by letter designations from A to F, with LOS A representing the best operating conditions and LOS F representing the worst. LOS D or better is typically considered an acceptable operating condition.

Ultimately, intersection LOS is defined by average delay, both on a lane group and total intersection basis. The delay criteria used in defining intersection LOS is presented in Attachment 5.

* All turning movements at Bayberry Road/Chestnut Street and Bayberry Road/Heald Street currently operate well within acceptable standards during the AM as well as the PM peak hour. Specifically, all movements occur at LOS B or better. These values will be unchanged in the future analysis year of 2011, with or without the proposed project. Also, all turning movements entering and exiting the site at its driveway intersection with Bayberry Road will operate at LOS A with full occupancy of the project. By definition according to professional evaluation criteria, there will be no perceptible adverse operational impacts (such as increased congestion and delay).

SAFETY

Sight Distance

The Stopping Sight Distance (SSD) provided on each side of the Bayberry Road/Site Drive intersection will exceed the minimum distances suggested by the American Association of State Highway and Transportation Officials (AASHTO) and adopted by MHD, for the 85th percentile speed under ambient design (with regard to roadway curvature and grade) as well as for wet pavement conditions on Bayberry Road.

The suggested 85th percentile speed minimum SSD north of the site driveway is 261 feet.

The suggested 85th percentile speed minimum SSD south of the site driveway is 283 feet.

The AASHTO Stopping Sight Distance criteria are presented in Attachment 6.

Turning Radii

The turning radii provided at the Bayberry Road/Site Drive intersection will be adequate to safely accommodate the vast majority of typical vehicles (resident automobiles/SUV's, service/delivery vehicles, etc.) expected to arrive/depart the site. Thus, vehicle maneuvers should occur without encroachment into opposite direction travel lanes and traffic streams and/or over curbing.

BAYBERRY ROAD LEFT-TURN LANE WARRANT ANALYSIS

Professionally accepted criteria, guidelines, and procedures were used to determine the need for a left-turn storage lane for turns that would be made from Bayberry Road northbound into the project driveway. The results of this analysis showed that 2011 traffic volumes will not warrant provision of such a lane.

MITIGATION

The final phase of this TIAS identifies mitigation measures which will enhance safety and operations for the traffic generated by the project, as well as ambient traffic in the study area. These recommended measures are as follows (in no particular order of importance):

* Egress movements from the Site Drive onto Bayberry Road should be placed under stop sign and stop bar (paint or thermoplastic material on pavement) control.

* A yellow centerline (paint or thermoplastic material on pavement) should be provided along a continuous 100-foot distance of the Site Drive, from a point beginning at the aforementioned stop bar at Bayberry Road.

* To the extent possible with respect to property ownership constraints, vegetation and plants within an eight foot setback distance of the project frontage on Bayberry Road should be maintained to a height of not more than 3.5 feet (professionally accepted standard for average height of driver's eye). Implementation of this measure will ensure that maximum stopping sight distances are maintained for the Bayberry Road/Site Drive intersection.

* An "SP-3" ("TRAFFIC ENTERING RIGHT") sign warning drivers on Bayberry Road of turning traffic at the Site Drive should be installed on Bayberry Road, at a location about 300 feet north of said driveway.

* The section of Bayberry Road between the project driveway and Heald Street should be widened from its existing relatively narrow width of approximately 18 feet to a safer and more comfortable width of 24 feet. This roadway section is expected to receive the heaviest amount of project-related traffic and therefore is considered a priority for improvement.

An illustration of recommended sign installations is included as Attachment 7.

It is recommended that mitigation be completed prior to project occupancy, and, to the extent reasonably possible, in accordance with guidelines, procedures, and standards stipulated by AASHTO, FHA, MHD, and the Town of Pepperell.

CONCLUSIONS

The proposed residential project of Bayberry Enterprise Realty Trust will have imperceptible and insignificant impact on study area roadways, following implementation of the recommended traffic control installations, vegetation/plant maintenance, and roadway widening.

Assuming this commitment to mitigation is made, the proposed project should be approved, from a traffic and safety standpoint.