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## **Meeting House Place Nitrogen Load Calculations June 28, 2019**

Total Perimeter Land Area = 54.3 acres

MVC WQMP Adjusted Nitrogen Load Limit (Edgartown Great Pond) = 1.40 kg/ac/year

MVC WQMP maximum nitrogen load for 54.3 acres = 76.0 kg/year

### **A & B 28 lots @29,553 sf average per lot**

Maximum interior house square footage = 4,800 sf + garage

Average footprint – roofs + covered decks & porches – 6,000 sf per lot

Average uncovered porch & deck – 1,000 sf per lot

Average driveway square footage – 2,500 sf per lot

Pools – 14 lots x 800 sf per lot (20'x40') (no Nitrogen contribution)

Patios – 2,000 sf per lot

Maximum number bedrooms = 5 per lot

Fertilized lawn & gardens = 4,000 sf per lot per policy (all land within lots exclusive of zoning setbacks, roofs, covered decks & porches, uncovered decks & porches, driveway, pool & patio shall be considered "landscaped area" as per MVC WQMP)

Zoning setbacks (30/10/10) 250,127 sf = 8,933 sf/lot average = 30% of average lot area

### **Roads**

Roads – sections A & B = 2,000 linear feet x 16 feet wide = 32,000 sf

Road shoulders – 2,000 linear feet x 6 feet (3 feet per side) = 12,000 sf

### **Townhouses 10 units + road on 1.4 ac lot**

Maximum unit square footage = 1,800 sf

Average footprint – roof + covered decks = 1,200 sf per unit

Average driveway square foot – 500 sf per unit (50' x 10' including parking)

Patios – 1,000 sf per unit

Maximum number of bedrooms (10 units @ 3 BR)

Fertilized lawn & gardens = 1,000 per unit

Road – section T – 190 linear feet x 16 feet wide = 3,040 sf

Road shoulders – 190 linear feet x 6 feet (3 feet per side) = 1,140 sf Zoning setbacks (30/10/10) = 15,868 sf = 26% of Townhouse lot

2.

## Nitrogen Loading Estimates

### N loads from Wastewater

MVC WQMP Formula:

$67,700 \text{ gal /year water usage} \times 90\% \text{ leaching rate} \times 3.785 \text{ liter/gal} \times$

$3 \text{ mg/liter town sewer N output} / 1,000,000 = 0.691 \text{ kg/unit/year}$

$28 \text{ lots} \times 0.691 = 19.3 \text{ kg/year}$

$10 \text{ units} \times 0.691 = 6.9 \text{ kg/year}$

**Total 26.2 kg/year**

### Roads

$\text{Impervious roads} = 32,000 \text{ sf} + 3,040 \text{ sf} = 35,040 \text{ sf}$

MVC WQMP Formula:

$35,040 \text{ sf} \times 46.9 \text{ inches annual precip} / 12 \text{ inches per ft} \times 90\% \text{ leaching rate} \times 28.3 \text{ liters/cu ft} \times 0.75 \text{ mg/liter N per policy} / 1,000,000 = \mathbf{2.6 \text{ kg/year}}$

### Road Shoulders

$\text{Road Shoulders} = 12,000 \text{ sf} + 1,140 \text{ sf} = 13,140 \text{ sf}$

MVC WQMP:

$13,140 \text{ sf} \times 46.9 \text{ inches precip} / 12 \text{ inch per ft} \times 65\% \times 28.3 \text{ liters/cu ft} \times 0.75 \text{ mg/liter} / 1,000,000 = \mathbf{0.7 \text{ kg/year}}$

### Roofs + Covered Decks & Porches

$28 \times 6,000 \text{ sf} + 10 \times 1,200 \text{ sf} = 180,000 \text{ sf}$

MVC WQMP Formula:

$180,000 \text{ sf} \times 46.9 \text{ inches annual precip} / 12 \text{ inches per foot} \times 90\% \text{ leaching rate} \times 28.3 \text{ liters/cu ft} \times 0.38 \text{ mg/liter N per policy} / 1,000,000 = \mathbf{6.8 \text{ kg/year}}$

**3.**

**Driveways**

Driveways = 28 lots x 2,500 sf + 10 units x 500 sf = 75,000 sf

MVC WQMP Formula:

75,000 sf x 46.9 inches annual precip / 12 inches per foot x

65% leaching rate x 28.3 liters/cu ft x 0.75 mg/liter N per policy / 1,000,000 =

**4.0 kg/year**

**Uncovered Porch & Decks**

28 lots x 1,000 sf + 10 units x 500 sf = 33,000 sf

33,000 sf x 46.9 inches precip per year / 12 inches per foot x

65% leaching rate x 28.3 liters/cu ft x 0.75 mg/liter / 1,000,000 = **1.8 kg**

**Pools**

14 x 800 sf per pool (assume 20 x 40)

No nitrogen load

**Patios**

28 x 2,000 sf + 10 x 1,000 sf = 66,000 sf

66,000 sf x 46.9 inches precip per year / 12 inches per foot x 90% leaching rate x 28.3 liters/cu ft x 0.38 mg/liter N (roofs) / 1,000,000 = **2.5 kg**

**Fertilized Lawn & Gardens**

28 lots x 4,000 sf per lot = 112,000 sf

10 units x 1,000 sf per unit = 10,000 sf

122,000 sf x 3 lbs N per 1,000 sf x 20% leaching rate / 2.205 lb/kg = **33.2 kg/year**

**Sub Total = 26.2 + 2.6 + 0.7 + 6.8 + 4.0 + 1.8 + 2.5 + 33.2 = 77.8 kg/year**

**\*\*\* This total does not count "remaining land" in lots, which is the total lot area exclusive of land within no-cut zoning setbacks, roofs, driveways, uncovered decks, patios, pools, and 4,000 sf of fertilized lawn and gardens \*\*\***

4.

**Remaining Land Calculations (treated the same as landscaped areas)**

<b>Average Lot</b>	<b>29,553 sf</b>
Zoning setbacks	8,933 sf
Roof/covered porches	6,000 sf
Uncovered Porch & Deck	1,000 sf
Driveway	2,500 sf
Pool	400 sf (800 sf for half of the lots)
Patios	2,000 sf
Fertilized lawn/shrubs	4,000 sf
Total	24,833 sf of average lot used

$$29,553 \text{ sf} - 24,833 \text{ sf} = 4,720 \text{ sf remaining land per lot (landscaped area)}$$

28 lots x 4,720 sf remaining land per lot = 132,160 sf remaining land  
132,160 sf x 3 lbs/1000 sf x 20% / 2.205 lb/kg =

**36.0 kg from 28 lots "remaining land" (landscaped area)**

<b>Townhouse lot</b>	<b>60,984 sf</b>
Zoning setbacks	15,868 sf
Roof + covered decks	12,000 sf
Road	3,040 sf
Road shoulders	1,140 sf
Driveways	5,000 sf
Patios	10,000 sf
Fertilized lawn/shrubs	10,000 sf
Total	57,048 sf of lot used

$$60,984 \text{ sf} - 57,048 \text{ sf} = 3,936 \text{ sf remaining land (landscaped area)}$$

3,936 sf x 3 lbs/1,000 sf x 20% / 2.205 lb/kg =

**1.1 kg from townhouse lot "remaining land" (landscaped area)**

**77.8 kg** subtotal + **36.0 kg** 28 lots "remaining land" + **1.1 kg** townhouse lot "remaining land" = **114.9 kg total (38.9 kg over MVC WQMP limit)**

## 5.

### Mitigation

#### 1. Hotchkiss lots

12 lots x 5.36 kg per lot sewerred = **64.3 kg**

#### 2. Increase untouched setback areas to reduce "landscape area"

Increase side zoning setbacks from 10' to 15'

This reduces the "remaining land" (landscaped area) by 15.0 kg, so the nitrogen generation from landscaped areas is reduced from 36.0 kg to **21.0 kg**.

If the 3,936 sf of remaining land in Townhouse Lot is restricted to no-cut, This reduces the overall nitrogen generation by an additional **1.1 kg**.

#### 3. Groundwater Irrigation Wells and weather station based irrigation controls for lawn and shrub irrigation

Use same lawn vs shrubs percentages as in GZA report (54% lawn, 46% page 4 under Average Lot). Landscaped area = 4,000 sf fertilized area + 4,720 sf of remaining land = 8,720 sf per average lot.

Irrigation rate will be controlled to 4 inches per month for lawns, 3 inches per month for shrubs.

Irrigation will take place over the course of 5 months.

##### **28 Lots – Lawn**

4,709 sf lawn x 28 lots = 131,852 sf lawn (54% of 8,720)

131,852 sf x 4 inches water per month x 5 months / 12 inches per foot =

219,753 cu ft. x 28.32 L per cu ft = 6,223,405 L x 1 mg per L = 6,223,405 mg N x 0.001 g per mg x 0.001 kg per g =

**6.2 kg N removed with lawn irrigation with wells**

##### **28 Lots – Shrubs**

4,011 sf shrubs x 28 lots = 112,308 sf

112,308 sf x 3 inches water per month x 5 months / 12 inches per foot =

140,385 cu ft x 28.32 L per cu ft = 3,975,703 L x 1 mg per L = 3,975,703 mg N X 0.001 g per mg x 0.001 kg per g =

**4.0 kg N removed with shrub irrigation with wells**

6.

**Townhouse Lot**

10,000 sf total lawn & shrubs for 10 units

10,000 sf x 54% = 5,400 sf lawn, x 46% = 4,600 sf shrubs

**Lawn**

5,400 sf x 4 inches water per month x 5 months / 12 inches per foot =

9,000 cu ft x 28.32 L per cu ft = 254,880 L x 1 mg per L = 254,880 mg N

X 0.001 g per mg x 0.001 kg per g =

**0.3 kg N removed with lawn irrigation with wells**

**Shrubs**

4,600 sf x 3 inches water per month x 5 months / 12 inches per foot =

5,750 cu ft x 28.32 L per cu ft = 162,840 L x 1 mg per L = 162,840 mg N

x 0.001 g per mg x 0.001 kg per g =

**0.2 kg N removed with shrub irrigation with wells**

**Nitrogen reduction with groundwater irrigation wells =**

**6.2 kg + 4.0 kg + 0.3 kg + 0.2 kg = 10.7 kg**

Of the 10.7 kg nitrogen extracted from groundwater, it is assumed that 10% to 20% may leach back into the groundwater, for a range of nitrogen removal from 8.6 kg to 9.6 kg = **an average of 9.1 kg of nitrogen removal from 28 lots plus the townhouse lot.**