A Risk-Based Analysis of General Fund Reserve Requirements for Douglas County, Colorado

Produced by:

The Government Finance Officers Association

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Section 1 - Executive Summary

A local government's "reserves" are the portion of fund balance that serves as a hedge against risk. Douglas County (hereinafter referred to as "the County") has asked the question: "what is the right amount of reserves for us?". The Government Finance Officers Association (GFOA) has helped the County answer this question by examining the risks that the County is subject to.

First, we identified the risks that posed the most clear and present danger to the County. These include floods, wild fires, and hazardous materials spills. We also accounted for the other risks, such as the potential for decreased revenues due to an economic downturn.

Next, for each risk, we calculated the probability that the County would experience one of the aforementioned risks over a ten-year period and, if an event did occur, what the magnitude of the loss would be for the County. Most the risk falls on the County's general fund, but we also considered the following additional funds: Road and Bridge, Human Services, Law Enforcement Authority, Road Sales and Use Tax, and Justice Center.

To calculate the probability and magnitude of risks, we primarily used the following sources of data:

- **Douglas County's own experience.** For example, the County's revenue losses during 2001 "Dot.Com" recession and 2007 "Great Recession" provide insight into the potential losses the County could incur during a future recession.
- **The experience of other Colorado Counties.** Fortunately, Douglas County hasn't had a lot of direct experience with some of the extreme events it is at risk for. For example, it has had just one major flood in the last 15 years. The experiences of other Colorado counties can serve as analogues.
- **Research produced by other agencies.** For example, we used historical snow fall data collected by regional weather monitoring services.
- **Expertise of County staff.** County staff work every day on preparing the County for the risks it faces. Staff helped us fill in gaps in the sources of data above. For example, we worked with a member of the County's Hazmat Response Team to estimate the potential impact of a Hazmat spill.

We modeled each risk individually and then combined each individual risk into a ten-year model of the County's reserves. Our analysis found that the County's existing level of reserves, combined with the County's willingness to cut spending before using reserves, are sufficient to provide the financial resources necessary to respond the vast majority of extreme events.

GFOA cannot prescribe a precise level of reserves that the County *should* hold, because the exact amount the County might wish to maintain is a product of the County's appetite for risk. For example, the County's willingness to cut the budget before using reserves is a policy decision on how to respond to risk. However, we can make a number of suggestions to help the County identify a risk management strategy that makes sense for Douglas County.

- There is a point at which the County starts to receive less value from reserves. This is because as the severity of extreme events goes up, the amount of money required to respond to them goes up even more. Our analysis shows the points at which using reserves is most economical and where it might be more prudent to consider other risk financing tools like debt or insurance.

- The County should supplement reserves with other risk management strategies. This is because there is a point at which reserves become inefficient, as per the point we made above. Other financial risk management tools like debt or insurance could be used to provide additional confidence.

- The County may wish to have risk mitigation strategies beyond the reserves discussed in this report. Our analysis cannot account for every risk the County could possibly experience. Our analysis does cover the most clear and present dangers to the County, but other risk management tools could be helpful.

- Our analysis is based on historical records. Hence, historical data could underestimate the likelihood and/or severity of extreme events in the future. Unfortunately, no one can say precisely what the future holds. Hence, GFOA could not make an objective adjustment to the results of our analysis to account for the inability of past trends to predict the future. GFOA's Microsoft Excel risk model[1] provides the County with the ability to adjust the likelihood and/or magnitude of future extreme events, if it would like to test different scenarios.

- The County should select a range of preferred reserves, instead of a single target number. GFOA's research into how local governments can best maintain financial sustainability has found that decision-making "boundaries" are essential. For example, if the County were to adopt a policy to maintain reserves between X% and Y% of revenues, then that would constitute a clear boundary that defines when reserves are too high and too low. Compare this to if the County just adopted a policy that reserves should be at X% of revenues. It is then impossible to say how far reserves can go above or below this number and still be at acceptable levels. A range also can accommodate the risk appetites of more County officials. Thus, a range might be more reflective of the preferences of a greater number of people.

[1] GFOA provides the model to the County so that the County can update the model on its own.

Section 2 - Introduction

"Reserves" are the portion of a local government's fund balance that are available to respond to the unexpected. Reserves are the cornerstone of financial flexibility. Reserves provide a government with options to respond to emergencies and afford a buffer against shocks and other forms of risk. Managing reserves, though, can be a challenge. Foremost, is the question of how much money to maintain in a general fund reserve? How much is enough and when does a reserve become too much? This can be a sensitive question because money held in reserve is money taken from constituents, and the argument could be made that excessive reserves should be returned to residents in the form of lower taxes/fees or enhanced services.

The Douglas County has been considering this question recently, especially given its vulnerability to extreme events like floods and wildfires and because of the potential for revenue instability owing to an economic downturn. The County engaged the GFOA to produce a recommendation to help the County decide how much reserves is appropriate for the following funds: General, Road and Bridge, Human Services, Law Enforcement Authority, Road Sales and Use Tax, and Justice Center. GFOA is a non-profit association of over 19,000 state and local government finance professionals and elected officials from across North America. A key part of GFOA's mission is to promote best practices in public finance, including reserve policies.

GFOA's approach to reserves does not suppose "one-size-fits-all." But, GFOA's "Best Practice" on general fund reserves recommends, *at a minimum*, that general-purpose governments, regardless of size, maintain reserves of no less than two months of regular operating revenues or regular operating expenditures (i.e., reserves equal to about 16.7 percent of revenues).[2] However, this 16.7 percent is only intended as a rule-of-thumb, and it needs to be adjusted according to local conditions. To make the adjustment, GFOA worked with the County to conduct an analysis of the risks influencing the need for reserves as a hedge against uncertainty and loss.

A "risk" is defined as the probability and magnitude of a loss, disaster, or other undesirable event.[3] The GFOA's framework of risk assessment is based on the risk management cycle: identify risk; assess risk; identify risk mitigation approaches; assess expected risk reduction; and select and implement mitigation methods. The framework focuses primarily on risk retention, or using reserves, to manage risk. However, the framework also encourages the County to think about how other risk management methods might alleviate the need to hold larger reserves. In other words, can the County manage its risks in some other way besides holding reserves? For example, could insurance or debt instruments complement the County's reserve strategy? A thorough examination of the risk factors should lead to a range of desired reserves and improve the County's understanding of its overall risk profile.

[2] GFOA Best Practice. "Appropriate Level of Unrestricted Fund Balance in the General Fund." GFOA. 2009.
[3] Definition of risk taken from: Douglas W. Hubbard. *The Failure of Risk Management: Why It's Broken and How to Fix It.* John Wiley and Sons, Inc. Hoboken, New Jersey. 2009.

As a first step to this project, GFOA conducted a review of the risk factors influencing the amount of reserves a local government should hold.[4] This review enabled the County and GFOA to classify factors as either primary or secondary risks. Exhibit 2.1 lists how the risk factors were classified.

Exhibit 2.1 – Categorization of Risk Factors that Influence Reserve Levels for Douglas County	
Primary Risk Factors	
Vulnerability to extreme events and public safety concerns, with emphasis on: • Wildfires • Floods (includes mudslides, landslides)	• Hazardous Material Spills • Extreme Snowfall • High Winds
Revenue source stability, particularly as it relates to the potential for revenue decline from an economic downturn	
Secondary Risk Factors	
Leverage from indebtedness	
Liquidity concerns	
Expenditure spikes (e.g., from impending lawsuits)	
Growth	

The next section gives an overview of how we analyze these risks and what you can expect to see in the rest of this report.

[4] The risk factors and basic review method were developed and published in the GFOA publication: Shayne C. Kavanagh. *Financial Policies*. (Government Finance Officers Association: Chicago, IL) 2012.

Section 3 - The Approach to Uncertainty

The accomplished forecasting scientist, Spyros Makridakis, suggests a "Triple-A" approach for dealing with highly uncertain phenomena.[5]

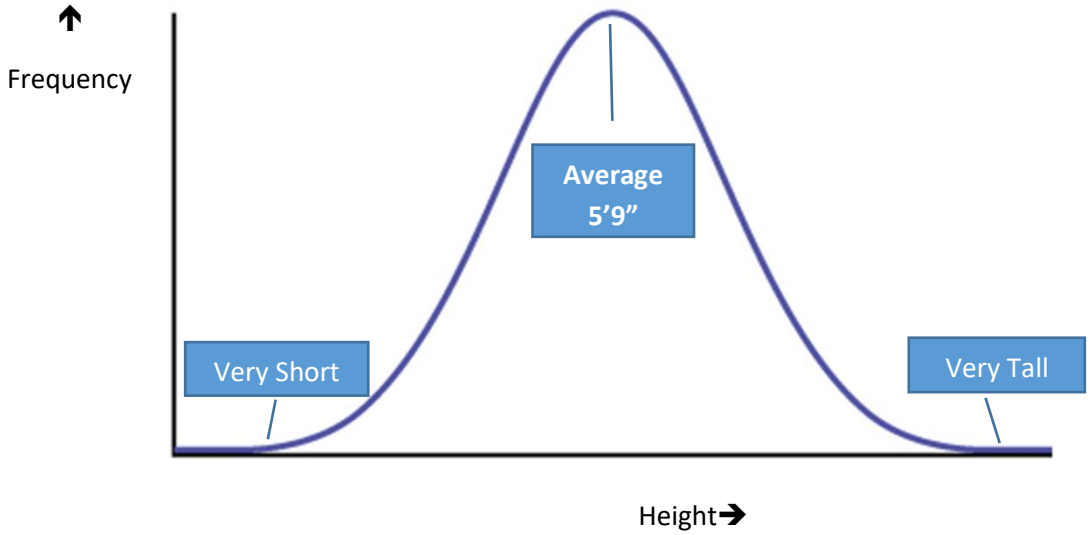
1. **Accept.** First we must accept that we are subject to uncertainty. For example, wild fire could experience a great deal of variability, from one that can be contained in a matter of hours, to one that rages for days.
2. **Assess.** Next, we must assess the potential impact of the uncertainty, with history providing a useful reference point. The experiences of other local governments is also a good reference point. For example, we used the historical experiences of Douglas County and other Colorado Counties to estimate the potential impact of future extreme events.
3. **Augment.** The range of uncertainty we actually face will almost always be greater than what we initially assess it to be. Therefore, we must augment our understanding of risk beyond what our historical experiences show us. For example, the County has not experienced a major flood in the last few years. This does not mean there is no risk of a future flood. We can augment our understanding of risk using a technique called "Probability Management".[6] Probability Management is an application of modern information processing technology that allows us to simulate thousands of potential events (e.g., wildfires, floods) so that we can observe the probability of events of various magnitudes coming to pass.

In order to use Probability Management, we express any given type of extreme event as a range of possibilities that the County might experience. This range is called a "distribution". A distribution is a shape that signifies how frequently the County might expect to experience a certain type of event and/or how severe the event might be. The most common type of distribution is called the "normal distribution", more popularly known as the "bell curve". Many phenomena fit a bell curve. To help us understand how to read a distribution, we can start with an example that is related to everyday life: Exhibit 3.1 shows a bell curve for the height of American men. The horizontal axis of Exhibit 3.1 represents height. The vertical axis represents frequency. 5'9" is the most common height, so it is shown at the top of the curve. Much taller men, like NBA centers, would be found on the right-hand side of the curve. Very short men would be found on the left.

[5] See: Spyros Makridakis, Robin Hogarth, and Anil Gaba. *Dance with Chance: Making Luck Work for You*. (Oneworld Publications: Oxford, England). 2009.

[6] The discipline of "Probability Management" was developed by Dr. Sam Savage, author of *The Flaw of Averages*. You can learn more about Probability Management at probabilitymanagement.org.

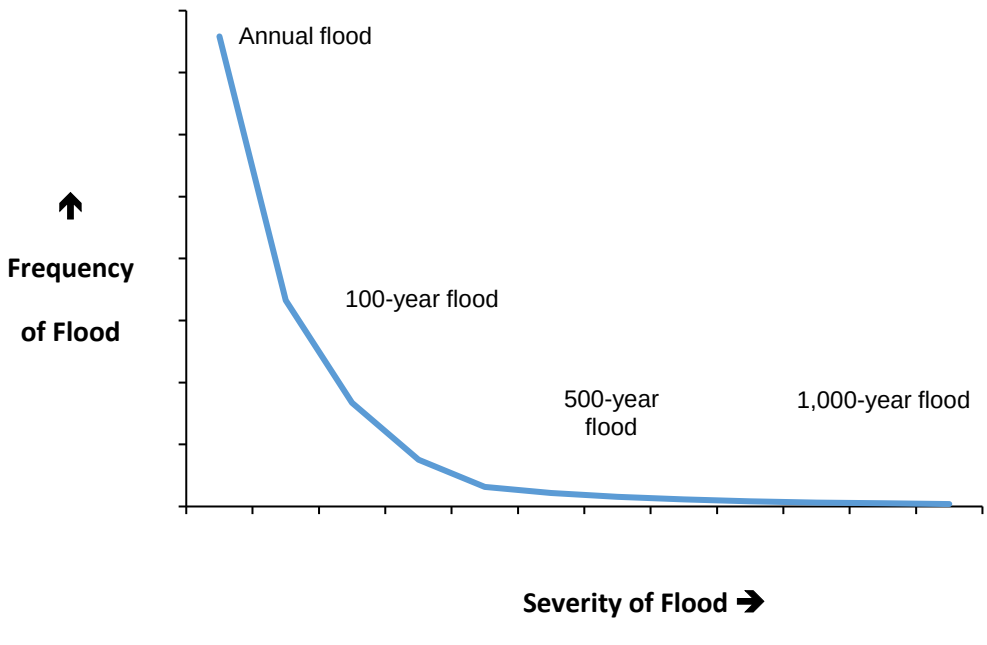
Exhibit 3.1 – The Normal Distribution for American Men



The normal distribution can help analyze the County's risk. To illustrate, the severity of snowfall during a snow season downturn is roughly normally distributed. A few snow seasons are light, few are severe, but most are closer to average.

Another common distribution we use is called an "asymmetrical" distribution. An asymmetrical distribution is in Exhibit 3.2. Floods, for example, fit an asymmetrical distribution. Exhibit 3.2 shows that small floods are the most common type of flood, by far. Large floods are relatively rare.

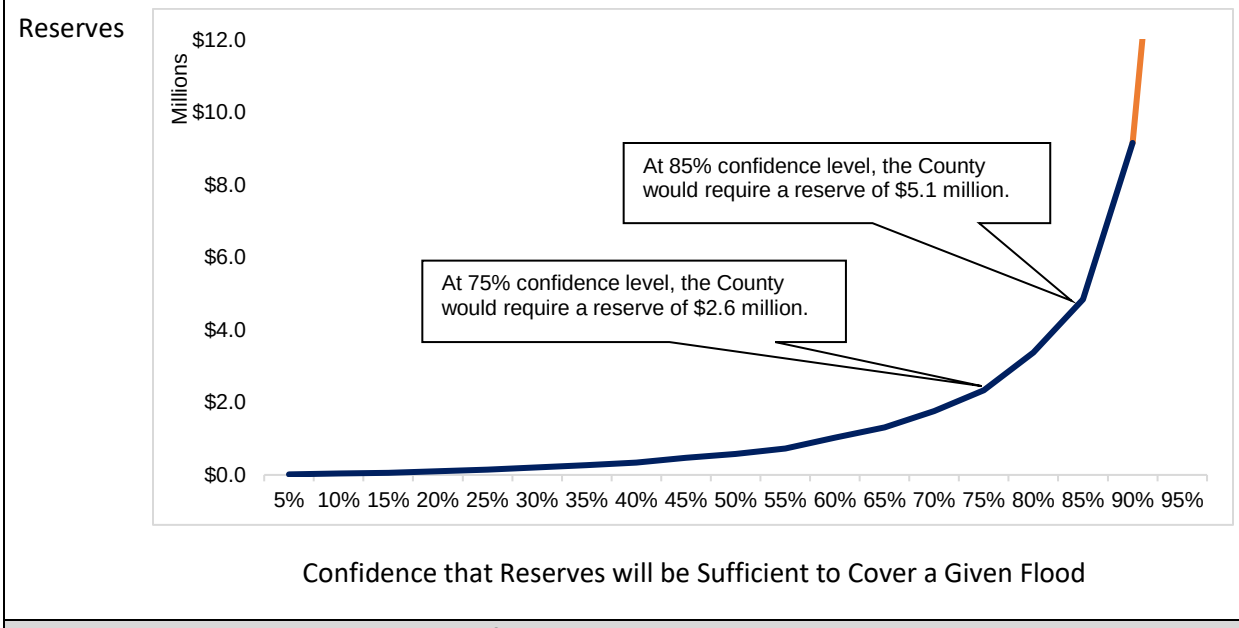
Exhibit 3.2 – Sample Asymmetrical Distribution



Expressing Douglas County's vulnerability as distributions allows us to calculate the probability that an event of a given magnitude will come to pass. When we associate a dollar amount with that event, we can estimate the probability or chance that Douglas County will need to have a given amount of money on-hand to respond.

Exhibit 3.3 is not a distribution, but is a type of graphic we will use often in this report. It is called a "cumulative probability chart". It shows that increasing amounts of reserves are needed to gain more confidence that the County will have enough money to cover the extraordinary cost to the general fund arising from a flood. We can see that reserving $5.1 million will give the County an 85% chance of being able to cover the costs of a given flood. The curve is relatively flat for most of the chart and then begins to move sharply upward. This is because increasingly large amounts of money are needed to cover the costs from the most extreme flood.

Exhibit 3.3 - Percent of Flood Costs Covered by Varying Reserve Levels



As we move to the right of the graph, the amount Douglas County needs to reserve to cover the cost of a flood increases. At the top right, as the line color changes to orange, it indicates an increasing level of reserves to address greater than 95% confidence level.

For most risks the County faces, GFOA recommends a range of possible reserve amounts for the County to consider. This is because there is never one single, objectively best amount of reserves to hold. The amount of reserves the County wants to hold will partially be a function of the County's willingness to take on risk. If County officials are willing to take on risk, they might opt for lower reserves and spending more money on current services. If officials are more risk averse, they might opt for higher reserves. GFOA's recommended ranges of reserves are based on where reserves produce the best value or "bang for the buck". For example, on Exhibit 3.3 we see that to go from 95% confidence to 99% confidence would require an extraordinary amount of money. Conversely, to go from 75% to 80% or 85% does not cost

nearly as much. Hence, we recommend that the County pick reserve targets that offer the best value. On Exhibit 3.3, we see that an efficient range lies between $2.6 million and $5.1 million for floods. Other strategies for covering risk beyond these amounts may be more financially prudent (e.g., debt or insurance).

In Section 4 of this report, we will review all of the County's primary risks posed by extreme events. In Section 5, we cover revenue instability owing to economic downturns. We will analyze them in the manner described above and suggest where reserves offer the greatest value. Section 6 reviews secondary risk factors that have less weighty implications for the County's reserve strategy. These risks will be analyzed in a similar way to the primary risks.

After we analyze the individual risks, in Section 7, we will consider the risks holistically. This section will address the following concerns:

- It is highly unlikely that the County will experience many of the extreme events discussed in this report in a short time period. This means that simply adding the reserve amounts for each event on top of one another would cause the County to reserve more than its appetite for risk suggests is needed.
- Considering the risks over a multi-year time period provides a more complete perspective on potential vulnerability and how to use reserves.

In Section 8, we provide our recommended steps for how the County might move forward using our analysis.

Section 4 - Extreme Events

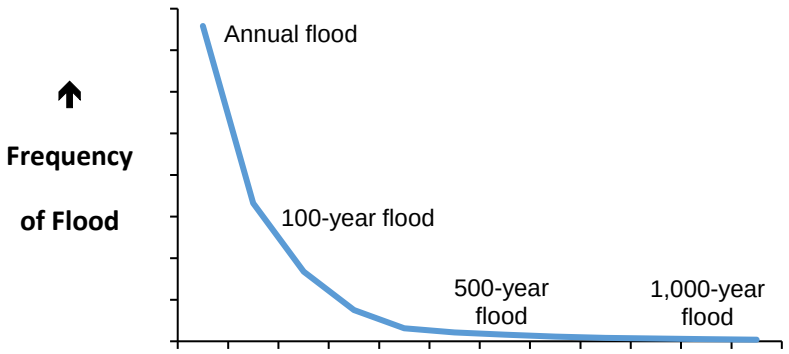
Although Douglas County has received reimbursement for past natural disasters, having adequate reserves in place is important to quickly and decisively respond to extreme events. For example, FEMA reimbursement will not cover all the costs the County incurs and it could take months, if not years, to receive reimbursement. In discussions with County staff, wildfires, floods, landslides, blizzards, and chemical spills are of the greatest concern and will be the focus of this section of the analysis.

FEMA and Reserves

The U.S. Federal Emergency Management Agency (FEMA) reimburses local governments for monies spent in response to a federally-declared disaster. Reimbursement is only partial (typically 75 percent) and is often not immediate. Therefore, local governments must have the financial capacity to respond quickly and decisively, independent of other governmental financial support.

The range of potential damages for many natural disasters takes the shape of an "asymmetrical" distribution. That is, a community is much more likely to incur natural disasters of less severity and lower cost with greater frequency than higher cost, more severe natural disasters. For illustrative purposes, the image on the right is an asymmetrical distribution of floods. Floods are categorized by their recurrence interval. For example, annual floods are, as the name suggest, likely to happen every year whereas 100-year floods have a 1% chance of occurring in a given year, 500-year floods have a 0.2% chance of occurring in a given year and 1,000-year floods have a 0.1% chance of occurring in a given year.[7] It is significantly more likely that we experience annual flooding than a severe 1,000-year flood.

Exhibit 4.1 – Sample Lognormal Curve



In the following subsections, we analyze wildfires, floods, landslides, blizzards, and hazardous material spills. Our method primarily relies on analogues from either the County's own history or the experiences of other jurisdictions estimates of future risk. For some extreme events, such as wildfires, we have historic information from the County. For other disasters, we do not. As such, we gather additional reference cases using publically available data from FEMA-declared disasters.[8] An important

[7] U.S. Department of Interior, U.S. Geological Survey, "Floods: Recurrence intervals and 100-year floods (USGS)," March 13, 2018, https://water.usgs.gov/edu/100yearflood.html.

[8] FEMA Public Assistance Funded Projects Summary provides information on "Federal disaster grant assistance for debris removal, emergency protective measures, and the repair, replacement, or restoration of disaster-damaged, publicly owned facilities and the facilities of certain Private Non-Profit (PNP) organizations." Federal Emergency Management Agency, "FEMA Public Assistance Funded Projects Summary," http://www.fema.gov/media-library/assets/documents/28344, updated December 8, 2017.

limitation with the dataset is the reference information may represent instances of greater damage than what the County may experience. Less severe events would not be declared disasters and would not be included in FEMA's database. Also, we do not attempt to control for every factor that could affect the frequency or severity of an extreme event. For example, the severity of a wildfire would be impacted by the amount of vegetation in the area that would continue to fuel the fire. Gathering such information on the condition of the terrain is beyond our scope of analysis. However, to help make our set of analogues more comparable to the County's circumstances, we do analyze the relationships between population density and wildfires and between population, assets, and floods/landslides.

Finally, the reader should note that the analysis in this section considers the risk for all six of the funds included in our analysis. We will discuss the implications for each fund in the conclusion to our report.

Subsection A - Wildfires

Douglas County is susceptible to wildfires year-round. The County's Local Hazard Mitigation Plan also identifies wildfires as a high magnitude event that can result in "Property damages to greater than 50% of all buildings and infrastructure. Significant loss of quality of life, emergency response capability; economic and geographic effects of the hazard are of sufficient magnitude to require federal assistance."[9]

The County has experienced past wildfires and provided costs for GFOA to examine. Additionally, we reviewed FEMA's database for additional wildfires experienced by other Colorado counties. Exhibit 4.A.1 lists the event and affected counties, estimated cost to the counties adjusted for inflation to 2018 dollars[10], population density the year of the event, and estimated cost per capita. There are two important items to note. First, the figures represent cost incurred by the local government and does not include cost related to private property. Second, we use total estimated cost figures because governments might or might not be reimbursed for disasters. For example, the list below includes events for which Douglas County incurred all cost and no reimbursement was received. Additionally, as noted at the beginning of this section, if reimbursement is received, there is often a lag time from when the incident occurred and when reimbursement is received. To swiftly address incidents such as natural disasters, a government would need to have funds readily available.

[9] Douglas County, CO, "Local Hazard Mitigation Plan," updated June 2015.

[10] For FEMA-declared incidents, GFOA estimates the total cost using the typical FEMA reimbursement rate of 75 percent of total cost. For Douglas County incidents, the County finance staff provided actual figures.

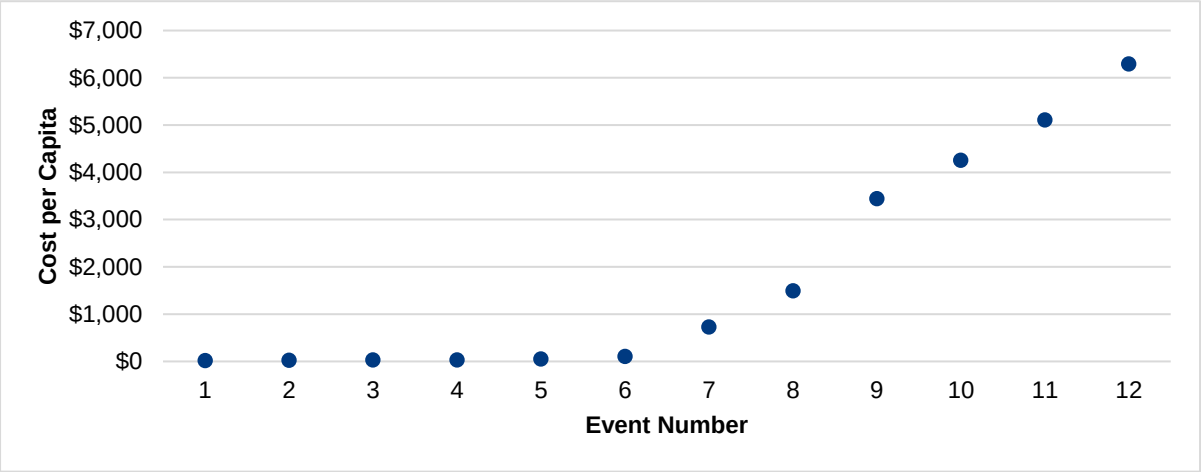
Exhibit 4.A.1: Estimated Wildfire Cost to Select Colorado Counties

Event & County	Total Estimated Cost (2018 $)	Population Density (year of event)	Estimated Cost per Capita
Schoonover Fire (May 2002)*			
Douglas County	$1,057,233	248.6	$4,252
Hayman Fire (June 2002)*			
Douglas County	$855,778	248.6	$3,442
Burning Tree Fire (2010)**			
Douglas County	$10,120	339.7	$30
Waldo Canyon (2012)**			
Douglas County	$8,151	339.7	$24
Colorado High Park And Waldo Canyon Wildfires (June 2012)			
El Paso County	$220,137	303.3	$726
Larimer County	$610,760	119.6	$5,107
Teller County	$62,596	42.0	$1,491
Colorado Black Forest Wildfire (June 2013)			
El Paso County	$1,939,171	308.0	$6,296
Colorado Royal Gorge Wildfire (June 2013)			
Fremont County	$3,241	30.3	$107
Pre Black Forest Fire (2013)**			
Douglas County	$10,315	348.7	$30
Chatridge Fire (2016)*			
Douglas County	$19,947	374.0	$53
Range 5 Fire (2017)**			
Douglas County	$6,523	374.0***	$17

Sources: Federal Emergency Management Agency, U.S. Census Bureau, and Douglas County, CO.
* Figure provided by Douglas County, CO.
** Disasters for which no reimbursement was received by Douglas County, CO.
*** The most recent year for which the U.S. Census has county population data available is 2016.

Of the 12 references we examined, we see that there are estimated damage per capita cost ranges greatly from $17 that Douglas County incurred for the Range 5 Fire in 2017 to over $6,000 that El Paso County incurred for the Colorado Black Forest Wildfire in June 2013. In graphing the data, we see the cost per capita takes a linear shape, particularly for more costly events. Exhibit 4.A.2 shows a scatterplot of the events, ordered from least costly to most costly.

Exhibit 4.A.2 – Scatterplot of Cost Per Capita for Wildfire Analogues



The cost per capita for the wildfire analogues take a linear shape, particularly on the right side of the graph.

The events that take a linear shape are mainly FEMA-declared disasters. In this analysis, we will focus solely on the FEMA-declared disasters and the May and June 2002 Douglas County fires for two reasons:

- Our data on smaller fires is not exhaustive, so we can't say how common smaller fires are relative to larger fires. This means we cannot build a meaningful frequency distribution that includes both types of fires.
- The cost of smaller fires would easily be covered by a reserve sized for a larger fire. We can see in Exhibit 4.A.1 that the cost of the smaller fires is trivial compared to the cost of the larger fires.

As such, we focus on the estimated damages per capita for the following fires: the May 2002 Schoonover Fire, the June 2002 Hayman Fire, the June 2012 Colorado High Park and Waldo Canyon Wildfires, June 2013 Colorado Black Forest Wildfire, and June 2013 Colorado Royal Gorge Wildfire. Because the two Douglas County fires were relatively costly, but not in FEMA's database, we assume the other counties have experienced similar fires in the past. We take the cost per capita of these two fires—$3,442 and $4,252—and assume each of the other four counties included in Exhibit 4.A.1 have experienced similar cost non-FEMA-declared fires. To make these references applicable to Douglas County, we apply each reference's estimated cost per capita to the County's current population density of 374 residents per square mile.[11] From there, we developed a cumulative probability chart to account for the linear shape that we saw with the references.

Exhibit 4.A.3[12] shows the cumulative distribution chart of potential cost the County would incur for a declared wildfire disaster. This chart essentially shows the "value" that the County gets from reserves.

[11] According to the U.S. Census, the County's 2016 population is 314,238 and land is 840.25 square miles.

[12] Exhibit 3 does not graph the amount required to cover 99.9% of wildfire disasters in order to focus on more probable scenarios. To cover 99.9% of wildfires would require $4.3 million.

Where the curve is flatter, the value of reserves is high because a relatively modest increase in the size of the reserves "buys" a substantial increase in the confidence the County can have that reserves will be adequate for a wildfire. Where the curve gets steeper, the County needs to put aside more money to gain less confidence. The horizontal axis represents the percent likelihood that the cost of a disaster-level wildfire will be covered. The vertical axis represents the size of the reserve that the County could put aside. The chart below shows a blue line that turns into orange. The line represents increasingly extreme wildfires as we move towards the right hand side of the graph. The orange line represents the most extreme, where the largest reserves would be needed. In examining the graph, if the County wants to be 85 percent confident that it can cover the cost of a wildfire disaster, it would reserve an amount of $1.9 million. As we move to the right, it becomes increasingly more costly for the County to be confident that its reserves will be sufficient to cover the cost of a wildfire. Up until 85 percent confidence, the County needs to increase its reserve level by a marginal amount of about 3/50 (0.06) to gain an additional 5 percent of confidence. The incremental cost to gain an additional 5 percent confidence when we go from the 85 percent and 90 percent is nearly 1/10 (0.09). By the time we reach 95 percent confidence, the incremental cost is over 1/10 (0.14). As such, we would recommend the County consider the following:

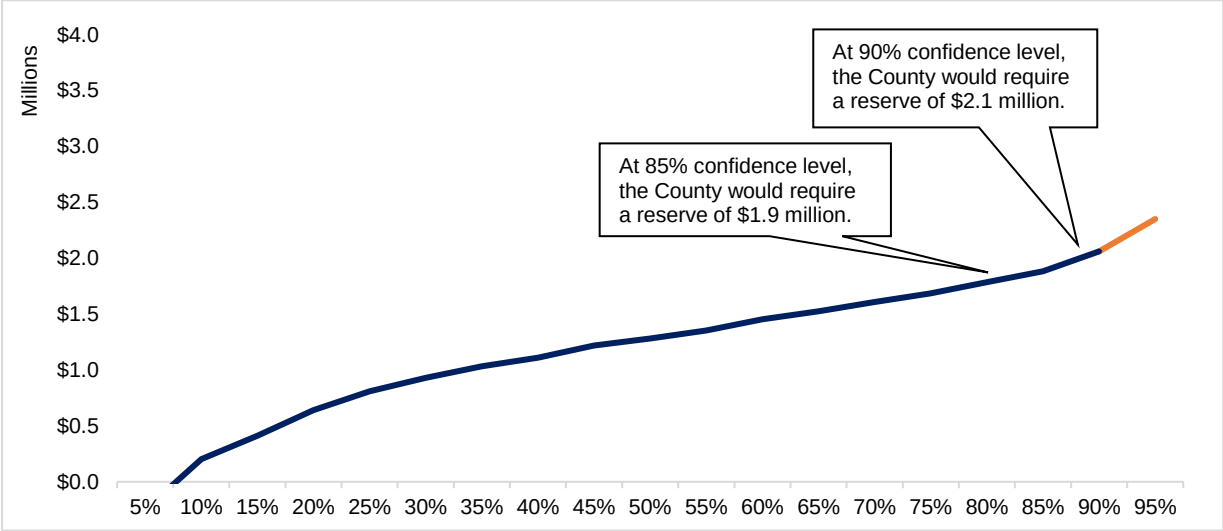
- ***85% confident of covering disaster wildfires or reserve $1.9 million as a less risk averse approach***: This the point at which reserves offer the best value – becoming more confident past this point gets increasingly expensive.
- ***90% confident of covering disaster wildfires or reserve $2.1 million as a more risk averse approach***: Past this point, the cost of becoming more confident escalates significantly.

In order to cover the most extreme wildfire disasters (those above our 90th percentile), the County might consider other strategies besides reserves because of the high cost of covering additional wildfire possibilities. Examples of such strategies might be interfund loans and insurance.

As stated earlier, our recommendation focuses on severe wildfires that have received disaster declaration. Cost for more frequent, less severe wildfires, such as what the County has experienced in the past, could also be covered in this reserve range. When selecting a reserve target, the County might also take into account its wildfire mitigation projects and strategies, which are described in the County's Hazard Mitigation Plan.[13] Such mitigation efforts might mean Douglas County might not need to rely as much on reserves to remediate the impact of a wildfire after it occurs.

[13] Douglas County, CO, "Local Hazard Mitigation Plan," updated June 2015.

Exhibit 4.A.3 - Percent of Declared Wildfire Disasters Covered by Varying Reserve Levels



To cover 85% of declared wildfire disasters, the County would reserve $1.9 million, which would also cover less severe wildfire events.

Wildfire Checkpoints

- ✓ Large wildfires are an important risk to the County, so our analysis focuses on larger, but less frequent fires. Smaller fires can be handled largely within the County's other resources.
- ✓ The most efficient range of reserves is from $1.9 million to $2.1 million. Past this point, the cost of becoming more confident escalates significantly.

Subsection B – Floods (Includes Mudslides and Landslides)

Flooding and related mudslides/landslides are of concern for Douglas County. For example, in June 1965, Castle Rock and areas of the County experienced significant rainfall during a 100-year storm.[14,15] The County's Local Hazard Mitigation Plan identifies localized floods, or under 100-year floods, as occurring once every five to ten years and mudslides/landslides as occurring once every year or up to once every five years. Flooding related to the County's 41 dams, 100-year floods, and 500-year floods[16] are each identified as occurring less than once every ten years. All of these events are identified as having a moderate potential impact to the County.

The County provided us with past flood costs, and we used FEMA's database for other analogues of Colorado counties. FEMA provided the reimbursement amount it provided to each county, and GFOA estimated the actual cost assuming the federal government reimbursed 75 percent of total cost. We use

[14] A 100-year flood is used to describe a flood that has a 1% chance in any given year of being equaled or exceeded in depth.

[15] U.S. Department of Interior, Floods of June 1965 in South Platte River Basin, Colorado, by H.F. Matthai, Geological Survey Water-Supply Paper 1850-B (Washington, DC, 1969), https://pubs.usgs.gov/wsp/1850b/report.pdf.

[16] A 500-year flood is used to describe a flood that has a 0.2% chance in any given year of being equaled or exceeded in depth.

total estimated cost figures because governments might or might not be reimbursed for disasters. There are a few important notes regarding the examples. First, FEMA's examples are of storms that caused subsequent hazards, including floods, landslides, mudslides, etc. Because of the relationships between these hazards, we focus on Douglas County's flooding and mudslide/landslide risk together. Second, we examine the estimated cost to the county using the assessed value rather than population. The rationale for this is some Colorado counties are less populated and estimating cost using population density would not accurately represent potential cost. Because the U.S. Army Corps of Engineers uses factors such as population exposure, asset exposure, and asset damages to identify the consequences of flooding, we chose each county's population per assessed value as a proxy.[17,18] This helps make the experiences of other counties more comparable to Douglas County, accounting both for population and urban density differences. Exhibit 4.B.1 lists the event and respective affected counties, estimated cost to the county adjusted for inflation to 2018 dollars[19], population at the year of the event, County's total assessed value at the year of the event, and estimated cost per resident per dollar of assessed value. Note the figures represent cost incurred by the government and does not include cost related to private property.

Exhibit 4.B.1: Estimated Flood Costs to Select Colorado Counties

Event & County	Total Estimated Cost (2018 $)	Population (year of event)	Assessed Value (year of event)	Estimated Cost Based on Resident per Dollar of Assessed Value*
Westcreek Flood (July 2006)				
Douglas County	$832,323**	256,136	$4,750,496,570	$15,436,909,383
Colorado Severe Storms, Flooding, Landslides, and Mudslides (September 2013)				
Adams County	$2,208,712	469,193	$4,649,869,420	$21,889,116,454
Arapahoe County	$23,654	607,070	$7,619,680,770	$296,899,323
Boulder County	$96,227,887	310,048	$5,733,962,685	$1,779,618,350,983
Broomfield County	$491,517	59,471	$1,101,245,714	$9,101,604,696
Clear Creek County	$1,366,206	9,031	$590,522,210	$89,333,977,608
Denver County	$3,324,371	649,495	$11,264,201,000	$57,654,619,662
El Paso County	$2,228,339	655,044	$37,001,770,072	$125,873,194,636
Jefferson County	$6,158,102	551,798	$7,056,234,000	$78,748,037,424
Larimer County	$50,786,042	315,988	$4,123,984,142	$662,812,617,687
Logan County	$253,243	22,450	$260,054,690	$2,933,499,379
Morgan County	$1,267,700	28,404	$427,416,980	$19,076,056,805
Weld County	$9,911,170	269,785	$7,118,834,517	$261,526,682,942
Colorado for Severe Storms, Tornadoes, Flooding, Landslides, and Mudslides (July 2015)				

[17] See U.S. Army Corps of Engineers, "National Flood Risk Characterization Tool: Overview of Capabilities and Current Limitations," http://www.iwr.usace.army.mil/Portals/70/docs/frmp/Flood_Risk_Char/NFRCT_Slides_FRM_wkshp_v1.pdf.

[18] Fair market value is an alternative indicator, but that information was not readily available for all counties. Additionally, some counties did not report assessed value information in their annual financial report or did not publish theirs publicly. These counties were Crowley, Elbert, Gilpin, Lake, Lincoln, Park, Sedgwick, Washington, and Yuma Counties, which have populations ranging from approximately 4,800 to 46,500 residents and significantly smaller than Douglas County.

[19] For FEMA-declared incidents, GFOA estimates the total cost using the typical FEMA reimbursement rate of 75 percent of total cost. For Douglas County incidents, the County finance staff provided actual figures.

Adams County	$151,148	491,337	$5,249,463,010	$1,614,871,209
Boulder County	$968,163	319,372	$6,881,534,694	$20,861,094,798
Denver County	$602,723	682,545	$14,384,910,000	$12,702,621,986
El Paso County	$3,816,444	674,471	$38,444,437,634	$217,534,965,033
Fremont County	$623,800	46,692	$431,555,639	$5,765,536,754
Logan County	$734,554	22,036	$301,357,520	$10,045,530,927
Morgan County	$647,405	28,360	$470,619,610	$10,743,345,390
Pueblo County	$235,237	163,591	$1,561,908,000	$2,245,959,754

Sources: Federal Emergency Management Agency, U.S. Census Bureau, Douglas County, CO, each respective counties' annual financial report

* The figure is derived from the total estimated cost over the population per assessed value: (total estimated cost) / [(population) / (assessed value)].

** Figure provided by Douglas County, CO.

In reviewing the 21 county events in the exhibit above, we see the September 2013 event caused significant damages, particularly in Boulder and Larimer Counties. According to FEMA, these two counties saw the most rainfall of the affected area, with Boulder County experiencing more than 17 inches in four days.[20] The damages that these two counties incurred for the September 2013 incident are more extreme scenarios (1,000-year events[21]) and might not apply well to Douglas County. Therefore, we reviewed the three counties' local hazard mitigation plans to compare their hazard profiles for floods and mudslides/landslides. Boulder and Larimer Counties considered both floods and mudslides/landslides to be a high risk whereas Douglas County considers these hazards to be a medium risk.[22] Because the severe September 2013 incident experienced by Boulder and Larimer Counties might not apply well to Douglas County given their different vulnerability to floods, we removed them from our analysis. For the remaining 19 county events, we apply the Douglas County's resident per dollar of assessed value of 0.00005.[23] This provides us with a range of potential cost, which takes the shape of an asymmetrical distribution whereby there are greater instances of lower cost, more frequent floods and mudslides/landslides than severe, less frequent ones.

Exhibit 4.B.2[24] provides a cumulative probability chart of the potential flooding and mudslide/landslide cost the County would incurred. This chart essentially shows the "value" that the County gets from reserves. Where the curve is flatter, the value of reserves is high because a relatively modest increase in

[20] U.S. Department of Homeland Security, Federal Emergency Management Agency, "Reducing Losses through Higher Regulatory Standards: 2013 Colorado Floods Case Study," May 2015, http://www.floods.org/Files/Conf2015_ppts/B3_Bausch.pdf.

[21] Matt Ferner, "The 1,000 Year Storm: Colorado's Flood Is One For The History Books," *Huffington Post*, updated December 6, 2017, https://www.huffingtonpost.com/2013/09/20/1000-year-storm_n_3956897.html.

[22] Douglas and Boulder Counties considered the geographic extent, probability of occurring, and magnitude/severity of each hazard in its risk score. Larimer County considered these factors along with warning time before the hazard and the duration of the hazard.

[23] This figure is derived from the County's population over its total assessed value. According to the U.S. Census, the County's 2016 population 314,238. According to the County's 2016 comprehensive annual financial report, the total assessed value is $6,817,317,050.

[24] Exhibit 2 does not graph the amount required to cover 99.9% of floods in order to focus on more probable scenarios. To cover 99.9% of floods would require $1.1 billion.

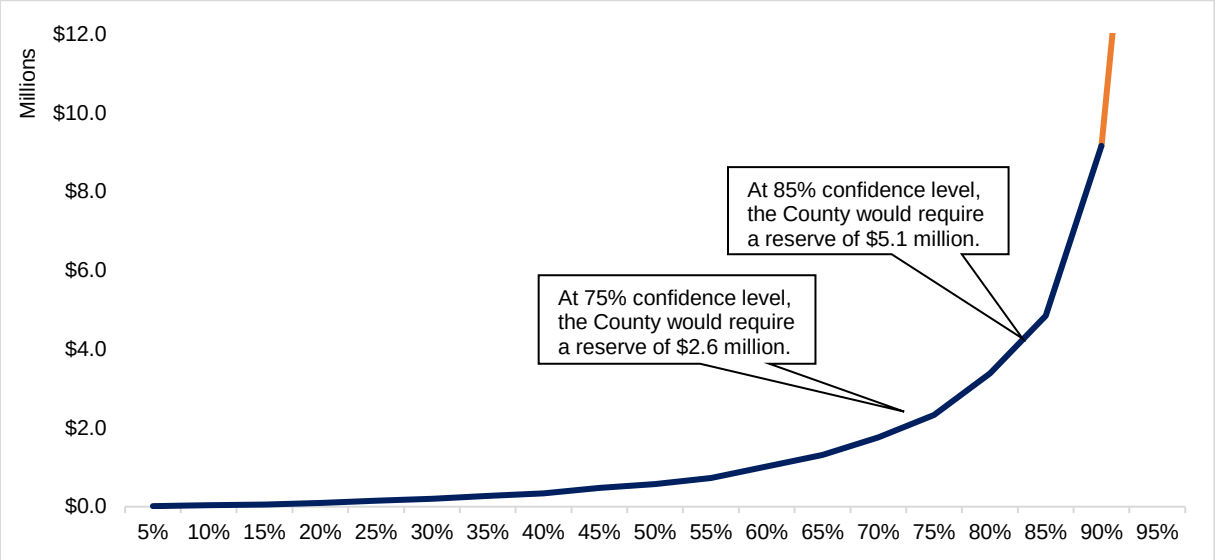
the size of the reserves "buys" a substantial increase in the confidence the County can have that its reserves will be adequate for a flood. Where the curve gets steeper, the County needs to put aside more money to gain less confidence. The horizontal axis represents the percent likelihood that the cost of floods and mudslides/landslides will be covered. The vertical axis represents the size of the reserve that the County could put aside. As we move to the right, the line turns from blue to orange to represent more extreme scenarios. As the graph shows, large reserves are required to give the County confidence that it could cover some of the most extreme scenarios. For more probable scenarios, we look at where the value of reserves is highest. In order to move to 75 percent confident from 70 percent confident, the County would need a reserve that is 3/10 larger (0.30). At 80 percent to 85 percent confidence, the incremental cost to gain confidence is a reserve that is just over 2/5 larger (0.41). In order to get to 90 percent confident from 85 percent, the County would need a reserve approximately 4/5 larger (0.80). Hence, the value of reserve drops precipitously once the County achieves 85 percent confidence that it reserves will be sufficient to cover the cost of a flood. As such, we would recommend the County consider the following:

- ***75% confident of covering floods and mudslides/landslides or reserve $2.6 million as a less risk averse approach***: This is the point at which reserves offer the best value – becoming more confident past this point gets increasingly expensive.
- ***85% confident of covering floods and mudslides/landslides or reserve $5.1 million as a more risk averse approach***: Past this point, the cost of becoming more confident escalates significantly.

As with other extreme events, those above our 95th percentile, the County might consider other strategies besides reserves, including interfund loans and insurance. In determining a reserve target for floods and mudslides/landslides, the County could also consider the mitigation strategies it is working on to better assess and prepare for this risk, including flood hazard area structure inventory, flood hazard prediction tool, and others outlined in its local hazard mitigation plan.[25]

[25] Mitigation strategies taken from Douglas County's hazard mitigation plan.

Exhibit 4.B.2 - Percent of Floods and Mudslides/Landslides Covered by Varying Reserve Levels



The County would reserve $2.6 million to cover 75% of floods and landslides/mudslides.

Flood Checkpoints

- ✓ Though Douglas County has not experienced a large flood recently, floods are still an important risk.
- ✓ A reserve $2.6 million provides the County with 75% confidence of covering a given flood. $5.1 million provides 85% confidence. This is the most efficient range of reserves. This the point at which reserves offer the best value – becoming more confident past this point gets increasingly expensive.

Subsection C – Extreme Snowfall

Douglas County is vulnerable to heavy snowfall because of the area's geography. The County has seen several serious snowfall events in the past several years, including two official FEMA-declared snow disasters in 2003 and 2007. Due to these factors, the County has developed a detailed snow removal action plan that includes a predetermined number of snowplows and personnel, the number of shifts for snowplow drivers, and materials to be used for snow removal (including liquid, granular de-icing products, and machinery). The County has also been broken into six snow removal districts, each with a specific allocation of resources based on the population's needs in those areas.

Douglas County's spending on snow removal has varied from year to year. Since 2000, the County has seen removal costs as low as $727,000 and as high as $3.56 million.[26] Due to wide variation in the potential yearly cost of snow removal to the County, we felt it important to look closer at the relationship between yearly cost and the number of extreme snow events. This can help the County be more prepared financially with the yearly risk of extreme snow events.

[26] Measured in current dollars

To analyze the risk, GFOA looked to two sources of data—the number of snow events per year and the amount of snowfall in a given year. Unfortunately, a significant amount of monthly snowfall data was unavailable. To maintain the integrity of the analysis, we decided to look only at the number of snow events per year starting in 2000. First, we use the data to compare the total number of snow events in a given year to the County's expense for snow removal from 2000-2016. Using the data, we were able to project forecasted snow removal costs at different numbers of snow events. We used the relationship to estimate the County's future costs to respond to a given number of snow events.[27] Using these estimates as a basis, we analyzed the financial risk the County faces for responding to snow events each year.

We found that the average annual snowfall is 80.8 inches, the average number of snow events per year is 22, and the average amount spent on snowfall in a given year is $1.65 million. This means that a budget of $1.65 million would be sufficient to cover about 50% of the snow seasons the County may experience.

Douglas County's 2017 Public Works department budget held $2.3 million for snow and ice removal. A budget of $2.3 million accounts for a worse-than-average snowfall year; in fact, it currently covers about 75% of potential snow seasons.

Our analysis found that a budget of $2.9 million is sufficient to cover 90% of the snow seasons the County may experience. The same analysis reveals that a $3.3 million budget is sufficient to cover 95% of snow seasons in the County.

Exhibit 4.C.1 shows the expected percent of snow seasons that will be covered by a given amount of money. The Exhibit shows the County's existing budget of $2.3 million and also shows points beyond this amount of money.

Hence, the County may wish to account for the possibility of especially costly snow seasons in its reserve. This is because about 25% of snow seasons would not be fully covered by the regular budget. A reserve is a better way to cover this risk than increasing the regular budget. This is because a budget must be allocated every year. A reserve is established once and lasts until it is used.

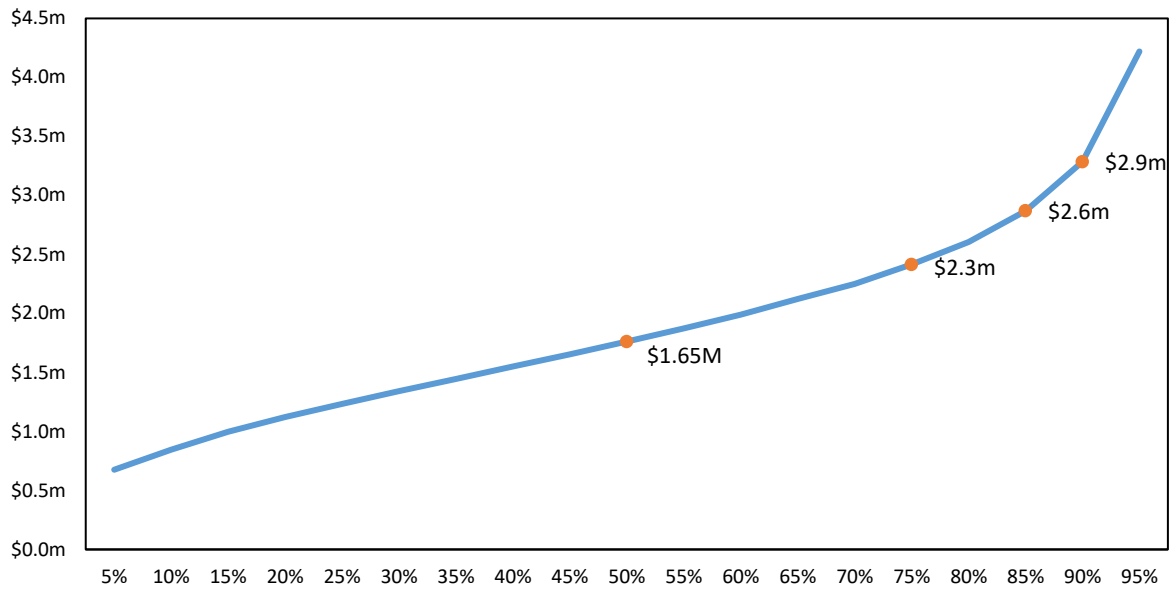
As we can see on Exhibit 4.C.1, the blue line has about the same slope until it reaches $2.6 million, which gives the 85% confidence that it could cover a given snow season. From $2.3 million to $2.6 million, the County is getting about the same increases in its confidence that it will be able to cover a more severe snow seasons for each dollar it puts towards snow removal. After $2.6 million the line gets noticeably steeper. This means it costs relatively more to become increasingly confident in the County's ability to cover even more severe snow seasons. After $2.9 million (90% confident), the line goes very sharply upwards. After this point, it would appear that reserves don't offer nearly as good a value for mitigating the risk from severe snow seasons. Hence, the County might consider the following reserve strategies:

- For a less risk averse strategy the County could reserve $300,000 ($2.6 million minus a regular budget of $2.3 million). This allows the County to be 85% confident that it could cover the cost of a given snow season.

[27] Our statistical tests showed that the number of snow events was not a perfect predictor of the County's snow removal costs. However, the number of snow events did suggest a range of costs that we used to develop a distribution of possible costs.

- For a more risk averse strategy the County could reserve $600,000 ($2.9 million minus a regular budget of $2.3 million). This allows the County to be 90% confident that it could cover the cost of a given snow season.

Exhibit 4.C.1: Percent of snow seasons covered by given snow removal budget



Extreme Snowfall Checkpoints

- ✓ The County experiences some snowfall every year. Sometimes, the amount of snow is so extreme that the County's regular budget can't handle it. A reserve could help the County prepare for extreme snowfalls.
- ✓ The County's budget has recently been about $2.3 million, which is sufficient to cover about 75% of potential snow seasons.
- ✓ For a less risk averse strategy the County could reserve $300,000 ($2.6 million minus a regular budget of $2.3 million). This allows the County to be 85% confident that it could cover the cost of a given snow season.
- ✓ For a more risk averse strategy the County could reserve $600,000 ($2.9 million minus a regular budget of $2.3 million). This allows the County to be 90% confident that it could cover the cost of a given snow season.

Subsection D – Tornadoes

Tornadoes are a severe weather hazard for Douglas County. Between 1950 and 2014, the County has recorded 59 tornadoes, with a 90.9 percent chance of tornadoes occurring in any given year. Though not many of these have impacted populated areas, it is certainly possible a tornado could in the future.

To identify the potential damage that the County could face from a tornado, we used FEMA's database for tornado reimbursement. Because the database did not include any reimbursements to Colorado governments, GFOA found reimbursements to counties across the U.S. To hone in on ones more applicable to Douglas County, we identified counties with a similar population density. The rationale is certain types of structures and buildings are more susceptible to damage than others[28] and counties with a comparable density would likely have similar types of structures and buildings as Douglas County.

Tornado Magnitude

Prior to February 2007, the National Oceanic and Atmospheric Administration utilized the Fujita (F) scale to identify the magnitude of a tornado. Now, NOAA uses the Enhanced Fujita (EF) scale. The three-second gust of the tornado in miles per hour is a variable to compare the two scales.

3 Second Gust (mph)		
Scale	Fujita Scale (F)	Enhanced F-Scale (EF)
0	45-78	65-85
1	79-117	86-110
2	118-161	111-135
3	162-209	136-165
4	210-261	166-200
5	262-317	Over 200

In discussions with the County Sherriff's Office, we focused on tornadoes that had severity of Fujita (F) 2 or lower. The majority of tornadoes recorded in Douglas County have recorded severity of F0 or F1, so we focus on tornadoes of more plausible severity as to what the County faces.[29] This leaves us with four events we might use as Analogues for Douglas County: Calvert County, MD in 2004, Sangamon County, IL in 2002, Olmsted County, MN in 2010, and Lowndes County, GA in 2017. Exhibit 4.D.1 lists the disaster event and respective affected counties, number of tornadoes involved, severity of the tornadoes, and estimated cost to the counties adjusted for inflation to 2018 dollars.[30] There are two important notes with the references. The first is for Calvert County, two defined tornadoes occurred on the same day. The National Oceanic and Atmospheric Administration identifies separate instances if a tornado lifts off the ground for greater than 5 minutes or 2.5 miles, irrespective of geographic boundaries. Because the impact of each tornado cannot be distinguished and it is plausible for the County to experience two tornadoes in a single day, we examine it as one reference. Second, while a tornado can affect one area, it can cause hail, thunderstorm, wind, and flash flooding in other areas. This is the case for Sangamon County, IL in the references listed below.

[28] Roger Edwards, James G. LaDue, John T. Ferree, Kevin Scharfenberg, Chris Maier, and William L. Coulbourne, "Tornado Intensity Estimation: Past, Present, and Future," *American Meteorological Society*, 94, No. 5 (2013) http://www.spc.noaa.gov/publications/edwards/ef-scale.pdf/.

[29] U.S. Department of Commerce, NOAA, "Severe Weather Database Files (1950-2016)," March 9, 2016, https://www.spc.noaa.gov/wcm/#data.

[30] For FEMA-declared incidents, GFOA estimates the total cost using the typical FEMA reimbursement rate of 75 percent of total cost. For Douglas County incidents, the County finance staff provided actual figures.

Exhibit 4.D.1: Estimated Tornado Costs to Select U.S. Counties

Event & County	Severity	Total Estimated Cost (2018 $)
Maryland Tornado (April 2002)		
Calvert County, MD	F1 and F2	$312,500
Illinois Severe Storms, Tornadoes, and Flooding (April-May 2002)		
Sangamon County, IL	N/A	$7,713
Minnesota Severe Storms, Tornadoes, and Flooding (June 2010)		
Olmsted County, MN	EF1	$14,306
Georgia Severe Storms, Tornadoes, and Straight-line Winds (January 2017)		
Lowndes County, GA	EF1	$317,156

Sources: Federal Emergency Management Agency, National Oceanic and Atmospheric Administration, and U.S. Census Bureau

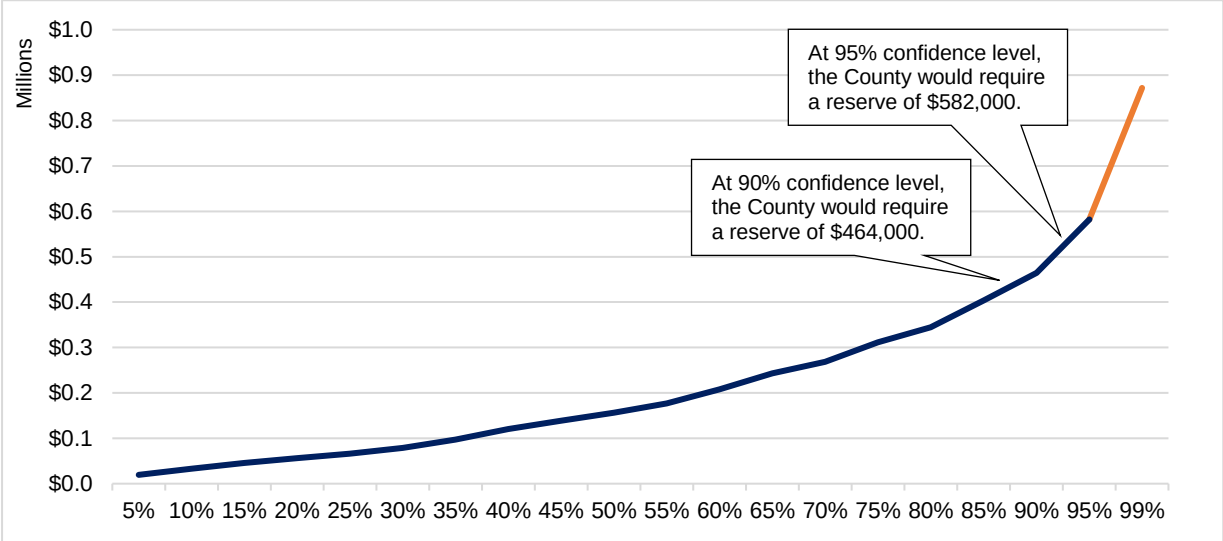
We used the four references as a range of potential damages. However, four references does not give us a high degree of confidence that we have captured the full spectrum of possible damages. A statistical rule of thumb tells us that if we double the size of a range that is constituted by just a few observations then we can be much more confident that we have captured most of the possibilities.[31] Exhibit 4.D.2 provides a cumulative probability chart of the tornado cost the County could incur using the data described above plus widening the range as the aforementioned rule-of-thumb suggests. As with previous cumulative probability charts in this report, where the curve gets steeper, the County needs to put aside more money to gain less confidence. The horizontal axis represents the percent likelihood that the cost of tornadoes will be covered. The vertical axis represents the size of the reserve that the County could put aside.

The more probable outcomes are the blue portion of the curve. When the curve turns orange, it represents more extreme tornadoes and where risk strategies aside from reserves should be considered. Reserves offer the highest value for the County at the 90 percent confidence level. From the 40 percent confident to 45 percent confident, the County would need a reserve that is 3/20 larger. The incremental cost to gain confidence for each subsequent 5 percent increment up to 90 percent confidence requires approximately the same proportion in additional reserves. At 95 percent confidence, the County would need a reserve that is 1/4 more and increases significantly from there. At 99 percent confidence, the County would require ½ more in reserves or $872,000. GFOA would found the most "efficient" range of reserves is:

- ***90% confident of covering tornadoes or reserve $464,000 as a less risk averse approach***: This the point at which reserves offer the best value.
- ***95% confident of covering tornadoes or reserve $582,000 as a more risk averse approach***: Past this point, the cost of becoming more confident noticeably increases.

[31] The accomplished forecasting scientist, Spyros Makridakis, suggests a "Triple-A" approach for dealing with highly uncertain phenomena. See: Spyros Makridakis, Robin Hogarth, and Anil Gaba. *Dance with Chance: Making Luck Work for You*. (Oneworld Publications: Oxford, England). 2009.

Exhibit 4.D.2 - Percent of Tornadoes Covered by Varying Reserve Levels



The County would reserve $464,000 to cover 90% of tornadoes of similar magnitude that it has experienced in the past.

Tornado Checkpoints

- ✓ A reserve of $464,000 provides 90% confidence of covering the cost of a given tornado.
- ✓ A reserve of $582,000 provides 95% confidence of covering the cost of a given tornado.
- ✓ The two numbers of above represent the range that offer the "best value" for risk mitigation.

Subsection E – Hazardous Materials Spills

Douglas County faces a risk that private parties could spill hazardous materials on County property and that the responsible party either doesn't have the financial capacity to clean up the spill or can't be located. We examined four types of hazardous material spills that are of greatest concern to the County:

- A tanker truck transporting hazardous materials through the County gets into a traffic accident (a roll over), releasing hazardous materials.
- A freight train transporting hazardous materials through the County derails, releasing hazardous materials.
- The County finds a methamphetamine or explosive laboratory and needs to clean it up.
- A private party abandons hazardous materials on County property.

Most of the time, the costs of a hazmat spill will be entirely shouldered by a third party (i.e., the party responsible for the spill). If the responsible party can't be found or can't pay for the cleanup, then the County could be forced to shoulder some or even all of the costs.

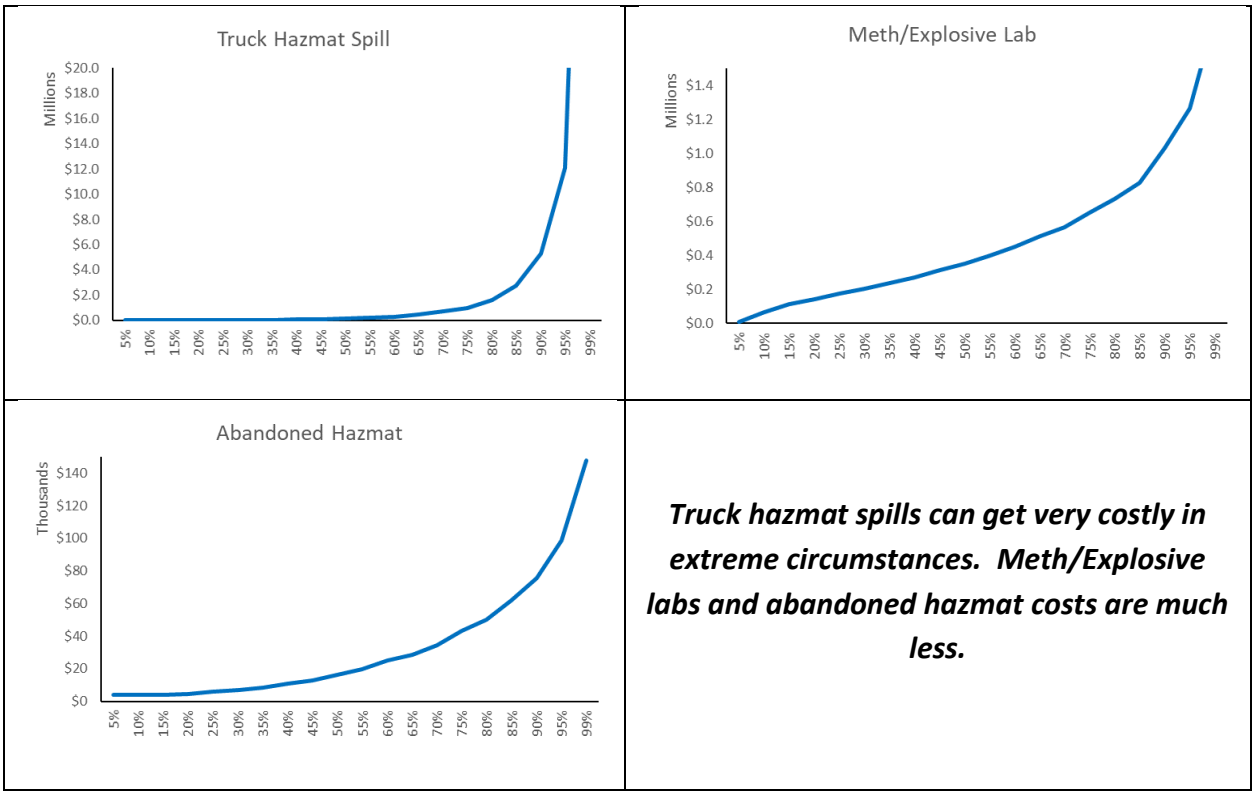
Hence, the risk to the County comes from extremely rare, but extremely consequential events – where a large hazmat spill occurs (e.g., high volume or especially toxic materials) and where the responsible party doesn't cover the costs. The vast majority of the time the ultimate financial impact on the County of a given hazmat spill will be negligible or nothing, either because the responsible party or property owners

pays for the costs and/or the spill was small. However, under very rare circumstances the financial impacts on the County could be extreme. To provide a sense of how rare these events are, the County has not experienced a truck accident, train derailment or methamphetamine lab cleanup where the County has had to bear the costs within the working memory of the County emergency preparedness staff who we spoke with (a span covering about 15 years). In this section, we will examine the costs the County could face if it did have to bear these costs. In Section 7, we will account for the low probability that the County would actually incur these costs.

Below are the cumulative probability charts for a truck hazmat spill, a methamphetamine / explosive lab, and an abandoned hazmat event.[32] We will discuss train hazmat derailment immediately following. In Exhibit 4.E.1, we see that truck hazmat spills are easily the most consequential, with damages potentially reaching multiple millions of dollars. Meth/Explosive labs are unlikely to break $1 million and other abandoned hazmats are expected to cost a couple hundred thousand dollars in extreme circumstances. The damage curve for truck spills also has a very sharp turn upwards as we move to the right. This represents the more extreme possible outcomes, where the truck is carrying some of the most toxic materials and the nature of the accident is such that most, if not all, of the payload spills. Because the relative rarity of these events is such an important consideration in the risk they pose to the County, we will address how these various possibilities fit into an effective reserve strategy in Section 7. Hence, we will not suggest an "efficient" reserve amount here as it would not be very meaningful without the context of the probability that a hazmat event actually happens.

[32] The data to construct the analysis for meth/explosive labs and abandoned hazmat was derived from the professional judgments of county staff. The analysis for truck hazmat spills was based on historical experiences of the cost of clean-up of minor spills and the physical characteristics of tanker trucks (e.g., the volume of material carried)

Exhibit 4.E.1 – Hazmat Sill Cumulative Probability Charts for Truck Spills, Abandoned Hazmat, and Meth/Explosive Labs



We did not develop a cumulative probability chart for a train derailment. This is because there was far too much speculation involved given the complete lack of historical experience, the rarity of analogous experiences to draw upon from other counties, and the wide range of variation in the factors that could impact the cost of the spill (e.g., type of material spilled, the number of cars in the train, the number of cars that derail, the amount spilled from each derailed car, etc.). That said, we did build a rough damage model based on the data we were able to gather[33] and we found that damages from a train derailment could easily reach tens of millions of dollars (an "average" derailment cost just under $30 million in our model). Thankfully, train derailments are exceedingly rare, even rarer than a spill from a tanker truck. The extreme rarity of train derailments and the potentially extreme costs suggests that reserves may not be the best strategy for protecting the County from derailment costs. We will further discuss these other options in Chapter 7.

Hazmat Checkpoints

- ✓ A spill of a truck carrying hazardous materials could get very costly, reaching tens of millions of dollars in the most extreme circumstances.
- ✓ Abandoned hazardous materials and meth/explosive labs are potentially much less costly.

[33] This includes the number of cars in a train, the size of rail cars, the cost per gallon of a spill, and other relevant factors.

- ✓ Train derailments could easily cost tens of millions of dollars, but we did not have enough data to develop as detailed a model as we did for the other hazmat risks.
- ✓ Hazmat spills that the County needs to pay are extremely rare. Therefore, in Section 7 we will address the financial impact of hazmat spills on the County's reserve policy, where we will also account for the frequency of these events.

Section 5 - Revenue Volatility

An important risk for any local government is revenue volatility, primarily owing to downturns in the economy. Reserves can be used to help a local government make a "soft landing" in the event of a revenue downturn.

In this section of the report, we will analyze the County's vulnerability to revenue downturns for the following six funds: General, Road and Bridge, Human Services, Law Enforcement Authority, Road Sales and Use Tax, and Justice Center.

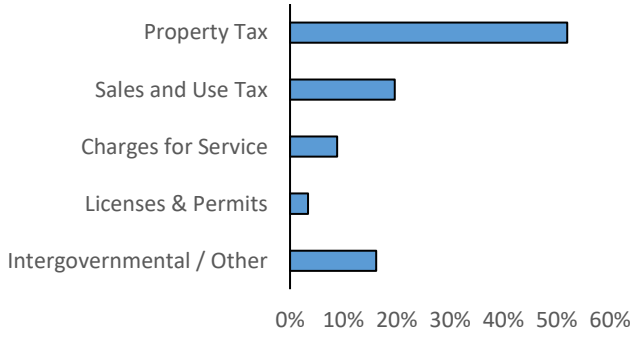
There are three major subsections to this report:

1. **Analysis of each major revenue source across all funds.** Each source has its own distinct characteristics and responses to economic downturns. Understanding these can help us better understand future risk.
2. **Analysis of historical trends in each fund.** By seeing how each fund has responded to economic downturns in the past, we can estimate future risk for each fund.
3. **Risk analysis.** In this section, we estimate the amount of reserves the County would need to provide varying levels of protection against future economic downturns.

Subsection A - Major Revenue Source Analysis

There are five categories of revenue we will examine in this section: property taxes, sales and use taxes, charges for service, licenses and permits, and intergovernmental/other. Exhibit 5.A.1 shows the relative importance of each revenue across all six funds that are the subject of this report. We see that property tax is, by far, the largest. Sales taxes are approved by a local option. Sales taxes also have the reputation of being more vulnerable to economic downturns. Hence, we will start with a detailed examination of sales taxes, then move on to property taxes, and then to the remaining revenue sources shown on Exhibit 5.A.1.

Exhibit 5.A.1 – Revenue sources as a percent of the total for all six funds that are being analyzed



Property taxes are the most important single revenue source

Sales Taxes

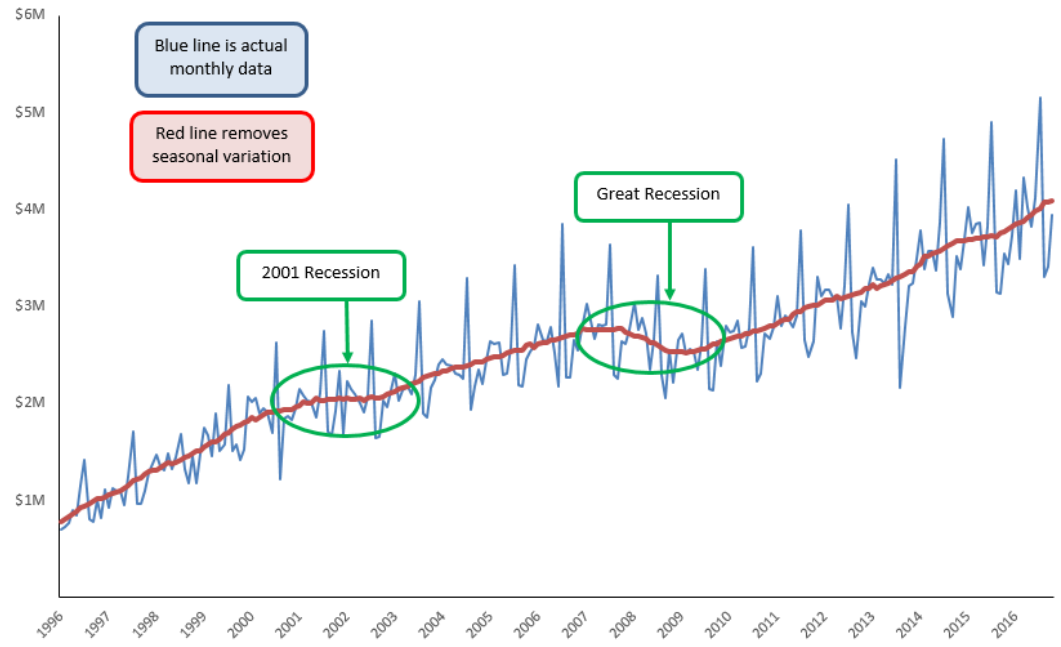
For many local governments, sales taxes are a volatile revenue that are vulnerable to economic downturns. Douglas County is no different. For example, if we look at annual revenues, sales tax revenues

declined 7.5% from the end of 2007 to the end of 2009. However, we can look deeper in order gain more insight into sales taxes. The first step is to look at monthly revenues instead of just annual totals. Looking at monthly revenues can reveal a more precise point in time for when revenues began to turn down and then eventually recover. This allows us to more accurately judge the length and depth of the revenue downturn. Annual revenue figures are essentially an average of all 12 months. However, if, for example, three of those months are part of an economic downturn and nine are part of the subsequent recovery, then the year as a whole will show revenue growth. This could cause us to underestimate the length of time County revenues are negatively impacted by an economic downturn.

In order to make the best use of monthly data for risk analysis, we need to remove the effects of what is known as "seasonal" variation. This means that there is some regularly occurring variance in the revenue that is independent from economic cycles. For instance, in Douglas County, the 12th period of the year always provides the most sales tax revenue, presumably due to holiday spending. So, if the 12th period produces more revenue than the 10th period, that does not necessarily mean that an economic downturn has ended – it just indicates seasonal variation. A simple way to remove season variation is to create a 12-month moving average of the monthly data. This means that for every single month in our data set we take an average consisting of that month plus the six months prior and the five months after (for a total of 12 months). This essentially averages out annual seasonal variation and gives us a purer sense of the impact of economic cycles on Douglas County's sales tax revenues.

In Exhibit 5.A.2, monthly revenues are plotted out from 1996 to 2016. The red line represents the 12-month moving average, while the blue line is actual monthly revenues. We can see that the blue line exhibits large swings during the year such that it is hard to pick out when there is an economic downturn. The red line removes seasonal effects, which results in a much smoother line. We can see the revenue downturn associated with the Great Recession easily – it is highlighted by the green circle on the right side of the graph. The sales tax downturn lasted 16 months and resulted in a 9.0% decline in revenues.

Exhibit 5.A.2 – Monthly sales tax revenue, millions of dollars & with seasonal variation removed

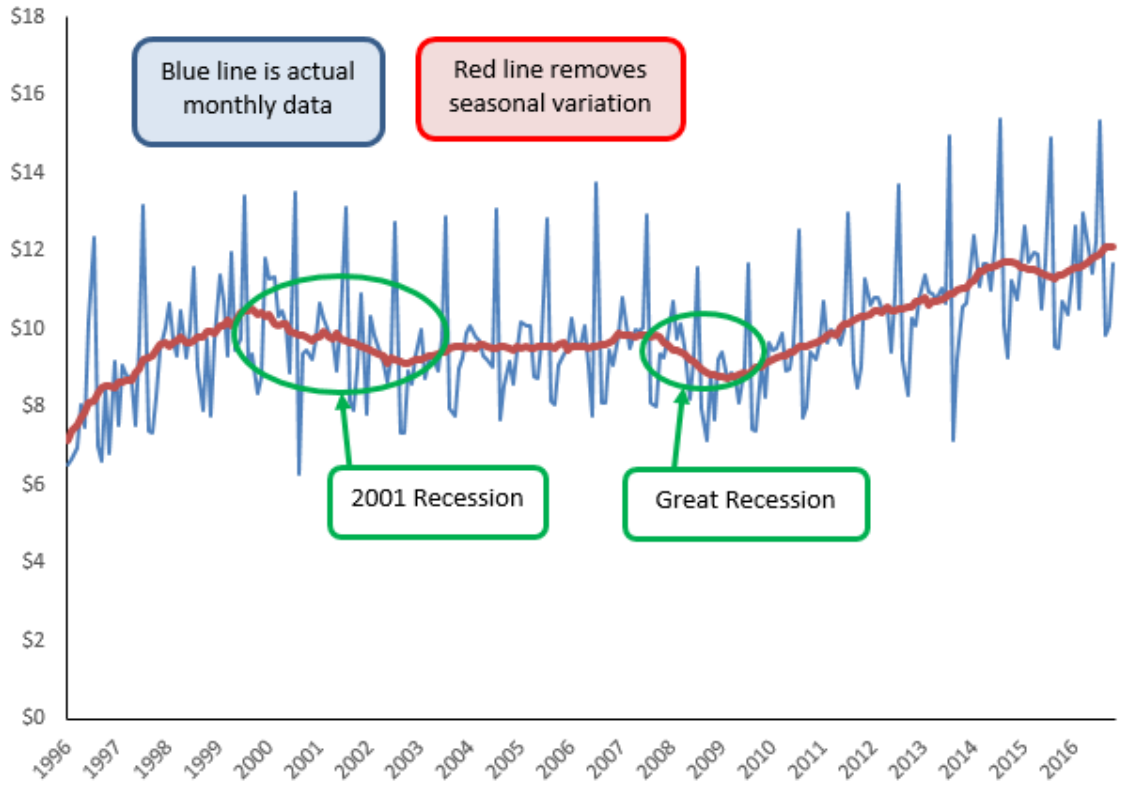


Removing seasonal variation in the monthly revenue shows us the trends associated with recessions much more clearly

Exhibit 5.A.2 shows that sales tax revenue remained essentially flat during the 2001 Recession, which might imply that the sales tax is a stable revenue. However, the County was also experiencing double-digit rates of population growth during this time. The influx of population brought in new revenues, which helped bolster the County's total sales tax inflows. If we factor out population and graph per-capita revenues, the red line looks much different. This is shown in Exhibit 5.A.3. We can see that per capita revenues declined 12% over about 2 ¼ years due to the 2001 Recession. The per capita decline associated with the 2007 Great Recession was actually less severe on the whole: revenues declined by 9.3% over 15 months.[34] While analyzing per capita revenues will not provide perfect comparability between sales tax behavior during the Great Recession and 2001 Recession, it does make clear that the sales tax is more susceptible to economic downturns than the nominal historical data implies.

[34] This is not much different from the nominal monthly figures because Douglas County's population was not changing much during this time.

Exhibit 5.A.3 – Monthly sales tax revenue per capita



When changes in population are accounted for, the negative impact of the 2001 becomes apparent.

We can also gain more insight into sales tax behavior by examining how different segments of sales tax producers performed during the Great Recession.[35] According to the data provided by the State of Colorado, there are three major categories of sales tax producers in Douglas County:

- **Specific retailers:** This category produced 40% of sales tax revenues over the past five years. It is composed mostly of retailers that specialize in a particular good, like car dealerships or electronics and appliance stores. These types of retailers could be more vulnerable to economic downturns because their business comes from discretionary purchases by consumers. This category also includes gas stations and food and beverage stores. These retailers could be less vulnerable to downturns because consumers cannot lower their spending as easily on essentials like food and fuel. So, on balance, this category is vulnerable to downturns, but that should be moderated somewhat by the retailers of consumer essentials that are included in this category.

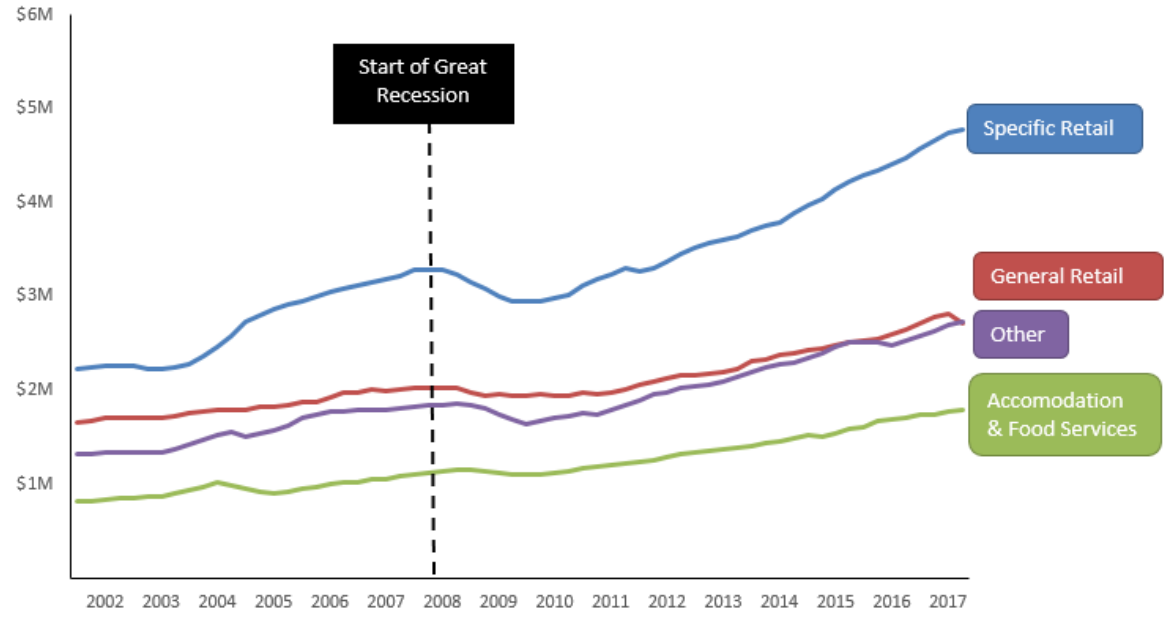
[35] Data by producer segment was only available back to 2001 so we could not analyze for the beginnings of the 2001 recession.

- **General retailers.** This category produced 23% of sales tax revenues and includes a variety of other types of retailers, most of which are not as specialized as those found in the other categories. Although it is impossible to tell from the data provided by the State, it seems likely that "big box" retailers like Walmart or Target are responsible for a large portion of the sales taxes generated by this category.
- **Accommodation and food services.** This includes restaurants and hotels. It produced 15% of sales tax revenues over the past five years.

In addition to the three categories above, the State tracks over 20 other categories, none of which produces much more than 5% of County sales tax revenue. Taken together, these "other" categories produced 23% of County sales tax revenues over the past five years.

Exhibit 5.A.4 shows how these revenues performed since 2001, by quarter. The Great Recession is of the most interest. We can see that specific retailers had a noticeable decline and revenues declined by 3.8% over a 21-month period. General retailers also declined, though by less: 2.3% over a 30-month period. Accommodation and food services did not experience any decline at all. Instead, sales tax revenues grew by about 3.7% over the period in question. Finally, "other" revenue fell by 4%.

Exhibit 5.A.4 – Quarterly Sales Taxes, by Category of Sales Tax Producer (millions)



The relative share of the County's sales tax producers is very simliar today compared to right before the 2007 Great Recession.

This is important because if the relative shares of the sales tax bases have shifted since the Great Recession, then the County might be more vulnerable or less vulnerable to future recessions. However, the share of category is pretty similar today compared to what it was during the Great Recession. The share of specific retailers is almost identical, as is the share of "other" sales tax producers. General retailers' share is slightly down, while accommodation and food service's is slightly up. Since the latter category proved least vulnerable to the Great Recession, the County's sales tax based might even be more resilient to an economic downturn than in past.

Property Taxes

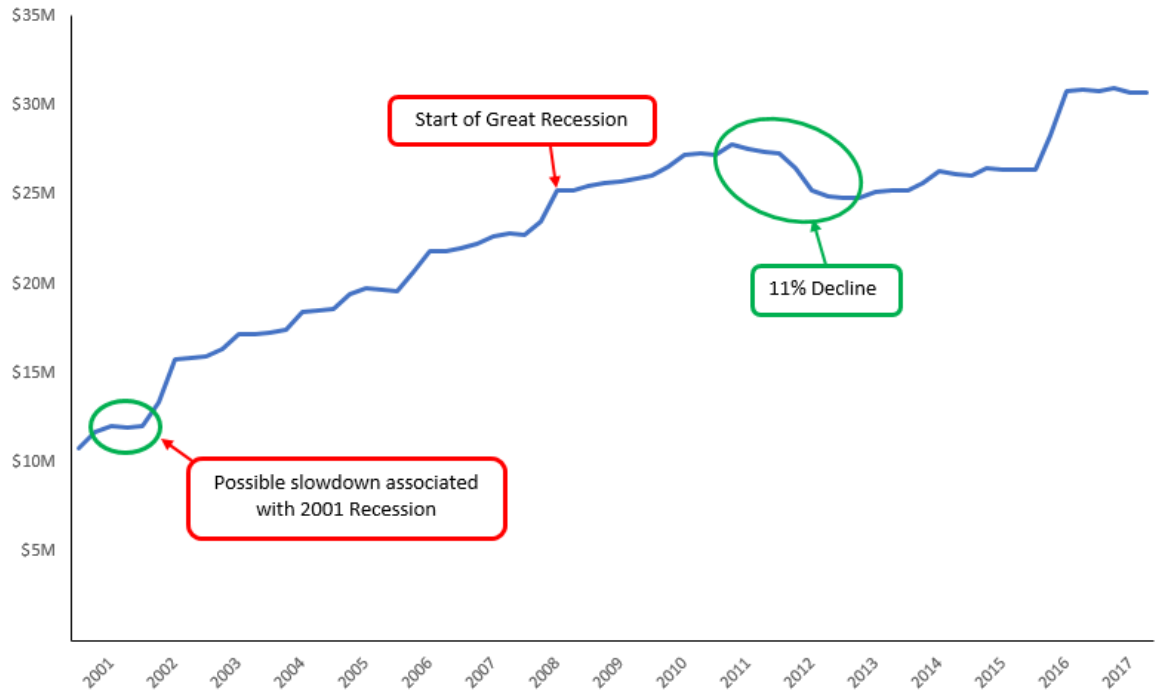
Property taxes are the County's single largest revenue source by a wide margin. Property tax revenues have a reputation of being resistant to economic downturns. However, this appears to be only partially true in Douglas County. Exhibit 5.A.5 shows quarterly property tax revenues, where the quarters have been mathematically adjusted to remove seasonal variation, similar to sales taxes. In the chart, we can see a sharp decline that starts in 2011 and goes to late 2012. Property tax revenues decreased by almost 11%. This is an even greater decline than sales taxes experienced during the Great Recession. We can also see that the decline started about two to three years after the onset of the Great Recession. This is because properties are valued and taxed in arrears, so changes in the market value of properties don't show up in County revenues right away. Revaluation of property in Douglas County occurs every other year, in odd numbered years (by statute). The appraisal is based on June of the prior year. So, for example, the 2009 revaluation would have been based on June 2008 property values. By June 2008, property values would not have experienced anywhere near the impact of the Great Recession as they later would. The 2011 revaluation would show these impacts.

This feature of the property tax made it easier for Douglas County's General Fund to contend with the Great Recession. First, the County had forewarning that a decline in property taxes was coming. Second, the negative impacts of the Great Recession were distributed over a longer period of time, meaning other General Fund revenues were impacted more immediately by the recession and then started to recover by the time the property tax declined. This reduced the size of the revenue shortfall that the County had to contend with in any single year.

We can also see that there does not appear to be much impact on property tax revenues from the 2001 Recession. We see in Exhibit 5.A.5 that property tax revenues appear to go flat for a brief period in what otherwise should have been a growth period for property taxes. During this this time, the County was growing rapidly, with average double-digit increases in assessed value and population during the first few years of the millennium. There also was an increase in the mill levy from 2001 to 2002. If we control for these factors, it appears that property taxes would have declined slightly – by around 4%.

It is worth noting that growth in the County's property tax revenues is constrained by the Gallagher amendment. This law says that the amount of property taxes collected, statewide, always has to be lower than the amount of non-residential property taxes collected (residential has to be about 45% of total versus 55% for non-residential). Gallagher also fixed the assessment rate for non-residential property, which then places an effective limit on residential rates (since the amount of taxes that can be collected is limited).

Exhibit 5.A.5 – Quarterly property tax revenues (millions of dollars)



Property taxes fell sharply almost three years after the onset of the Great Recession. This is because the way in which property taxes are administered causes a two-year lag between changes in market prices and County tax revenue.

With respect to the vulnerability of the property tax base in the future, one consideration is the concentration of the property tax base in particular industries or with certain taxpayers. Douglas County does not appear to have a big risk here. The largest part of the tax base is the Park Meadows Mall, at 1.31% of total assessed value in the County, followed by HCA HealthOne LLC at 1.25% and Intermountain Rural Electric Association at 1.14%. Together, the top ten largest taxpayers comprise 7.40% of assessed value. Further, they do not appear to be concentrated in a particular industry that would be vulnerable to a downturn. For instance, a number of these taxpayers are utility companies or in health care. Hence, Douglas County does not appear to be at risk from a shift in the economy negatively impacting a specific and critical piece of its property tax base.

Charges for Services

Charges for services raised $22.3 million in 2017 or just under 9% of the total revenues of the six funds we are examining in this report. Charges for service are about 17% the size of the property tax in total revenue and a little less than half of the size of sales tax revenues. The major types of charges for services are:

- **Clerk and Recorder Fees:** Including but not limited to receptions, title fees, and motor vehicle sales tax vendor fees.
- **Treasurer Fees:** Property tax collection fees.
- **Zoning/Development Fees:** Including but not limited to development review fees, rezoning fees, plat fees, and site plans.
- **Public Safety Fees:** Includes alarm registration fees, incorporated area patrol fees (e.g., Castle Pines/Larkspur), prisoner boarding charges, dispatch services, and extra duty services.

Each of these different charges exhibit different responses to an economic downturn. For example, during the two-year period from 2007 to 2009 (the heart of the Great Recession) the following changes in revenue occurred:

Change in User Fees from 2007 to 2009	Percent Change	Dollar Change
Clerk and Recorder Fees	+1.79%	+$98,000
Treasurer Fees	+15.56%	+$600,000
Zoning/Development Fees	-62.12%	-$1,765,000
Public Safety Fees	+8.85%	+$287,000
Total	**-5.24%**	**-$798,000**

Hence, all fees actually experienced growth during 2007 to 2009, except zoning/development, which experienced a massive decline. Many of the services offered by the County are not something people will readily choose to forgo – for example, public safety services. The zoning and development declines are not surprising given the collapse of the housing market that was part of the Great Recession. Also, it is worth noting that although Treasurer fees did not decline during the Great Recession, they did decline a few years later – relating to the decline in property tax revenues that the County experienced during this time.

This all means that charges for service, as a whole, are a relatively stable revenue source for the County. The largest annual decline was 4.23% (from 2007 to 2008). From 2007 to 2009 (the Great Recession) the decline was 5.24%. This is less than the sales tax and less than the decline eventually experienced by the property tax when the effects of the Great Recession caught up with it. Across the six funds we analyzed the relative share of charges for services to total revenue has remained much the same from today versus right before the start of the Great Recession. However, charges for service are much more important to some funds than others, as we will see later in this report.

Permits

The County issues different kinds of permits. Together, they are the smallest of the revenue categories we analyzed. For the purposes of this analysis, we will divide them into three types of permits:

- General permits includes cable TV franchise fees, marriage licenses, driver's licenses, right-of-way-use permits, and more. It comprises 65% of all permit revenue, as of 2016.
- Building permits. Building permits comprise 24% of all permit revenue.
- Roofing permits. Roofing permits comprise 11% of all permit revenue.

Permit revenue proved to be very vulnerable to the Great Recession. During the two-year period from 2007 to 2009, revenue declined 47%. Given the housing market slump that occurred during this time, it is not surprising that building permit revenue dropped 68%. General permit revenue also declined precipitously: 40%. Roofing permit revenue actually increased; however, roofing permits were such a small revenue source that the impact on total permit revenues was negligible. The increase in roofing permit revenue is largely attributable to hailstorms.

Permit revenue also proved vulnerable to the 2001 Recession, dropping by 31%. Again, building permit revenues fell more than general permit revenue.

Intergovernmental / Other Revenues

Finally, the County receives other revenues besides those mentioned above. The largest of these is intergovernmental, which comprises a range of grants and state-shared revenues. Some of the more important examples include highway user fees in the Road and Bridge Fund and state and federal grant programs in the Human Services Fund. These revenues exhibit some fairly divergent behavior in each fund, as we will see in the next section. Hence, there is not much of use that can be said about them as a group. Douglas County's reliance on intergovernmental revenue is about the same in 2017 as in 2007.

Other revenues (besides intergovernmental) are very small – they only comprise 2% of County revenues. Douglas County has actually seen a marked decrease in reliance on other revenues since 2007, when they were about 9% of total revenue. The main reason for the decline is a drop in earnings on deposits as investment returns declined sharply during the Great Recession.

Major Revenue Source Analysis Checkpoints

- ✓ **Sales Tax:** The County's sales taxes are vulnerable to downturns. Considering tax revenue on a per capita basis reveals that sales taxes were much more negatively impacted by the 2001 Recession than the nominal historical data implies.
- ✓ **Property Taxes:** Property taxes experienced an 11% decline from 2010 to 2012. Hence, this "echo" of the Great Recession appeared in County revenues almost three years after the onset of the Great Recession.
- ✓ **Charges for service:** Charges for service proved resistant to the Great Recession, except for zoning/development fees.
- ✓ **Permits:** Permits proved very vulnerable to the Great Recession, declining 47%.
- ✓ **Intergovernmental / Other:** Intergovernmental revenue is an important part of the County's revenue portfolio. The intergovernmental revenues received by each fund behave differently.

Subsection B - Historical Analysis of County Revenues by Fund

To analyze the risk that an economic downturn poses to the County we should consider the County's historical experience with past downturns. We will examine the following funds: General, Road and Bridge, Human Services, Law Enforcement Authority, Road Sales and Use Tax, and Justice Center Sales and Use Tax. We will use what we learned about the County's individual revenue sources earlier in this report to help us better understand the historical experiences of each fund. Note that all figures in this section are based on per capita revenue numbers (e.g., revenues adjusted for population). This provides a better sense of how revenues behaved during the 2001 recession, which was a period of high population growth in the County. All figures are also based on 12-month moving averages, which remove seasonal variation from the numbers.

General Fund

Exhibit 5.B.1 shows per capita revenues in the General Fund since 2001. We use per capita revenues to factor out the rapid population growth the County experienced at the turn of the century. We see that the County general fund experienced three revenue downturns from the two recessions.[36] Two of the downturns happened concurrently with their associated recessions. The third was when the housing bubble bust caught up with the County's property tax revenues (an "echo" of the Great Recession). The 2001 Recession was the single worst period, where the County experienced a revenue decline of 15.3% over the 17-month period circled on the chart. During the Great Recession itself, the County experienced a 7% revenue decline over the 18-month period circled on the chart. As we saw earlier, revenues like permits, sales taxes, and, to a lesser extent, charges for services all experienced a decline during the Great Recession. When the Great Recession echoed in property taxes, starting in 2011, the County experienced an 11% revenue decline over 18 months. In essence, the effect of the Great Recession was split into two parts – one part impacted property taxes and another impacted all General Fund revenues.

[36] We also can see a small dip in 2017. This was due to a temporary property tax credit of 0.5 mills provided by the County. This dip was not due to a recession.

Exhibit 5.B.1 – Per capita monthly revenue in the General Fund

To better understand the implication of these historical experiences for the County's risk today, we must consider how the current composition of the General Fund's revenue portfolio compares to what it was just before the Great Recession. We saw earlier in this report that some revenues are more volatile than others. The table on the right shows how the composition of the revenue portfolio differed in 2017 versus 2007. We see that property taxes are more important in 2017. Earning on deposits declined in importance the most. Property taxes did not decline much at all during the Great Recession itself, but did decline significantly in the aftermath of the Great Recession. Earnings on deposits proved to be a very vulnerable revenue during the Great Recession, going from $6 million to $1.5 million in three years. So, any increase in vulnerability brought on by increased reliance on the property tax is probably balanced out by the much reduced reliance on earnings from deposits.

Revenues Sources as a Percent of Total Revenue in General Fund			
	2017	**2007**	**Difference**
Property Taxes	69.8%	60.3%	**9.5%**
Licenses & Permits	7.2%	6.8%	**0.3%**
Intergovernmental	2.2%	3.8%	**-1.6%**
Charges for Service	18.3%	18.9%	**-0.6%**
Fines and Forfeits	0.1%	0.3%	**-0.1%**
Earnings on Deposits	0.7%	7.0%	**-6.3%**
Misc.	1.6%	2.6%	**-1.0%**
Other financing sources	0.2%	0.3%	**-0.2%**

Road and Bridge

This fund accounts for construction and maintenance of County roads and bridges. It is funded by property taxes and highway user fees (revenue shared with the County by the State of Colorado). Property taxes are about 2/3 of the fund's revenue, with the bulk of the rest made up by highway user fees. We can see in Exhibit 5.B.2 that the Road and Bridge fund has two revenue dips associated with the Great Recession, much like the General Fund (though hardly any discernable downturn associated with the 2001 Recession). Intergovernmental revenue experienced double-digit declines for two years in a row during the Great Recession, which contributed to a protracted downturn, as we can see on the graph. The subsequent property tax decline lasted only about 12 months and resulted in a downturn of about 8.4%

Exhibit 5.B.2 – Per capita monthly revenues in the Road and Bridge Fund

The following table illustrates how the current composition of the Road and Bridge Fund's revenue portfolio compares to what it was just before the Great Recession. The table shows how the composition of the revenue portfolio differed in 2017 versus 2007. We see that property taxes are more important in 2017.

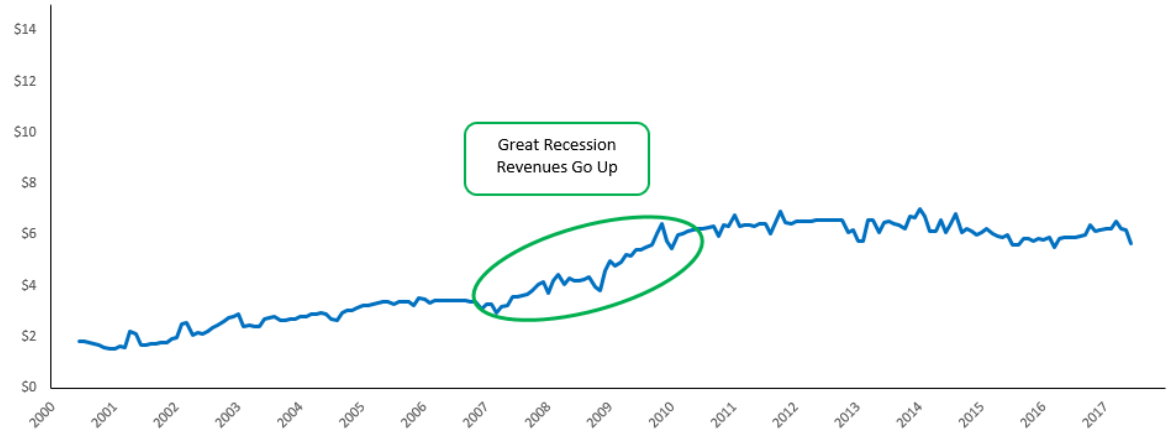
We see the biggest decline was in intergovernmental revenue. Intergovernmental revenue declined significantly during the Great Recession and never recovered. For local governments generally, intergovernmental revenues are often notoriously undependable. Hence, the County may be subject to less risk by relying more on local property taxes.

Revenues Sources as a Percent of Total Revenue in Road and Bridge Fund			
	2017	**2007**	**Difference**
Property Taxes	77.3%	65.3%	**12.1%**
Licenses & Permits	1.8%	1.6%	**0.2%**
Intergovernmental	19.8%	30.6%	**-10.8%**
Charges for Service	0.0%	0.6%	**-0.6%**
Earnings on Deposits	0.0%	0.0%	**0.0%**
Misc.	0.2%	1.6%	**-1.4%**
Other financing sources	0.8%	0.2%	**0.6%**

Human Services Fund

This fund accounts for all federal and public aid and assistance programs administered by the County. It is funded by property taxes and intergovernmental agency grants. Almost 90% of this fund's revenues are supplied by intergovernmental revenues, with almost all the rest from property taxes. We can see in Exhibit 5.B.3 that this fund's revenues, as measured in per capita terms, actually went up during the Great Recession and it did not experience the same property tax aftershock that the General or Road and Bridge Funds did. As the economy pulled back during the Great Recession, the need for assistance to people in the community went up. Therefore, the Human Services Fund received more money.

Exhibit 5.B.3 – Per capita monthly revenues in the Human Services Fund



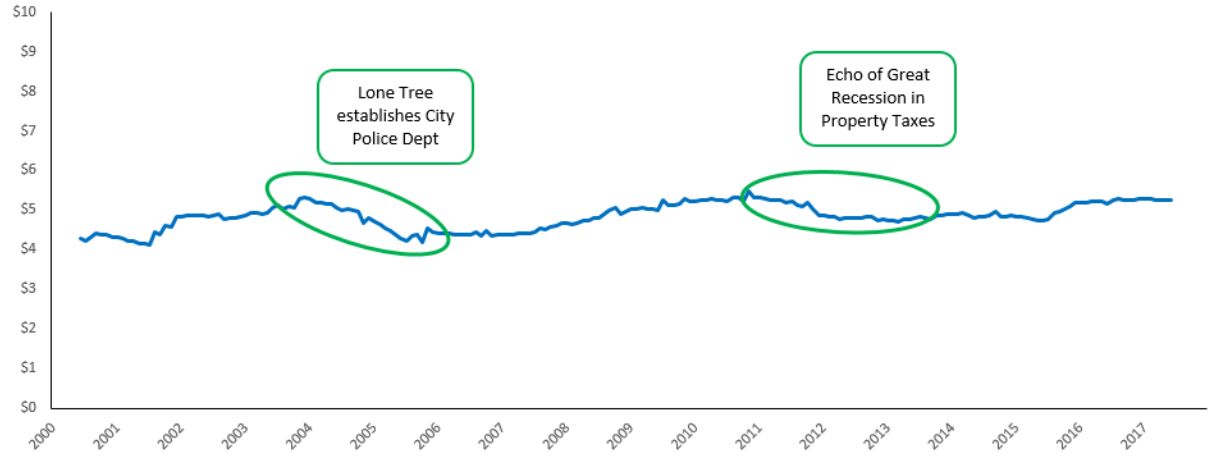
Comparing the composition of the Human Services Fund revenue portfolio before the Great Recession to today, we don't see much change.

Law Enforcement Authority Fund

This fund is used to account for designated property taxes levied by the Douglas County Law Enforcement Authority (a special taxing district, which excludes properties located within incorporated municipalities) and other special revenues that are restricted for the use of law enforcement services provided by the Sheriff's Office in the unincorporated areas located within the County. Property taxes make up about 80% of this fund's revenue, with most of the rest composed of charges for service. We saw earlier in this report that charges for service, and those associated with public safety in particular, were resistant to the economic downturn. Hence, there is no drop in revenue associated with the Great Recession. There was however, an almost 10% drop in property tax after the Great Recession.

Exhibit 5.B.4 also shows another per capita revenue dip around 2004 to 2005. This is because the County had been providing patrol services for the City of Lone Tree up to the year 2004. Lone Tree then formed its own police department, so the County's services were no longer required and revenues declined accordingly. Because the County would have forewarning of such a change in its revenue structure, it would not need reserves to compensate – instead it would adjust expenditures to accommodate the reduction in services that the County is required to provide.

Exhibit 5.B.4 – Per capita monthly revenues in the Law Enforcement Authority Fund



When we compare the Law Enforcement Authority Fund's revenues in 2017 versus 2007, we see that the biggest change is a decreased reliance on property taxes and an increased reliance on charges for service. This reduces risk because charges for services, especially those associated with public safety services, have proven less vulnerable to economic downturns than the property tax as discussed in the section on charges for section.

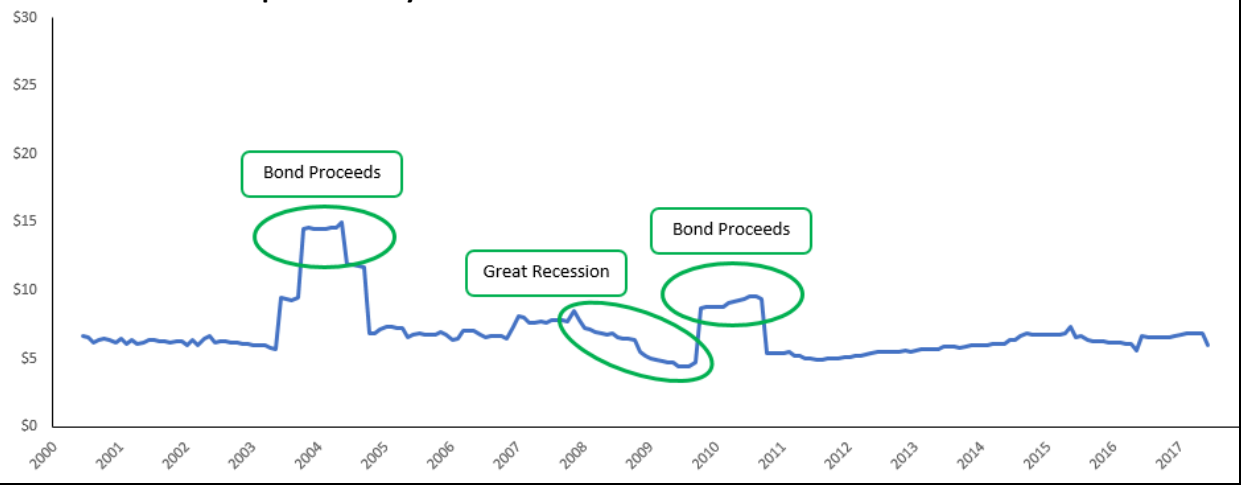
Revenues Sources as a Percent of Total Revenue in Law Enforcement Authority Fund			
	2017	**2007**	**Difference**
Property Taxes	79.1%	88.8%	**-9.8%**
Intergovernmental	3.8%	2.5%	**1.3%**
Charges for Service	12.5%	0.3%	**12.2%**
Fines and Forfeits	3.2%	5.5%	**-2.3%**
Earnings on Deposits	0.9%	2.3%	**-1.4%**
Misc.	0.4%	0.2%	**0.3%**
Other financing sources	0.1%	0.4%	**-0.2%**

Road Sales and Use Tax Fund

This fund accounts for revenues derived from the 0.4% sales and use tax approved by voters, which makes up almost 100% of the fund's revenues. Monies are designated for the improvement and maintenance of County roads and bridges. We see a downturn associated with the Great Recession, which is not surprising given the fund's reliance on sales tax: revenues declined by almost 20%.

We see some sharp increases in per capita revenue at a few points in Exhibit 5.B.5. These represent bond proceeds. To ensure that these bond proceeds did not obscure a further decline in sales tax revenue, we factored out the bond revenues. We found that the sales tax was starting to stabilize and turn back up at the same time that the bond revenues were received. This means that the circled downturn on the graph is the full downturn in revenues that the fund experienced.

Exhibit 5.B.5 – Per capita monthly revenues in the Road Sales and Use Tax Fund



Comparing the Road Sales and Use Tax Fund's revenue portfolio in 2017 versus 2007, we see some significant changes. Reliance on sales taxes is up dramatically and all other sources are now almost inconsequential. Back in 2007, these other sources were primarily contributions from municipal governments and developers to assist in the construction of new roads. As new construction declined with the recession, these revenues declined as well. Although sales tax is vulnerable to downturns, these other sources were also clearly vulnerable to downturns and have not regained their former stature. Hence, the County's vulnerability to future downturns is probably no worse, relying just on local sales taxes.

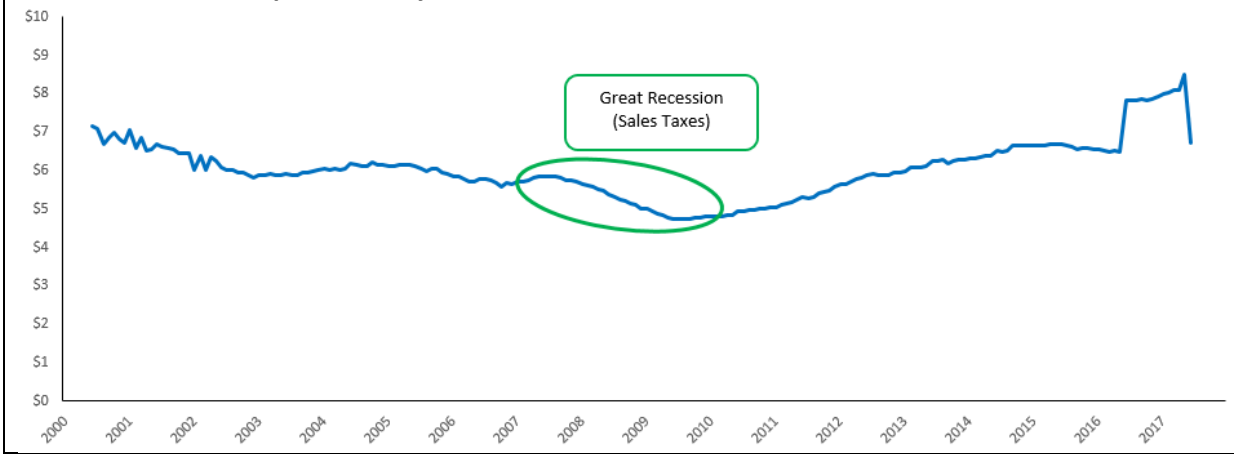
Revenues Sources as a Percent of Total Revenue inroad Sales and Use Tax Fund			
	2017	**2007**	**Difference**
Sales and Use Tax	97.8%	68.8%	**29.0%**
Intergovernmental	1.0%	7.1%	**-6.1%**
Earnings on Deposits	1.2%	8.6%	**-7.5%**
Misc.	0.0%	15.5%	**-15.5%**

Justice Center Sales and Use Tax Fund

This fund is used to account for revenues derived from the 0.43% sales and use tax approved by voters. This tax provides over 90% of the fund revenues. Monies are designated for the construction, operation and maintenance of the County's Robert Christensen Justice Center and related facilities. We can see in Exhibit 5.B.6 that this fund's revenues declined dramatically during the Great Recession and the 2001 Recession. During the Great Recession, per capita revenues declined almost 18% over a 24-month period.[37]

[37] The reader will notice a sharp increase in 2016. This is a donation received to build an emergency vehicle operations course.

Exhibit 5.B.6 – Per capita monthly revenues in the Justice Center Fund



When we compare revenues in in the Justice Center in 2017 versus 2007, we find that little has changed. Sales taxes predominated then, as they do today.

Historical Analysis of County Revenues by Fund Checkpoints

- ✓ **General Fund:** The fund experienced three separate revenue downturns from 2000 to 2017. Two were associated with the 2001 and 2007 recessions. The third was due property tax revenue declines in the aftermath of the Great Recession.
- ✓ **Road & Bridge Fund:** This fund also experienced a two-part downturn associated with the Great Recession. The first part was due to a decline in state-shared revenue (highway user fees) and the second was due to decline in property taxes.
- ✓ **Human Services Fund:** The Human Services Fund's revenue actually increased during the Great Recession due to increased resources provided to a growing demand for services caused by the downturn.
- ✓ **Law Enforcement Authority Fund:** Because this fund relies mostly on property taxes, it experienced a revenue downturn a couple of years after the Great Recession.
- ✓ **Road Sales & Use Tax Fund:** Because the Road Sales & Use Tax Fund relies heavily on sales taxes, its revenue declined significantly during the Great Recession. However, the Fund also received some bond revenue proceeds.
- ✓ **Justice Center Fund:** Because the Justice Center Fund relies heavily on sales taxes, its revenue declined significantly during the Great Recession.

Subsection C - Risk Analysis

In this section, we will analyze the amount of reserves each fund would need to guard against the risk of an economic downturn. To estimate risk, we must consider both the potential length and depth of an economic downturn. The analysis in the preceding pages provided us with data to help estimate both. We can use data from the Great Recession and 2001 Recession to estimate the how much revenues might decline in any given month or quarter during a recessionary period. For this analysis, we will use quarters. We will define a "quarter" as any consecutive three-month period during a revenue downturn (we do not limit ourselves to calendar year quarters). This gives us a sample of plausible changes in revenue during a hypothetical future recession. For example, we found that the average quarter-to-quarter decline in

General Fund revenue was 0.4% during the recessionary periods included in our data. We also found that changes were roughly normally distributed around this average, meaning they took the approximate shape of the "bell curve" that we introduced at the beginning of this report. We then were able to simulate potential revenue declines over multiple subsequent quarters. For example, we found that for a hypothetical 4-quarter recession in the General Fund there was only a 1% chance of a decline in revenue of 11.22% or more and a 10% chance of a decline of 8.02% or more. This gave us the probable depth of a recession for every quarter in a hypothetical future recession.

The next step was to define the likelihood of different potential lengths of a future recession. To do so, we gathered data on the lengths of all recessions that occurred in the U.S. since 1950. However, we also found that Douglas County's revenue downturns often lasted longer than both the 2001 Recession and Great Recession, by about three to four months. Hence, we assumed that Douglas County's revenues would also experience a one-quarter longer downturn in future recessions. With this in mind, we found the average length of a recession was four and 1/3 quarters or 13 months. However, the lengths of the recessions were not normally distributed around this average. The shape was closer to the "asymmetrical" distribution we saw earlier in this report, where shorter recessions were more likely and very long recessions unlikely. This gave use the probable length of a hypothetical future recession.

By combining length and depth we can get the amount of reserves that Douglas County would need to replace lost revenue from a hypothetical future recession. The following sections show our findings for each of the six funds that are in the scope of the analysis. Before we begin, let's review a few points of interest about how we present our findings:

- Our analysis does not highlight specific hypothetical recession lengths or depths because all plausible combinations of lengths and depth are combined in our findings. For example, a recession that would require a 10% fund balance to replace all revenue could be a product of shorter but deeper recession or a longer but shallower recession. So, if our analysis were to say that 10% reserve would give the County a 90% level of confidence that it could replace revenues lost due to recession, that 10% reflects many potential combinations of lengths and depths.
- It is unlikely that the County would replace every last dollar of lost revenue with reserves during an actual recession. Rather, it would cut some spending. Hence, GFOA's recommendations can be adjusted downward according to how much the County feels it could cut from its budget. We will address this possibility in more detail later in this report.
- For each fund, we will point out two potential reserve levels that bound where the County would get the most "bang for its buck." The upper bound is the point at which it becomes increasingly costly for the County to "buy" more confidence that it can withstand a recession. Note that these "suggested" ranges are only "suggested" in the sense that our statistical analysis suggests that this is the range in which the County gets the best value for a reserve. The suggestions do not constitute a normative judgment from GFOA.
- The County can also choose a point outside of these bounds if it feels a different point would better suit its willingness to take on risk. We will point out factors that might justify picking higher or lower levels of reserves. We will also see that approaching very high levels of confidence, like 95% or 99% quickly becomes very expensive.

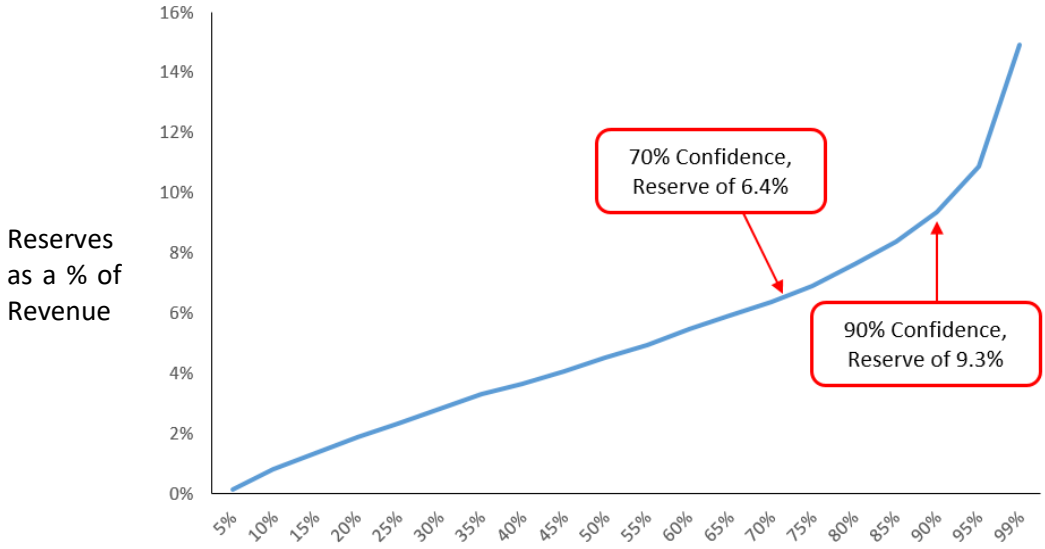
General Fund

The results of the General Fund risk analysis are shown in Exhibit 5.C.1. The vertical axis shows various possible reserve levels, expressed as a percent of revenues. The horizontal axis shows how confident the County would be that a given level of reserves could replace 100% of the County's revenue decline during a hypothetical future recession. We can see that the following range of reserves is suggested:

- **Low end:** A reserve equal to 6.4% of revenues would give the County 70% confidence in being able to replace all lost revenues during a future recession.
- **High end:** A reserve equal to 9.3% of revenues would give the County 90% confidence in being able to replace all lost revenues during a future recession.

We saw in the last section that the General Fund is now somewhat less reliant on volatile revenue sources than in the past, so this could justify picking a slightly lower reserve number than the County might otherwise, given its risk tolerances. We also know that the General Fund is highly dependent on property taxes and that the way in which property tax is administered gives the County forewarning between when the market declines and when County revenues decline. This might also justify a lower reserve target because the County would have more time to make orderly reductions to its expenditures.

Exhibit 5.C.1 – General Fund Risk Analysis



Confidence	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	99%
Reserve	4.5%	4.9%	5.4%	5.9%	6.4%	6.9%	7.6%	8.4%	9.3%	10.9%	14.9%

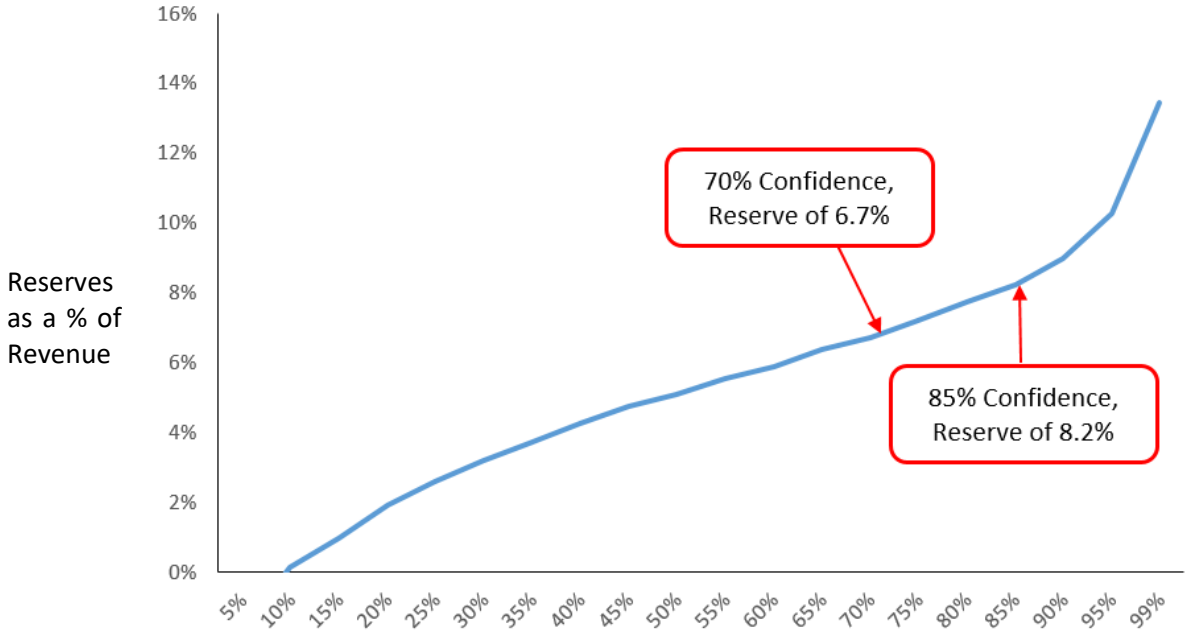
Road and Bridge

The results of the Road and Bridge Fund analysis is shown in Exhibit 5.C.2. We can see that the following range of reserves is suggested:

- **Low end:** A reserve equal to 6.7% of revenues would give the County 70% confidence in being able to replace all lost revenues during a future recession.
- **High end:** A reserve equal to 8.2% of revenues would give the County 85% confidence in being able to replace all lost revenues during a future recession.

We saw in the last section that the Road and Bridge Fund receives less intergovernmental revenue today than in 2007. Intergovernmental revenues proved more vulnerable to the Great Recession, even accounting for the aftershock that impacted property taxes. Because the Road and Bridge Fund is now somewhat less reliant on intergovernmental revenue, this might justify picking a slightly lower reserve number than the County might otherwise, given its risk tolerances. For example, if we were to look at just the downturn in property taxes that occurred after the Great Recession, a reserve of 6.7% would be sufficient for 70% confidence. Of course, that excludes any impact on intergovernmental revenue, but does illustrate that property taxes are the less vulnerable revenue. We also know that the way in which property tax is administered gives the County forewarning between when the market declines and when County revenues decline. This might also justify a lower reserve target because the County would have more time to make orderly reductions to its expenditures.

Exhibit 5.C.2 – Road and Bridge Fund Risk Analysis



Confidence	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	99%
Reserve	5.1%	5.5%	5.9%	6.4%	6.7%	7.2%	7.7%	8.2%	9.0%	10.2%	13.4%

Human Services Fund

We saw earlier that the Human Services Fund has not experienced a drop in revenues during a downturn. Therefore, it is not possible to estimate a reserve level as we have done for the other funds. Hence, we need to consider the potential condition of the fund going forward and develop a strategy based on that.

We do know that, according to County staff, the State of Colorado is considering reducing the funding for human services given to county governments. It would then be up to Douglas County to either continue existing service levels with its own revenues or to reduce services to match the lesser revenues from the State. This represents a budgetary policy decision that the County will need to make. The State revenue

reduction is not a risk that reserves can address because the costs for human services are on-going, so would need to be paid for by on-going revenues.

Hence, the County does not need a special reserve for the Human Services Fund, but will need to decide if it will continue existing service levels with its own revenues or reduce services.

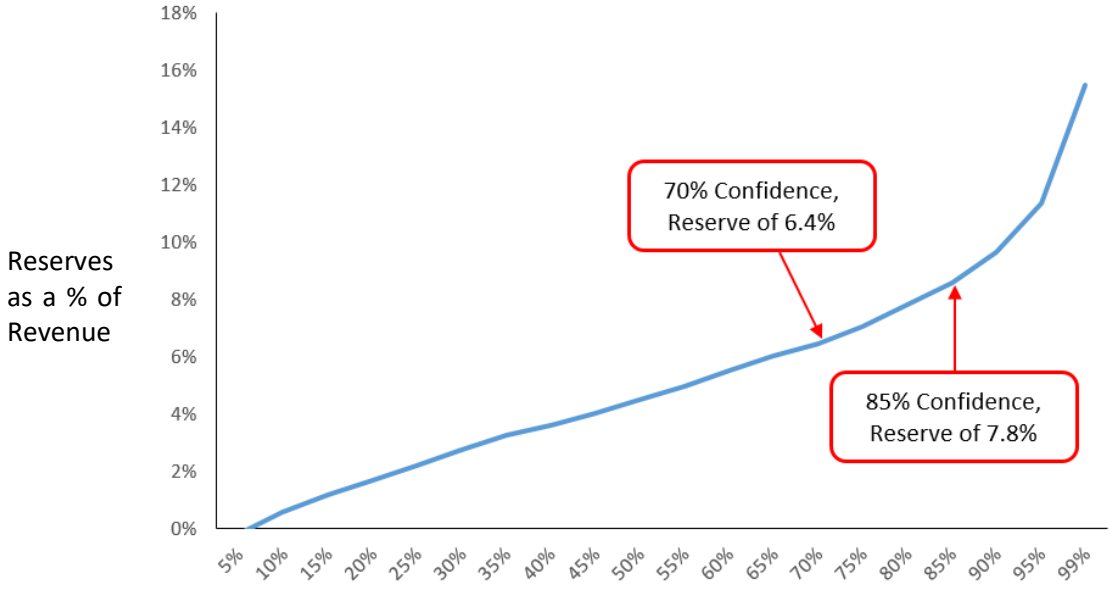
Law Enforcement Authority Fund

The results of the Law Enforcement Authority Fund analysis is shown in Exhibit 5.C.3. We can see that the following range of reserves is suggested:

- **Low end:** A reserve equal to 6.4% of revenues would give the County 70% confidence in being able to replace all lost revenues during a future recession.
- **High end:** A reserve equal to 7.8% of revenues would give the County 85% confidence in being able to replace all lost revenues during a future recession.

We saw earlier that the Law Enforcement Authority Fund is now more reliant on charges for services. Charges for services, especially those for public safety, have proven more resistant to downturns. This might justify a lower reserve target than the County might otherwise select, given its willingness to take on risk. We also know that this fund is highly dependent on property taxes and that the way in which property tax is administered gives the County forewarning between when the market declines and when County revenues decline. This might also justify a lower reserve target because the County would have more time to make orderly reductions to its expenditures.

Exhibit 5.C.3 – Law Enforcement Authority Fund Risk Analysis



Confidence	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	99%
Reserve	4.5%	4.9%	5.5%	6.0%	6.4%	7.0%	7.8%	8.6%	9.6%	11.3%	15.4%

Road Sales and Use Tax Fund

The results of the Road Sales and Use Tax Fund analysis is shown in Exhibit 5.C.4. Reserves in this fund are used to "cash finance" capital projects. We can see that the following range of reserves is suggested:

- **Low end:** A reserve equal to 9.1% of revenues would give the County 70% confidence in being able to replace all lost revenues during a future recession.
- **High end:** A reserve equal to 10.7% of revenues would give the County 85% confidence in being able to replace all lost revenues during a future recession.

These reserve amounts are noticeably higher than the other funds we have encountered so far. This is because this fund is almost totally reliant on sales taxes which is a volatile revenue. Earlier, we saw that this fund used to receive a number of other revenues, which it does not today. These revenues proved vulnerable to the Great Recession. Therefore, we removed them from the analysis, so the figures above are appropriate for a fund that is more heavily dependent on sales taxes than before.[38]

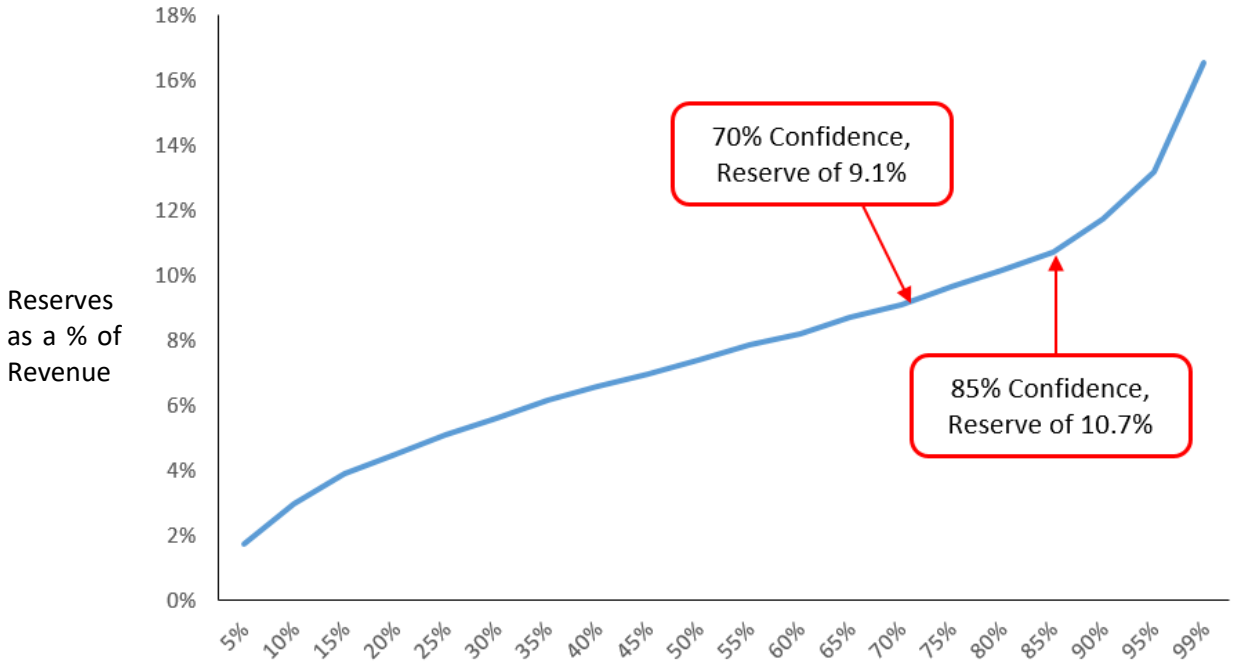
This fund accounts for road projects and these projects are funded before they begin. This means that a sales tax slump should not impact projects that are underway. A sales tax slump would, however, require the County to defer new projects. Deferring new projects has two potential disadvantages:

1. In some cases, during an economic downturn the cost of labor and materials would be lower than during an economic expansion. Hence, the County could get more "bang for its buck" by bidding road projects during a downturn.
2. Deferring projects could result in premature deterioration of County assets. As assets deteriorate further they cost proportionately more to rehabilitate. Hence, the County's total costs over the long-term would be greater. To the extent reserves can help the County maintain a consistent and efficient maintenance strategy, the County's total long-term costs would be reduced.

So, the County will need to decide if having a larger reserve in this fund would be worth the cost, given the opportunities it would provide to continue funding projects during economic downturns. It should be noted that part of the sales tax that supports this fund will sunset at the end of 2030. The sales tax rate is currently 0.4% and will be eliminated once the tax sunsets. Hence, the County would need to adjust its budgeting practices accordingly.

[38] If we were to leave these other revenues in the data set, the reserve requirements would be even higher because these other sources did prove so vulnerable.

Exhibit 5.C.4 – Road Sales and Use Fund Risk Analysis



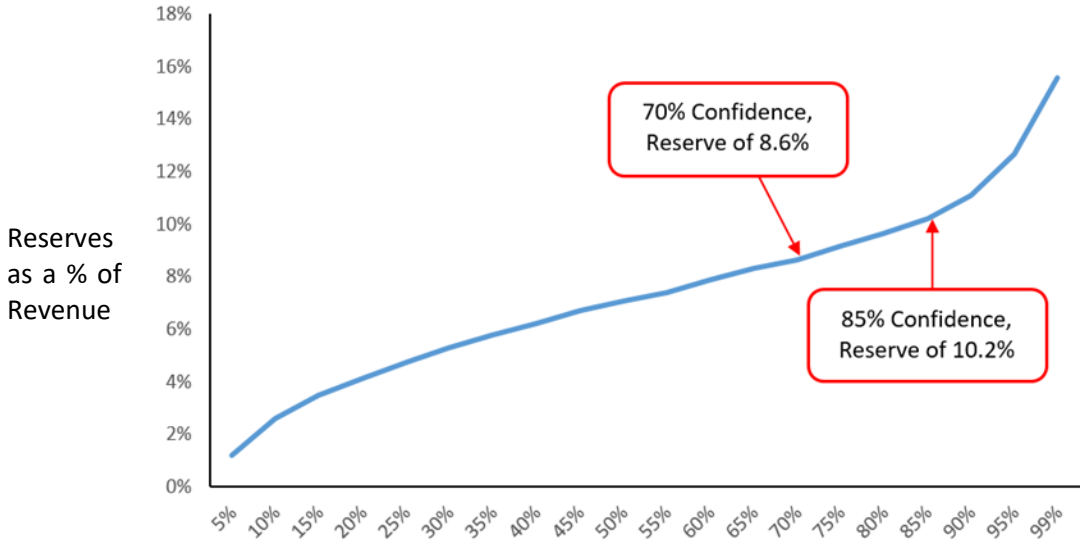
Confidence	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	99%
Reserve	7.4%	7.8%	8.2%	8.7%	9.1%	9.6%	10.1%	10.7%	11.7%	13.2%	16.5%

Justice Center Fund

The results of the Justice Center Fund analysis is shown in Exhibit 5.C.5. We can see that the following range of reserves is suggested:

- **Low end:** A reserve equal to 8.6% of revenues would give the County 70% confidence in being able to replace all lost revenues during a future recession.
- **High end:** A reserve equal to 10.2% of revenues would give the County 85% confidence in being able to replace all lost revenues during a future recession.

Exhibit 5.C.5 – Justice Center Fund Risk Analysis



Confidence	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	99%
Reserves	7.1%	7.4%	7.9%	8.3%	8.6%	9.2%	9.6%	10.2%	11.1%	12.7%	15.5%

We see that the suggested reserve levels are similar to those for the Road Sales and Use Tax Fund, which is not too surprising given that both are highly dependent on sales and use tax. The Justice Center Fund has a slightly more diversified revenue base, which leads to slightly lower suggested reserve levels. It should be noted that part of the sales tax that supports this fund will sunset at the end of 2020. The sales tax rate is 0.43% and it will decrease by 0.13 percentage points, to reach 0.30%. Hence, the County would need to adjust its budgeting practices accordingly.

Section 6 - Secondary Risks

This section of the report addresses other risk factors that have less weighty implications for the County's reserve strategy than those described in the previous sections. These include leverage;

Subsection A - Leverage

A highly leveraged organization has less flexibility. Examples of leverage include long-term debt and pension obligations. Reserves are a critical source of financial flexibility, so high leverage may call for higher reserves. This section will address each of the aforementioned sources of leverage.

Any form of leverage could reduce the County's financial flexibility, thus increasing the need for reserves to provide some offsetting flexibility. GFOA examined two forms of leverage: outstanding debt and pension liabilities.

Debt

The County's debt at end of fiscal year 2017 was $16,865,000. The County's total long-term liabilities amount to $25,230,826. Overall long-term debt obligations in the County are primarily limited to revenue bonds from Open Space and Parks Sales and Use Tax Revenue bonds issued by the County. Road Improvement Sales and use Tax Revenue Bonds are also issued by the County for road improvement.

All of the County's bonded debt comes from revenue bonds, and much of the County's debt is dedicated to road improvements and open space, secured as special revenue obligations from voter approved sales and use tax. At the end of 2017, the County was issued a credit rating of AA+ by Fitch ratings, roughly the equivalent of an Aa1 Moody's rating.[39] This provides a solid foundation for the County.

The table in Exhibit 6.A.1 uses figures from the County's FY 2016 CAFR to compare Douglas County's debt to similarly sized counties at different credit ratings. We use 2016 data because 2016 data was available from other counties in order to make comparisons. The table shows median indebtedness, by credit rating as reported in Moody's Investors Services. Douglas County has very little debt in general, and almost all of its debt is limited obligation debt payable solely from the special assignments levied against assessable land in the County. This puts the County in a unique position compared to its peers.

Exhibit 6.A.1 - Comparison of Douglas County's Financial Indicators to Counties with Between 250,000 and 1,000,000 in Population by Credit Rating as of 2016

	Douglas County	Aaa	Aa	A	Baa	Ba
Total Bonded Debt as % of Full Value	*0.05%*	0.7%	0.4%	0.9%	N/A	N/A
Total Bonded Debt (in thousands)	*$29,483*	$310,283	$136,375	$258,948	N/A	N/A

Source: "2015 US Local Government Medians – Tax Base Growth Reinforces Sector Stability as Pension Troubles Remain," Moody's Investors Service (March 30, 2017) and Douglas County FY 2016 CAFR.

[39] In 2013, the County received a AAA rating from Standard and Poors.

Exhibit 6.A.2 includes a group of Colorado counties that are comparable to Douglas County based on a combination of factors, including geography, population, General Fund revenue portfolio, and size. The exhibit provides summary statistics from each of the counties' FY 2016 CAFR and includes commonly used measures of indebtedness.

The first measure shows the burden placed on citizens by municipal indebtedness inclusive of direct debt, or total bonded debt in this case. The second measure compares total bonded debt as a percent of the full market value of properties in the jurisdiction.

Exhibit 6.A.2 - Comparison of Douglas County's Indebtedness with Other Counties

	Douglas County	Boulder County	Jefferson County	Larimer County
Population	*328,632*	322,226	571,837	339,993
Measures of Total Direct Debt				
Direct Debt per Capita	*$89.72*	$1,515.91	$264.10	$154.16
Direct Debt Burden (Total Bonded Debt as % Full Value)	*0.05%*	0.81%	0.20 %	0.13%

Source: FY 2016 CAFR for each represented county.

Douglas County has a lower overall debt burden than Boulder, Jefferson, and Larimer Counties, as well as a significantly lower amount of overall debt per capita than all compared counties. Neither Douglas County nor its three peer counties currently have any outstanding general obligation debt. While comparisons between counties are fundamentally difficult to draw, Douglas County can feel confident that it is in a similar—if not more advantageous—position when it comes to overall debt burden.

Pension Liabilities

The County participates in the ICMA-RC retirement association, which provides retirement benefits through a defined contribution plan to the County. Because the County uses a defined contribution plan, which relies solely on the amounts contributed to the plan and investment earnings, there are no unfunded past service liabilities for the County.

Since the County currently has no liability to its retirement plan, GFOA does not consider pensions or retirement funding to be a significant risk to the County's long-term fiscal stability.

Subsection B - Risk Management and Expenditure Spikes

The County chooses to self-insure for a variety of potential risks, including liability and property insurance, unemployment benefits, short term disability benefits, and medical/dental/vision. Financial data reveal that no claims filed in any of these categories from the last three years have created a significant outstanding liability at year-end.

The County's 2016 CAFR notes several unresolved legal claims and lawsuits involving the County. It has been determined that such claims could be covered in large part by insurance.

Subsection C - Liquidity

Timing discrepancies between payables and receivables can lead to liquidity issues for local governments. However, Douglas County does not experience cash flow issues as a result of timing differences between receivables and payables. The County also receives the vast majority of its property tax revenues in Quarters 1 and 2, providing an extra cushion earlier in the year. Thus, a special reserve for working capital appears unnecessary.

Subsection D - Growth

Population has increased approximately 17% between 2010 and 2017, with current population at about 346,000 people in the County. Population in the County, as well as the entire state of Colorado, have significantly increased the past 5-10 years. New development has spurred even more growth. The County's demographic summary indicates an 11.6% rise in permit issuances for new housing, as well as a 2.8% increase in new housing unit development. Home sales also increased by 8.2%. The population increases, paired with growth in housing development and permitting, indicates continued expansion for the County. The County should continue to monitor population growth, as larger increases may put a financial strain on the County's existing resources. However, current growth levels do not appear to warrant additional reserves.

Subsection E - Claims on Fund Balance

It is important to gain an understanding of existing claims on the County's fund balance in order to fully see the funds available to the County in case of a major, unforeseen expenditure. The County's FY 2017 CAFR details claims on the County's existing fund balance. As of 2017, the combined fund balance of all six major governmental funds was $239 million, including an increase of $8.3 million (3.6%) from the previous year.

About $5 million, 2.1% of the fund balances, is marked as non-spendable and tied to inventories or pre-paid expenses. $20.3 million is restricted to use of and control by outside agencies, including those agencies involved in highway and street improvements and disaster management. About $84.3 million, 5.2%, is committed to existing projects approved by the Board of County Commissioners. These projects primarily include highway and technology improvement initiatives. The remaining $120 million is assigned to various uses by the County or for use by specific revenue sources. $9.6 million, or 4% of the fund balance, accounts for unassigned fund balance, which can be spent at any time at the discretion of the government.

While there are significant claims on the existing fund balance, most of these are self-imposed by the County. Therefore, at least some of these intended uses could probably be deferred if an emergency situation arose. In the final recommendations section of this report we will see how these claims compare to the amount of reserves the risk analysis suggests is necessary.

Secondary Risk Checkpoints

- ✓ None of the secondary risks appear to pose a major potential problem for the County's finances.
- ✓ The County has a strong debt position, which strengthens its financial flexibility.
- ✓ The County does not have large, outside claims on its existing fund balances. This means that much of the County existing fund balances could be used in an emergency, if needed.

Section 7 - Putting it All Together

In Sections 4, 5, and 6, we examined individual risks such as floods, fires, and revenue losses due to economic downturns. We examined each of these risks individually in order to best understand the nature of each risk, and we found a range of reserves that represents an "efficient" use of reserves for mitigating each individual risk. However, to arrive at a final reserve strategy for the County we need to consider these risks as a group. Considering the risks as a group has important advantages.

The first advantage is that considering risks as a group recognizes the diversity in the risks that the County faces. This diversity actually is an advantage for County finances. Diversity in risks means we should not simply add together each of the reserve ranges for each individual risk. This may overstate the amount of reserves that the County really needs. This is because it is very unlikely that the County will experience a severe snow season, recession, fire, and flood all within a short time period. Exhibit 7.1 below illustrates using fires and floods. Let's imagine that the County wanted to be 90% confident that it could cover the damages from a flood and a fire happening at once. The table shows the amounts needed for each individual risk and then adds them together in a simple summation, arriving at $11 million. The "combined distribution" column creates an entirely new distribution from the data we have for fires and floods together. The 95% confidence level for this new distribution is only $10.4 million or about 6% less than the simple summation. This is recognizing that it is highly unlikely that the County will experience a severe fire and a severe flood at once. Rather, it is more likely that at least one of the events would be much milder. When we consider all of the County's risks in this manner, the reserves required to achieve a given level of confidence will be much less than when each risk is considered in isolation.

Exhibit 7.1 – Reserve Needed to be 95% Confident for Fire and Flood Risk

	Fire	Flood	Simple Summation	Combined Distribution	Difference
90% Confident	$2.0 M	$9.0 M	$11.0 M	$10.4 M	6.2%

The second advantage of considering all of the risks together is that not all of the risks have an equal chance of occurring over a given time period. For example, Douglas County has experienced more severe fires in its recent history than it has severe floods. This suggests that fires are more likely to occur than floods. The County's reserve strategy should reflect this fact. In the bullet points below, we show the relative chance of each of the major risks occurring over a ten-year period. We can use these probabilities to build a probabilistic model of risks over a long-term time horizon. You will note that some of the extreme events are expressed as a fraction. Of course, the County can't experience a portion of an event, but the fraction does impact our simulation of risk. For instance, the County can expect to experience two-thirds of a flood (2/3) in a ten-year period. If we created three different ten-year simulations, we might expect two of them to include a flood. We can create hundreds or even thousands of ten-year simulations, so there will be many that include a flood (or even more than one flood).

- **Revenue loss due to a recession.** Historical data suggests that it is highly likely (over 90% chance) that there will be at least one recessionary year in a ten-year period.[40] The historical data also tells us there is a considerable chance of having more than one recessionary year in a ten-year period.
- **Flood**. The County has experienced one large flood disaster in the last fifteen year period. Hence, over ten-year period we might expect "2/3" of a flood. We also examined the frequency of large flood disasters in other Colorado counties. We controlled for the relative size (in square miles) of Douglas County to the other counties and found that the frequency of a large flood was still about 2/3 of a flood in 10 years.
- **Fire**. The County has experienced 2 large wildfires in the last 15 years. That means about one and one-third (1.33) fires are expected every ten years.
- **Snow**. Snow happens every year, so we assume there is a chance of an extreme snow season every year.
- **Tornados**. Based on the historical frequency of tornados, there is a 90.9% chance of a tornado happening in Douglas County in a given year. However, only 20% of the County's land is urbanized, which is where a tornado would do significant damage. Further, most tornados (55%[41]) are not strong enough to cause significant damage. Taking this into account, we might expect only 0.8 strong tornados in an urbanized area over a ten year period.
- **Truck hazardous material spill**. The County will experience 0.026 spills per year. This is based on federal statistics of the number of rollover accidents per mile driven and an estimate of the number of miles driven in the County (provided by County staff).
- **Methamphetamine / Explosive lab**. The County will experience 0.12 meth or explosive labs that it must pay to clean up per year. The County has never actually had to pay for such a cleanup within the working memory of County staff (a period of about 15 years). This is because the owners of the property as usually amenable to paying for the clean up. Our estimate of 0.12 is meant to acknowledge that there is some chance that the county could have to pay for an event.
- **Abandoned Hazmat**. The County will experience one abandoned hazmat that it must clean up per year. This is based on the County's experience in past years.

To realize the advantages described above, we built a model that considers the County's risks over a ten-year time horizon. As with our other models, the model runs hundreds or even thousands of simulations of possible futures for Douglas County. Here are the key assumptions behind the model:

- **Probability of an undesirable event.** The probability of any undesirable event occurring (e.g., fire, flood, etc.) is consistent with the assumptions described above.
- **Magnitude of an undesirable event.** Should a simulation show that an undesirable event occurs in a given year, the magnitude is generated randomly in a manner identical to the individual risk models we showed earlier in this report.
- **FEMA reimbursement.** The County could recoup some of its losses from extreme events due to reimbursements from FEMA. The model assumes the reimbursements are received two years after the event occurs.[42] The model also assumes that a disaster must cost the County at least $100,000 to receive any reimbursement (anything smaller would not be declared a FEMA-eligible

[40] We took economic data since 1950 and used that to calculate the odds of a recession occurring in a ten year period, including how many of those years would be recession years.

[41] We mean 55% are rated a "zero" on the Fushida scale of tornado intensity.

[42] Our research shows that FEMA reimbursements are completed 18 months after the disaster occurs, on average. So, this is a conservative assumption.

disaster). We also assume the County will be reimbursed at the customary rate of 75% of incurred costs.

- **The County cuts spending in response to an unexpected decline in revenue or increase in costs.**[43] The County will not use reserves to absorb an unexpected revenue decline or cost increase – rather it will adjust its spending to absorb smaller changes within its existing annual budget. We assume the County will adjust its budget by a maximum of 5%. After that, reserves are used. This assumption is based on the County's prior experience with cutting its budget in response to unexpected cost increases and/or revenue losses.
- **The County has a "red line" of reserves it does not want to go below.** All of the analysis assumes the County will want to stay above at least some given number of dollars in its reserve. The amounts required for working capital under taxpayer biller of rights (TABOR) legislation is considered the "red line" and is equal to about 10% of the budget.
- **Distribution of extreme event costs between funds.** The cost to respond to an extreme event is divided between the General Fund, Road and Bridge Fund, and Law Enforcement Authority Fund in an amount proportionate to their annual budget.

We combined all of the information described above to create a ten-year probabilistic model for the General Fund, Road and Bridge Fund, and Law Enforcement Authority Fund. This is because these funds are exposed to all of the risks we analyzed in this model. For these funds, we developed a cumulative probability chart for each fund to show the confidence that the County could have with various levels of reserves. We also developed an interactive Excel model that allows the County to change many of the variables we described above. This would allow the County to reach a reserve strategy that would most closely align with the County's risk appetite. In the following sections, we show the results for General Fund, Road and Bridge Fund, and Law Enforcement Authority Fund. The other funds are discussed immediately following. After that, we will present a few considerations that the County should keep in mind when making its final decision on a reserve amount for any fund.

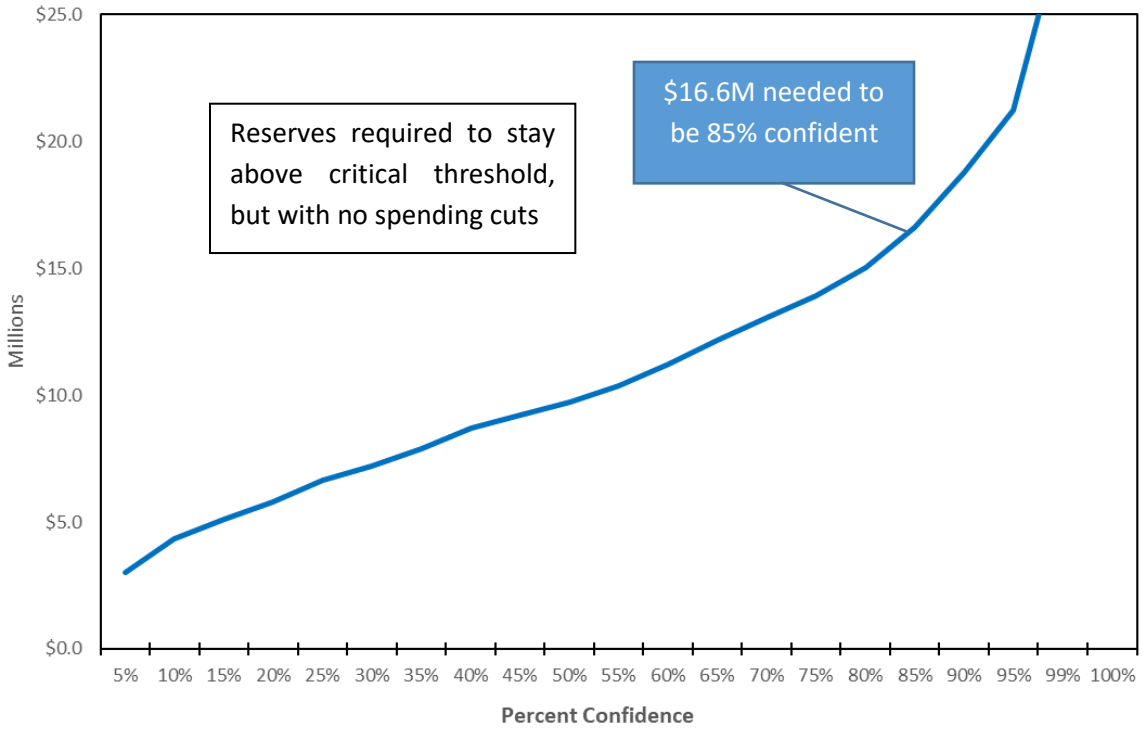
A. General Fund

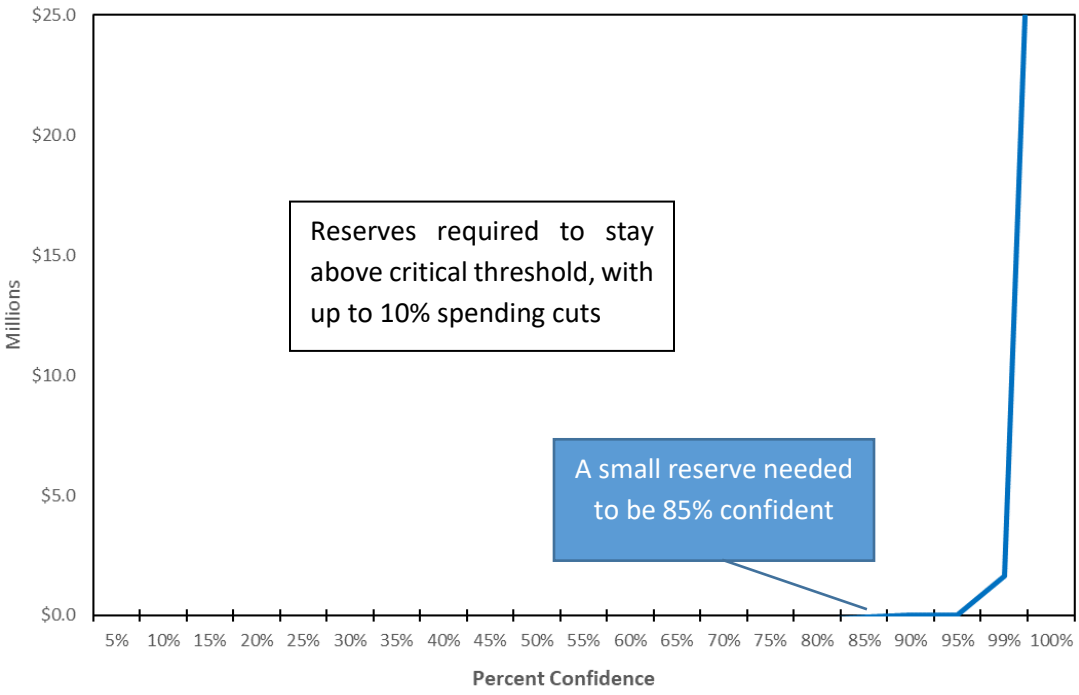
Exhibit 7.2 shows two cumulative probability curves. The top curve shows the confidence the County can have that a given level of general fund reserves will prove sufficient over a ten-year period to cover the extraordinary costs incurred as a result of the risks covered in this report. "Sufficient" is defined as the reserves not dropping below the abovementioned "red line". The bottommost graph is the same, but also accounts for the County's aforementioned willingness to cut the budget before using reserves.

Showing both of these graphs together illustrates the considerable impact that the County's willingness to cut spending has on its reserve strategy. For example, the County's willingness to cut spending means that it can be about 85% confident of not having to use reserves at all to stay above the critical threshold, over a ten-year period (see second graph). In the first graph, with no spending cuts, a reserve of $16.6 million would be required to provide an 85% chance of staying above the critical threshold during the 10 year period. Note that we selected 85% confidence for illustrative purposes only. The County's risk appetite should guide the level of confidence it is comfortable with.

[43] Absorbing some of the revenue loss makes a substantial difference in the reserves required. To illustrate, planning on a dollar-for-dollar replacement of lost revenue with reserves would require about $40 million to be 90% confident.

Exhibit 7.2 – Cumulative Probability that a Given Amount of General Fund Reserves will be Sufficient to Cover Extraordinary Costs (or Revenue Losses)



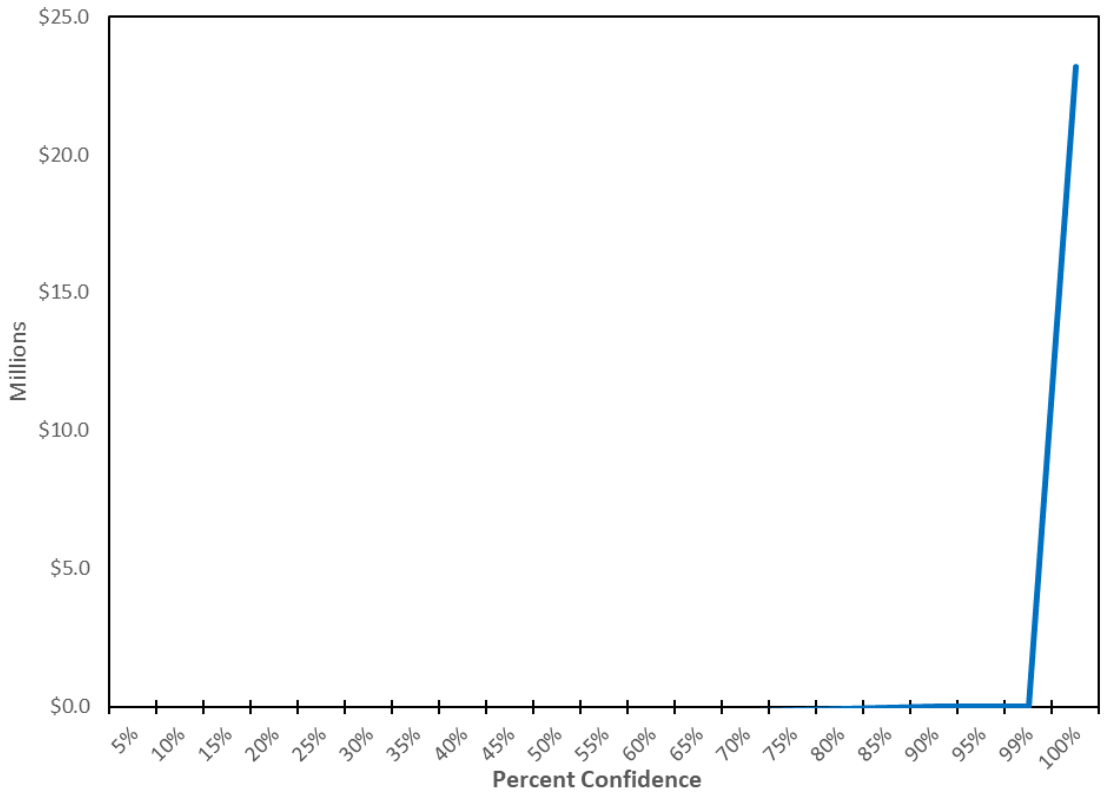


Another notable feature of Exhibit 7.2 is that the amount of reserves to achieve complete confidence extends past $25 million in both graphs. This is because a few of our simulated futures include catastrophic events like a large and highly toxic hazardous material spill. This illustrates the importance of thinking about other risk mitigation tools to complement reserves.

B. Road and Bridge Fund

The curve is presented in Exhibit 7.3. It shows the level of confidence the County can have that a given level of Road and Bridge Fund reserves will prove sufficient over a ten-year period to cover the extraordinary costs incurred by the Road and Bridge Fund as a result of the risks covered in this report. "Sufficient" is defined as the reserves not dropping below the abovementioned "red line" *and* that accounts for the County's willingness to cut spending. Like the chart we saw for the General Fund, the County's willingness to cut its budget means that there is a low chance that reserves will be needed, except in the most extraordinary of circumstances. However, should a catastrophic event happen there is a chance that reserves will be insufficient. We did not include a graph illustrating the curve with no spending cuts, but with no spending cuts, a reserve of about $8.6 million would be necessary to be 85% confident in being able to cover extraordinary costs or revenue losses.

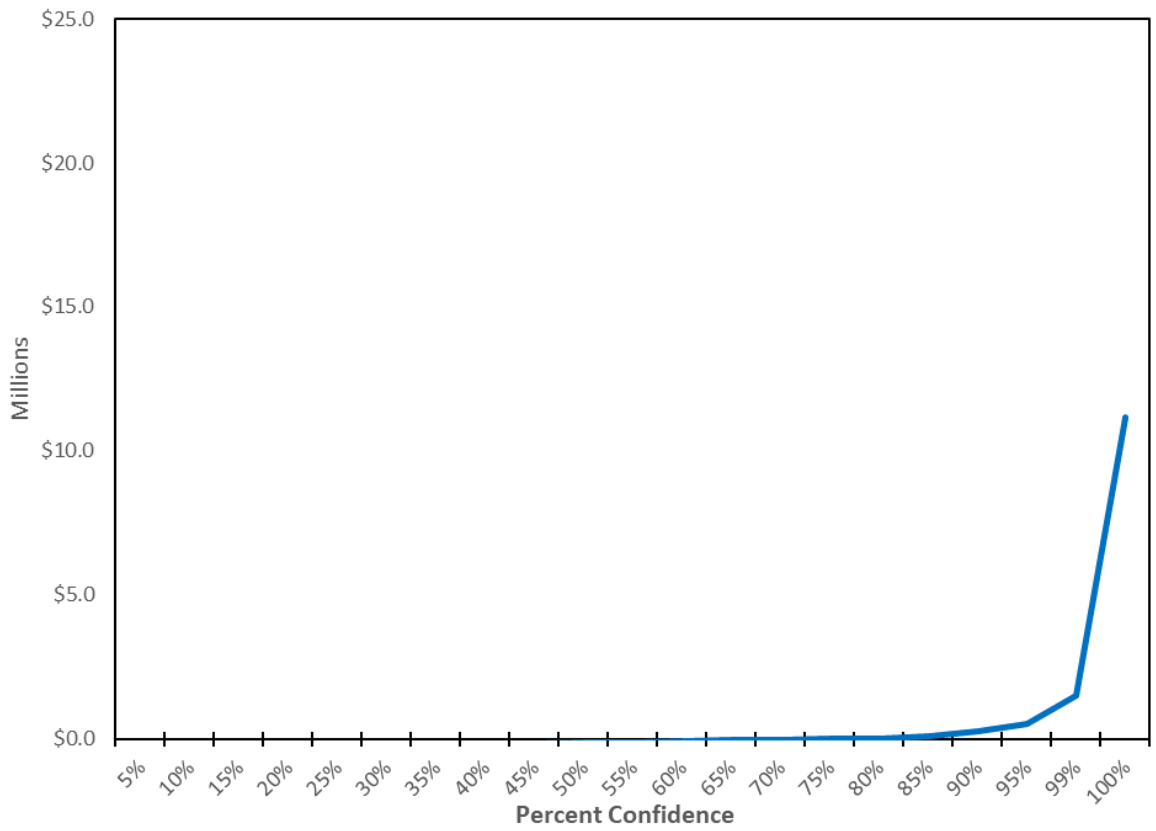
Exhibit 7.3 – Cumulative Probability that a Given Amount of Road and Bridge Fund Reserves will be Sufficient to Cover Extraordinary Costs (or Revenue Losses)



C. Law Enforcement Authority Fund

The curve is presented in Exhibit 7.4. It shows the level of confidence the County can have that a given level of Law Enforcement Authority Fund Reserves will prove sufficient over a ten-year period to cover the extraordinary costs incurred by the Law Enforcement Authority Fund as a result of the risks covered in this report. "Sufficient" is defined as the reserves not dropping below the abovementioned "red line" *and* that accounts for the County's willingness to cut spending. Like chart we saw for the General Fund, the County's willingness to cut its budget means that there is a low chance that reserves will be needed, except in the most extraordinary of circumstances. However, should a catastrophic event happen there is a chance that reserves will be insufficient. We did not include a graph illustrating the curve with no spending cuts, but with no spending cuts, a reserve of about $5.3 million would be necessary to be 85% confident in being able to cover extraordinary costs or revenue losses.

Exhibit 7.4 – Cumulative Probability that a Given Amount of Law Enforcement Authority Fund Reserves will be Sufficient to Cover Extraordinary Costs (or Revenue Losses)



D. Other Funds

Because the other funds we analyzed aren't impacted by natural disasters to nearly the same extent as the funds we analyzed above, the reserves for these other funds can be mainly focused on getting through a revenue downturn from a recession. As such, the reserve strategy for these funds can be derived directly from the revenue downturn analysis shown in Section 5. The County can select the level of confidence and dollar amount it is comfortable with, adjusted for the amount of spending it is willing to cut (instead of replacing lost revenue with reserves). The only modification to this would be if the County wishes to maintain a little extra "cushion" in one or more of the funds to account for other considerations we did not consider in this report.

E. Considerations When Making a Final Reserve Decision

Before the County settles on a reserve amount for any fund, it should take account of the following:

Other risk management mechanisms can complement reserves. We saw in Exhibits 7.2 through 7.4 that reserves can't cover every conceivable risk. In particular, catastrophic disasters (e.g., a large and/or particularly toxic hazardous material spill) could have financial impacts greater than the County's reserves. Other financial risk management tools like debt or insurance could be used to provide additional confidence beyond that provided by reserves. For example, insurance might be particularly useful for a risk like a train hazardous material spill. The County could also explore pooling its exposure with other nearby Counties that face similar risks. A pool could bring greater resources to bear, should an event occur.

Our analysis is not inclusive of every risk the County could possibly face. We used the County's disaster management plan to identify the risks that posed the most clear and present danger to the County. We also talked to County emergency management staff about their concerns. However, it is possible that the County could experience a shock that no one was expecting. However, we have seen that the County's willingness to cut spending already provides a substantial de facto extra "cushion". GFOA has provided a Microsoft Excel model that would allow the County test out hypothetical scenarios that imagine greater risk than this report assumed.

Our analysis is based on historical records. The County could be more vulnerable to extreme events in the future than historical data suggests. For example, GFOA's discussed the frequency of insurance claims with the large re-insurer wholesaler SwissRE and we learned that insurance claims have tripled since 1970. This means that historical data could underestimate the likelihood and/or severity of extreme events in the future. Unfortunately, no one can say precisely what the future will hold. Hence, GFOA can't speculate if an upward adjustment to the reserves is necessary and, if so, by how much. GFOA's Microsoft Excel[44] risk model provides the County with the ability to adjust the likelihood and/or magnitude of future extreme events, if it would like to test different scenarios.

The reserves held by comparable counties. The reserves held by comparable counties can provide context to Douglas County officials for selecting their own reserve levels. Appendix 1 contains a detailed comparison of Douglas County's General Fund reserves with those of Boulder, Larimer, and Jefferson

[44] GFOA has provided the model to the County so it can run its own scenarios

counties. The comparison shows that Douglas County already holds more reserves for risk mitigation than the comparable counties.

The County's desired level of reserves should be memorialized in a formal policy and expressed as a percent of revenue or expenditures. GFOA helped the County develop a draft of such a policy, so the policy can be updated based on how the County wishes to use GFOA's analysis to adjust its desired level of reserves. The dollar figures contained in this report can be converted into a percent of the County's annual revenues or expenditures. This way, the dollar amount will automatically adjust with changes in the County's budget.

The County's desired level of reserves should be a range, rather than a single number. GFOA's research into how local governments can best maintain financial sustainability has found that decision-making "boundaries" are essential. For example, if the County were to adopt a policy to maintain reserves between X% and Y% of revenues, then that would constitute a clear boundary that defines when reserves are too high or too low. Compare this to if the County just adopted a policy that reserves should be at X% of revenues. It is then impossible to say how far reserves can go above or below this number and still be an acceptable amount. A range also can accommodate the risk appetites of more County officials. Thus, a range could be more reflective of the preferences of a greater number of people and, thereby, get more support. GFOA's Excel model could be used to test different scenarios, which would help the County define its risk appetite. For example, we saw earlier that the County's willingness to cut spending was a major determinant of how much reserves it would need. The County could test scenarios where it cuts less spending in order to define the other end of the range.

Section 8 - Next Steps

Based on the information presented in this report, we suggest that Douglas County take the following steps:

#1 - Pick a desired range of reserves.

This can be based on County officials' appetite for risk. Section 7 provided a number of suggested factors that might help County officials decide on their preferred level of reserves. For example, the County's current level of reserves appears to pose little risk of the County not being able to cover the cost of extraordinary unexpected costs or revenue losses, given the County's willingness to cut its budget. This might be considered a "risk averse" approach. The County might also think about a less risk average approach, perhaps by reducing the assumed spending cuts or considering other plausible scenarios that might lead to great reliance on reserves.

#2 - Consider how debt and insurance can complement the reserve strategy.

Debt and/or insurance can provide protection to the County past the point where reserves are efficient.

In the case of debt, the County might be able use a line of credit with a local lending institution, certificates of participation, or revenue anticipation notes. The County might also think about interfund borrowing opportunities. The County could develop policies to provide the flexibility to use these borrowing tools while also providing the necessary guidelines and limitations to ensure that borrowing occurs in a fiscally prudent manner.

The County could also investigate newer types of insurance instruments, like parametric policies. Parametric policies provide a payout based on the occurrence of a defined event, not based primarily on whether damages were experienced. For example, if a flood of a given magnitude occurs, the County would get a payout of a defined amount. The County has some flexibility in how this money is used. For example, it could be used to pay for the overtime costs of public safety personnel who responded to the flood.

#3 - Memorialize the County's desired range of a reserve in a formal policy.

We strongly recommend expressing this as a range, rather than a single number. A range provides a "boundary" within which decisions must be made. GFOA has helped the County develop a draft policy, so the findings of this analysis could be merged with the draft policy.

Section 9 - Appendix 1: Reserves in Comparable Counties

To help the County consider the exact amount of reserves to maintain, Exhibit 9.1 provides a table of General Fund balances as a percent of General Fund revenues for Colorado counties that are comparable to Douglas County. Several notes should be made about Exhibit 9.1 in order for the reader to fully understand its meaning. First, "fund balance" is an accounting term describing the difference between assets and liabilities in the General Fund. "Reserves" (which are the main topic of GFOA's analysis for Douglas County) are the portion of fund balance set aside, by County Board policy, as a hedge against risk. Hence, not all "fund balance" is necessarily available as a reserve. The right-hand section of Exhibit 9.1 shows how much each county holds in fund balance as a percent of general revenue. Each of three columns in this exhibit examines fund balances from a different perspective on the relationship between fund balance and risk mitigation.

The first column shows "unrestricted" fund balance as a percentage of General Fund operating revenue. This is an accounting term describing fund balances that do not have constraints placed on their use by an outside entity (e.g., a bond covenant might restrict the use of some portion of fund balance to debt service) and are spendable (e.g., do not represent inventory or other non-liquid assets). An "unrestricted" fund balance may still have constraints placed upon its use, but these constraints would be created by the county government itself. One common constraint is to dedicate some portion of fund balance to hedging against the types of risks described in this report. However, other constraints have nothing to do with risk mitigation - to illustrate: a common self-imposed constraint is setting aside fund balance to pay for a special capital project. Douglas County has imposed several such constraints, including a $4 million set aside for Highway 85 improvements. While such a constraint *could* be removed and, thus, the entirety of monies in the "unrestricted" category made available for risk mitigation, it is not the intent of the county to do so.

The second column shows the amount of fund balance available for risk mitigation after fund balances having self-imposed restrictions (not germane to risk mitigation) are removed from consideration. This leaves self-imposed restrictions that are germane to risk mitigation as well as unrestricted fund balance, which could easily be used for responding to emergency events if needed.

The third category includes only those fund balances that have been specifically identified by the county as intended for creating a risk mitigating reserve. It should be noted that since the analysis in Exhibit 9.1 is based only upon the information included in each county's FY 2016 CAFR, it is possible the amount dedicated to risk mitigation could be somewhat higher for some of the county as a legislative policy document might call for maintaining a given amount in fund balance as a reserve without creating an accounting restriction that would show up in the financial report.

Local governments in Colorado have a requirement under the Taxpayer's Bill of Rights (TABOR) to maintain 3 percent of fiscal year spending as an emergency reserve balance. While TABOR funds cannot be used towards compensation for poor economic conditions or revenue shortfalls, they can be used in other emergency situations. Many local governments in Colorado, including all counties below, consider TABOR funds to be dedicated to potential emergencies (including natural disasters).

It is also important to note that some counties, like Larimer County, include some element of disaster relief in funds outside of the general fund. Usually these are small amounts intended for specific use in road or bridge repair in the wake of a natural disaster. These funds are not reflected in Exhibit 9.1.

Exhibit 9.1 - Fund Balances as Percent of General Fund Revenue

County	Population	Unrestricted	Available for Risk Mitigation	Dedicated to Risk Mitigation*
Douglas	328,632	48%	23%	15%
Boulder	322,226	27%	21%	3%
Larimer	571,837	48%	53%	13%
Jefferson	339,993	33%	22%	4%
Average	***390,672***	***39%***	***30%***	***9%***
Median	***334,313***	***41%***	***23%***	***9%***

*The figures are based on details identified in each County's CAFR. These include both specified emergency funds (if applicable) and TABOR funds available.

Sources: FY 2016 CAFR for each represented county.

Douglas County has about $10 million assigned to County emergencies or disasters, as well as $6.6 million in TABOR funds. It also has $8.7 million in unassigned funds. This combination would most likely be available for immediate risk mitigation should the County require it. The County currently has the equivalent of 15% of its $109 million annual general revenue dedicated to risk mitigation.

Douglas County sits at the top of its peer group in terms of dedicated risk mitigation funds. The County is the only of its peers to have a separate and specific emergency reserve (a restricted portion of the total fund balance) within the general fund. Jefferson County policy requires an additional 7 to 12 percent of general fund expenditures above the TABOR emergency reserve requirement, as well as a small Wildland Fire Fund external to the general fund[45]. Larimer County only considers its 3% TABOR reserves as its emergency fund with a small additional fund for natural disasters, while Boulder County maintains a combination of unassigned and assigned fund balances as well as TABOR reserves to meet its minimum reserve requirement of two months budget expenditures.

[45] Jefferson County's Wildland Fire Fund is not included in the above calculations since it is not a part of the County's General Fund. It is a separate fund that may only be used for wildfire recovery and cleanup. The Wildland Fire fund balance was $146,291 at the end of FY 2016.