BURGESS & NIPLE Memorandum

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Jim Hudson, PE
Andrew Stewart, PE
Kentucky Transportation Cabinet

February 9, 2018

From: **Randy Kill, PE, PTOE**
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Burgess & Niple, Inc.

Subject: KY 185 Relocation Safety Analysis

A safety analysis was conducted for the proposed relocation of KY 185 in Warren County, Kentucky. The limits of the proposed relocation extend 2500 feet north of the junction with KY 263 (near Pruitt Road) to the Green River Bridge. There are numerous horizontal and vertical geometric design deficiencies throughout the existing section of KY 185. The two-lane roadway has a speed limit of 55 mph. Generally, the travel lanes are between 10.5 feet and 11 feet and with no shoulder provided. The land uses surrounding the corridor are primarily residential or agricultural with about 15 to 30 driveways per mile. Within the study area of the corridor, there are a few low-volume, unsignalized intersections. KY 185 intersects KY 1320 (Penns Chapel Road), KY 1037 (Anna-Sand Hill Road), and KY 1037 (Lake Road) within the study limits. The goal of upgrading the roadway is to provide a safer facility. This safety analysis will quantify the existing safety concerns along the current alignment and will determine the benefits of constructing the new alignment.

Existing Crash Patterns and Analysis

Between January 1, 2012 and December 31, 2016 there were 86 reported crashes along this nearly 5.5 mile stretch of KY 185.

Crash Severity

Of the 86 crashes, there were three crashes that resulted in a fatality (4%) and 25 injury crashes (29%). **Figure 1** shows the crash frequency and severity per year along the corridor.

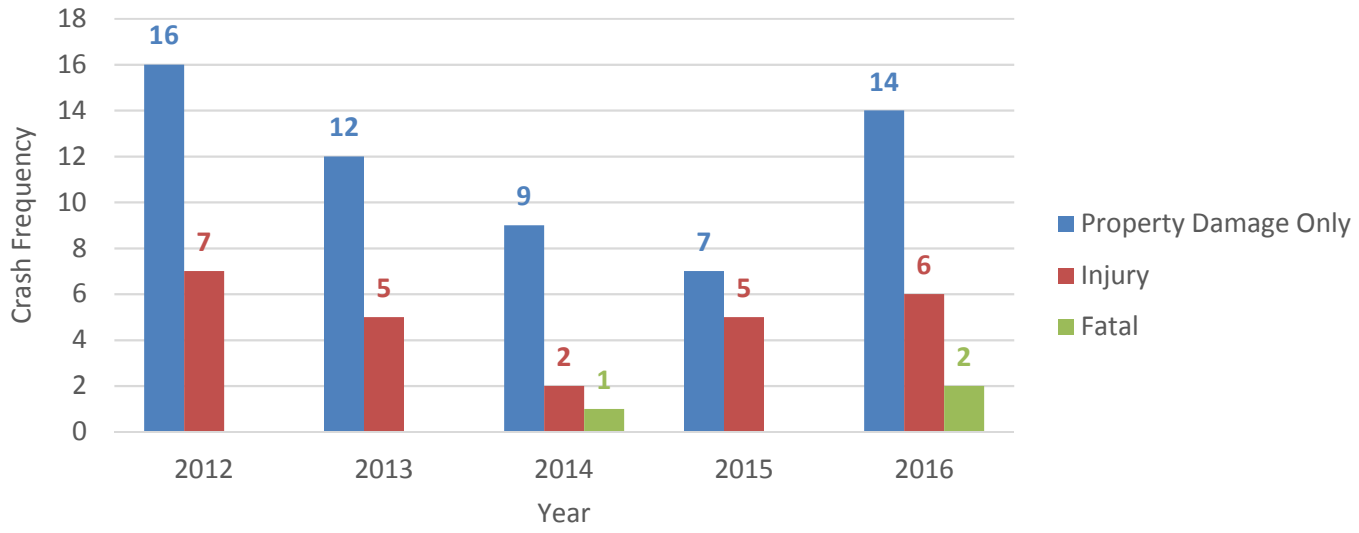


Figure 1: Crash Frequency on KY 185 by Year and Severity

There were three fatal crashes along the KY 185 corridor in the five-year study period. The first fatal crash occurred on Sunday, October 26, 2014 at approximately 2:00 PM. A pickup truck was stopped in the northbound direction waiting to turn onto Pruitt Road and was struck from behind and as a result, was pushed into the southbound lane into the path of another vehicle. The driver of the pickup truck died from his injuries. At the time of the collision, the weather was reported to be clear and the roadway condition was dry. The driver of the vehicle that rear ended the pickup truck was cited for distraction and inattention.

Another fatal crash occurred on Wednesday, October 26, 2016 at approximately 1:30 PM. In this crash, a vehicle was traveling southbound in the 10000 block of KY 185 and was navigating a left-hand curve when the right-side tires dropped off the west side of the roadway. As a result, the vehicle left the roadway and went airborne. When it landed, the vehicle overturned at least twice and ejected the driver. The weather was reportedly clear and the roadway was dry at the time of the crash.

The third fatal crash occurred on Tuesday, December 6, 2016 at approximately 6:30 PM. A vehicle was traveling southbound along KY 185 when it crossed the centerline and collided with an oncoming northbound vehicle. The driver of the southbound vehicle was pronounced dead at the scene of the crash and it is unclear as to why the vehicle crossed the centerline. However, one witness to the crash indicated that the southbound vehicle was traveling at a high rate of speed. According the crash report, the pavement was wet but the weather was clear and it was dusk at the time of the crash.

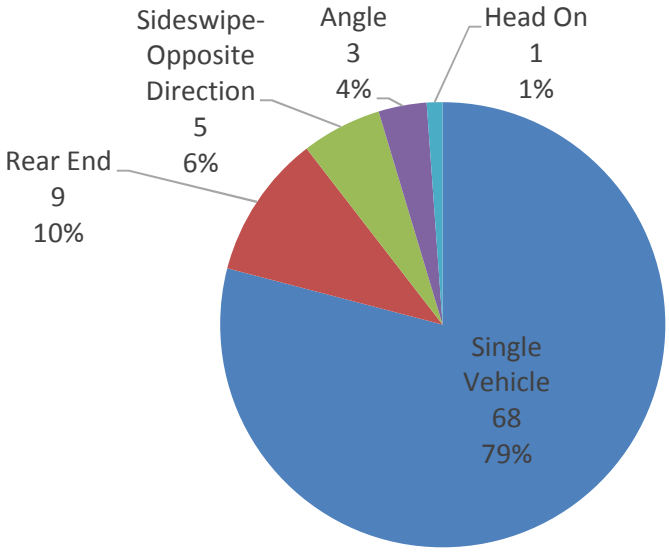


Figure 2: Crash Type on KY 185

Crash Type

The vast majority of crashes involved only one vehicle as shown in **Figure 2**. However, as previously discussed, two of the three fatalities were not single vehicle and were rear end and head on collisions, respectively.

The single vehicle crashes can be further broken down into the type of collision as illustrated in **Figure 3**. In the majority of the single vehicle crashes, the driver lost control of the vehicle and left the roadway and collided with an embankment, guardrail, or other fixed object outside the roadway or overturned. The one fixed object crash occurred when a pickup truck's trailer struck several mailboxes as it was traveling along KY 185.

There were also a number of animal crashes along the corridor. Animal crashes made up 16% of the total crashes and 21% of the single vehicle crashes.

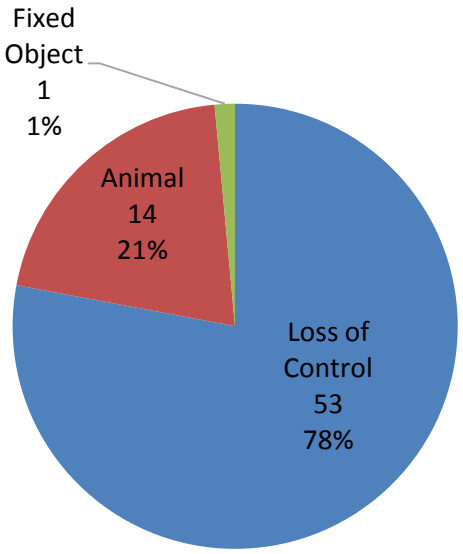


Figure 3: Types of Single Vehicle Crashes on KY 185

Weather, Roadway, and Lighting Conditions

The weather, roadway, and lighting conditions likely contributed to crashes along this corridor. **Figure 4** summarizes the weather conditions at the time of the crash while **Figure 5** illustrates the roadway condition. The lighting conditions are summarized in **Figure 6**.

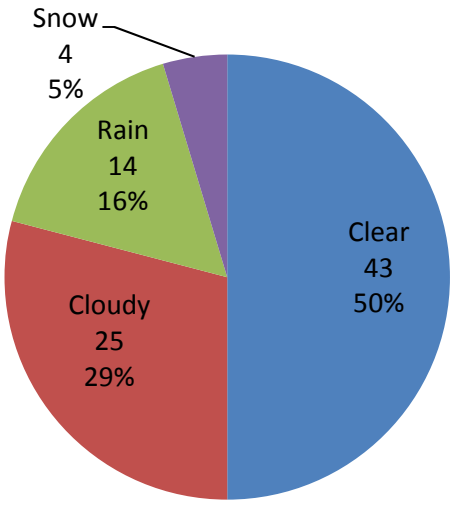


Figure 4: Weather Conditions

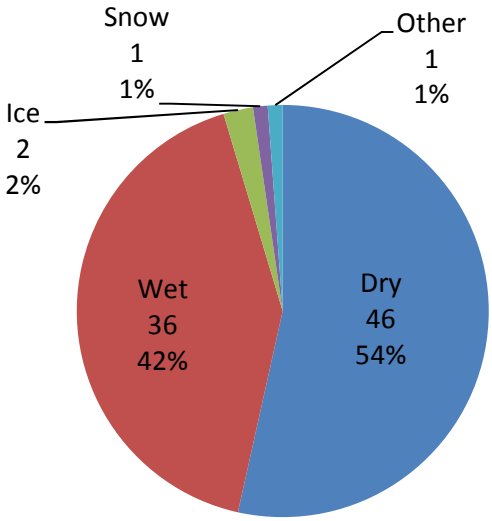


Figure 5: Roadway Conditions

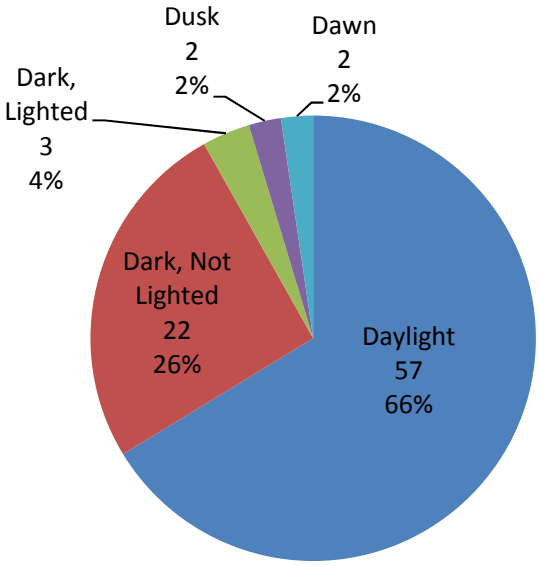


Figure 6: Lighting Conditions

The majority of the crashes occurred under clear or cloudy conditions. Only 21% of the crashes occurred during adverse weather conditions. However, in 46% of the crashes, the pavement was not dry which was likely a contributing factor to the crashes that occurred along this corridor. As a result of the wet pavement, vehicles lost control in the tight curves along the corridor. Additionally, the wet pavement results in a longer required stopping distance which contributed to some of the multi-vehicle crashes. The majority of crashes also occurred under daylight lighting conditions. However, nearly a quarter of the crashes occurred under dark, not lighted conditions, which could be a contributing cause of crashes. The dark conditions coupled with the narrow travel lanes and sharp curves resulted in drivers losing control of their vehicles and running off the road.

HSM Distribution Comparisons

The *Highway Safety Manual* (HSM) provides a default distribution of crash severity and type. These values are used within the HSM analysis but can also be used to compare the crash frequencies along a study corridor with typical crash frequencies along other similar roadway segments. **Figure 7** illustrates the differences between the crashes along KY 185 and the HSM distributions for rural two-lane roadways.

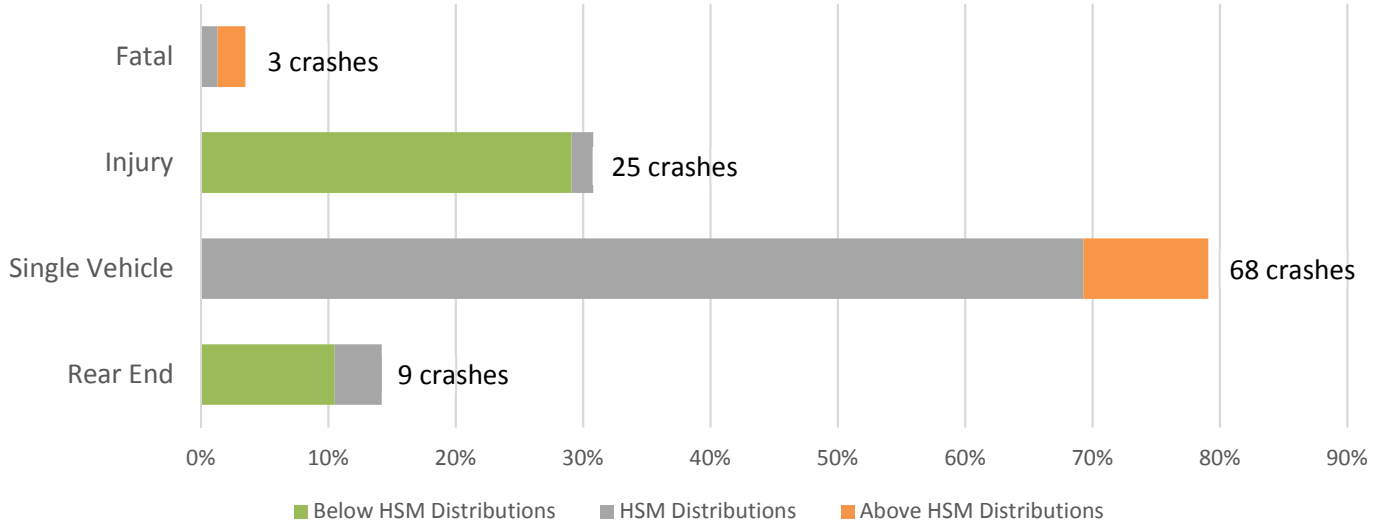


Figure 7: HSM Distribution Comparisons

The frequency of fatal and single vehicle crashes is higher along KY 185 compared to the HSM distributions. The narrow existing lane widths and lack of shoulder likely contribute to the number of single vehicle crashes in the corridor. The frequency of injury crashes in the corridor were similar to the HSM distributions while the rear end crashes collisions were lower than the values provided in the HSM. The relatively low-volume intersections likely contribute to the lower number of rear end collisions. This comparison shows the need to mitigate the fatal crashes and single vehicle collisions which will be reduced with the proposed realignment.

High Crash Locations

A collision diagram that shows crash patterns by illustrating the approximate location of each reported crash along the corridor is provided in **Figure 8**.

There were six loss of control crashes in the curve north of Pruitt Road (see **Figure 8A**). Two property damage only crashes occurred in the southbound direction and one property damage only and three injury crashes occurred in the northbound direction. In three of the crashes, the roadway was wet or snow-covered which in addition to the curve is a likely contributing factor to these crashes. In addition to the horizontal curve in the roadway alignment, there is also a vertical curve that crests near the center of the horizontal curve.

There were a number of loss of control and rear end crashes in the curves just north of Scoggins Road (see **Figure 8B** and **Figure 8C**). Two loss of control crashes occurred in each the northbound and southbound directions in this area. Two northbound rear end crashes were also reported along this segment of KY 185. The horizontal and vertical curvature were likely contributors to the crashes in this location.

Five loss of control crashes occurred in the southbound direction in the curve south of KY 1320 (see **Figure 8D**). Two of these crashes resulted in injury. The sharp horizontal curve coupled with the downgrade in the southbound direction likely contribute to the number of crashes at this location.

In the curves north of the cemetery, there were seven loss of control crashes in the southbound direction and five in the northbound direction (see **Figure 8H**). There were also two sideswipe crashes in this segment that occurred when a vehicle left its travel lane, crossed the centerline, and struck a vehicle in the opposing direction. In 11 of the 14 crashes in this segment, the pavement condition was wet, which when coupled with sharp horizontal curves and steep vertical grades contributes to the number of crashes in this area. Eight of the 14 crashes resulted in injury.

Highway Safety Manual Analysis – Existing Conditions

Using the Interactive Highway Safety Design Model (IHSDM), an analysis was conducted using the methodologies in the HSM to determine how the corridor is performing relative to other similar sites. The following three factors are calculated from the HSM analysis:

- Predicted Crash Frequency ($N_{predicted}$) – How the segment would be expected to perform relative to 1,000 similar corridors with comparable volumes
- Expected Crash Frequency ($N_{expected}$) – Average performance of the segment over an extended period of time based on actual crash history
- Potential for Safety Improvement (PSI) – Difference between expected crash frequency and predicted crash frequency. A positive PSI indicates that the location is performing poorly compared to similar locations and safety improvements would likely have a significant impact in reducing the crash frequency.

For this analysis, the traffic forecasts developed for KYTC as part of the original design study were used. Because the intersection volumes were so low along KY 185 and there were no significant crash patterns at these intersections, all intersections were modeled as driveways for the analysis. Results from the HSM analysis for analysis years 2018 through 2037 (20 years) are summarized in **Table 1** and graphically on **Figure 9**. IHSDM results are provided in the Appendix.

Table 1 – Existing Conditions HSM Analysis Results

	Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
$N_{predicted}$	137.82	290.94	428.49
$N_{expected}$	150.50	297.85	448.04
PSI	**12.68**	**6.91**	**19.59**

Note: Fatal and injury crashes and property damage only crashes do not necessarily sum up to total crashes because the distribution of these crashes has been derived independently

This HSM analysis shows that KY 185 is estimated to have 20 more crashes in the 20-year period between 2018 and 2037 than other similar sites. Furthermore, the number of fatal and injury crashes is also expected to be higher along KY 185 by nearly 13 crashes than along other similar corridors.

Highway Safety Manual Analysis – Future Conditions of Entire Corridor

To evaluate the safety benefits of rebuilding KY 185 on a new alignment, the HSM analysis was conducted for the new alignment and compared with the predicted crash frequency of the old alignment. The expected crash frequency could not be used for comparison since there is no crash data for the proposed alignment so it would not be an

accurate comparison. The results from this HSM analysis are summarized in **Table 2** with IHSDM output included in the Appendix.

Table 2 – Predicted Crash Frequency for Existing and Proposed KY 185

	Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
Existing Alignment	137.82	290.94	428.49
Proposed Alignment	66.69	140.78	207.34
Reduction in Crashes	**71.13**	**150.16**	**221.15**

Note: Fatal and injury crashes and property damage only crashes do not necessarily sum up to total crashes because the distribution of these crashes has been derived independently

This analysis shows that the new alignment has the potential to mitigate over 221 crashes, or 11 crashes per year. This reduction includes over 71 fatal and injury crashes.

Highway Safety Manual Analysis – Spot Improvements 1 & 5

In lieu of building the entire corridor, two spot improvements have been proposed to realign the segments of KY 185 that would provide the most safety benefit. Spot Improvement 1 realigns KY 185 from just north of Runner Road to just south of Penns Chapel Road. Spot Improvement 5 begins about 1,000 feet north of Austin Raymer Road and ends near the bridge over Ivy Creek. Both of these improvements provide reconstructed curves with design speeds of at least 50 mph. All of the previously discussed high crash locations have been addressed by Spot Improvements 1 and 5.

An HSM analysis was conducted to quantify the safety benefits of constructing these two spot improvements. The predicted number of crashes (without crash data) for the existing alignment was compared to the predicted number of crashes for the proposed spot improvement alignment to determine the safety benefit. The existing safety performance of the current alignment of KY 185 is summarized in **Table 3**. The IHSDM output is included in the Appendix

Table 3 – Existing Safety Performance for KY 185 Segments

	Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
Spot Improvement 1			
$N_{predicted}$	51.24	108.18	159.32
$N_{expected}$	54.77	113.75	168.40
PSI	**3.53**	**5.57**	**9.08**
Spot Improvement 5			
$N_{predicted}$	29.35	61.96	91.25
$N_{expected}$	49.51	62.21	111.62
PSI	**20.16**	**0.25**	**20.37**

Note: Fatal and injury crashes and property damage only crashes do not necessarily sum up to total crashes because the distribution of these crashes has been derived independently

The existing safety performance analysis shows that both segments of KY 185 being replaced by the proposed spot improvements have the potential for safety improvement. The segment of KY 185 being replaced by Spot Improvement 1 has approximately 9 more crashes over a 20-year period that other similar locations. There are over 20 more fatal and injury crashes in the 20-year period along the segment of KY 185 being replaced by Spot Improvement 5.

Based on the HSM analysis performed on the existing conditions of KY 185, there were 48 different horizontal curve and tangent elements that were analyzed. Of these 48 elements, 17 elements had worse safety performance than other similar sites (expected number of crashes was higher than the predicted number of crashes) meaning that more crashes occurred along these segments than other locations with similar roadway and traffic volume characteristics. This analysis indicated that there is a need for improvement along these segments. Spot Improvements 1 and 5 improve 11 of these 17 segments. The results of this analysis indicate that these spot improvements are improving some of the worst segments along the existing KY 185 and thereby have the potential to significantly improve safety in the entire corridor. The quantitative safety benefit of constructing the spot improvements is summarized in **Table 4**. IHSDM results are provided in the Appendix.

Table 4 – Safety Benefits of Constructing Spot Improvements 1 and 5

	Fatal and Injury Crashes	Property Damage Only Crashes	Total Crashes
Spot Improvement 1			
Existing Segment	51.24	108.18	159.32
Proposed Alignment	22.88	48.31	71.14
Reduction in Crashes	**28.36**	**59.87**	**88.18**
Spot Improvement 5			
Existing Segment	29.35	61.96	91.25
Proposed Alignment	11.90	25.12	36.99
Reduction in Crashes	**17.45**	**36.84**	**54.26**

Note: Fatal and injury crashes and property damage only crashes do not necessarily sum up to total crashes because the distribution of these crashes has been derived independently

The safety benefit of constructing Spot Improvement 1 is a reduction of over 88 crashes in the 20-year analysis period which is equivalent to more than four crashes per year. Additionally, more than one fatal or injury crash will likely be mitigated per year as a result of the construction of Spot Improvement 1.

Spot Improvement 5 is estimated to result in a reduction of over 54 crashes in the 20-year analysis period or just under three crashes per year. Nearly one fatal or injury crash per year is expected to be eliminated with the construction of Spot Improvement 5.

Economic Analysis

After calculating the potential reduction in crashes as a result of the entire corridor realignment and the two proposed spot improvements, the economic benefits can also be determined. According to KYTC, the comprehensive costs of crashes include wage loss, medical expense, administration costs, property damage, employer costs. These also include a measure of the value of lost quality of life associated with deaths and injuries. The cost for a fatal or injury crash for the purposes of this analysis was $471,212.60. The cost for a property damage only crash was assumed to be $8,500. These crash costs were compared to the estimated construction costs of the improvements to determine the benefit-to-cost ratios of the improvements. All values were calculated as a net present value in year 2018 using a discount rate of 3%. Results of the economic analysis are summarized in **Table 5** with calculations included in the Appendix.

Table 5 – Economic Analysis Results

	Net Present Value of Safety Benefit	Net Present Value of Construction Costs	Benefit-to-Cost Ratio
Entire Corridor	$25,128,000	$23,290,000	**1.08**
Spot Improvement 1	$10,019,000	$8,530,000	**1.17**
Spot Improvement 5	$6,165,000	$4,805,000	**1.28**

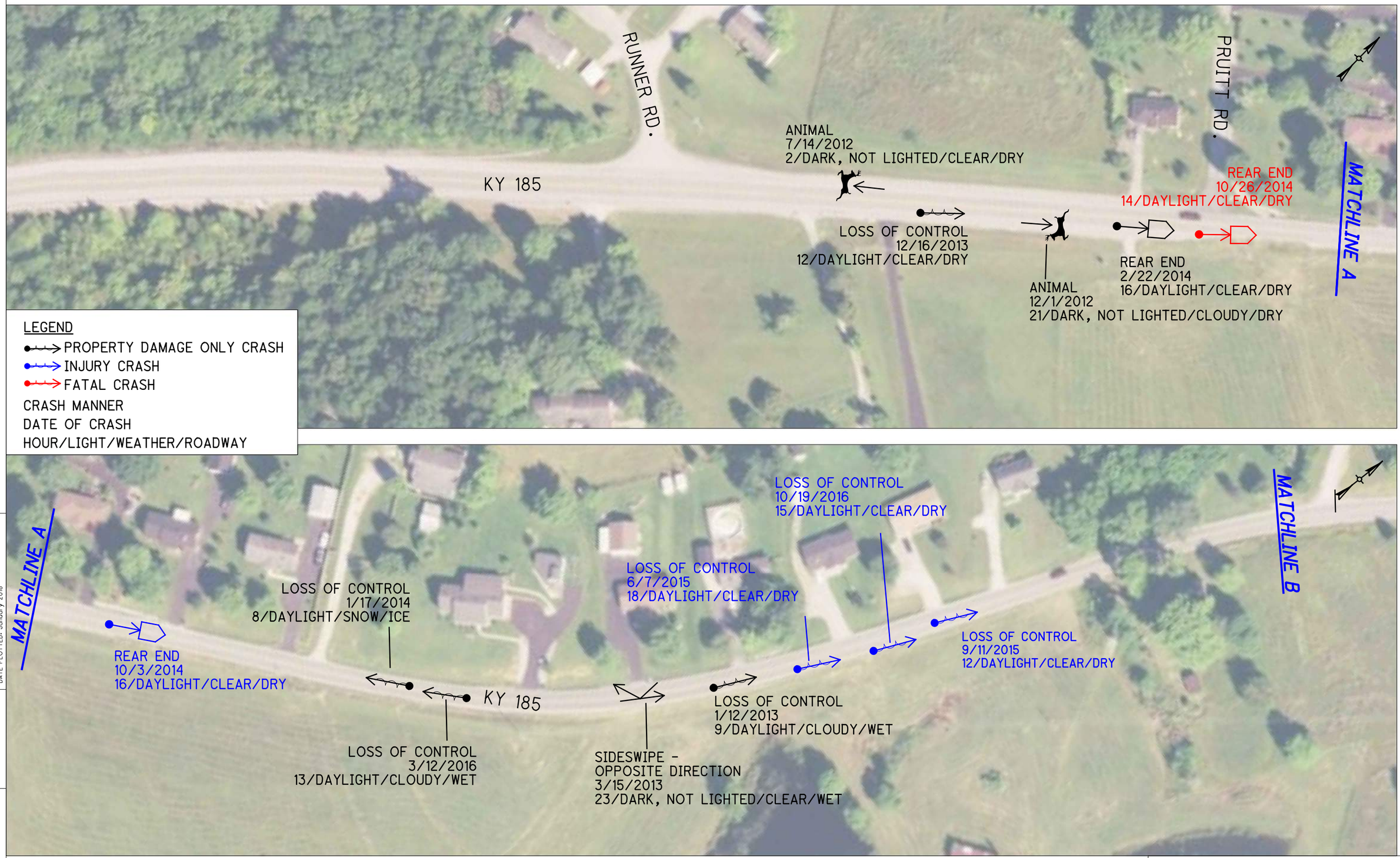
While all three analyses show a benefit-to-cost ratio greater than or equal to 1.0, the two spot improvements have a higher benefit-to-cost ratio than constructing the entire corridor. By spending just over half of the costs to complete the entire corridor, a large portion of the crashes will be mitigated with the two spot improvements.

Conclusions and Other Short-Term Improvements

Given the safety performance evaluation and economic analyses, it is recommended that Spot Improvement 1 and Spot Improvement 5 are the best expenditure of funds to improve safety along KY 185 as they each have benefit-to-cost ratios of 1.17 and 1.28, respectively.

The existing safety performance analysis for the entire corridor showed a potential for improvement on some segments of the corridor that were not being addressed with the two identified spot improvements. Therefore, the following short-term, and lower cost improvements are proposed in segments of KY 185 to further reduce the crash frequencies:

- Segment south of KY 1037 (Anna-Sand Hill Road) (See **Figure 9D**):
  - Install larger advanced intersection warning signs for the intersection of KY 185 with KY 1037.
  - Consider installing high-friction surface treatment along the KY 185 segment – three out of the four crashes that occurred along this segment occurred in wet pavement conditions.
- Segment north of Lodge Hall Road (See **Figure 9E**):
  - Install larger advanced intersection warning signs for the intersection of KY 185 with Lodge Hall Road
  - Consider minor widening along the west side of KY 185 to provide wider shoulder on the inside of the curve
- Segment north of Jack Simmons Road (See **Figure 9F**):
  - Ensure advanced signing is provided and install chevron signs in the curves with an advisory speed less than 55 mph
  - Consider minor widening along the east side of KY 185 to provide wider shoulder on the inside of the curves
- Segment north of Austin Raymer Road (See **Figure 9G**):
  - Ensure advanced signing is provided and install chevron signs in the curves with an advisory speed less than 55 mph
- Segment north of bridge over Ivy Creek (See **Figure 9I**):
  - Ensure advanced signing is provided and install chevron signs in the curves with an advisory speed less than 55 mph
  - Consider installing high-friction surface treatment – all three crashes that occurred along this segment occurred in wet pavement conditions.
- Segments south of the bridge over Green River (**See Figure 9J**):
  - Ensure advanced signing is provided and install chevron signs in the curves with an advisory speed less than 55 mph
  - Consider minor widening along KY 185 to provide wider shoulders in the curves



LEGEND

PROPERTY DAMAGE ONLY CRASH

INJURY CRASH

FATAL CRASH

CRASH MANNER

DATE OF CRASH

HOUR/LIGHT/WEATHER/ROADWAY

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.3.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8A

LEGEND

PROPERTY DAMAGE ONLY CRASH

INJURY CRASH

FATAL CRASH

CRASH MANNER

DATE OF CRASH

HOUR/LIGHT/WEATHER/ROADWAY

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

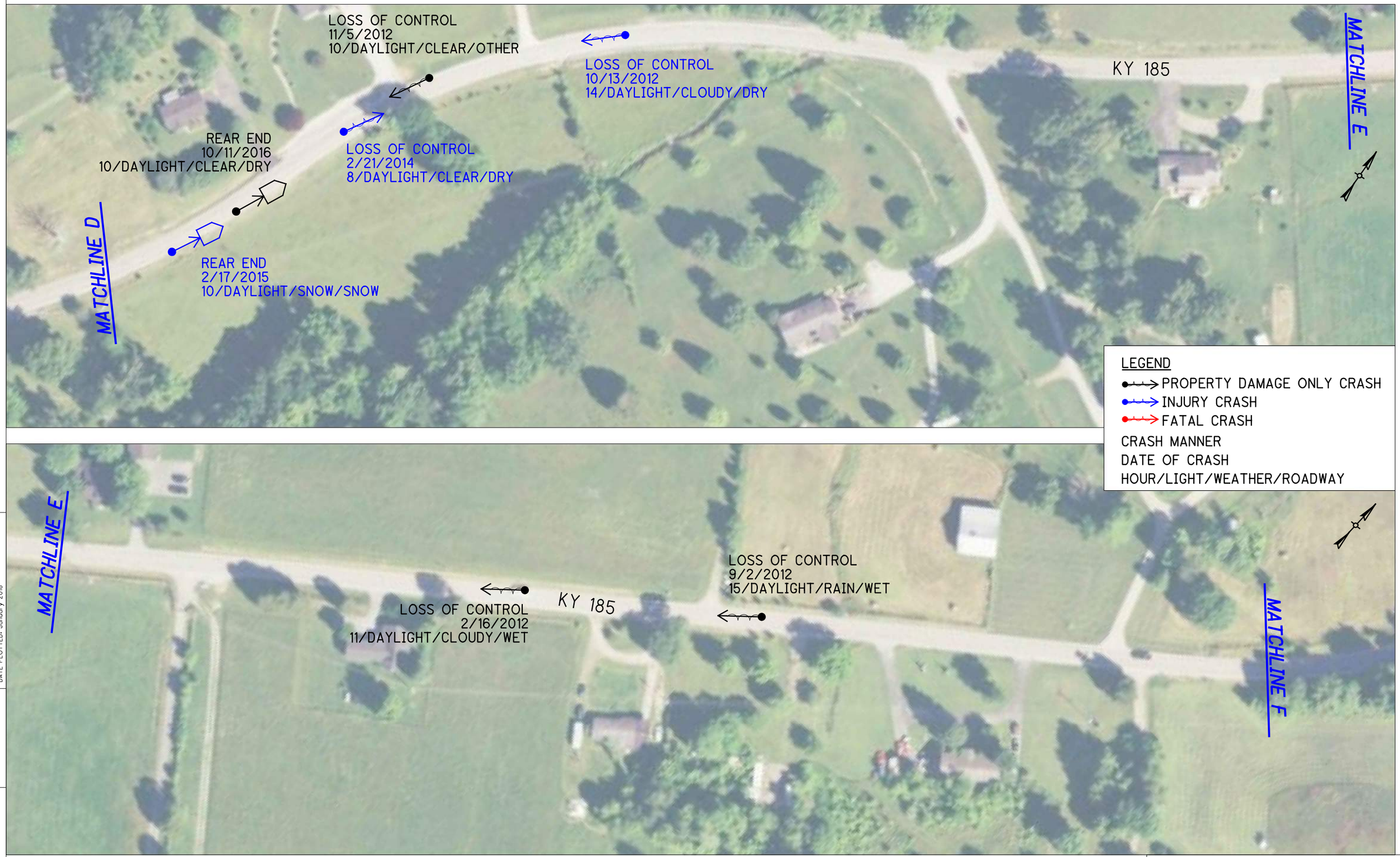
Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8B



FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.3.832

DRAFT

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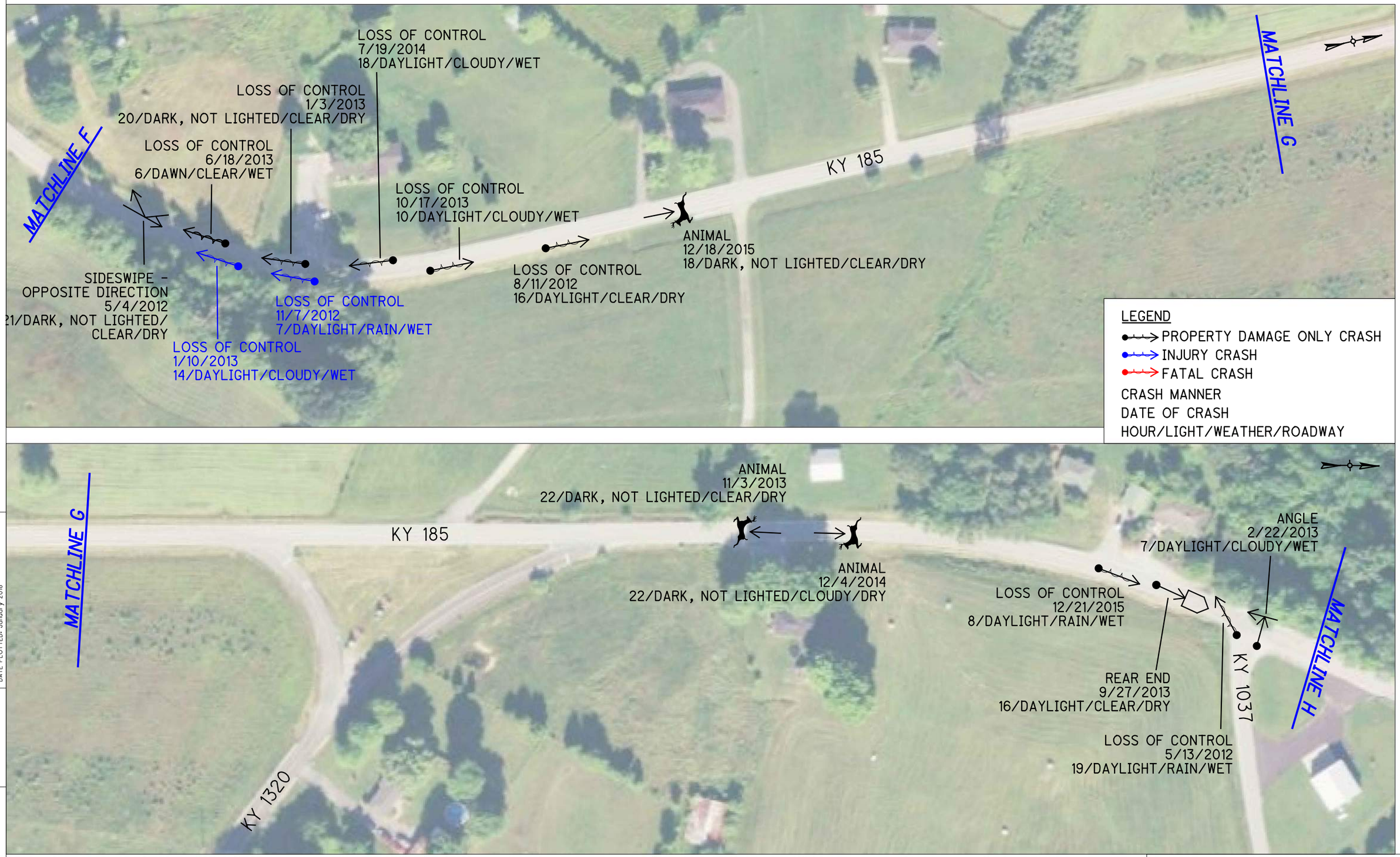
SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8C



FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

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SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8D

FILE NAME:
USER: kschenk
DATE PLOTTED: January 2018
E-SHEET NAME:
Power GEOPAK v8.11.3.832

DRAFT

0' 50' 100' 200' SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8E

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.3.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8F

AUSTIN RAYMER RD.

R/WET

MATCHLINE L

ANIMAL
10/22/2014
21/DARK, NOT LIGHTED/CLEAR/DRY

KY 185

LOSS OF CONTROL
5/6/2015
14/DAYLIGHT/CLEAR/DRY

REAR END
1/14/2016
5/DUSK/CLEAR/DRY

MATCHLINE M

LEGEND
PROPERTY DAMAGE ONLY CRASH
INJURY CRASH
FATAL CRASH
CRASH MANNER
DATE OF CRASH
HOUR/LIGHT/WEATHER/ROADWAY

LOSS OF CONTROL
11/5/2016
10/DAYLIGHT/CLEAR/DRY

LOSS OF CONTROL
10/26/2016
13/DAYLIGHT/CLEAR/DRY

ANIMAL
7/10/2015
13/DAYLIGHT/CLOUDY/DRY

KY 185

LOSS OF CONTROL
1/4/2013
14/DAYLIGHT/CLEAR/DRY

MATCHLINE M

MATCHLINE N

FILE NAME:
USER: kschenk
DATE PLOTTED: January 2018
E-SHEET NAME:
Power GEOPAK v8.11.9.832

DRAFT

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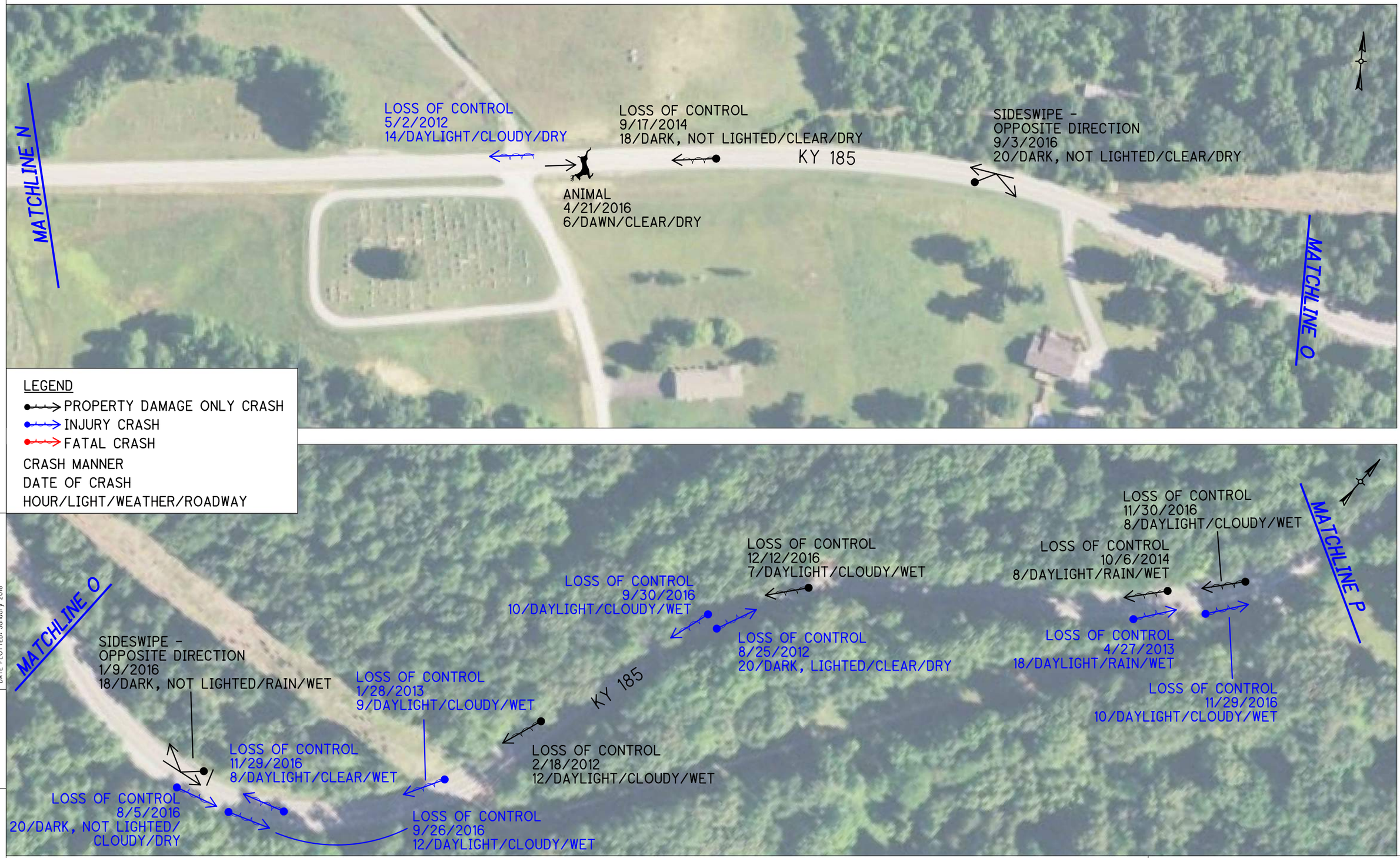
SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8G



LEGEND

PROPERTY DAMAGE ONLY CRASH

INJURY CRASH

FATAL CRASH

CRASH MANNER

DATE OF CRASH

HOUR/LIGHT/WEATHER/ROADWAY

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0′ 50′ 100′ 200′

SCALE: 1"=100′

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8H

LEGEND

- PROPERTY DAMAGE ONLY CRASH
- INJURY CRASH
- FATAL CRASH

CRASH MANNER
DATE OF CRASH
HOUR/LIGHT/WEATHER/ROADWAY

FILE NAME:
USER: kschenk
DATE PLOTTED: January 2018
E-SHEET NAME:
Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8I

LEGEND

PROPERTY DAMAGE ONLY CRASH

INJURY CRASH

FATAL CRASH

CRASH MANNER

DATE OF CRASH

HOUR/LIGHT/WEATHER/ROADWAY

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

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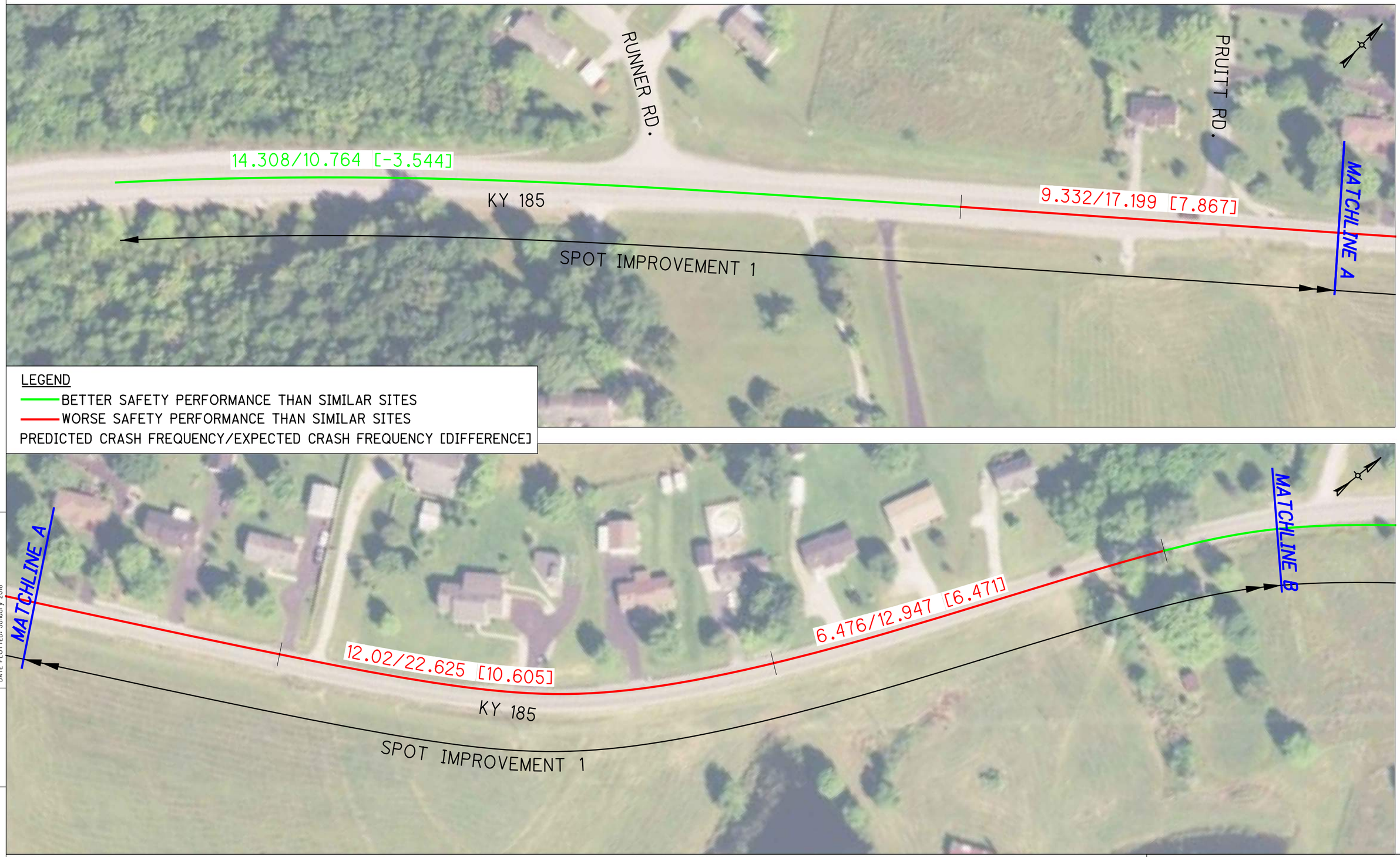
SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
COLLISION DIAGRAM
FIGURE 8J



LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0′ 50′ 100′ 200′

SCALE: 1"=100′

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9A

LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

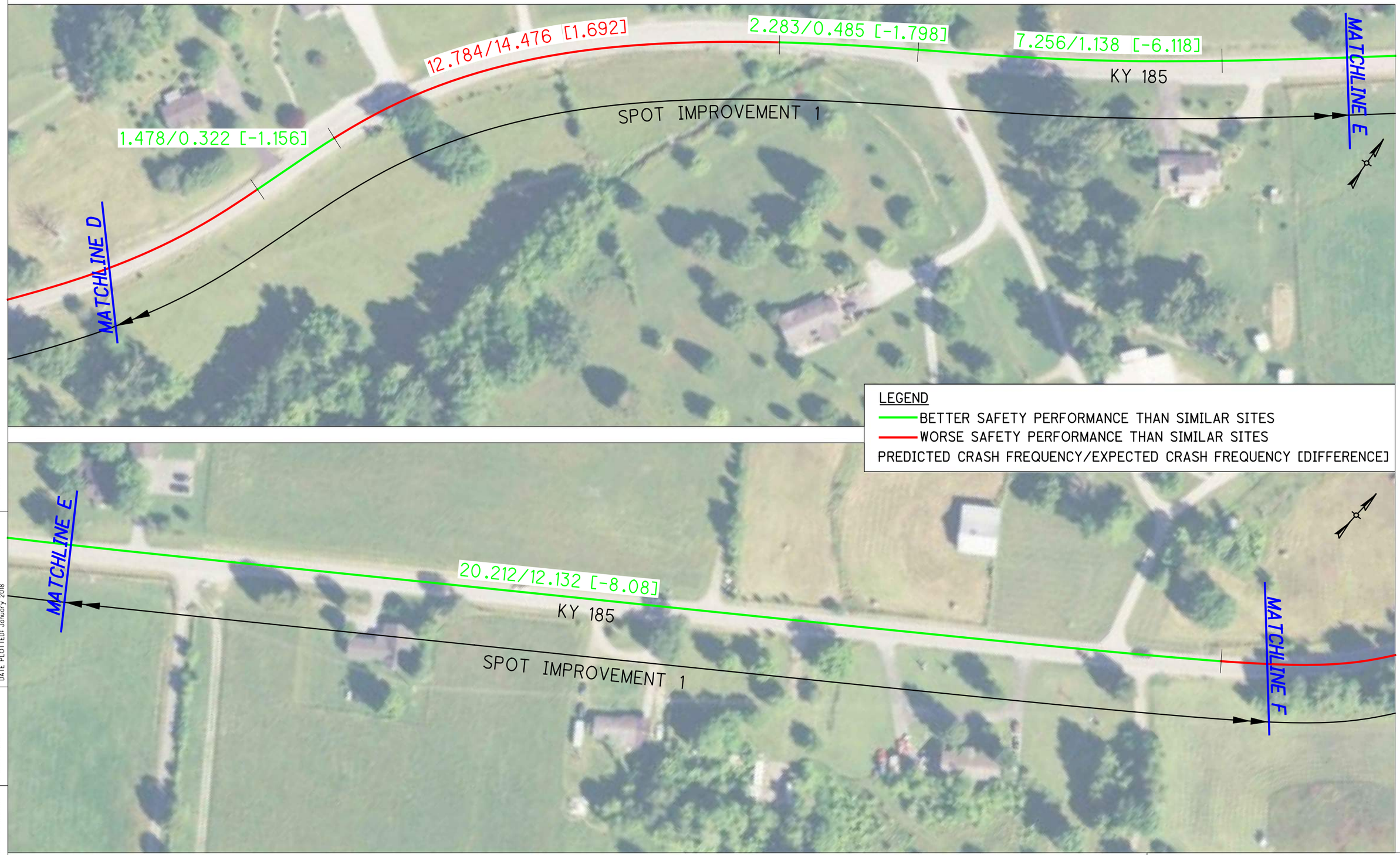
Power GEOPAK v8.11.9.832

DRAFT

0′ 50′ 100′ 200′

SCALE: 1"=100′

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9B



LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

FILE NAME:

USER: Kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9C

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200' SCALE: 1"=100'

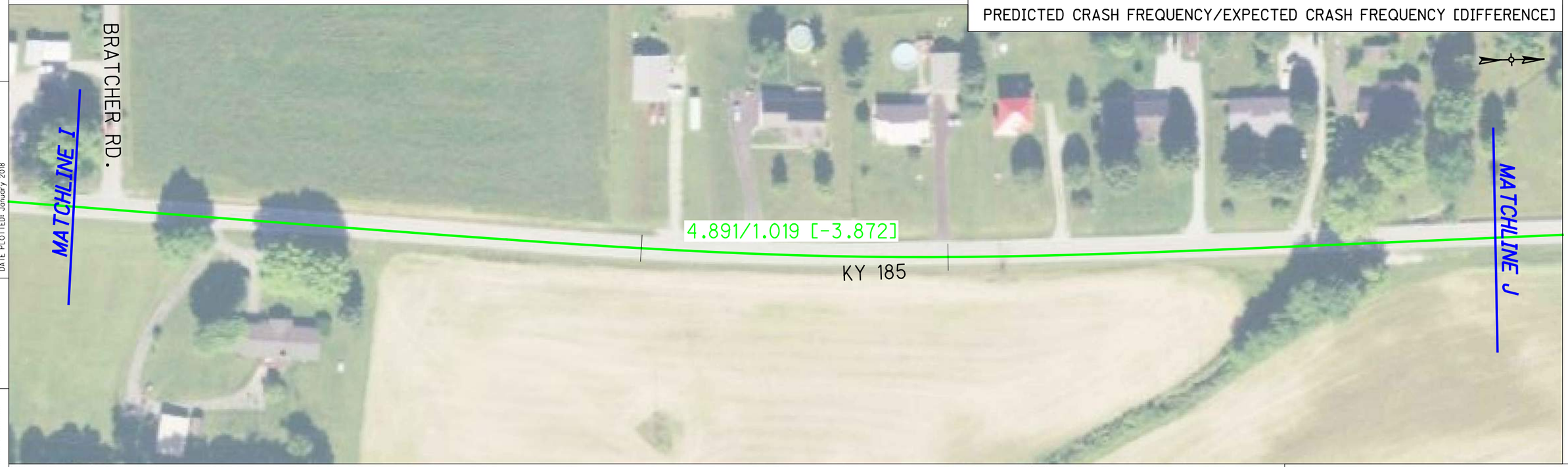
KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9D

LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]



FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9E

LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

FILE NAME:

USER: Kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9F

AUSTIN RAYMER RD.

MATCHLINE L

6.308/1.355 [-4.953]

10.628/14.597 [3.969]

KY 185

SPOT IMPROVEMENT 5

MATCHLINE M

LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

11.851/15.386 [3.535]

6.666/1.887 [-4.779]

KY 185

SPOT IMPROVEMENT 5

7.83/5.766 [-2.064]

MATCHLINE M

MATCHLINE N

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

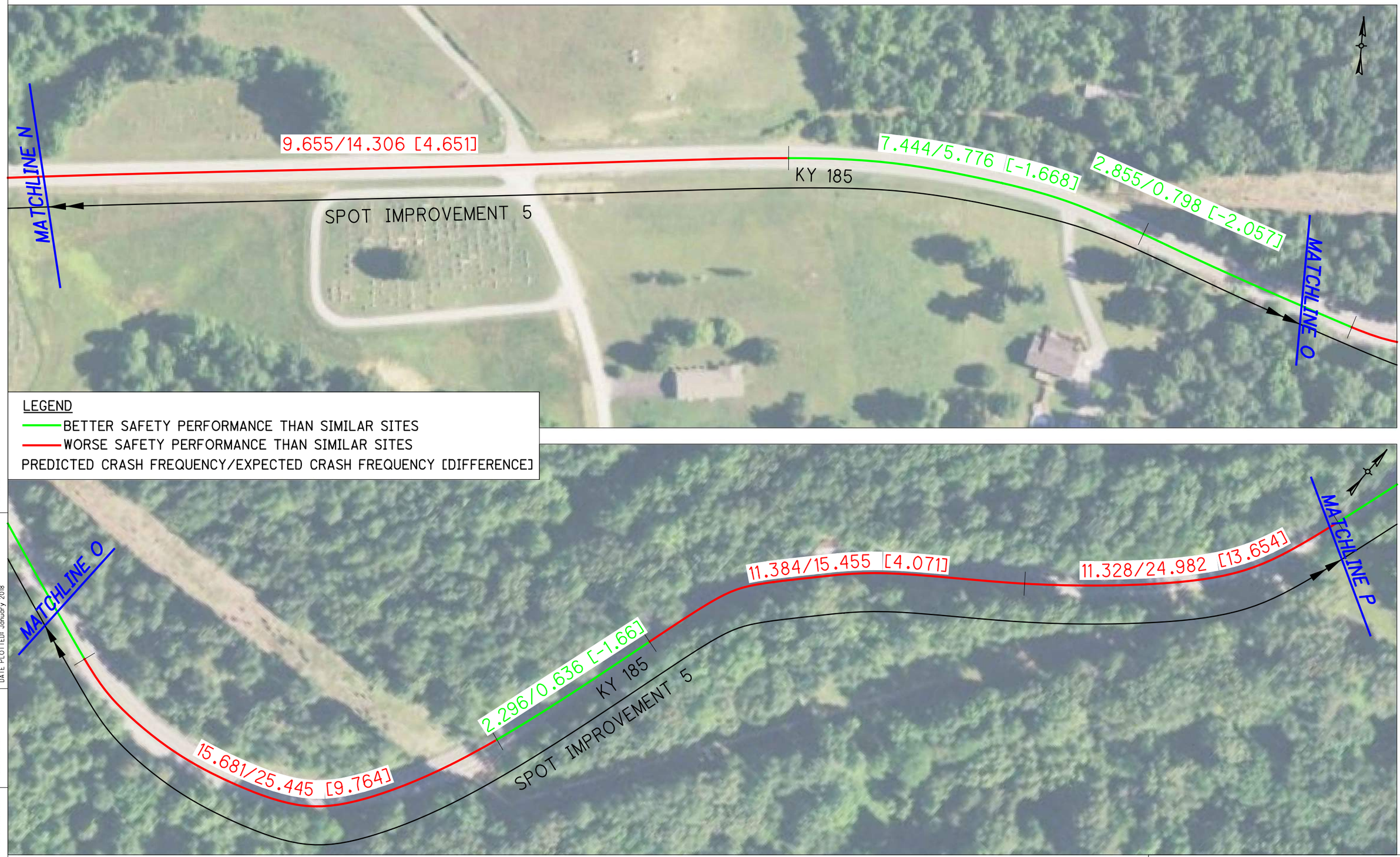
Power GEOPAK v8.11.3.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9G



LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

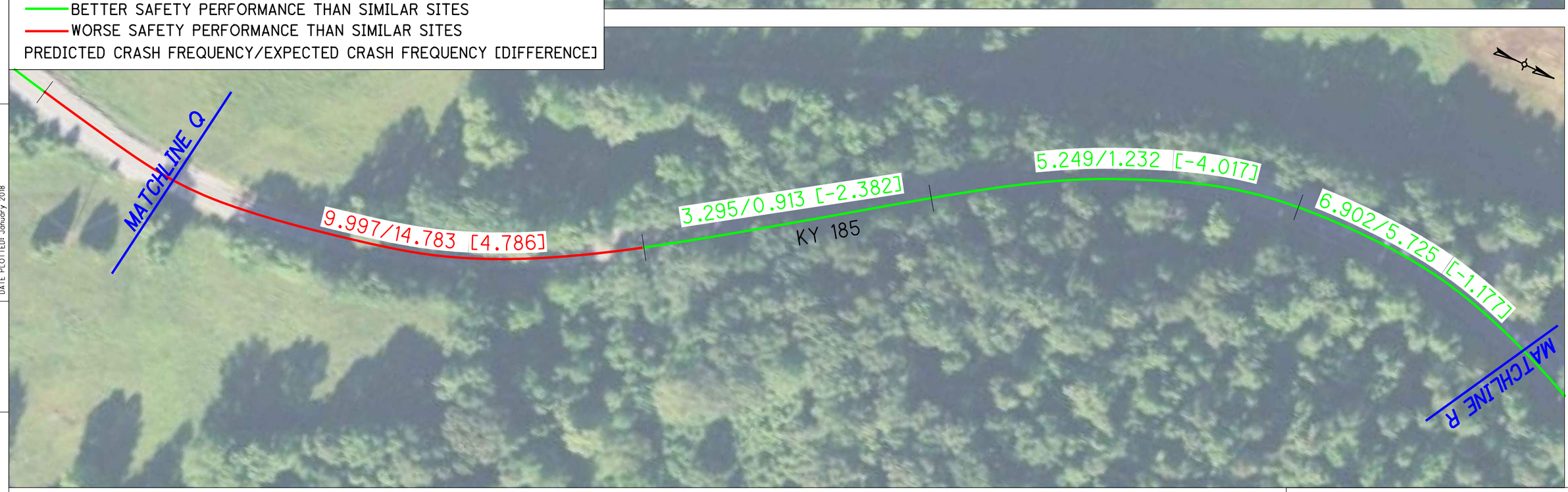
KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9H

LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]



FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.3.832

DRAFT

0' 50' 100' 200'

SCALE: 1"=100'

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 91

LEGEND

BETTER SAFETY PERFORMANCE THAN SIMILAR SITES

WORSE SAFETY PERFORMANCE THAN SIMILAR SITES

PREDICTED CRASH FREQUENCY/EXPECTED CRASH FREQUENCY [DIFFERENCE]

FILE NAME:

USER: kschenk
DATE PLOTTED: January 2018

E-SHEET NAME:

Power GEOPAK v8.11.9.832

DRAFT

0′ 50′ 100′ 200′

SCALE: 1"=100′

KY 185 RELOCATION SAFETY ANALYSIS
EXISTING CONDITIONS HSM ANALYSIS RESULTS
FIGURE 9J