Engineering Analyses of Motorized Mixed Use Analysis: National Forest Roads in Idaho

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<u>DfA, р.с.</u>



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Basis for Mixed-use Analysis is....?

What is an RSA/R?

An evaluation of a roadway by a team

- Focused on safety
- Proactive rather than reactive
- An evaluation of the "whole" picture including traffic distribution and environmental conditions





What an RSA is <u>NOT</u>

- A tool to check for standards compliance
- A tool to "rate" a project
- A tool for accident investigations





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Why Perform an RSA?

Definable Benefits include:

- Identify overlooked safety opportunities
- Roadway safety at/above minimum standards
- Reduce roadway life cycle costs
- Incorporate multi-disciplinary input
- Consistent safety focus throughout project development process





Also....



Liability

The Design Immunity Exception and the associated rise in liability and risk



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Design Immunity Exceptions

... approval of a plan or design was arbitrary, unreasonable, or made without adequate consideration

... plan or design was prepared without adequate care

... project contained an inherent, manifestly dangerous defect(s) or was defective from the beginning of actual use

... changed conditions demonstrate the need for additional remedial action





Common Sense RSA – Step by Step

- 1. Determine team makeup
- 2. Provide team with roadway/project data
- 3. Conduct field review/inspection
- 4. Discuss inspection findings
- 5. Write and distribute audit report





How do RSAs Reduce Risk?

- Document a systematic review of roadway safety concerns
- Identify high accident locations
- Identify solutions to safety concerns
- Develop a safety improvement plan
- Improve public communications regarding roadway safety





When to Conduct an RSA?

- Feasibility/Planning Stage
- Preliminary Design Stage
- Final Design Stage
- Construction Stage
- In-Service





So, What are we talking about?





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Evaluate risk due to SB 1098, and likely effect of training requirement (future legislation)

Develop an analysis methodology and field data collection procedure to enable analysis of each road segment for

- Crash probability and
- Crash severity of mixed use crashes.







Create a decision matrix that categorizes risk and indicates potential mitigation based on different threshold criteria (traffic volume, speed, type, and mix; road surface, width, alignment, geometry, etc; OHV use and type);





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Where are these roads?





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Determine Team Makeup

- Matt Ulberg, PE Roadway Design and Geometrics Traffic Safety
- Bob Powell, PE R4 Roads Engineer, USFS Retired Safety and Roadway Operations and Maintenance

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 Mike Noland R3 USFS Retired Signing and Safety

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Review USFS Guidance

United States Department of Agriculture

Forest Service

Technology & Development Program

7700-Transportation Management 0577 1205-SDTDC December 2005

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Guidelines for Road Maintenance Levels



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Review USFS Guidance

Forest Service Handbook

- FSH 7709.55 Chapter 20: Travel Analysis
- FSH 7709.55 Chapter 30: Engineering Analysis

Road Systems Operation and Maintenance HB

- FSH 7709.59 Chapters 10-60
- Guidelines for Engineering Analysis of Motorized Mixed Use on National Forest System Roads EM 7700-30
 - No analysis procedures identified
 - No standards for documentation
 - Did not consider non-licensed or underage operators



Flow Chart

Figure 6: Analysis Flow Chart







Obtain and Review Available Data

- Forest Service Roads Managers
- Maintenance personnel
- DOT Crash Records
- County Records: Traffic, Crashes, interviews





Analysis Methodology and Field Data Collection

- Identify Critical geometric and operational criteria
- Review multiple road segments to determine threshold values for ratings
- Correlate observed elements with crash records if possible
- Set up evaluation Matrices and Data Sheets
- Collect Field Data





INCIDENT PROBABILITY

Table 1: Incident Probability Likely Seldom/Unlikely Frequent Possible Element/ Criteria 4 3 2 1 Value Notes Overlap allowed to account for specific site Traffic conditions, including user mix, surface type, and Speed 45+ 30-50 15-40 0-25 surface condition Volume (ADT) >600 350-600 100-450 <150 AASHTO Very Low Vol < 400 vpd ISD* Inadequate NA NA Adequate note specific locations, reasons for inadequacies SSD** NA NA Inadequate Adequate Noted alignment deficiencies. Note changes in roadway character and context. Horizontal often terrain driven. Violates Consistent character and Inconsistent, sharp curves NA Be aware of need for signage prior to these driver expectancy at one or curvature Alignement changes. more locations. Frequent and Likely Probabilities are similar, as Single lanes can be safer than 1.5 lane roads. Roadway Judgment is required based on overall road Road Width <14'. or 14'<width<18' 16'<width<22' <14', or 14'<width<18' >20' character. Mitigation to road width is unlikely unless road improvements are programmed that include turnouts and/or curve widening. Road width <18', Inadequate turnouts. Inadequate sight Ask USFS Road Supervisor if in question on Road width <18'. Pullouts lines along alignment, NA NA adequacy of turnouts adequate turnouts warranting turnouts for safe two-way operation Paved in very poor condition, Agg Surface in good or Aggregate with Rough Aggregate surface, If higher speeds are present, elevate rating for Road Surface Paved Surface condition, or surface Intermediate Corrugations. or cobble corrugated surfaces Consistently Corrugated only present on curves Yes, on paved surface with Underage/ Yes, on paved surface, Legal little commercial traffic, Yes, on aggregate surfaced Specific to Idaho - Judgment required regarding Unlicensed Allowed and/or frequent commercial Not Allowed the effects of traffic mix and surface type. possibly aggregate surface road vehicle presence with little commercial traffic

Footnote: Consider Crash History: Increase Probability Score for any individual Criteria attributed to a crash causal factor.

* Intersection Sight Distance

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** Stopping Sight Distance





INCIDENT SEVERITY

Table 2: Severity Rating														
Eler	ment/Rating	Catastrophic 4	Major 3	Moderate 2	Minor 1	Notes								
dside	Roadside Character	Cut-side Cliffs, water, etc.	Large Trees, unshielded bridge ends, large rocks	Yielding vegetation and trees < 6" dbh	Not Present	Rock Buttressing and MSE Wall = 4, General condition 2 and 3								
Road	Slope and Height	Unshielded vertical drops (downhill side cliffs)	Side slopes > 1V:2H, vertical drops < 2.5'	Traversable Slope ~1V:2H	Recoverable Slope, < 1V:3H	Rock Buttressing and MSE Wall = 4, General condition 2 and 3								
Traffic	Traffic Type	Commercial Truck Traffic Present	Known occurrence of Commercial Truck Traffic, though seasonal or only during short periods	Recreational Traffic with Trailers, large campers, motorhomes	Mixed Recreational Traffic	General Condition =1, occasional 3, closures with commercial haul are expected								
	Speed (mph)	40+	30-50	15-40	0-25	Moderate (2)due to vegetative growth and brushing issues								





COMPOSITE RISK

Tab	le 3: Composit	e Risk	Probability Rating												
A	Assessment Ma	ıtrix	Frequent 4	Likely 3	Possible 2	Unlikely 1									
	Catastrophic	4	Extreme (16)	Very High (12)	High (8)	Medium (4)									
erity	Major	3	Very High (12)	High (9)	Medium (6)	Medium (3)									
Seve	Moderate	2	High (8)	Medium (6)	Medium (4)	Low (2)									
	Minor	1	Medium (4)	Medium (3)	Low (2)	Low (1)									

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Flow Chart

Figure 6: Analysis Flow Chart









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Data Sheet

US	USFS Mixed Use Analysis Data Sheet														
Fo	Forest: <u>Nez Perce/Clearwater</u> Road(No)														
Tra	raffic														
	Rating Value	4	3	2	1										
	Speed	45+	30-50	15-40	0-25										
	NOTE : Overlap allowed <u>to account</u> for specific site conditions, including user mix, surface type and surface condition														
	Rating Value	4	3	2	1										
	Volume (ADT) NOTE: AAS	>600 HTO Very Lo	350-600 w Vol ~400 ypd	100-450	<150										
Ro	Roadway														
	4- Inadequate		1- Ad	equate											
мот	E: Note discuss (+ pho	to) specific loc	cations, reasons for in	adequacies											
	SSD** 4- Inadequate		1- Ad	equate											

Horizontal Alignment: Noted alignment deficiencies are often terrain driven.

4. Violates driver expectancy at one or more locations.

- 3. Inconsistent, sharp curves
- 2. (mitigation value only: "3" can be mitigated to a "2" with signing, physical improvements)
- 1. Consistent character and curvature

Note changes in roadway character and context. Be aware of need for signage prior to these changes.

Road Width 4, <14', 14'<width<18' 3. <14', 14'<width<18' 2. 16'<width<22' 1. >20'



NOTES: Frequent and Likely Probabilities are similar, as Single lanes can be safer than 1.5 lane roads. Judgment is required based on overall road character. Mitigation to road width is unlikely unless road improvements are programmed that include tumouts and/or curve widening.



Data Sheet

USFS Mixed Use Analysis Data Sheet	2012
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 Pullouts
 4. Road width <18'. Inadequate turnouts. Inadequate sight lines along alignment, warranting turnouts for safe two-way operation</th>

 3. NA
 2. NA

 1. Road width <18', adequate turnouts, or width > 18'

 NOTES: Ask USFS Road Supervisor if in guestion on adequacy of turnouts

Le	egal	

Underage/	
Unlicensed	
Allowed	4. Yes, on paved surface, and/or significant commercial vehicles present
	3. Yes, on paved surface, or aggregate surface with little or no commercial traffic
	2. Yes, on unpaved or aggregate surfaced road
	1. Not Allowed
	NOTE: Specific to Idaho

NOTES:





Roadway Data

Basic Volume Report: NEZ1

Version Number : 0.06
Serial Number: 55049
Number of Lanes : 2
Posted Speed Limit :

				Lane	e #1 Configuration	
# Dir.	Information	Volume Mode	Volume Sensors	Divide By 2	Comment	
1	WB					8

Lane #1 Basic Volume Data From: 18:00 - 09/03/2010 To: 08:59 - 09/07/2010

Date	DW	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	Total
090310	F																			4	1	2	1	2	2	12
090410	S	0	3	0	1	0	0	0	0	2	5	3	6	22	8	10	8	10	3	5	4	2	0	1	0	93
090510	S	2	0	0	0	0	0	1	0	1	8	4	6	18	12	15	5	10	5	4	2	1	0	0	0	94
090610	м	0	0	0	0	0	0	0	1	1	0	2	2	4	3	9	3	2	1	4	1	0	0	0	0	33
090710	Т	0	0	0	0	0	0	0	0																	0
Month T	otal :	2	3	0	1	0	0	1	1	4	13	9	14	44	23	34	16	22	9	17	8	5	1	3	2	232
Per	roent :	1%	1%	0%	0%	0%	0%	0%	0%	2%	6%	4%	6%	19%	10%	15%	7%	9%	4%	7%	3%	2%	0%	1%	1%	
1	ADT :	1	1	0	0	0	0	0	0	1	4	3	5	15	8	11	5	7	3	4	2	1	0	1	1	73

	Sun	Mon	Tue	Wed	Thu	Fri	Sat		Total	Percent
DW Totals :	94	33	0	0	0	12	93	Weekday (Mon-Fri) :	45	19%
# Days :	1.0	1.0	0.3	0.0	0.0	0.3	1.0	ADT :	28	
ADT :	94	33	0	0	0	48	93	Weekend (Sat-Sun) :	187	81%
Percent :	41%	14%	0%	0%	0%	5%	40%	ADT :	94	





Roadway Data





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Flow Chart

Figure 6: Analysis Flow Chart







What kinds of Forest Roads are relevant to the analysis?





Road Maintenance Level 4



Figure 11-Maintenance level 4 road with single lane, gravel surface, and gravel shoulders.





Maintenance Level 3



Figure 13-Maintenance level 3 road with single lane, gravel surface, and gravel shoulders.





Maintenance Level 3



Figure 19-Maintenance level 3 road with single lane, gravel surface, and no shoulders.





Maintenance Level 2 NOT analyzed



Figure 23—Maintenance level 2 road with single lane and native surface.





Summary Tables

TABLE 4:									L.	daa		h-h-10				5.00	meite	Batio		t or contraction		Roadvide Composite Ratinza										le Com	Parformance Measure								
Nez P	erce-Clearwater National Forest Road	as		<u> </u>			-	-		-+	-		10	aden	t PTO	Dabili	tγ	-	_	24	verny	sating	t Ave.	sevenny	Ή.		- "	CORD'S DE	Compo	site nat	nga			<u> </u>	1740	ic com	pasibe in	atings		Performan	ce measure
Road No.	NAME	Paved	Non Paved	BMP	EMP	LENGTH	% Trucks	WIDTH 1	WIDTH 2	LANES	Speed (average)	Speed (85%)	ADT	8		HOL AIGN.	Pulloute	Surface	Underage	Rua delide	Sique	Traffic Type Second	Av. Rdskie	Aw. Traffic	Strawd	ADT	8	85	Hora. Align.	uppy the	Puliputs	Surface	agenabel	Speed	ADT	05	055	Horz. Align.	Rd. Wdth	Roadside Composite Numeric Average (Total)	Traffic Composite. Numeric Average (Total)
	Field Data			16.5	6.3	10.2	6%	19	23	2	27.5	33.3	90	1.1																											
16	Lolo Creek Road																																								
ŝ	(average-risk locations) Lolo Creek Road	x			+	+		+		\vdash	2	2	2	1 .	1	1 1	1	3	3	z	2	2 2	2.0	2.0	6.	9 4.0	2.0	2.0	2.0	2.0	2.0	4.0	6.0	6.0	4.0	2.0	2.0	2.0	2.0	3.5	3.0
9,1	(MITIGATED average-risk locations)	х									2	2	2	1	1	1 1	1	3	2	2	2	2 2	2.0	2.0	-4,	0 4.0	2.0	2.0	2.0	2.0	2.0	6.0	4.0	4.0	4.0	2.0	2.0	2.0	2.0	3.1	2.7
11	Lolo Creek Road (NIGH-risk locations)	×						1			3	3	3	4		1 1	1	3	3	2	2	3 3	2.0	2.5	6	6.0	8.0	2.0	2.0	2.0	2.0	6.0	6.0	7.5	7.5	10.0	2.5	2.5	2.5	4.4	5.4
8	Lolo Creek Road			\vdash	\vdash	<u> </u>	\vdash	+			-	-	-		1	+	-			Ē	-				1																
<u> </u>	(MITIGATED HIGH-risk locations)	х									3	3	3	1	1	1 1	1	3	2	2	2	2 2	2.0	2.0	6.	0 6.0	2.0	2.0	2.0	2.0	2.0	6.0	4.0	6.0	6.0	2.0	2.0	2.0	2.0	3.6	3.3
<u> </u>	Eold Data				0.0		494	16	10		34	10	20		Т		Т	Т	Т	Т	П		—	T	Π			—	T -	T -			<u> </u>			<u> </u>	<u> </u>	<u> </u>	<u> </u>		
š.	Smith Creek Road			0.0	0.0	0.0	436	10	40	4	41	20	200	-							+		-		H	-															
ě.	(average-risk locations)		х					<u> </u>			2	1	1	1	1	1 2	1	2	3	2	2	2 2	2.0	2.0	-4.	0 2.0	2.0	2.0	2.0	4.0	2.0	4.0	6.0	4.0	2.0	2.0	2.0	2.0	4.0	3.1	2.7
Ĩ	(MITIGATED average-risk locations)		×				1	1			2	1	1				1	1	2	2	2	2 2	2.0	2.0	4	2.0	2.0	2.0	2.0	4.0	2.0	2.0	4.0	4.0	2.0	2.0	2.0	2.0	4.0	2.7	2.7
101,	Smith Creek Road Road			\vdash	\vdash	\vdash	\vdash	+				-	-	-	+		-	-	-	-	-																				
18	(HIGH-risk locations)		х		<u> </u>	<u> </u>	_				3	3	3	4 :	1	1 3	1	2	3	3	3	3 3	3.0	3.0	9.	9.0	12.0	3.0	3.0	9.0	3.0	6.0	9.0	9.0	9.0	12.0	3.0	3.0	9.0	7.0	7.5
æ	(MITIGATED HIGH-risk locations)		x					1			3	3	3	1	1	1 2	1	2	2	3	3	2 3	3.0	2.5	2	9.0	3.0	3.0	3.0	6.0	3.0	6.0	6.0	7.5	7.5	2.5	2.5	2.5	5.0	5.3	4.6
					_		_	_									_			_																					
	Field Data			0.0	13.0	13.0	<4%	14	16	1.5	15	19	<50																												
2	O'Hara Road																																	2.0							
3 E	O'Hana Road Road			\vdash	\vdash	+	\vdash	+		\vdash	1	-	1	-	-		-	-		-	3	3 3	3.0	2.0	3.	0 0.0	3.0	3.0	3.0	6.0	3.0	6.0	9.0	2.0	4.0	2.0	2.0	2.0	4,0	4.7	2.1
551,	(MITIGATED average-risk locations)		х					<u> </u>			1	1	1	1	1	1 2	1	1	2	2	2	2 1	2.0	1.5	2.	0 2.0	2.0	2.0	2.0	4.0	2.0	2.0	4.0	1.5	1.5	1.5	1.5	1.5	3.0	2.4	1.8
200	O'Hana Road Road (HIGH-risk locations)		x					11	14	1	1	1	2	1	1	1 4	1	2	3	4	4	3 1	4.0	3.5	4.	0 8.0	4.0	4.0	4.0	16.0	4.0	8.0	12.0	3.5	7.0	3.5	3.5	3.5	14.0	7.1	5.8
œ	O'Hana Road Road				\square	\vdash	\vdash			-																															
<u> </u>	(MITIGATED HIGH-risk locations)		х								1	1	2	1	1	1 2	1	2	2	3	3	3 1	3.0	2.0	3.	0 6.0	3.0	3.0	3.0	6.0	3.0	6.0	6.0	2.0	4.0	2.0	2.0	2.0	4.0	4.3	2.7
*	Field Data			0.0	7.2	7.2	4%	16	22	2	22	27	78	Т	Т	Т	Т	Т	Т	Т	П				Π																
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ų.	(average-risk locations) Lightening Creek Board Board		х	┣		4.0		+			1	1	1	1 :	1	1 2	1	2	3	2	3	3 1	2.5	2.0	2.	5 5.0	2.5	2.5	25	5.0	2.5	5.0	7.5	2.0	4.0	2.0	2.0	2.0	4.0	3.9	2.7
NUR.	(MITIGATED average-risk locations)		х								1	1	1	1	1	1 2	1	1	2	2	2	2 1	2.0	1.5	2.	0 2.0	2.0	2.0	2.0	4.0	2.0	2.0	4.0	1.5	1.5	1.5	1.5	1.5	3.0	2.4	1.8
44,1	Lightening Creek Road Road		~			4.0			10															2.0					20		2.0	6.0		2.0	6.0	2.0	2.0	2.0		5.0	4.5
6 pe	Ughtening Creek Road Road		~	-	-	4.0	+	16	10	\vdash	1	+	6	*	-		1	2	- 3	3	4	- 1	3.0	3.0	3.	0 6.0	3.0	3.0	3.0	9.0	2.0	6.0	9.0	3.0	6.0	3.0	3.0	3.0	9.0	5.0	4.5
8	(MITIGATED HIGH-risk locations)		x	1	1	1	1	1		I	1	1	2	1	1	1 2	1	2	2	8	3	3 1	2.0	2.0	2	9 40	2.0	2.0	2.0	4.0	2.0	4.0	4.0	2.0	4.0	2.0	2.0	2.0	4.0	2.9	2.7



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orized Mixed Use Analysis: Nez Perce-Clearwater National Forest Roads Region 1

Road 651 O'Hara

This segment is a single to 1 ½ lane road varying between 11 ft and 16 ft wide with turnouts. The aggregate surface is in good condition, and there are 1½:1 cuts and the fill side is sometimes unshielded, with erosion on the fill slope in areas such as MP 6.25, where the loss of section is in an ongoing failure that constitute a structural, maintenance and safety problem. This slump needs to be evaluated and a repair action designed and constructed.

The roadside has significant vegetation adjacent to the road, much of which should be regularly brushed. This area sees significant precipitation, and supports a lot of vegetation. The road has a steady winding alignment, with adequate, but tight sight distance for the majority of the road segment.

No ATV trail junctions were noted on this segment, but there was some evidence of OHV use along the road. There are few access roads intersecting this segment. Washboards and potholes were not noted, but over time minor corrugation would be expected on this road. The road generally meets 15-25 MPH sight distance, with an average speed of 15-20 mph as observed and travelled during the field review. Slower speeds are likely on sections of road as sight distance and approaching vehicle visibility is reduced due to vegetation or alignment.

No excessive speeds were observed during the field review.

The road is accessed via the Selway road, and a non-standard Speed Limit sign on Selway Road near <u>Fenn</u> Ranger Station.

Replace post and sign with R2-5 (20) at proper height.



Prepared by: M. A. Ulberg Date: 6-28-2012

Approved by_____ Date (USFS qualified engineer)

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Motorized Mixed Use Analysis: Nez Perce-Clearwater National Forest Roads Region 1

MP 1.07 - Brushing needed for Object Marker (Type 3) visibility at bridge end.



Maintenance attention: MP 2.43, Cut-slope slump into road at MP



- The curve sign for downhill traffic (below) is partially obscured by brush. Minor maintenance brushing needed.
- No matching sign for uphill traffic is currently installed. Installation of a symmetrical sign for uphill traffic should be considered near MP 4.2.



Prepared by: M. A. Ulberg Date: 6-28-2012

Approved by_____ (USFS qualified engineer) Date:



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Some things are just beyond the scope of Mixed Use Analysis







Others are in the "sweet spot"





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"Barney Fife" speed limits....

































ROAD CLOSED Except Snowmobiles & ATV All Other Vehicles Will Be Subject To A \$500.00 Fine Idaho Code 19-622



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Numerous Problems

- Signage
- Brushing needs
- Roadside hazards
- Alignment concerns
- Unauthorized access
- OHV/ATV Use patterns
- Blind/Oblique to mainline





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Follow through with mitigation recommendations in reports











Bottom Line...

- Stay active and involved in Legislative process
- Review bill draft and testify in committees
- Realize that existing guidance may not address situations that need analysis.
 - Guidelines for Engineering Analysis of Motorized Mixed Use on National Forest System Roads EM 7700-30
 - FSH 7709-55

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• http://www.fs.fed.us/eng/transp/em770030.htm

An ounce of prevention is worth a pound of cure!





Take-home: Don't be blind to the effects of poor legislation....





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