

# Hangman Creek TMDL Total Phosphorus TMDL

- Adjustments to the WARMF model since June meeting
- Adjustments to Spokane River Load Allocation to Hangman Creek
- Annual Loading: Comparing Current to Reference Conditions
- Watershed Loading Patterns
- Discussion

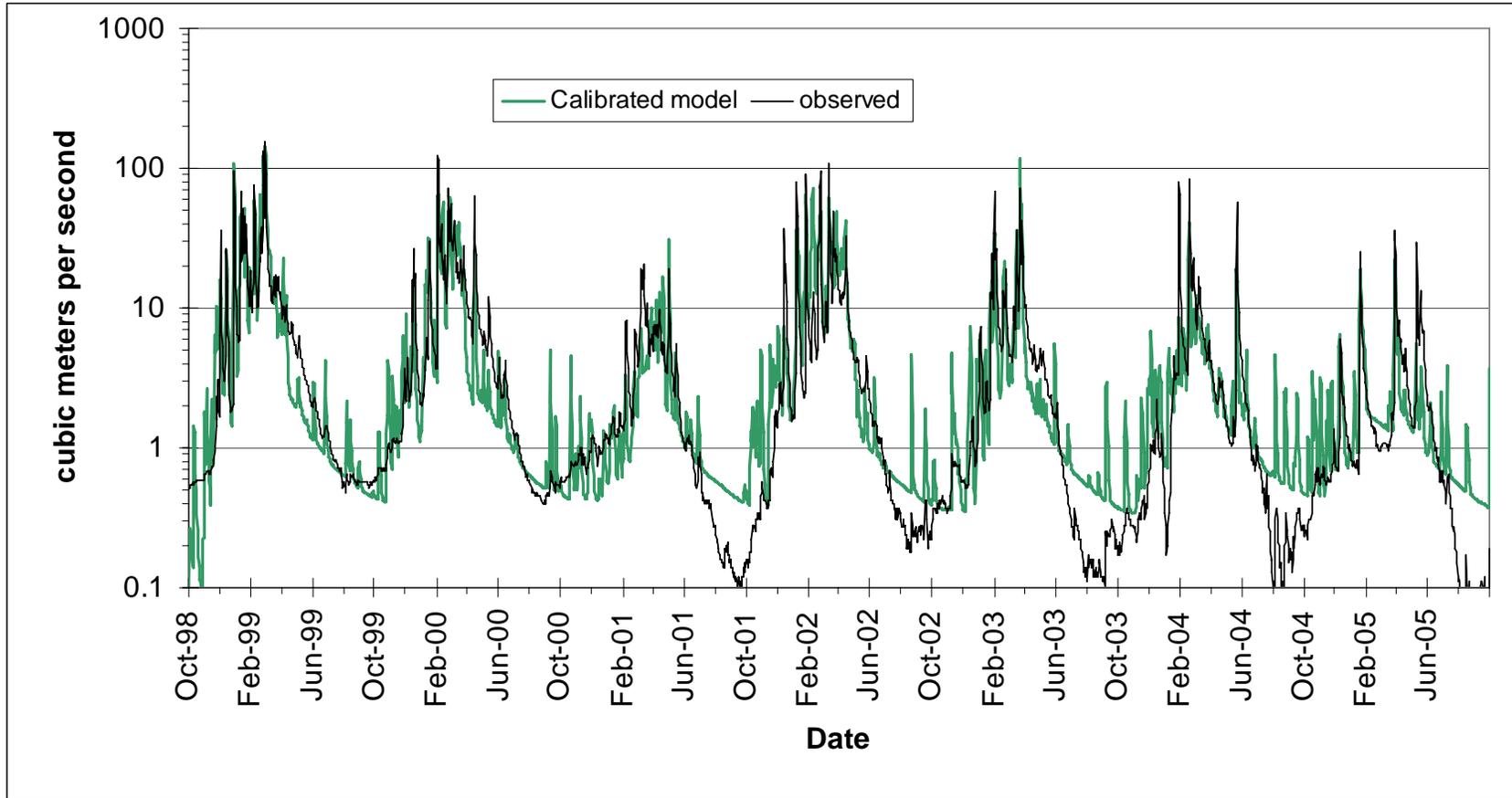


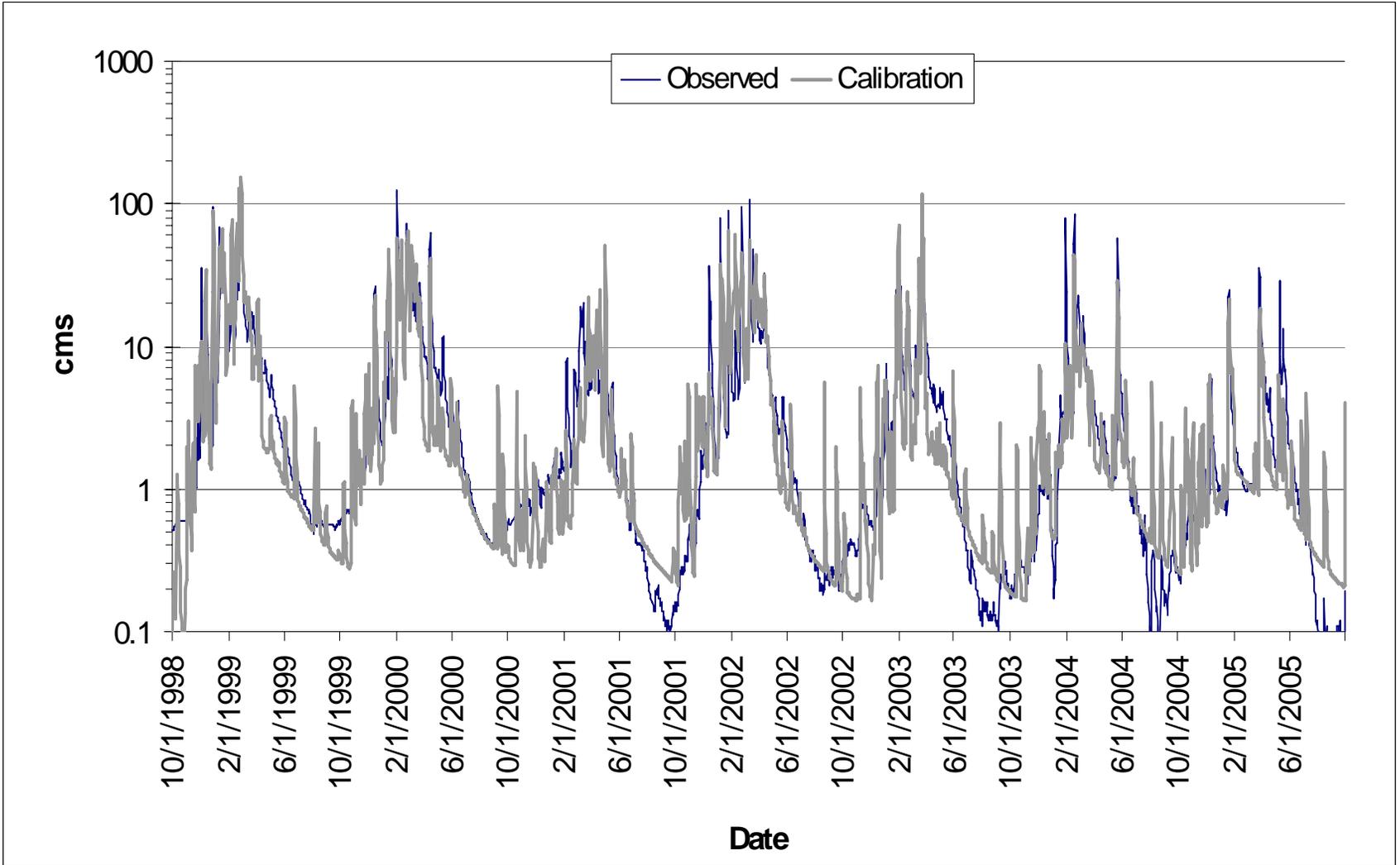
# Adjustments to WARMF

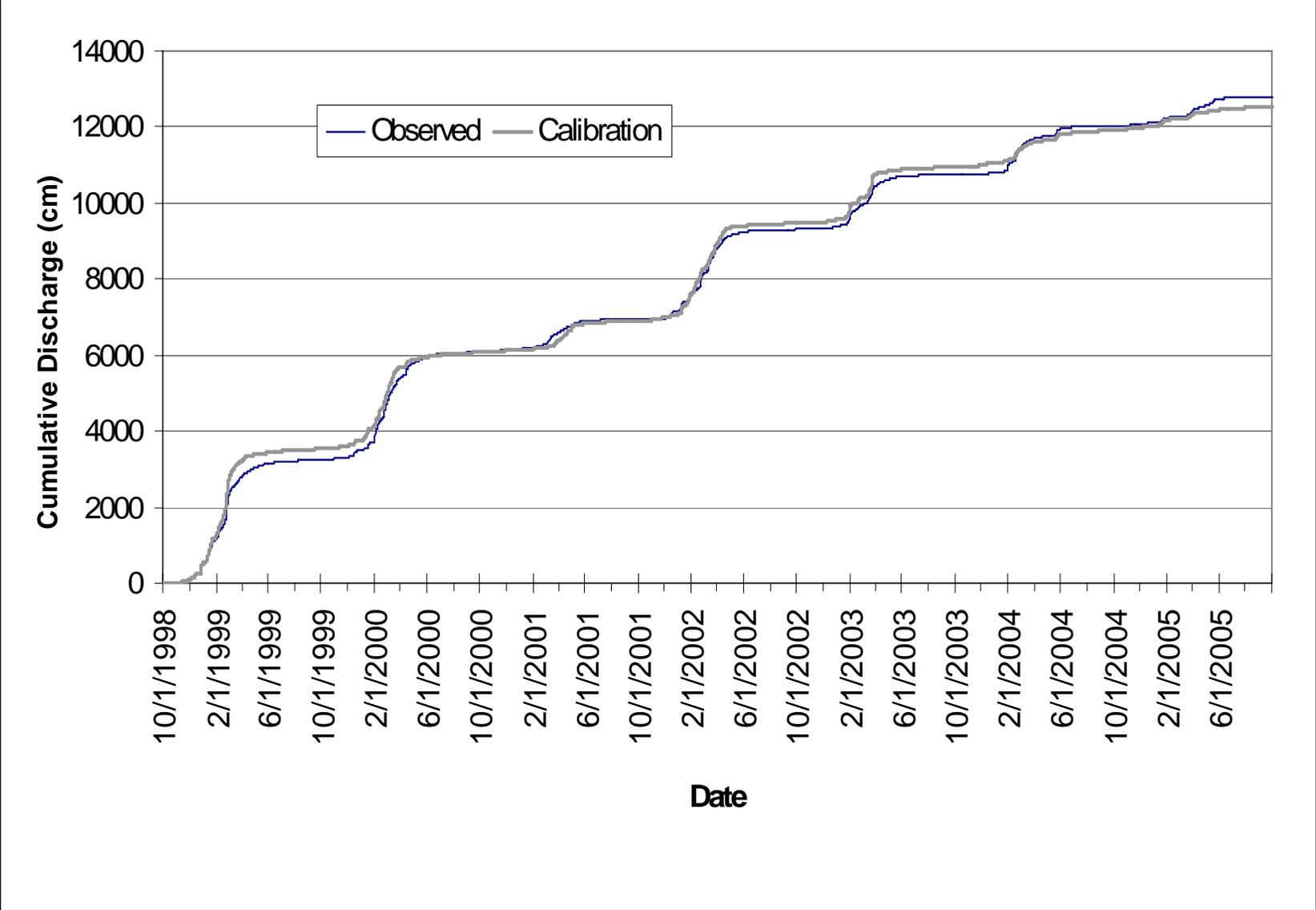
- Tried to get a better fit to the seasonal hydrology
- Adjusted meteorological stations to fit placement in watershed
- Adjusted soil phosphorus to soil sample results

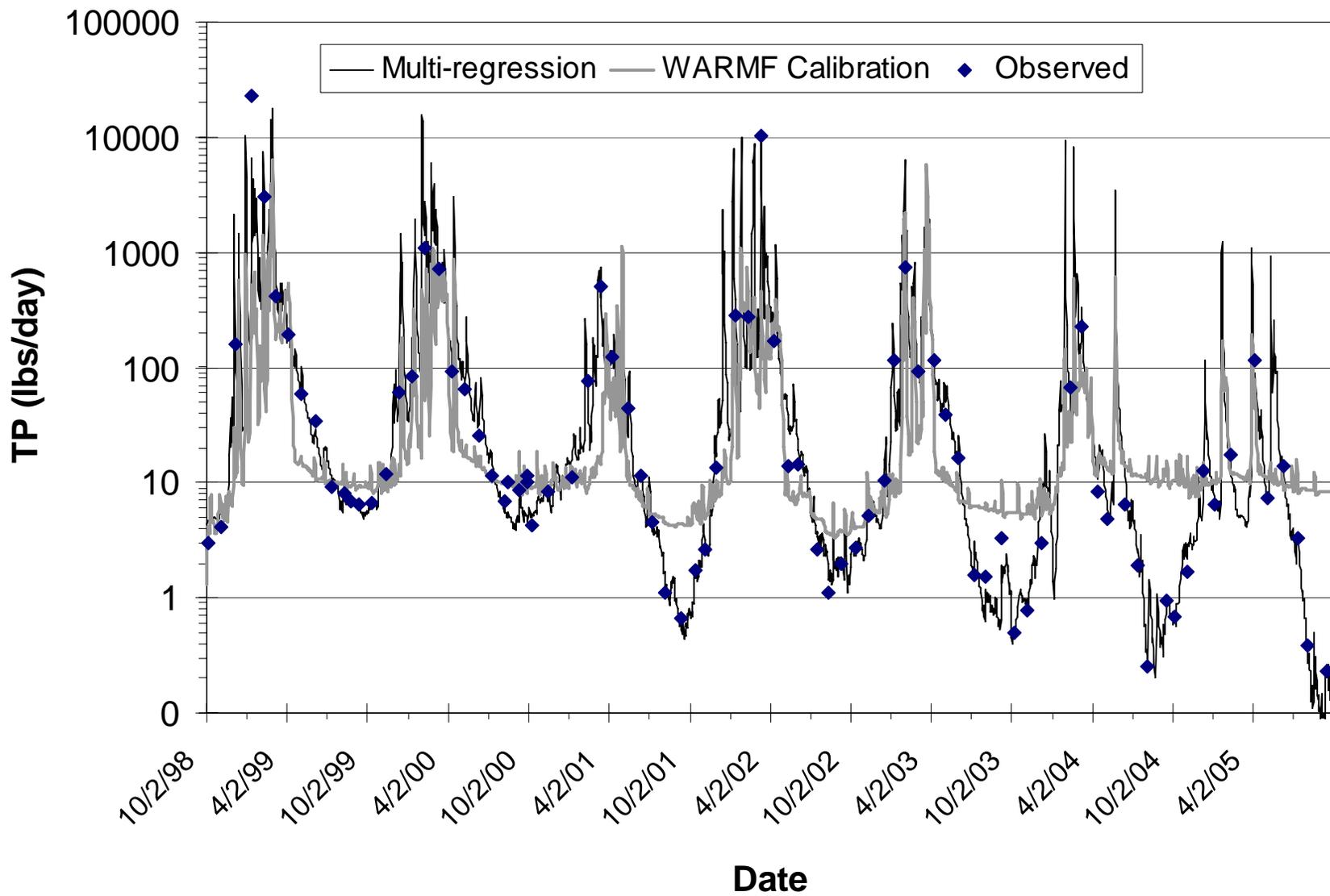


# Original Streamflow Calibration









# New Spokane River LA for Hangman Creek

- Hangman Creek streamflows in April and May of 2001 were only 65% of reported
- USEPA assigned phosphorus loads to Idaho dischargers on the Spokane River
- CE-QUAL-W2 model was re-calibrated to all of the April through October period



# Load Allocation Changes Compared to Estimated Monthly Average Loads in Hangman Creek

| YEAR            | April              | May       | June                  | July       | August      | September   | October     |
|-----------------|--------------------|-----------|-----------------------|------------|-------------|-------------|-------------|
| 1996            | 693                | 183       | 33                    | 14         | 7.8         | 7           | 14.5        |
| 1997            | 554                | 252       | 79                    | 42         | 25          | 21          | 17.6        |
| 1998            | 73                 | 164       | 43                    | 12         | 4.8         | 4.2         | 4.8         |
| 1999            | 138                | 48        | 20                    | 11         | 7.2         | 5.9         | 7.0         |
| 2000            | 376                | 85        | 39                    | 12         | 5.2         | 5.3         | 6.0         |
| 2001            | 97                 | 74        | <b>8.3</b>            | 4.2        | <b>1.3</b>  | <b>0.6</b>  | <b>1.5</b>  |
| 2002            | 265                | 42        | 15                    | 4.2        | 2.0         | 2.1         | 2.6         |
| 2003            | 90                 | <b>37</b> | <b>7.9</b>            | <b>1.6</b> | <b>0.9</b>  | 1.4         | <b>0.8</b>  |
| 2004            | <b>16</b>          | 184       | 15                    | <b>2.7</b> | <b>0.6</b>  | <b>0.7</b>  | <b>1.4</b>  |
| 2005            | <b>40</b>          | 95        | 8.6                   | <b>2.0</b> | <b>0.21</b> | <b>0.17</b> | <b>0.67</b> |
| LA-1*           | 16.9               | 10.9      | 3.3                   | 1.2        | 0.8         | 0.7         | 1.5         |
| LA-2*           | 60.6               | 40.6      | 8.3                   | 3.8        | 1.3         | 1           | 2.1         |
| <b>Seasonal</b> | <b>April - May</b> |           | <b>June - October</b> |            |             |             |             |
| LA-1*           | 13.9               |           | 1.5                   |            |             |             |             |
| LA-2*           | 50.6               |           | 3.3                   |            |             |             |             |

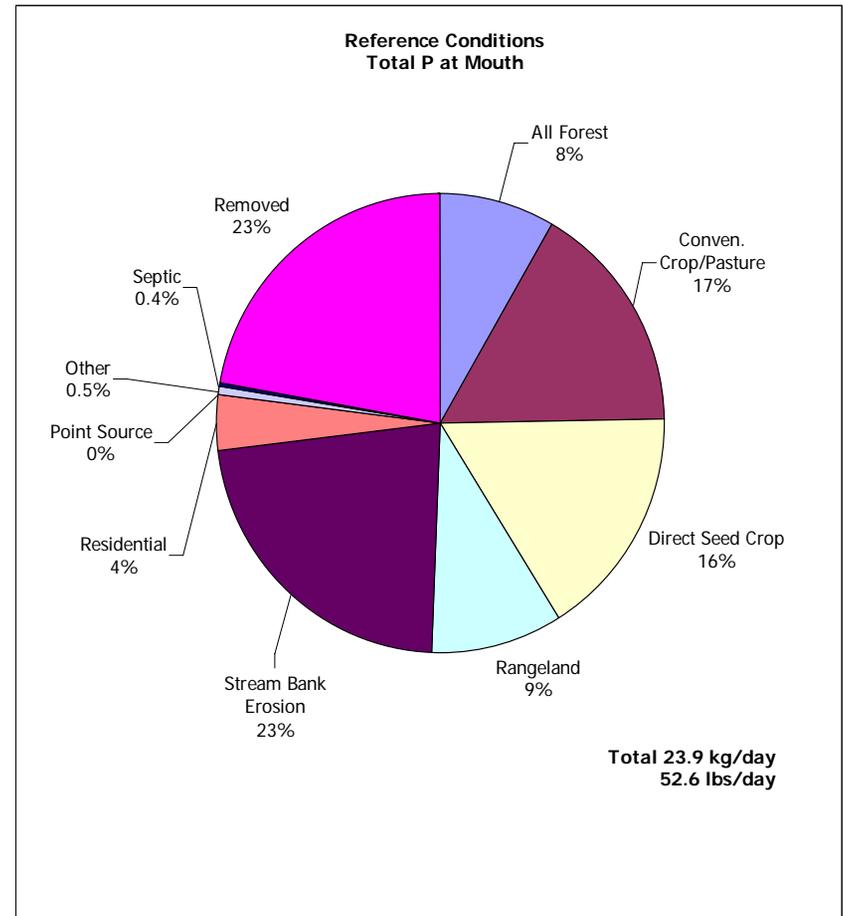
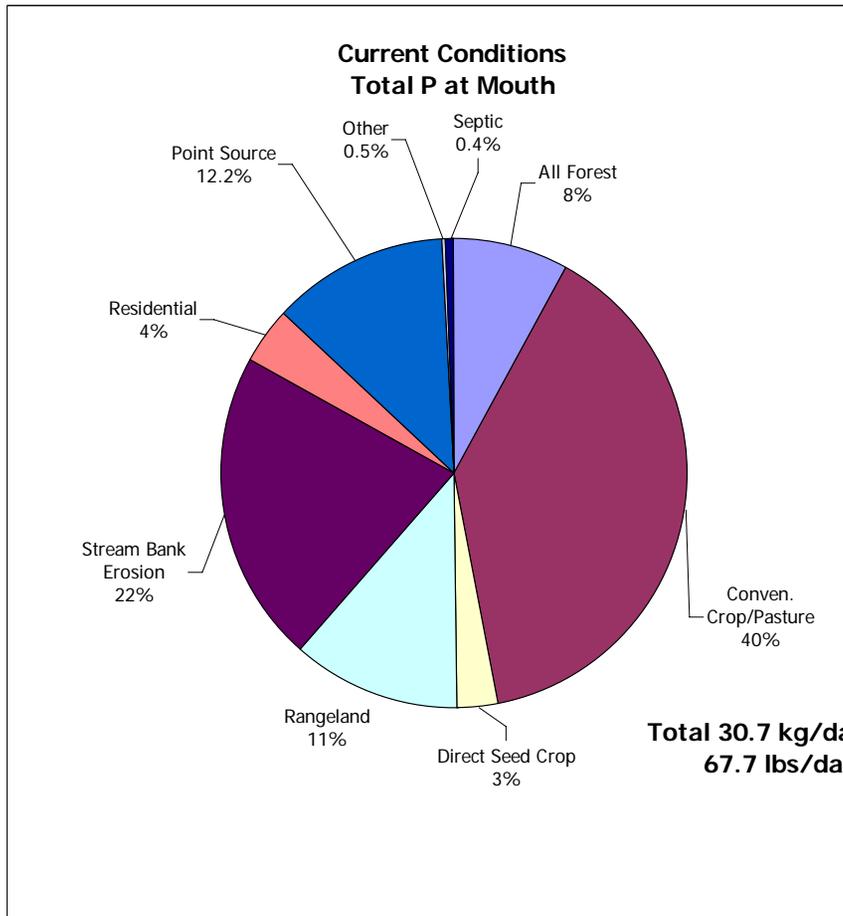
# Model Comparisons

|               | April     |         |           | May       |         |           | June      |         |           |
|---------------|-----------|---------|-----------|-----------|---------|-----------|-----------|---------|-----------|
| Original LA-1 | 16.9      |         |           | 10.9      |         |           | 3.3       |         |           |
| Revised LA-2  | 60.6      |         |           | 40.6      |         |           | 8.3       |         |           |
|               | Multi-reg | Current | Reference | Multi-reg | Current | Reference | Multi-reg | Current | Reference |
| 1999          | 138       | 150     | 112       | 48        | 14      | 4         | 20        | 11      | 2.3       |
| 2000          | 376       | 109     | 85        | 85        | 17      | 5         | 39        | 14      | 3.6       |
| 2001          | 97        | 73      | 56        | 74        | 101     | 78        | 8.3       | 7       | 1.7       |
| 2002          | 265       | 194     | 156       | 42        | 10      | 5         | 15        | 8       | 1.4       |
| 2003          | 90        | 51      | 38        | 37        | 10      | 3         | 7.9       | 7       | 1.4       |
| 2004          | 16        | 15      | 5         | 184       | 66      | 46        | 15        | 15      | 3.7       |
| 2005          | 40        | 24      | 13        | 95        | 11      | 2         | 8.6       | 10      | 1.2       |

**April and May Average**

|               | 13.87     |         |           |
|---------------|-----------|---------|-----------|
| Original LA-1 | 50.6      |         |           |
| Revised LA-2  | Multi-reg | Current | Reference |
| 1999          | 92        | 81      | 57        |
| 2000          | 228       | 63      | 44        |
| 2001          | 85        | 87      | 67        |
| 2002          | 152       | 101     | 79        |
| 2003          | 63        | 30      | 20        |
| 2004          | 102       | 41      | 26        |
| 2005          | 68        | 17      | 8         |

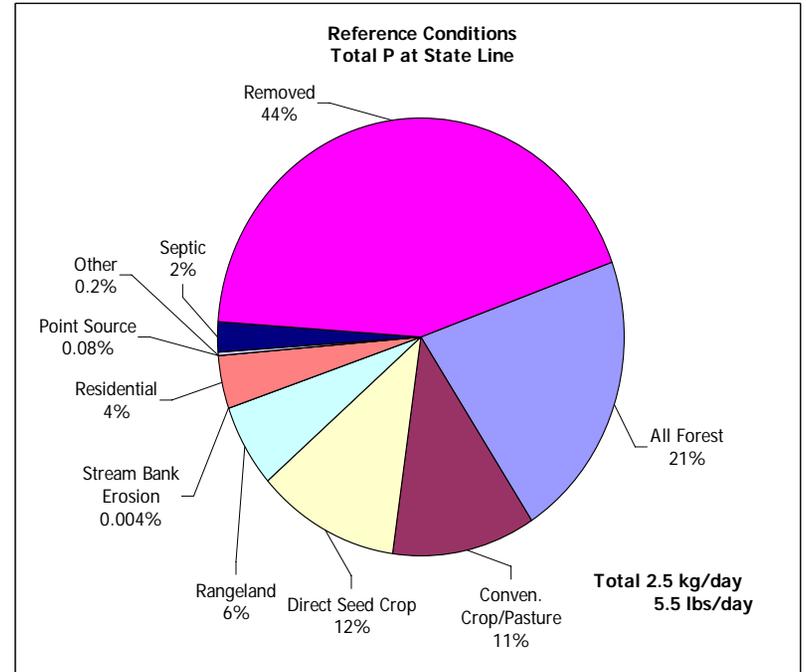
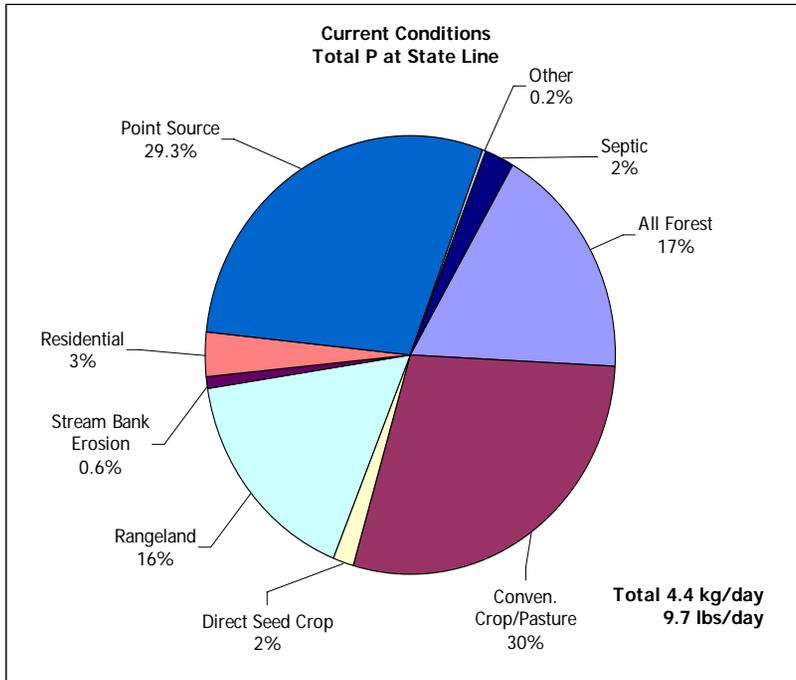
# Base to Reference: Hangman at Mouth



## Hangman Creek at the Mouth

|                      | Reference Condition |           | Current Condition |           |
|----------------------|---------------------|-----------|-------------------|-----------|
|                      | lbs/day             | kg/day    | lbs/day           | kg/day    |
| All Forest           | 5.6                 | 2.5       | 5.5               | 2.5       |
| Conven. Crop/Pasture | 11.2                | 5.1       | 26.2              | 11.9      |
| Direct Seed Crop     | 11.1                | 5.0       | 2.0               | 0.9       |
| Rangeland            | 6.3                 | 2.9       | 7.7               | 3.5       |
| Stream Bank Erosion  | 15.2                | 6.9       | 14.8              | 6.7       |
| Residential          | 2.7                 | 1.2       | 2.5               | 1.1       |
| Point Source         | 0.0                 | 0.01      | 8.3               | 3.8       |
| Other                | 0.3                 | 0.2       | 0.3               | 0.2       |
| Septic               | 0.3                 | 0.1       | 0.3               | 0.1       |
| Removed              | 15.0                | 6.8       |                   |           |
| <b>TOTAL</b>         | <b>53</b>           | <b>24</b> | <b>68</b>         | <b>31</b> |

# Base to Reference: Hangman at State Line



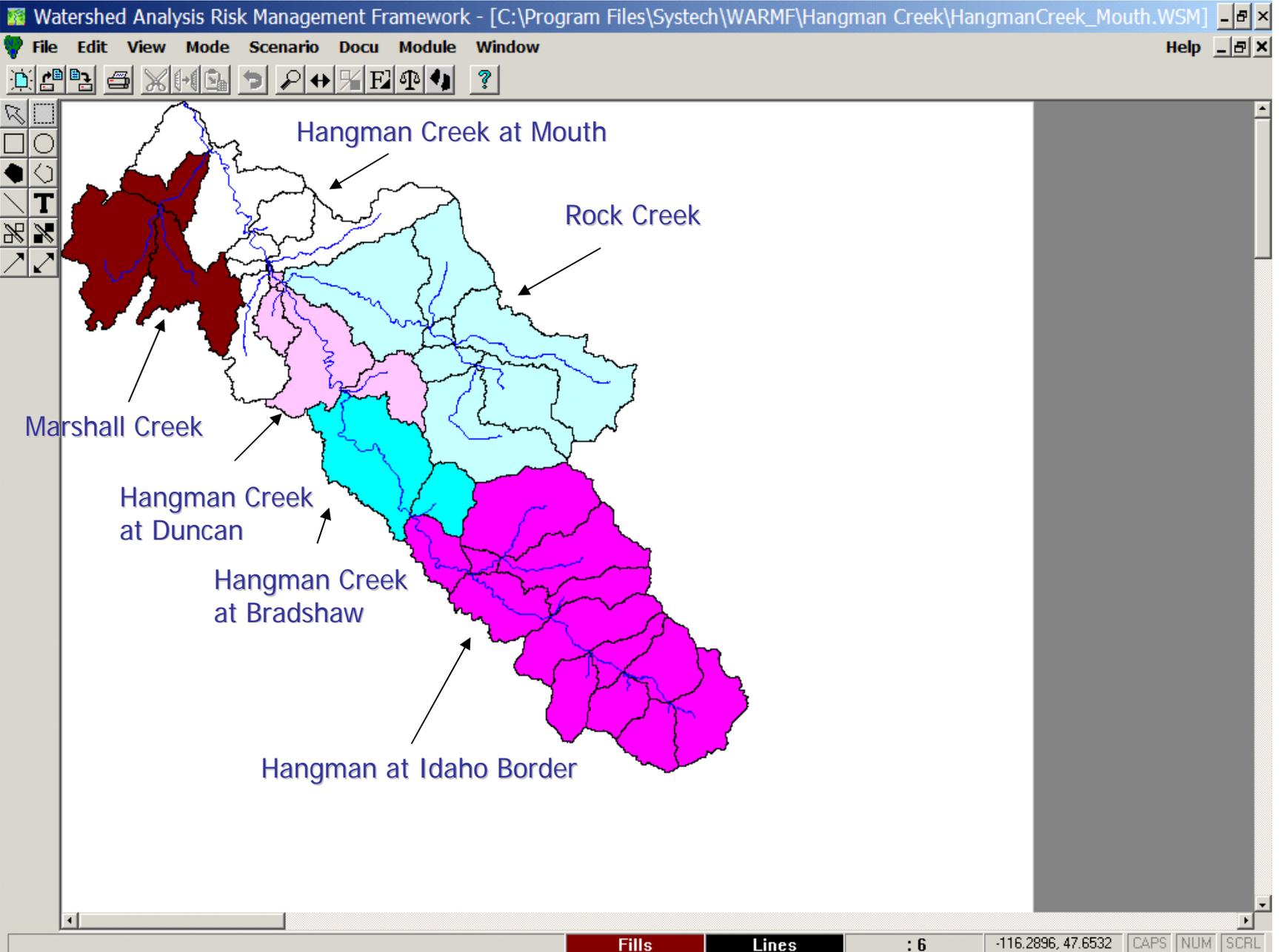
## Hangman Creek at the Idaho Border

|                      | Reference Condition |          | Current Condition |          |
|----------------------|---------------------|----------|-------------------|----------|
|                      | lbs/day             | kg/day   | lbs/day           | kg/day   |
| All Forest           | 2.1                 | 0.94     | 1.7               | 0.77     |
| Conven. Crop/Pasture | 1.1                 | 0.51     | 2.8               | 1.26     |
| Direct Seed Crop     | 1.1                 | 0.51     | 0.2               | 0.08     |
| Rangeland            | 0.6                 | 0.26     | 1.6               | 0.72     |
| Stream Bank Erosion  | 0.0                 | 0.00     | 0.1               | 0.03     |
| Residential          | 0.4                 | 0.17     | 0.3               | 0.15     |
| Point Source         | 0.0                 | 0.00     | 2.8               | 1.29     |
| Other                | 0.0                 | 0.01     | 0.0               | 0.01     |
| Septic               | 0.2                 | 0.10     | 0.2               | 0.10     |
| Removed              | 4.2                 | 1.92     |                   |          |
| <b>TOTAL</b>         | <b>6</b>            | <b>2</b> | <b>10</b>         | <b>4</b> |

# Point Sources

- Reference condition assumes no discharge
- Significant TP reductions if point sources are reduced
- Additional simulations suggest 50 ug/L or less effluent concentrations will not significantly increase TP over reference conditions.





# Hangman Creek at Mouth

| <b>Current Load</b>   | % of Load | % of area | <b>Best Future</b>   | % of Load | % of area |
|-----------------------|-----------|-----------|----------------------|-----------|-----------|
| Deciduous             | 0.000%    | 0.003%    | Deciduous            | 0.000%    | 0.003%    |
| Coniferous            | 4.8%      | 24.9%     | Coniferous           | 5.1%      | 25%       |
| Mixed Forest          | 0.020%    | 0.035%    | Mixed Forest         | 0.020%    | 0.035%    |
| Cropland / Pasture    | 14.6%     | 29.3%     | Cropland / Pasture   | 7.1%      | 12%       |
| Rangeland             | 14.8%     | 30.0%     | Rangeland            | 17%       | 30%       |
| Forested Wetland      | 0.006%    | 0.04%     | Forested Wetland     | 0.007%    | 0.036%    |
| Non-forested Wetland  | 0.015%    | 0.12%     | Non-forested Wetland | 0.016%    | 0.12%     |
| Barren                | 0.01%     | 0.01%     | Barren               | 0.011%    | 0.0%      |
| Residential           | 5.6%      | 12.7%     | Residential          | 7.1%      | 14%       |
| Comm./Industrial      | 0.20%     | 0.5%      | Comm./Industrial     | 0.23%     | 0.53%     |
| Water                 | 0.001%    | 0.048%    | Water                | 0.001%    | 0.05%     |
| Direct Seed           | 0.7%      | 2.3%      | Direct Seed          | 6.5%      | 18%       |
| Stream Bank Erosion   | 56%       |           | Stream Bank Erosion  | 57%       |           |
| Type 1 Septic System  | 0%        |           | Type 1 Septic System | 0.33%     |           |
| Type 2 Septic System  | 0%        |           |                      |           |           |
| General Point Sources | 2%        |           |                      |           |           |

# Marshall Creek at Mouth

| <b>Current Load</b>   | <b>% of Load</b> | <b>% of area</b> | <b>Best Future</b>    | <b>% of Load</b> | <b>% of area</b> |
|-----------------------|------------------|------------------|-----------------------|------------------|------------------|
| Deciduous             | 0.0%             | 0.00%            | Deciduous             | 0.000%           | 0%               |
| Coniferous            | 20.8%            | 37%              | Coniferous            | 21%              | 37%              |
| Mixed Forest          | 0.06%            | 0.04%            | Mixed Forest          | 0.062%           | 0.040%           |
| Cropland / Pasture    | 29.5%            | 21%              | Cropland / Pasture    | 13%              | 8%               |
| Rangeland             | 34.2%            | 34%              | Rangeland             | 37%              | 34%              |
| Forested Wetland      | 0.1%             | 0.21%            | Forested Wetland      | 0.14%            | 0.21%            |
| Non-forested Wetland  | 0.5%             | 0.94%            | Non-forested Wetland  | 0.49%            | 0.94%            |
| Barren                | 0.05%            | 0.02%            | Barren                | 0.059%           | 0.021%           |
| Residential           | 13.4%            | 6.8%             | Residential           | 14%              | 7%               |
| Comm./Industrial      | 0.40%            | 0.12%            | Comm./Industrial      | 0.43%            | 0.12%            |
| Water                 | 0.04%            | 0.39%            | Water                 | 0.04%            | 0.39%            |
| Direct Seed           | 0.0%             | 0.00%            | Direct Seed           | 13%              | 13%              |
| Stream Bank Erosion   | 0.4%             |                  | Stream Bank Erosion   | 0.41%            |                  |
| Type 1 Septic System  | 0.4%             |                  | Type 1 Septic System  | 0.47%            |                  |
| Type 2 Septic System  | 0.3%             |                  | Type 2 Septic System  | 0.27%            |                  |
| General Point Sources | 0.0%             |                  | General Point Sources | 0%               |                  |

# Hangman Creek at Duncan

| <b>Current Load</b>   | <b>% of Load</b> | <b>% of area</b> | <b>Best Future</b>    | <b>% of Load</b> | <b>% of area</b> |
|-----------------------|------------------|------------------|-----------------------|------------------|------------------|
| Deciduous             | 0.0%             | 0.02%            | Deciduous             | 0.01%            | 0.02%            |
| Coniferous            | 0.3%             | 4.0%             | Coniferous            | 0.37%            | 3.9%             |
| Mixed Forest          | 0.1%             | 0.14%            | Mixed Forest          | 0.08%            | 0.14%            |
| Cropland / Pasture    | 44.3%            | 69%              | Cropland / Pasture    | 37.8%            | 30%              |
| Rangeland             | 1.2%             | 18%              | Rangeland             | 2.17%            | 18%              |
| Forested Wetland      | 0.00%            | 0.03%            | Forested Wetland      | 0.00%            | 0.03%            |
| Non-forested Wetland  | 0.0%             | 0.00%            | Non-forested Wetland  | 0.00%            | 0.00%            |
| Barren                | 0.0%             | 0.01%            | Barren                | 0.00%            | 0.01%            |
| Residential           | 1.0%             | 0.45%            | Residential           | 1.82%            | 0.63%            |
| Comm./Industrial      | 1.4%             | 0.83%            | Comm./Industrial      | 2.9%             | 0.83%            |
| Water                 | 0.0%             | 0.11%            | Water                 | 0.01%            | 0.11%            |
| Direct Seed           | 6.0%             | 7.3%             | Direct Seed           | 54.1%            | 46%              |
| Stream Bank Erosion   | 0.00%            |                  | Stream Bank Erosion   | 0.00%            |                  |
| Type 1 Septic System  | 0.3%             |                  | Type 1 Septic System  | 0.00%            |                  |
| Type 2 Septic System  | 0.0%             |                  | Type 2 Septic System  | 0.70%            |                  |
| General Point Sources | 45.5%            |                  | General Point Sources | 0.00%            |                  |

# Rock Creek at Mouth

| <b>Current Load</b>   | % of Load | % of area | <b>Best Future</b>    | % of Load | % of area |
|-----------------------|-----------|-----------|-----------------------|-----------|-----------|
| Deciduous             | 0.004%    | 0.01%     | Deciduous             | 0.006%    | 0.010%    |
| Coniferous            | 4.2%      | 10.5%     | Coniferous            | 7.1%      | 14%       |
| Mixed Forest          | 0.38%     | 0.44%     | Mixed Forest          | 0.55%     | 0.59%     |
| Cropland / Pasture    | 73.0%     | 70.0%     | Cropland / Pasture    | 42%       | 30%       |
| Rangeland             | 11.0%     | 9.7%      | Rangeland             | 10%       | 8%        |
| Forested Wetland      | 0.03%     | 0.06%     | Forested Wetland      | 0.034%    | 0.064%    |
| Non-forested Wetland  | 0.05%     | 0.07%     | Non-forested Wetland  | 0.073%    | 0.068%    |
| Barren                | 0.00%     | 0.003%    | Barren                | 0.000%    | 0.003%    |
| Residential           | 2.8%      | 1.2%      | Residential           | 3.9%      | 1.2%      |
| Comm./Industrial      | 0.42%     | 0.61%     | Comm./Industrial      | 0.56%     | 0.61%     |
| Water                 | 0.0002%   | 0.03%     | Water                 | 0.000%    | 0.034%    |
| Direct Seed           | 4.8%      | 7.5%      | Direct Seed           | 35%       | 45%       |
| Stream Bank Erosion   | 0.0%      |           | Stream Bank Erosion   | 0.000%    |           |
| Type 1 Septic System  | 0.0%      |           | Type 1 Septic System  | 0.025%    |           |
| Type 2 Septic System  | 0.0%      |           | Type 2 Septic System  | 0.000%    |           |
| General Point Sources | 3.21%     |           | General Point Sources | 0.000%    |           |

# Hangman Creek at Bradshaw

| <b>Current Load</b>   | <b>% of Load</b> | <b>% of area</b> | <b>Best Future</b>    | <b>% of Load</b> | <b>% of area</b> |
|-----------------------|------------------|------------------|-----------------------|------------------|------------------|
| Deciduous             | 0.016%           | 0.02%            | Deciduous             | 0.019%           | 0.020%           |
| Coniferous            | 8.4%             | 12%              | Coniferous            | 9.4%             | 12%              |
| Mixed Forest          | 3.1%             | 1.2%             | Mixed Forest          | 3.3%             | 1.2%             |
| Cropland / Pasture    | 62%              | 68%              | Cropland / Pasture    | 36%              | 30%              |
| Rangeland             | 9%               | 9.4%             | Rangeland             | 13%              | 9.4%             |
| Forested Wetland      | 0.035%           | 0.05%            | Forested Wetland      | 0.037%           | 0.05%            |
| Non-forested Wetland  | 0.062%           | 0.13%            | Non-forested Wetland  | 0.079%           | 0.13%            |
| Barren                | 0.022%           | 0.003%           | Barren                | 0.030%           | 0.003%           |
| Residential           | 1.6%             | 1.1%             | Residential           | 2.2%             | 1.05%            |
| Comm./Industrial      | 1.0%             | 0.84%            | Comm./Industrial      | 1.4%             | 0.84%            |
| Water                 | 0.0002%          | 0.009%           | Water                 | 0.000%           | 0.01%            |
| Direct Seed           | 4.3%             | 7.3%             | Direct Seed           | 34%              | 45%              |
| Stream Bank Erosion   | 1.0%             |                  | Stream Bank Erosion   | 0.33%            |                  |
| Type 1 Septic System  | 0.2%             |                  | Type 1 Septic System  | 0.3%             |                  |
| Type 2 Septic System  | 0.0%             |                  | Type 2 Septic System  | 0.00%            |                  |
| General Point Sources | 8.9%             |                  | General Point Sources | 0.0%             |                  |

# Hangman Creek at Idaho Line

| <b>Current Load</b>   | <b>% of Load</b> | <b>% of area</b> | <b>Best Future</b>    | <b>% of Load</b> | <b>% of area</b> |
|-----------------------|------------------|------------------|-----------------------|------------------|------------------|
| Deciduous             | 0.004%           | 0.01%            | Deciduous             | 1.01%            | 1.7%             |
| Coniferous            | 22%              | 41%              | Coniferous            | 43%              | 53%              |
| Mixed Forest          | 0.05%            | 0.06%            | Mixed Forest          | 0.06%            | 0.060%           |
| Cropland / Pasture    | 29%              | 36%              | Cropland / Pasture    | 18%              | 15%              |
| Rangeland             | 25%              | 16%              | Rangeland             | 12.1%            | 5.8%             |
| Forested Wetland      | 0.21%            | 0.40%            | Forested Wetland      | 0.28%            | 0.40%            |
| Non-forested Wetland  | 0.20%            | 0.56%            | Non-forested Wetland  | 0.32%            | 0.56%            |
| Barren                | 0.011%           | 0.0%             | Barren                | 0%               | 0.0%             |
| Residential           | 4.7%             | 2.5%             | Residential           | 8.0%             | 2.5%             |
| Comm./Industrial      | 0.08%            | 0.37%            | Comm./Industrial      | 0.11%            | 0.37%            |
| Water                 | 0.0%             | 0.01%            | Water                 | 0.0001%          | 0.006%           |
| Direct Seed           | 1.6%             | 3.0%             | Direct Seed           | 16%              | 21%              |
| Stream Bank Erosion   | 0.38%            |                  | Stream Bank Erosion   | 0.004%           |                  |
| Type 1 Septic System  | 1.2%             |                  | Type 1 Septic System  | 1.8%             |                  |
| Type 2 Septic System  | 0.0%             |                  | Type 2 Septic System  | 0.0%             |                  |
| General Point Sources | 15.6%            |                  | General Point Sources | 0.1%             |                  |

# Tentative Hangman TMDL Schedule

- **Late October** – Joe completes technical language
- **Early November** – Advisory group reviews technical language
- **November 15<sup>th</sup>** – Advisory group meeting (discuss technical language, etc)
- **Early January** – Technical language combined with implementation strategy and sent to group
- **January 17<sup>th</sup>** – Advisory group meeting (discuss TMDL document; determine if we are ready for public comment period)

