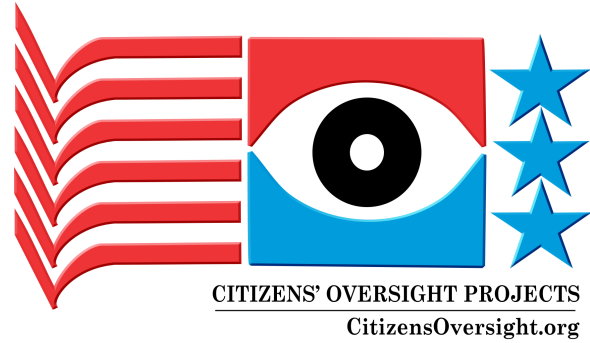Ray Lutz, Executive Director
CitizensOversight, Inc.
771 Jamacha Rd 148
El Cajon, CA 92019
raylutz@citizensoversight.org
619-820-5321

Dec. 8, 2023

Jena Griswold, Colorado Secretary of State
1700 Broadway, Suite 550
Denver, CO 80290

303-894-2200
elections@coloradosos.gov

REF: M2004

Amanda Gonzales, County Clerk and Recorder
Jefferson County Elections Office
3500 Illinois Street, Suite 1100
Golden, CO 80401
303-271-8111
elections@votejeffco.com

RE: Urgent Concerns Regarding Arvada Mayor's Contest Audit

Dear Secretary of State Jena Griswold:

I hope this message finds you well. My name is Ray Lutz, and I am the developer of AuditEngine[1], a ballot image auditing platform. We are happy to see that in Colorado, you have embraced improved auditing of elections.

I am writing to bring to your attention some critical concerns regarding the Risk-Limiting Audit (RLA) in Colorado, specifically related to the **Arvada Mayor's Contest.** (I may be somewhat long-winded here for your high expertise in the matter, but members of the public asked that I explain this as clearly as possible.)

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[1] https://auditengine.org

Urgent Concerns Regarding Arvada Mayor's Contest Audit

SUMMARY:

An additional ~400 to ~650 ballots should be sampled in the area of Arvada city to respect RLA procedures. We recommend that you consider allowing us to perform a ballot image audit (BIA) to demonstrate how we may help on this in the future.

In essence, we believe that although well-intentioned, RLA audits are difficult to deploy with uniformly limited risk. Many close contests are not sufficiently audited, particularly in this post-2020 era. We believe the auditing approach should be much stronger and err on the safe side. BIAs are the best answer to fully audit all contests in a timely manner (initial results within 24 hours of getting the images), and with predictable low cost. BIAs can be conveniently coupled with existing RLA audits or used alone.

Problem: Arvada Mayor's Race is not adequately audited

Most RLA literature implies that all contests will be covered by the audit. However, as implemented in Colorado, only a couple of contests are specifically chosen for the audit, one that is state-wide, and one in each of the 64 counties. These contests are used to guide the audit, but other contests are also (theoretically) included on an "opportunistic" basis. Based on the margins in the targeted contests, ballots are chosen randomly county-wide to cover the chosen contest, but this does not necessarily cover the other contests.

If the contest is county-wide, then all ballots will be useful for checking that contest. On the other hand, if the contest is in a district smaller than the entire county, then there will be a "dilution" factor. For example, if a district covers only half the ballots cast in the county, then about twice as many samples will be needed from across the entire county to acquire enough samples in the targeted contest's area. By pulling samples from the entire county, all contests are audited to some degree. When a contest is not one that is targeted, then it <u>may</u> be adequately checked on this "opportunistic" basis.

Ideally, when a contest is chosen as the target in a county, it is best if it has a relatively tight margin, because then checking that one contest will adequately cover all contests in the county with larger margins and similar dilution. In contrast, if the targeted contest has a wide margin and other contests have tight margins (or are diluted to a great degree), then the audit

will not provide much assurance that the other tight-margin contests are accurate unless additional samples are included from those areas of concern.

RLA audits may require a very large number of ballot samples if the margin is close in the targeted contest, or if the contest is highly diluted. Such "escalation" of the sample size is the whole idea of RLA audits, because as the margin gets tighter, more samples are required to limit the risk. But if the guiding contest is tight and also covers only a small portion of the county, then it will result in pulling a great number of samples county-wide and being relatively inefficient.

In this case, the Arvada Mayor's contest was the closest contest in Jefferson County. It included about 45K ballots out of 206K ballots cast, a dilution factor of about 21%. The margin of victory was very close, about 1%. To achieve a 3% risk limit by randomly sampling county-wide (in Jefferson County), about 5,124 ballots are required[2], and that is a relatively large number of samples that would need to be individually located and entered by hand.

The SOS has selected a different contest to guide the audit, and has designated that the contest for **City of Lakewood Mayor** would be used as the guiding contest. It has a much larger margin of victory (18.76%), and as a result, <u>only 179 ballots are needed (as the starting sample) to provide a 3% risk limit.</u>

The selection of Lakewood Mayor may be viewed as a prudent decision to reduce the workload for workers in Jefferson county. But as a result, the sample size is insufficient -- in the case of the Arvada Mayor's contest -- to achieve the claimed risk limit of 3%. In fact, the risk is about 80% with this number of ballots. That's 2,567% greater risk than the risk limit target of 3%.

Therefore, we assert that to fulfill the notion that you are conducting a risk limiting audit, additional samples are necessary.

In summary,

- The Arvada Mayor's contest has two candidates. This contest is mostly within Jefferson County (>98%), and the other <2% within Adams County.

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[2] per https://www.stat.berkeley.edu/~stark/Vote/auditTools.htm Philip Stark's Calculator for Ballot Comparison RLAs with audit parameters all set to 0.

Urgent Concerns Regarding Arvada Mayor's Contest Audit

- To achieve a 3% risk limit in the Arvada Mayor's contest, 5,124 ballots would be required if they are randomly selected county-wide in just Jefferson county. This will ensure that sufficient ballots are included for the Arvada Mayor's contest.

- Instead, only 179 county ballots are being randomly selected to audit the Lakewood Mayor's contest with the Arvada Mayor's contest included as an opportunistic audit.

- **Select additional ballot samples**
  If ballots were randomly selected from among **only ballots cast in the Arvada City area (and including appropriate ballots in Adams County)** instead of randomly selecting county-wide, then the starting number of samples should be 695 to respect the risk limit of 3%. A 10% risk limit would require 457 samples. Across both counties, only about 46 ballots were chosen within the Arvada City area.

  This procedure of selecting ballots for only one contest is outlined in this reference: "More style, less work: card-style data decrease risk-limiting audit sample sizes" at https://arxiv.org/abs/2012.03371[3]. This paper requires the CVR be used to identify ballots specifically in tight contests, and then evaluate the differences in those ballots using normal RLA procedures.

- **Ballots are already organized for additional sampling**
  Colorado devotes a great deal of effort to organizing and imprinting the paper ballots so they can be individually chosen for the audit. To fulfill the notion of a risk-limited audit, ballots from both Jefferson County and Adams County should be randomly sampled from the Arvada City area only (those that include the Arvada Mayor's contest), based on the metadata in the cast vote record. An additional 650 samples should be individually pulled for the audit to respect the 3% risk limit, as the starting sample size, since it appears 46 have already been pulled and included in the initial audit.

- **Otherwise, Perform a Ballot Image Audit (BIA)**
  If you decide to not proceed with selecting these additional samples and processing them using RLA procedures, then we would like to offer

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[3] "More style, less work: card-style data decrease risk-limiting audit sample sizes" -- Amanda K. Glazer, Jacob V. Spertus, Philip B. Stark https://arxiv.org/abs/2012.03371

the option of performing a ballot image audit (BIA) of Jefferson County, so we can showcase our solution.

Cooperative Workflow: We have recently introduced the "cooperative workflow" methodology where AuditEngine uses some data prior to the election to fully configure AuditEngine so it can quickly process the ballot images as soon as they are available and produce initial reports usually within 24 hours. After that is produced and published, it compares with the CVR and produces a discrepancy report, among many other reports about the election.

0% Sampling Risk: If used alone, a ballot image audit does not require the careful organization of all ballots, because our solution does not perform individual ballot sampling, and thus, the risk due to sampling is 0%. A BIA is predictable in overall cost and complexity because it does not need to escalate -- all ballots are already included. This means it can provide much lower overall risk while still able to check any tight contest, quickly and cost-effectively.

We differ from other services because we "read" the voter-verifiable text on all Ballot Marking Device (BMD) summary cards, and we do not rely on any barcodes to interpret the vote.

As part of our audit procedures, we support pulling a number of sample batches which can be scanned using a non-voting system scanner, and compared with the other results. This can eliminate the concern that the ballot images may be compromised. We can also scan and interpret samples drawn using RLA procedures and eliminate the error data-entry step.

- **Review RLA Procedures**

Finally, we suggest that you conduct a formal review of the RLA procedures being used in CO. Optimizing the workload may result in high risks. It is better err on the safe side rather than allowing many contests to be inadequately audited, even if RLA audits work well, they may actually reduce the number of ballots to a very low number that does not account for any other risk factors other than the sampling risk, and anyone hearing that just a few dozen ballots are enough to check a contests in the entire state just doesn't pass the sniff test. Ballot Image Audits can audit all ballots and all contests economically and help to restore confidence.

Urgent Concerns Regarding Arvada Mayor's Contest Audit

We are now completing a pilot audit with the state of Maryland and we hope we can attract you to our solution because we believe it will be superior to the situation in Colorado now. We have conducted "public oversight" audits in Florida, Georgia, New Jersey, and Wisconsin.

Thank you for your attention to these concerns. Please contact me at your convenience to discuss further.

Ray Lutz

Citizens' Oversight Projects
citizensoversight.org
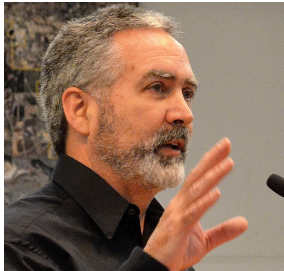
Raymond Lutz is the founder and executive director of Citizens' Oversight Projects, a 501(c)3 nonpartisan nonprofit organization that has been involved in providing oversight to elections for over 15 years. Lutz has a Masters degree in electronics and software engineering, with experience in the document management and printer/scanner/fax/copier industry, and medical device industry. He is the lead developer of AuditEngine.

AuditEngine has been used in many elections in Florida, Georgia, New Jersey, and now is being piloted by the State of Maryland for future state contracts there.

For more information, visit https://AuditEngine.org or contact Ray at raylutz@citizensoversight.org

APPENDIX 1

The Problem in Detail

To illustrate the discrepancy, I have gathered information on the vote totals in Jefferson County and Adams County. Detailed data can be found in the provided links to the corresponding results.

You can see the details here for Jefferson County, a total of 43,824 votes. (Please note, these totals may be dynamically updated and slightly different if you visit this page.)

https://results.enr.clarityelections.com/CO/Jefferson/118893/web.317647/#/detail/2?v=323831%2F

★ City of Arvada Mayor (Vote For 1)		
1 John Marriott	49.66%	21,765
2 Lauren Simpson	50.34%	22,059
		43,824
↱ Share		
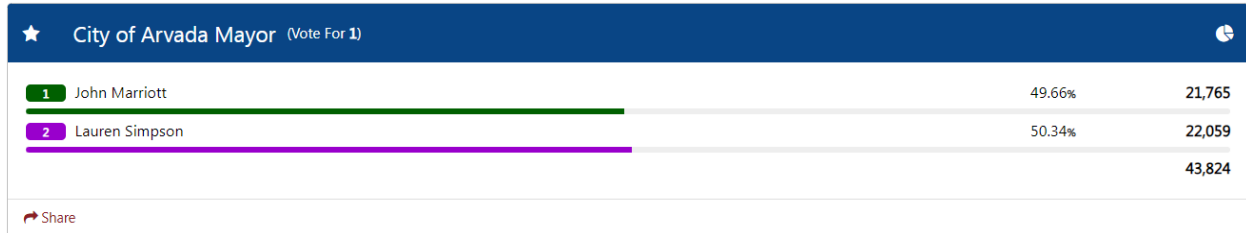
And here for Adams, only 693 votes were cast for this contest.

https://results.enr.clarityelections.com/CO/Adams/118895/web.317647/#/summary?v=323819%2F

★ City of Arvada Mayor (Vote For 1)		
1 John Marriott	37.52%	260
2 Lauren Simpson	62.48%	433
		693
↱ Share		
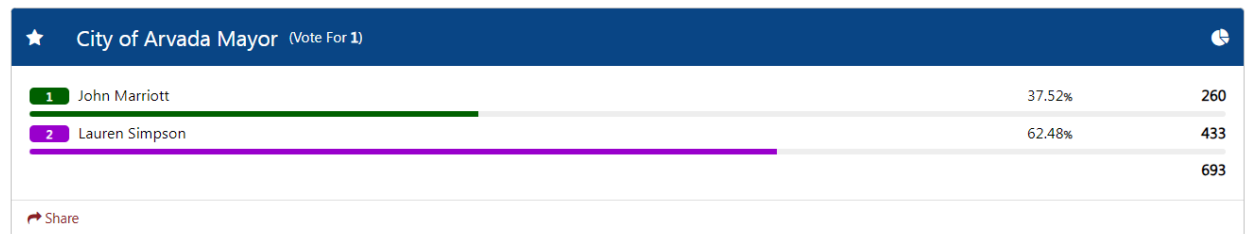
Here is a summary of this information.

	Jefferson County		Adams County		Total (2 counties)	
Total votes cast	206,727		103,214		309,941	
Arvada Mayor						
John Marriott	21,765	49.66%	260	37.52%	22,025	49.48%
Lauren Simpson	22,059	50.34%	433	62.48%	22,492	50.52%
Margin	294	0.67%	173	24.96%	467	1.05%
Total	43,824		693		44,517	

Urgent Concerns Regarding Arvada Mayor's Contest Audit

The SOS website has the summary of the plans for the state-wide RLA. I have extracted just those rows of interest.

County	Contest	Vote For	Lowest Winner	Highest Loser	Contest Margin	Diluted Margin	Risk Limit	Estimated # of CVRs to audit	# of CVRs	Remarks
Colorado	Proposition HH (STATUTORY)	1	856,182	566,663	289,519	20.08%	3%	36	1,441,848	Audited in all 63 counties
Adams	City of Thornton Mayor	1	13,396	11,327	2,069	2.63%	3%	277	25,916	
Jackson	Jackson County Ballot Issue 1B	1	282	171	111	23.82%	3%	31	466	
Jefferson	City of Lakewood Mayor	1	21,038	12,636	8,402	4.07%	3%	179	49,523	
Kiowa	Proposition II (STATUTORY)	1	372	153	219	41.71%	3%	17	525	Single county audit

(See full table at the link, although it appears this is not dynamically updated and the totals in the contests are a few days old. We don't actually know if the official starting numbers are adjusted based on fresh results, but we have not seen any updates. The red column "Estimated # of CVRs to audit" are the number of ballot samples that are required in the audit.)

https://www.sos.state.co.us/pubs/elections/RLA/files/2023/coordinated/targetedContests.pdf)

Instead of using RLA procedures to audit the tight contest of Arvada Mayor, a much wider contest was selected: the Mayor's contest in the city of Lakewood, which has a 18.76% margin of victory. There, the number of ballots to be sampled is listed as 179, and when we calculated it, the count is 180, essentially the same.

State-wide, ballots will be chosen to audit Proposition HH. My calculations indicate that 3% does roughly match the 36 ballots specified. calculates 34 ballots (see image further down).

It appears the listed plan for Adams County will audit 277 ballots across Adams County for the Thornton Mayor's contest.

The 2023 Colorado RLA is designed to achieve a 3% risk limit. So how many ballots are required to actually properly audit the Arvada Mayor's contest to a 3% risk limit?

The following table[4] lists the samples required for various risk limits. These starting sample sizes came directly from Philip Stark's calculator. As the *starting sample sizes*, the actual number of samples required may need to be expanded. We learned in the process of editing this letter in our interactions

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[4] Full spreadsheet can be viewed in detail here:
https://docs.google.com/spreadsheets/d/1q4frLwUaI6YHCHxyYVCBrGs4g4lUJ3x7_gPkoUKYip8/edit?usp=sharing

Urgent Concerns Regarding Arvada Mayor's Contest Audit

with Philip Stark and Neal McBurnett on the "State Audit Working Group" email list, that the "audit parameters" must all be 0, and then we obtained similar results.

	Jefferson County		Adams County		Total (2 counties)		All Arvada Mayor Only	
Total votes cast	206727		103214		309941		44517	
Arvada Mayor								
John Marriott	21765	49.66%	260	37.52%	22025	49.48%	22025	49.48%
Lauren Simpson	22059	50.34%	433	62.48%	22492	50.52%	22492	50.52%
Margin	294	0.67%	173	24.96%	467	1.05%	467	1.05%
Total	43824		693		44517		44517	
Sample @ 3%	5124		4348		4837		695	
Sample @ 4%	4704		3991		4440		639	
Sample @ 5%	4378		3715		4132		594	
Sample @ 10%	3365		2855		3176		457	
Sample @ 20%	2352		1996		2220		319	
Sample @ 80%	327		277		308		45	
Actual Sample	179		277		456		46	
Corrected Actual	180		352		532			

Thus, 4,837 ballots are required county-wide across the two counties to respect a 3% risk limit. If only Jefferson County is considered, the RLA requires 5,124 ballots.

Here is an example of the use of the ballot comparison audit calculator to estimate the initial sample size. Please note that this is the initial sample which may have to be increased based on the results.

Initial sample size

Contest information

Ballot cards cast in all contests: `309941`   Smallest margin (votes): 467. Diluted margin: 0.15%.

Contest 1. Contest name: `Arvada (full city in two counties)`
Contest type: ⦿ plurality ○ super-majority

Winners: `1 ▾`

Reported votes:

Candidate 1 Name: `Lowest Winner`	**Votes:** `22492`	
Candidate 2 Name: `Highest Loser`	Votes: `22025`	

`Add candidate to contest 1` `Remove last candidate from contest 1`

`Add contest` `Remove last contest`

Audit parameters

Risk limit: `3%`
Expected rates of differences (as decimal numbers):
Overstatements.   1-vote: `0`   2-vote: `0`
Understatements. 1-vote: `0`   2-vote: `0`

Starting size

☑ Round up 1-vote differences. ☐ Round up 2-vote differences. `Calculate size` 4837.

Use of Stark's calculator in comparison with published sample sizes.

For Proposition HH, Stark's tool says:

Urgent Concerns Regarding Arvada Mayor's Contest Audit


```
┌─Initial sample size──────────────────────────────────────────────────────────┐
│ ┌─Contest information────────────────────────────────────────────────────────┐ │
│ │ Ballot cards cast in all contests: [1441848]    Smallest margin (votes): 289,519. Diluted margin: 20.08%. │ │
│ │                                                                            │ │
│ │ Contest 1.  Contest name: [HH                                            ] │ │
│ │ Contest type:  ◉ plurality  ○ super-majority                              │ │
│ │                                                                            │ │
│ │ Winners: [1 ▼]                                                             │ │
│ │                                                                            │ │
│ │ Reported votes:                                                            │ │
│ │                                                                            │ │
│ │ Candidate 1 Name: [Lowest Winner          ]   Votes: [856182]             │ │
│ │ Candidate 2 Name: [Highest Loser          ]   Votes: [566663]             │ │
│ │                                                                            │ │
│ │ [Add candidate to contest 1] [Remove last candidate from contest 1]       │ │
│ │                                                                            │ │
│ │ [Add contest] [Remove last contest]                                       │ │
│ ├─Audit parameters───────────────────────────────────────────────────────────┤ │
│ │ Risk limit: [3%]                                                          │ │
│ │ Expected rates of differences (as decimal numbers):                       │ │
│ │ Overstatements.   1-vote: [0]     2-vote: [0]                             │ │
│ │ Understatements. 1-vote: [0]     2-vote: [0]                             │ │
│ ├─Starting size──────────────────────────────────────────────────────────────┤ │
│ │ ☑ Round up 1-vote differences.  ☐ Round up 2-vote differences. [Calculate size] 37. │ │
│ └────────────────────────────────────────────────────────────────────────────┘ │
└──────────────────────────────────────────────────────────────────────────────┘
```

It calculates the requirement of a starting sample of 37 ballots state-wide. The summary on the CO website lists that they need 36 samples statewide, which is slightly fewer, and we are not sure why there is a difference.

This is <u>not</u> a PER COUNTY requirement. It is only 37 total for the entire state. That is fewer than one ballot randomly selected from each of the 64 counties, on average. If this were the only contest being checked, it might be easiest to choose one sample per 49,000 ballots (rounded-up) per county, as some counties are much larger than others. In this case, since each county will be gathering many more samples for any local contest, this requirement will be easily satisfied.

The trouble is that, by definition, contests for Mayor <u>do not overlap at all</u>. So when CO audits the Lakewood Mayor's contest, CO calculates that 179 ballots are needed from across the entire county. If we calculate the sample size with that level of dilution, then the starting sample size is 180 at a 3% risk limit.

Urgent Concerns Regarding Arvada Mayor's Contest Audit

★	City of Lakewood Mayor (Vote For 1)		◕
1 Wendi Strom		47.16%	21,120
2 Don Burkhart		28.33%	12,689
3 Cathy Kentner		24.51%	10,979
			44,788

↪ Share
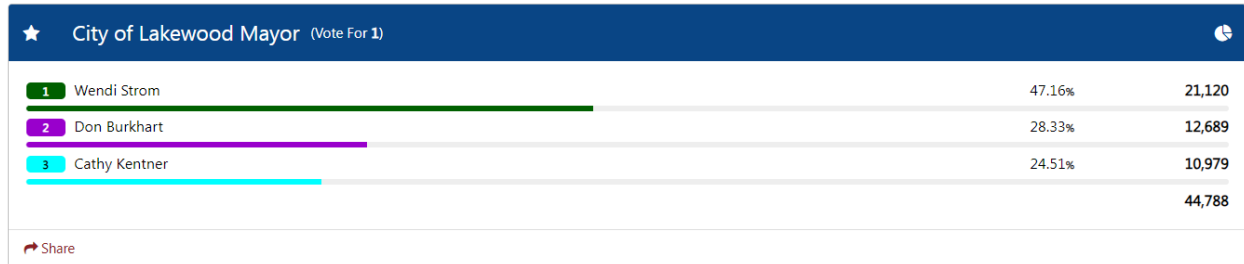
Lakewood Mayor			
Lowest Winner	21038	46.97%	
Highest Loser	12636	28.21%	
Margin	8402	18.76%	
Total Votes	44788		
Sample @ 3%		180	(across all ballots)
Sample @ 4%	165		
Sample @ 5%	154		

Similar calculations for Thornton Mayor in Adams County can be made, and they differ from the planned 277 samples. This appears to be due to initial figures for the ballots cast to be a bit lower than the numbers I see on their website now. I would imagine they might update these, but if they do not, then they are likely consistently under-sampling.

Thornton Mayor					
Lowest Winner			16945	53.37%	
Highest Loser			14804	46.63%	
Margin			2,141	6.74%	
Total Votes			31749		
Sample @ 3%			352		
Sample @ 4%			323		
Sample @ 5%			301		
THEIR PLAN			277	<-- based on preliminary counts	

Below is the result of entering the data in this tool for only the Arvada Mayor's contest, in the case where we are able to sample from all the ballots in the City with no dilution. This will require the CVR to find the ballots of interest, and by depending on the CVR, it means that there may be other paper ballots that do not have a CVR entry that should be sampled but are not.

Urgent Concerns Regarding Arvada Mayor's Contest Audit

Initial sample size

Contest information

Ballot cards cast in all contests: 44513   Smallest margin (votes): 465. Diluted margin: 1.04%.

Contest 1. Contest name: Arvada (full city in two counties)
Contest type: ● plurality ○ super-majority

Winners: 1 ▾

Reported votes:

| Candidate 1 Name: | Lowest Winner | Votes: | 22489 | |
| Candidate 2 Name: | Highest Loser | Votes: | 22024 | |

[Add candidate to contest 1] [Remove last candidate from contest 1]

[Add contest] [Remove last contest]

Audit parameters

Risk limit: 3%
Expected rates of differences (as decimal numbers):
Overstatements.   1-vote: 0   2-vote: 0
Understatements. 1-vote: 0   2-vote: 0

Starting size

☑ Round up 1-vote differences. ☐ Round up 2-vote differences. [Calculate size] 698.

.