GradeDec.NET

Federal Railroad Administration

Training Course and Workbook

ICC and IDOT, Volume 1

September 2009

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FEDERAL RAILROAD ADMINISTRATION

TRAINING COURSE AND WORKBOOK FOR GRADE CROSSING IMPROVEMENTS EVALUATION USING GRADEDEC.NET

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MODULE 1 INTRODUCTION

1.1 Introduction of Instructors and Participants

The course will be conducted by instructors from FRA or its consultant. Participation in the course is critical to its success. Participants bring invaluable local experience to the course and your instructors hope to learn from the participants and incorporate their experiences in the course as it evolves.

The course will be divided in time between presentation/discussion sessions and lab sessions. The lab sessions will involve hands-on direct use with GradeDec.NET.

The course and this workbook have been tailored to include examples from Illinois.

1.2 Course Goals and Objectives

1.2.1 To gain a working knowledge of:

- The evaluation of safety impacts from grade crossing improvements.
- The evaluation of other benefits from grade crossing improvements.
- The use of GradeDec.NET to support resource allocation decisions.
- The use of GradeDec.NET to plan and evaluate grade crossing solutions on proposed Next Generation High Speed Rail corridors.
- Using the advanced features of GradeDec.NET.

1.2.2 Discussion of Goals and Objectives

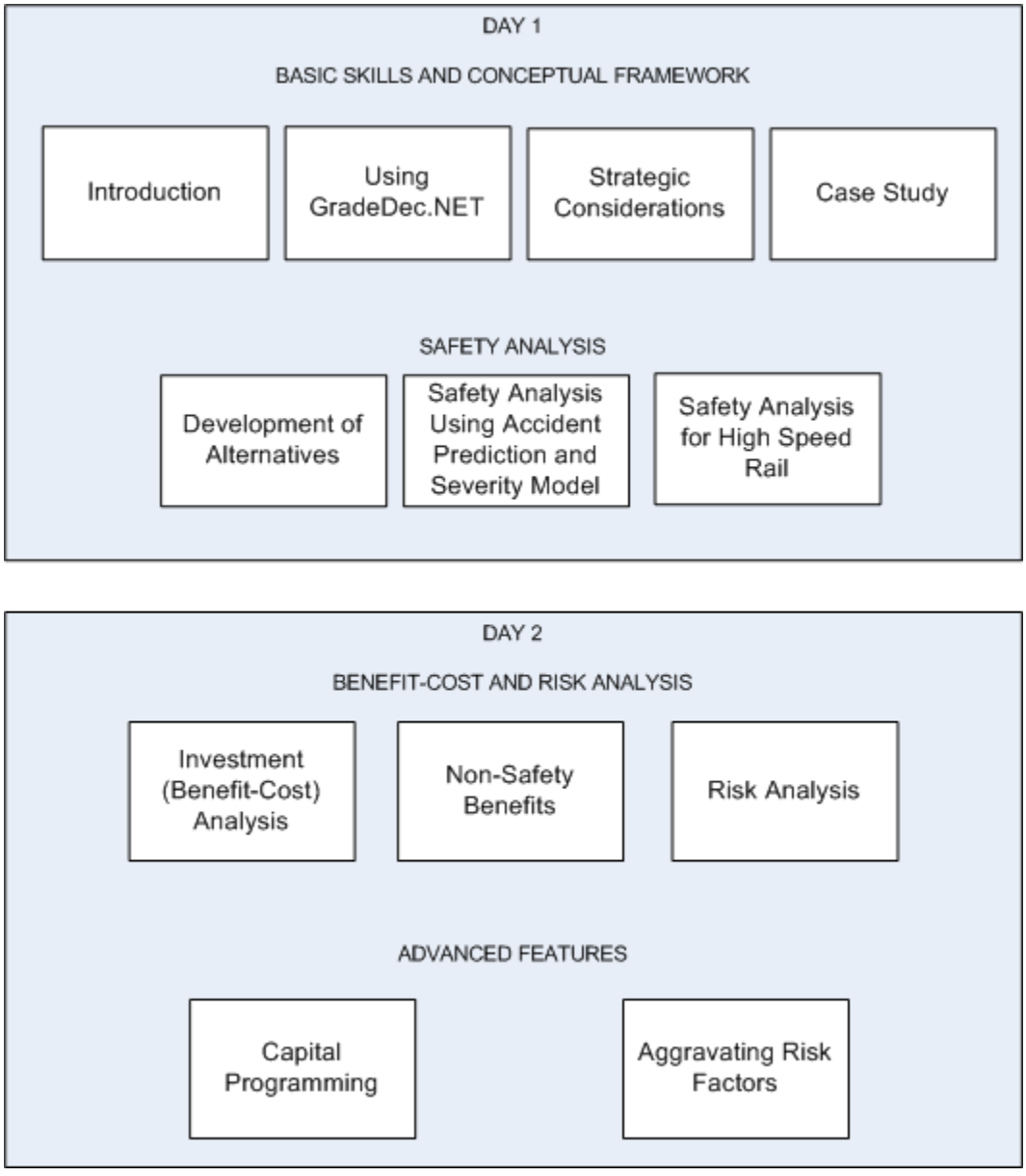
The goal of this course is to provide a comprehensive and practical understanding of the GradeDec.NET software for the planning and evaluation of highway-rail grade crossing improvements. Cost-benefit analysis of infrastructure investment is often a complex process that may require close interaction and coordination among professionals, decision-makers, rail operators and citizen groups. GradeDec.NET incorporates best practice models, analytic tools and data management capabilities to facilitate the analysis, whose purpose is to assess a range of economic, social and environmental impacts and tradeoffs so as to enable informed decision-making.

This course seeks to impart a good working knowledge of using GradeDec.NET while reviewing the principles and practice of benefit-cost analysis that are critical to supporting sound decisions. The course presents: a conceptual framework; methodologies of evaluation used in GradeDec.NET; review of computational algorithms; modes of use; and, a discussion of data requirements. The sections on safety and non-safety impacts include explicit exercises that replicate the calculations in the software. A case study from Illinois accompanies the course and demonstrates the practical application of GradeDec.NET.

1.3 Course Overview

The course is presented over a period of two days and covers 12 modules, including this Introduction (Module 1). Presentations will be interspersed with lab sessions in which participants will work with GradeDec.NET and apply skills acquired.

Figure 1 Course Overview



1.4 Course Materials

- Workbook, Volumes 1 and 2 (materials in each volume will be covered on days 1 and 2, respectively)
- CSV file containing list of crossings to import for Case Study 1 (regional model)

- PC or terminal with browser and Internet connection
- *GradeDec.Net* User's Manual
- *GradeDec.Net* Reference Manual

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MODULE 2 USING GRADEDEC.NET

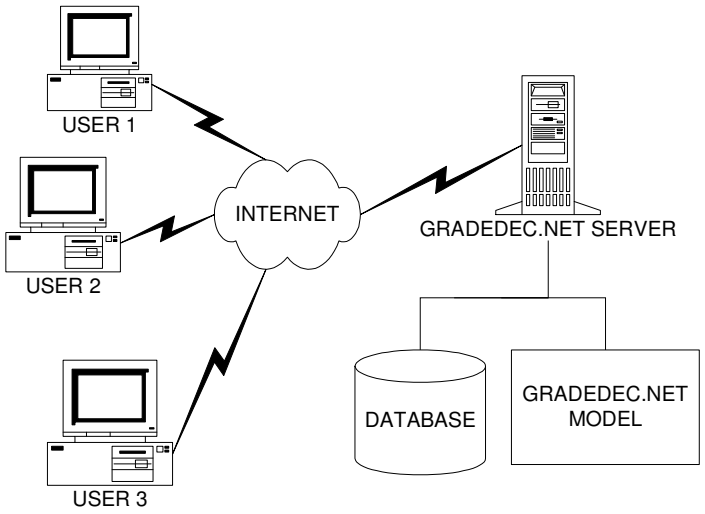
2.1 Introduction

This section is a description of GradeDec.NET and how to use it to conduct analyses. Parts of this section will be covered in the "Introduction" session of the workshop. The remaining parts of this section are for the participant's reference. The material in this section also appears in the User's Manual.

2.2 GradeDec.NET – System Overview

GradeDec.NET is a web-based application deployed over the Internet. This enables many users to access the system simultaneously, while using minimal resources from each user's computer.

Figure 2 Schema of GradeDec.NET



Advantages to the web-based system over desktop systems:

No special hardware or software user requirements

No need for installation on secure systems

Model and data updates immediately accessible to all users

Few demands on user to manage data and analyses

2.3 Registration and Logon

To use GradeDec.NET you must register the first time you logon. You will then use the user ID and password that you select during registration to logon during subsequent sessions.

The logon page includes a toolbar at the top, which links to "About", "Terms of Use" and "Messages". You should check the messages periodically. Also, read and understand the terms of using the system.

2.4 Navigation

After logging in, you will be shown the Settings page. From this page you select the data object (see 1.8 below). On the left side of the screen is a navigation bar, which enables access to all the pages of GradeDec.NET. Note that while the navigation bar is fixed, the submenu for each item on the bar only appears after the user has navigated to the page.

2.5 Modes of Use

GradeDec.NET has several modes of use, and the specific mode of use that you choose will depend upon the type of decision that your analysis should support. This section identifies and describes the two principal modes of use with *GradeDec.NET*. These are:

- Safety analysis, and
- Full investment analysis

2.5.1 Safety Analysis

For a safety analysis, the user examines predicted accidents at grade crossings and for the corridor (or region) as a whole. The safety analysis is, essentially, a comparison of a "before" and "after" situation, where "before" represents the *status quo* and "after" reflects the impact of crossing improvements (through device upgrade, closures, separations, traffic management measures, etc). The safety analysis is restricted to examining the safety impacts at a crossing. The safety analysis reflects a snapshot of current conditions and does not account for the forecast growth of highway traffic or rail operations.

2.5.2 Full Investment (Benefit-Cost) Analysis

A full investment analysis supports resource allocation and planning decisions. The full investment analysis accounts for safety benefits and, as well, other highway user costs. These user costs include time savings, vehicle operating costs and emissions. The full investment analysis monetizes the benefits from each benefits category and sums the benefits from the improvements over the time horizon of the investment. This analysis includes user assumptions regarding the forecast of traffic growth, by highway and rail, and analyzes the risk associated with the forecast values.

A "safety analysis" will involve a subset of the *GradeDec.NET* features required for a "full investment analysis". The following table shows the two modes of use, purposes associated with each, and the functional pages in *GradeDec.NET* used in each type of analysis.

Table 1 GradeDec.Net Modes of Use

Mode of Use	Purpose	Functional Pages in GradeDec.NET to Use
Safety analysis	Calculate accident risk and impacts of improvements, identify improvement programs, analyze the supplementary safety measure specified in FRA rule. Support safety decisions.	Settings, Import, Crossings, Parameters
Full investment analysis	Benefit-cost and risk analysis of programs of improvements; analyze safety, delay and user cost impacts Support resource allocation and investment decisions. Support planning process.	Settings, Import, Crossings, Parameters, Scenario, Simulation, Results

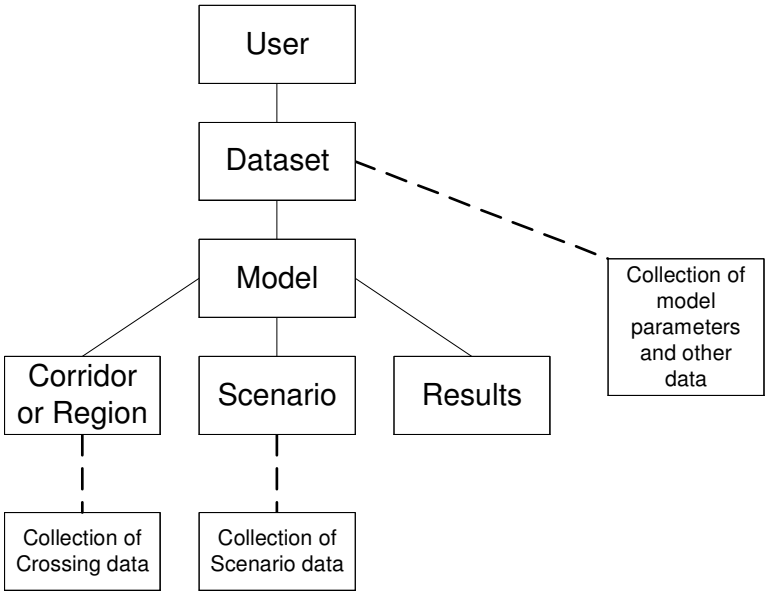
2.6 *The Data Hierarchy in* GradeDec.NET

In order to conduct analyses effectively in *GradeDec.NET* you should be familiar with its data hierarchy.

Every active session of *GradeDec.NET* has a data hierarchy that is populated with values at all times. These values correspond to the current selections of data collections that are viewable, editable and are used in *GradeDec.NET* model calculations. You navigate among different data collections by making selections on the **Settings** page, which sets the values in the data hierarchy.

The data hierarchy is shown in the figure below. A brief description of each of the nodes (boxes) in the figure follows at the end of this section.

Figure 3 Data Hierarchy in GradeDec.NET



The connecting lines in the data hierarchy figure mean that the lower node is a "child" of the parent node above it to which it is connected. When you change the value of a parent node (by making a selection in the **Settings** page) you are also re-populating the nodes in the hierarchy below the parent with values that represent data collections belonging to the newly selected parent node value.

For example, when a newly registered user logs on, the data hierarchy is populated with values like in the table below.

Table 2 Data Heirarchy at New User Logon

Data Hierarchy Node	Value
User	Your user id
Dataset	"Initial dataset"
Model	"Corridor Model"
Corridor	"South Empire"
Scenario	"Strong rail growth"
Result	"Placeholder – Corridor Model"

Suppose the user then changes the Model selection in the **Settings** page to "Regional Model". The data hierarchy will then be populated with the following values (changed values in italics):

Table 3 Data Heirarchy After Changing Model

Data Hierarchy Node	Value
User	Your user id
Dataset	"Initial dataset"
Model	"Regional Model"
Region	"Montgomery, MD"
Scenario	"Strong highway growth"
Result	"Placeholder – Regional Model"

For every parent node value there are designated default values for its child nodes, which fill the data hierarchy when the parent node value is selected. When you first register as a *GradeDec.NET* user you are assigned an "Initial Dataset" that includes data collections with sample values, and the system designates some of these data collections as defaults. You can never delete a data collection that is a default of its parent node. You can designate another data collection to be a default, and then delete the collection that was previously designated as default. You can create and delete data collections, set their defining values and set defaults from the **Settings** page.

The following are descriptions of the nodes in the data hierarchy.

2.6.1 User

When you log in to *GradeDec.NET*, a value representing your user account is set in the User node. This never changes during your session and ensures that users can only access their own data and not those of others.

2.6.2 Dataset

User data for analyses are organized in datasets in the *GradeDec.NET* database. A user may create and maintain up to 10 datasets. A dataset is a comprehensive container of data collections used in *GradeDec.NET* analyses. Note that data from different datasets cannot be combined in a single analysis. You can use datasets to preserve a baseline analysis, and then develop new analyses from copies of the baseline. You can download a dataset to your computer and restore it to the system at a later date. You can also share data with a colleague by sending him or her your downloaded dataset, which your colleague can then upload during a session with *GradeDec.NET*.

Access the options for selecting, creating, deleting, downloading and uploading datasets from the **Settings** page.

2.6.3 Model Parameters and Other Data

Each dataset contains a set of model parameters (including: crossing device effectiveness rates; model coefficients for emissions and fuel consumptions calculations; high speed rail model calculations – see the *Model Reference* for a full description). "Other data" refers to traffic time-of-day distributions and cost data for grade crossing devices and supplementary safety measures.

These parameter and data are specific to the selected dataset and can be viewed and modified from the **Parameters** page.

2.6.4 Model

GradeDec.NET has both a corridor model and a regional model. The data requirements are slightly different for each model so that data collections below the Model node are specific to the selected model.

2.6.5 Corridor

A corridor has a set of defining values (these can be viewed and modified in the data grid at the bottom of the **Settings** page – see Section 2.1 Settings Page below) and refers to a collection of grade crossings along a single rail alignment. A corridor is selected in the data hierarchy only if the Model node is set to the corridor model. A dataset will contain at least one corridor and may contain as many as 50.

Create and delete corridors, and modify their defining values in the **Settings** page. After selecting a corridor, view or modify its crossings data from the **Crossings** page.

2.6.6 Region

A region has a set of defining values (these can be viewed and modified in the data grid at the bottom of the **Settings** page – see Section 2.1 Settings Page below) and refers to a collection of grade crossings in a designated region. A region is selected in the data hierarchy only if the Model node is set to the regional model. A dataset will contain at least one region and may contain as many as 50.

Create and delete regions, and modify their defining values in the **Settings** page. After selecting a region, view or modify its crossings data from the **Crossings** page.

2.6.7 Scenario

A scenario has a set of defining values (a description, start year, last year of near term, and end year) and an associated collection of scenario data. A dataset will contain at least one scenario for each of the two models, and may contain as many as 30 scenarios for each model.

Create and delete scenarios, and modify their defining values from the **Settings** page. After selecting a scenario, view and modify the scenario data from the **Scenario** page.

2.6.8 Results

You set the description of a results set when you create it. GradeDec.NET sets the other defining values of a results set automatically when you run a simulation.

Create and delete result sets, and modify its description from the **Settings** page. After selecting a results set and running a simulation, view results from the **Results** page.

2.7 Steps in Conducting a GradeDec.NET *Analysis*

2.7.1 Overview

The following table shows a sample set of steps that you would undertake to conduct each of the two analyses. The Case Study sections in the respective analysis modules will walk you through these steps in a sample analysis.

Table 4 GradeDec.Net Modes and Sample

Mode of Use	Functional Steps	Page
Safety analysis	(Optional) Create and select a new dataset	Settings
	Create and select a new corridor (or region)	Settings
	Set values for corridor (or region)	Settings
	(Optional) Set default crossing device cost data	Parameters/OtherData
	Import data from Grade Crossing Inventory (or, use Quick Import to import data of pre-identified crossings)	Import
	Verify and refine data, assumptions and choice of alternative	Crossings
	Calculate predicted accidents, view/print reports and charts	Crossings
Full investment analysis	Conduct all of the steps in the "Safety analysis" mode of use listed above	
	Create new results set	Settings
	Create new scenario	Settings
	Populate the scenario data with forecast data and assumptions	Scenario
	Verify and modify parameters and other data values	Parameters
	Set the simulation parameters and run the simulation	Simulation
	View results table and charts, print report	Results

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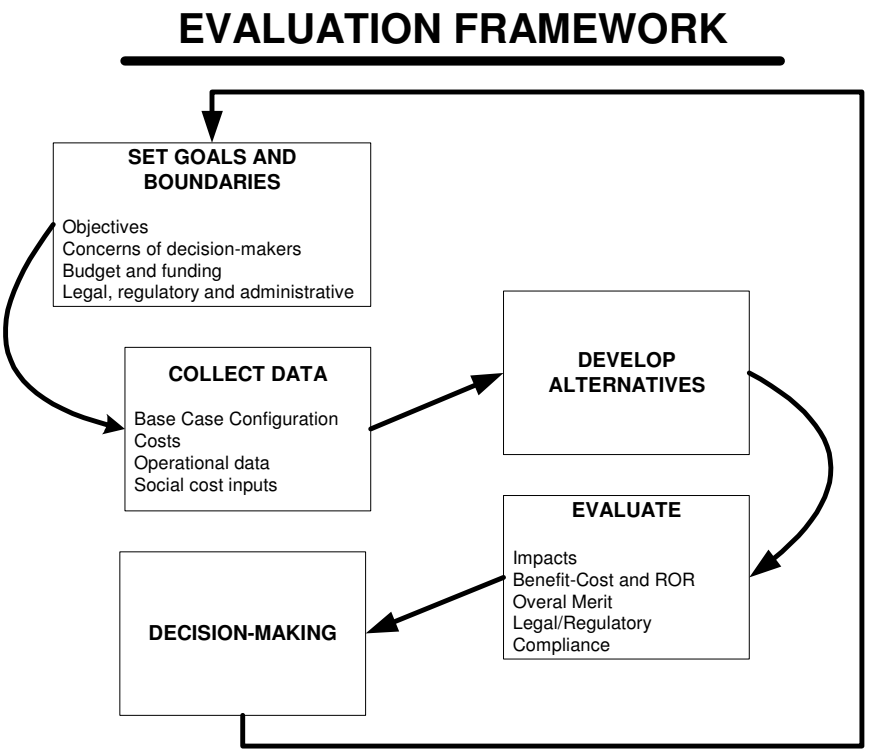
MODULE 3 STRATEGIC CONSIDERATIONS IN EVALUATION

3.1 Conceptual Framework for Evaluation



3.2 Objectives of Evaluation

An analysis of grade crossing improvements can have one or several objectives:

- To address acute safety issues for a crossing, corridor or region.
- To support funding allocation decisions for safety improvements.
- To support investment analysis decisions considering the additional benefits of congestion relief and emissions reduction.
- To develop a grade crossing improvement program to accommodate high speed rail initiatives.
- Optionally, to support evaluation of compliance with new and emerging regulations that govern horn-blowing, whistle bans and grade crossing quiet zones.

3.2.1 Safety Analysis

With safety analysis the user estimates predicted accidents and severity for a specified corridor or region and evaluates the safety impacts of improvements and mitigating measures.

The safety analysis can utilize the Accident Prediction and Severity model, which is suited for the evaluation of crossings in corridors and regions with general freight or regular passenger service. For analyzing and developing risking mitigation strategies for high-speed rail corridors, the safety analysis can utilize the High Speed Rail safety model.

3.2.2 Non-Safety Impacts

Non-safety benefits (or disbenefits) stem from a change in queuing at crossings. In general, benefits will accrue only when improvements include grade separations. Grade crossing closures may result in safety benefits, but disbenefits occur when highway travelers drive circuitous routes and queue up at other crossings.

3.2.3 Investment Analysis and Resource Allocation Decisions

GradeDec.Net analyses support resource allocation decisions. It can be used to evaluate the comprehensive benefits and costs associated with improvement alternatives in a crossing or region.

Use investment analysis to develop and recommend alternatives for crossing improvements where safety and non-safety benefits, and best resource use, are important factors in the decision process.

3.3 Evaluation Context

You should conduct your evaluation with the concerns of decision makers in mind. It is often best to conduct discussions with stakeholders to gauge their concerns. Listen especially to the concerns of the rail operators, affected agencies and affected citizens.

Understand the impacts of rules, regulations and pre-existing agreements that could affect improvements and their cost- and liability-bearing implications.

MODULE 4 WORKSHOP CASE STUDIES

4.1 Introduction

In this section we present case studies from which subsequent examples in the course will be drawn. The case studies are hypothetical examples that correspond to specific sets of grade crossings in Illinois currently being studied (the analysis here is not indicative of the actual study and the assumptions and alternatives presented are for exposition purposes only).

4.2 Case Study 1

4.2.1 The Study Area

(Note: the case study has been developed for exposition purposes and use in the training workshop. While based on an actual set of grade crossings, some of the data does not reflect actual conditions in this region).

The data following is an assortment of crossings throughout Illinois provided by the Illinois Commerce Commission (ICC). The improvements are based on the ICC FY 2010-2014 Plan.

The study objectives are to improve grade crossing safety and mitigate highway congestion in state-wide analyses.

4.3 Case Study 1 (Regional Model) in GradeDec.NET

4.3.1 Set Up the Data for the Regional Safety Analysis

4.3.1.1 Create and select a new dataset

On the **Settings** page, click on the link "Create New Dataset" on the row with "Selected Dataset". This will transfer you to the **New Dataset** page. On this page you choose to either "Create new dataset by copying a dataset" – in which case you select one of your datasets from the drop down list – or choose "Create new dataset from sample data". Select the second option.

Enter a name for the new dataset (i.e., "Illinois State".) and then click create. This will transfer you back to the **Settings** page. From the dataset drop down list, select the dataset that you just created.

4.3.1.2 Create and select a new region

The case study examines individual crossings throughout the state of Illinois, therefore we will use the GradeDec.NET Regional Model.

Select the "Regional Model" tab next to where it says "Selected Model"

On the **Settings** page, click on the link "Create New Region" to the right of "Selected Region". This will transfer you to the **New Region** page. On this page select "Create a

new, empty region". Enter a name for the new region (e.g., ICC Illinois State) and then click create. This will transfer you back to the **Settings** page.

Enable the "Region" drop down list by selecting the radio button by "Selected Region" (or, ensure that it is selected).

From the "Selected Region" drop down list, select the region that you just created.

4.3.1.3 (Optional) Modify or Add Time-of-Day Traffic Distributions

If the sample time-of-day traffic distributions provided, adequately reflect the distributions of highway traffic at crossings and for rail movements in the region, then skip this step. Otherwise, browse to the **Parameters** page by clicking on the link on the main navigation menu. On this page select from the toolbar at the top "Other data".

Add new time-of-day crossings distributions as needed. (The provided time-of-day traffic distributions should be adequate for the case study). NOTE: Time-of Day Traffic Distributions can be especially important when evaluating shared use or passenger rail lines as highway and rail traffic may be highly correlated.

4.3.1.4 (Optional) Set default crossing device cost data

If needed, modify the default costs for crossing improvements. These default values can be applied to all crossings in the corridor and can save time entering data for each crossing.

Browse to the **Parameters** page by clicking on the link on the main navigation menu. On this page select from the toolbar at the top "Other data". From the drop down list select crossing device costs. Enter alternative values to the ones listed, as needed.

4.3.1.5 Import data using the GradeDec "Import List" feature

The ICC's FY 2010-2014 plan provides a list of grade crossings which require improvements. The list can be easily imported into GradeDec using the "Import List" feature, which allows a user to upload a CSV (comma-separated values) file containing the desired crossings to import. A CSV file containing the crossings of interest will be distributed to all participants of this workshop. To use the feature, follow the steps below:

1. In the navigation menu, place the cursor over the 'Crossings' link, and select 'Go to Crossings page' from the submenu.
2. In the **Crossings** page, place the cursor over the 'Crossings' link in the navigation menu and select 'Quick import' from the submenu.
3. In the new window, click on the 'Import List' tab at the top of the page.
4. Click on the 'Browse' button at the bottom of the page, and select the CSV file from your computer.
5. Click on the 'Import Crossings' button.
6. Close the window when finished.

7. Click on any tab in the "Select data to view/edit" row to make the imported crossings appear in the list.

4.3.2 Customizing the Crossing Data for the Analysis

Imports with Quick Import Page do not set the alternative device type. When importing with the Import Page instead, alternate crossing improvements are assigned to each imported crossing. You will need to manually customize the alternate crossing. You should review each crossing and set data and parameters that best reflect the conditions at the crossing.

In particular you should review and examine the following factors:

Supplementary Safety Measures – The Devices tab on the GradeDec.NET **Crossings** page allows for seven supplementary safety measures that are available for gated crossings and you can include these in your crossing improvements. The seven measures are: four quadrant-gates (without detection), four-quadrant gates (with detection), four-quadrant gates with 60 foot medians, mountable curbs, barrier curbs, one-way street, and photo enforcement.

Time-of-day Traffic Distribution – In the corridor definition (see the **Settings** page), the user sets the time-of-day distribution for rail operations in the corridor. Use the Highway tab on the **Crossings** page to set the time-of-day distribution of highway traffic at the crossing. This value determines the correlation between highway and rail traffic arrival rates at the crossing and the degree of exposure to accident risk. For each crossing, the user can set the time-of-day distribution for each of three highway traffic segments: car, truck and bus. There are five default time-of-day distributions. However, you can enter additional distributions by clicking the Other Values button on the **Parameters** page. See the Reference Manual for additional discussion of the time-of-day distribution.

Traffic Management Measures – An additional option to consider in the alternate case is the implementation of traffic management measures (i.e., signage, restricted turns, restrictions on trucks, periodic closure of crossings) that result in changes to the flow of highway traffic at the crossing. To make use of this option, go to the Highway tab on the **Crossings** page and edit the Traffic Management Measures to equal "True", then click "Update". You can apply this additional capability to one or all crossings. A new "Highway Alt" tab will be added to the "Crossings" page. Use the Highway Alt page to specify the anticipated changes to AADT and time-of-day distribution of traffic by segment (car, truck, bus) at the crossing.

Costs (for investment analysis only) – The costs associated with the crossing are entered on the Costs tab of the **Crossings** page. However, the costs are only used in the calculation of the benefit-cost analysis and have no impact on the results of the *GradeDec.Net* safety analysis.

The base case costs (operating and maintenance, other lifecycle) and alternate case costs (O&M, other lifecycle and capital costs) should be specified for each crossing. The user can specify default values (set by clicking Other Data on the **Parameters** page).

4.3.2.1 Calculate predicted accidents, view/print reports and charts

When you are satisfied with all the crossing data including the investments in the alternative case, click APS Model tab on the Crossings page, then click the "Recalculate" link above the Annual Predicted Accidents table in order to calculate the predicted accidents for each crossing and for the whole corridor. You can view the results in the Annual Predicted Accidents section of the page.

You can generate a report for viewing and printing by clicking Crossings on the left hand toolbar and selecting Generate Corridor Report. You can view a chart of the predicted accidents by selecting "Show Chart" link just above the Annual Predicted Accidents table.

4.3.2.2 Sources of Data

Users can look to the sources listed below for data.

Sources for Safety Analysis

For rail and highway operations data, the railroads and state DOTs are good, likely sources.

Sources for Investment Analysis

The best source for traffic forecasts growth is likely to be the local MPO (for metropolitan areas). For social costs you may want to rely on the default values that come packaged with GradeDec.NET, unless the user has access to better sources reflecting local conditions.

The Reference Manual contains a complete description of the data requirements for GradeDec.NET.

4.3.3 Next Steps in the Case Study Safety Analysis

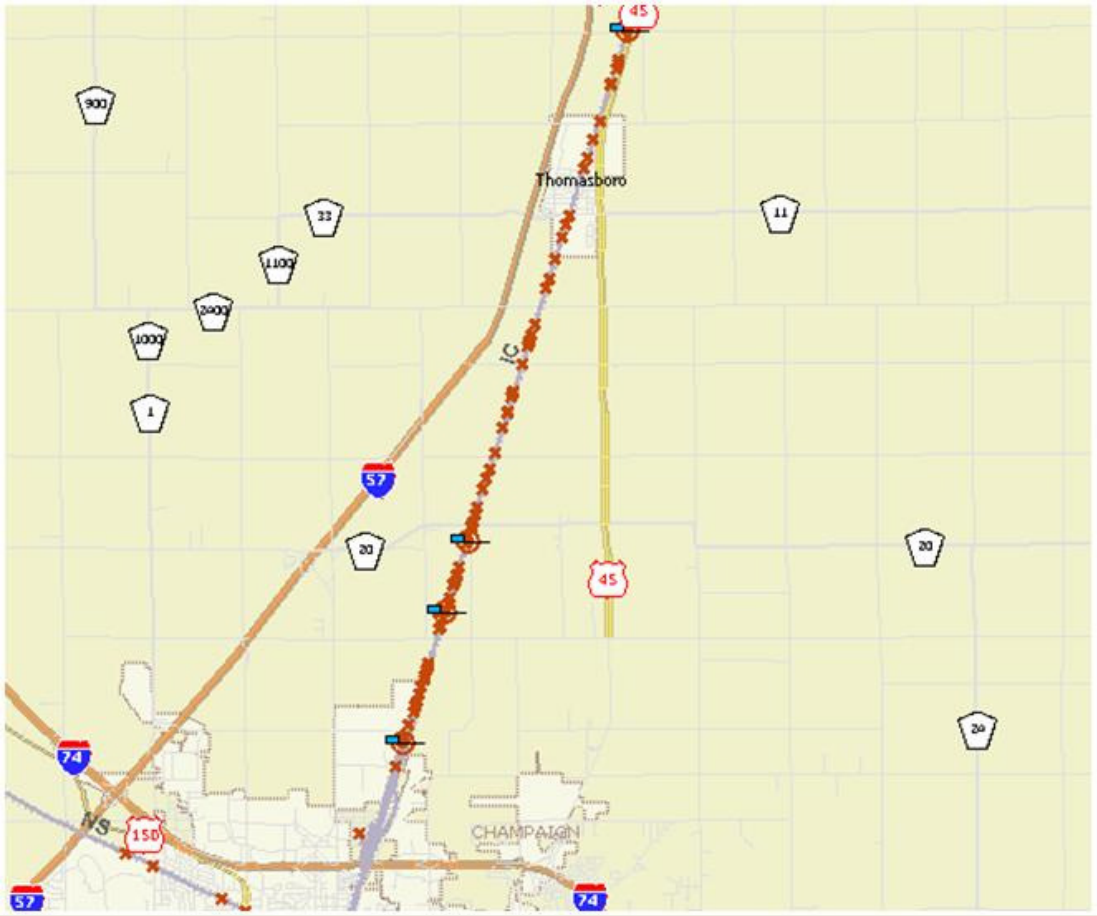
The next module, Module 5, continues with the ICC case study and develops the alternative case for the safety analysis. Module 6 conducts a safety analysis using the Accident Prediction and Severity Model, and presents the results of the case study safety analysis.

4.4 Case Study 2

4.4.1 The Study Area

The corridor is the Illinois Central line from Champaign running Northeast towards Chicago parallel to I-57.

Figure 4 Map of the Case Study Area



4.5 Case Study 2 (corridor model) in GradeDec.NET

4.5.1 Set Up the Data for the Corridor Safety Analysis

4.5.1.1 Create and select a new dataset

On the **Settings** page, click on the link "Create New Dataset" on the right side of the row with "Selected Dataset". This will transfer you to the **New Dataset** page. On this page you choose to either "Create new dataset by copying a dataset" – in which case you select one of your datasets from the drop down list – or choose "Create new dataset from sample data". Select the second option.

Enter a name for the new dataset (i.e., "IL Workshop".) and then click create. This will transfer you back to the **Settings** page. From the dataset drop down list, select the dataset that you just created.

4.5.1.2 Create a new corridor

On the **Settings** page, click on the link "Create New Corridor" on right side of the row with "Selected Corridor". This will transfer you to the Create new Corridor page. On this page you choose to either "Create a new, empty corridor", or "Create a new corridor by

copying an existing corridor in the dataset" -- in which case you select one of the corridors from the drop down list. Choose the first option.

Enter a name for the new corridor (i.e., "Champaign, IL".) and then click create. This will transfer you back to the **Settings** page, and the new corridor will automatically be selected.

4.5.1.3 Set values for corridor characteristics

In the table at the bottom of the **Settings** page you need to set the characteristics that correspond to your corridor. This includes: set parameters for train traffic, set parameters for time-of-day distributions.

Modify the values in the table by clicking on the “Edit” button.

For this case study, modify the values in the form as follows:

- Daily passenger trains to 6
- Daily freight trains to 20
- Rail TOD Distribution to "Day Flat"

Click on “Update” after entering the new values. The settings table should now look like:

Figure 5 - Corridor Settings

Settings for the selected corridor. Edit

Item	Value
Corridor ID	6
Description	Champaign, IL
Daily Passenger Trains	6
Daily Freight Trains	20
Daily Switch Trains	0
Rail TOD Distribution	Day Flat
Rail TOD Distribution - Freight	Uniform
Rail TOD Distribution - Switch	Uniform
Signal Synchronization?	False
Allow Capital Programming?	False
Effectiveness Factor, New Technology 1	0.5
Effectiveness Factor, New Technology 2	0.5
Effectiveness Factor, New Technology 3	0.5
Default corridor for the dataset?	False
Last Modified	9/25/2009 4:49:15 PM

Edit to modify the settings for the selection.

We found the "Day Flat" rail TOD distribution to be a fair representation of passenger train schedules on the corridor; however, other information could suggest that another TOD distribution would be more appropriate.

Values for "Daily Passenger Trains" and "Daily Freight Trains" can be found in the Grade Crossing Inventory Records. See the end of the following section for more information.

4.5.1.4 Import data from Grade Crossing Inventory

Using the Import page we find the crossings for inclusion in the corridor.

From the main navigation menu on the left side of the screen, select the **Import** page. From the drop down lists on the left select:

State: Illinois

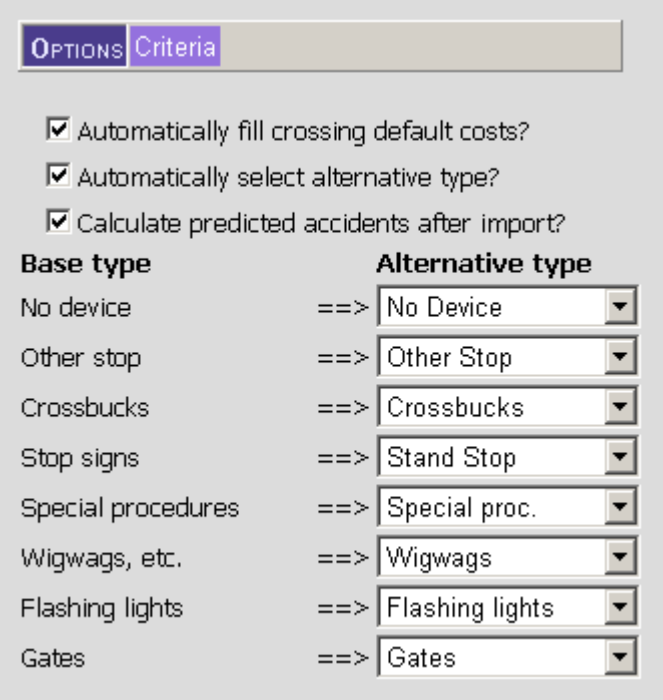
Counties: Champaign, Clay, Coles, Cumberland, Douglas, Effingham, Fayette, Jackson, Marion, Perry, Shelby, Washington (hold CTRL while selecting each county).

The “Selected Areas” table will show your selection. Click on the button “Create list of corridors in selected areas”. From the "Select corridor(s) in selected areas" list, choose "IC NORTHERN REG. CHAMPAIGN MAINLINE 112 crossings" and "IC NORTHERN REG. CENTRALIA MAINLINE 52 crossings" using the CTRL key, then click 'Go'.

Click on the "View selected inventory records" link. In the new window, find the "TOTALTRN", "TOTALSWT", and "PASSCNT" columns. The "PASSCNT" column should provide a reasonable estimate for which "Daily Passenger Trains" value to use in the corridor settings. Similarly, the sum of "TOTALTRN" and "TOTALSWT" can be used to find a reasonable estimate of the total number of trains in the corridor. Subtracting "Daily Passenger Trains" from the total number of trains in the corridor will produce an estimate for "Daily Freight Trains" to use in the corridor settings. You may close the window when finished.

Before importing the data, there is an important option to make use of. Make sure that the "Automatically select alternative type" checkbox is checked, and change the "Alternative type" drop down boxes to match the "Base Type" devices. The "Options" section should be set in the following way:

Figure 6 - Import Options



Click on the "Import Crossings Data" button below the table. This will transfer you to the Crossings page.

4.5.2 Customizing the Crossing Data for the Analysis

You should review each crossing and set data and parameters that best reflect the conditions at the crossing.

Important factors to review and examine are supplementary safety measures, time-of-day traffic distributions, traffic management measures, and costs. See section 4.3.2 for more details.

4.5.3 Next Steps in the Case Study Safety Analysis

The next module, Module 5, will conduct a brief safety analysis on the 30 riskiest crossings in the corridor. In the "Capital Planning" module in Volume 2, a capital program will be developed and applied to these crossings to mitigate risk in the corridor. Volume 2 will also present the case study investment analysis and illustrate use of advanced GradeDec.NET features.

MODULE 5 DEVELOPMENT OF ALTERNATIVES

5.1 Introduction

In this section we review the crossing data and identify improvements in accordance with the studies' objectives. For the Case Studies, the objectives are: Improve safety and mitigate traffic congestion.

5.2 Case Study 1 (Regional Model)

5.2.1 Base Case Devices

One of the factors that determine the accident risk at a crossing, and the one which is a prime target for improvement, is the device type. The conventional crossing device types are: passive (signs and road markings only) and flashing lights with gates. The base case crossing types for the first 20 crossings in the region (according to the imported data from the Grade Crossing Inventory) are as follows:

Figure 7 Base Case Crossing Devices

No.	Crossing ID	Milepost	Description	Base Case Device
1	004414P	006351	BNSF - TYNAN RD	Crossbucks
2	004520X	010744	BNSF - TH-S 60	Crossbucks
3	004656K	017710	BNSF - SEMINARY	Gates
4	063098E	019605	BNSF - LIBERTY	Crossbucks
5	063101K	019653	BNSF - 1175 E	Crossbucks
6	063789M	019308	BNSF -	Crossbucks
7	063799T	015561	BNSF - COUNTY ROAD	Crossbucks
8	065682S	004798	BNSF - 248 ST. N.	Crossbucks
9	069857G	011888	BNSF - GRANDVIEW RD	Crossbucks
10	070058Y	000918	IR - HOLCOMB RD	Crossbucks
11	070071M	001520	IR - EDSON RD	Crossbucks
12	072292W	006433	BNSF - KIRKHAM	Flashing lights
13	072320X	014466	BNSF - E DUBOIS RD	Crossbucks
14	072417U	024692	BNSF -	Crossbucks
15	072590W	020530	BNSF - E 950TH ST	Flashing lights
16	072823R	022545	BNSF -	Crossbucks
17	072974F	017005	BNSF -	Crossbucks
18	078518B	003586	BNSF - THAYER RD	Flashing lights
19	079213G	016975	BNSF - 160TH ST	Crossbucks
20	079216C	017271	BNSF - 130TH ST	Crossbucks

1 2 3 4

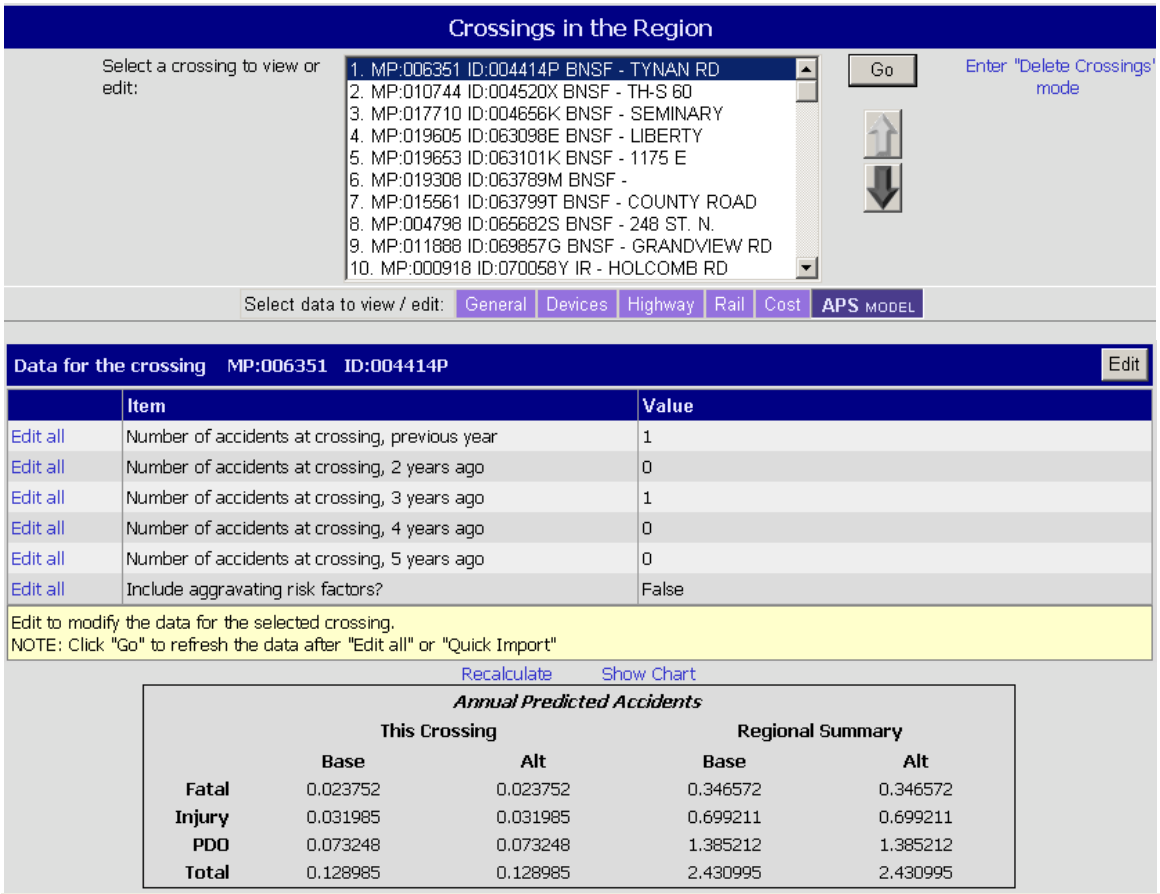
5.2.2 Identify Accident Risk in the Region

Two of the convenient features for identifying accident risk in the region are: 1) the regional summary of predicted accidents and 2) the Regional Risk Charts.

From the navigation menu, go to the **Crossings** page, then click on the APS Model tab. Click on the "Recalculate" link above the Annual Predicted Accidents table. This chart shows you the predicted accidents by type for the crossing and the corridor. For now we focus on the Base Case. The Alternate Case reflects the automatic assignment of improvements from the data import process – in this section we seek to refine the improvements in the alternate case.

Note that the table shows total annual predicted accidents in the region to be 2.430995 in the base case.

Figure 8 Case Study - Summary Table of Predicted Accidents



The table also shows that for the selected crossing (Milepost 6351) the predicted accidents in the base case is 0.12899. You can browse each crossing to find its predicted accident and pick out the higher risk crossing.

An easier way to accomplish this is using the charting feature. Click on the "Show Chart" link above the Annual Predicted Accidents table. The first chart you see displays crossings by annual predicted fatal accidents in the Base Case. This gives you a good initial indicator of which crossings contribute the most to the current accident risk in the region.

The chart below is the crossings for the Case Study region:

Figure 9 Predicted Fatal Accidents – Ordered by Milepost

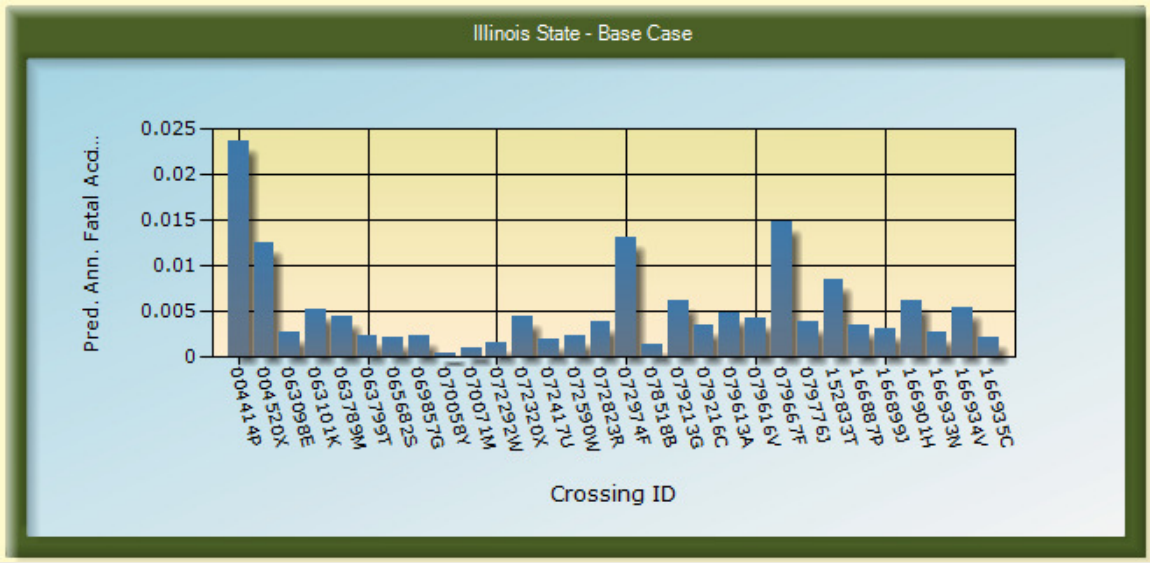
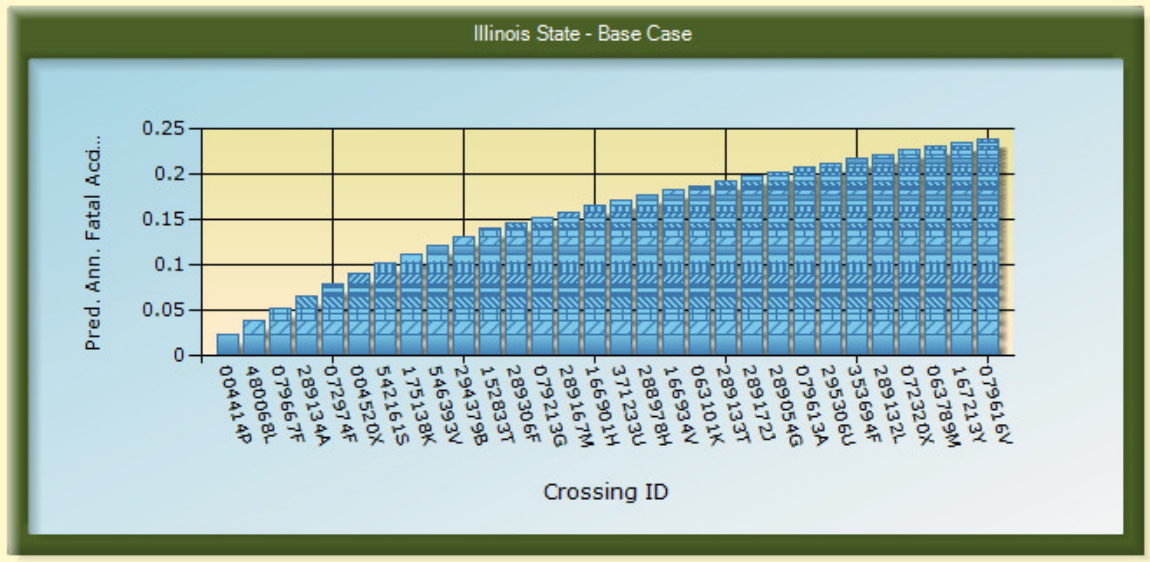


Figure 10 Cumulative Predicted Fatal Accidents – Ordered by Risk



By selecting options in the drop-down lists you can show the cumulative risk in the corridor and rank the crossings by predicted fatal accidents.

The chart shows us that the first nine riskiest crossings contribute nearly 50% of the accident risk in the region.

5.2.3 Summarizing Improvement Targets

For the Case Study region, the following table shows the ranked fatal accident risk by crossing. For regions with a large number of crossings you may want to focus only on the crossings that contribute 50 or 80 percent of the total risk in the region.

Table 5 Ranking of Crossings with the most Fatal Accident Risk in the Region

	ID	Predicted annual fatal accidents
1	004414P	.023752
2	480068L	.014805
3	079667F	.014785
4	289134A	.013137
5	072974F	.013109

The next table looks at crossings from the perspective of the congestion management objective. Here the crossings are ranked by AADT.

Table 6 Top 5 Crossings in Case Study Region Ranked by AADT

Rank	ID	AADT
1	475125M	2900
2	475126U	2900
3	260616P	2050
4	292764X	1800
5	724789P	1600

5.2.4 Developing Alternatives

In this case study, the Alternative Device Upgrades have been provided in the ICC's FY 2010-2014 Plan. The table below lists these improvements, along with their associated costs:

Table 7 Crossing Improvements

No.	Crossing ID	Milepost	Description of Improvement	Cost
1	004414P	6351	Gates	250
2	004520X	10744	Gates	250
3	004656K	17710	Grade Separate	13970
4	063098E	19605	Gates	250
5	063101K	19653	Gates	250
6	063789M	19308	Gates	250
7	063799T	15561	Gates	250
8	065682S	4798	Gates	250
9	069857G	11888	Gates	250
10	070058Y	918	Gates	250
11	070071M	1520	Gates	250

12	072292W	6433	Gates	250
13	072320X	14466	Gates	250
14	072417U	24692	Gates	250
15	072590W	20530	Gates	250
16	072823R	22545	Gates	250
17	072974F	17005	Gates	250
18	078518B	3586	Gates	250
19	079213G	16975	Gates	250
20	079216C	17271	Gates	250
21	079613A	6199	Gates	250
22	079616V	6405	Gates	250
23	079667F	9608	Gates	250
24	079776J	14939	Gates	250
25	152833T	19693	Gates	250
26	166887P	14120	Gates	250
27	166899J	13670	Gates	250
28	166901H	13560	Gates	250
29	166933N	11660	Gates	250
30	166934V	11650	Gates	250
31	166935C	11540	Gates	250
32	166936J	11420	Gates	250
33	166937R	11415	Closed	150
34	166977N	9090	Gates	250
35	166978V	19040	Gates	250
36	167213Y	8290	Gates	250
37	167869V	19755	Gates	250
38	167917H	22662	Gates	250
39	175138K	8667	Gates	250
40	175139S	8693	Gates	250
41	175734K	1203	Gates	250
42	176810E	3978	Gates	250
43	177018B	6885	Gates	250
44	260616P	924	Gates	250
45	288978H	7485	Gates	250
46	289054G	12010	Gates	250
47	289132L	16450	Gates	250
48	289133T	16530	Gates	250
49	289134A	16635	Gates	250
50	289167M	18880	Gates	250
51	289172J	19175	Gates	250
52	289306F	8780	Gates	250
53	292764X	4385	Gates	250
54	293697J	8210	Gates	250
55	293699X	8220	Gates	250
56	293700P	8225	Gates	250

57	294379B	21960	Gates	250
58	294570Y	4261	Gates	250
59	294577W	4685	Gates	250
60	295306U	23808	Gates	250
61	299038A	33409	Gates	250
62	353694F	11299	Gates	250
63	371233U	5349	Gates	250
64	372365H	9514	Gates	250
65	430959S	10297	Gates	250
66	430960L	10289	Gates	250
67	431031N	11478	Gates	250
68	475125M	40780	Closed	190
69	475126U	40800	Closed	190
70	479891V	31790	Gates	250
71	479984P	40943	Gates	250
72	480068L	43992	Gates	250
73	542128S	20708	Gates	250
74	542161S	22975	Gates	250
75	546393V	12150	Gates	250
76	546482M	16390	Gates	250
77	546483U	16408	Closed	50
78	603742K	5284	Gates	250
79	724789P	7185	Gates	250
80	724790J	7195	Gates	250

5.2.4.1 The Alternate Case

5.2.4.1.1 Modifying Alternate Case Devices

Table 7 lists the device improvements required for each crossing.

In the **Crossings** page, click on the 'Devices' tab in the 'Select data to view / edit' row. In the table below, click on the 'Edit all' link corresponding to the Alternate Case Device item. In the new window, click on the 'Edit' button in the top-right corner of the table. When the page refreshes, change the Alternate Case Device values according to the table above. When finished, click on 'Update'. The window should now look like the following:

Figure 11 Alternate Case Devices for First 20 Crossings in Region

No.	Crossing ID	Milepost	Description	Alternate Case Device
1	004414P	006351	BNSF - TYNAN RD	Gates
2	004520X	010744	BNSF - TH-S 60	Gates
3	004656K	017710	BNSF - SEMINARY	Grade separation
4	063098E	019605	BNSF - LIBERTY	Gates
5	063101K	019653	BNSF - 1175 E	Gates
6	063789M	019308	BNSF -	Gates
7	063799T	015561	BNSF - COUNTY ROAD	Gates
8	065682S	004798	BNSF - 248 ST. N.	Gates
9	069857G	011888	BNSF - GRANDVIEW RD	Gates
10	070058Y	000918	IR - HOLCOMB RD	Gates
11	070071M	001520	IR - EDSON RD	Gates
12	072292W	006433	BNSF - KIRKHAM	Gates
13	072320X	014466	BNSF - E DUBOIS RD	Gates
14	072417U	024692	BNSF -	Gates
15	072590W	020530	BNSF - E 950TH ST	Gates
16	072823R	022545	BNSF -	Gates
17	072974F	017005	BNSF -	Gates
18	078518B	003586	BNSF - THAYER RD	Gates
19	079213G	016975	BNSF - 160TH ST	Gates
20	079216C	017271	BNSF - 130TH ST	Gates

1 2 3 4

Repeat the process above for pages 2-4, making sure that each crossing's alternate case device agrees with the crossing's improvement in table 7. Close the window when finished.

5.2.4.1.2 Modifying Device Costs

The final step is to enter costs for each device improvement. According to the ICC's plan, we can apply the following costs to the crossings in our region:

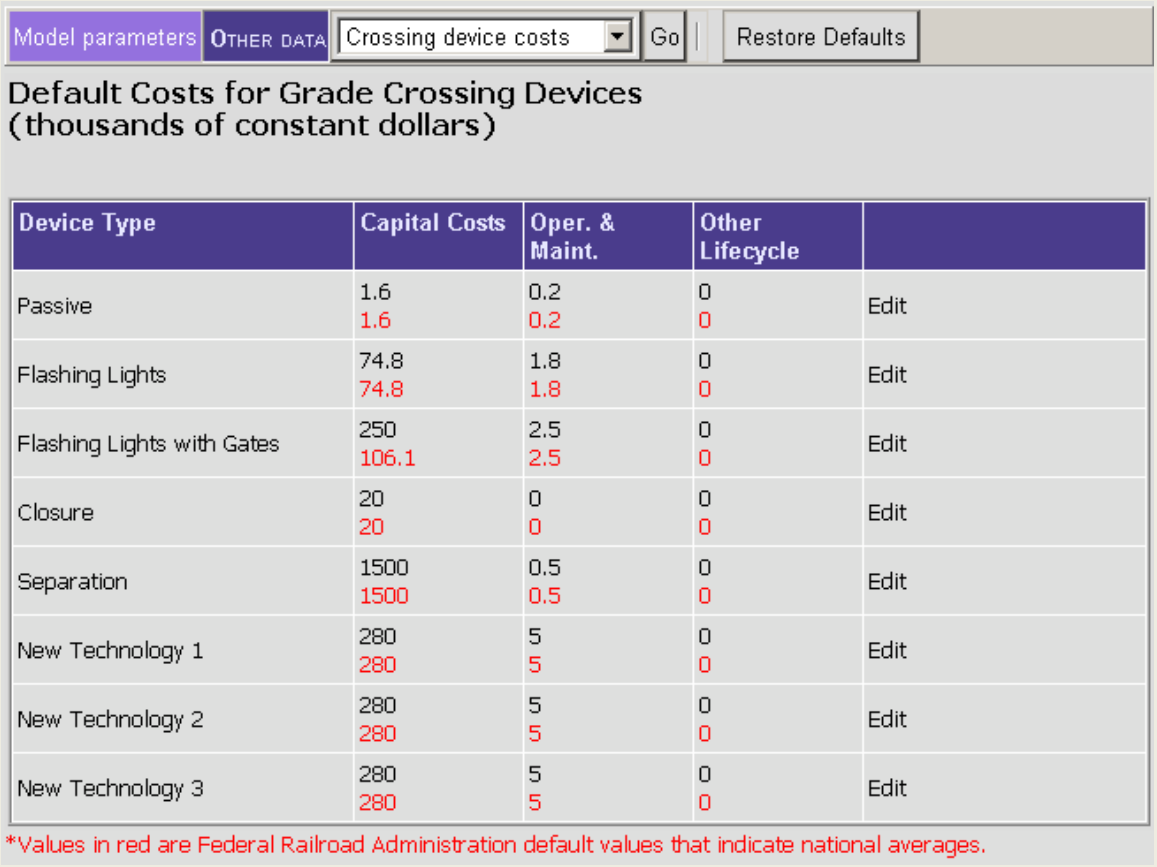
Table 8 Crossing Improvements Costs

Crossing ID	Milepost	Device Improvement	Cost ($thous)
004656K	017710	Grade Separation	13970
166937R	011415	Closed	150
475125M	040780	Closed	190
475126U	040800	Closed	190
546483U	016408	Closed	50
All remaining Crossings		Gates	250

From the navigation menu, go to the **Parameters** page. Click on the 'Other data' tab from the menu bar. Select 'Crossing Device Costs' from the drop down menu, then click 'Go'. Click on the 'Edit' link corresponding to the 'Flashing Lights with Gates' Device

Type. Change the 'Capital Costs' value from 106.1 to 250, then click 'Update'. This effectively changed the default costs of upgrading a crossing to Gates.

Figure 12 Default Device Costs in Region



From the navigation menu, go to the **Crossings** page. The **Crossings** tab in the navigation menu should now have more options. Click on 'Set Default Costs (All Crossings)'. This will apply our new cost of Gates to all crossings with Gates as their alternative device.

For the crossings that will be either closed or grade separated, we must change their costs manually. In the **Crossings** page, select crossing 004656K, MP 017710 from the list, then click 'Go'. Click on the 'Cost' tab in the 'Select data to view / edit' row. The table below should now display the various costs associated to the crossing. Click on the 'Edit' button in the top-right corner of the table. In the row corresponding to the 'Principle Device - Alt. Case Capital Cost (000$)' item, change the item value from 1500 to 13970, then click the 'Update' button.

Figure 13 Cost Tab for Crossing 004656K

Data for the crossing MP:017710 ID:004656K — Edit

	Item	Value
Edit all	Principal device - Base Case Ann. Oper. & Maint. Cost (000 $)	2.5
Edit all	Principal device - Base Case Ann. Other Lifecycle Cost (000 $)	0
Edit all	Principal device - Alt. Case Ann. Oper. & Maint. Cost (000 $)	0.5
Edit all	Principal device - Alt. Case Ann. Other Lifecycle Cost (000 $)	0
Edit all	Principal device - Alt. Case Capital Cost (000 $)	13970
Edit all	SSM - Base Case Ann. Oper. & Maint. Cost (000 $)	0
Edit all	SSM - Base Case Ann. Other Lifecycle. Cost (000 $)	0
Edit all	SSM - Alt. Case Ann. Oper. & Maint. Cost (000 $)	0
Edit all	SSM - Alt. Case Ann. Other Lifecycle. Cost (000 $)	0
Edit all	SSM - Alt. Case Capital Cost (000 $)	0
Edit all	Roadway Improvement Capital Cost (000 $)	0

Edit to modify the data for the selected crossing.
NOTE: Click "Go" to refresh the data after "Edit all" or "Quick Import"

Repeat the process above for crossings 166937R, 475125M, 475126U, 546483U, using the costs provided for each crossing in table 8.

5.2.4.2 Creating Additional Alternatives

You can create and save more than one alternative set of improvements. Do this by returning to the **Settings** Page and create a new region, this time using the Case Study region as the source to copy. Give the new region a name like "Illinois State– Alternative 2". Develop your alternative and enter the data in the crossings for the newly defined region.

5.2.5 Managing your Data and Creating Versions

GradeDec.NET automatically stores your data on the GradeDec.NET server. Data are saved automatically when you import from the National Grade Crossing Inventory and when you click on either the "Update" button or "Realculate" link on the APS model tab.

From the **Settings** page you can download your dataset and save it locally as a backup (or, in case you wish to delete your data from GradeDec.NET server). You can upload your dataset for use in a subsequent session.

5.3 Case Study 2 (Corridor Model)

5.3.1 Base Case Devices

One of the factors that determine the accident risk at a crossing, and the one which is a prime target for improvement, is the device type. The conventional crossing device types are: passive (signs and road markings only) and flashing lights with gates. The base case crossing types for the first 20 crossings in the corridor are as follows:

Figure 14 Base Case Crossing Devices

No.	Crossing ID	Milepost	Description	Base Case Device
1	289084Y	131.17	IC - CURTIS RD	Gates
2	289086M	132.18	IC - CHURCH ST	Gates
3	289089H	133.23	IC - 1100 N	Gates
4	289093X	135.26	IC - PHILO RD	Gates
5	289094E	136.67	IC - WALNUT ST	Gates
6	289095L	136.92	IC - HOLDEN ST	Gates
7	289097A	137.26	IC - WOODWORTH ST	Gates
8	289098G	138.28	IC - 600 N	Gates
9	289099N	139.33	IC - 500 N	Passive
10	289100F	140.34	IC - 400 N	Passive
11	289101M	141.35	IC - 300 N	Gates
12	289102U	141.83	IC - ADAMS ST	Gates
13	289103B	141.92	IC - S LINCOLN ST	Gates
14	289104H	142.36	IC - 200 N	Gates
15	289106W	143.36	IC - PARKVILLE RD (100	Passive
16	289107D	144.37	IC - 1550N	Passive
17	289108K	145.43	IC - HA1/VILLA GROVE R	Gates
18	289110L	146.45	IC -	Passive
19	289112A	147.44	IC - 1250N	Gates
20	289113G	148.45	IC - 1150N	Gates

1 2 3 4 5 6 7 8 9

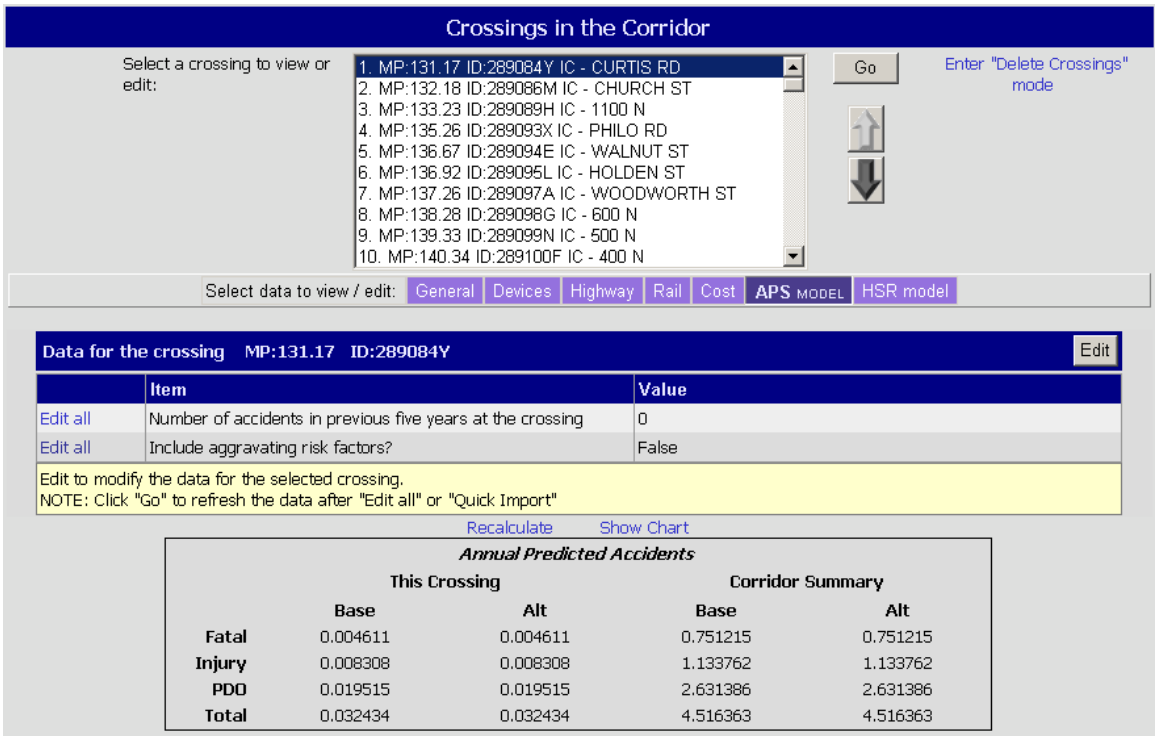
5.3.2 Identify Accident Risk in the Corridor

Two of the convenient features for identifying accident risk in the corridor are: 1) the summary of predicted accidents in the corridor and 2) the Corridor Risk Charts.

From the navigation menu, go to the **Crossings** page, then click on the APS Model tab. Click on the "Recalculate" link above the Annual Predicted Accidents table. This chart shows you the predicted accidents by type for the crossing and the corridor. For now we focus on the Base Case. The Alternate Case reflects the automatic assignment of improvements from the data import process – in this section we seek to refine the improvements in the alternate case.

Note that the table shows total annual predicted accidents in the region to be 2.430995 in the base case.

Figure 15 Case Study - Summary Table of Predicted Accidents



The table also shows that for the selected crossing (Milepost 131.17) the predicted accidents in the base case is 0.032434. You can browse each crossing to find its predicted accident and pick out the higher risk crossing.

An easier way to accomplish this is using the charting feature. Click on the "Show Chart" link above the Annual Predicted Accidents table. The first chart you see displays crossings by annual predicted fatal accidents in the Base Case. This gives you a good initial indicator of which crossings contribute the most to the current accident risk in the region.

The charts below present predicted fatal accidents for the crossings in the Case Study corridor:

Figure 16 Predicted Fatal Accidents – Ordered by Milepost

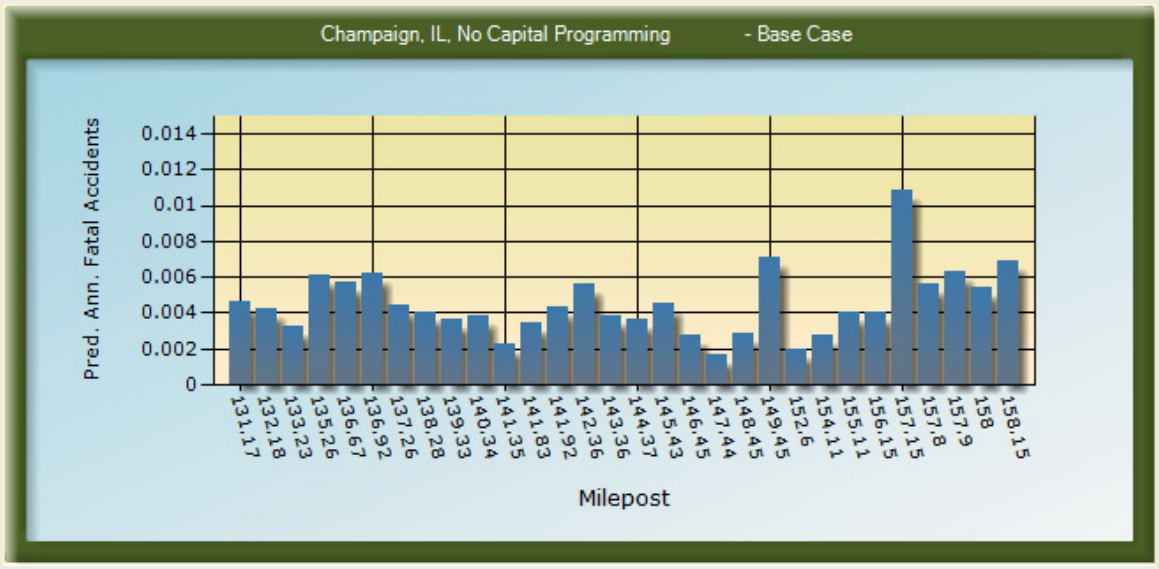
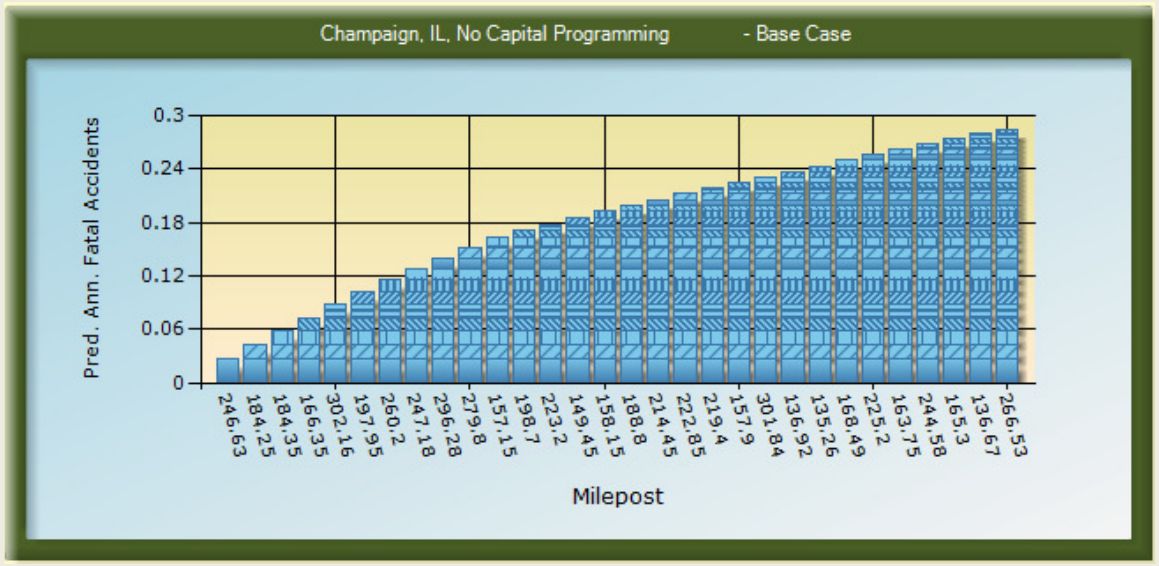


Figure 17 Cumulative Predicted Fatal Accidents – Ordered by Risk



By selecting options in the drop-down lists you can show the cumulative risk in the corridor and rank the crossings by predicted fatal accidents.

5.3.3 Summarizing Improvement Targets

Figure 17 above ranks the 30 riskiest crossings in the corridor based on predicted annual fatal accidents. Our device improvements will consist of gating each of these thirty crossings, and adding barrier curbs to them as a supplementary safety measure.

5.3.4 Developing Alternatives

The table below lists the improvements to be made to the corridor:

Table 9 Corridor Improvements

Crossing ID	Milepost	Alternate Device	Supplementary Safety Measure
289093X	135.26	Gates	Barrier Curbs
289094E	136.67	Gates	Barrier Curbs
289095L	136.92	Gates	Barrier Curbs
289114N	149.45	Gates	Barrier Curbs
289121Y	157.15	Gates	Barrier Curbs
289123M	157.9	Gates	Barrier Curbs
289125B	158.15	Gates	Barrier Curbs
289131E	163.75	Gates	Barrier Curbs
289133T	165.3	Gates	Barrier Curbs
289134A	166.35	Gates	Barrier Curbs
289136N	168.49	Gates	Barrier Curbs
289157G	184.25	Gates	Barrier Curbs
289158N	184.35	Gates	Barrier Curbs
289167M	188.8	Gates	Barrier Curbs
289180B	197.95	Gates	Barrier Curbs
289185K	198.7	Gates	Barrier Curbs
295279A	214.45	Gates	Barrier Curbs
295284W	219.4	Gates	Barrier Curbs
295288Y	222.85	Gates	Barrier Curbs
295291G	223.2	Gates	Barrier Curbs
295293V	225.2	Gates	Barrier Curbs
295320P	244.58	Gates	Barrier Curbs
295322D	246.63	Gates	Barrier Curbs
295323K	247.18	Gates	Barrier Curbs
295004S	260.2	Gates	Barrier Curbs
295016L	266.53	Gates	Barrier Curbs
295044P	279.8	Gates	Barrier Curbs
295067W	296.28	Gates	Barrier Curbs
295082Y	301.84	Gates	Barrier Curbs
295083F	302.16	Gates	Barrier Curbs

5.3.4.1 The Alternate Case

5.3.4.1.1 Modifying Alternate Case Devices

Table 9 lists the device improvements required for each crossing.

In the **Crossings** page, click on the 'Devices' tab in the 'Select data to view / edit' row. In the table below, click on the 'Edit all' link corresponding to the Alternate Case Device item. In the new window, click on the 'Edit' button in the top-right corner of the table. When the page refreshes, change the Alternate Case Device value according to the table

above. When finished, click on 'Update'. The window should now look like the following:

Figure 18 Alternate Case Devices for First 20 Crossings in Corridor

No.	Crossing ID	Milepost	Description	Alternate Case Device
1	289084Y	131.17	IC - CURTIS RD	Gates
2	289086M	132.18	IC - CHURCH ST	Gates
3	289089H	133.23	IC - 1100 N	Gates
4	289093X	135.26	IC - PHILO RD	Gates
5	289094E	136.67	IC - WALNUT ST	Gates
6	289095L	136.92	IC - HOLDEN ST	Gates
7	289097A	137.26	IC - WOODWORTH ST	Gates
8	289098G	138.28	IC - 600 N	Gates
9	289099N	139.33	IC - 500 N	Passive
10	289100F	140.34	IC - 400 N	Passive
11	289101M	141.35	IC - 300 N	Gates
12	289102U	141.83	IC - ADAMS ST	Gates
13	289103B	141.92	IC - S LINCOLN ST	Gates
14	289104H	142.36	IC - 200 N	Gates
15	289106W	143.36	IC - PARKVILLE RD (100	Passive
16	289107D	144.37	IC - 1550N	Passive
17	289108K	145.43	IC - HA1/VILLA GROVE R	Gates
18	289110L	146.45	IC -	Passive
19	289112A	147.44	IC - 1250N	Gates
20	289113G	148.45	IC - 1150N	Gates

1 2 3 4 5 6 7 8 9

Repeat the process above for pages 2-9, making sure that each crossing's alternate case device agrees with the crossing's improvement in table 9. Close the window when finished.

Back in the **Crossings** page, click on the 'Edit all' link corresponding to the Alternate Case Supplementary Safety Measure item. In the new window, click on the 'Edit' button in the top-right corner of the table. When the page refreshes, change the Alternate Case Supplementary Safety Measure value according to table 9. When finished, click on 'Update'. The window should now look like the following:

Figure 19 Alternate Case Supplementary Safety Measures for First 20 Crossings in Corridor

No.	Crossing ID	Milepost	Description	Alternate Case Supplementary Safety Measure
1	289084Y	131.17	IC - CURTIS RD	None
2	289086M	132.18	IC - CHURCH ST	None
3	289089H	133.23	IC - 1100 N	None
4	289093X	135.26	IC - PHILO RD	Barrier curbs
5	289094E	136.67	IC - WALNUT ST	Barrier curbs
6	289095L	136.92	IC - HOLDEN ST	Barrier curbs
7	289097A	137.26	IC - WOODWORTH ST	None
8	289098G	138.28	IC - 600 N	None
9	289099N	139.33	IC - 500 N	None
10	289100F	140.34	IC - 400 N	None
11	289101M	141.35	IC - 300 N	None
12	289102U	141.83	IC - ADAMS ST	None
13	289103B	141.92	IC - S LINCOLN ST	None
14	289104H	142.36	IC - 200 N	None
15	289106W	143.36	IC - PARKVILLE RD (100	None
16	289107D	144.37	IC - 1550N	None
17	289108K	145.43	IC - HA1/VILLA GROVE R	None
18	289110L	146.45	IC -	None
19	289112A	147.44	IC - 1250N	None
20	289113G	148.45	IC - 1150N	None

1 2 3 4 5 6 7 8 9

Repeat the process above for pages 2-9, making sure that each crossing's alternate case supplementary safety measure agrees with the crossing's entry in table 9. Close the window when finished.

5.3.4.2 Creating Additional Alternatives

You can create and save more than one alternative set of improvements. Do this by returning to the **Settings** Page and create a new region, this time using the Case Study region as the source to copy. Give the new region a name like “Illinois State– Alternative 2”. Develop your alternative and enter the data in the crossings for the newly defined region.

5.3.5 Managing your Data and Creating Versions

GradeDec.NET automatically stores your data on the GradeDec.NET server. Data are saved automatically when you import from the National Grade Crossing Inventory and when you click on either the “Update” button or “Recalculate" link on the APS Model tab.

From the **Settings** page you can download your dataset and save it locally as a backup (or, in case you wish to delete your data from GradeDec.NET server. You can upload your dataset for use in a subsequent session.

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MODULE 6 SAFETY ANALYSIS USING THE ACCIDENT PREDICTION AND SEVERITY MODEL (APS)

6.1 Introduction

This section covers safety benefits using the Department of Transportation Accident Prediction and Severity Models. This model is one of two models in GradeDec.NET that is used for estimating safety impacts and is available for both the Corridor and Regional models. The other model, the High Speed Rail model, is available only in the Corridor Model.

In GradeDec.NET, there are two levels of safety analysis:

The **Crossings** pages show predicted accidents and includes ranking charts for the base year data.

The simulation results report on the monetized safety benefits, corridor summary and by crossings, for the full forecast time horizon. The results also report the changes between base and alternate predicted accidents for selected years.

6.2 Analysis with the Crossing Pages

In the Corridor and Regional Crossing pages, you can evaluate the predicted accidents in the base year (this is the year that precedes the "Start" year of the analysis). Select the tab "APS model". This shows a table of the predicted accidents for the selected crossing and the corridor (or region), for each of the three accident categories (fatal, injury and property damage only). The values here are calculated based upon the data for the corridor or region and each of the individual crossings.

At the end of this section there is a demonstration of the calculation of predicted accidents using the Accident Prediction and Severity Models.

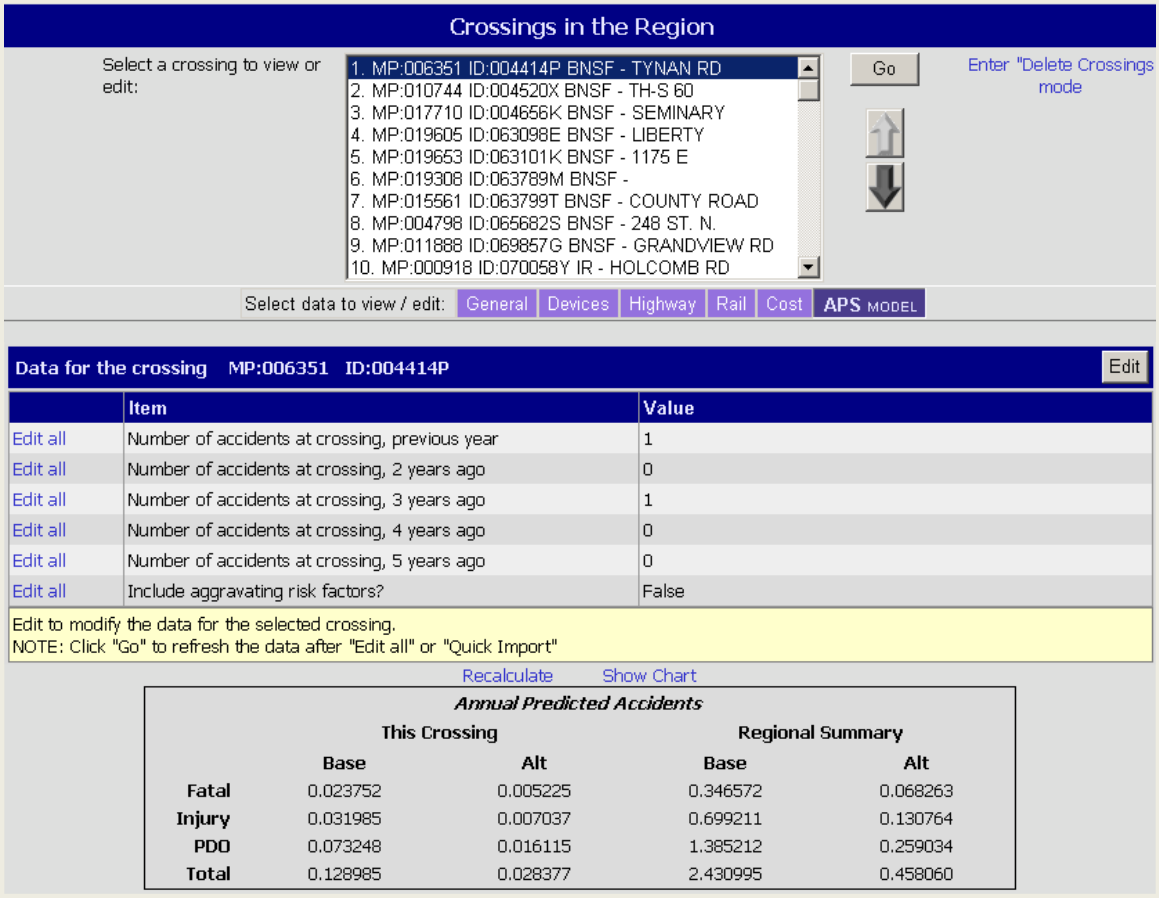
In addition to this table, by clicking on the 'Show chart' link above the table you can view summary charts that rank crossings by predicted fatal accidents in the base year.

Analysis from the Crossing page is useful in identifying those crossings with the highest risk. You can use this information to screen and develop alternatives, prior to conducting you full analysis (that covers all benefit categories and all years of the forecast time horizon).

6.2.1 Case Study 1: Results for the Safety Analysis

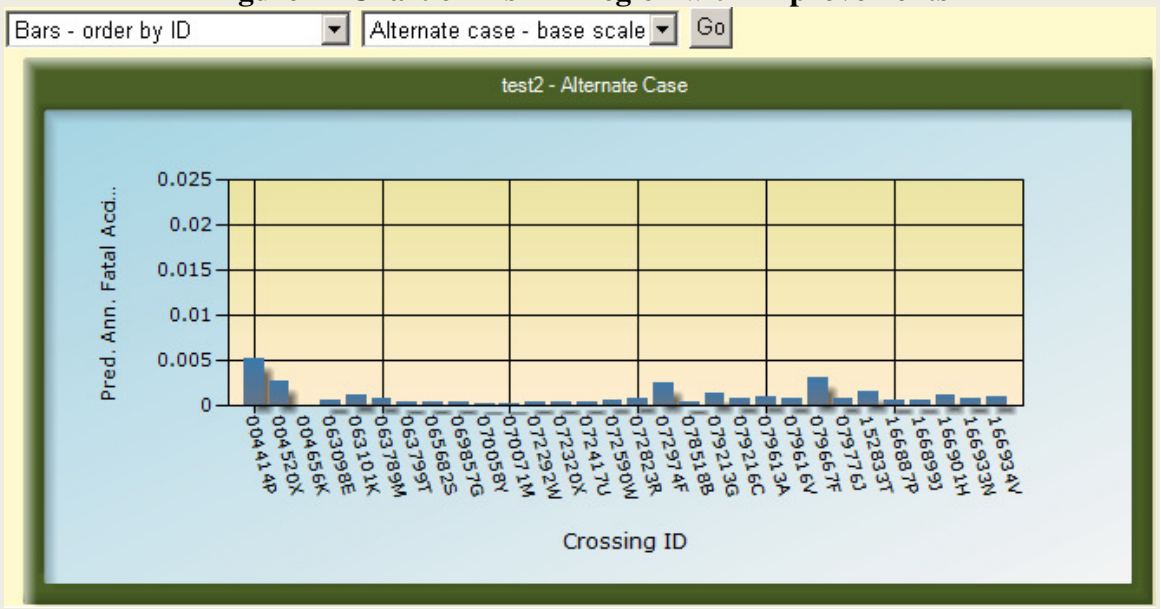
In the **Crossings** page, click on the 'APS Model' tab, then click on the 'Recalculate' link above the Annual Predicted Accidents table. This will refresh the table, and it should now look like the table in the figure below:

Figure 20 Accident Risk Summary with Improvements



Click on the 'Show Chart' link next to 'Recalculate'. In the new window, select 'Alternate case - base scale' in the second drop down box, then click 'Go'. The following chart is produced:

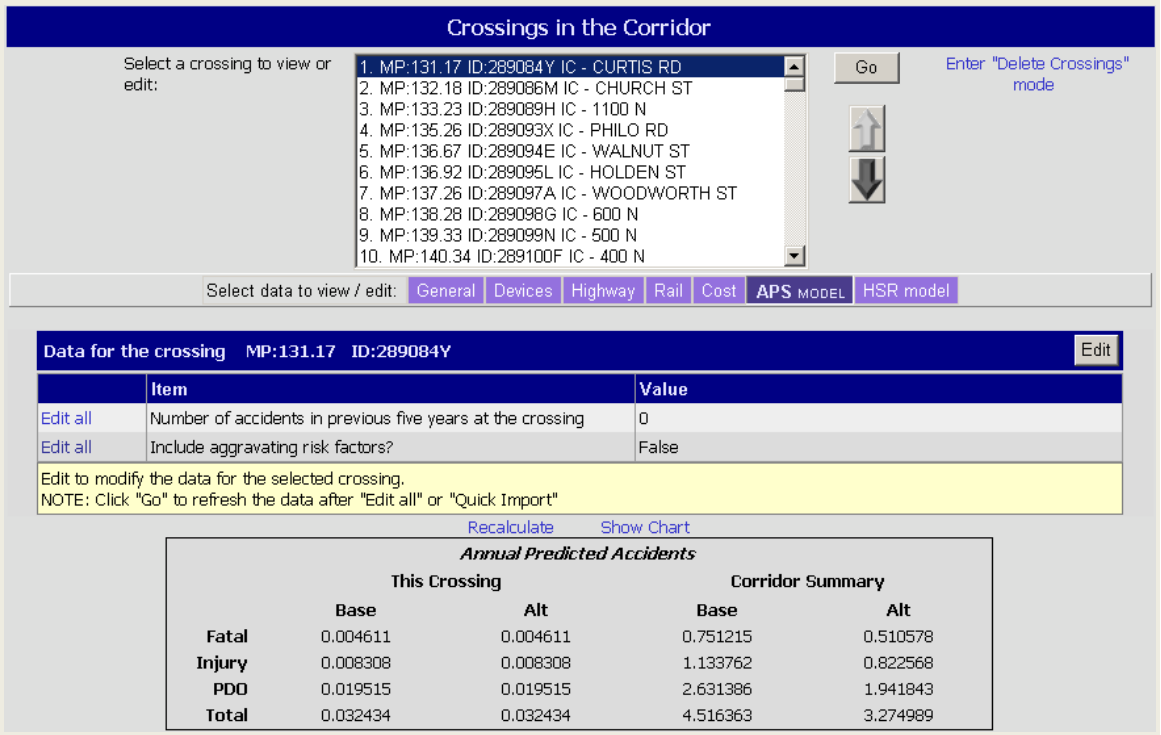
Figure 21 Chart of Risk in Region with Improvements



6.2.2 Case Study 2: Results for the Safety Analysis

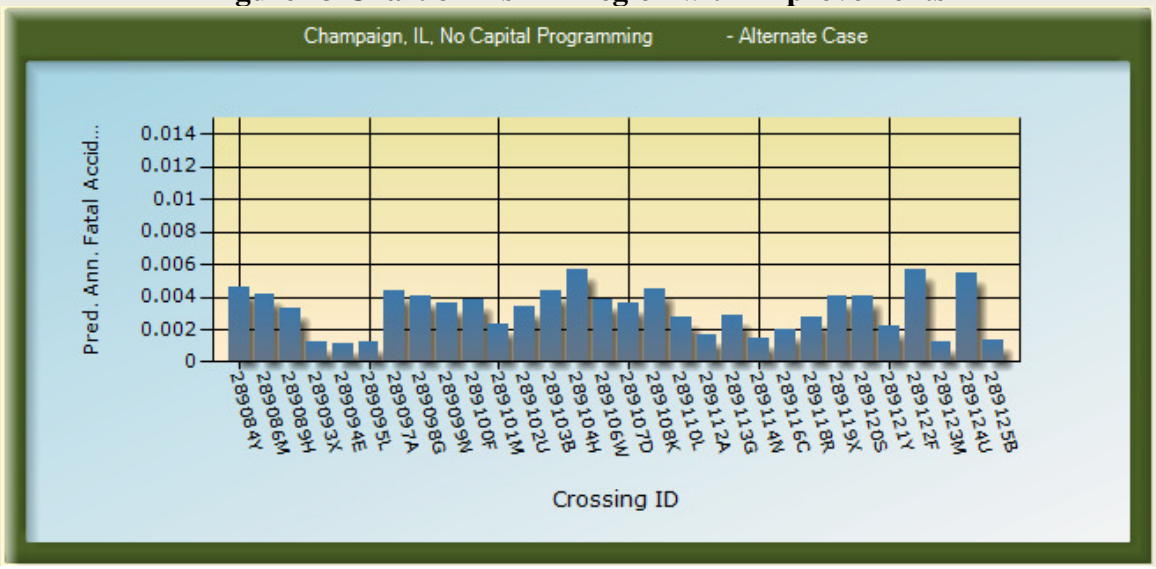
On the **Crossings** page, click on the 'APS Model' tab, then click on the 'Recalculate' link above the Annual Predicted Accidents table. This will refresh the table, and it should now look like the table in the figure below:

Figure 22 Accident Risk Summary with Improvements



Click on the 'Show Chart' link next to 'Recalculate'. In the new window, select 'Alternate case - base scale' in the second drop down box, then click 'Go'. The following chart is produced:

Figure 23 Chart of Risk in Region with Improvements



6.3 Safety Analysis Component of Investment Analysis Results

The investment (benefit-cost) analysis includes safety benefits over the period of analysis along with non-safety benefits. If you complete all the steps in an investment analysis you can view the monetized safety benefit results of that analysis.

The following are the steps for completing the investment analysis and reviewing its safety results:

- Run a simulation (see Module 8) after completing the following tasks:
- Select the alternative for each crossing and enter data as required
- Select a scenario and modify data as required
- Verify that the parameter and default values are suited to your locale
- When a simulation completes the Results Page appears. From the Results Page you can view the safety benefits that accrue over the entire period of analysis. The following results metrics track the safety benefits in GradeDec.NET. The "safety benefits" in the GradeDec.NET results is:

  The reduction in predicted accidents (base less alternate) by accident type (fatal, injury and property damage only), with each type multiplied by its social cost and summed. Total safety benefits for the region is summed over the crossings in each year and the present value of the safety benefit stream is reported in the "Benefits and Benefit-Cost Summary" sheet of the Results page.

Safety benefits are also tracked in the results through the following:

- The present value safety benefit is given for each individual grade crossing in the "Benefit by GCX – Safety" sheet.
- A quantity measure, the decrease in predicted fatal, injury and property damage only accidents is reported for each of three years: the start year, the last year of the near term and the last year.

ANALYSIS WORKSHEETS

SAFETY BENEFITS (Module 6)
A. Predicted Accidents - Calculate Exposure Correlation Factor

		D	E	F	G	
	Determine Inputs					
		Early AM	**Late AM**	**Early PM**	**Late PM**	
6	Time-of-day distribution of trains	0.4	0.1	0.1	0.4	
7	Time-of-day distribution of autos	0.1	0.4	0.4	0.1	
8	Time-of-day distribution of trucks	0.1	0.5	0.35	0.05	
9	Time-of-day distribution of buses	0.1	0.4	0.4	0.1	
10						
11	of this, % trucks	28				
12	of this, % buses	2				
13						
14	Share of auto traffic	0.7				
15	Share of truck traffic	0.28				
16	Share of bus traffic	0.02				
17						
18	**Calculate Factor**					
19	Weighted highway time-of-day distribution	0.1	0.428	0.386	0.086	=SUMPRODUCT(D7:D9,$D$14:$D$16)
20	Weighted with time-of-day distribution	0.1558				=SUMPRODUCT(D19:G19,D6:G6)
21	Sum-of-squares, train distribution	0.34				=SUMPRODUCT(D6:G6,D6:G6)
22	Sum-of-squares, weighted highway distribution	0.349576				=SUMPRODUCT(D19:G19,D19:G19)
23	Exposure Correlation Factor	0.445683				=D20/MAX(D22,D21)

ANALYSIS WORKSHEETS

SAFETY BENEFITS (Module 6)

B. Predicted Accidents - Calculate Factors and Predicted Accidents

(Calculation for a gated crossing)

	B	C	D
2			
3			
4	**Exposure - "EI"**		
5	Average daily train operations	16	
6	AADT	4500	
7	Exposure correlation factor	0.44568277	
8	Exposure factor	43320.365	=1.35*D4*D5*D6
9	"EI"	37.1323	=((D7+0.2)/0.2)^0.2942
10			
11	**Day Through - "DT"**		
12	Total day through trains	10	
13	"DT"	1.3	=((B10+0.2)/2)^0.1781
14			
15	**Maximum Timetable Speed - "MS"**		
16	Maximum timetable speed	55	
17	"MS"	1	Fixed for gated crossings
18			
19	**Number of Tracks - "MT"**		
20	Number of tracks	2	
21	"MT"	1.35310	=EXP(0.1512*B19)
22			
23	**Number of Highway Lanes - "HL"**		
24	Number of lanes	2	
25	"HL"	1.152576649	=EXP(0.142*(B23-1))
26			
27	**Highway Pavement - "HP"**		
28	Paved=1, Not paved=2	1	
29	"HP"	1	Fixed for gated crossings
30			
31	**Constant**	0.000575	Fixed for gated crossings
32	**Adjustment factor**	0.4921	Fixed for gated crossings
33			
34	**Number of accidents - first estimate**	0.044469386	=B8*B12*B16*B20*B24*B28*B30
35	**Adjusting factor**	10.58543982	=1/(0.05+B33)
36	**Number of Accidents at crossing in 5 years**	0	
37	**Number of accidents - revised estimate**	0.030203062	=((B33*B34)+B35)/(B34+5)

ANALYSIS WORKSHEETS

SAFETY BENEFITS (Module 6)
A. Number of Accidents by Severity

	B	C	D
3	Maximum timetable speed	55	
4	**Maximum speed factor fatal accidents**	0.018321	=C3^-0.9981
5	**Maximum speed factor casualty accidents**	0.252962	=C3^-0.343
6	Number of through trains	12	
7	**Through trains factor**	0.799584	=(C6+1)^-0.0872
8	Number of switch trains	4	
9	**Switch trains factor**	1.150668	=(C8+1)^0.0872
10	If urban then 1, else 0	1	
11	**Urban factor fatal accidents**	1.429179	=EXP(C10*0.3571)
12	**Urban factor casualty accidents**	1.34447	=EXP(C10*0.296)
13	Number of tracks	2	
14	**Track factor**	1.259355	=EXP(C13*0.1153)
15	**Number of predicted accidents**	0.030203	
16			
17	**Fatal Accidents**	0.000796	=C15/(1+440.9*C4*C7*C8*C11)
18	**Casualty Accidents**	0.005142	=C15/(1+4.481*C5*C7*C8*C12)
19	**Injury Accidents**	0.004345	=C18-C17
20	**Property Damage Only Accidents**	0.025061	=C15-C17-C19

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