# Special Study
# Debris and Contributing Materials in Roadway (CMR)

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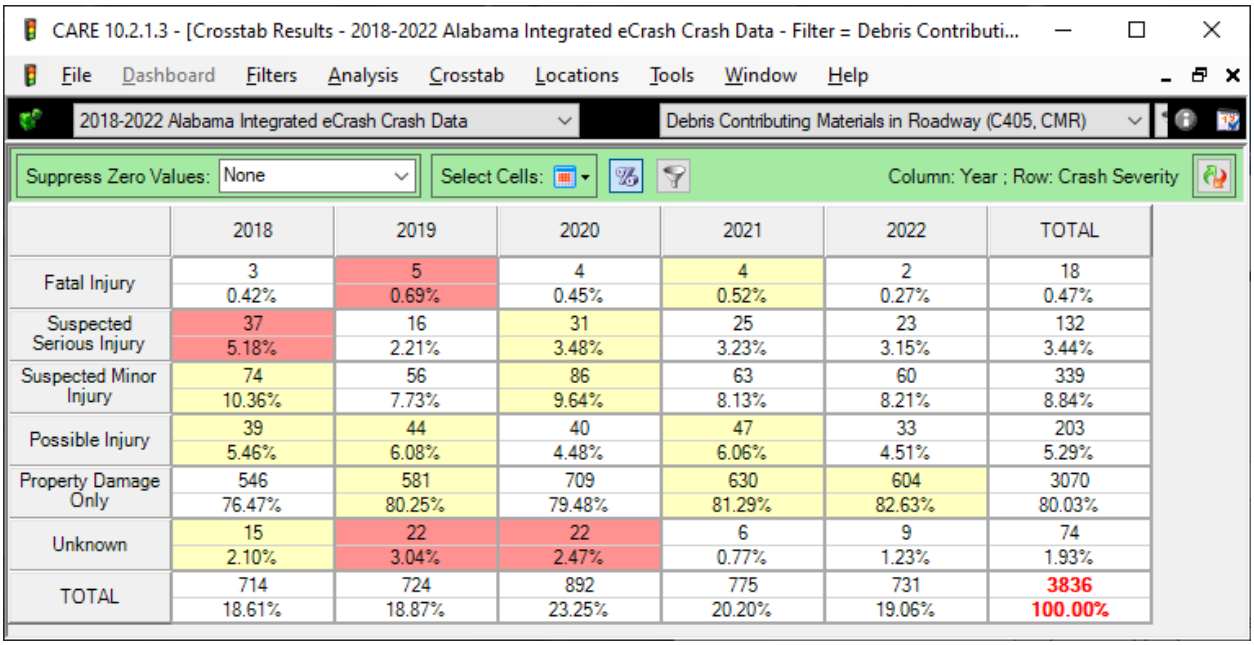
## Introduction

Debris and Contributing Materials in the Roadway will be covered collectively in this document using the acronym Contributing Materials in the Roadway (CMR). Over the past five years (2018-2022) in Alabama there were 3,836 CMR crashes of which 19 were fatal crashes causing 21 deaths. In addition, the total number of injured (including fatalities) was 863 persons.

The purpose of this report is to reduce the number of CMR (which includes roadway debris) crashes as much as possible, and thereby reduce the resulting fatalities and injuries. The following cross-tabulation shows how the number of CMR crashes (henceforth CMRs) have remained fairly constant over the five years of this study. Year 2020 was an exception.

**CMR-Involved Crash Severity (C025) by Year (C003) 2018-2022 Cross-tabulation**




| | 2018 | 2019 | 2020 | 2021 | 2022 | TOTAL |
|---|---|---|---|---|---|---|
| Fatal Injury | 3<br>0.42% | 5<br>0.69% | 4<br>0.45% | 4<br>0.52% | 2<br>0.27% | 18<br>0.47% |
| Suspected Serious Injury | 37<br>5.18% | 16<br>2.21% | 31<br>3.48% | 25<br>3.23% | 23<br>3.15% | 132<br>3.44% |
| Suspected Minor Injury | 74<br>10.36% | 56<br>7.73% | 86<br>9.64% | 63<br>8.13% | 60<br>8.21% | 339<br>8.84% |
| Possible Injury | 39<br>5.46% | 44<br>6.08% | 40<br>4.48% | 47<br>6.06% | 33<br>4.51% | 203<br>5.29% |
| Property Damage Only | 546<br>76.47% | 581<br>80.25% | 709<br>79.48% | 630<br>81.29% | 604<br>82.63% | 3070<br>80.03% |
| Unknown | 15<br>2.10% | 22<br>3.04% | 22<br>2.47% | 6<br>0.77% | 9<br>1.23% | 74<br>1.93% |
| TOTAL | 714<br>18.61% | 724<br>18.87% | 892<br>23.25% | 775<br>20.20% | 731<br>19.06% | **3836**<br>**100.00%** |

Generally, the year 2020 could be discounted in many such presentations in that it was the year that COVID caused irregular changes in the crash data. For general studies of the effects of COVID on crashes in 2020 and 2021, please see http://www.safehomealabama.gov/caps-special-studies/ under the topic of COVID-19/Coronavirus. Generally, because of reduced traffic, the number and proportion of crashes in 2020 is lower for most crash causes. However, the above shows it to be the high year. Further analysis showed that this increase was due to Trees/Limbs; there were 561 as compared with the other four year average of 325. This would indicate that the weather was the cause of this spike (see C032 Weather in the IMPACT analyses below).

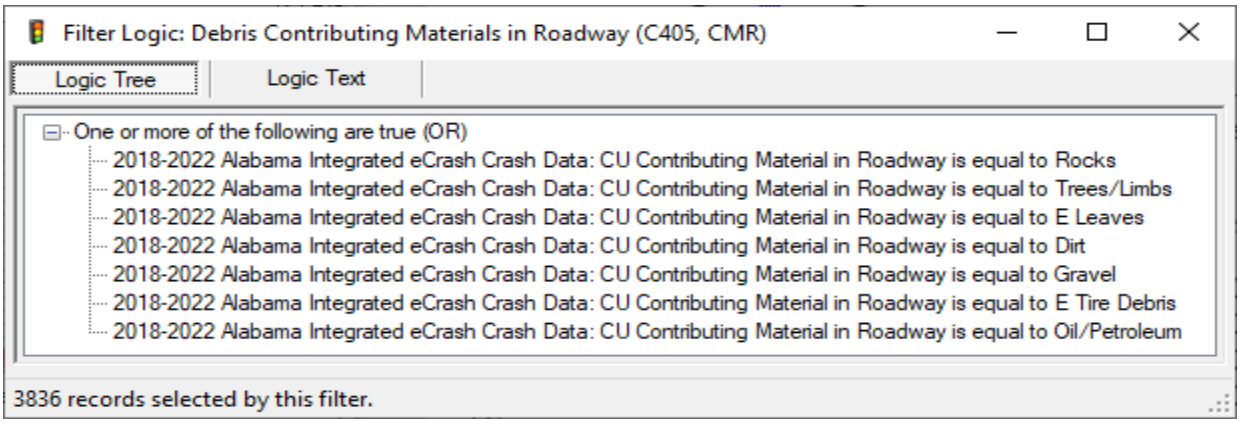
This report will begin with a filter definition section intended to demonstrate the exact nature of HMRs as given by the CARE variables for this subset. This is followed by an Executive Summary that will give a very short summary of the findings of each of the IMPACT analyses that are given in detail in Section 2. This is followed by recommendations, to drivers. The IMPACT studies in Section 2 compare the CMRs against the non-CMRs for all relevant attributes.

*Variable number nomenclature*: for the attribute comparisons in Section 2, the numbering of the variables (aka attributes) will be indicated by C followed by the variable number in CARE (e.g., C015 for Primary Contributing Circumstances).

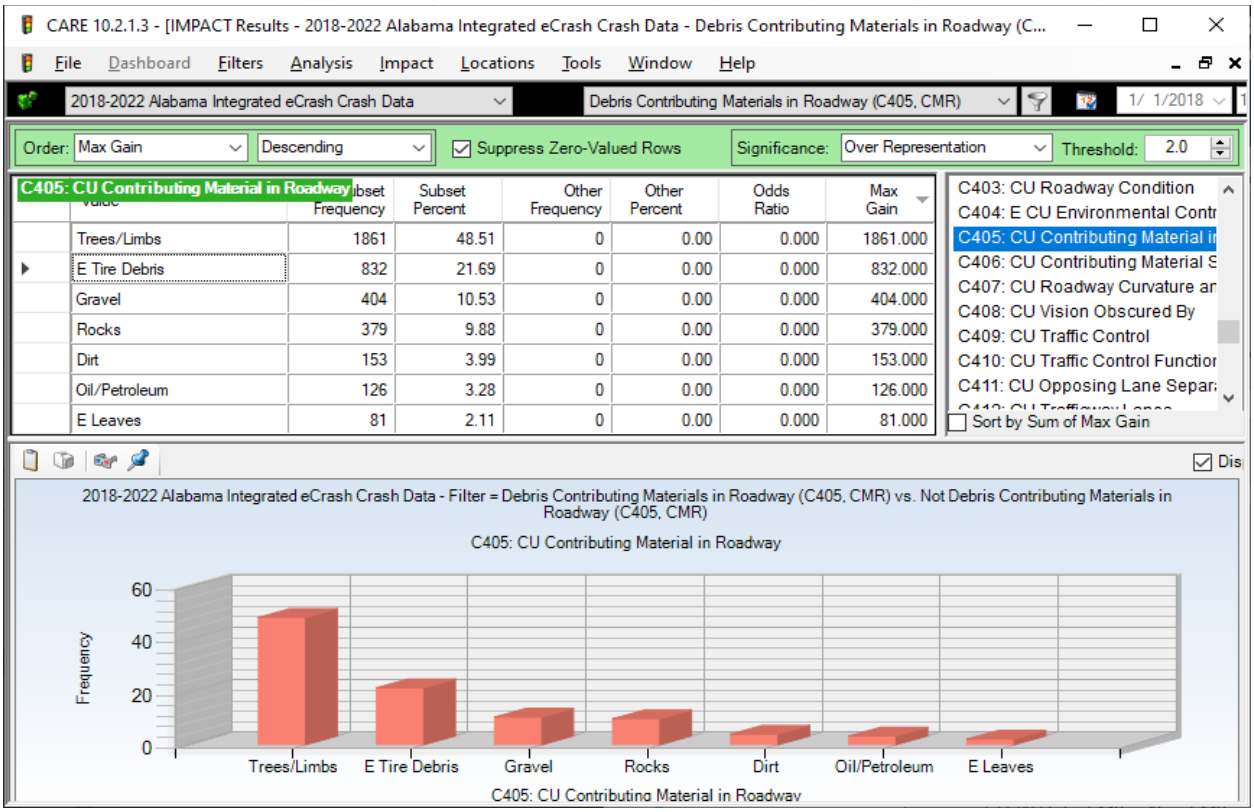
# 1.0 Filter Definition, Executive Summary, Recommendations to Drivers

## 1.1 Filter Definition: CMR Involved Crashes (CMRs)

The following is an image of the filter for all CMRs over the years 2018-2022 five-year period.




The following shows their relative frequencies to each other.



## 1.2 Executive Summary and Abstract of Findings

The following is a brief abstract of findings of each of the CARE IMPACT analyses according to the attribute numbering indicated above, along with the report Section 2 numbers that appear below. For the complete IMPACT report on any of them, see the corresponding Section 2 references.

2.1 C001 County. Over-represented counties typically have the largest proportions of County and Interstate crashes.

2.2 C002 City. As with the over-represented counties, those cities that have heavy Interstate traffic rose to the top (see C011). County roads did not play as large a role since there are relatively few county roads in most cities.

2.3 C004 Month. Months correlate heavily with the number or rural crashes in that time period. April through August and October are generally those that have the highest rural travel (see C010 and C011).

2.4 Cross-tabulation C010 Rural or Urban by C011 Highway Classification. The highway classifications that have the highest over-representations in rural areas are County and Interstate followed by State and Federal).

2.5 C006 Day of the Week. Saturday, Sunday and Thursday are significantly over-represented. Tuesday and Friday are significantly under-represented.

2.6 C008 Time of Day. The night-time (after dark) hours were consistently over-represented from 7:00 PM through 6:59 AM indicating that there is a problem of drivers not being able to see the CMR materials after dark.

2.7 C010 Rural/Urban. Nearly 65% (64.39) of CMRs occur in Rural areas, which is a proportion of 2.728 times more than expected compared the control subset of non-CMR crashes. This has reflected itself in several of that attributes discussed above.

2.8 C011 Highway Classification. County and Interstate both have over twice their expected CMR crashes as compared to their non-CMR controls. This is expected from the results presented in several of the attributes above.

2.9 C015 Primary Contributing Circumstances (PCCs). The following PCCs (with frequencies) are very significantly over-represented: Unseen Object/Person/Vehicle (1,927, over 50%), Swerved to Avoid Object (218), and the combined, Driving Too Fast for Conditions and Over Speed Limit (235+78=313).

2.10 First Harmful Event. Direct hits of CMR materials are rarely of high severity. The only First Harmful Event item that may involve CMR direct hits is “Collision with Other Non-Fixed

Object", which had 1,159 occurrences (31.84% and 3 fatal crashes). But it was second to Collision with Tree, which had 1,213 occurrences (33.32% and 8 fatal crashes). Most of the harmful events occur mainly in avoiding CMR items. This output lists the wide variety of crash types that commonly result from CMR secondary collisions.

2.11 C023 Manner of Crash. Close to 80% (79.64%) of CMR crashes involve only a single vehicle. Most of the other items in this list show the results when a second vehicle is involved. Seventeen out of the 18 fatal crashes involved only a single vehicle.

2.12 C031 Lighting Conditions. Highly correlated with time of day, all dark conditions were over-represented except E Dark - Spot Illumination One Side of Roadway (117), Dark - Continuous Lighting One Side of Roadway (4), Dark - Continuous Lighting Both Sides of Roadway (28). and Dark - Spot Illumination Both Sides of Roadway (107). This demonstrates that there are some roadway lighting conditions that can reduce CMR crashes.

2.13 C025 Crash [Injury] Severity. The only over-represented crash injury severity category was Suspected Serious Injury, which had 132 occurrences. Property Damage Only was also over-represented with 80.03% of the CMR crashes.

2.14 C032 Weather. Weather contributes to CMR crashes in two ways: (1) it is often the creation of the foreign materials that end up on the roadway, and (2) it limits the visibility to be able to effectively react to these materials. Rain is the highest frequency characteristic because of the frequency of its occurrence. Severe winds have less than one tenth of the frequency of rain, but their over-representation (Odds Ratio = 112.710) is enormous, indicating that severe winds either bring down tree limbs or blow foreign materials into the roadway. Fog is also significantly over-represented indicating problems with the further limitation in visibility. No doubt fog at night would be the worst visibility situation, and driving in these conditions should be avoided if at all possible.

2.15 C033 Locale. Corresponding to the Rural/Urban findings given above, almost three quarters (73.15%) of CMR crashes occur in open country. While this is generally classified as rural, there are some Open Country areas in many urban areas as well. The speed problem in rural and open country situations is compounded with that of the presence of trees, many of which are at an age where they have dead wood or weak limbs that can break off onto the roadway.

2.16 C052 Number of Vehicles. About 85% (84.36) of CMR crashes are single vehicle. We would suspect that multiple-vehicle crashes would cause more severe injuries. However, the cross-tabulation of Crash Severity by Number of Vehicles indicates that 17 out of 18 of the fatal crashes involved only a single vehicle.

2.16a Cross-tabulation of C025 Crash Severity by C052 Number of Vehicles

2.17 C110 Distance from Residence. Greater than 25 Miles is over-represented by about 55.1% more than expected (Odds Ratio = 1.551). This is probably caused by the unfamiliarity with distant roadways, and the fact that they are often traveled at night.

2.18 C121 CU Driver Condition. The major finding here is that alcohol/drugs were significantly under-represented and thus did not contribute to the frequency or severity of CMR crashes.

2.19 C224 CU Estimated Speed at Impact. Impact speeds are generally higher for CMRs than for other crashes. This is largely because of their rural nature, and quite often drivers (especially at night) are taken by surprise by the materials in the roadway.

2.20 C403 Roadway Condition. Wet conditions are present in 41.21% of CMR crashes, but only in 17.05% of the non-CMRs. The two reasons for this is that wet weather is highly correlated with tree limbs and the limited visibility that goes with bad weather.

2.21 C406 Contributing Materials Source. The source of the CMR materials are primarily (69.94%) the natural environment. A smaller, but significant number (28.10%) fall from other vehicles, and even fewer are from those things expected in some neighborhoods and business environments. All three of these are very-highly significantly over-represented because the comparison subset was defined as non-CMR crashes.

2.22 C407 Roadway Curvature and Grade. Generally, it seems from this attribute that grades play a larger part in contributing to CMR crashes than do curves. This could be in requiring greater braking on down-slopes when a CMR situation is encountered. Also, many drivers increase their speeds to adapt to upgrades, which could also create similar problems.

2.23 C412 Trafficway Lanes. Two-lane roads have a significantly higher proportion of CMR crashes than any other lane conditions, probably because of the limited ability to avoid CMR materials without causing greater potential danger. It is possible that some CMRs do not get reported as such because other conditions are considered to be more significant to the reporting officers.

### 1.3 Recommendations to Drivers

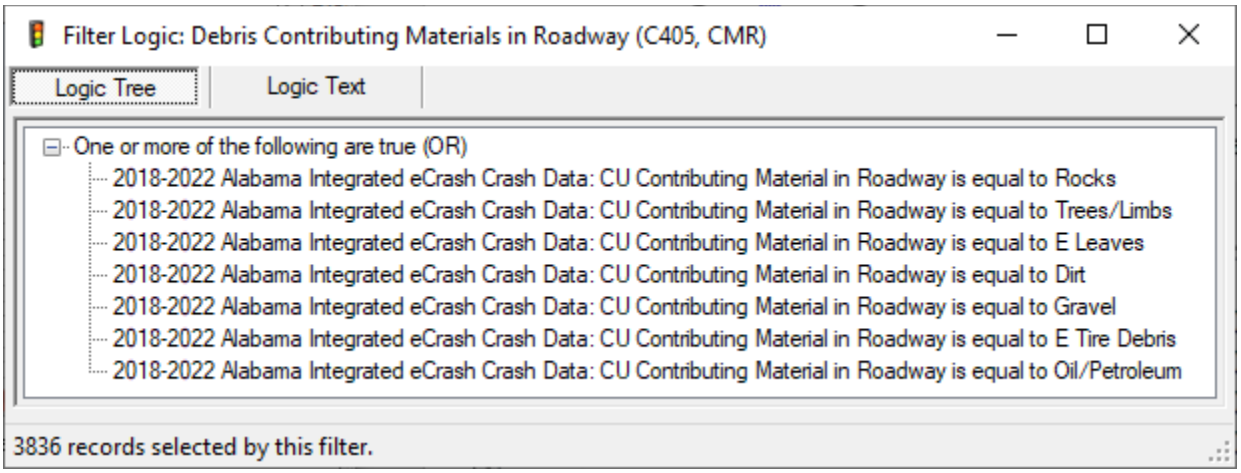
Based upon the findings of this study the following recommendations are offered to all driver to help reduce that frequency and severity of CMR crashes:

- The failure to see CMR materials arises when drivers are not expecting to see these obstacles in the roadway.
    - Recommendation: expect these possibilities all the time while driving.
    - This problem is compounded at night when visibility depends almost completed on the vehicle's headlights. Use high beams in all cases when they will not create a problem for approaching vehicles. Recognize that your bright lights could prevent the oncoming driver from seeing a CMR obstacle in the roadway.

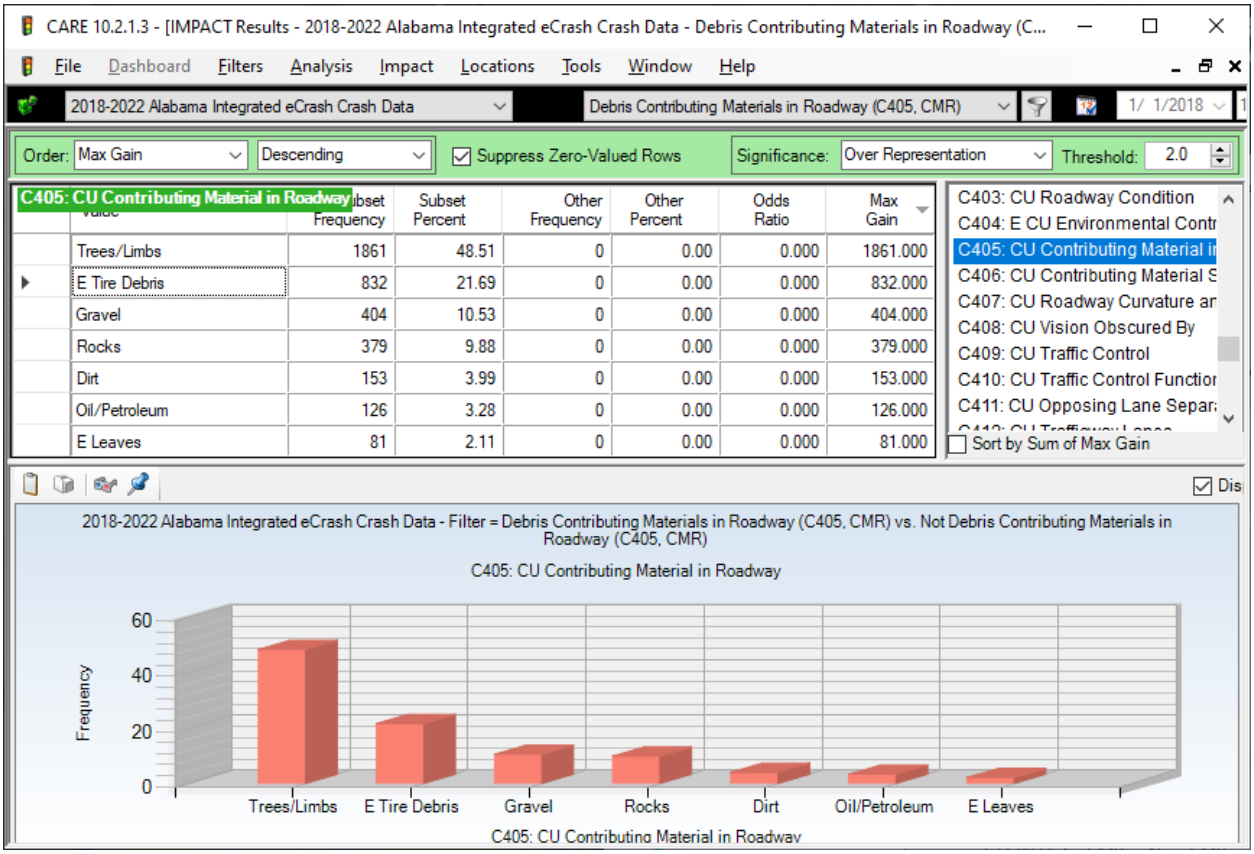
    - Weather is a second compounding factor in restricting visibility. Rain, mist or fog can make seeing a CMR object impossible. Exercise your option to pull over and wait-out the bad weather if at all possible. Some of the most severe weather is relatively short-lived, so not much is lost in such a delay.
    - Be aware of additional wind problems that accompany bad weather. It is relatively common for tree limbs to come down on the roadway especially in situations where windy weather had not been experienced for some time.
    - Anticipate CMR before actually seeing it. High winds and rain in rural areas should put drivers on special alert that CMR obstacles may be in the offing.
- The hazard of all of the factors above can be mitigated by taking the foot off the gas and turning the cruise control off. A few additional seconds to react to danger can save lives.
- Think through exactly how you will respond to various CMR hazards. Consider the pros and cons of the reaction responses that follow:
    - Brake sharply. Sometimes there are no other alternatives, but recognize and condition your response recognizing that often sharp braking only complicates the situation, especially if you lose control of the vehicle. Do not think that you are the exception that can handle it. If at all possible, take advantage of a local driver performance course that has exercises in wet asphalt conditions.
    - Pump your brakes to get down to a more survivable speed without losing control of your vehicle. Not only can this increase your chances of survival in a crash, but the slower speed vehicle will be easier to control. DO NOT DO THIS if the vehicle manual warns against it. Some newer models have non-skid brake features. In these cases sharp braking is recommended as opposed to pumping the brakes.
    - If braking is out of the question, then choose the safest way out of the situation, recognizing:
        - The worst case is generally to swerve left into the lane of oncoming traffic.
        - Look to the right and compare the obstacles on the shoulder of roadside against those in the roadway.
        - If there is no good alternative, then hit the obstacle in the best way to reduce the harm. If there is no safe alternative to avoiding the obstacle, hard braking may be an alternative since retaining control at this point may be of little value.
- Follow speed limits, but do not allow the speed limit to govern your speed in the possible presence of CMRs. Slow down at their first indication, and be ready to stop if necessary.

### 1.4 Filter Definition: CMR Involved Crashes (CMRs)

The following is an image of the filter for all CMRs involved in crashes over 2018-2022.




The following shows their relative frequencies to each other.

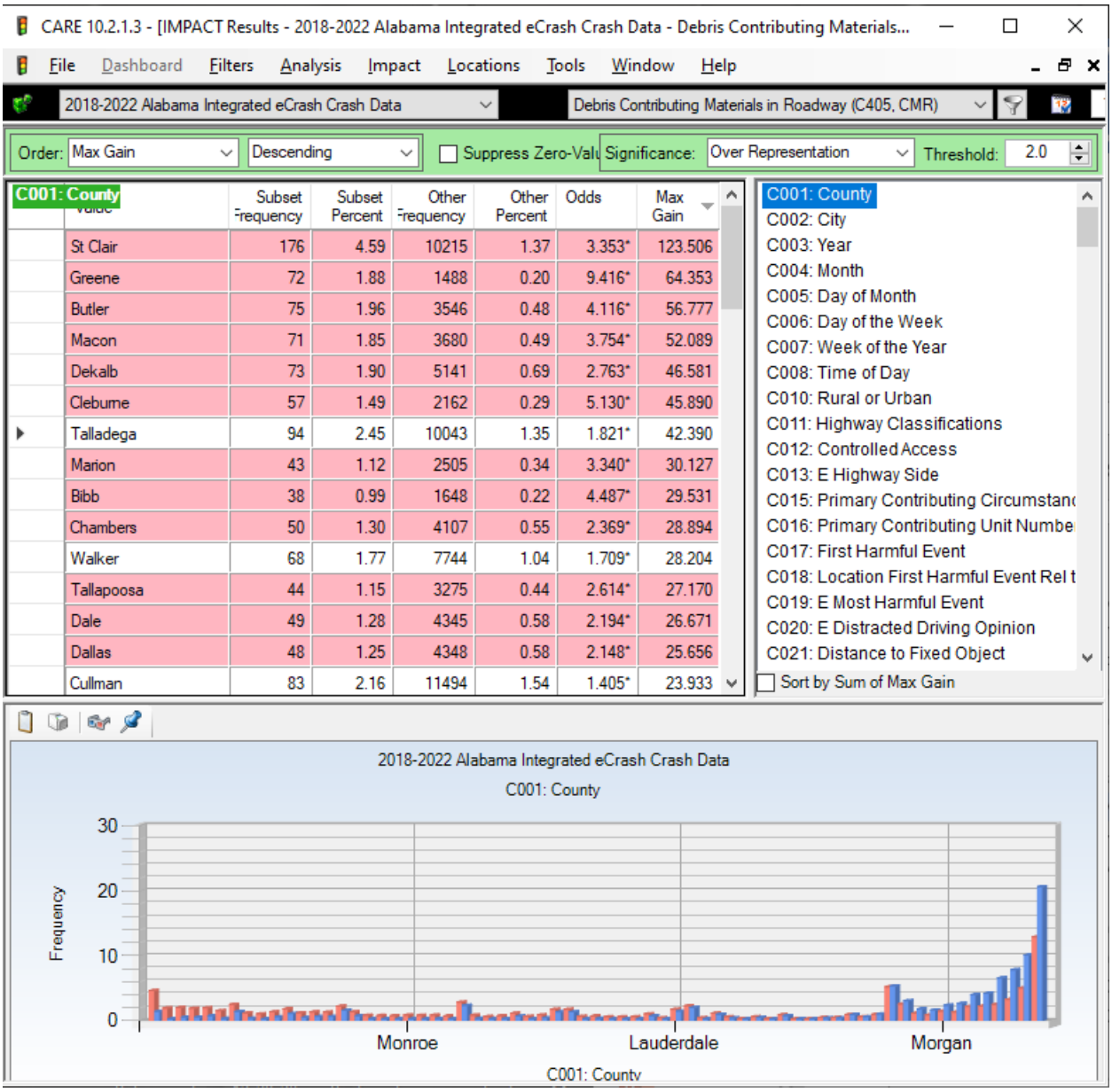


## 2.0 CMR-Involved Crash (CMR) IMPACT Analyses

This section contains several IMPACT comparisons of CMR crashes compared to non-CMR crashes of all types.

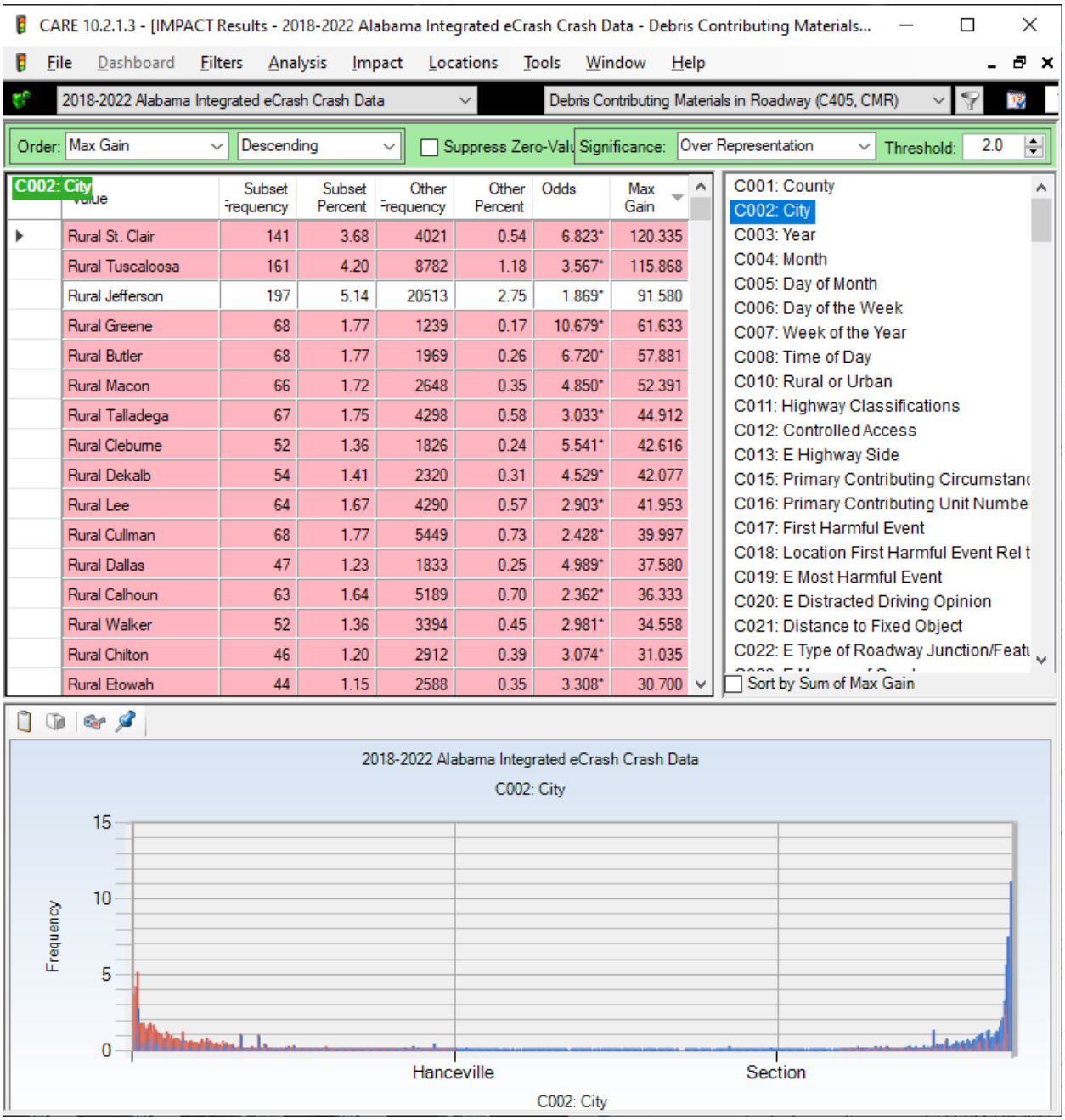
For an explanation of the IMPACT output displays, please see the discussion entitled "General Discussion of IMPACT Output Terms …" at the end of the introduction of the following Special Study:
http://www.safehomealabama.gov/wp-content/uploads/2023/03/Rural-Urban-IMPACT-Study-v07.pdf

## 2.1 C001 County; CMR vs Non-CMR All Counties with Max Gains > 25.000



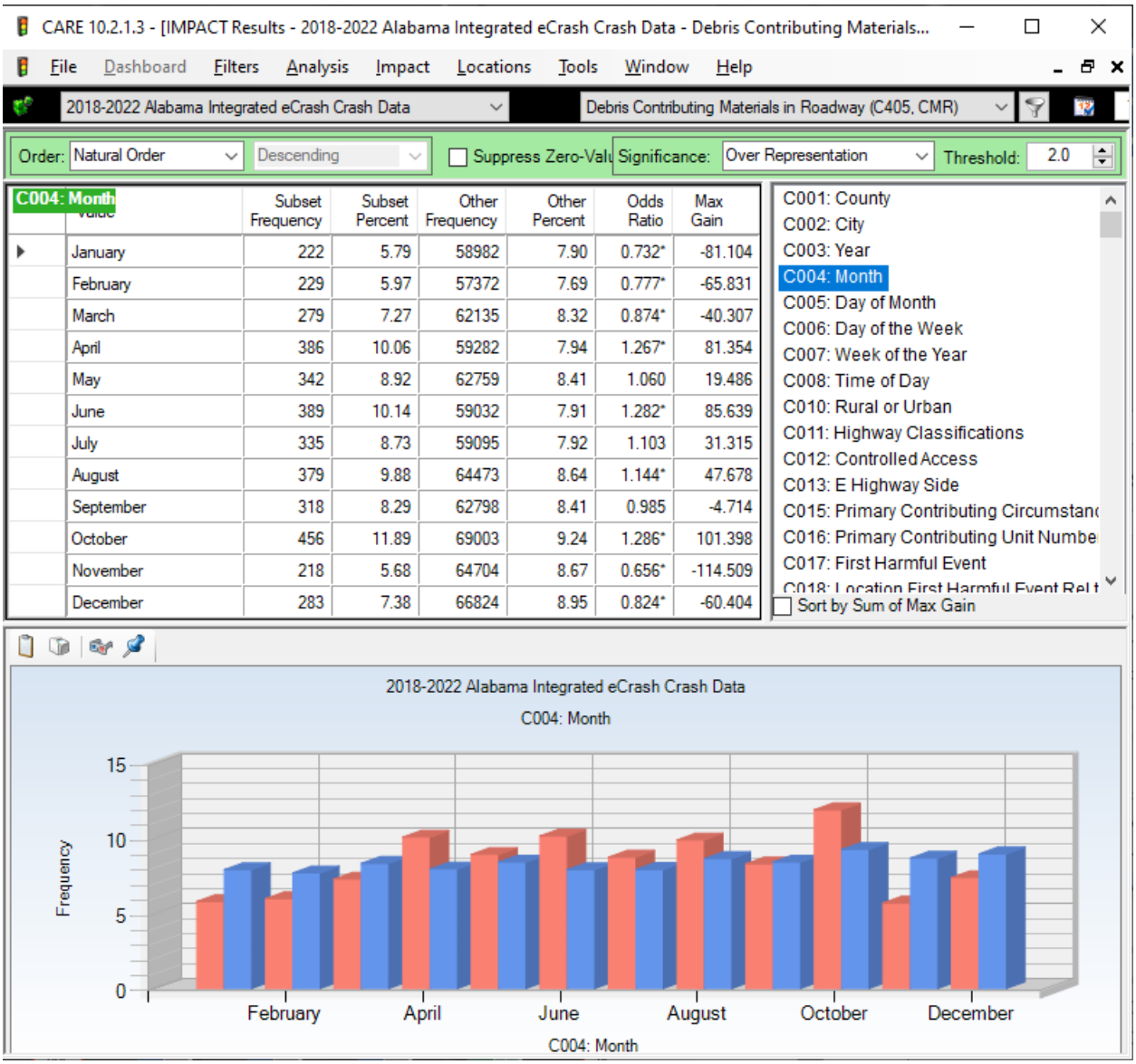

The above are all counties that had a Max Gains greater than 25. Counties with a high mileage of County and Intestate roadways are the ones that rise to the top of this list. See C011.

## 2.2 C002 City; CMR vs Non-CMR All Cities with Max Gains > 30.000



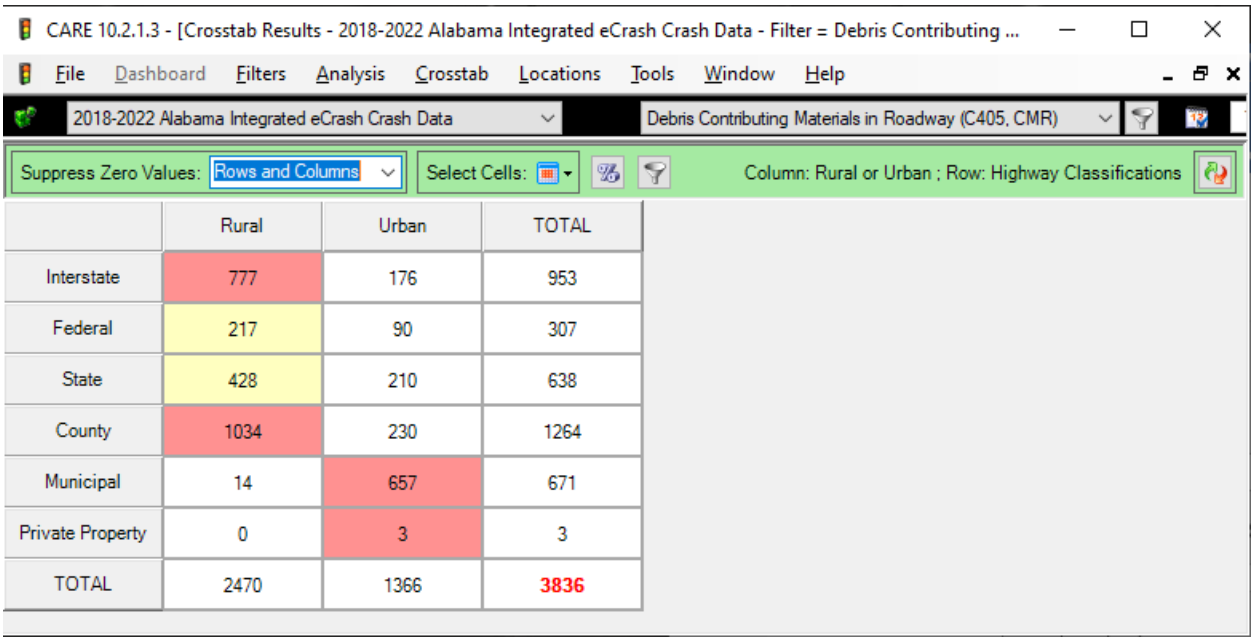

The above are all cities that had a Max Gain of 30 or more. As with the over-represented counties, those cities that have heavy Interstate traffic rose to the top (see C011).

## 2.3 C004 Month; CMR vs Non-CMR



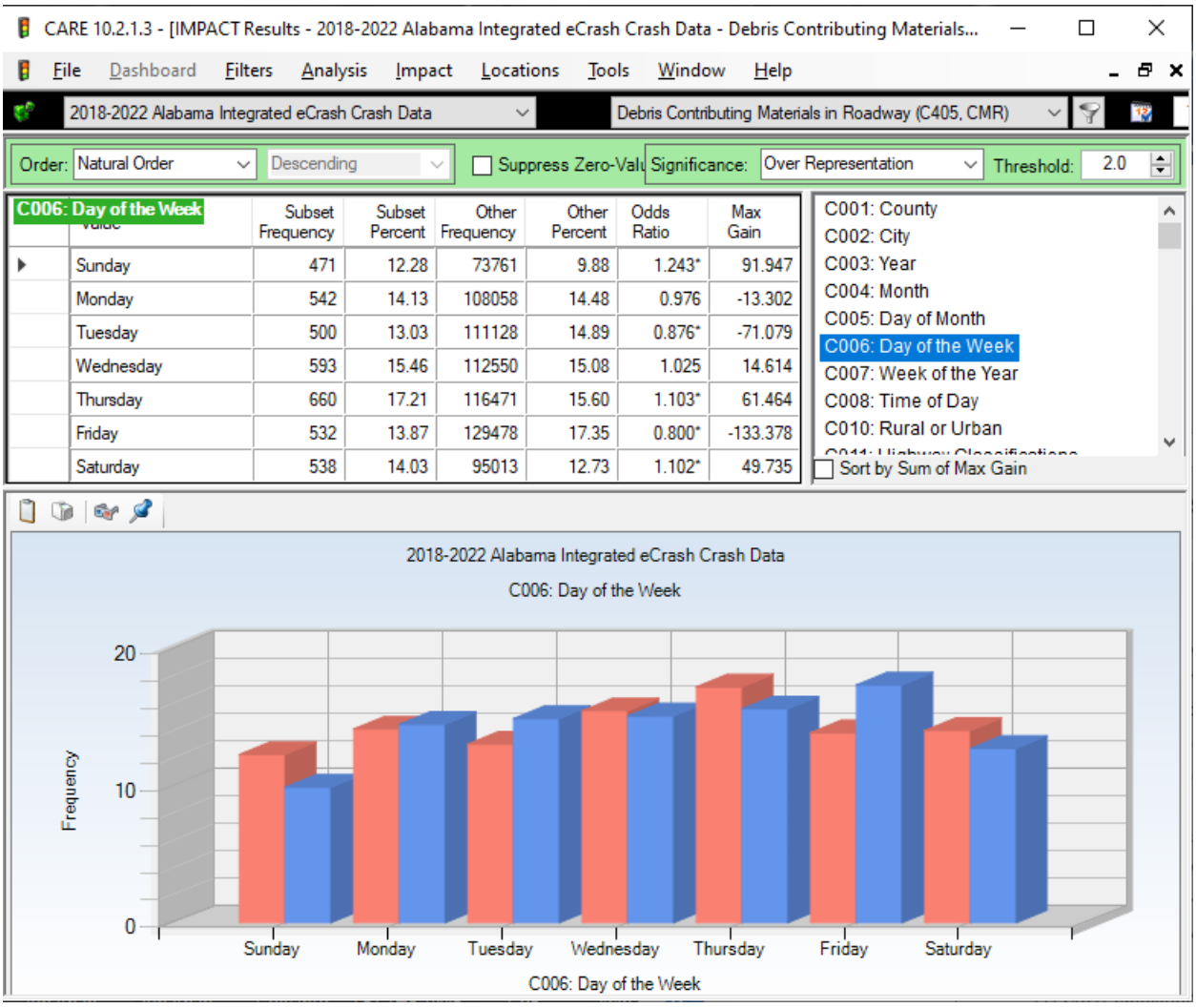

The over-represented months, April through August and October are generally those that have the highest rural travel (see C010). The cross-tabulation on the next page indicates those Highway Classifications that are over-represented in Rural crashes (See C010 and C011).

## 2.4 Cross-tabulation C010 Rural or Urban by C011 Highway Classification



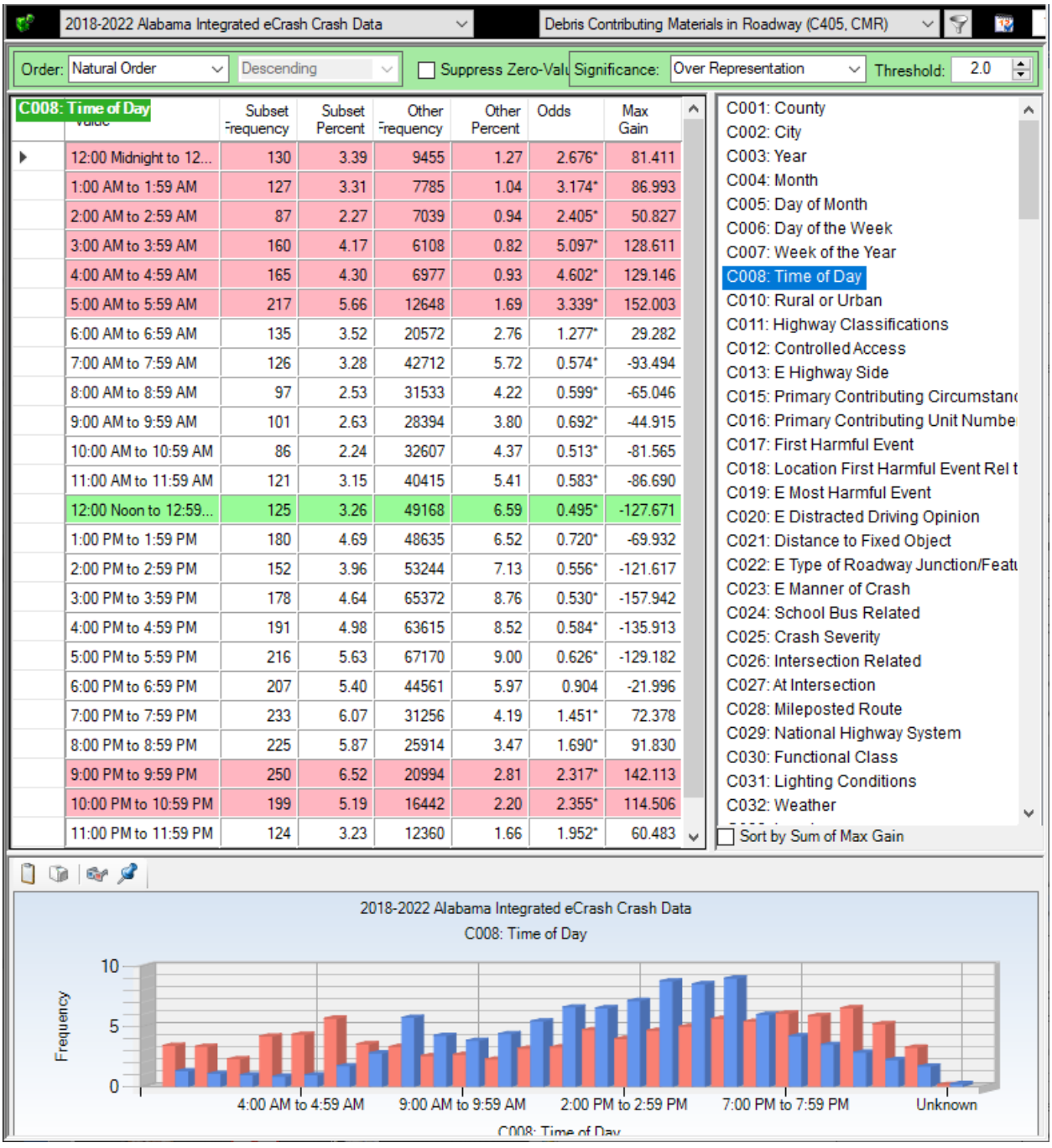

| | Rural | Urban | TOTAL |
|---|---|---|---|
| Interstate | 777 | 176 | 953 |
| Federal | 217 | 90 | 307 |
| State | 428 | 210 | 638 |
| County | 1034 | 230 | 1264 |
| Municipal | 14 | 657 | 671 |
| Private Property | 0 | 3 | 3 |
| TOTAL | 2470 | 1366 | **3836** |

## 2.5 C006 Day of the Week; CMR vs Non-CMR



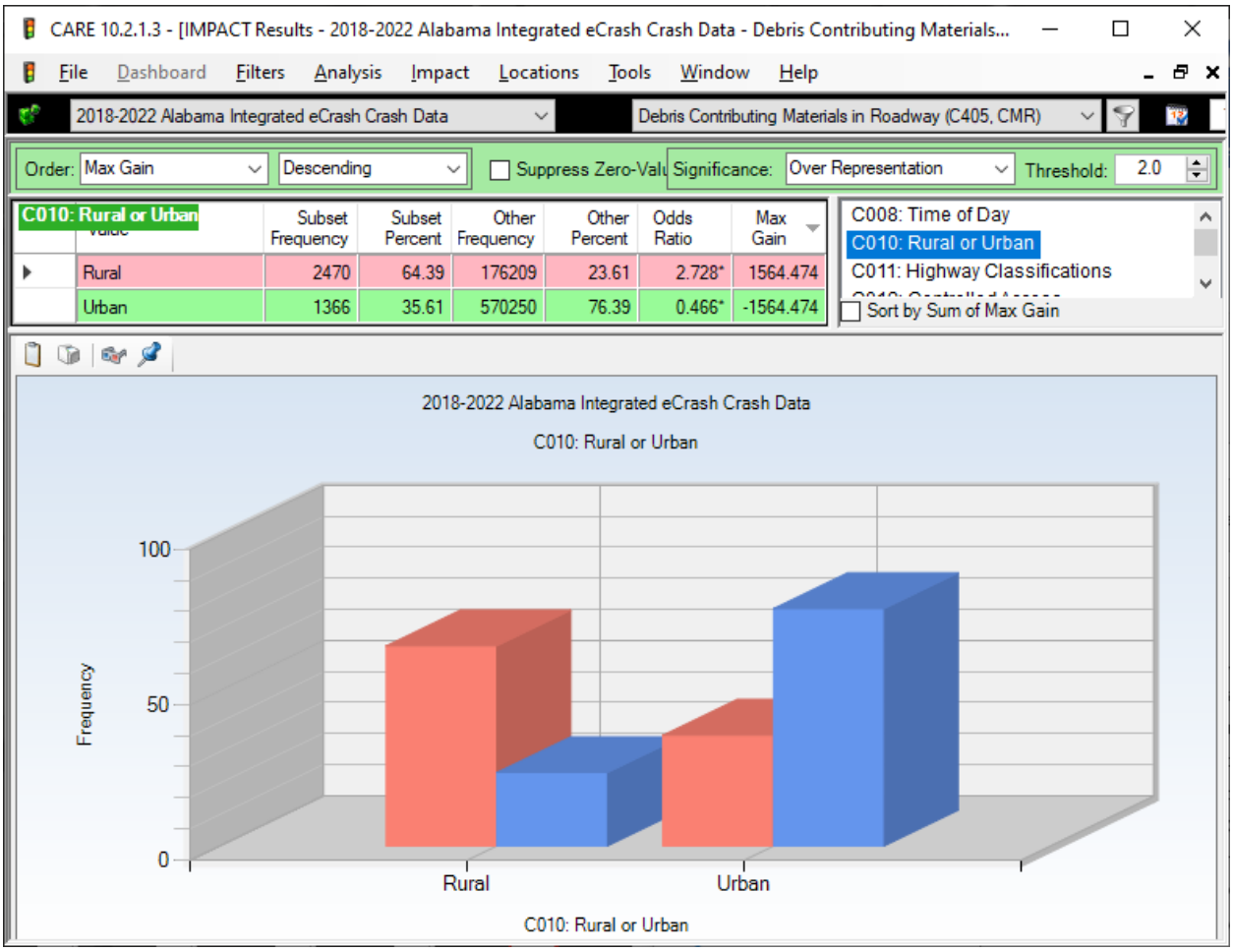

Saturday, Sunday and Thursday are significantly over-represented. Tuesday and Friday are significantly under-represented.

## 2.6 C008 Time of Day; CMR vs Non-CMR



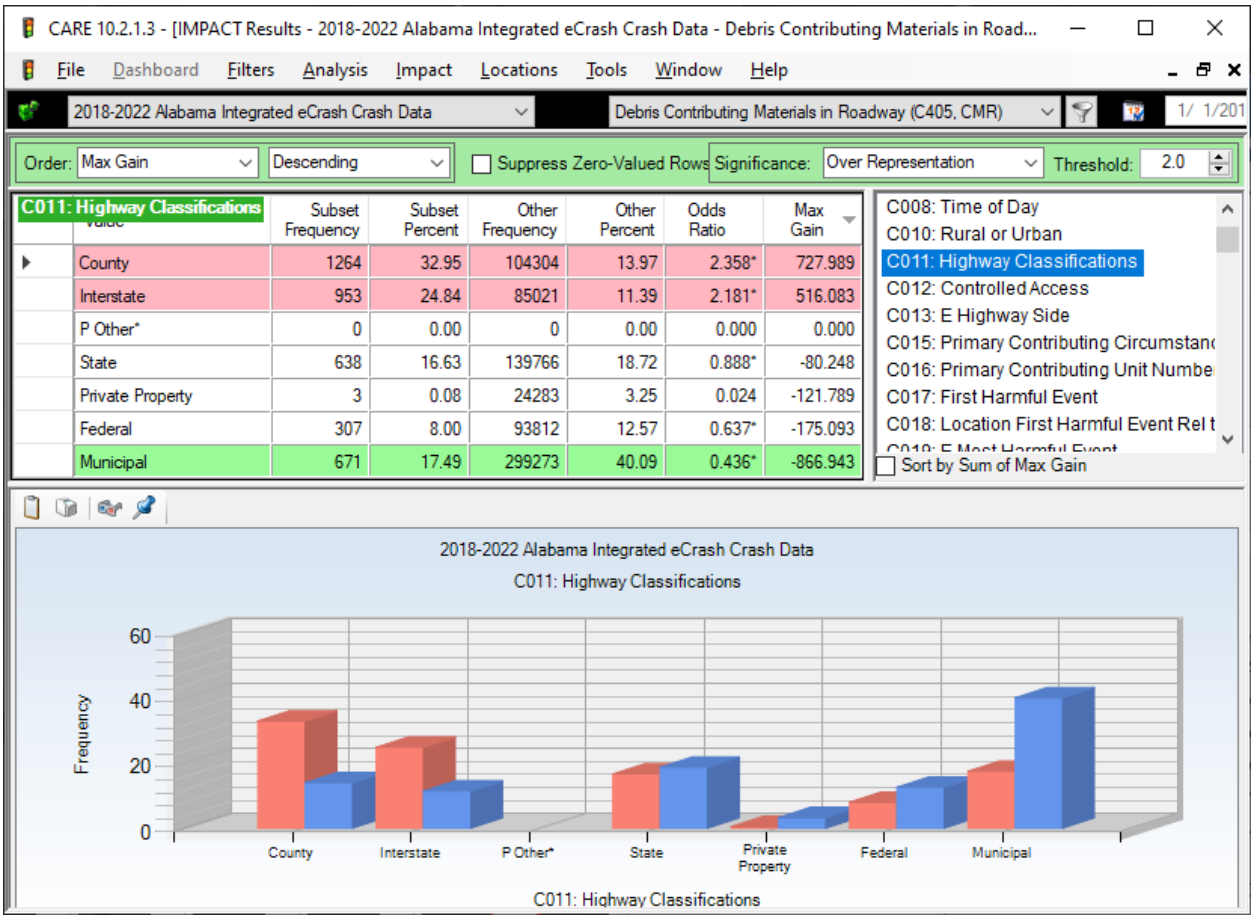

The night-time (after dark) hours were consistently over-represented from 7:00 PM through 6:59 AM. This is probably a problem of not being able to see the CMR materials in the dark. See the over-representation of Unseen Object/Person in C015.

## 2.7 C010 Rural/Urban; CMR vs Non-CMR Crashes



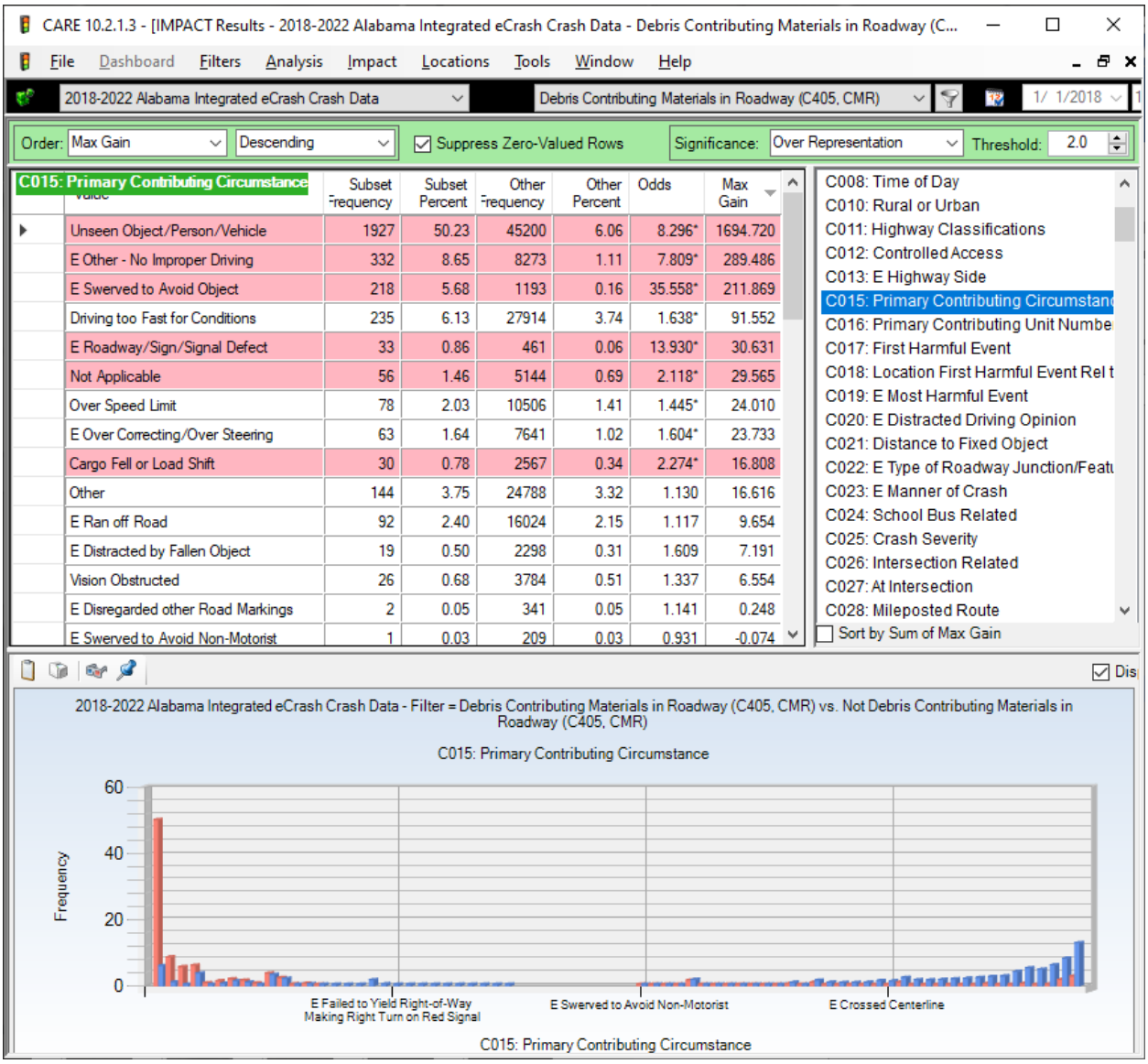

Nearly 65% (64.39) of CMRs occur in Rural areas, which is a proportion of 2.728 times more than expected from the control subset of non-CMR crashes.

## 2.8 C011 Highway Classification; CMR vs Non-CMR Crashes



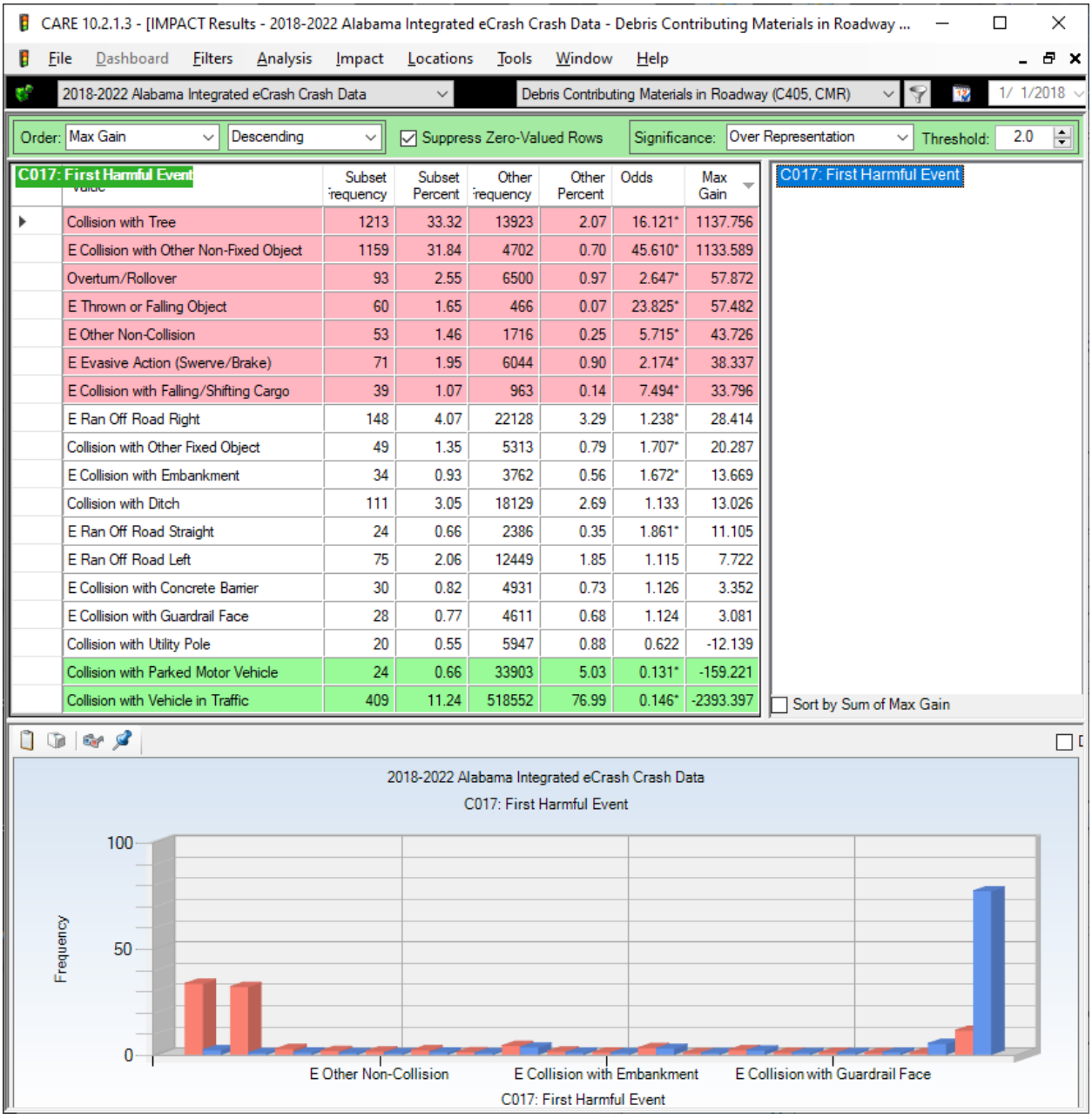

County and Interstate both have over twice their expected CMR crashes as compared to the non-CMR control.

## 2.9 C015 Primary Contributing Circumstances (PCCs); Odds Ratio > 1.000



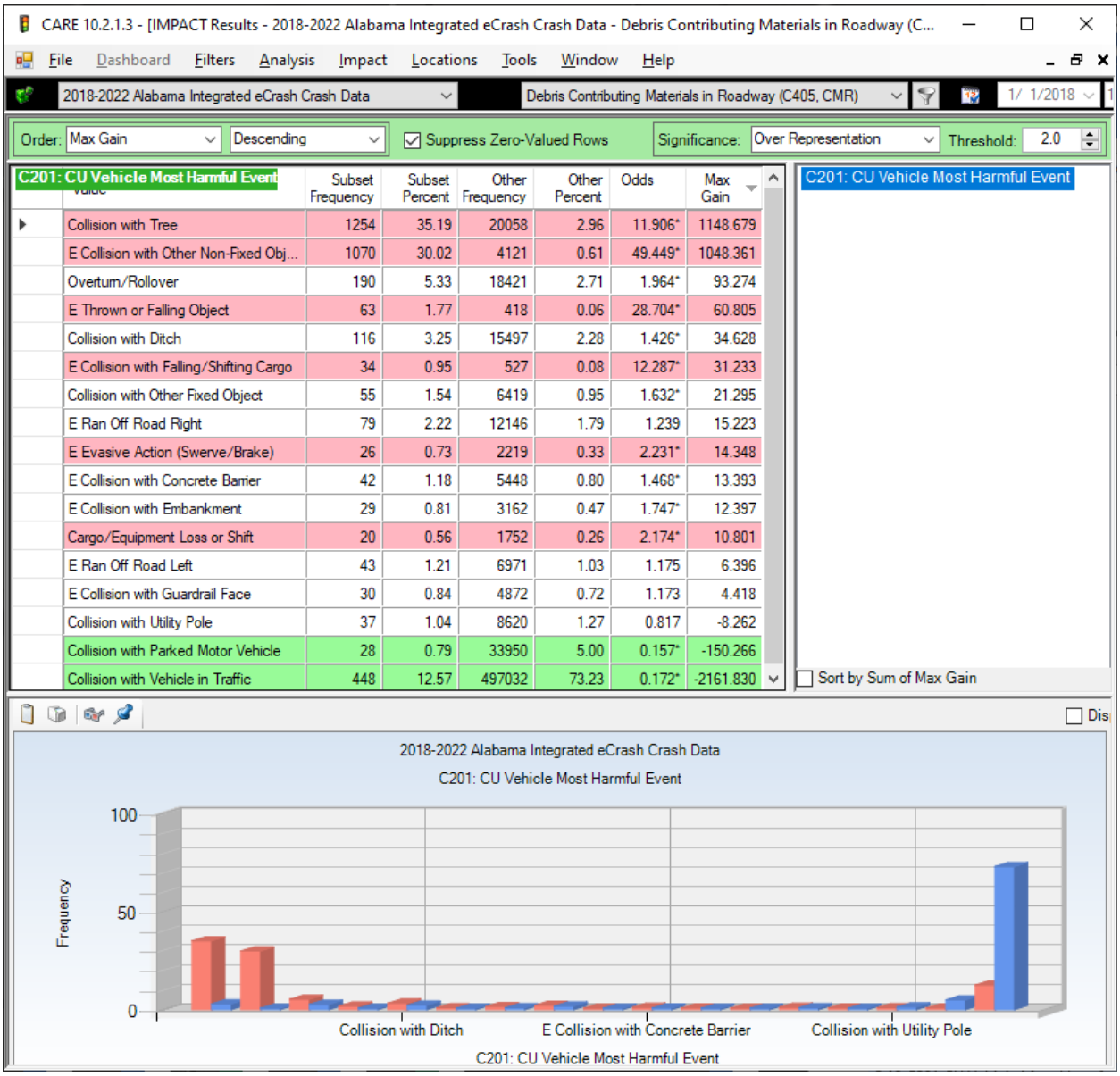

Over 50% (1927) of the CMR cases were Unseen Object/Person/Vehicle, which in this case are most likely to be CMR objects. This accounts for the large over-representations in the night-time hours. Other items with high frequencies are Swerved to Avoid Object (218) and Driving Too Fast for Conditions (235).

## 2.10 C017 First Harmful Event (Items with At Least 20 occurrences)



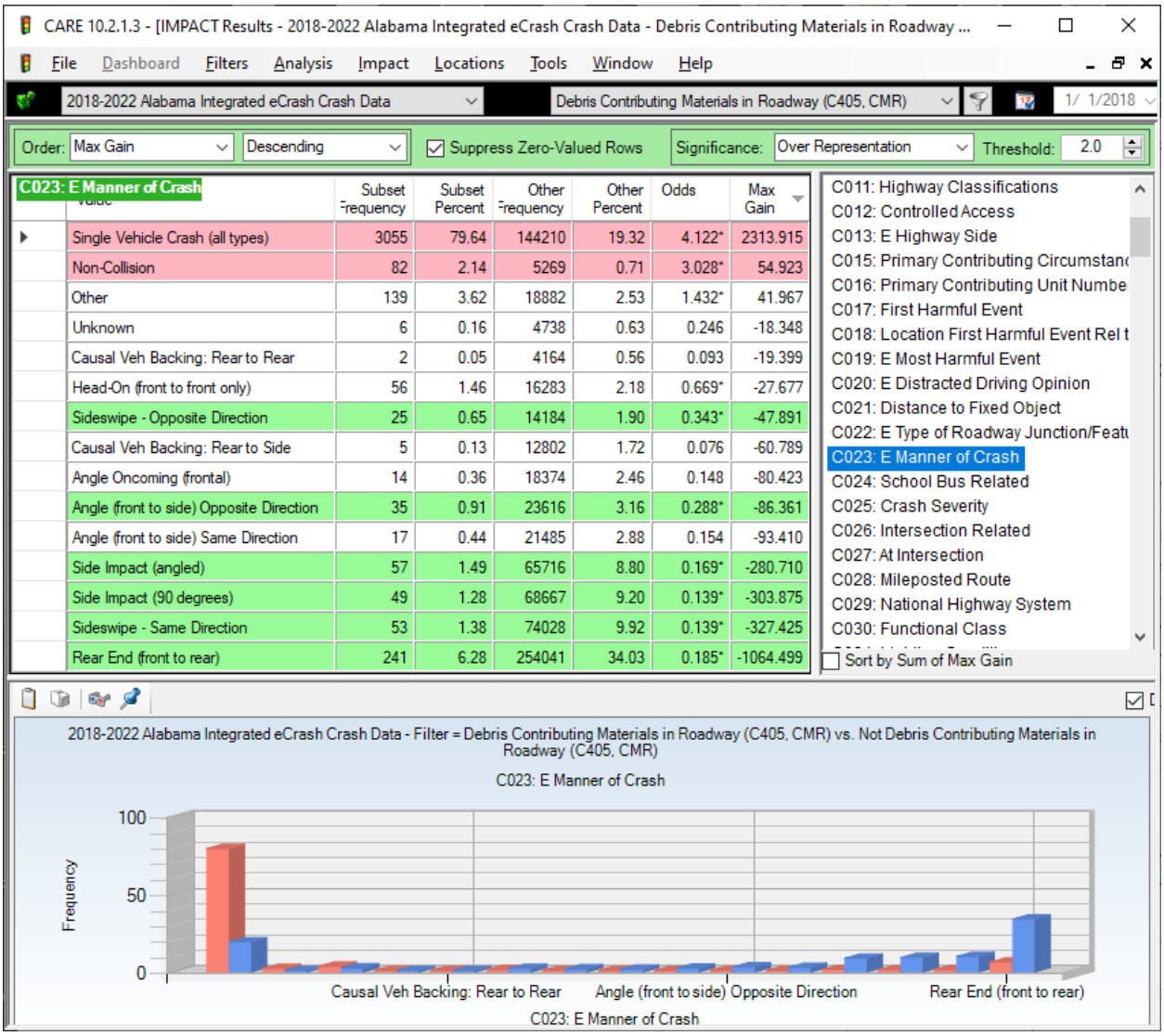

This display illustrates that collisions with the debris or other contributing materials are rarely harmful. The only item that may involve a CMR direct hit is "Collision with Other Non-Fixed Object", which had 1,159 occurrences (31.84% and 3 fatal crashes). But it was second to Collision with Tree, which had 1,213 occurrences (33.32% and 8 fatal crashes). Many of the most harmful events occur mainly in avoiding CMR items. There are a wide variety of crash types that result from these secondary collisions.

## 2.11 C201 CU Vehicle Most Harmful Event (Items >= 20)



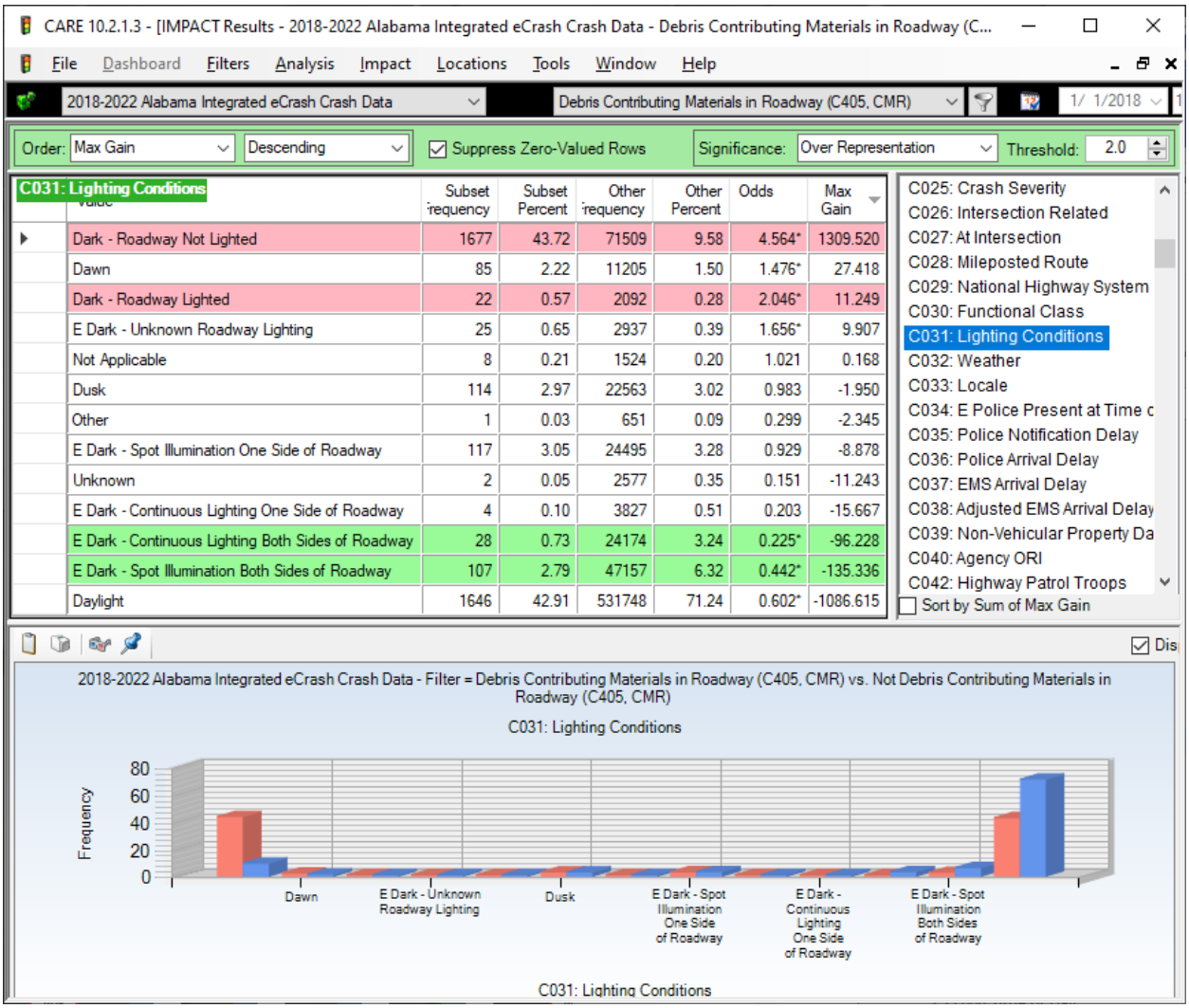

This correlates very highly with the First Harmful Event.

## 2.12 C023 Manner of Crash



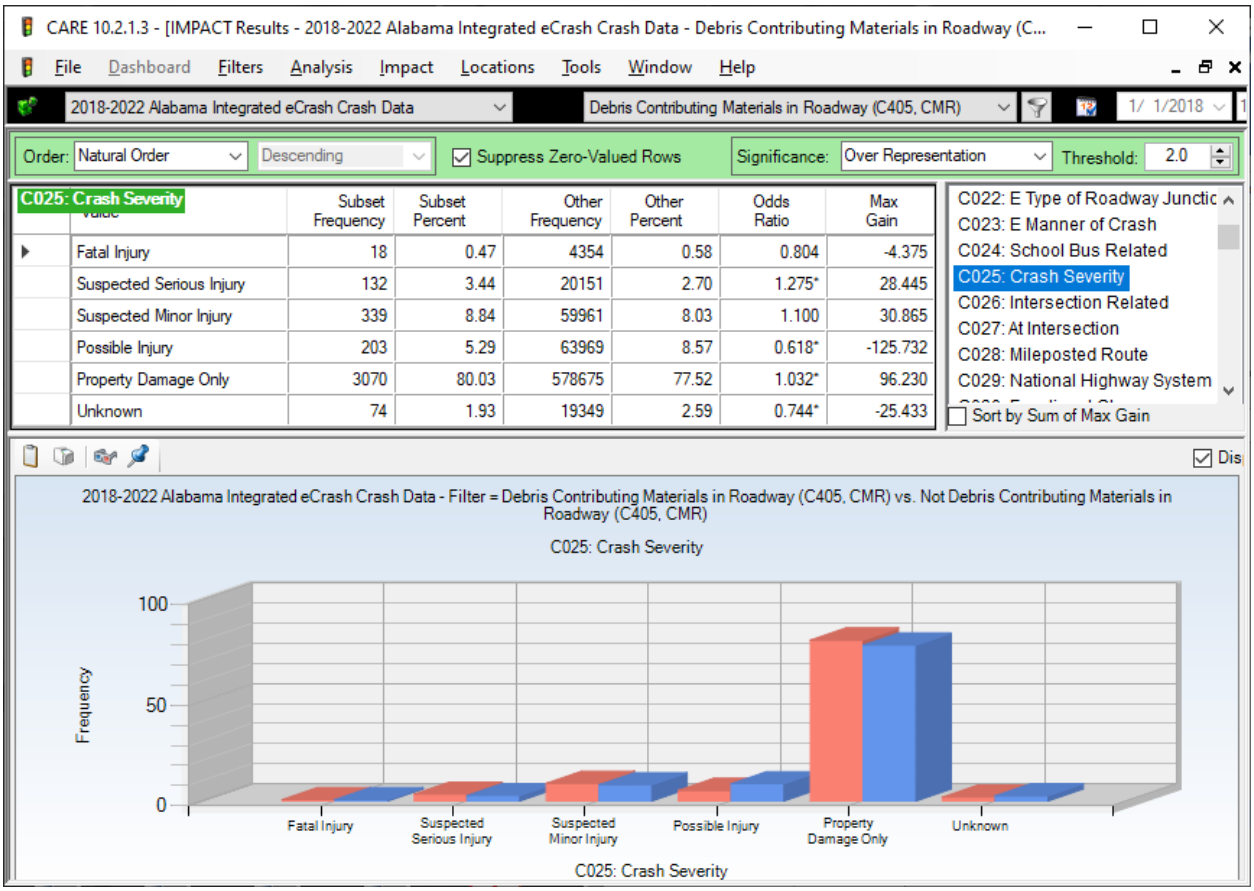

Close to 80% (79.64%) of CMR crashes involve only a single vehicle. Most of the other items in this list show the results when a second vehicle is involved. While most of these are under-represented in comparison with their non-CMR counterparts, some of them tend to be quite lethal, namely Head-On (front to front, 56), Sideswipe – Opposite Direction (25), Angle Oncoming (frontal, 14), Angle (front to side) Opposite Direction (35), Angle (front to side) Same Direction (17), Side Impact (angled, 57), Side Impact (90 degrees, 49), and Sideswipe - Same Direction (53).

## 2.13 C031 Lighting Conditions; CMR vs Non-CMR Crashes



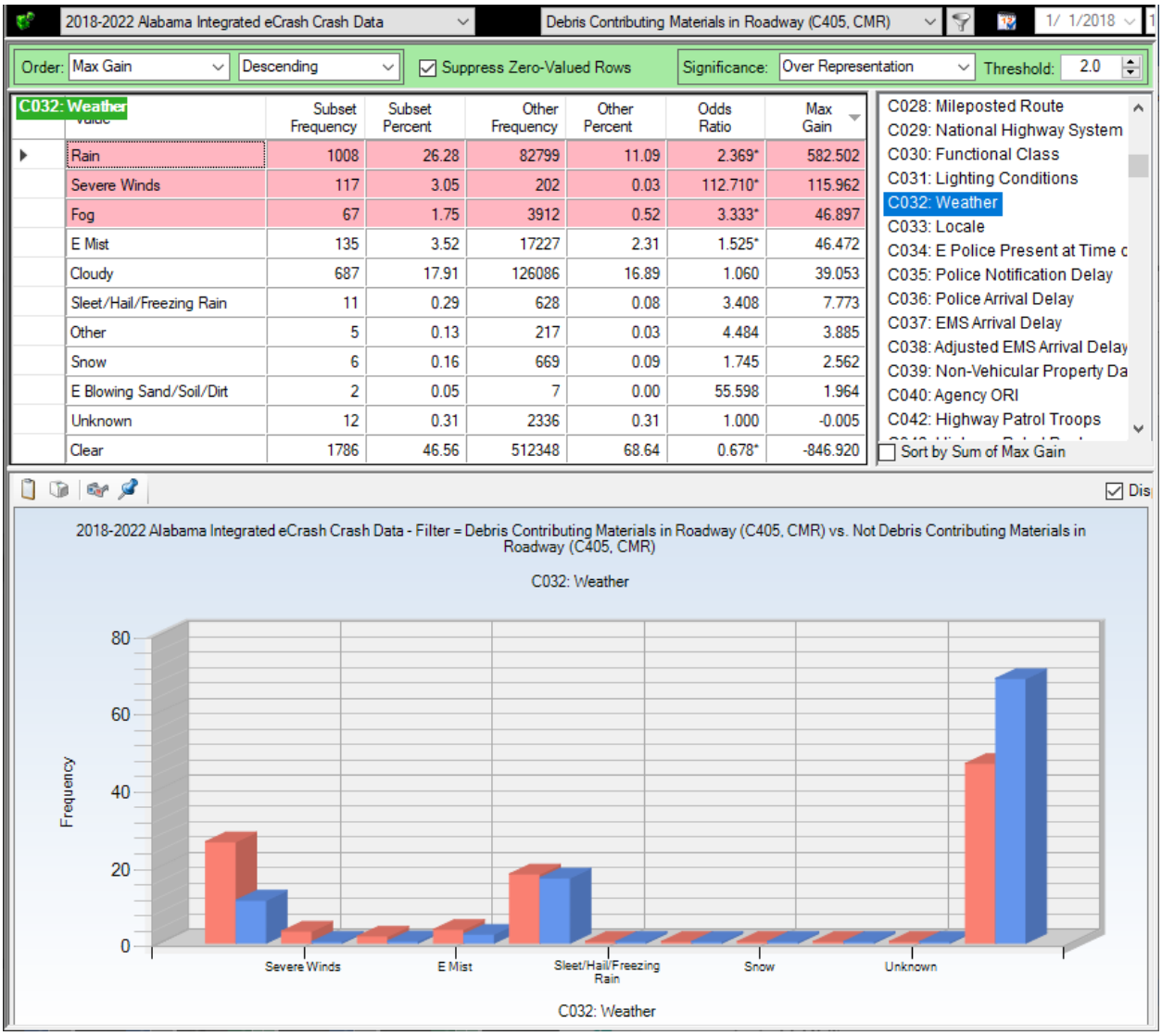

Drivers need to be particularly vigilant in the night-time hours in looking for potential debris of foreign materials in the roadway. It does not appear that having a dark roadway lighted has too much of a positive effect.

## 2.14 C025 Crash Severity; CMR vs Non-CMR Crashes



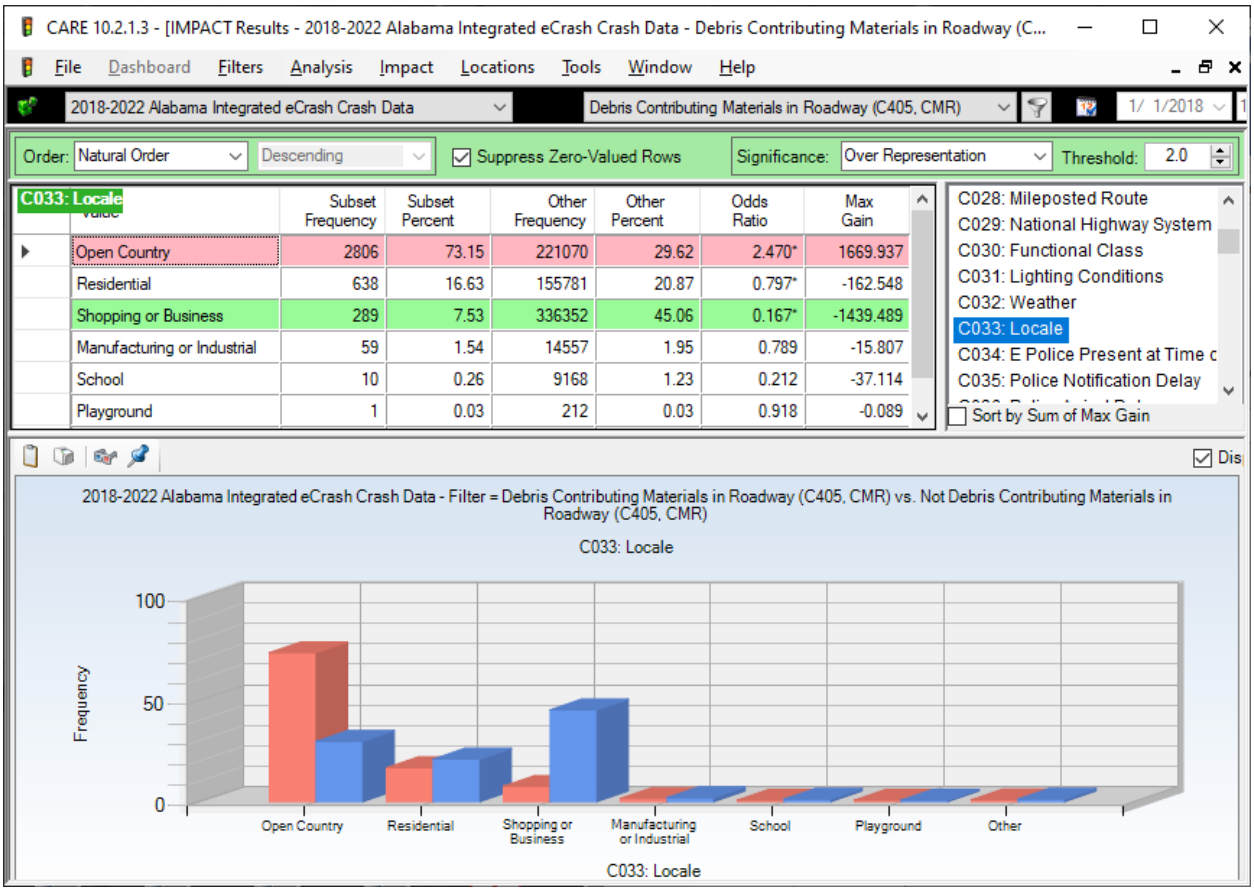

Generally, CMR crashes are not as serious in causing injury and death as many other crash types. However, their over-representation in the Suspected Serious Injury category indicates that CMR crashes are not to be taken lightly.

## 2.15 C032 Weather; CMR vs Non-CMR Crashes



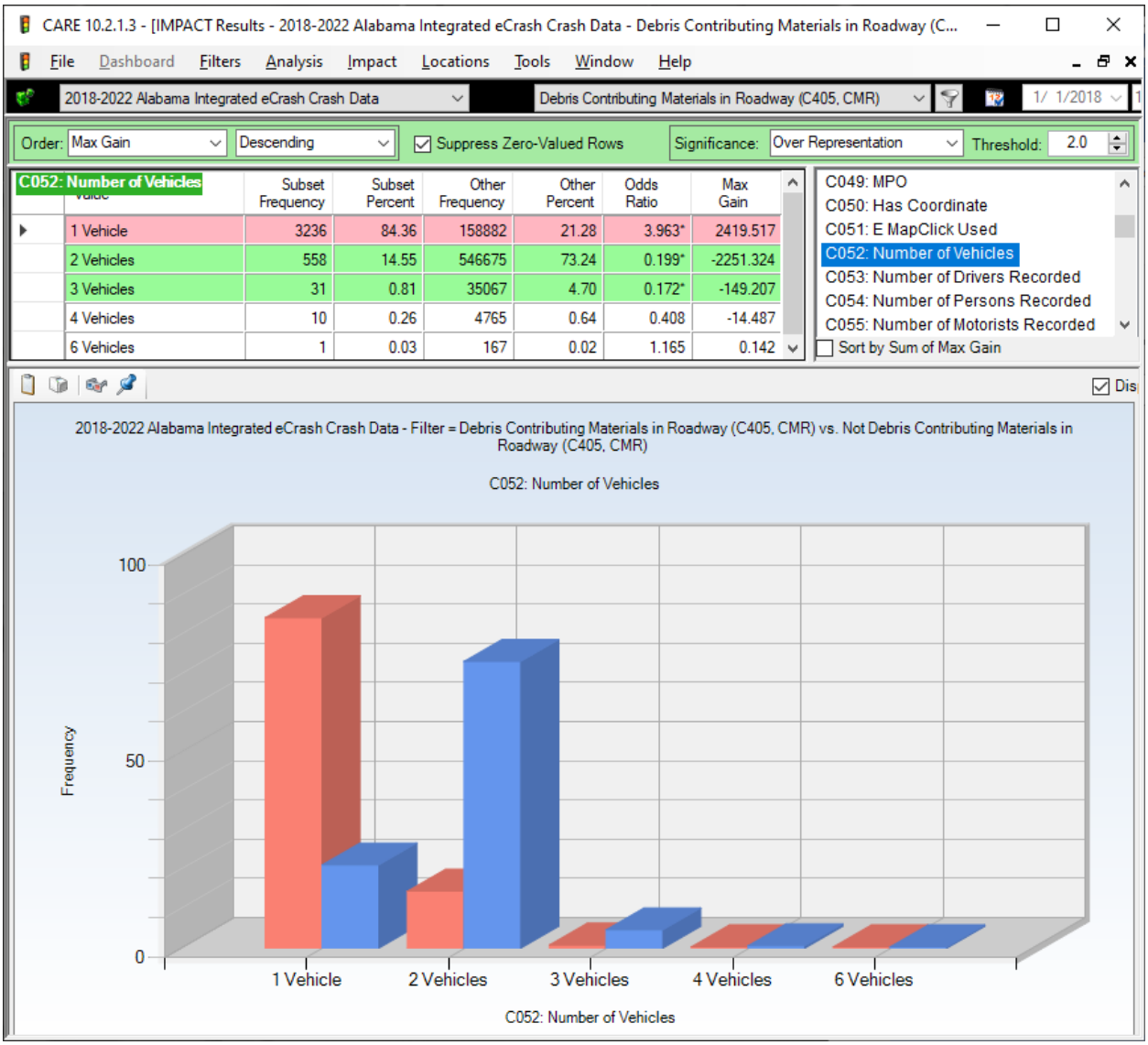

Weather contributes to CMR crashes in two ways: (1) it is often the creation of the foreign materials that end up on the roadway, and (2) it limits the visibility to be able to effectively react to these materials. Rain is the highest frequency characteristic because of the frequency of its occurrence. Severe winds have less than one tenth of the frequency of rain, but their over-representation (Odds Ratio = 112.710) is enormous, indicating that severe winds either bring down tree limbs or blow foreign materials into the roadway. Fog is also significantly over-represented indicating the further limitation in visibility. No doubt fog at night would be the worst visibility situation, and driving in these conditions should be avoided if at all possible.

## 2.16 C033 Locale; CMR vs Non-CMR Crashes



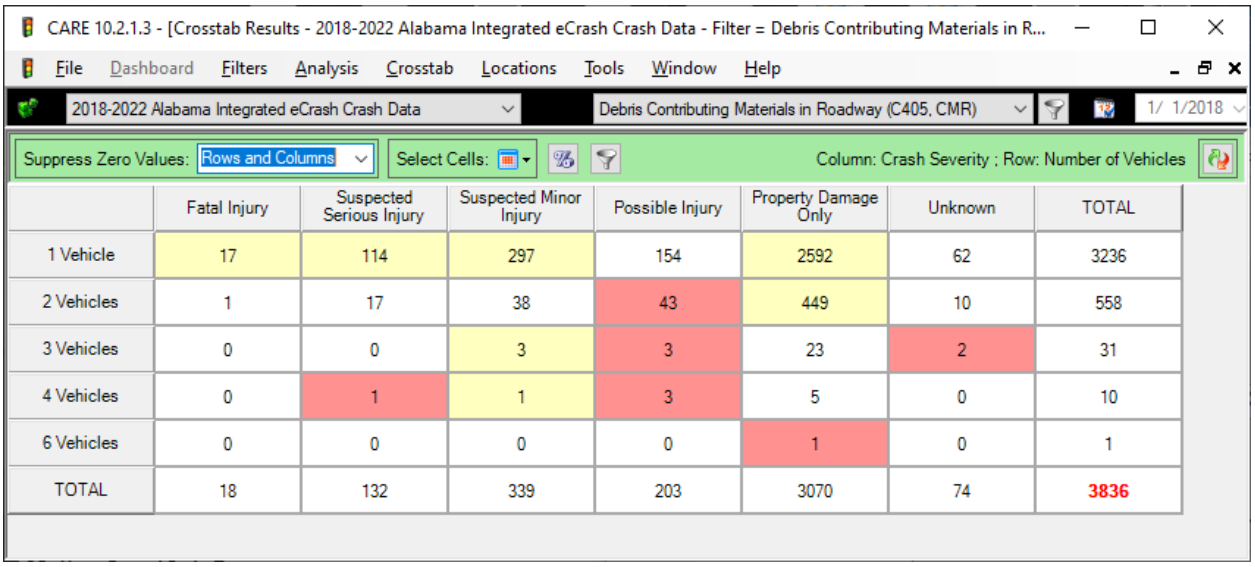

Almost three quarters (73.15%) of CMR crashes occur in open country. While this is generally classified as rural, there are some Open Country areas in many urban areas as well.

## 2.17 C052 Number of Vehicles



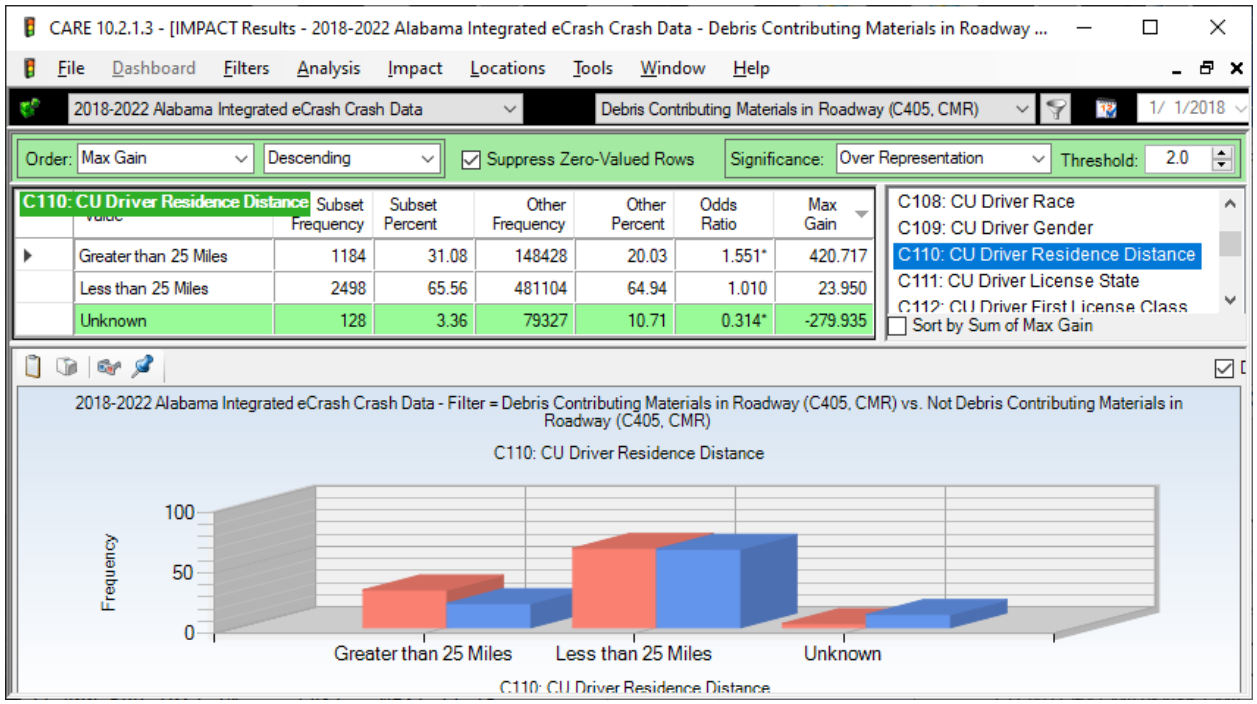

About 85% (84.36) of CMR crashes are single vehicle. We would suspect that multiple-vehicle crashes would cause more severe injuries. However, the cross-tabulation on the following page indicates that 17 out of 18 of the fatal crashes involved only one vehicle.

## 2.17a Cross-tabulation of C025 Crash Severity by C052 Number of Vehicles



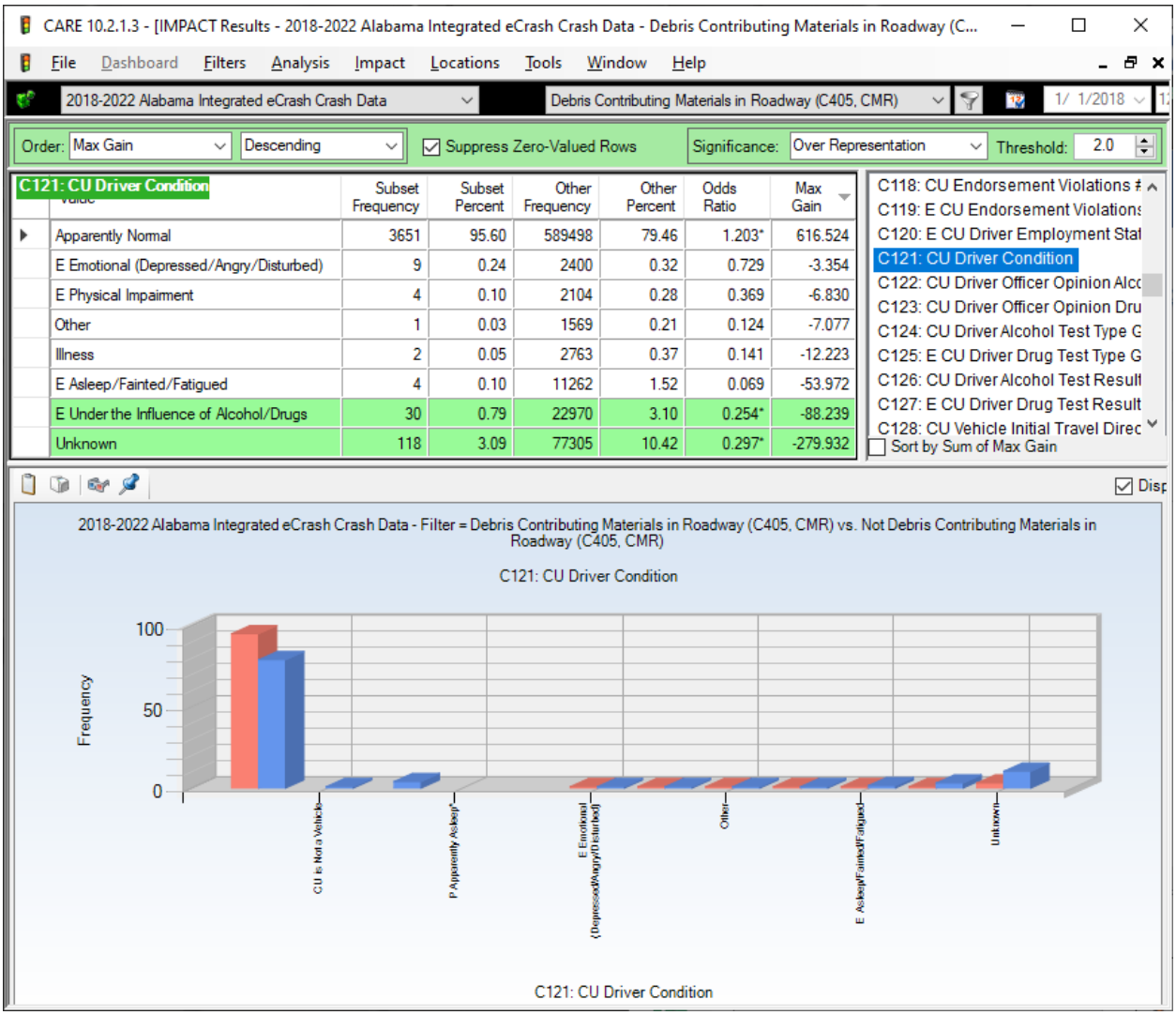

| | Fatal Injury | Suspected Serious Injury | Suspected Minor Injury | Possible Injury | Property Damage Only | Unknown | TOTAL |
|---|---|---|---|---|---|---|---|
| 1 Vehicle | 17 | 114 | 297 | 154 | 2592 | 62 | 3236 |
| 2 Vehicles | 1 | 17 | 38 | 43 | 449 | 10 | 558 |
| 3 Vehicles | 0 | 0 | 3 | 3 | 23 | 2 | 31 |
| 4 Vehicles | 0 | 1 | 1 | 3 | 5 | 0 | 10 |
| 6 Vehicles | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| TOTAL | 18 | 132 | 339 | 203 | 3070 | 74 | 3836 |

## 2.18 C110 Distance from Residence



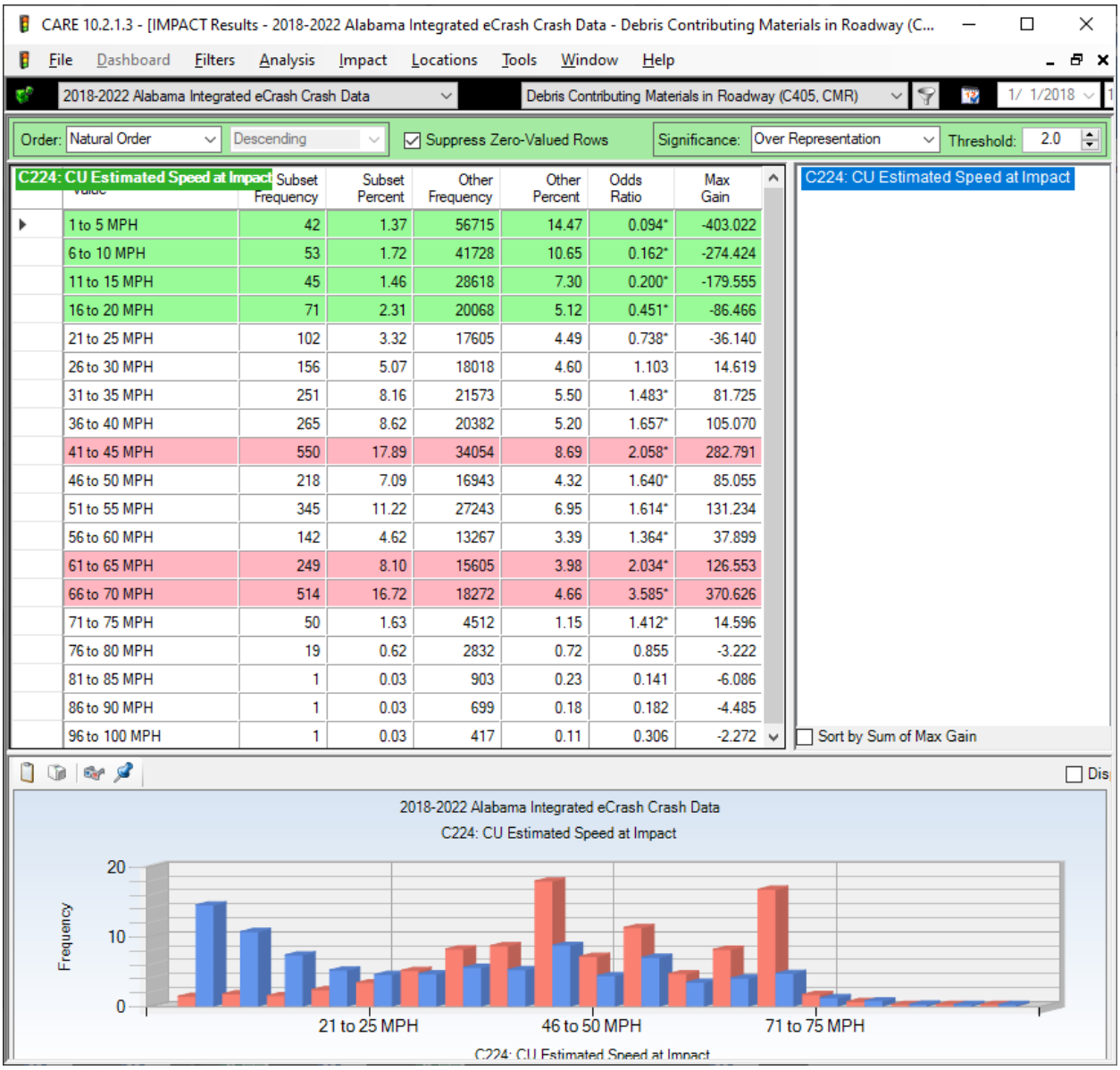

A significantly higher proportion of CMR (55.1% more) crashes occur at distances greater than 25 miles. These roads are often not as familiar to drivers, requiring more alert consideration.

## 2.19 C121 CU Driver Condition



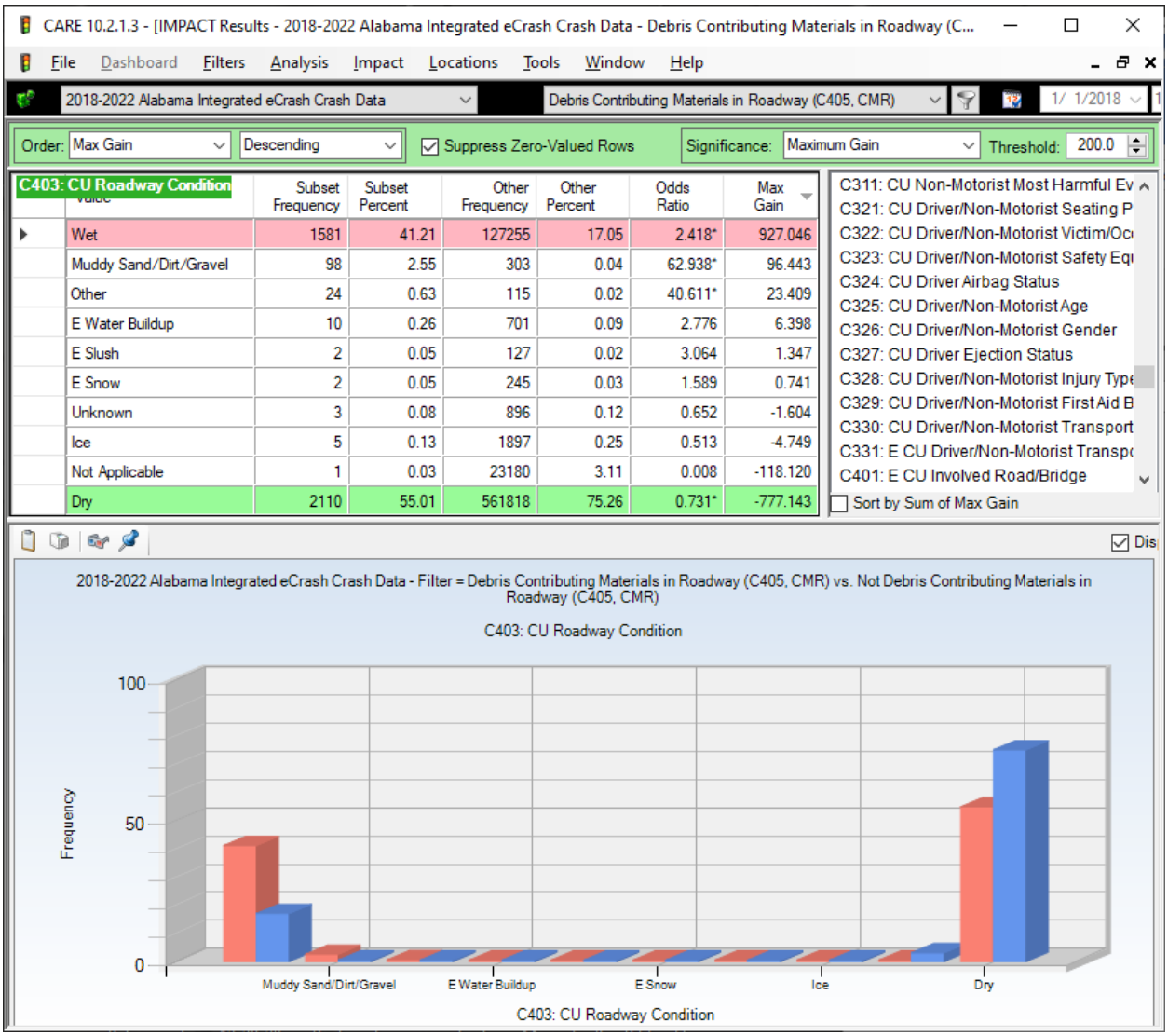

These findings show that, relatively speaking, DUI Alcohol/Drugs is not the problem with CMR that it is with many other crash types.

## 2.20 C224 CU Estimated Speed at Impact



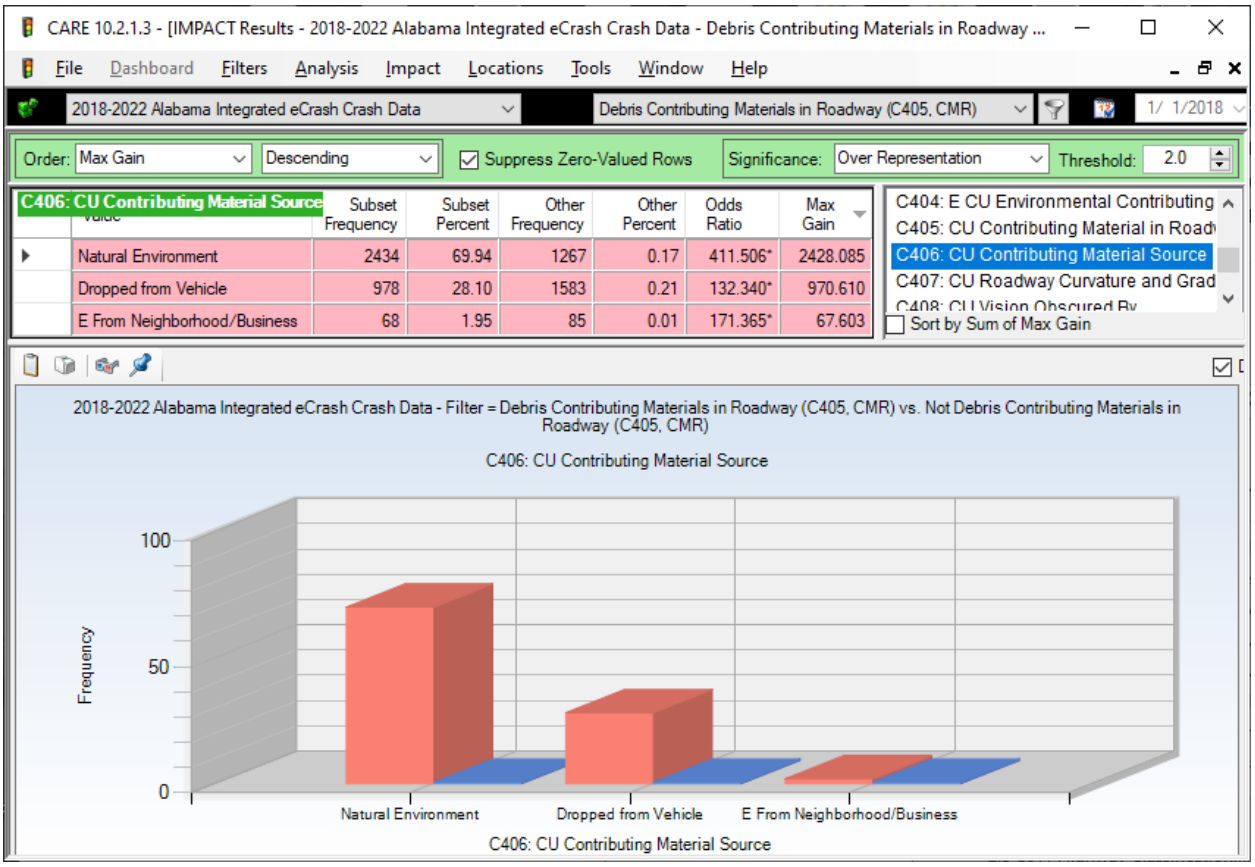

Impact speeds are generally higher for CMRs than for other crashes. This is largely because of their rural nature, and quite often drivers (especially at night) are taken by surprise by the materials in the roadway, so they have limited time to adjust their speeds.

## 2.21 C403 Roadway Condition



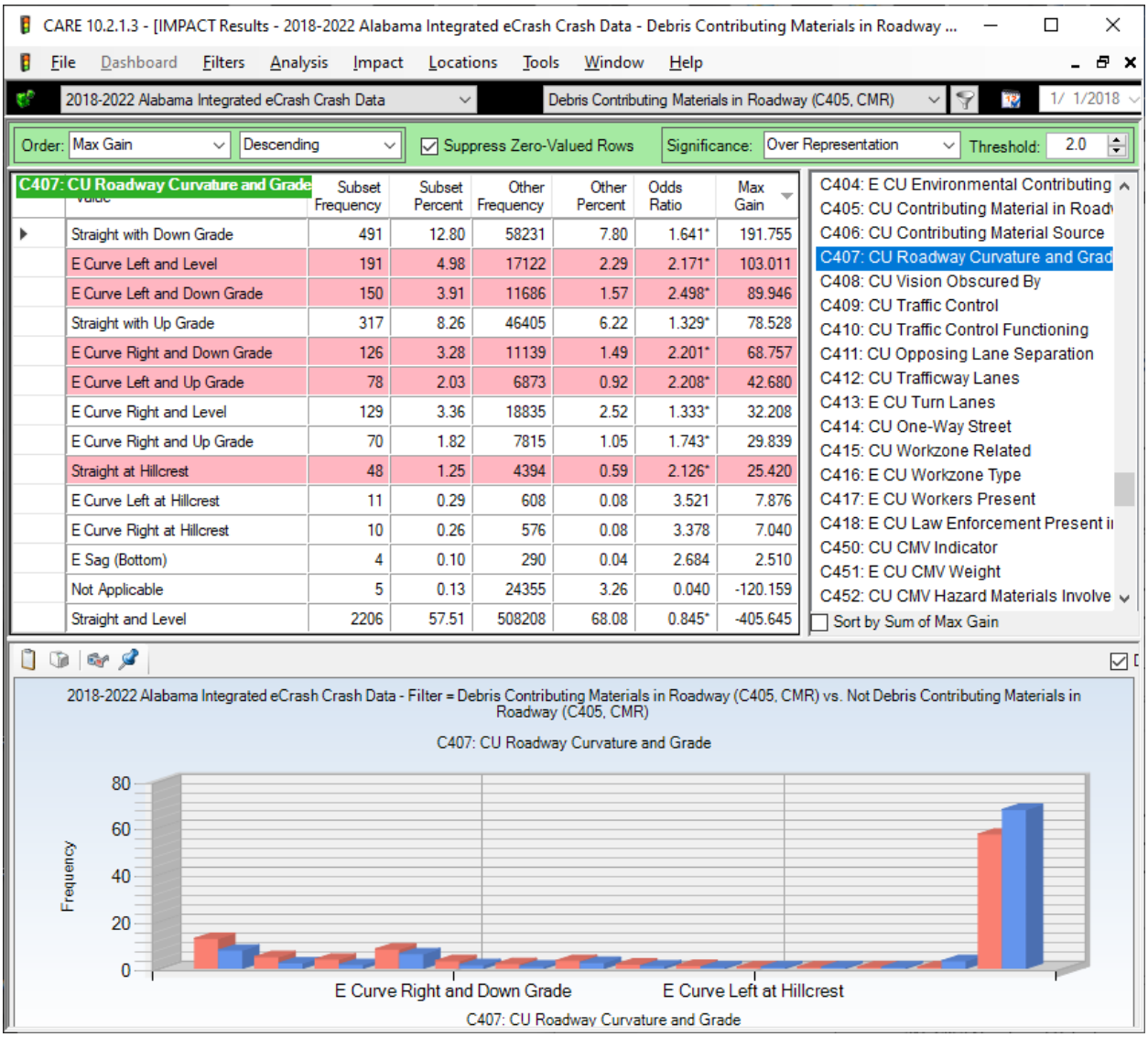

Wet conditions are present in 41.21% of CMR crashes, but only in 17.05% of the non-CMRs. The two reasons for this is that wet weather is highly correlated with tree limbs and the limited visibility that goes with bad weather.

## 2.22 C406 Contributing Materials Source; CMR vs Non-CMR Crashes



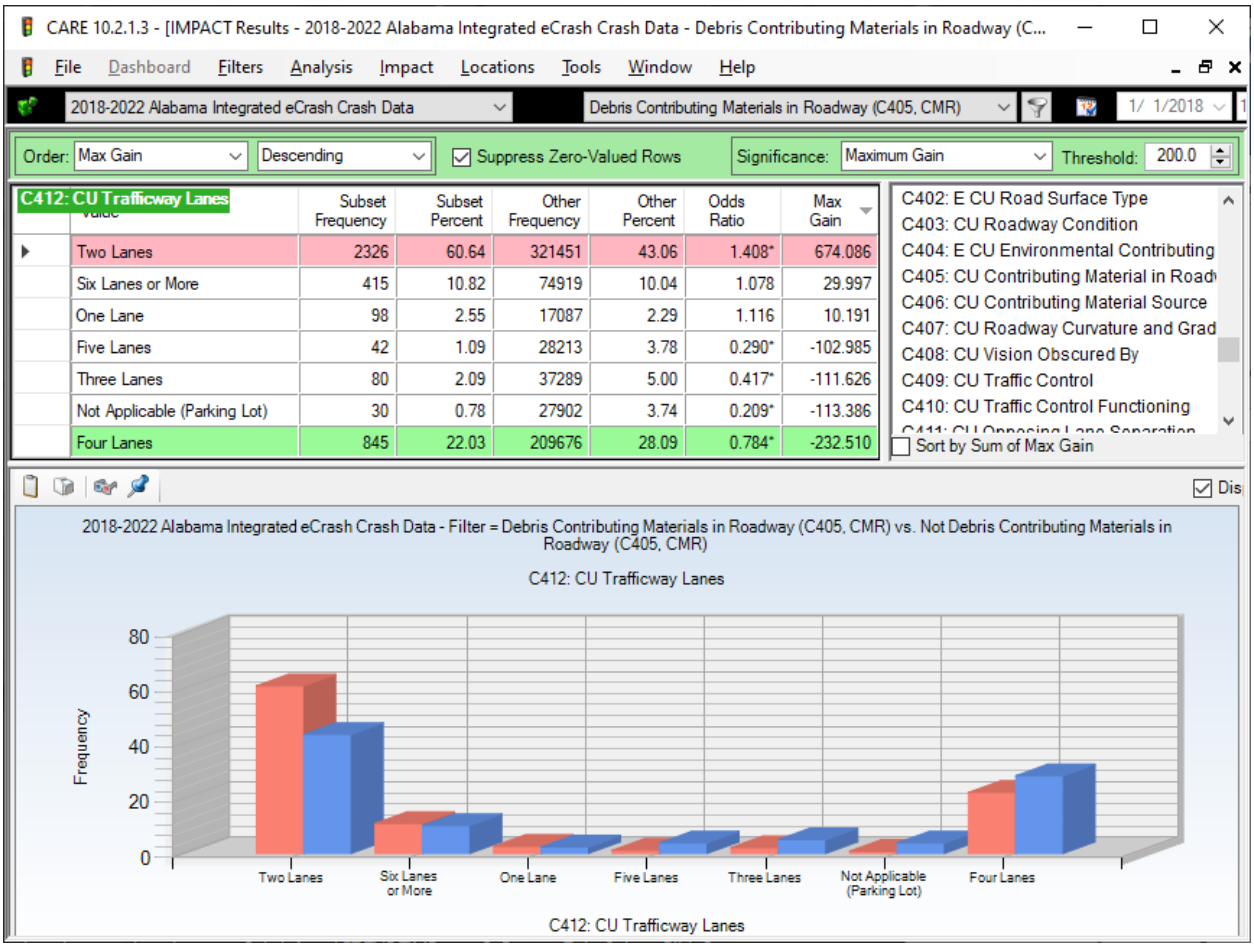

The source of the CMR materials are primarily (69.94%) the natural environment. A smaller, but significant number (28.10%) fall from other vehicles.

## 2.23 407 Roadway Curvature and Grade




Generally, it seems from this attribute that grades play a larger part in contributing to CMR crashes than do curves. This could be in requiring greater braking on down-slopes when a CMR situation is encountered. Also, many drivers increase their speeds to adapt to upgrades, which could also create a similar problem.

## 2.24 C412 Trafficway Lanes




Two-lane roads have a significantly higher proportion of CMR crashes than any other lane conditions, probably because of the limited ability to avoid CMR materials without causing greater potential danger.