

APPENDIX G

ASSESSMENT STUDY STANDARDS/MISC.

HYDROGEOLOGIC STUDY GUIDELINES

1.0 BASE MAP – Should include:

- 1.1 Existing surface water bodies and wetlands
- 1.2 Location of existing wells and septic systems for abutting properties
- 1.3 Existing and planned land surface elevations
- 1.4 Groundwater contours at minimum two (2) foot intervals
- 1.5 Detailed description of proposed project, including:
 - a) location of planned septic systems
 - b) water supply wells
 - c) residential dwellings
 - d) lawn areas
 - e) paved areas

2.0 BACKGROUND INFORMATION – Should include:

- 2.1 Existing condition of ground and surface water quality, including physical characteristics and water chemistry. Measurements shall specifically include concentrations of total phosphorus if in the recharge zone of freshwater pond; nitrate-nitrogen if in the recharge zone of saltwater pond or embayment; and nitrate-nitrogen if in a zone of contribution to a private or public water supply well.
- 2.2 Subsurface geology
- 2.3 Surface drainage patterns

3.0 ANALYSIS OF DEVELOPMENT IMPACT

The analysis of the impact of the development will vary depending on its location in relation to sensitive water resources within the Town. One of four categories will apply. They are: 1) Zone II protection areas to public drinking water supplies; 2) contributing areas to fresh water lakes or ponds; 3) contributing areas to coastal estuaries; and 4) those areas designated as not impacting in a significant way the sensitive water resources. Subdivisions with upland in excess of 80,000 square feet per buildable lot would be designated as being in the fourth category. No further analysis of development impact by subdivision in category four need to be performed, unless specifically required by the Planning Board.

3.1 Zone II Protection Areas to Public Drinking Water Supplies

Analysis should include:

The existing condition of the water supply, including well location and construction and the quality of water pumped by the well.

A calculation of the total nitrogen loading from the proposed development (in pounds per year) and the predicted nitrogen concentration in ground water underneath the development (in mg/l) using loading rates provided in Table G-1 below.

A calculation of the predicted nitrogen concentration in ground water pumped by the water supply well from throughout the Zone II area. This analysis must include a calculation of the total loading within the Zone II area from all sources under saturation or build-out conditions. The loading analysis should use the loading rates provided in Table G-1 below.

A comparison of the results of the post-development Zone II loading analysis to the critical nitrogen concentration of 5 mg/l for water pumped by the water supply well. If the predicted concentration is above 5 mg/l, the applicant must indicate nitrogen reduction measures for the proposed development that will reduce the nitrogen loading so the predicted concentration is 5 mg/l or less.

3.2 Contributing Areas to Fresh Water Lakes or Ponds

Analysis should include:

A map showing the boundaries of the contributing area based on ground water flow and/or surface water runoff.

A calculation of the total phosphorus loading from the proposed development (in pounds per year) using loading rates provided in Table G-2 below.

A calculation of the predicted phosphorus concentration in the fresh water system from sources throughout the contributing area. This analysis must include a calculation of the loading within the contributing area from all sources under saturation or build-out conditions. The loading analysis should use the loading rates provided in Table G-2 below.

A comparison of the results of the post-development phosphorus loading analysis to the critical phosphorus concentration of 0.2 mg/l for the fresh water resource. If the predicted concentration is above 0.2 mg/l, the applicant must indicate phosphorus reduction measures for the proposed development that will reduce the phosphorous loading so the predicted concentration is 0.2 mg/l or less.

3.3 Contributing Areas to Coastal Ponds or Estuaries

Analysis should include:

A map showing the boundaries of the contributing area based on ground water flow.

A flushing calculation showing how quickly water and associated nutrients and other contaminants are removed from the coastal system into Massachusetts Bay.

A calculation of the total nitrogen loading from the proposed development (in pounds per year) using loading rates provided in Table G-1 below.

A calculation of the predicted nitrogen loading to ground water (in pounds per year) throughout the contributing areas. This analysis must include a calculation of the total loading within the contributing area from all sources under saturation or build-out conditions. The loading analysis should use the loading rates provided in Table G-1 below.

A comparison of the results of the predicted loading analysis for the post-development condition to the critical nitrogen loading levels provided in Table G-3 below which are based on the flushing characteristics of the coastal system. If the predicted concentration is above the critical loading levels, the applicant must indicate nitrogen reduction measures for the proposed development that will reduce the nitrogen loading so the predicted concentration is reduced to, or below the critical rate.

**Table G-1
Nitrogen Loading Analysis Parameters**

SOURCE	CONCENTRATION	LOADING RATE	FLOW/RECHARGE
Sewage	40 mg N/liter	(6.72 lbs N/person/yr) (165 gallons/dwelling)	55 gallons/person/day
Fertilizer (Lawns)		(0.9 lbs N/1000 sq. ft./yr.)	18 in./year
Pavement Runoff	2.0 mg N/liter	(.42 lbs N/1000 sq.ft./yr.)	40 in./yr
Roof Runoff	0.75 mg N/liter	(0.15 lbs N/1000 sq.ft./yr.)	40 in./yr
Precipitation	0.05 mg N/liter	(0.005 lbs N/1000 sq.ft./yr.)	18 in./year

Average Loading Rate Per Dwelling (25.3 lbs/yr)

*Agricultural fertilizer loading rates should be determined for dominant local crops, if appropriate.

**TABLE G-2
Watershed Phosphorus Loading Model
Build-out Conditions**

	QUANTITY	SOURCE LOADING	PERSISTENCE	LOADING LBS/YR.
GROUNDWATER				
Septic Systems	*	9.6 lbs/unit/yr	0.20	**
Lawns	*	0.91 lbs/5000 sq.ft/yr	0.19	**
Agricult.Fields (w/ manure) (acres)	*	10 lbs/acre/yr	0.24	**
Feedlots (acres)	*	227 lbs/acre/yr	0.24	**
Forested (acres)	*	0.2 lbs/acre/yr	0.37	**
Road Drainage (acres)	*	0.92 lbs/acre/yr	0.00	**
TOTAL (Loading to Stream/Pond)				***
STORMWATER FLOW				
Septic Systems	*	9.6 lbs/unit/yr	0.31	**
Lawns	*	0.91 lbs/5000 sq.ft/yr	0.31	**
Agricult.Fields (w/ manure) (acres)	*	10 lbs/acre/yr	0.40	**
Feedlots (acres)	*	227 lbs/acre/yr	0.40	**
Forested (acres)	*	0.2 lbs/acre/yr	0.63	**
Road Drainage (acres)	*	0.92 lbs/acre/yr	1.00	**
TOTAL (Loading to Stream/Pond)				***
		TOTAL LOADING		*****

Runoff/Recharge Calculations:

	Soils (acres)	Runoff (ft/yr)	Runoff (M gal/yr/acre)	Recharge (ft/yr)	Result (M gal/yr/acre)
Glacial Till	*	1	0.3258	0.25	0.0814
Sandy Soils	*	0.25	0.0814	1.50	0.4887
Total	***		0.4072		0.569
Average stormflow (cfs)		1.86	Average baseflow (cfs) 0.69		

* quantity of

** quantity times unit loading times persistence measured in pounds per year

*** Column total

***** Sum of groundwater and stormwater flows

NOTE: Number of acres times 43,560 square feet times runoff/recharge in ft/yr times 7.48 gallons per cubic foot equal gallons per year. Convert to liters and convert pounds per year to milligrams to get MG/L concentration.

TABLE G-3

Recommended Critical Nitrogen Loading Limits

Type of Embayment	SB* Waters	SA* Waters	Sensitive Waters
Shallow:			
Flushing in less than or equal to 5 days	350 mg/M3/Vr	200 mg/M3/Vr	100 mg/M3/Vr
Flushing in greater than 5 days	30 g/M2/yr	15 g/M2/yr	5 g/M2/yr
Deep: Use lesser loading rate	500 mg/M3/Vr or 45 g/M2/yr	260 mg/M3/Vr or 20 g/M2/yr	130 mg/M3/Vr or 10 g/M2/yr
Vr = residence time/square root (1+ residence time)			
* SB and SA are classifications for coastal waters relating to existing, desired water quality based on waterbody type, location, size, etc. and adjacent land uses. SB is lower quality based on waterbody type, location, size, etc. and adjacent land uses. SB is a lower quality than SA. The Commonwealth of Massachusetts has classified all coastal waters under the authority of 314 CMR 4, and has currently classified Duxbury coastal waters as SA.			

OUTLINE OF MINIMUM REQUIREMENTS FOR A TRAFFIC STUDY REPORT

1. Introduction

- Project Description
- Locus Map

2. Description of Existing Conditions

- Existing Road Geometrics
 - Lane and shoulder widths
 - Lateral Clearances
 - Horizontal and Vertical Alignment
 - Intersection Geometrics
 - Traffic Signalization
 - Sight Distances
- Abutting Land Uses and Zoning
- Existing Traffic Characteristics Based on Traffic Counts or Observation
 - Vehicle Speeds
 - Average Daily Traffic (ADT)
 - Peak Hour Traffic
 - Directional Distribution
 - Truck Percentage for ADT and Peak Hour
 - Turning Movements at Adjacent Intersections
 - Pedestrian Volumes
- Accident Data Collection and Analysis
 - Summary of Three Year Accident History
 - Accident Diagrams
 - Evaluation of Accidents

3. Projected Traffic Impacts Due to Proposed Development

- Methodology for Making Projections
- Average Daily Traffic (ADT)
- Peak Hour Traffic
- Directional Distribution
- Truck Percentage for ADT and Peak Hour
- Turning Movements at Adjacent Intersections
- Pedestrian Volumes

4. Proposed Methods of Mitigating Traffic Impacts

- Geometric Improvements
- Traffic Signalization

5. Level of Service Chart

<u>Level</u>	<u>Delay in Seconds</u>	<u>Description</u>
A	Less Than 5.0	Very little delay, rare stopping
B	5.1 – 15.0	Majority of vehicles do not stop
C	15.1 – 25.0	Some pass-through, significant # stop
D	25.1 – 40.0	Most stop, sometimes twice in cycle
E	40.1 – 60.0	Almost all stop, cycle failure frequent
F	Greater than 60.0	Gridlock