Table 6 Default TMDL Allocation of Phosphorus based upon 2004 Discharge Levels and Impact to Gulf Island Pond.

**Applies June to September**

<table>
<thead>
<tr>
<th>Municipal</th>
<th>Phosphorus Alloc Outfall in pfd</th>
<th>Assimilation Factors</th>
<th>Phosphorus Alloc Twin in pfd</th>
<th>2004 Discharge Levels in pfd</th>
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<tbody>
<tr>
<td></td>
<td>% P Remaining @ Twin Br.</td>
<td></td>
<td></td>
<td>Total-P</td>
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<tr>
<td></td>
<td>TP pfd</td>
<td>OP pfd</td>
<td>OPO4-P pfd</td>
<td>TP pfd</td>
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<tr>
<td>Berlin</td>
<td>13.1</td>
<td>1.7</td>
<td>11.4</td>
<td>60.7%</td>
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<tr>
<td>Gorham</td>
<td>8.6</td>
<td>0.7</td>
<td>7.9</td>
<td>64.00%</td>
</tr>
<tr>
<td>Bethel</td>
<td>5.0</td>
<td>0.5</td>
<td>4.5</td>
<td>65.50%</td>
</tr>
<tr>
<td>Rumford-Mexico</td>
<td>21.0</td>
<td>3.0</td>
<td>18.0</td>
<td>82.80%</td>
</tr>
<tr>
<td>Livermore Falls</td>
<td>9.0</td>
<td>0.7</td>
<td>8.3</td>
<td>93.30%</td>
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</table>

**Paper Mills**

<table>
<thead>
<tr>
<th></th>
<th>Phosphorus Alloc Twin in pfd</th>
<th>2004 Discharge Levels in pfd</th>
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<tr>
<td>Fraser</td>
<td>135</td>
<td>133</td>
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<td>76</td>
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<tr>
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<td>62.10%</td>
<td>1.70%</td>
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<td></td>
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<td>97</td>
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<td>79.60%</td>
<td>13.80%</td>
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<td>22.4</td>
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<td></td>
<td>90.90%</td>
<td>97.60%</td>
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<td>136.4</td>
<td>114.5</td>
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<td></td>
<td>21.9</td>
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</tr>
</tbody>
</table>

**Total TMDL WLA (Point Sources) with clustering factor**

240.3 191.9 48.4

**Total TMDL WLA (Point Sources) reduced by clustering factor**

208.2 163.1 45.0

**Total TMDL LA (Non-Point Source + Natural)**

77.7 77.4 0.3

**Explicit MOS 10%**

31.7 26.7 5

**Total TMDL**

317 267 50

**Implementation of Phosphorus TMDL in Licensing**

<table>
<thead>
<tr>
<th>Point Source</th>
<th>Licensing Recommendation</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>Monitor total-P and ortho-P from June-Sept for initial stage of phased TMDL. Re-evaluate appropriateness of P-limits at end of initial phase.</td>
<td>These 4 points sources have a de-minimus contribution to algae problems on Gulf Island Pond but should still be monitored to assure phosphorus contributions do not increase significantly in the future.</td>
</tr>
<tr>
<td>Gorham</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bethel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rumford-Mexico</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Livermore Falls</td>
<td>Mass ortho-P limit as monthly average from June to Sept based upon loads in Table 6. Monitor total-P and ortho-P from June to Sept.</td>
<td>Ortho-P is significant contribution to algae problems on Gulf Island Pond in a river segment of demonstrated low phosphorus assimilation.</td>
</tr>
<tr>
<td>Fraser Paper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MeadWestvaco International Paper</td>
<td>Mass ortho-P and total-P limit as monthly average from June to Sept based upon loads in Table 6. Monitor total-P and ortho-P.</td>
<td>Each mill has some responsibility for P-reductions. The mill with the most impact, IP has more responsibility and the mill with the least amount of impact, Fraser has less reponsibility.*  Implement in stepped reductions with ongoing ambient monitoring as licensing requirements.</td>
</tr>
</tbody>
</table>

* Although only about 1/2 the size of the Maine mills, Fraser will be allowed total phosphorus levels similar to MWV. Fraser may be licensed as mass total-P only, due to the de-minimus impact of their ortho-P to Gulf Island Pond.

**Summary of Allocation Method**

1. Assign 2004 average summer discharges of phosphorus as initial allocations whenever possible (shaded boxes). Assignment priority inversely proportional to receiving water impact.
2. Inflate phosphorus TMDL by clustering factor which accounts for actual load going to Gulf Island Pond given unlikelyhood of all point sources simultaneously discharging monthly maximum loads.
3. Point source allocations inflated by clustering factor of 1.18 for organic-P and 1.07 for ortho-P, which accounts for simultaneous loads to the pond. Clustering factor derived from DMR's.*
4. Assign 10% explicit MOS for total TMDL of all phosphorus forms.
5. All point sources given 2004 discharge rates except IP whose ortho-P must be reduced from 37 to 22.4 ppd to meet ortho-P TMDL. IP is point source with highest impact to Gulf Island Pond.
6. All mill organic-P levels can be increased 2% from 2004 discharge levels and still meet TMDL for organic-P.

* The clustering factor eliminates the assumption used in implicit margins of safety by MDEP, which assumes that all point sources discharge their maximum loads simultaneously.

**End Point of phased implementation of TMDL results when two summers of monitoring occurs without algae blooms during which both the river flow at Rumford < 2000 cfs or one summer when the flow < 1740 cfs for 30 consecutive days and river temperature at Turner Bridge > 24°C for a minimum of 30 consecutive days in each given summer.**
Figure 1
Summary of Chlorophyll-a Gulf Island Pond
Summer 2004

Aug 4  Algae bloom observed
Figure 2- River Flow at Rumford
Vs
Calibration Data Sets

Androscoggin River TMDL - DEPLW-0675 - May 2005
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Figure 4 - Androscoggin River Model Verification of Phosphorus Assimilation July 21 - August 11, 2004

Organic-P Verification

Ortho-P Verification
Figure 5 Gulf Island Pond Model Calibration June 16 to July 7, 2004

Chlorophyll-a

Ortho-P

Organic-P
Figure 6 Gulf Island Pond Model Calibration July 21 to August 11, 2004

Chlorophyll-a

River Mile

Ortho-P

River Mile

Organic-P

River Mile
Figure 7 Gulf Island Pond Model Calibration August 1998

Chlorophyll-a

Ortho-P

Organic-P

Androscoggin River TMDL
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Figure 8 Gulf Island Pond Model Calibration August 2000

Chlorophyll-a

Ortho-P

Organic-P
Figure 9
Model Prediction of Chlorophyll-a in Gulf Island Pond
Using Alternate Rates

Androscoggin River TMDL - DEPLW-0675 - May 2005

River Mile

Chl-a ppb

0 2 4 6 8 10 12

Androscoggin River - DEPLW-0675 - May 2005

Tumer
Upper Narrows
Lower Narrows
GIP4
Deep Hole

HydroQual
DEP1
DEP2
To prevent algae blooms in Gulf Island Pond, the pond averaged chlorophyll-a at the five pond sampling locations should be maintained at < 10 ppb.

Figure 9a Model Predicted Chlorophyll-a

<table>
<thead>
<tr>
<th>River Mile</th>
<th>Without TMDL</th>
<th>With TMDL</th>
<th>Zero Discharge</th>
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<tr>
<td>25</td>
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<tr>
<td>41</td>
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<td>41</td>
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</tbody>
</table>

Pond Averaged Chl-a
- 20.4 ppb
- 10.0 ppb
- 4.5 ppb
Figure 10 - Phosphorus Component Analysis Summer 2004

Percentages of Total Phosphorus Loads at Gulf Island Pond Entrance

Percentages of Orthophosphorus Loads at Gulf Island Pond Entrance
Figure 12 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
Current Licensed Loading of Point Sources with GIPOP @ Upper Narrows @ 92000 ppd O2 Injection

DO Compliance Depth = 10 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C

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Figure 13 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
Current Licensed Loading of Point Sources with GIPOP @ Upper Narrows @ 92000 ppd O₂ Injection

DO Compliance Depth = 10 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C

- Twin Bridges: 6.4
- Nezinscot River: 6.6
- Turner Bridge: 6.8
- U. Narrows: 8.9
- L. Narrows: 8.9
- GIP4: 8.7
- Deep Hole: 8.5
- GIP1 @ 92000 ppd

Depth (ft):
- 0
- 3.5
- Thermocline: 0

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Figure 14 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with GIPOP @ Upper Narrows @ 92000 ppd O2 Injection

DO Compliance Depth = 20 feet
Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C
Figure 15 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with GIPOP @ Upper Narrows @ 92000 ppd O2 Injection

DO Compliance Depth = 20 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C

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Figure 16 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1= 30,000 ppd; GIPOP2=150,000

DO Compliance Depth = 60 feet
Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C
Figure 17 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1= 105,000 ppd; GIPOP2=105,000

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C

<table>
<thead>
<tr>
<th>River Mile</th>
<th>Twin Bridges</th>
<th>Turner Bridge</th>
<th>U. Narrows</th>
<th>L. Narrows</th>
<th>GIP4</th>
<th>Deep Hole</th>
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<td>11.5</td>
<td>9.6</td>
<td>8.7</td>
<td></td>
</tr>
</tbody>
</table>

Depth (ft)

- DO Compliance Depth = 60 feet
- Minimum DO > 5 ppm for Class C

Nezinscot River

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Figure 18 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1= 30,000 ppd;  GIPOP2=150,000

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C
Figure 19 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1= 105,000 ppd; GIPOP2=100,000

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C

<table>
<thead>
<tr>
<th>River Mile</th>
<th>Twin Bridges</th>
<th>Turner Bridge</th>
<th>U. Narrows</th>
<th>L. Narrows</th>
<th>GIP4</th>
<th>Deep Hole</th>
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<td>9.1</td>
<td>11.5</td>
<td>9.4</td>
<td>8.8</td>
</tr>
</tbody>
</table>

GIPOP1 = 105000 ppd
GIPOP2 = 100000 ppd

TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1= 105,000 ppd; GIPOP2=100,000
Figure 20 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1 = 50,000 ppd; GIPOP2 = 65,000 ppd; GIPOP3 = 42,000 ppd

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C

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Figure 21 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
TMDL for Phosphorus, BOD, and TSS Implemented with O2 Injection at GIPOP1 = 50,000 ppd; GIPOP2 = 65,000 ppd; GIPOP3 = 42,000 ppd

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C
**Figure 22 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond**

**Point Sources at Zero Discharge with No Oxygen Injection**

**DO Compliance Depth = 30 feet**

Model non-attainment segment with predicted dissolved oxygen (ppm)

Minimum DO > 5 ppm for Class C

<table>
<thead>
<tr>
<th>River Mile</th>
<th>Twin Bridges</th>
<th>Turner Bridge</th>
<th>U. Narrows</th>
<th>L. Narrows</th>
<th>GIP4</th>
<th>Deep Hole</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 10</td>
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Figure 23 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
Point Sources at Zero Discharge with No Oxygen Injection

DO Compliance Depth = 20 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C
Figure 24 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
Point Sources at Zero Discharge with Oxygen Injection at GIPOP2 = 55,000 ppd

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C

Nezinscot River

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Figure 25 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
Point Sources at Zero Discharge with Oxygen Injection at GIPOP2 = 65,000 ppd

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
30-Day Average DO > 6.5 ppm for Class C
Figure 26 - Model Prediction of Minimum Dissolved Oxygen in Gulf Island Pond
Point Sources at Zero Discharge with Oxygen Injection at GIP0 = 90,000 ppd

DO Compliance Depth = 60 feet

Model non-attainment segment with predicted dissolved oxygen (ppm)
Minimum DO > 5 ppm for Class C
Figure 27 - Model Prediction of 30-Day Average Dissolved Oxygen in Gulf Island Pond
Point Sources at Zero Discharge with Oxygen Injection at GIPOP1 = 105,000 ppd

<table>
<thead>
<tr>
<th>River Mile</th>
<th>Twin Bridges</th>
<th>U. Narrows</th>
<th>L. Narrows</th>
<th>GIP4</th>
<th>Deep Hole</th>
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<td>9.3</td>
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<tr>
<td>40</td>
<td>7.8</td>
<td>7.7</td>
<td>7.6</td>
<td>7.5</td>
<td>9.3</td>
</tr>
<tr>
<td>50</td>
<td>7.8</td>
<td>7.7</td>
<td>7.6</td>
<td>7.5</td>
<td>9.3</td>
</tr>
</tbody>
</table>

**DO Compliance Depth = 60 feet**

Model non-attainment segment with predicted dissolved oxygen (ppm)

30-Day Average DO > 6.5 ppm for Class C

**Depth (ft)**

- 0 ft (surface)
- 10 ft
- 20 ft
- 30 ft
- 40 ft
- 50 ft
- 60 ft
- 70 ft

**Thermocline**

4.9
Figure 28
Androscoggin River Flow at Rumford
During Aquatic Life Criteria Evaluations
June to August
Figure 29 - Water Quality Model Sensitivity Analysis at 7Q10 Flow for TMDL Loads

Organic-P Mineralization Rate Sensitivity Analysis

Chlorophyll-a (ppb)

River Mile Gulf Island Pond

Kop=.05 (TMDL)
Kop=.04
Kop=.03
Kop=.02 (HydroQual)

Saturated Light Intensity Sensitivity Analysis

Chlorophyll-a (ppb)

River Mile Gulf Island Pond

Kl=175 (TMDL)
Kl=200
Kl=250
Kl=300 (HydroQual)
Figure 30 - Water Quality Model Sensitivity Analysis at 7Q10 Flow for TMDL Loads

**Boundary Ortho-P Concentration Sensitivity Analysis**

- Ortho-P = 5.5 ppb (TMDL)
- Ortho-P = 6 ppb
- Ortho-P = 7 ppb
- Ortho-P = 8 ppb

**Fraction of Dead Algae Recycled to Organic-P Sensitivity Analysis**

- Frac = 0.5 (TMDL)
- Frac = 0.6
- Frac = 0.7