Annual Rock Requirement Estimate: Granular Roads Asset Management System (GRAMS) User Manual

User Manual December 2019

IOWA STATE UNIVERSITY

Sponsored by Iowa Highway Research Board (IHRB Project TR-729) Iowa Department of Transportation (Intrans Project 17-615)

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User Manual December 2019

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TABLE OF CONTENTS

ACKN	OWLE	DGMENTS v	ii
1.	INTRO	DDUCTION	1
2.	INITIA	AL SETUP	1
	2.1 2.2	Security Warning Launching the GRAMS Tool	1 1
3.	REQU	IRED INPUT	2
	3.1 3.2	Editing Guidelines Input Parameters	2 3
4.	ROCK	REQUIREMENT ESTIMATES	4
5.	FINAL	REPORT	6

LIST OF FIGURES

Figure 1. Security warning notification	1
Figure 2. Introduction sheet	2
Figure 3. Editing guidelines	3
Figure 4. Input screen sheet	4
Figure 5. Inventory condition	5
Figure 6. Rock requirement estimates	
Figure 7. Total cost and risk curves for 100% network maintenance	6
Figure 8. Material cost and risk curves for 100% network maintenance	7
Figure 9. Summary of cost and risk for 100% network maintenance	7
Figure 10. User-defined maintenance range	8
Figure 11. Total cost and risk curves for user-defined network maintenance level	8
Figure 12. Material cost and risk curves for user-defined network maintenance level	9
Figure 13. Roadway network life cycle	9

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1. INTRODUCTION

The Iowa County Engineers Association (ICEA) Granular Roads Asset Management System (GRAMS) is a useful tool to estimate the annual rock requirements for efficient granular roadway network maintenance. It provides a quick estimation of annual rock and budget requirements using key parameters such as agency location, existing roadway inventory condition, rock quality, annual traffic, and engineering estimates. The GRAMS tool also approximates the risk level of the roadway system for various budget situations.

This manual provides step-by-step guidance for generating annual rock requirements using the GRAMS tool.

2. INITIAL SETUP

2.1 Security Warning

GRAMS is a Microsoft Excel-based tool that requires Excel macros to be enabled. Depending on the version of the operating system on which the tool is being used, various security warning messages may appear when the tool is first opened, as shown in Figure 1.

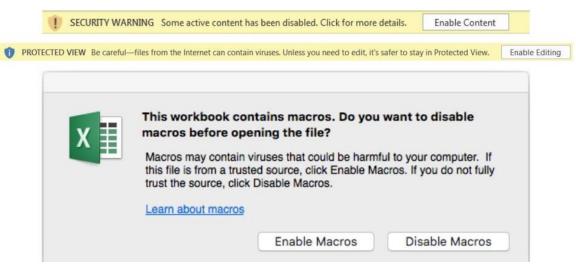


Figure 1. Security warning notification

Click either the **Enable Content**, **Enable Macros**, or **Enable Editing** button. Note that the user may not see any security warning if the computer is set up to enable macros automatically.

2.2 Launching the GRAMS Tool

An introduction sheet appears when the tool is first opened, as shown in Figure 2.



Welcome to Iowa County Engineers Association (ICEA) Granular Roads Asset Management System (GRAMS)

This tool is developed to help Iowa local agencies to approximate annual rock requirement to effectively maintain the granular roadway network. Local agencies can choose roadway treatment policy based on unique budget scenario and required level of service to determine amount of rock needed in terms of ton per mile (TPM).

GRAMS tool consists of two major section. User needs to provide agency specific local information in the input screen regarding the granular roadway inventory condition and cost information. Based on input data, the tool will generate annual rock requirement report.



Figure 2. Introduction sheet

This sheet provides basic information on each sheet of the GRAMS tool. Click the **Launch Tool** button to see the specific parameters needed for estimation.

3. **REQUIRED INPUT**

3.1 Editing Guidelines

Light yellow colored cells indicate that user input is allowed, and light green colored cells indicate inputs calculated from historical data. The inputs based on historical data will automatically be generated after the user provides a county name.

Please note: All light green colored cells are accompanied by corresponding light yellow colored cells. The user has the option to gain administrative access when the user does not agree with the inputs calculated from the historical data. To override these inputs, the user is required to edit only the light yellow colored cells, as shown in Figure 3.

Aggregate Properties	-
Los Angeles Abrasion (LAA) test result (%)	40.22% Do not edit!
Percentage fine than #200 sieve (%)	8.25% Historical Data.
or	
Los Angeles Abrasion (LAA) test result (%)	Note: Enter your estimation if you
Percentage fine than #200 sieve (%)	disagree with above mentioned values

Edit here if needed

Figure 3. Editing guidelines

3.2 Input Parameters

The following input parameters are required to estimate rock requirements in the GRAMS tool:

• County Information

- County Name
- Granular Roadway Network Size
- Average Width of Granular Roadway
- Percentage of Roadway with Very Poor Drainage

• Rock Quality Information

- Los Angeles (LA) Abrasion (%)
- Fines Content (%)

• Cost Information

- Material Cost
- Crushing Cost
- Hauling Cost
- Transportation Cost
- Placing, Grading, and Miscellaneous Cost

• Level of Service Information

• Thickness for 50% Level of Service

After clicking the Launch Tool button, the user sees the Input Screen sheet shown in Figure 4.



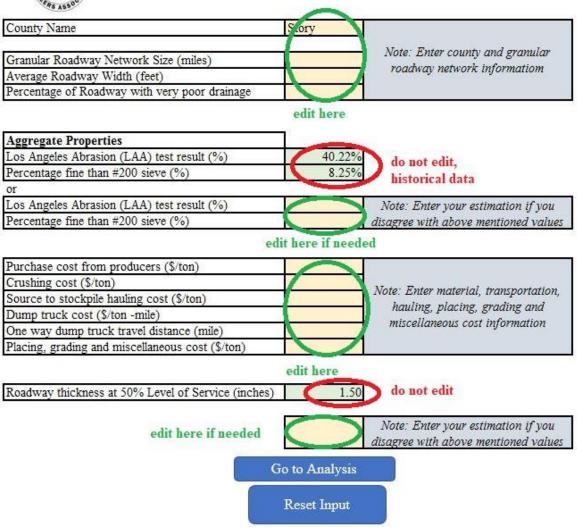


Figure 4. Input screen sheet

Within this sheet, the user can provide county, rock quality, cost, and level of service information. After inputting this information, click the **Go to Analysis** button to access the **Rock Requirement Estimates** sheet. The user can click the **Reset Input** button to clear all of the values entered.

4. ROCK REQUIREMENT ESTIMATES

In the **Rock Requirement Estimates** sheet, the roadway inventory condition must be entered manually to estimate the rock requirements, as shown in Figure 5. The user can also provide an annual gravel loss estimation if needed.

a wa court	GRAMS Inventory Condition]		
Roadway Condition	Thickness (inches)	Percentage of Granular Road Network	edit here	Estimate Rock Requirements
Excellent	over 5	10.00%		Reset Values
Good	4 to 5	10.00%	Vote: Enter granular	
Fair	3 to 4	10.00%	roadway network	Go Back to Input Screen
Poor	2 to 3	20.00%	nventory information	Go Back to input Scient
Jnacceptable	below 2	50.00%	do not edit	Proceed to Final
Annual Gravel Loss (inches)	0.86	do not edit		
it here if needed	\bigcirc	Note: Enter your estimation if you disagree with above mentioned value		

Figure 5. Inventory condition

Clicking the **Estimate Rock Requirements** button will generate the rock requirements, as shown in Figure 6.

Minimum Resurfacing Required (miles)	5.21				
	Range of Options	Aggregate Type 1			
Ton per Mile (TPM)	Rock Quantity (Ton)	Annual Cost (\$)	Material Cost (\$)	Level of Service (%)	System Performance
100	30,000	\$330,000	\$90,000	53.01%	Marginal
200	60,000	\$660,000	\$180,000	60.92%	Fair
300	90,000	\$990,000	\$270,000	68.41%	Fair
400	120,000	\$1,320,000	\$360,000	75.20%	Good
500	150,000	\$1,650,000	\$450,000	81.13%	Very Good

Figure 6. Rock requirement estimates

Here, the Minimum Resurfacing Requirements cell approximates the length of the roadway network, for which a thickness of less than 2 inches is assumed. In the range of options, the annual budget in terms of the total cost and material cost is shown, along with the risk level.

After reviewing this information, click the **Proceed to Final Report** button. The user can click the **Reset Values** button to clear all of the values entered and click the **Go Back to Input Screen** button to change the input values.

5. FINAL REPORT

In the final report, Graphs A and B simulate what-if scenarios for the budget and the percentage of the system at risk when 100% of the granular roadway network is maintained annually, as shown in Figures 7 and 8 for the total and material costs, respectively.

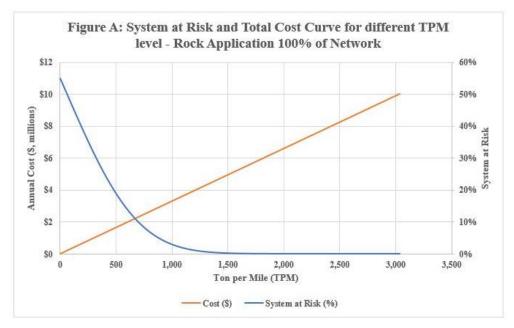


Figure 7. Total cost and risk curves for 100% network maintenance

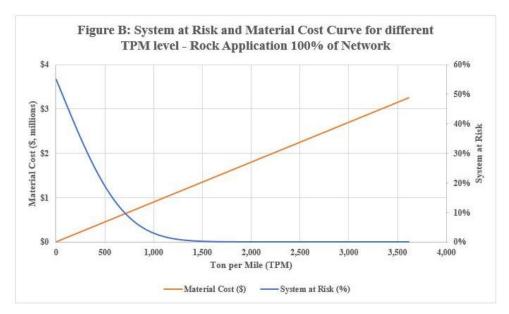


Figure 8. Material cost and risk curves for 100% network maintenance

A summary of Graphs A and B is also tabulated for convenience, as shown in Figure 9.

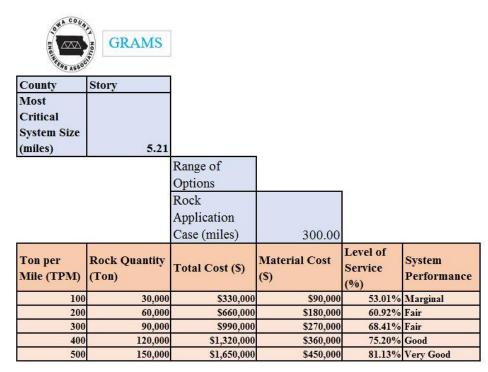


Figure 9. Summary of cost and risk for 100% network maintenance

The user can define how much of the roadway network will be maintained in a given year in the light yellow colored cell shown in Figure 10.

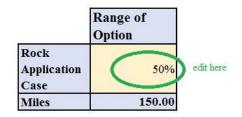


Figure 10. User-defined maintenance range

Graphs C and D provide the percentage of the system at risk, the budget, and the rock requirement estimations for the user-defined roadway maintenance level, as shown in Figures 11 and 12 for the total and material costs, respectively.

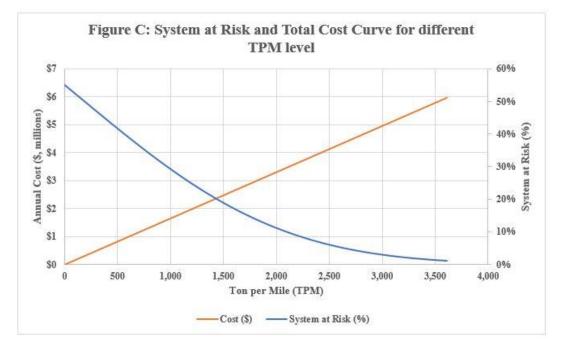


Figure 11. Total cost and risk curves for user-defined network maintenance level

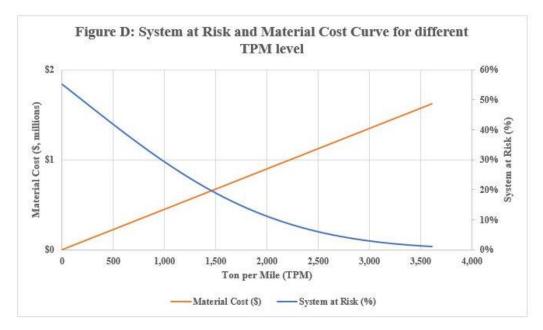


Figure 12. Material cost and risk curves for user-defined network maintenance level

Graph E, shown in Figure 13, simulates a time series curve to predict when the roadway system will collapse under the scenario in which no maintenance activity is performed.

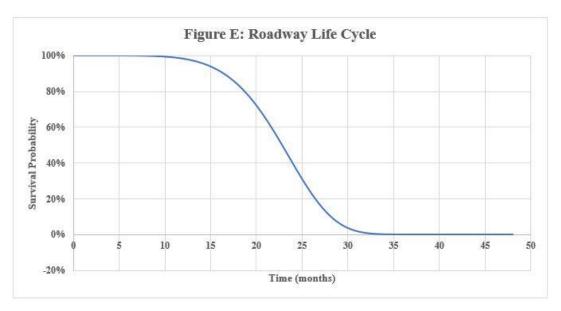


Figure 13. Roadway network life cycle

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