Sweeping Scenarios for Street Sweeping Pilot Workshop

Introduction to the Spreadsheet
During the demonstration I will showcase the various functions and constraints of the calculator tool along with basic instructions for using the tool.

1) Defined Routes (I will type these in)

<table>
<thead>
<tr>
<th>Route ID</th>
<th>Curb-miles</th>
<th>Canopy (%)</th>
<th>Priority</th>
<th>Unique Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>20</td>
<td>20</td>
<td>(discuss)</td>
<td>(discuss)</td>
</tr>
<tr>
<td>Medium</td>
<td>20</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>20</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Main Points of discussion:
- User must have defined sweeping routes to use the spreadsheet, but certainly it could be used with approximate route information as part of iterative design process.
- An average tree canopy cover must be defined for each route.
  - Model Calibration range = 0.5% - 20% tree canopy over the street.
  - There is some extrapolation in the model, but over street canopy cover > 30% are estimated at 30% coverage. (Some evidence from Cap Region to support the extrapolation to 30%, but very high canopy covers were felt to be too far out of the prediction range to be modeled).
  - The model will accept a value of zero canopy cover. Note: At very low canopies, other factors may drive differences in loading to the Street, ex. street type, condition, land use – the model does not account for these differences (at any canopy cover).

2) “Planning Tab” Inputs
   A) Default Cost/Curb-mile – fill in Prior Lake value
      - I will use the hand-out on Prior Lake cost estimate to discuss how this would be approached.

   B) Calling Routes – alternatively call High, Medium, and Low Routes and use the “Clear Form” feature.
      - Route characteristics (curb-miles, canopy, etc.) can be overwritten on this page, but at this point, there is not an option to edit those characteristics from the “Planning” tab. Route characteristics will default to the values on the “Routes” tab the next time the route is called.
3) Designing sweeping operations
   
A) Predict recovery for a sweeping event(s) in a given month - Use spring clean-up (one month)
   
- **What does the spreadsheet predict?**
  - Wet Solids (regression)
  - Dry Solids (regression)
  - Recoverable Nitrogen (regression)
  - Recoverable Phosphorus (regression)
  - Total cost of the operation (= curbmiles x $/curb-mile)
  - Cost per lb P (=total Cost/predicted recoverable P)

- **Frequencies are restricted to integer values from 0-5.** (Demonstrate).
  - This reflects the range of model calibration (monthly – weekly).

B) Design a sweeping operation for a given route
   
- **Note that predictions are sub-totaled at the bottom of the table**
  - Average $lb/P is Total Cost ÷ Total lb P (at present the lb P is not truncated in the program which explains the small differences in the estimate and what you might put in your calculator based on the spreadsheet output).

- **Note that predicts will adjust to account for sweeping frequency in the previous month.**
  - The model can only account for intervals from 7 to around 30 days, so for intervals greater than 30 day, the one month interval is assumed.
  - For changes from higher frequency to lower frequency (ex. 4X to 1X the next month), the model assumes an interval or 2 weeks (interval really depends on when you sweep the next month, 2 weeks if “average”).
  - **Word of Caution** – The calculator predicts an expected average value for recovered loads. Users need to think big-picture when interpreting the results. Predictions are not expected to be highly accurate for a single sweeping event. The model is best for predicting annual averages.

C) Design a sweeping scenario using all routes – in the demonstration scenario we will simply sweep all routes once in the spring (April) and fall (October), with an additional sweep in the fall for medium and high canopy routes (2X, October).
   
- Use the “Accept Changes” feature to save sweepings for each route.
  - “Accept Changes” adds route to three summaries:
    - Summary by Route
    - Planned Sweeping
    - Summary by Month

- Use the “Edit Routes” feature to change scenarios
  - This feature is calling the frequencies stored in “Planned Sweepings” and loading into the calculator (it re-calculated using defaults from the “Routes” tab).

- Use the “Save/Clear” feature to export summaries to a new workbook or to start from scratch – nothing is saved when you choose the “clear all” option.
Introduction to Planning Nutrient Recovery
These are interactive exercises designed to demonstrate how the tool can be used to optimize sweeping operations given certain constraints (cost, timing, P-load Reductions).

NOTE: for these exercises the demonstration routes all have the same curb-miles value to limit variables.

Exercise 1 – Use the tool to optimize solids recovery for a set budget and given cost constraint.

We should provide a handout of the Routes used in the exercise.

Goal: You have a sweeping budget of $7,000 and sweeping ordinances that include some required sweepings, how can you optimize solids recovery within your budget?

Step 1 – use the tool to calculate the cost of current sweeping operations. (I will use a default cost of $25/curb-mile – will demonstrate how to update after a change in cost using the ‘edit route’ feature).

- The required sweepings have been labeled in the “priority” column so that they can be viewed on the planning page.
- Showcase the way routes have been designed and labeled to suite the goal.

After adding each required sweeping has been added to the “Planning Summary”, the current cost is $4,940, so approximately $2,000 left to spend.

Step 2 – Explore options for additional sweeping

a) First we will simply take a new route and compare the solids recovered in different months putting a “1” in for each month. The effect of canopy can be demonstrated by comparing solids recovered in the same month for any two routes.

- Discuss the limitations of the spreadsheet in predicting 1st sweep of the year.

b) At this point I will ask the group for a suggestion

- I will allow any person to add one sweeping event at a time
- I will decide whether or not I need to speed things up by editing routes, adding some sweepings, etc. or slow things down by adding constraints. Examples:
  - Only 2 sweeping event allows for March-April interval for any route (weather conditions too uncertain)
  - You must sweep every route at least once.
  - You may not sweep residential streets more than once.
  - Etc.

Best solution - with no March sweeping allowed, every route swept at least once, and all the original constraints in place the best scenarios would add spring sweepings to alleys and residential streets, and then add one in the fall rather than a 2nd sweep in April.
Exercise 2 – Use the tool to compute the cost of optimizing phosphorus recovery given a labor constraint.

Goal: You would like to recover as much phosphorus as possible with a limited amount of sweeping. In this case, labor constraints dictate that your sweeping operations are limited to 12 days of vehicle operator time, which we will equate to 24 sweepings.

Note – for this exercise, I will clear the priority rating for the routes to reflect different constraints.

Step 1 - Look at the effect that month and canopy have on phosphorus recovery. As before I will use one route to look at the effect that month has and two routes to look at the effect of canopy on phosphorus recovery.

- Again discuss limitations in predicting first sweeping of the year.

  c) I will add the constraint that all arterials and commercial streets must be swept once before June and enter that information (may ask which months they would like).

  b) At this point I will ask the group for a suggestion

    o I will allow any person to add one strategy at a time (ex. sweep EVERYTHING once in March).

    o I will decide whether or not I need to speed things up by editing routes, adding some sweepings etc. or slow things down by adding constraints.

Examples:

- All arterials and commercial streets must be swept in both spring and fall (non-skid, prepare for plowing season).
- You must sweep every route at least once.
- You may not sweep routes more than once each in the Sept-Oct.
- Alley can only be swept once in the Fall

Best solution - looks something like (assuming March is OK)

Every route swept once (march) = +8 sweepings
All residential swept 2X in Fall = +4 sweepings
Or All res 1X in Oct AND 1X in May (just as good as sept). (Canopy cover makes a difference whether or not 1X in Sept/Oct or 2X in October is better – but should be taken with a grain of salt).

Add 1 sweeping in October to non-res = + 6 sweepings
Add 1 addition sweep in Sept or May for Com and Art = + 4 sweepings
Add May or Sept in highest remaining canopies = + 1 sweeping (High canopy res)