

Railroad Casualties & Trespass Epidemic



Roger Smock- NCDOT



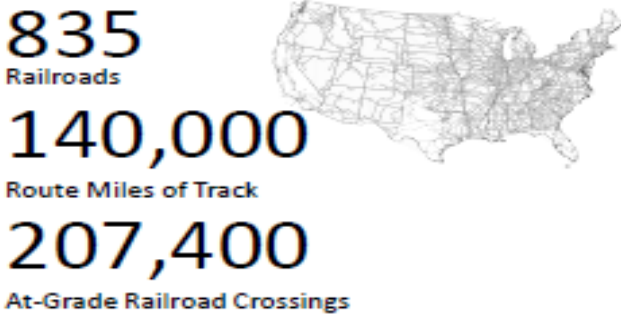
What is NCDOT BeRailSafe?

NCDOT safety outreach program created to prevent rail-related deaths and injuries in North Carolina.

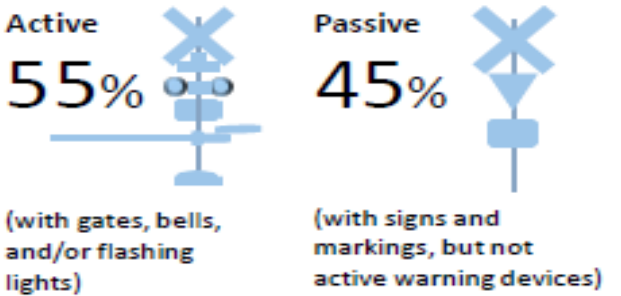
NC only state with an outreach dedicated to rail countermeasures



The U.S. Railroad System



Public Crossings in the U.S.



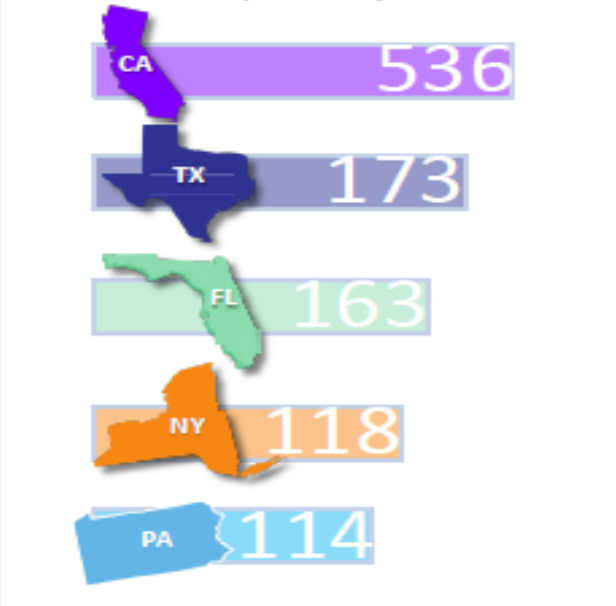
Stop! Trains Can't!



5-Year Trespassing Trends



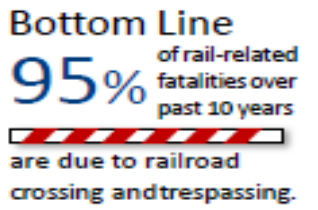
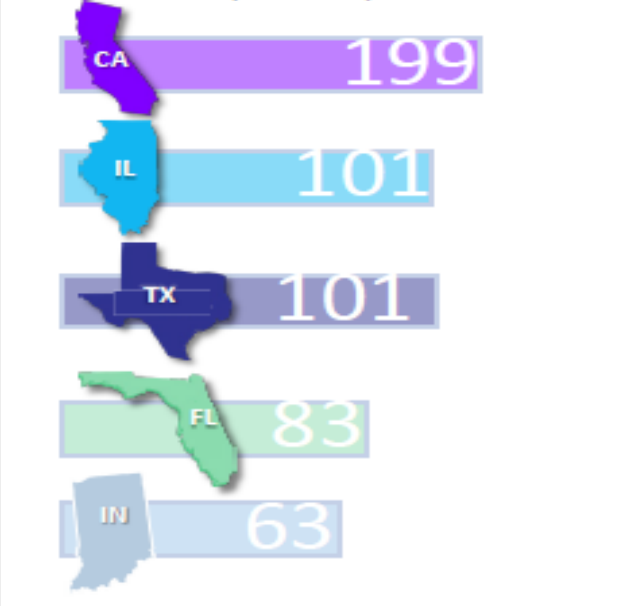
Top 5 for Trespassing Fatalities (2015—2019)



5-Year Crossing Trends

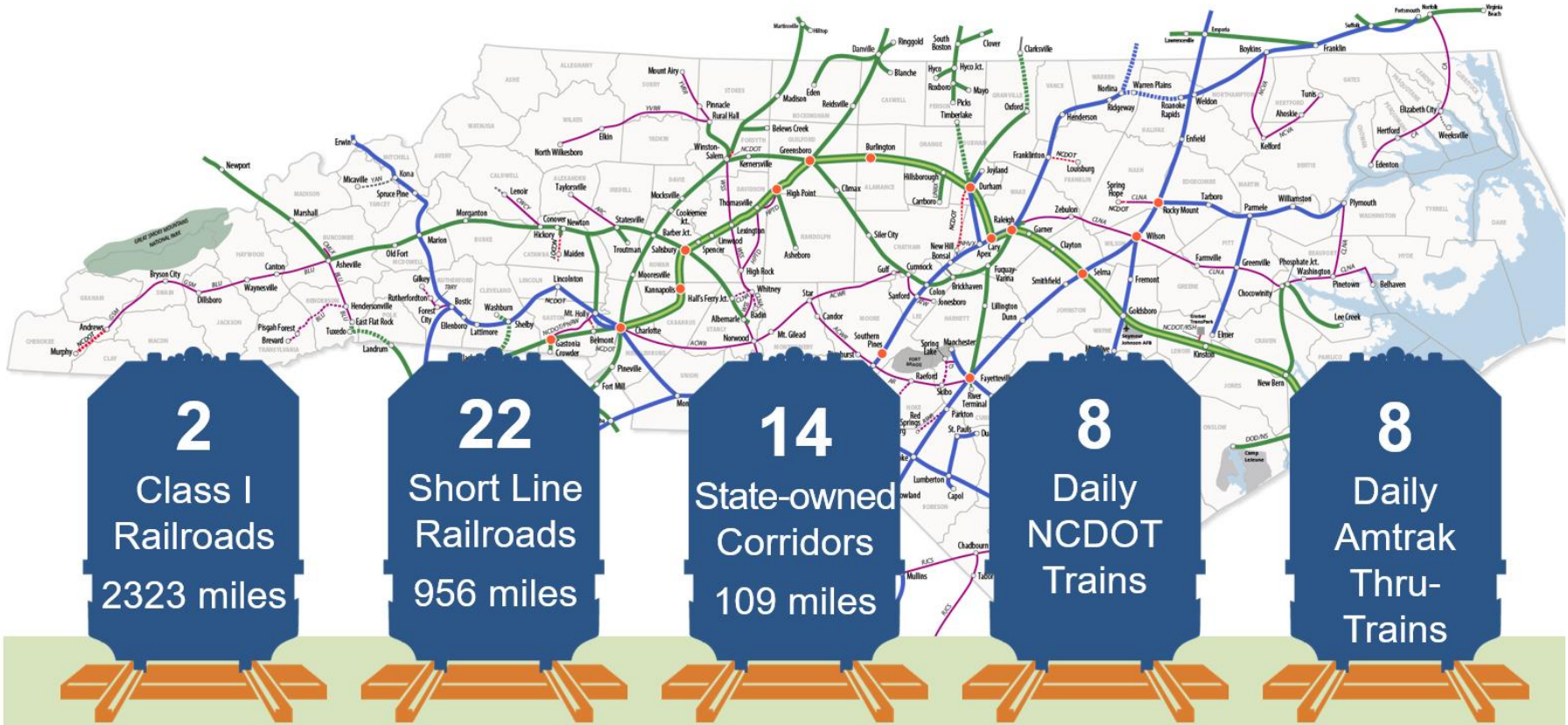


Top 5 for Crossing Fatalities (2015—2019)





Railroads Operate in 86 NC Counties



Direct Economic Impacts for Freight and Passenger Rail in North Carolina – \$1,875M

Freight – \$1,754M, Passenger – \$121M

Source: North Carolina Comprehensive State Rail Plan, 2015

U.S. RAIL INCIDENTS

- A RAIL RELATED INCIDENT EVERY 3 HOURS
 - Person or vehicle struck
- A DEATH EVERY 10.6 HOURS

U.S. RAIL INCIDENTS

- U.S. crossing crashes
- 1981= 9,317 ~702 Fatalities
- 2020= 1901 ~ 198 Fatalities
- 80% decrease crashes
- 72% decrease fatalities*
- * trending up 26% 2015-2019

U.S. RAIL INCIDENTS

- U.S. trespass fatalities
- 1981-1985 = avg. 434
- 2019 = 535
- 19% avg. increase 39 years
- NC top 10 nationally in trespass fatalities
 - 2011-2020 averaging 7th nationally
 - Annual fatalities since 1980-upper teens/ low 20s

Not a recent concern

- Scientific American, 2 July 1910

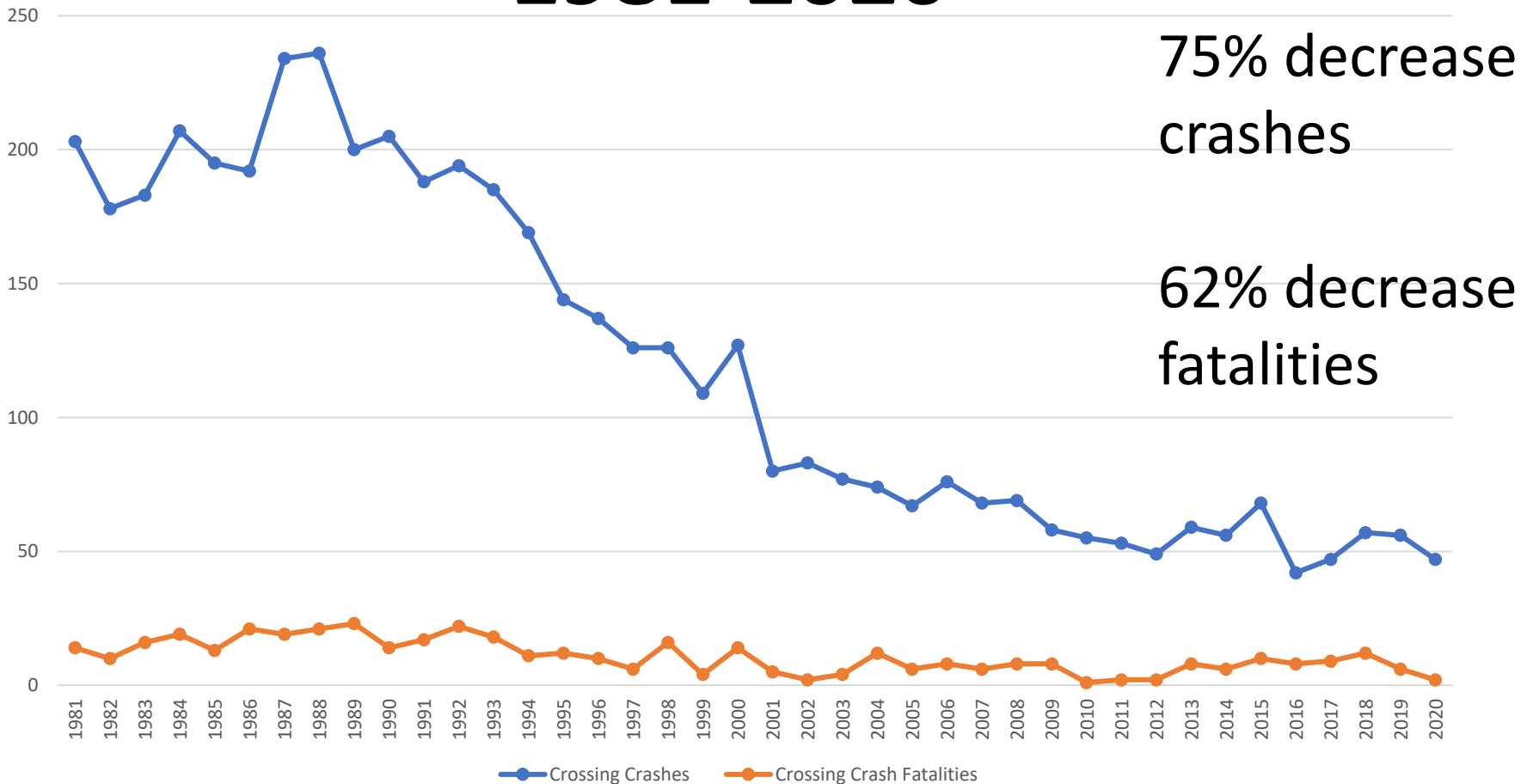
THE ANNUAL SLAUGHTER OF TRESPASSERS ON RAILROADS.

IT is not generally understood how large a proportion of the deaths and injuries on the railroads of this country is due to the risks willfully taken by trespassers who persist in using the right-of-way as a public thoroughfare. The annual reports of the Interstate Commerce Commission for the past eleven years show that, during this

In 1907 there were 5,612 trespass fatalities,
@ 15 per day...

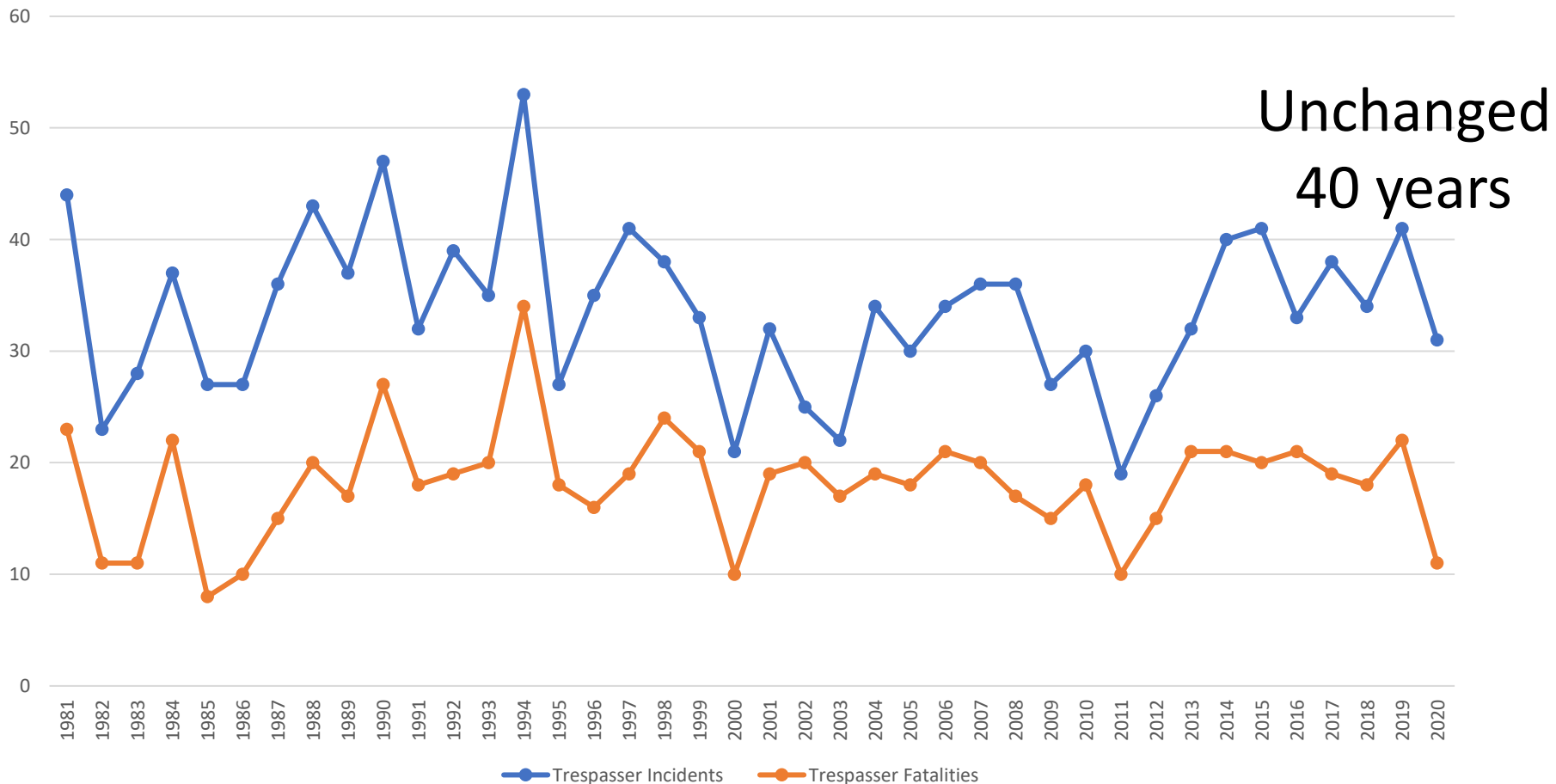


NC Crossing Crashes and Fatalities 1981-2020





NC Trespasser Incidents and Fatalities 1981-2020





Crossing Crashes down Trespass incidents up

- Why?
- Overlooked issue/ lack of awareness
- No systemic programmed education
- Social conditioning/ beliefs
- Low/no enforcement- victimless crime?
- No systemic countermeasure programs
- Contributors-Zoning, planning by MPOs & others?



Victim or Criminal?





NCDOT Committed to Rail Safety -funded rail research projects

- **NC/2015-18 Reduction in Railroad Right-of-Way Trespassing Incidents**
- **NC/2017-15: Rail Corridor Trespass Severity Assessment**
- **NC/2019-08: Rail Network Trespass Statewide Severity Assessment and Predictive Modeling**
- **NC/2019-50: Pedestrian Incident Detection using Artificial Intelligence (Software Implementation)**
- **NC/2020-50: Pedestrian Incident Detection using Artificial Intelligence**
- **NC/ 2020-44: Comprehensive Cost of Rail Incidents in North Carolina**
- **Technical Assistance Requests- study & analyze certain acute needs**
- **Technology Transfer Program- move the research to the end user**



NC/2019-08 Rail Network Trespass Statewide Severity Assessment and Predictive Modeling

- Sarah Searcy, primary investigator
 - Bicycle and Pedestrian Program Manager- ITRE

ACCESS THIS RESEARCH at NCDOT R&D Site.

<https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2019-08>

PDF.

https://connect.ncdot.gov/projects/research/RNAProjDocs/RP%202019-08_Final%20Report.pdf



NC/2019-08 Rail Network Trespass Statewide Severity Assessment and Predictive Modeling

Similar to: NC/2017-15: Rail Corridor Trespass Severity Assessment

- 6 camera sites, motion activated, 24/7 recording
- Four years of data
- Expanded the demographic/census data
- Builds upon all data to create predictive models
- Developed profiles of trespassing activity by season, month, day, and hour of day
- Profiles important to inform local-level intervention strategies

Thermal Camera- motion activated

Solar Panel

Battery Box- (plastic ammo can)







Camera Sites and Activity



NCDOT 2019-08 Project Final Report

Latitude	Longitude	Site	Number of Events	Number of Dates with Events	Number of Dates with No Events	Total Dates	% of Dates with Events	Average Number of Events per Date
35.26484	-80.88366	Charlotte	525	65	1	66	98%	8
35.99461	-78.90190	Durham	1,104	67	2	69	97%	16
36.10044	-79.50804	Elon	4,638	111	28	139	80%	42
35.26476	-81.19401	Gastonia	396	62	4	66	94%	6
36.06946	-79.78339	Greensboro	2,912	69	0	69	100%	42
34.61783	-79.01216	Lumberton	875	45	4	49	92%	18
36.09700	-79.27110	Mebane	1,978	61	0	61	100%	32
35.78313	-78.66521	Raleigh	496	52	2	54	96%	10
35.92995	-77.80037	Rocky Mount	978	48	1	49	98%	20
35.66734	-80.46552	Salisbury	28	14	26	40	35%	2
35.29779	-81.52864	Shelby	1,640	58	1	59	98%	28
Grand Total			15,570	Average Number of Events per Day: 24				

Exhibit 9. Total Number of Trespassing Events and Dates Observed by Site



Activity Summary of Camera Sites

7	Rocky Mount	978	48	1	49	98%	2
2	Salisbury	28	14	26	40	35%	2
4	Shelby	1,564	38	1	33	99%	2
Grand Total		15,570	Average Number of Events per Day: 24				

Number of Trespassing Events and Dates Observed by Site

4-years camera site data

Thermal cameras at 11 trespasser paths across NC

721 observation days

652 days of trespasser activity

15,570 documented individual trespassing events

- 95% involved crossing tracks

- 5% involved movement along the track

- 3 seconds- median time on the tracks



Trespass Duration Summary & Distance TO Crossing

Site	Median Time on Tracks (Seconds)	Maximum Time on Tracks (Seconds)	Minimum Time on Tracks (Seconds)	Number of Events with Arriving Train	% of Events with Arriving Train	Distance (Feet)* and Description** to Authorized Crossing
Charlotte	6	46	1	24	5%	241' to S. Hoskins Rd. at-grade crossing
Durham	2	270	1	6	1%	165' to Blackwell St. at-grade crossing
Elon	2	604	1	28	1%	390' to S. Williamson Ave. at-grade crossing
Gastonia	8	222	2	9	2%	343' to N. Trenton St. at-grade crossing
Greensboro	8	1,641	1	40	1%	703' to Washington St. at-grade crossing
Lumberton	6	731	1	11	1%	808' to MLK Jr. Dr. at-grade crossing
Mebane	2	474	1	11	1%	398' to N. Third St. at-grade crossing
Raleigh	12	1,296	2	22	4%	726' linear, 854' reasonable walking path through the perimeter of Pullen Park to Pullen Rd. separated crossing**
Rocky Mount	2	333	1	9	1%	1504' linear, 1700' reasonable walking path via Washington St. to Bennett St. at-grade crossing**
Salisbury	30	165	3	0	0%	420' north to E. Kerr St. at-grade crossing or 420' south to E. Council St. at-grade crossing
Shelby	3	602	1	4	<1%	176' to E. Lineberger St. at-grade crossing
Overall	3	1,641	1	164	1%	

*Distances measured with Google Maps distance tool from the camera location to the edge of pavement on the nearest at-grade crossing.

**Rocky Mount and Raleigh measurements include a linear distance from the known trespass path to the nearest authorized crossing and a distance for a reasonable safe walking route to the nearest authorized crossing.

Exhibit 11. Summary of Trespassing Event Duration by Site with Distance to Nearest Authorized Railroad Crossing



Rail Network Trespass Statewide Severity Assessment and Predictive Modeling featured findings;

- Research team hypothesized-most people trying to reach their destinations through shortest, most direct route
- 35% of people were traveling in groups of two or more
- Train was present in 1% of events captured
- Example of scaled data
 - Elon-12,264. Mebane-11,688. Greensboro-15,330.
Rocky Mount-7,154.



Rail Network Trespass Statewide Severity Assessment and Predictive Modeling featured findings;

- People traveling alone, pairs, groups, adults and children, carrying bags, bikes, walking dogs, pushing strollers.
- Most moved on their way, some lingered, very few stood around or sat on or near the tracks.
- Median time on tracks- 3 seconds
 - 95% crossed track
 - 5% moved parallel to track

Who is trespassing?

Age?

Race?

Sex?



EVERYONE



Rail Network Trespass Statewide Severity Assessment and Predictive Modeling *, additional findings;

- Magnitude of trespassing much greater than FRA incident reporting
- Profile of average trespasser may not be consistent with FRA incident data (vs. w/m, 38, impaired, 2/3 between 20-49 yoa)
- Several factors were identified as associated with higher frequencies of daily trespassing events:
 - Greater densities of pedestrian attractors such as; Schools, Universities, social services, restaurants & other eating places in proximity to RR right-of-way



Rail Network Trespass Statewide Severity Assessment and Predictive Modeling *,
additional findings;

- Communities with
- Less access to vehicles for transportation
- Greater density of racial minorities
- Greater density of low-income housing



NCDOT Technology Transfer Program

- **Outreach, education and mitigation efforts.**
- Developing trespass awareness and education outreach workshops
- Include case studies based on research findings
- Deliver to community policy and decision makers.
 - **Gaps in research**
- We need to answer the “WHY?”
- Interviews of those engaged in trespassing
- Polls of rail knowledge VS. rail myths
- Train Noise/Train Horn propagation research request



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NC Traffic Safety Webinar

RP 2020-44: Comprehensive Cost of
Rail Incidents in North Carolina



Project Reflection

Mission:

Determine the full spectrum of costs that result from railroad incidents in North Carolina.

Develop a tool that is capable of estimating these costs.



Property Damage Input Guidance	Dropdown Menu	Total Damages Incurred	Clear Values
When property damage costs are unknown, select from a set of default values from the dropdown menu		--From Dropdown Menu to Left--	Clear Values
When property damage costs are known, enter the total dollar value (in \$2020) of property damages incurred during the incident.		--From PropDMG_Custom Tab--	
When a more in-depth custom estimate of incurred damages is required, use the "PropDMG_Custom" Tab		--From PropDMG_Custom Tab--	
Step by Step Guidance: Enter the number of fatalities and injury by type that have occurred during a rail incident. Rail casualty statistics can be found in Tables 2, 3, and 4 may be used as benchmarks.			Clear Values
Property Damage Subtotal	--Enter Values Above--		

Part II: Casualty Input Values

Casualty Characteristics for a Rail Incident				
Casualty Type	Fraction of VSL	No. of Occurrences	Monetized Injury Cost in \$2020*	Total Casualty Cost Incurred
MAIS Scale				
	1.000		\$9,984,000	--
Level 1	0.003		\$30,000	--
Level 2	0.047		\$469,200	--
Level 3	0.105		\$1,048,300	--
Level 4	0.266		\$2,655,700	--
	0.593		\$5,692,800	--
KABCO Scale				
			\$3,300	--
			\$66,500	--
			\$130,000	--



Comprehensive Cost of Rail Incidents

Foundational Literature and Data Sources

Lit	USDOT BCA Guidance, FRA Documentation	USDOT BCA Guidance, FRA Documentation	USDOT BCA Guidance, NCHRP 755, Lovett et al. (2015), Winston and Shirley (2004), other Lit	NCHRP 755, US Fire Administration, other Lit and interviews
Data	FRA 6180.54, FRA 6180.57, AAR Cost Repair & Replacement Matrix	FRA 6180.55	Amtrak Status Maps Archive Database, NC Waybill Data Sample, NC Freight Plan, NCHRP 755, and others	Computer Aided Dispatch Records, Public Service Answering Point Interviews, FEMA cost schedule




Property Damage



Injury and Fatality



Delay, Rerouting, and Supply Chain



Emergency Responder

Property Damage Components

- Railroad rollingstock
(locomotives, carriages, wagons, or other vehicles used on a railroad)
- Railroad Infrastructure
(ballast, ties, track, bridges, tunnels, signs, mileposts, switches, or other elements in the right-of-way)
- Highway vehicles, infrastructure, and other property

FRA 6180.57

DEPARTMENT OF TRANSPORTATION
HIGHWAY-RAIL GRADE CROSSING
ACCIDENT/INCIDENT REPORT

1. Name of Reporting Railroad
2. Name of Other Railroad or Other Entry for Equipment Involved in Train Accident/Incident
3. Name of Railroad or Other Entry Responsible for Track Maintenance
4. U.S. DOT Grade Crossing Identification Number
7. Name of Railroad Station
11. City (if a city)
13. Type of Equipment
14. Reported Speed
16. Position
20. Was the highway user and/or rail equipment involved?
24. Temperature
27. FRA Track Class
35. Location of Warning
38. Highway User's Gender
42. Driver Posted Standing
46. Highway-Rail Crossing Users
49. Railroad Employees
53. Special Study Block

1a. Alphabetic Code
2a. Alphabetic Code
3a. Alphabetic Code
5. Date of Accident
8. Subdivision
9. Code
12. Highway Name of Rail
17. Equipment
18. Position of Car Unit in Train
19. Circumstances
21. Weather
22. Visibility
23. Whether
25. Type of Equipment
26. Track Type Used by Rail
28. Number of Locomotives
29. Number of Cars
30. Contact Speed
31. Signal Crossing
32. Crossing/Warning Interfered with
33. Crossing/Warning Interfered with
34. Date of Vehicle Approach
36. Crossing/Warning Interfered with
37. Code
39. Highway User's Gender
40. Highway User's Age
41. Highway User's Sex
43. View of Track Obscured by
44. Obstruction
45. Obstruction
47. Highway User's Gender
48. Highway User's Age
49. Highway User's Sex
50. Total Number of People on Train
51. Special Study Block A
52. Special Study Block B

FORM FRA F 6180.57 (Rev. 08/10) OMB approved 6/6/2015, Approval expires 6/30/2021

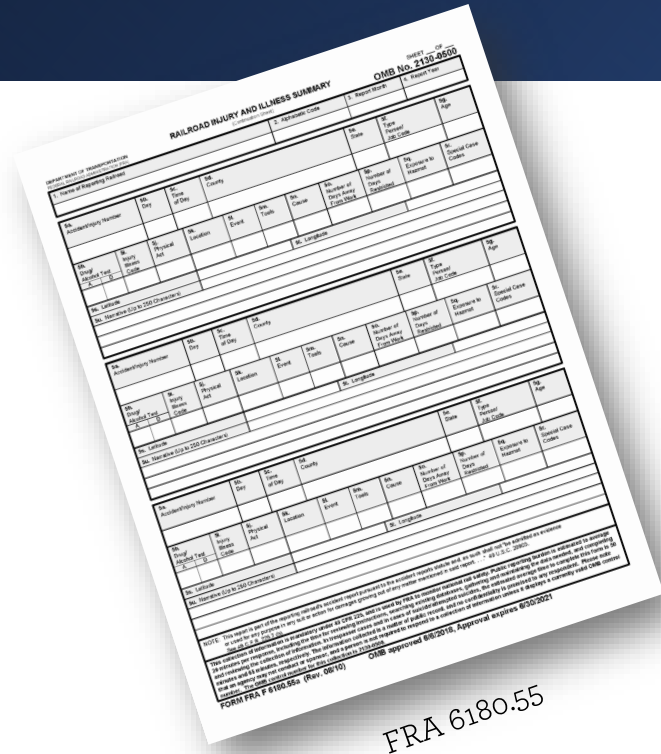
FRA 6180.54

DEPARTMENT OF TRANSPORTATION
RAIL EQUIPMENT ACCIDENT/INCIDENT REPORT
OMB No. 2130-0500

1. Name of Reporting Railroad
2. Name of Other Railroad or Other Entry with Car Unit Involved
3. Name of Railroad or Other Entry Responsible for Track Maintenance
4. U.S. DOT Grade Crossing Identification Number
7. Type of Accident
8. Cars Carrying HAZMAT
13. Nearest City/Town
17. Temperature
21. Track Number
25. Type of Equipment
28. Speed
31. Principal Car Unit
34. Causation
36. Locomotive Data
37. Train Data
38. Equipment Damage
40. Engineer/Operator
41. Crewmembers
42. Railroad Employees
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100. Railroad Employees

FORM FRA F 6180.54 (Rev. 08/10) OMB approved 6/6/2015, Approval expires 6/30/2021

Casualty Cost Components



- Injuries
- Fatalities

USDOT Recommended Parameter Values

MAIS Level	Severity	Fraction of VSL	Unit value (\$2018)
MAIS 1	Minor	0.003	\$28,800
MAIS 2	Moderate	0.047	\$451,200
MAIS 3	Serious	0.105	\$1,008,000
MAIS 4	Severe	0.266	\$2,553,600
MAIS 5	Critical	0.593	\$5,692,800
Fatal	Not Survivable	1.000	\$9,600,000

Source: USDOT 2020

KABCO Level	Monetized Value (\$2018)
O – No Injury	\$3,200
C – Possible Injury	\$63,900
B – Non-incapacitating	\$125,000
A – Incapacitating	\$459,100
K – Killed	\$9,600,000
U – Injured (Severity Unknown)	\$174,000
# Accidents Reported (Unknown if Injured)	\$132,200

Source: USDOT 2020

Delay, Rerouting, & Supply Chain Cost Components

- Value of Time Costs
(lost production, lost leisure, degraded travel experience)
- Shipper Costs
(costs accrued to cargo that has deteriorated or lost a portion of its useful life)
- Cargo Replacement Costs
(costs accrued to cargo units that have destroyed and require replacement)
- Operating Costs
(wear and tear, fuel, financing)
- Emissions Costs
- Upstream & Downstream Effects
(trip cancellations, passenger and cargo rerouting, additional value of time costs)

First & Emergency Responder Costs

- Emergency Responder Personnel

(Law enforcement, EMS, medic, county rescue, fire suppression, Hazmat, other safety response personnel)

- Emergency Responder Equipment Costs

(Police cars, ambulances, helicopters, fire engines, fire rescue trucks, quick response and other safety vehicles)

Emergency Response Organizations and Types of Data Inputs Gathered

County / Organization	Recorded Events	Type
Guilford County	10	Computer Aided Dispatch
Lincoln County	5	Computer Aided Dispatch
Cumberland County	3	Computer Aided Dispatch
Burke County	2	Computer Aided Dispatch
Rutherford County	5	Phone Interview
Moore County	4	Phone Interview
Mitchell County	3	Phone Interview
Cleveland County	2	Phone Interview
Warren County	2	Phone Interview
Hoke County	1	Phone Interview
Wake County	1	Phone Interview
Pitt County	1	Phone Interview
Rockingham County	1	Phone Interview
Edgecombe County	Provided Context	Phone Interview
Forsyth County	Provided Context	Phone Interview
Granville County	Provided Context	Phone Interview
Macon County	Provided Context	Email Information
Perquimans County	Provided Context	Phone Interview
Stanly County	Provided Context	Phone Interview
Wilkes County	Provided Context	Email Information
NC Association of Police and Fire Chiefs	Provided Context	Phone Interview
21	40	

Composition of Rail Incident Costs



Summary of Findings

FRA Reported Incidents in 2019

- 187 total incidents
- 53 highway-rail; 26 not at grade crossings; 108 other incidents*
- 96 injuries, 24 fatalities

2019 Rail Incident Costs by Category



Total Costs: \$258,303,000

Source: ITRE Analysis

*It should be noted that the FRA database contains records of safety incidents that are generally not included in rail incident totals reported by NCDOT. These types of incidents are classified as "other incidents" by the FRA and generally result from accidents that occur independently of railroad crashes, collisions, or other events caused by railroad operational issues.

Summary of Rail Incident Costs from 2010-2019 (in \$2020)

Year	Casualty Costs ¹	Equipment Damage ²	Delay, Rerouting & Supply Chain ³	Emissions Costs ⁴	Operating Costs ⁵	Emergency Responder Costs ⁶	Total Costs
2010	\$207,296,000	\$7,945,000	\$776,000	\$102,000	\$59,000	\$63,000	\$216,241,000
2011	\$175,556,500	\$3,631,000	\$1,074,000	\$112,000	\$64,000	\$143,000	\$180,580,500
2012	\$177,069,000	\$2,624,000	\$658,000	\$95,000	\$55,000	\$74,000	\$180,575,000
2013	\$270,225,000	\$3,195,000	\$1,531,000	\$146,000	\$83,000	\$74,000	\$275,254,000
2014	\$257,766,000	\$3,507,000	\$1,449,000	\$141,000	\$81,000	\$160,000	\$263,104,000
2015	\$247,835,500	\$4,849,000	\$1,484,000	\$140,000	\$80,000	\$90,000	\$254,478,500
2016	\$285,930,500	\$2,919,000	\$1,222,000	\$117,000	\$67,000	\$68,000	\$290,323,500
2017	\$177,069,000	\$2,663,000	\$1,082,000	\$121,000	\$69,000	\$62,000	\$181,066,000
2018	\$324,766,500	\$10,554,000	\$2,585,000	\$169,000	\$96,000	\$164,000	\$338,334,500
2019	\$252,816,000	\$3,651,000	\$1,572,000	\$131,000	\$73,000	\$60,000	\$258,303,000
Total	\$2,376,330,000	\$45,538,000	\$13,433,000	\$1,274,000	\$727,000	\$958,000	\$2,438,260,000

¹Monetized cost of injuries using the KABCO injury scale at unknown injury severity and the USDOT value of statistical life for fatalities (see “Monetized Casualty Costs” for methodology)

²Equipment damage reported on FRA form 6180.54 and 6180.57 (Train Accidents and Highway-Rail Accidents) from 2010-2019, converted to \$2020 (see “Property Damage Costs” for methodology)

³Includes value of time for passengers and workers, opportunity, spoilage, useful life, and replacement costs for cargo, and up/downstream delay effects (see “Delay, Rerouting, and Supply Chain Costs” for methodology)

⁴Includes emissions costs resulting from additional locomotive runtime (see “Additional Emissions Costs” for methodology)

⁵Includes fuel and ownership costs resulting from additional locomotive runtime (see “Additional Operating Costs” for methodology)

⁶Includes first responder and emergency personnel and equipment costs resulting from an incident (see “First Responder and Emergency Management Costs” for methodology)

Cost Tool Demonstration

If you would work alongside the demo

- Google “Comprehensive Cost of Rail Incidents in NC”
- Select “NC Rail Cost Tool”

Connect NCDOT
BUSINESS PARTNER RESOURCES

Home Help Site Map

Doing Business Bidding & Letting **Projects** Resources Local Governments Search...

Planning Construction **Research** Roadway Design Work Zone Contracts Toolkit Bike & Pedestrian Project Management Value Management

Project Details

Connect NCDOT > Projects > Research > Project Details


Comprehensive Cost of Rail Incidents in North Carolina

NCDOT Research Project Number: 2020-44

Executive Summary

This research provides a comprehensive appraisal and cost tool for the broad spectrum of events occurring on North Carolina's rail network. It evaluates costs associated with property damage, casualty, and delay, rerouting, and supply chain events. It also analyzes upstream effects, emissions costs, railroad operating costs, and emergency responder costs. FRA safety database records are used to inventory rail incidents that have occurred in North Carolina, while a collection of journal articles, reports, and other data sources such as Amtrak delay records, American Association of Railroads repair and maintenance costs schedules, and public safety answering point data are used for the analysis.

In 2019, there were 187 rail incidents in North Carolina, imposing a total estimated cost of approximately \$258.3 million. Of the costs incurred, casualties comprised the largest cost component valued at a cost of \$252,816,000. Property damage costs were approximately \$3,651,000; costs associated with delay, rerouting, and supply chain disruptions were approximately \$1,572,000; emissions costs were \$131,000; operating costs were \$73,000; and first and emergency responder costs were an estimated \$60,000. From 2010-2019, rail incident costs in North Carolina totaled an estimated \$2.4 billion.



Project Members

Principal Investigator
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Researchers
Steve Bert
Sarah Searcy
Daniel Findley

Committee Chairman
Roger Smook

Project Manager
John W. Kirby

Related Documents

SUPPORTING DOCUMENTS

- [Rail Cost Tool Video Tutorials](#)
- [NC Rail Cost Tool](#)

FINAL REPORT

- [Comprehensive Cost of Rail Incidents in North Carolina](#)

Additional Information on:

Project Participants: Researchers, Managers, Chairpersons
Participants in NCDOT's Research Projects

Download the
cost tool here





One dies after train crashes into tractor-trailer, North Carolina police say

BY NOAH FEIT

AUGUST 28, 2019 09:00 PM, UPDATED AUGUST 30, 2019 04:53 PM



One person is dead after a [train collided with a tractor-trailer](#) in North Carolina on Wednesday, the Kernersville Police Department said.

[Emergency officials responded](#) to the Forsyth County crash [at about 3:30 p.m.](#), police said in a news release.

The [driver of the 18-wheeler truck was killed](#) in the wreck, but no passengers on the freight train were injured, the Winston-Salem Journal reported.

[The driver](#) will not be publicly identified until the coroner notifies the family.

Roads in the area near the collision are [expected to remain closed](#) through the night, according to WXII.

Cost Parameters

- Freight train and tractor trailer collision
- 1 Fatality
- 3:30pm (stated) to 6:00am (estimated) = 14.5 hours of delay

Questions?

Comprehensive Cost of Rail Incidents in North Carolina

- Cost Tool
- Video Tutorials
- Methodology
- Final Report
- Link: <https://connect.ncdot.gov/projects/research/Pages/ProjDetails.aspx?ProjectID=2020-44>



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- Claire Keller
- Olivia Parsons
- Max Randall
- James Poslusny, BS
- Payal Ashtankar, BS
- Abhinay Lahare, MS
- Manas Salunke, MS
- Sarah Searcy, MA
- Daniel Findley, PhD, PE