# Pavement Management

The Lucity pavement management modeling program is used to perform budget and maintenance forecasting. This helps you determine when and where to perform pavement rehabilitation, which rehabilitation techniques to use, and the ideal budget needed to accomplish your maintenance goals. Here are two training work books to help you go through this process.

- Workbook 1 – Explains and demonstrates the relationships between the Street Segment, Pavement Subsegment, and Pavement Supersegment modules. These are the three inventory modules required to complete a model run. Then, this workbook focuses on setting up pavement standards to help predict pavement condition over. Finally it goes into creating Field Inspection and Pavement Maintenance records for the street subsegments. These are used to determine the pavements' current conditions and PCI values, which are also required to complete the modeling process.
- Workbook 2 – This book is about the actual pavement models. It demonstrates how to setup the Model Run parameters, run a model, view and interpret model run results, export model run results, and view results in the Supersegments module.

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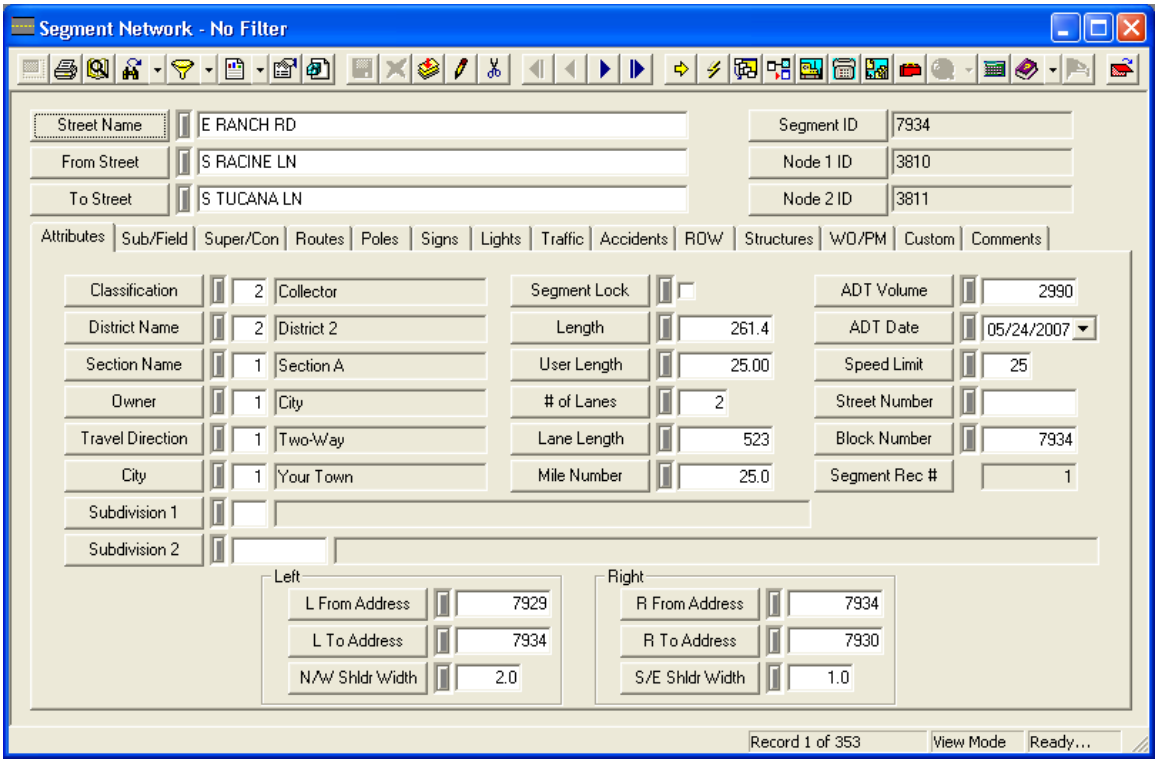
# Street Segments

The Street Segment module allows you to define each street segment from intersection to intersection. These segments are then used to create subsegments and supersegments. Throughout the Pavement Forecasting workbooks you'll notice that *Field Inspections* and *Model Runs* are mentioned many times. Field inspections are conducted on subsegments whereas model runs are conducted on supersegments. In order to accurately forecast your pavement maintenance needs, segment, subsegment, and supersegment records must all be created.

1. To view the segment records, open **Transportation>>Street Master>>Segment Network** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Segment Network* module will open.



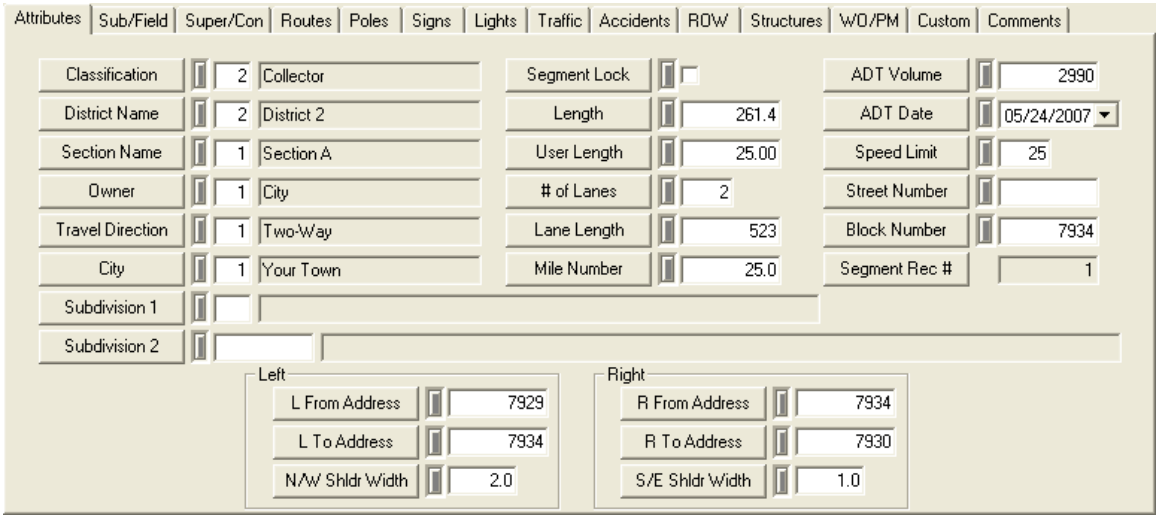

3. Street segment records can input by hand or imported:
   - Importing street segment records: Many users will not enter street segments by hand due to the volume of information. With extensive segment networks, it is easier for users to import data from a geodatabase.
   - Inputting street segment data by hand: If you choose not to import your data, you can input it by hand. Additional details for this process are provided in the online help guide. Since most users import their street segment data, we will not go over a step-by-step example showing you how to add a segment record. Instead, we'll show you an example using an already created record and explain its most important features and functions.

## *Header*

The *Segment Network* header fields allow you to select streets from the street name list. These streets are then linked to specific intersections. If you have imported your segment network data, segment and node IDs associated with the streets in the geodatabase will also be imported.

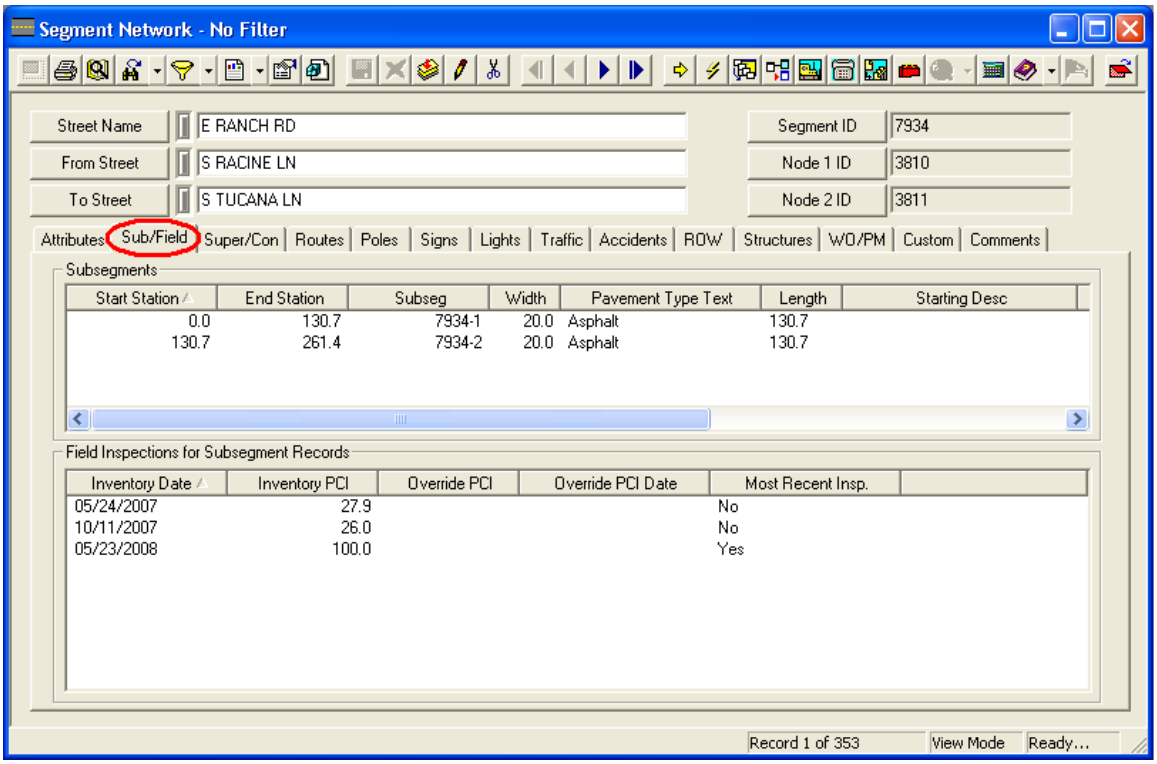

## *Attributes*

The Attributes tab allows you to record basic information about your street segments. This can include the street segment's district, section, owner, city, travel direction, speed limit, length, block width, and number of lanes. Additionally, you can use the Subdivision 1 and 2 fields to assist you with filtering for streets in specific parts of the city or with creating subsets based on filters.



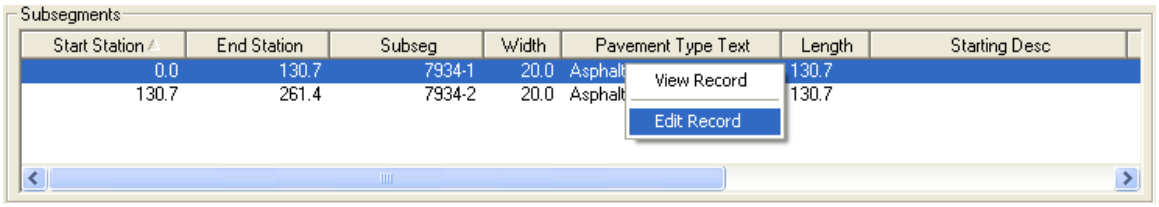

## *Sub/Field*

This tab identifies subsegments associated with the street segment in this record. Subsegments can be edited and split from here. In addition, this tab displays any field inspections for the subsegment. This provides quick and easy access to the related records.




Each time you add a new street segment to the *Segment Network* the system automatically adds a subsegment of the same length to the system. You can then edit and split subsegments to alter their length and other details.

1. To edit a subsegment, right click on the listing in the grid and select *Edit Record*. The Street Subsegment dialog will appear.




- Right click on the street diagram or Subseg # header and select *Edit.* You can then make any changes needed in the Subsegment # dialog.

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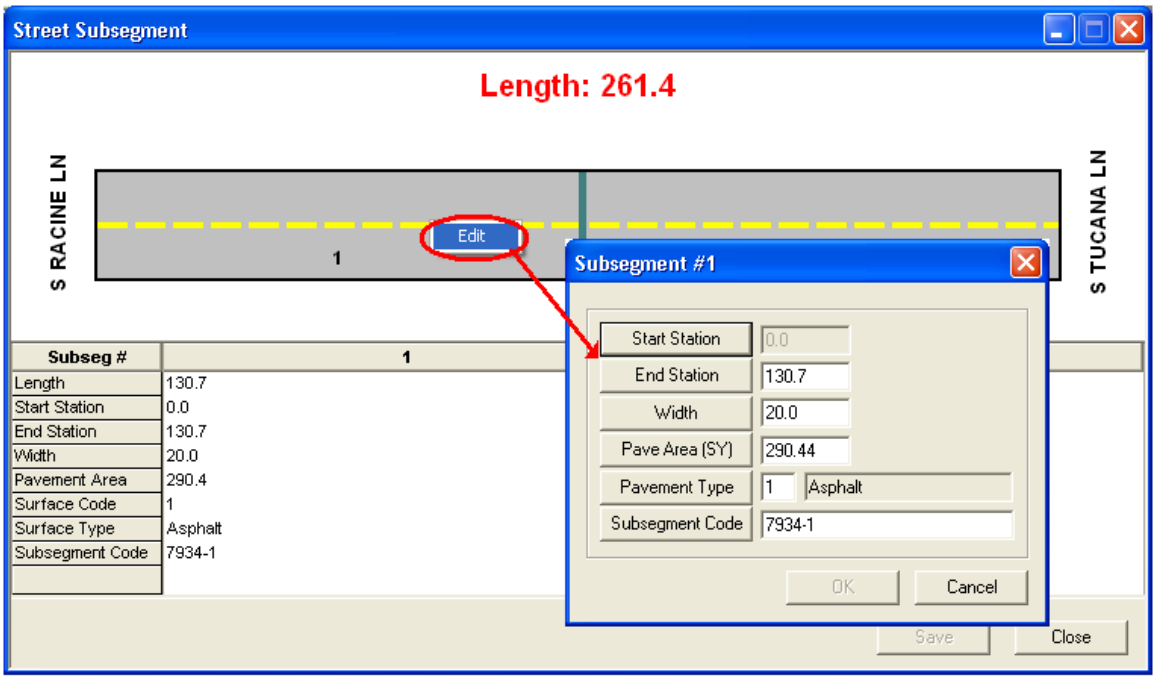


- As you can see in the example above, you can edit the start and end stations, width, pavement area, pavement type, and subsegment code. Click *OK* when your updates are complete. The new values will appear in the Street Subsegment dialog.

2. To split a subsegment, left click on the street diagram in the Street Subsegment dialog. This will highlight the street. Then, right click and select *Split*.
   - In the Split Subsegment dialog, indicate the number of subsegments into which you would like the segment to be split. Then click *OK*.
     - For our example, we'll split this segment portion into two subsegments.

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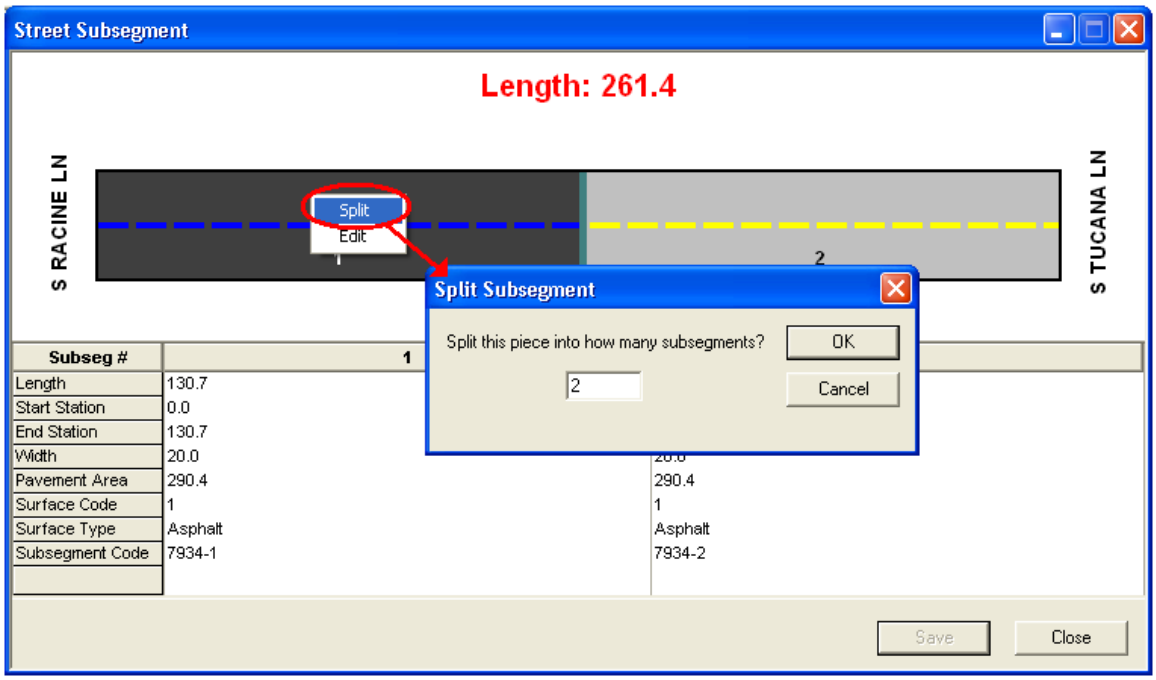
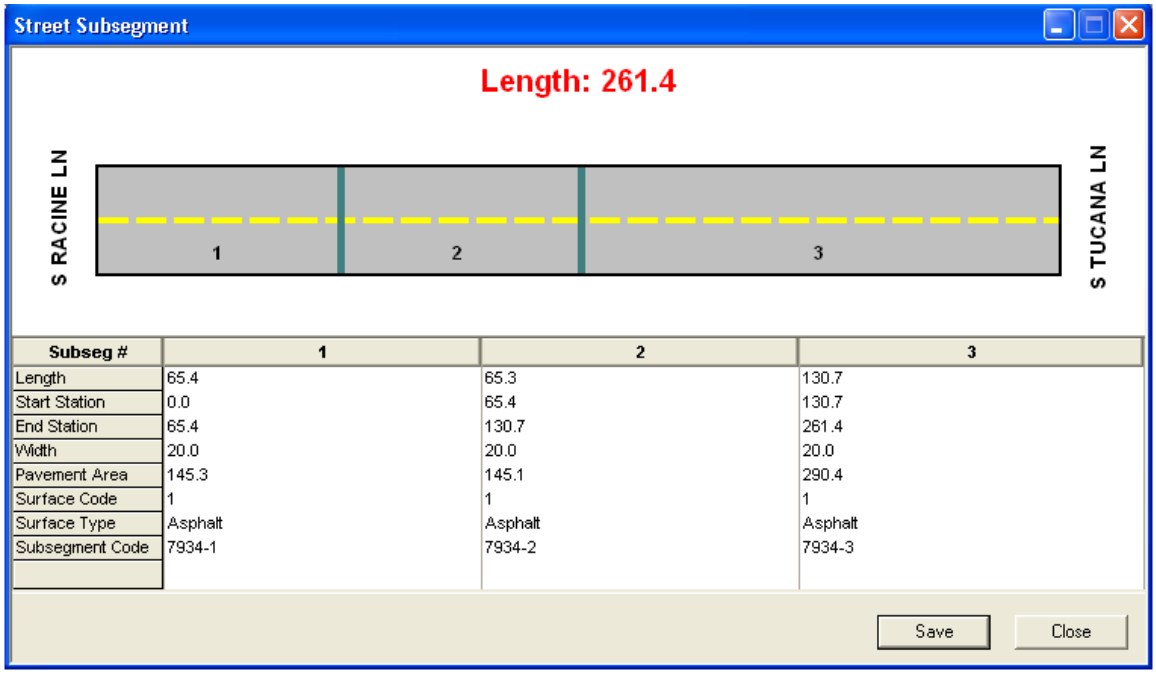


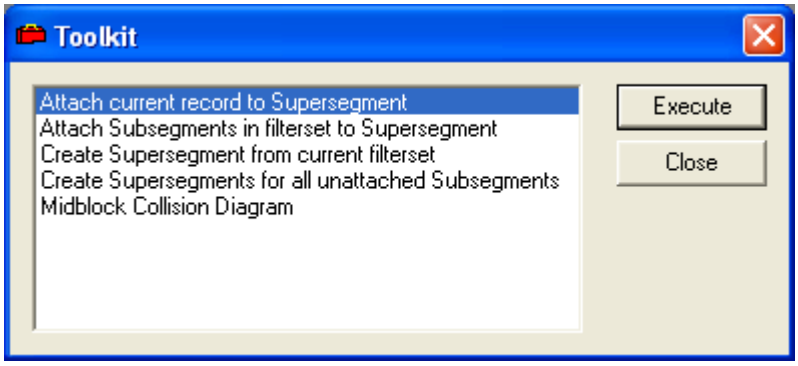

- After the split, the screen will resemble the following. There are now two subsegments of equal length, in addition to the third subsegment. To change the length of any portion or alter other attributes, edit the record as explained before.
- Note that if there are historical *Field Inspections* for the subsegment they will only be associated with the original street subsegment, not with the new portion.



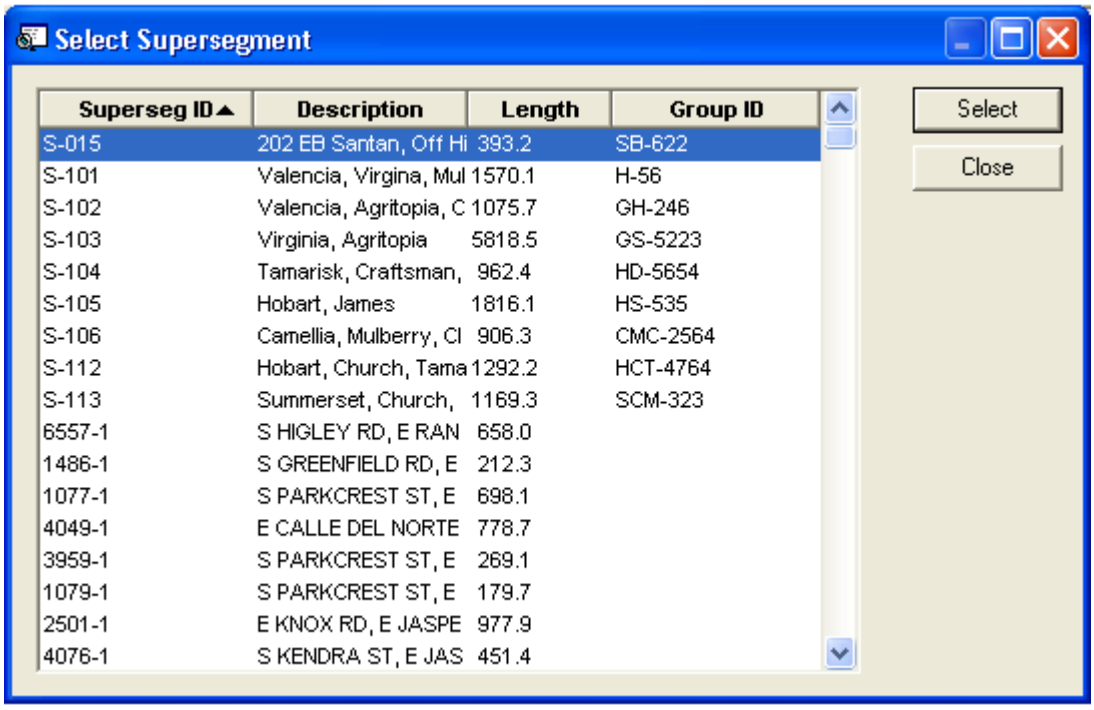
## *Toolkit Function*

The Toolkit is used to attach subsegments to existing supersegments or create new supersegments. To explain how this works, we'll go over a step-by-step example. Note that these Toolkit options also appear in the *Subsegments* module. You'll follow these same steps listed below to create a supersegment from a subsegment or attach a subsegment to an existing supersegment.

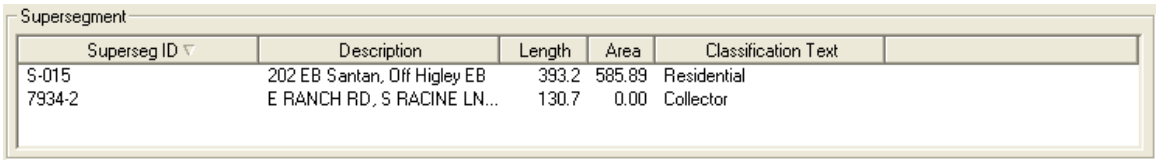
1. Click the  button at the top of the module toolbar. The Toolkit dialog will appear.
   - Two options are available to attach subsegments to existing supersegments:
     - You can attach the current subsegment record to an existing supersegment if it is not currently attached to another supersegment.
     - You can attach all subsegments in the current filtered set to an existing supersegment. Currently attached subsegments will be excluded from the new supersegment.
   - Two additional options are available to create new supersegments:
     - You can create a new supersegment that will include all records in the current filtered set. This new supersegment will include all currently unattached subsegments.
     - You can create new supersegments for each unattached subsegment. No prompts will be given with this toolkit option. The system will use the Subsegment ID for the Supersegment's ID. For the description, the system will concatenate the Street Name, From, and To streets.



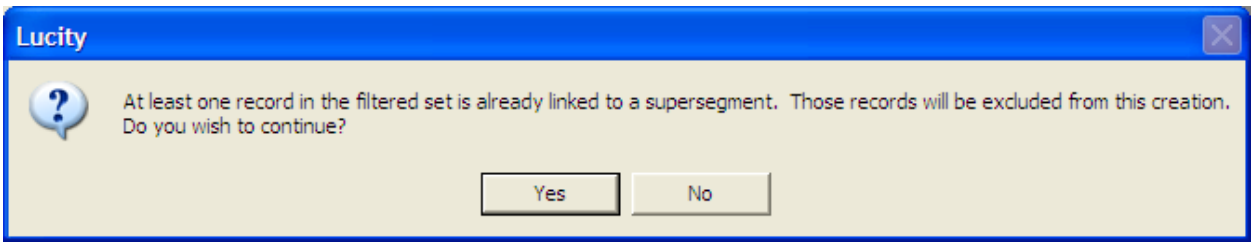

2. To attach records to an existing supersegment, select either "Attach current record to Supersegment" or "Attach Subsegments in filterset to Supersegment" from the Toolkit dialog. Then click *Execute*. The Select Supersegment dialog will appear.
   - This dialog will list all available supersegments. You'll see the supersegment ID, a description of its location, its length, and group ID.
   - Highlight a supersegment in the list and click *Select*.



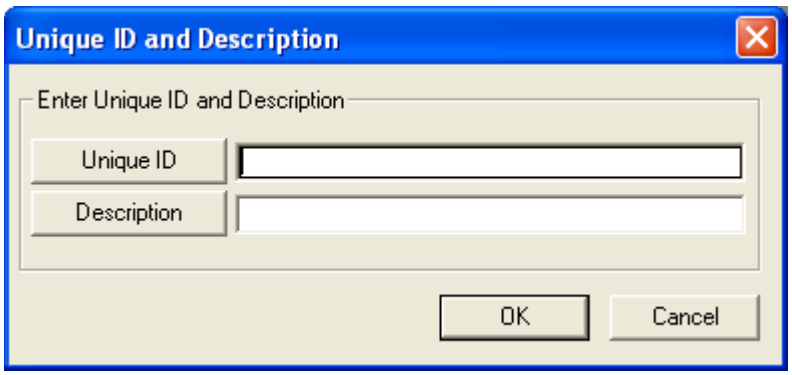

- The supersegment you choose will appear in the Supersegments/Construction Tab. Double-click on the listing in the grid to view the record in the *Supersegments* module.




3. To create a new supersegment, select either “Create supersegment from current filterset” or “Create supersegments for all unattached subsegments” from the Toolkit dialog. Then click *Execute*.
   - If any of your subsegments are currently attached to supersegments, you’ll receive the following prompt informing you that those records will be excluded from the creation of a new supersegment. Select *Yes* to continue.




- You’ll need to enter a unique ID and description for your new supersegment if the “Create supersegment from current filterset” option was selected.

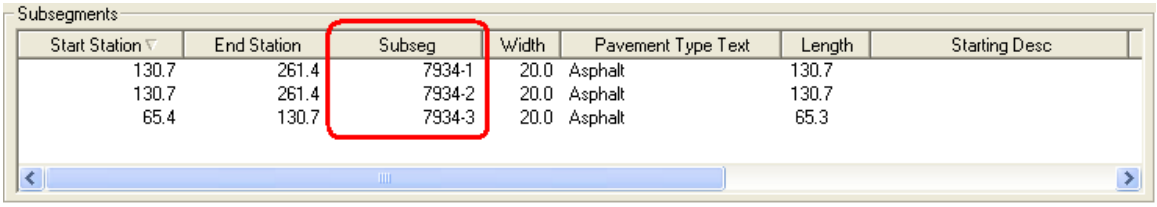



- The newly created supersegment(s) can then be located in the *Supersegments* module. Later in this workbook, we'll discuss supersegments in greater detail.

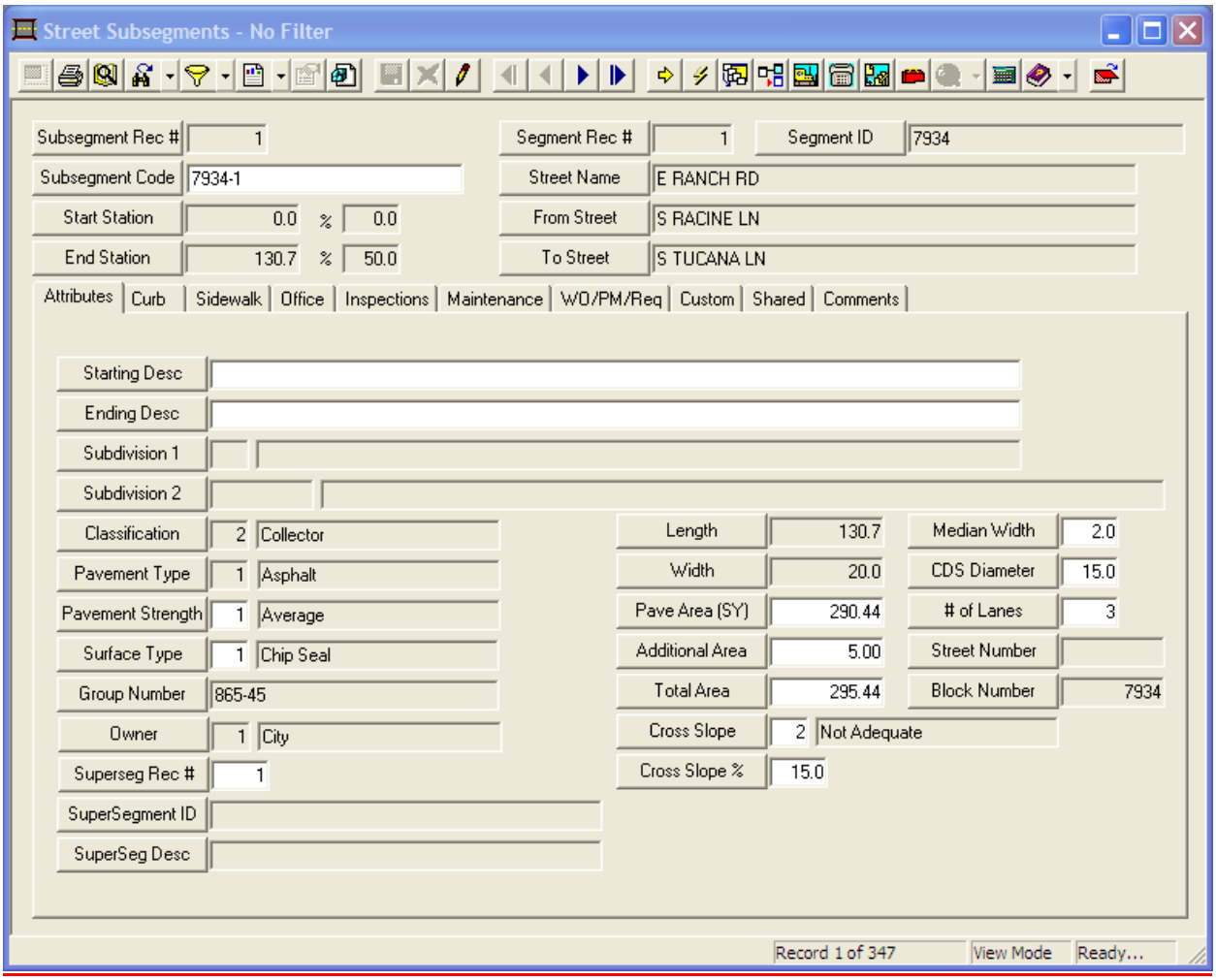
## Street Subsegments

As discussed above, subsegments are created in the Subsegment module each time a record is added to the Street Segment module. Subsegments are not created in this module. Instead, they inherit their properties from the original segment. You can, however, edit the subsegment records to suit your needs.

1. To access the *Subsegments* module, select **Transportation>>Pavement Manager>>Subsegments** from the Lucity main menu.
2. To identify related segments and subsegments, you'll need to understand the numbering scheme.
   - The street segment we used earlier in this workbook has a segment ID of 7934. We'll use this record to show you an example of the numbering scheme.
   - When a street subsegment is created, the system adds a -1 to the segment ID. For example, our first subsegment is numbered 7934-1.
   - When you split a street subsegment as we demonstrated earlier, the second portion of the subsegment is identified with a -2 after the segment ID. In our example, the second street subsegment is numbered 7934-2.
   - Each time you split a subsegment, it will be identified in this manner (-3, -4, etc.).

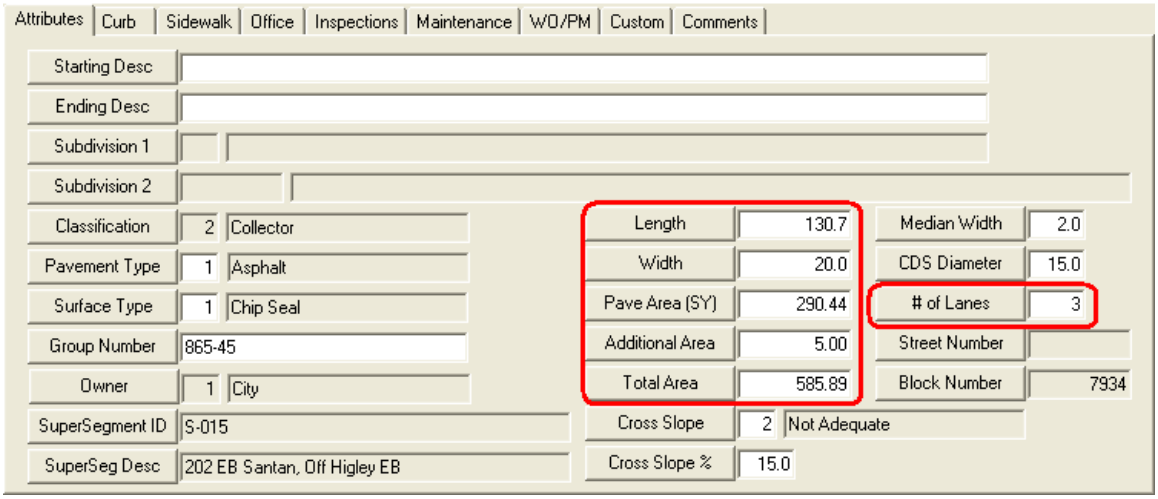



3. When a subsegment record is created, data from the *Street Segment Network* module is carried over into the header and Attributes tab; however, nearly all fields in this module can be edited by the user.




- The Starting and Ending Description text fields can be used to help define the starting and ending subsegment points.
- Using the Pavement Type pick list, you can select a pavement type from the *Pavement Standards* module. Also choose a Pavement Strength.
    - We will go over setting up pavement standards in this workbook on page 18. For this example we chose Asphalt.
- The Surface Type field simply stores information. It is not used in the model.
- The supersegment associated with the street segment will be identified in the SuperSegment ID and SuperSeg Desc fields. These cannot be edited by the user.

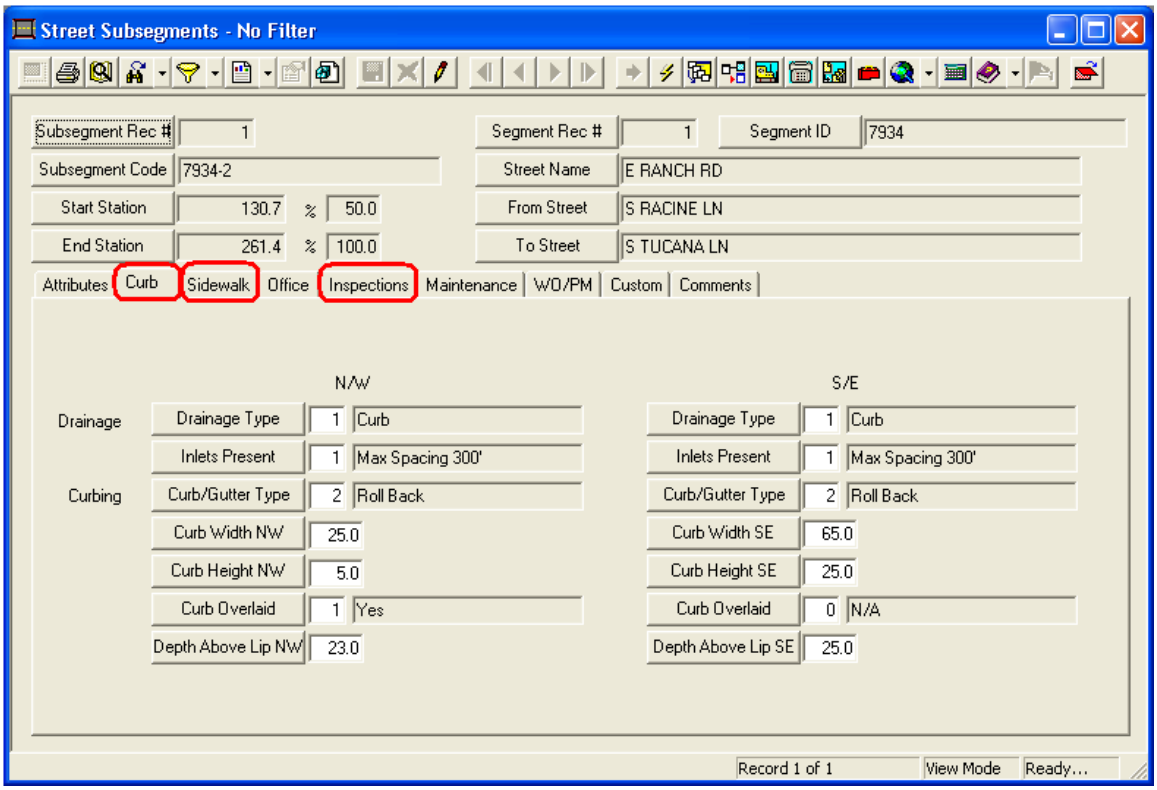
4. Several fields in the Attributes tab can be calculated by the system using the length and width data carried over from the street segment along with other user-entered data:




- To calculate pavement area, press the **F5** key with your cursor in the Pavement Area (SY) field. The area in square yards will be calculated as follows:
    - Area = (Length * Width) / 9
- To calculate additional area, press the **F5** key with your cursor in the Additional Area field. The field must be empty; the system will not overwrite a value in this field. The calculation for this field follows: (note that the calculation assumes that the length of the road extends to the center of the cul-de-sac).
    - W = Width of Road (user entered)
    - D = Diameter of cul-de-sac (user entered)
    - C = Area of Circle (calculated by system)
    - h = Distance from center of CDS to circular segment (calculated by system)
    - A = Area of circular segment (calculated by system)
- Thus, the simple calculation for the Additional Area is:
  AA = C – h * W - A
- The more advanced calculation for the Additional Area is:
  $A = \frac{D^2}{8}\left(2\left(\text{ASin}\left(\frac{W}{D}\right)\right)\right) - \left(\text{Sin}\left(2\ \text{ASin}\left(\frac{W}{D}\right)\right)\right)$
- To calculate total area, press the **F5** key with your cursor in the Total Area field. The system will add the values in the Pavement Area and Additional fields.

5. The subsegment record also contains data carried over from the *Field Inspection* module. This data can be found on the Curb, Sidewalk, and Inspections tabs. Note that the data on these tabs can be edited in this module. Any data you add or change here will also be added or changed in the corresponding inspection record.
    - The Curb tab contains field inspection data related to drainage and curbing.
    - The Sidewalk tab contains field inspection data related to sidewalks and driveway approaches.
    - The Inspections tab contains field inspection results for the street subsegment. This includes the PCI and factor values. The data in the Condition field can either be entered directly by the user or can be updated automatically from the

*Field Inspections* record. Later in this workbook, we'll discuss the *Field Inspections* module in greater detail.




## *Toolkit Function*

As we mentioned earlier, the *Subsegment* module contains Toolkit options that are also found in the *Segment* module. These are used to attach subsegments to existing supersegments or create new supersegments. In addition, a "Subsegment and Supersegment Association Tool" has been added for the version 7.0 release. This new tool allows you to select subsegments from a list and add them to an existing supersegment, or use them to create a new one. This provides you with an easy way to rapidly create supersegments.

1. Click the Toolkit button. The following dialog will appear:

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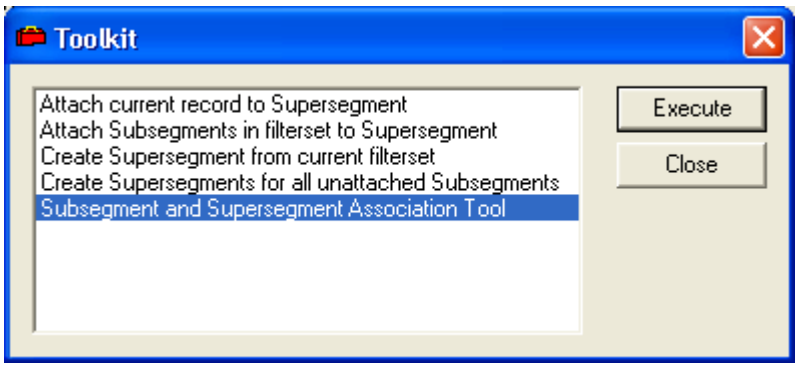
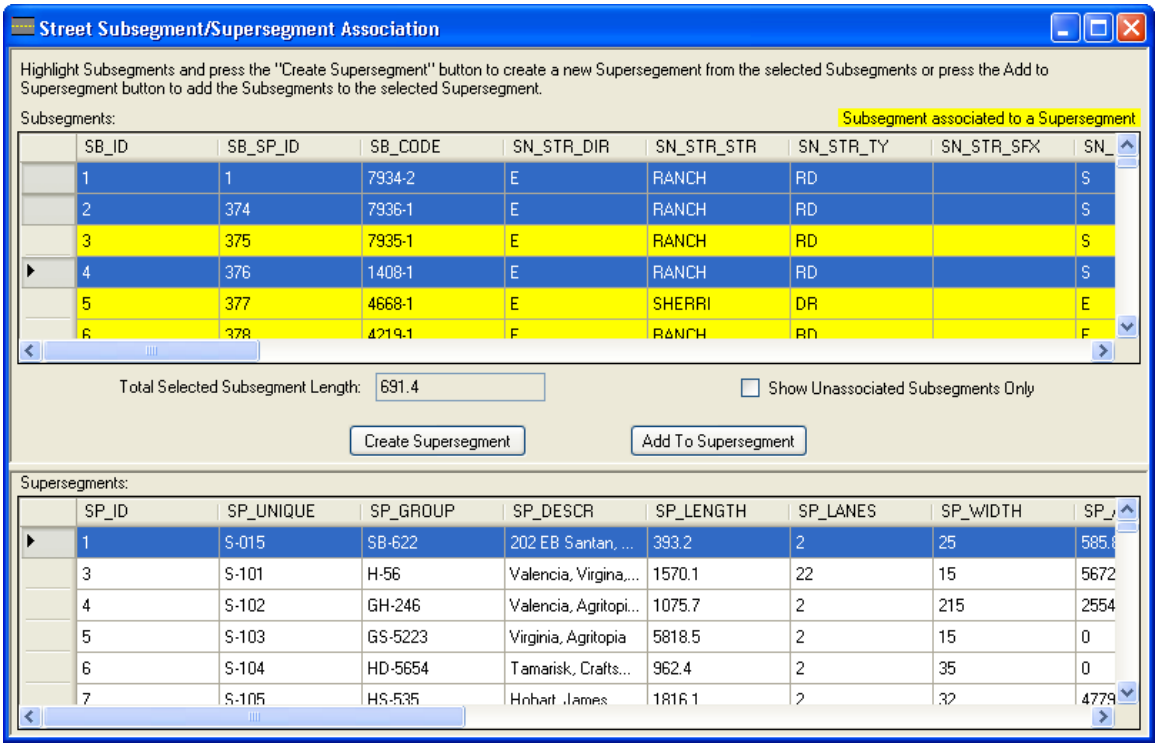
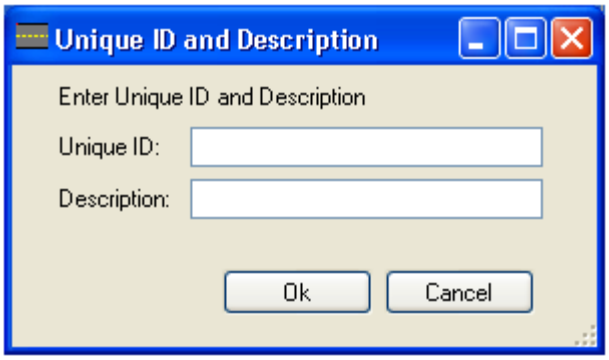



2. Select *Subsegment and Supersegment Association Tool* and click *Execute*.




3. In the Subsegments grid at top, highlight one or multiple subsegments to associate with a supersegment.
   - Mark the "Show Unassociated Subsegments Only" box if you'd like the grid to display only the subsegments that are not currently associated with a supersegment. (Subsegments that are currently associated with a supersegment are highlighted in yellow.)
   - The Total Selected Subsegment Length will be automatically calculated by the system as you add each additional subsegment to the selection.
4. Once you've finished selecting subsegments, you can either add them to an existing supersegment or use them to create a new supersegment:
   - **Add to Supersegment:** To add the selected subsegments to an existing supersegment, highlight a supersegment in the bottom grid. Then, click the *Add to Supersegment* button.

- **Create Supersegment:** To add the selected subsegments to a new supersegment, click on the *Create Supersegment* button. The following dialog will appear. Enter a unique ID and description for the new supersegment and click *OK*. The new supersegment will be added to the Supersegments grid in this dialog as well as to the *Supersegments* module.




## Street Supersegments

Street supersegments are made up of one or more street subsegments and can be created from the *Segments* or *Subsegments* modules using the Toolkit function. Remember, we discussed the Toolkit earlier in this workbook. These supersegments are then used to run the maintenance forecasting model; the model cannot be run off of street segments or subsegments.

1. To access the street supersegments, open **Transportation>>Pavement Manager>>Supersegments** from the Lucity main menu.
2. The Subsegments tab lists all street subsegments included in this supersegment.
   - As you can see in the example below, subsegment 7934-2 is included in this supersegment. This is one of the subsegments that we split earlier in this workbook. The other subsegments in this supersegment are related streets. It's useful to create a supersegment from a number of related or connected subsegments such as we've done below.

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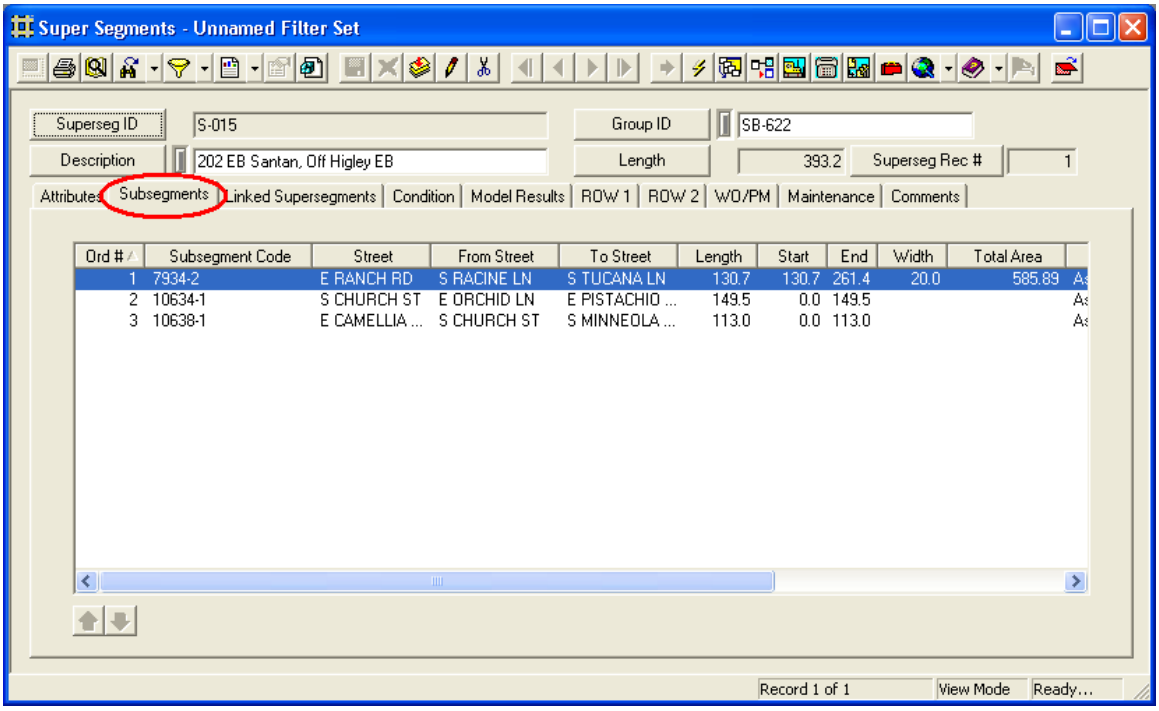
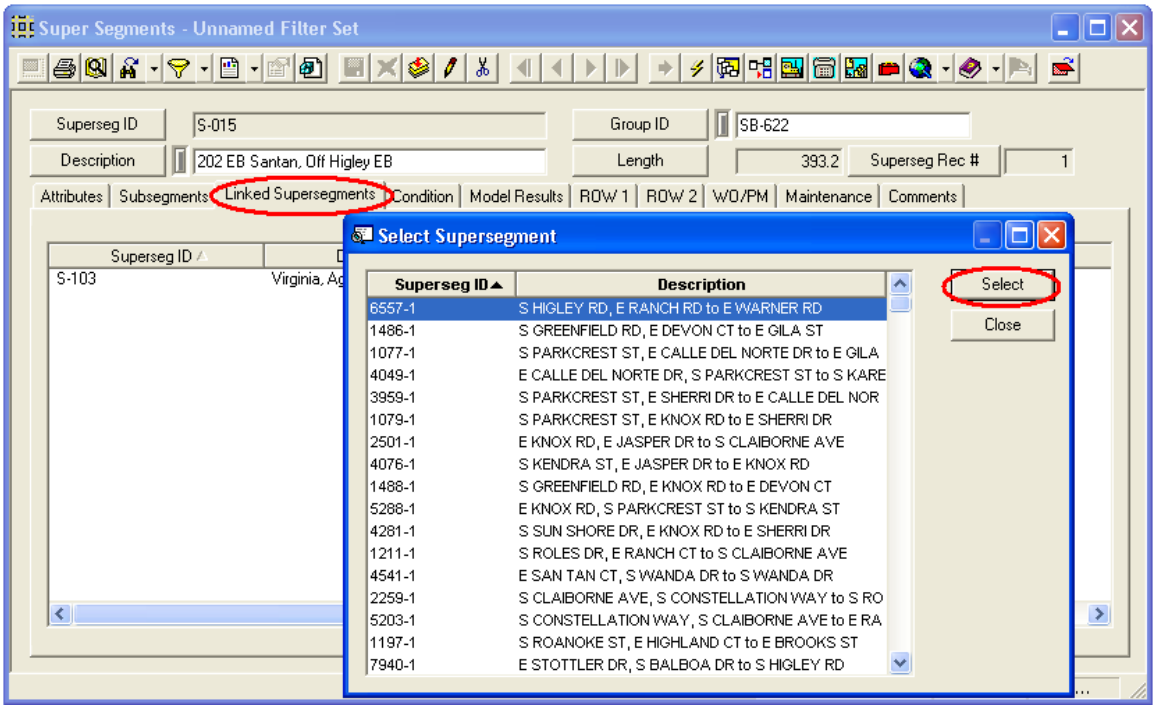



3. To view a subsegment record, double-click on a listing in the grid. The *Subsegments* module will open.
4. You can calculate the total length of all attached subsegments by right clicking in the grid and selecting *Calc Total Length*. The calculated value will appear in the header's Length field. This function is useful anytime you add, edit, or delete records associated with this supersegment.

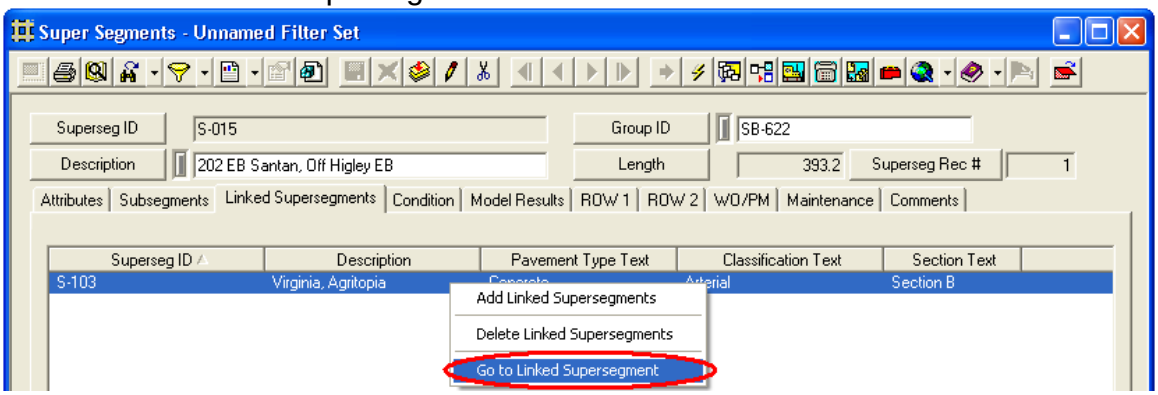
## *Linked Supersegments*

The *Supersegments* module allows you to link supersegments together. For example, you may have one supersegment that includes all of the residential streets in a subdivision and another including all of the collector streets through that subdivision. You may wish to link these two supersegments together if you'd like the model run to select them both for maintenance in the same model year.

1. On the Linked Supersegments tab, right click in the grid and select *Add Linked Supersegments*.




2. Choose a supersegment from the dialog and click *Select*. That supersegment will appear in the grid. To view the linked supersegment, right click on the listing and select *Go to Linked Supersegment*.
   - The associated supersegment record will now display the current supersegment on its Linked Supersegments tab.

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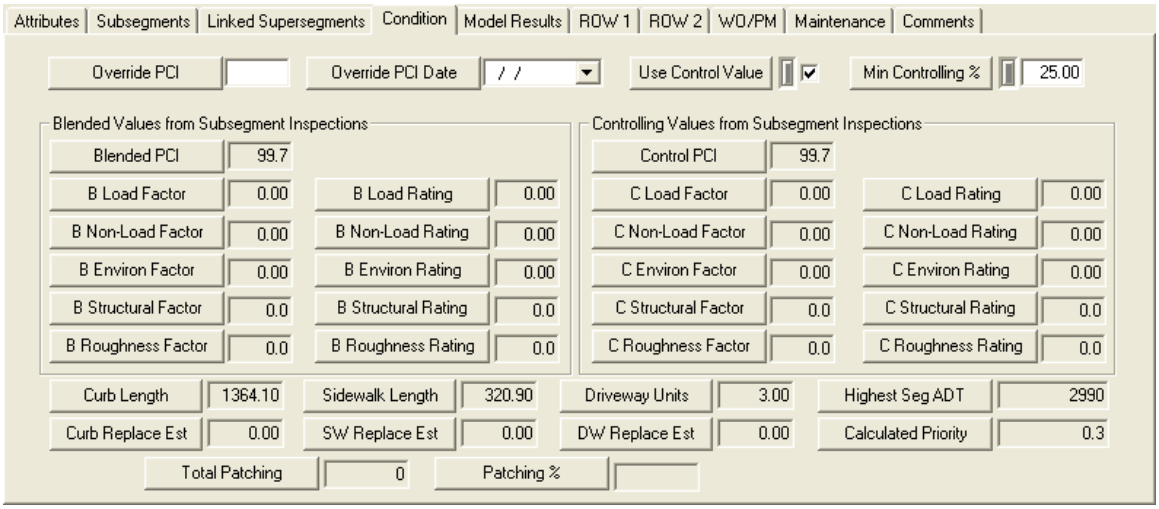
## *Supersegment Condition*

The Condition tab summarizes the condition of the supersegment using the results from the most recent *Field Inspections* for each subsegment linked to this supersegment.

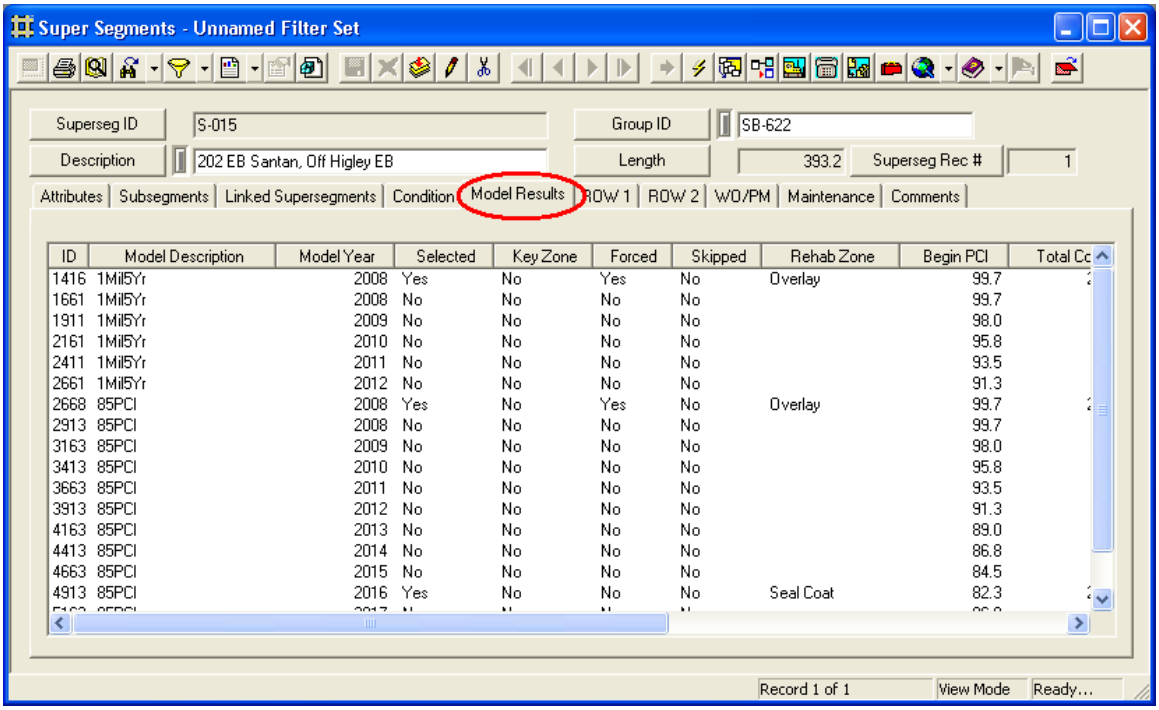



1. The Override PCI and Date fields allow you to manually set the PCI value that you would like for the modeling program to use. Otherwise, the calculated Blended or Controlling values will be used in the model runs.
2. Blended values are a blending of all subsegments connected to the supersegment. The system calculates these values as follows:
   - For each associated subsegment, the system multiplies the PCI * Area.
   - The system then adds the total value of the PCI * Area for all subsegments.
   - This total value is then divided by the total area of the supersegment.
   - This new value equals the blended or average PCI (Pavement Condition Indices).
3. Controlling Values allow you to set a portion of the supersegment as the controlling PCI for the supersegment. These are calculated by the system when you mark the Use Control Value checkbox and enter a Minimum Controlling Percent at the top of the tab (i.e. 20%, 50%). For instance, you could mark the checkbox and set the minimum controlling percent to 50. This would mean that if any of the connected subsegments are 50% or greater in area as compared to the supersegment, then that subsegment (or those subsegments) will be selected. The system then finds the subsegment(s) values with the largest PCI and displays that subsegment(s) data in this Supersegment record.
4. The Curb Length, Sidewalk Length, Driveway Units, replacement estimates, and Total Patching are simply totaled from the connected subsegments. The value for the segment with the Highest ADT (Average Daily Traffic) will be imported as well.
5. If you see that all of the fields in this tab are blank, you can use the Toolkit function to recalculate the values:
   - Click  on the module toolbar.

- In the Toolkit dialog, select *Update Supersegment Current Ratings* and click *Execute*. The system will then rerun the calculations.

### *Model Results*

Results from completed model runs can be seen on the Model Results tab. As we discussed before, pavement forecasting models can only be run against supersegments. Here, you can quickly and easily access model run results for the various model years associated with this supersegment. We'll discuss the model runs in greater detail in the related workbook, Pavement Management 2.




## Pavement Setup

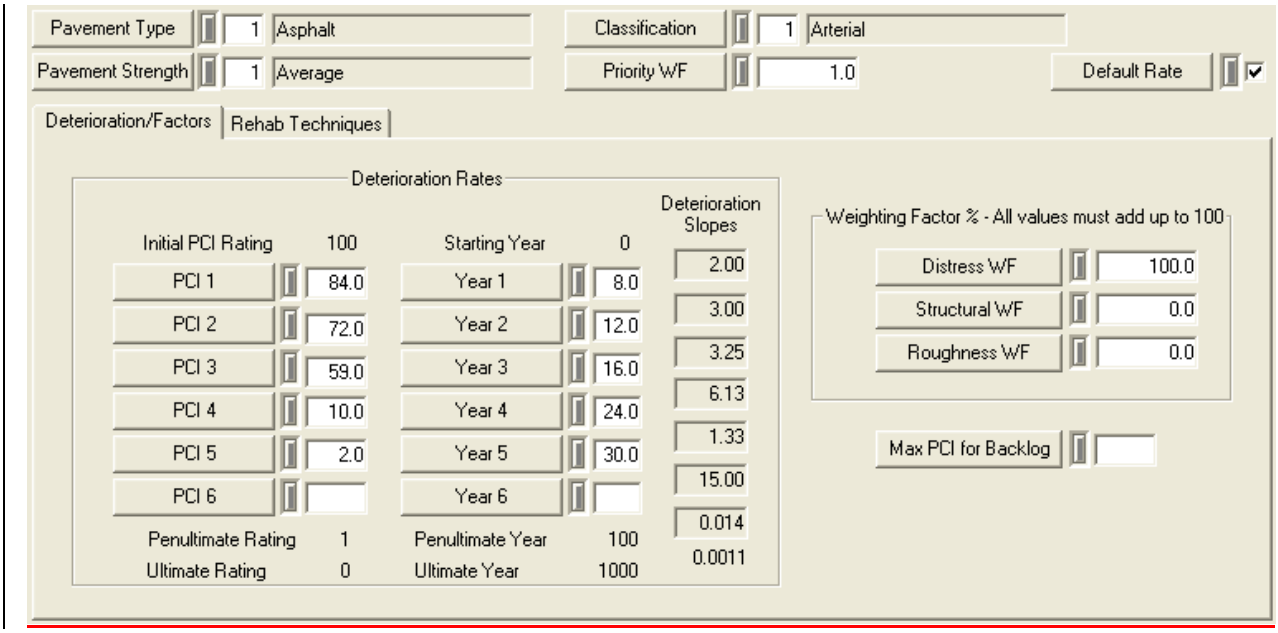
The pavement management modules provide you with four pavement setup modules. In the following pages, we'll demonstrate how these modules are used.

### *Pavement Standards*

This module allows you to create records for the different types and classifications of pavements along with their associated deterioration rates. The model runs will then select street segments for rehabilitation based on their deterioration schedules. Additionally, this module can be used to associate rehab techniques with these records.

In the next workbook we will return to this module to show you how this is accomplished; but first, we'll demonstrate the steps to create your *Pavement Standards*.

1. Open **Transportation>>Pavement Manager>>Pavement Setup>>Standards** from the Lucity main menu.
2. Click *GO* to bypass the filter screen. The *Pavement Standards* module will open.



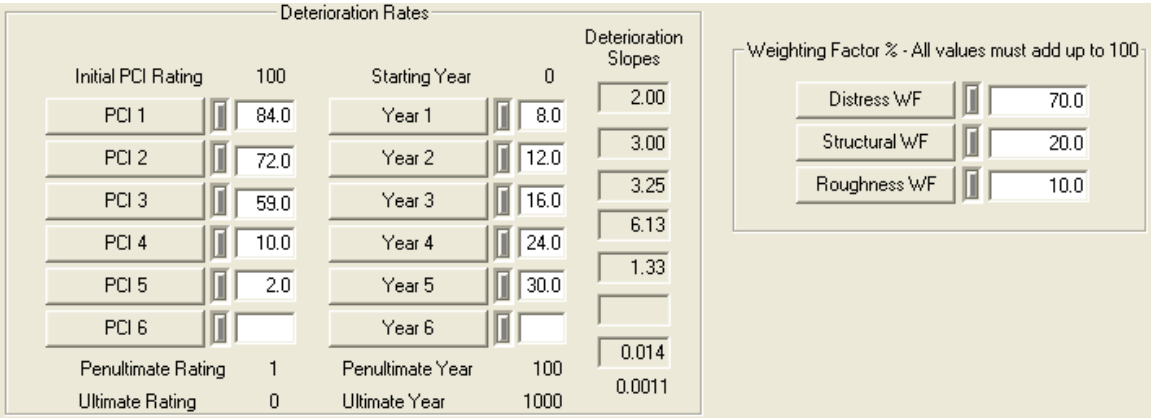

3. Create a unique Pavement Type and Classification combination to identify your street. You'll use this module to create one record for each of the pavement type/ street classification/ pavement strength combinations used in your segment network.
   - In the example above, we've created a record for an Asphalt/Arterial/Average street.
   - Other combinations may include Asphalt, Concrete, Composite, or Gravel pavements paired with Arterial, Collector, or Residential streets (for example).
   - These would then be given a pavement strength as well.
4. Set the Priority Weighting Factor. The higher the value, the more likely the supersegment is to be selected in the model run (when all other elements are equal).
5. Set the pavement deterioration rates.
   - Each street is given an initial PCI (Pavement Condition Indices) rating of 100 and a starting year of 0. This indicates the best possible condition of the street at the time it was created. Since streets deteriorate over time, you'll need to indicate the street's deterioration rate. This will help the model runs plan the pavement rehabilitation schedule.
   - To set up the deterioration schedule, you'll need to indicate the decreasing PCI ratings by year to form the points along the curve.
     - Note that the PCI values have a penultimate rating of 1 and an ultimate rating of 0. This means that the calculated PCI values can never reach 0. Similarly,

the street's age has a penultimate year of 100 and an ultimate year of 1000. This means that the calculated year can never reach 1000. Finally, based on the PCI and age, the deterioration slope can never reach 0.0011.

- In our example below, we've created a 30-year deterioration schedule with five points along the curve. For each point, we've set an increasingly smaller PCI value until the PCI reaches 2 (at the 30-year mark). We've also indicated each year in which the PCI values will change. Note that the PCI value must be greater than 1. Our deterioration schedule is as follows:
  - The street's PCI rating will equal 84 in the street's 8th year.
  - The street's PCI rating will equal 72 in the street's 12th year.
  - The street's PCI rating will equal 59 in the street's 16th year.
  - The street's PCI rating will equal 10 in the street's 24th year.
  - The street's PCI rating will equal 2 in the street's 30th year.
- When you click  to save the record, the system will automatically calculate the pavement deterioration slopes. These indicate the points along the curve. The final slope calculation is found using the penultimate year and last year entered.
  - Since our slope ends at 30 years, our final point on the slope equals 0.014.

6. Set the pavement distress, structural, and roughness weighting factors. These values allow you to default the emphasis that these factors have on the subsegment PCI.
   - Note that these three values must add up to 100.
   - If only visual distresses are being collected, then set the Distress WF to 100.
   - In our example, we've set the Distress WF to 70, Structural WF to 20, and Roughness WF to 10. This means that the Distress PCI will contribute 70% of the final PCI, the Structural PCI will contribute 20%, and the Roughness PCI will contribute 10%.

## *Pavement Distresses*




This module allows you to record individual pavement distresses that will be rated when inspecting street subsegments. Here, you can assign weighting factors to those distresses and indicate distress types. These records will be used again in the

*Pavement/Distress Matchups* module. In addition, the model runs will use these distresses to calculate PCI and determine which street segments to select for rehabilitation.

1. Open **Transportation>>Pavement Manager>>Pavement Setup>>Pavement Distresses** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Pavement Distresses* module will open.


3. Create a unique distress name and indicate the order in which this distress record will initially appear in the Field Inspection grid.
   - For our example, we've created a distress for riding comfort.
4. Indicate the Distress Type. These help categorize the type of impact that the distress has on the pavement.
   - The five Distress Types are: Load, Non-Load, Environmental, Roughness, and Structural.
   - When performing Field Inspections, the system will total up the final deduct values for each Distress Type. Those values then help to determine the appropriate rehabilitation method.
5. Set the weighting factor. This indicates the negative effect a distress has on pavement. This factor is combined with the quantifiable field observation to calculate PCI. You can use this value to declare the maximum deduction this particular distress can have against the PCI from Distresses. Consider the following when setting up your weighting factors:
   - All distresses are rated on a 10 point system: **10** represents a perfect street with no defects while **0** represents the worst possible street condition.
   - The numerical value for the pavement deterioration (from the field observation) is subtracted from the rating of 10. This new rating is then multiplied by the weighting factor to calculate PCI. In other words, the calculations are as follows:
     - 10 – Rating = Initial Deduct
     - Initial Deduct * Weighting Factor = Final Deduct
   - Based on the calculation we just defined, let's look at an example using the Riding Comfort Distress on the previous page:
     - If the Riding Comfort on a particular pavement was given a rating of 6, there would be 4 deduction points (10 – 6 = 4). These 4 points are then

multiplied by the Weighting Factor of 1.0 (4 * 1.0 = 4). This Weighting Factor is defined in the *Pavement Distress* record above. Thus, 4 points would be deducted from the PCI.
    - If the Weighting Factor in the *Pavement Distress* record had been 3, then the total deduction points would have equaled 12 (4 * 3 = 12). 12 points would then be deducted from the PCI.
- If you have been using an older version of *Master Series* and recently upgraded to v. 6.72 or higher, you'll want to use the following weighting factors to maintain your previous distress setup.
    - If your previous distress had a possible 10 index points, set the weighting factor to 1.
    - If your previous distress had a possible 5 index points, set the weighting factor to 0.5.

6. Mark the checkbox if you want to use severity and density analysis in the *Field Inspections* module calculations. Severity/density ratings indicate how bad a problem is and how often it occurs.

## *Match Up Your Pavements and Distresses*

The *Pavement/Distress Matchups* module is used to associate pavement types created in the *Pavement Standards* module with distresses created in the *Pavement Distresses* module. This helps you identify which distresses will be rated for different types of pavements. The relationships established here will be used in the *Field Inspections* module to calculate PCI. The model runs will then use these matchups and PCI values to help determine which street segments to select for rehabilitation.

1. Open **Transportation>>Pavement Manager>>Pavement Setup>>Pavement/Distress Matchups** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Pavement/Distress Matchups* module will open.

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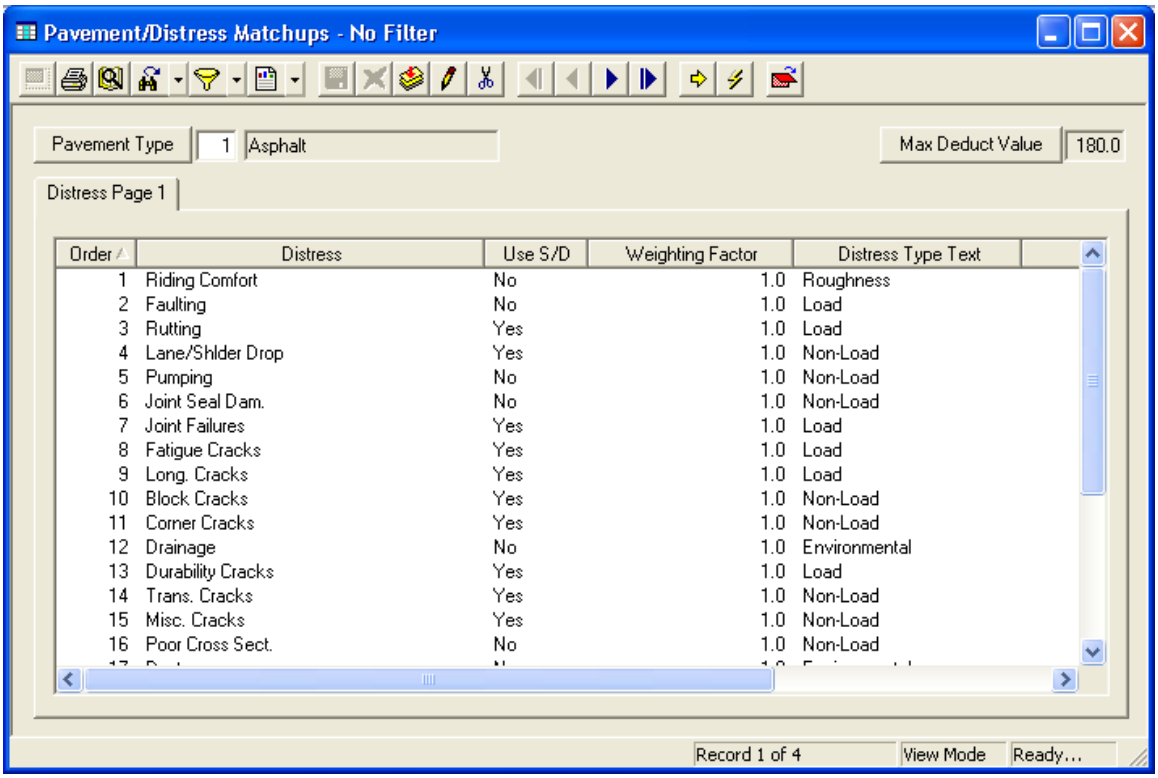


3. Select a Pavement Type from the *Pavement Standards* module.
   - In our example, we've selected an Asphalt street. This matches the record we created at the beginning of this workbook.

4. Using the Distresses grid, add distresses from the *Pavement Distresses* module.
   - Right click in the grid and select *Add Record*.
   - Choose one or multiple distresses from the pick list and click *Select*.
     - You can highlight multiple selections by holding down your SHIFT or CTRL key.
   - In the example below, we've highlighted "Riding Comfort". This is the distress from our earlier example. We'll also be adding a number of other distresses to the grid.

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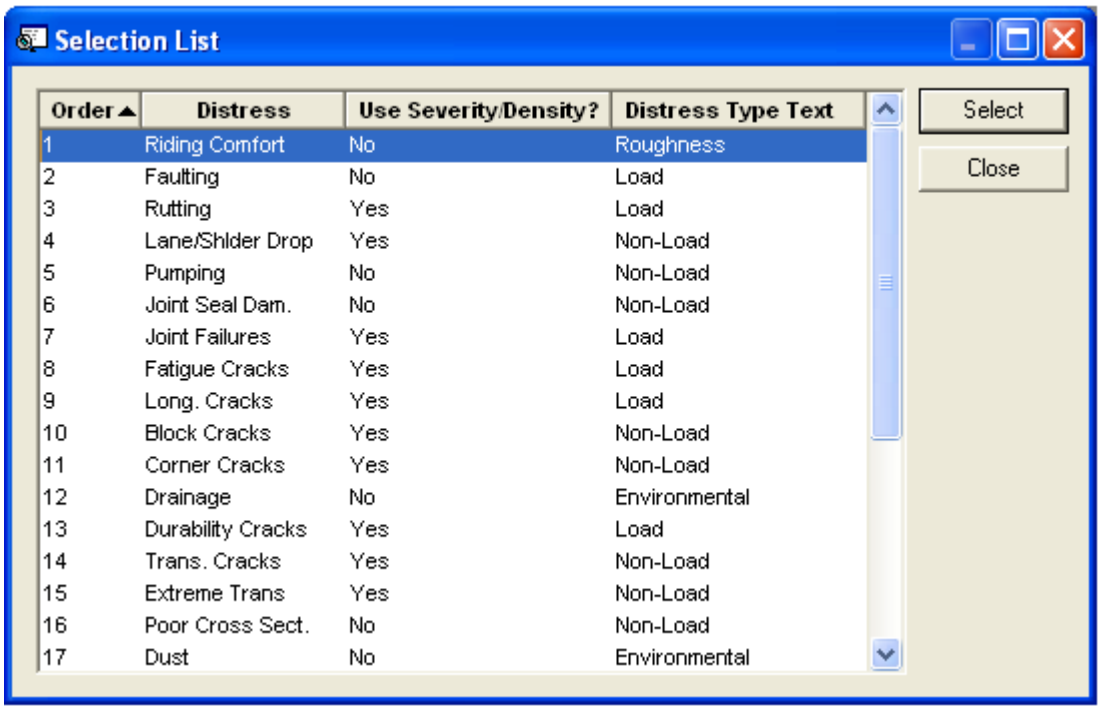
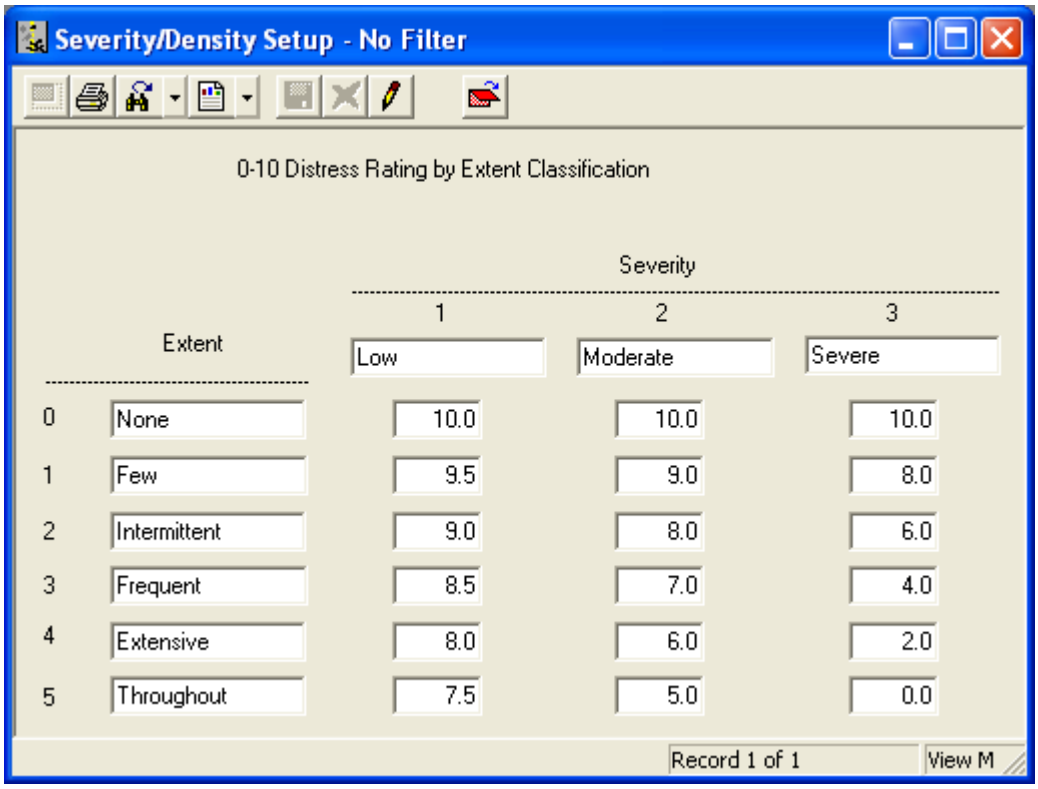



5. Once you have added distresses to the grid, the Max Deduct Value field in the header will be automatically calculated. This value will be updated each time you add or remove a distress from the grid.
   - The Max Deduct Value equals the sum of the weighting factors for all selected distresses multiplied by 10.

## *Set Up Severity and Density Values*

Severity and density ratings are used in the *Field Inspections* module to evaluate distresses. These ratings and distresses help the model runs determine which street segments to select for rehabilitation. Follow the steps below to set the initial distress ratings by defining the impact of the Extent and Severity values that you wish to use.

1. Open **Transportation>>Pavement Manager>>Pavement Setup>>Severity/Density Setup** from the Lucity main menu.
2. Click *GO* to bypass the filter. The *Severity/Density Setup* module will open.

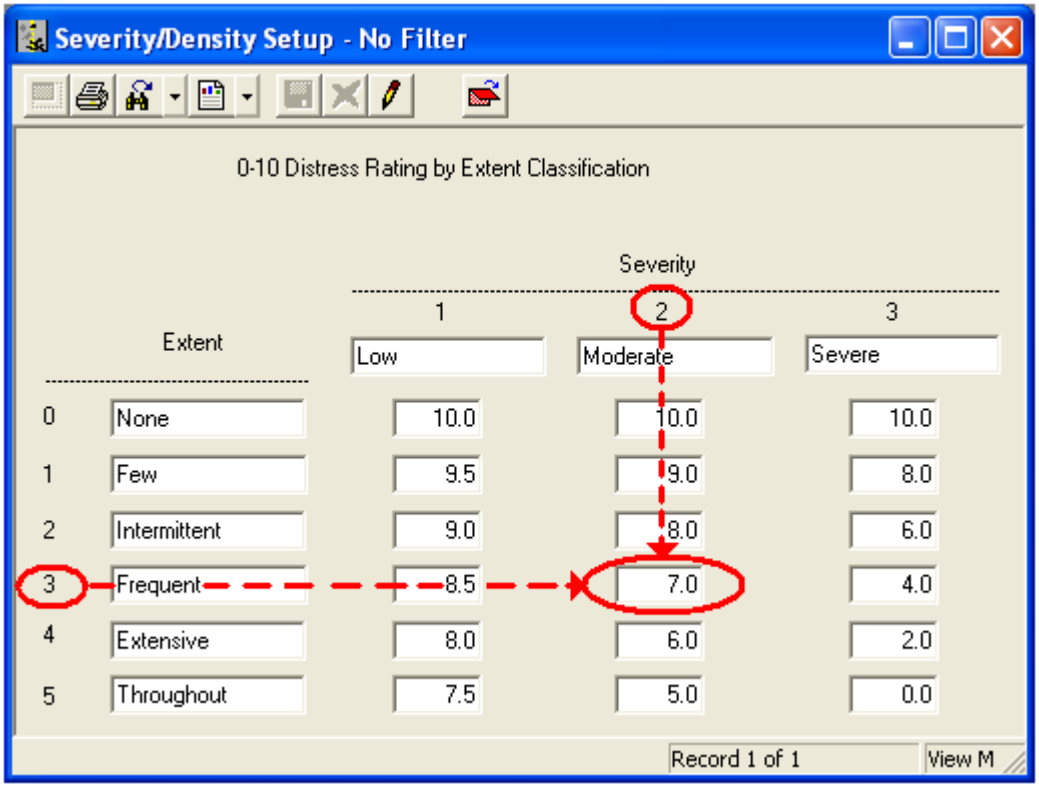



3. Only one severity/density record is needed. The example above displays the standard settings; however, you may choose to edit these values to suit your needs.
   - Click the button to enter edit mode.
   - Our standard settings use three severity ratings (low, moderate, and severe) and five extent ratings (none, few, intermittent, frequent, extensive, and throughout).
     - The severity values are used to indicate how bad the effect of the distress is on the pavement.
     - The extent values are used to indicate how much of the pavement is affected by the distress.
   - Each rating has an available scale of 0-10. 10 represents the best possible street. Our ratings have been set in descending order to reflect the extent of the distress.
   - Click to save the record once you have made your changes.

## How Severity/Density is Calculated

1. During the field inspection, a distress is observed on the pavement. The inspector will quantify this distress using the values in the *Severity/Density Setup* module. Based on your setup, the system will select a rating and then multiply it by the weighting factor (defined in the *Pavement Distress* module). The Model Runs then use these ratings calculations to help determine which street segments to select for rehabilitation.

2. In our example, an inspector has observed the Riding Comfort distress on a section of pavement. Remember, this is the distress record we created earlier.
   - The inspector gives the distress a severity value of 2 – Moderate.
   - The inspector gives the distress an extent value of 3 – Frequent.
   - Based on these values, the system gives the pavement a rating of 7 (example shown below).
   - This value is then multiplied by 1.0 (the weighting factor found in the *Pavement Distress* module), determining the actual rating for the distress (7 * 1.0 = 7).

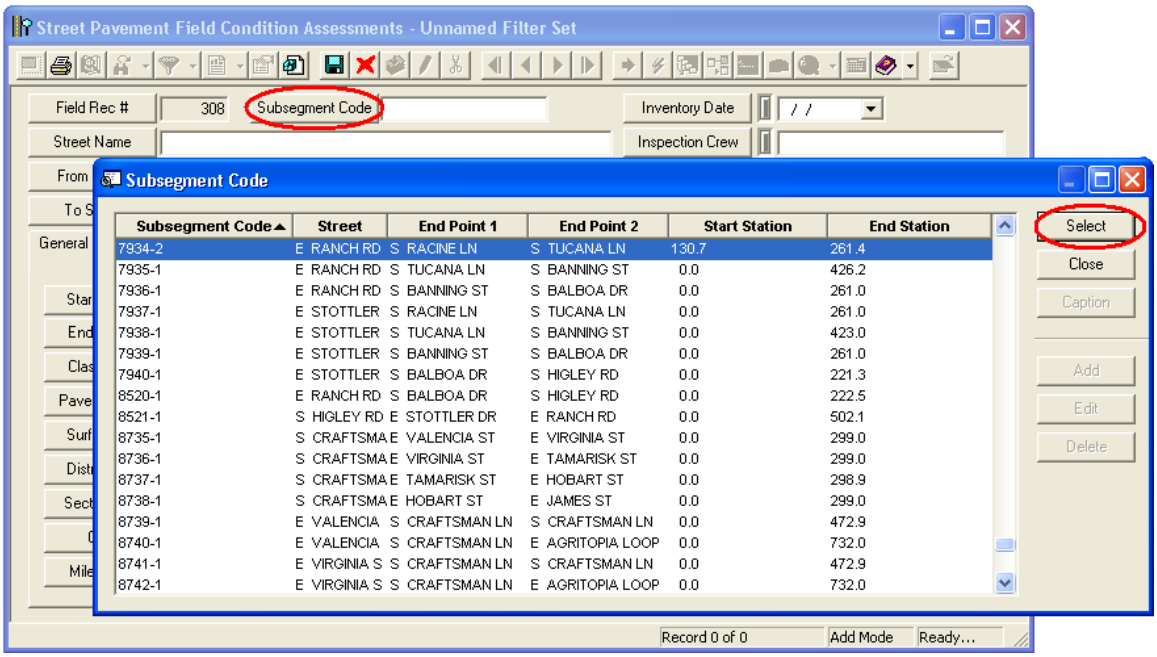



## Field Inspections

The Field Inspections module allows you to record street subsegment inspection results and observations. This module is then used to summarize the street defects, distresses, and ratings in order to calculate the street's PCI (Pavement Condition Indices). These values are then used by the Budget Forecasting Model Runs to determine which street segments to select for rehabilitation.

1. Open **Transportation>>Pavement Manager>>Field Inspections** from the Lucity main menu.
2. Click *GO* to bypass the filter. The Street Pavement Field Condition Assessments module will open.

3. To help you understand the typical workflow process, we'll continue using the segments and subsegments we created earlier in this workbook. Remember, from segment 7934, E. Ranch Rd., S. Racine Ln. to S. Tucana Ln., we created three subsegments. These subsegments are numbered 7934-1, 7934-2, and 7934-3.
4. Click the Add button  at the top of the module toolbar. Then, click the Subsegment Code field caption button to select from the pick list.
    - As you can see below, we've selected subsegment 7934-2. This is one of the subsegments we created in *the Street Segment*.
5. You'll need to add an Inventory Date (inspection date) in order to save the record.



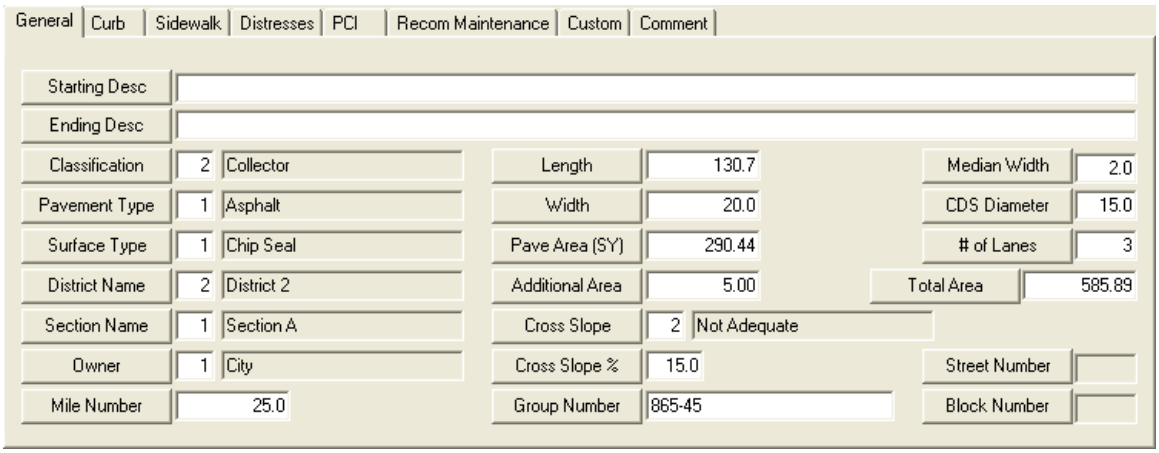

## *Imported Data*

Once you've selected the subsegment code, data from the corresponding module will be carried over into the header, General, Curb, Sidewalk, and Distress tabs.

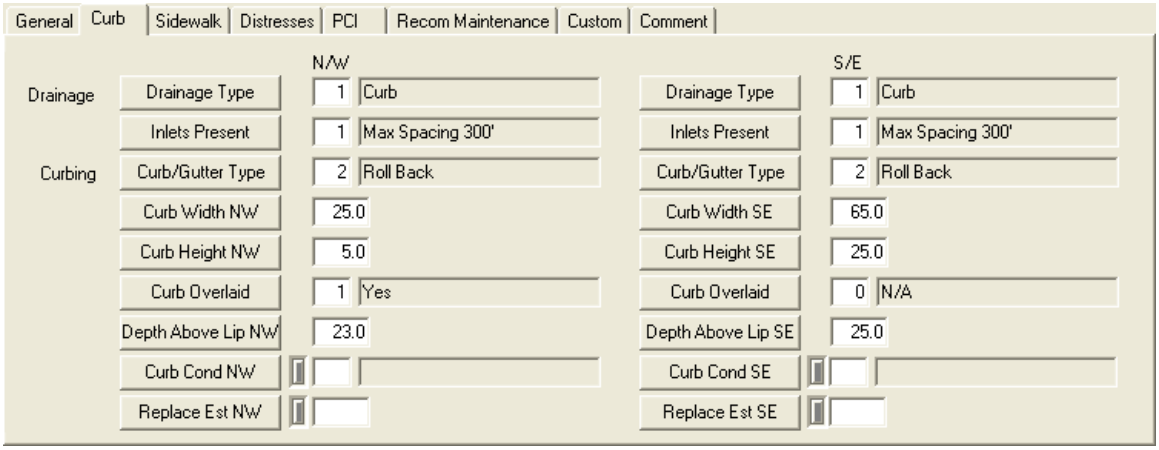
- Examples of these tabs and their imported data are pictured below. These imported fields can all be edited by the user.

### Header


### General Tab




## Curb Tab




- Note that the Curb Cond NW, Curb Cond SE, Replace Est NW, and Replace Est SE fields are not carried over from inspections. These fields allow you to enter condition data and replacement estimates. The *Supersegments* module then sums the total of all replacement estimates for all attached subsegments.

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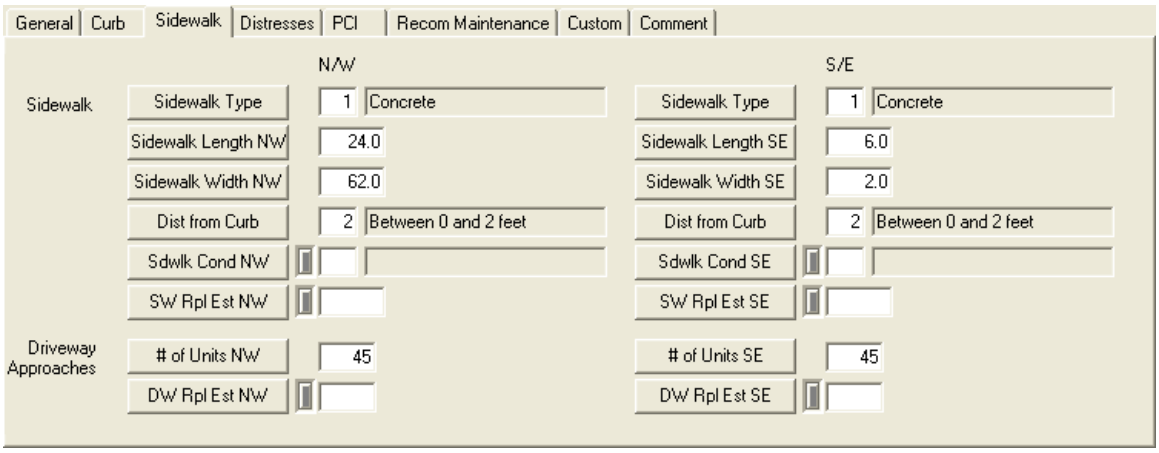
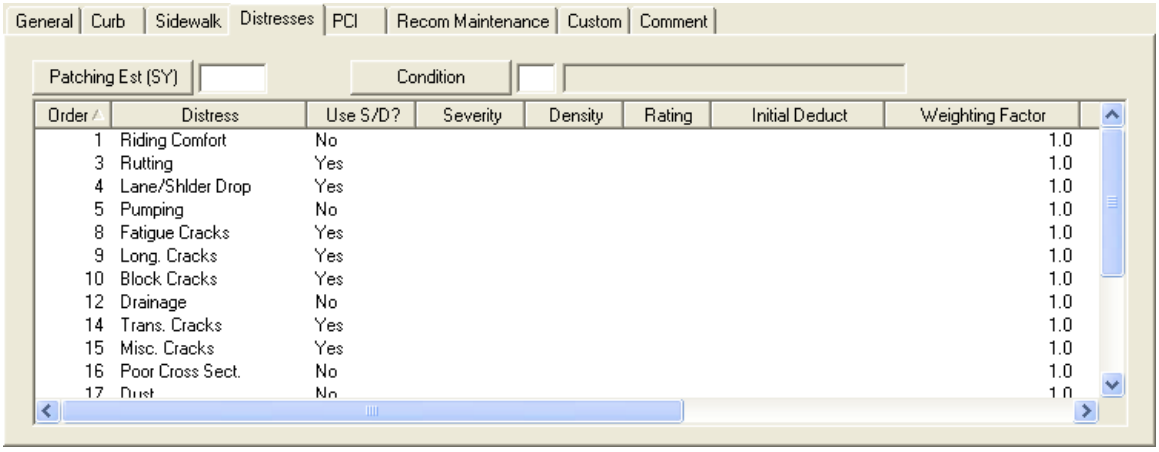
## Sidewalk Tab




- Note that the Sidewalk Condition NW, Sidewalk Condition SE, Sidewalk Replacement Estimate NW, Sidewalk Replacement Estimate SE, Driveway Replacement Estimate NW, and Driveway Replacement Estimate SE fields are not carried over from inspections. These fields allow you to enter condition data and replacement estimates. The *Supersegments* module then sums the total of all replacement estimates for all attached subsegments.

## Distresses Tab



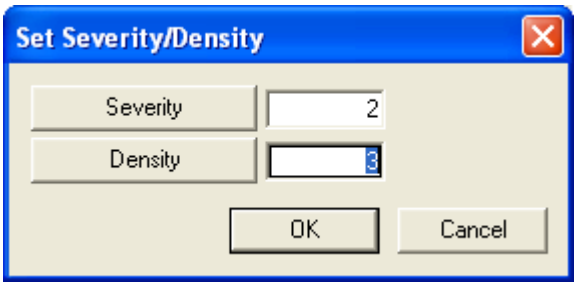

- Note the fields above the Distresses grid. The Patching Est (SY) field allows you to enter an estimated cost of patching the pavement, per square yard. The Condition field can be used to enter a general condition description. If you include a value in this field, and if this is the most recent inspection for the subsegment, then this condition value is added to the Subsegment Condition field on that record's Inspection tab.

**Distresses Grid**

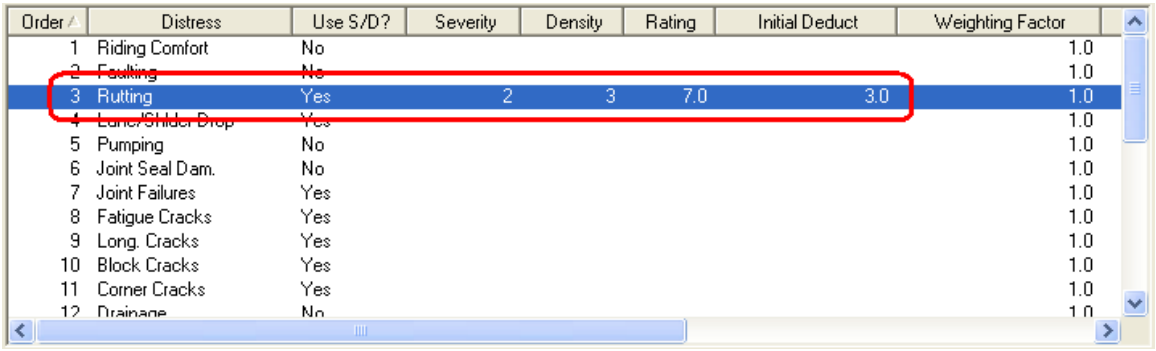
The Distresses tab is one of the most important features of the *Field Inspections* module. It allows you to input pavement condition ratings and severity/density values that are needed to calculate PCI. PCI is used in the Model Runs to determine which street segments to select for rehabilitation. We'll go through a step-by-step example to show you how this tab is used.

1. When you select a subsegment code in the header, the system imports all distresses associated with the subsegment's pavement type. Remember, you matched distresses to your pavement types earlier in this workbook.
2. For each distress in the grid, you'll need to indicate either the severity/density or rating values.
   - You'll enter severity and density values for a distress only if the "Use S/D?" column for that distress is marked "Yes".
     - Severity is used to indicate how bad the effect of the distress is on the pavement. Density is used to indicate how much of the pavement is affected by the distress.
   - If the "Use S/D?" column for a distress is marked "No", you'll enter ratings only.
3. To indicate severity and density, right click on a distress and select *Set Severity/ Density*. Enter values for both severity and density in the dialog.


- On page 23, we showed you an example of our standard *Severity/Density Setup* module. Our settings are as follows:
  - Severity: 1 – Low, 2 – Moderate, 3 – Severe
  - Density (extent): 0 – None, 1 – Few, 2 – Intermittent, 3 – Frequent, 4 – Extensive, 5 – Throughout
- In the example below, we've indicated a severity value of 2 (moderate) and density value of 3 (frequent).



- Once you've entered the severity and density values, the system will automatically calculate the distress rating. These ratings are also determined in the *Severity/Density Setup* module. Based on our standard settings, a severity value of 2 and density value of 3 equals a rating of 7.
- Once the ratings have been set, the system will calculate the initial deduct and final deduct on the Distresses tab. The calculations are as follows:
    - 10 – Rating = Initial Deduct
    - Initial Deduct * Weighting Factor = Final Deduct.
- In our example, the Initial Deduct equals 3 (10-7 = 3) and the Final Deduct equals 3 (3 * 1 = 3).
    - Remember, the Weighting Factor is defined in the *Pavement Distress* module. We discussed this module on page 20. You can see the Weighting Factor values in the Distresses grid below.



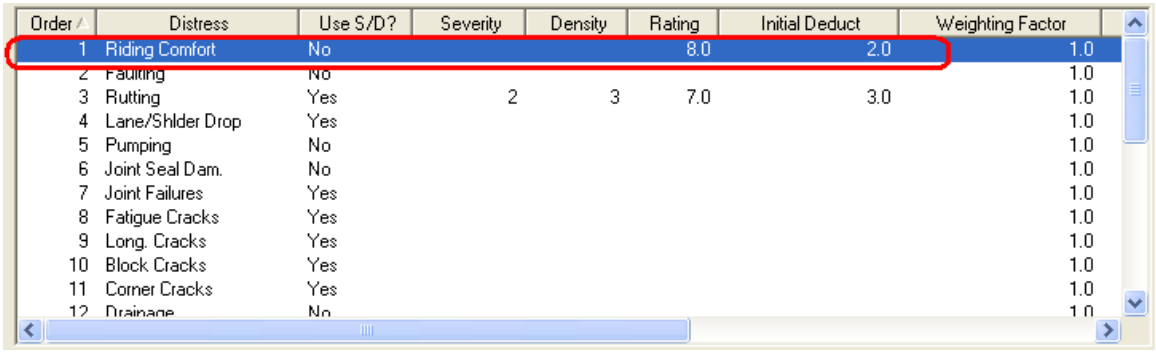
| Order | Distress | Use S/D? | Severity | Density | Rating | Initial Deduct | Weighting Factor |
|---|---|---|---|---|---|---|---|
| 1 | Riding Comfort | No | | | | | 1.0 |
| 2 | Faulting | No | | | | | 1.0 |
| 3 | Rutting | Yes | 2 | 3 | 7.0 | 3.0 | 1.0 |
| 4 | Lane/Shlder Drop | Yes | | | | | 1.0 |
| 5 | Pumping | No | | | | | 1.0 |
| 6 | Joint Seal Dam. | No | | | | | 1.0 |
| 7 | Joint Failures | Yes | | | | | 1.0 |
| 8 | Fatigue Cracks | Yes | | | | | 1.0 |
| 9 | Long. Cracks | Yes | | | | | 1.0 |
| 10 | Block Cracks | Yes | | | | | 1.0 |
| 11 | Corner Cracks | Yes | | | | | 1.0 |
| 12 | Drainage | No | | | | | 1.0 |

4. For distresses where the "Use S/D?" column is marked "No", you'll indicate a rating only.
    - Right click in the grid and select *Set Rating* or *Set Rating to 10*. A street with a distress rating of 10 is in perfect condition.


| Order | Distress | Use S/D? | Severity | Density | Rating | Initial Deduct | Weighting Factor |
|---|---|---|---|---|---|---|---|
| 1 | Riding Comfort | No | | | | | 1.0 |
| 2 | Faulting | No | | | | | 1.0 |
| 3 | Rutting | Yes | | 3 | 7.0 | 3.0 | 1.0 |
| 4 | Lane/Shlder Drop | Yes | | | | | 1.0 |
| 5 | Pumping | No | | | | | 1.0 |
| 6 | Joint Seal Dam. | No | | | | | 1.0 |
| 7 | Joint Failures | Yes | | | | | 1.0 |
| 8 | Fatigue Cracks | Yes | | | | | 1.0 |
| 9 | Long. Cracks | Yes | | | | | 1.0 |
| 10 | Block Cracks | Yes | | | | | 1.0 |
| 11 | Corner Cracks | Yes | | | | | 1.0 |
| 12 | Drainage | No | | | | | 1.0 |

- In the Set Rating dialog, enter the rating for the distress on a scale of 0-10. In our example, we've set the rating to 8.

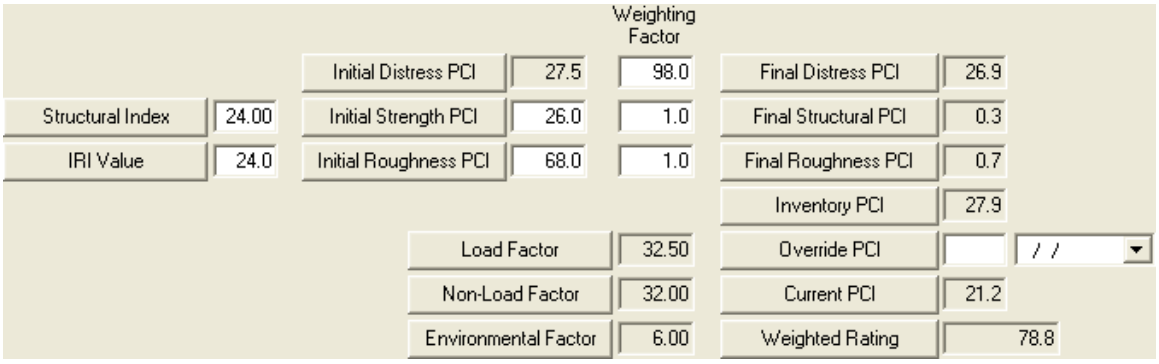

- Once you have set the rating, the Initial Deduct and Final Deduct will be calculated as before. As you can see in the example below, the initial and final deducts both equal 2.



| Order | Distress | Use S/D? | Severity | Density | Rating | Initial Deduct | Weighting Factor |
|---|---|---|---|---|---|---|---|
| 1 | Riding Comfort | No | | | 8.0 | 2.0 | 1.0 |
| 2 | Faulting | No | | | | | 1.0 |
| 3 | Rutting | Yes | 2 | 3 | 7.0 | 3.0 | 1.0 |
| 4 | Lane/Shlder Drop | Yes | | | | | 1.0 |
| 5 | Pumping | No | | | | | 1.0 |
| 6 | Joint Seal Dam. | No | | | | | 1.0 |
| 7 | Joint Failures | Yes | | | | | 1.0 |
| 8 | Fatigue Cracks | Yes | | | | | 1.0 |
| 9 | Long. Cracks | Yes | | | | | 1.0 |
| 10 | Block Cracks | Yes | | | | | 1.0 |
| 11 | Corner Cracks | Yes | | | | | 1.0 |
| 12 | Drainage | No | | | | | 1.0 |

**PCI Tab**

The PCI tab (Pavement Condition Indices) performs automatic system calculations based on the data in the Distresses tab. This tab also contains several user-entered fields that contribute to the final PCI calculations. The calculations are described in detail below:



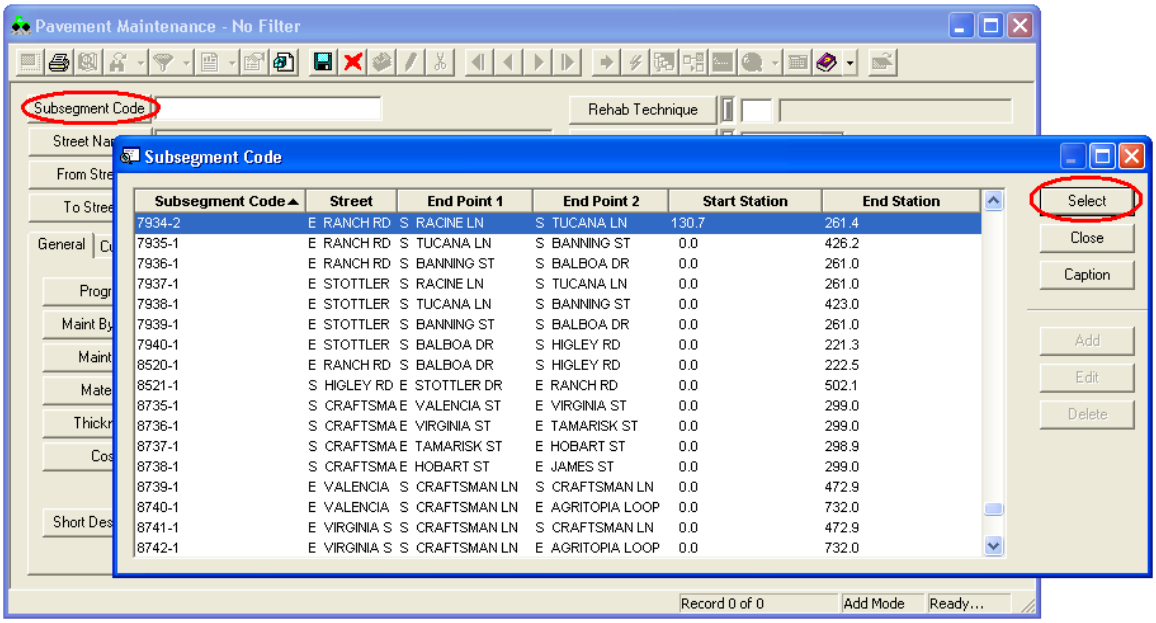

1. The Initial Distresses PCI field is calculated by totaling the Final Deduct values from Distresses and subtracting that total from 100. This value is then multiplied by the Weighting Factor (as set up in *Pavement Standards*) to find the Final Distress PCI.
   - You can edit the weighting factors if needed. If only visual distresses are being rated, set the Distress Weighting Factor to 100 and the other two factors to 0.
2. You can then alter this PCI value by entering the Initial Strength and Roughness PCI.
   - Strength ratings can improve or reduce the Inventory PCI. In our example, we've entered an Initial Strength PCI of 26. The weighting factor of 1 is carried over

from the *Pavement Standards* record for this type of pavement. The system multiplies these values to find the Final Structural PCI (0.3 in this example). This value is then added to the Final Distresses PCI to find the Inventory PCI.
    - Roughness ratings are also used to calculate the Inventory PCI. We have entered an Initial Roughness PCI of 68 which has been multiplied by the Weighting Factor of 1 (carried over from *Pavement Standards*). The system has found a Final Roughness PCI of 0.7. This has been added to the Final Distress PCI and Final Structural PCI to find the Inventory PCI. After all of these calculations, the Inventory PCI now equals 27.9.
3. If you disagree with the Inventory PCI value, you can enter an alternate number and date in the Override PCI fields. These will be used by the system in subsequent PCI calculations and the model runs.
4. The system then calculates the Current PCI as follows:
    - The system uses either the Inventory PCI or Override PCI (if one exists) and determines the time elapsed by subtracting the Inventory Date or Override Date from the current system date.
    - The system then determines the proper deterioration slopes as indicated by the values you set up in the *Pavement Standards* module.
    - To find the Current PCI, the system calculates:
        - Inventory or Override PCI – (time elapsed * slope)
5. The Weighted Rating is the final system calculation on this tab. It helps you prioritize your pavement repairs. The system uses the following equation:
    - 100 – PCI * Priority Weighting Factor
    - Remember, you entered the Priority Weighting Factor for this type of pavement in the *Pavement Standards* module.

## Pavement Maintenance

The Maintenance module allows you to record maintenance tasks performed on your street subsegments. You can record many additional details about the maintenance program used. In addition, this module is integrated with the pavement modeling program. In the example below, we'll show you how to create a *Pavement Maintenance* record and demonstrate how it is used to update values in the *Subsegment, Supersegment,* and *Model Runs*.

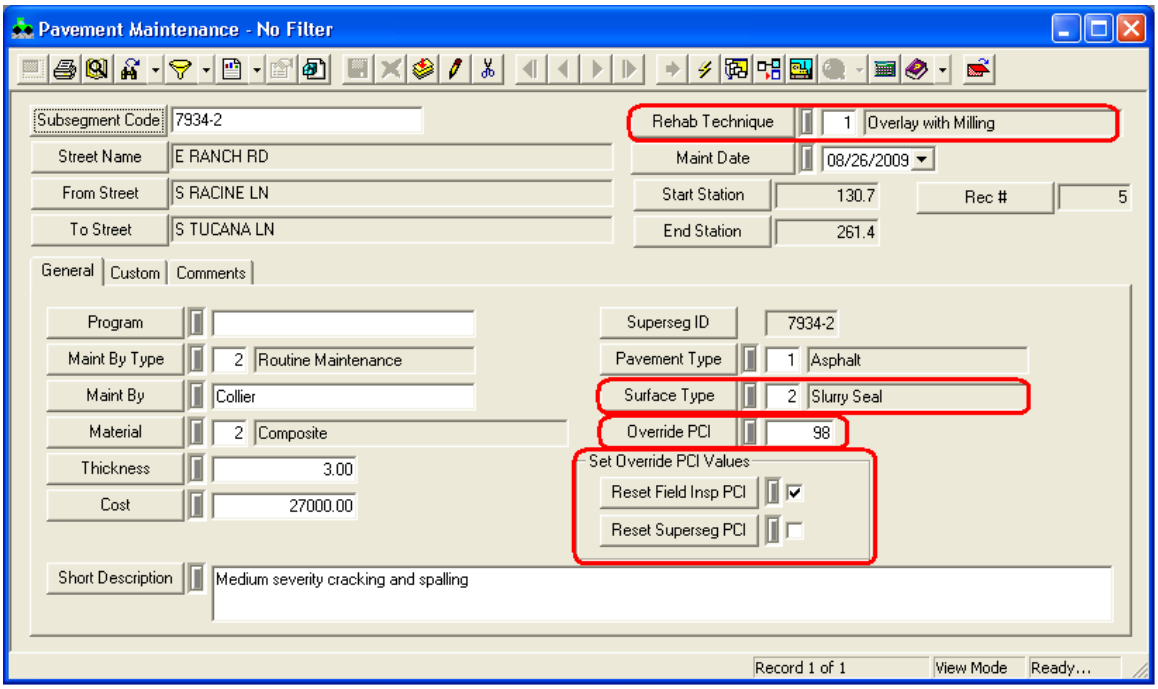
1. Open **Transportation>>Pavement Manager>>Maintenance** from the Lucity main menu.
2. Click *Go* to bypass the filter. The *Pavement Maintenance* module will open.
3. Click the Add button  at the top of the module toolbar. Then, click the Subsegment Code field caption button to select from the pick list.
    - In our example below, we've selected Subsegment 7934-2. You'll recognize this as the subsegment that was created earlier in this workbook.




- Once you select the Subsegment Code, the system will automatically fill in the corresponding Street Name, From Street, To Street, Start and End Station.


4. Next, select the Rehab Technique; enter the Maintenance Date, and record additional details about the pavement maintenance program. You can include the maintenance type, material, thickness, cost, and a description of the maintenance task.
   - Here, we've indicated that the Overlay with Milling technique is being performed as routine maintenance to combat medium severity cracking and spalling.
5. Several fields in this module integrate with the modeling program. These special fields are described below:
   - The Rehab Technique field allows you to select a rehabilitation method from the *Rehab Techniques* pick list. We will cover this module in workbook 2. If the technique you select here has an associated Reset PCI value, that value will be entered into the Override PCI field on the General tab. You can then edit the PCI value as needed.
   - The Set Override PCI Value checkboxes allow you to indicate how you would like the Override PCI Value to be applied. If you mark the "Reset Field Insp PCI" box, the system will update the *Field Inspection* module with the designated value. If you mark the "Reset Superseg PCI" box, the system will update the *Supersegment* record with the designated value. This value will then be used in

the *Model Runs* if the Maintenance Date in the header is more recent than the date of the last *Field Inspection* or *Supersegment* Override PCI dates.
    - In order to update the *Supersegment* record, the Subsegment must be associated with a Supersegment. When you select a Subsegment Code in the header, the Supersegment Rec # will be entered by the system.
- The Pavement Type field is carried over from the associated *Subsegment* record when you select a Subsegment Code in the header. It can be edited if needed.
- The Surface Type field allows you to indicate the surface type of the Subsegment in this record (i.e. Chip Seal, Slurry Seal, Crack Fill, etc.). If this *Pavement Maintenance* record is the most recent, then the linked *Subsegment* record's surface type will be updated with the data in this field.

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