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Board of Elections
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Greetings:

You have recently received the report and presentation on Risk Limiting Audits (RLAs) as a result of the pilot implementation that occurred earlier this year. Although I sincerely believe the work done on this project was excellent, this letter represents a dissenting opinion regarding the conclusions, and indeed the scope of the options considered. I submit this to you with respect to all concerned.

In summary, Citizens Oversight will recommend that you perform a Ballot Image Risk Limiting Audit (BIRLA) rather than the conventional statistical audits, even if you might want to continue to try those audits at the same time.

You are no doubt aware that since 2000, we have had increased scrutiny on elections and their trustworthiness. This has recently boiled up to the top of the national discourse. The fact that Rhode Island is working to improve the integrity of the results of the election through audits is very much appreciated. Any type of audit – if done well – is better than none. But audits done poorly can be worse than nothing.

By way of introduction, I hold a Master's degree in electronic and computer engineering and I have significant industry and standards experience in document processing equipment, including printer, scanners, facsimile, imaging, etc. I also was involved in a test-strategy development group for testing VLSI (very large scale integrated) circuits, and for a while ran a quality assurance department in a manufacturing setting. I have a number of patents and have developed dozens of products that have been brought to market. Since about 2006, I have been involved in election integrity oversight, particularly of election audits, and mainly with respect to those audits in California.

California requires that all counties implement the "1% Manual Tally" audit, where 1% of the precincts and Vote-by-Mail (VBM) ballots are randomly audited by precinct or batch. This is a fixed-percentage batch-comparison audit.  It is implemented prior to certification and it requires that all contests are audited with at least one batch. Usually batches are either precincts or mixed-precinct VBM ballots. Since it does not escalate automatically, it is not a risk-limiting audit, but it is still very useful <u>if conducted properly</u>.

We have carefully investigated how these are run in California, how the public can provide useful oversight. Our work started in San Diego County (which incidentally has roughly three times the population of Rhode Island) and we (I and other volunteers associated with Citizens Oversight) have provided oversight of these audits for the past 10 years including the top 24 counties in California, the most populous counties in Florida and several other states where audits are used. We were also active in the recount of 2016, especially in Michigan.

Over the past year or so, I have become involved in various audit groups, including the State Audit Working Group (SAWG), the Rhode Island Pilot Risk Limiting Audit group, and the AuditWare group lead by Ron Rivest at MIT. I was able to take part in many of the discussions regarding the pilot study in Rhode Island, although it was not feasible for me to physically participate in the audit itself.

To get an understanding of how RLAs will pan out when used, I also constructed a Monte Carlo simulation engine, which can simulate thousands of audits with elections of various margins and risk limits, considering the various audit types that were included in the implementation pilots in Rhode Island.

Thus, I believe this input on the question of how you will move forward to implement risk-limited audits will be useful to you.

## Statistical RLAs Become Infeasible with Tight Margins or Small Contests

What is true about the RLAs that were studied by this pilot – the Batch Comparison audit, Ballot Comparison Audit, and Ballot Polling audit – is that they are all based on statistical samples of ballots which are pulled and interpreted, then compared with the computer report. The Ballot Comparison audit requires the least ballots to be scrutinized for any given margin and risk limit. For all such sampled approaches, as the margin gets tight, the number of samples increases, eventually perhaps to require a full hand-count.



*Figure 1: Most Elections have wide margins*

Most elections have relatively wide margins. Review of the recent congressional seats nationally show that 90% of congressional elections have margins over 10%, and the typical contest of this sort has a margin of about 25%. For margins of this magnitude, RLAs that utilize sampling perform relatively well. Indeed, sometimes almost too well, as they require very few ballots to be reviewed and this may leave the public concerned that too few ballots are scrutinized.
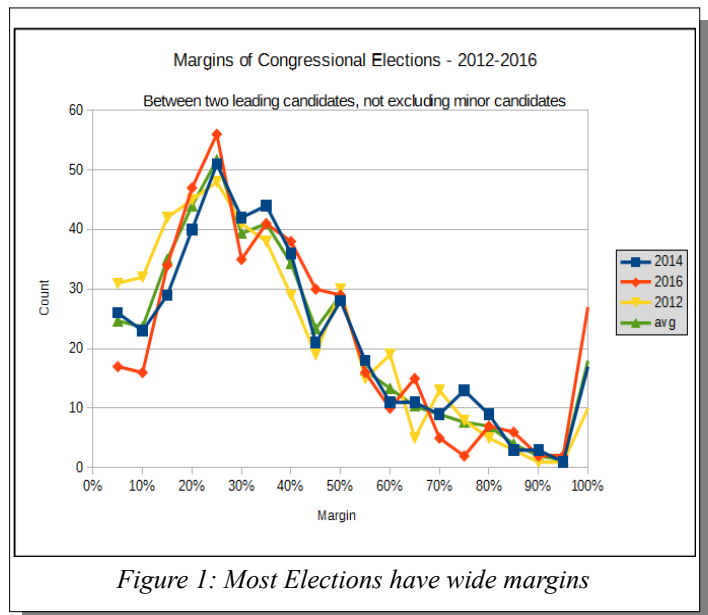
The real problem with statisically-sampled RLAs is that they start to require that a vast number of ballots be scrutinized when margins get tight. Assuming a risk limit of 5%, a ballot comparison RLA becomes infeasible at margins less than about 2% while for ballot polling RLA, they become infeasible at margins less than 10%.

When a contest is small – including only a few thousand ballots – the auditors may as well save time and forget random selection and start with a full hand count from the get-go.

For very large elections with few contests and with reasonably large margins, such RLAs do work pretty well. But Rhode Island is not a very large district and has many small contests, and let's face it, we are mostly interested in auditing the really close contests, not those that are a landslide.

## Not all races are risk-limited

We have noticed that in the places where such RLAs have been implemented, very few contests are chosen for full RLA treatment. Knowing that the tightest margin will determine the sample size, auditors reason that by focusing on one key (tightest) race, the others will naturally be covered. In Colorado, only one statewide contest is



*Figure 2: Ballot samples required for Ballot Comparison Audit according to Stark.pdf or balanced risk method becomes infeasible with margins less than about 2%*



*Figure 3: Ballot Samples required for Ballot Polling Audit at 5% risk limit -- Becomes infeasible with margins <10%*

chosen, and one countywide contest in each county[1]. Other statewide and countywide contests can be included in the audit on an "opportunistic" basis, meaning they could be evaluated with regard to risk, but will not drive the number of samples. In Colorado, they apparently do collect all the marks from every ballot they sample, but risk is not reported for any opportunistic contests, and there is no attempt to sample ballots from all contests. At least in California, the 1% manual tally does require that at least one batch is audited that includes every contest. Additional batches are added after the random draw is completed to make sure all contests are included.

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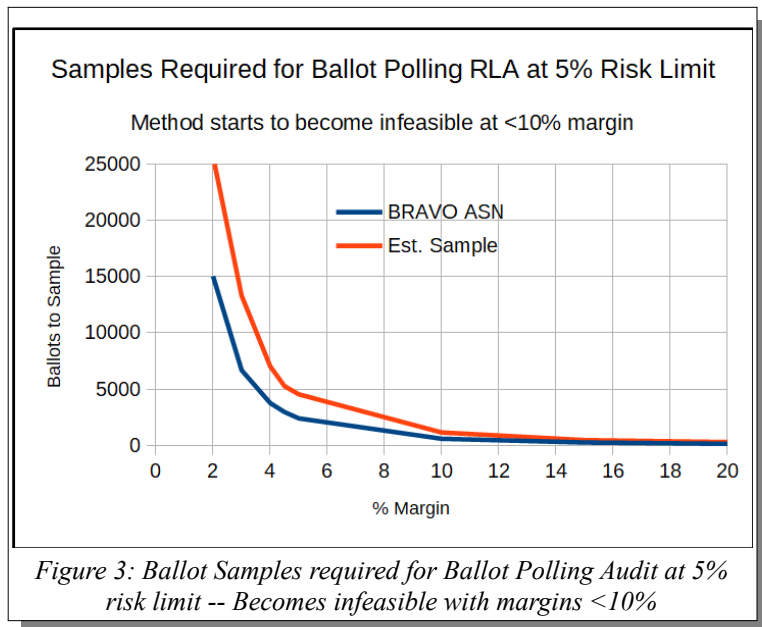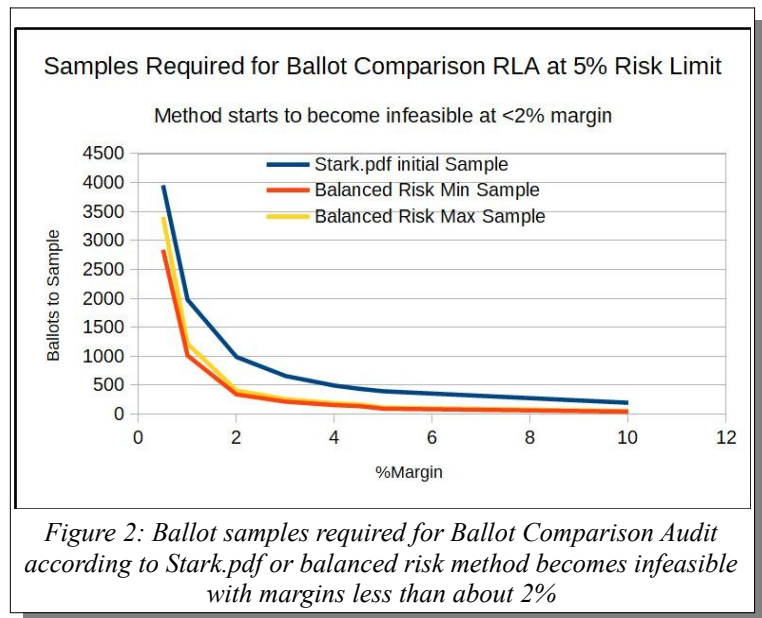
1    Determined by the Colorado Secretary of State.

## Small races are infeasible from the start

With any RLA that uses statistical samples, there is no guarantee that sufficient ballots will be reviewed for other local contests. It may be that they look at just a few ballots from each one, far fewer than would be necessary to obtain a risk limited to any specific value. In Colorado, there is no attempt to include all contests. Thus, the RLA procedures being entertained do not provide limited risk for all contests, and this is unfortunate. The truth is that small races can't be effectively sampled. If they were to be included in the requirements of a risk-limited audit, then they may as well just hand-count them from the start instead of doing any sampling at all.

## Close Races are Infeasible

Even more disturbing, when the margin gets close, they become infeasible with thousands or tens of thousands of ballots to be sampled. Promoters of these RLA procedures suggest that a full hand count is called for, but honestly that is not going to happen in many cases as it is too expensive in terms of time and effort. This is particularly true if the ballots are not sorted to make it easy to find those ballots that pertain to that small race.

In a recent municipal election in Colorado – which implements ballot comparison RLAs by statute – the margin was so close that they did not attempt to do the RLA at all. Rather, Colorado devolved into reviewing and adjudicating the images, and looking for over-votes and under-votes. Thus, they wound up using a ballot image audit of sorts in the end, but without the other features that should be part of the process to control the risk.

In short, statistically sampled RLAs are essentially worthless for very tight margins and small (local) contests.

## Audit Complexity risks "Innocent fix-up" of the audit

I need to mention one other concerning feature of these RLA methods, and most particularly the ballot polling or ballot comparison audits where individual ballot are sampled. These audits require that extreme care be taken in doing the audit itself, such as the process of pulling and evaluating the ballot samples, how the data is entered and then compared. This increases the risks in performing the audit itself.

What we have witnessed in actual election audits is the "innocent fix-up" hazard, where a departure from correct audit procedure defeats the effectiveness of the audit.

During the election canvass, election workers are in the mode of fixing problems and correcting issues that come up on a nearly unending basis. In the audit, however, such corrections are not allowed, because it then eliminates the usefulness of the audit results. "Fixing the audit" is not allowed, most of the time. And with a very small sample of ballots in the ballot-comparison audit, the procedures must be absolutely pristine. Such innocent fix-up is virtually impossible to avoid by election workers who are used to fixing problems, are actually auditing themselves, and want to produce a clean report.

Impossible, that is, unless carefully designed procedures are used, such as separating the review of ballots

from the knowledge of the computer results, and mandating that standard tally sheets are used. We have proposed such procedures and to a great extent the pilot did incorporate very good procedures. Yet, we have a great fear that the audits will not provide the sort of check we need and may devolve into nothing more than theater. Election officials will go into their back room and then return to announce that "everything is fine," while observers understand nothing.

Let me give you an actual example. Los Angeles is the largest election district in the nation with 10.6 million residents and about 4500 precincts. They carefully manually tally each of the 1% precincts (about 45) that were randomly drawn. When they compare with the computer result, if the tally matches or nearly matches, they report it without further work. But if the tally does not match the computer report by a significant number (maybe 10 or more, which we are certainly interested in, because it might flag where the cast-vote record (computer report) was changed maliciously), instead of reporting the result of the manual tally and the discrepancy, they would then take the stack of ballots and rescan them, and create a new computer report. So far, this could be all well and good. But here is where they make the big mistake: They would then only report discrepancies with the new computer report, effectively covering up the original discrepancy. No one really understood that this was a violation of the audit protocol, not even those volunteers that were attempting to oversee it. Fixing a precinct that is bad does <u>not</u> indicate that the audit is clean, but instead should raise a very large flag that something is seriously wrong. Unfortunately, this lack of compliance with careful audit protocol made their audit nothing more than theater.

## The most important concern

The most important concern I have of the RLA pilot and the report is not what was done, but what was not done. This pilot was artificially constrained to not include a very important option, that of the **Ballot Image Risk Limiting Audit**.

Frankly, I found the lack of interest in the Ballot Image Risk Limiting Audit (BIRLA) a bit of a surprise, and it seems this is built on a number of misconceptions that continue to be promulgated, most frequently that "ballot images are inherently dangerous." The truth is that ballot image audits are extremely powerful and cover the vast majority of possible hacks or errors in the election. There is some risk for a very small set of hacking scenarios, and that small risk can be mitigated easily.

To implement a ballot-image audit, it is necessary to either have election equipment that produces ballot images (most modern equipment does) or to rescan the ballots and produce the images (as has been proposed for Rhode Island). These images need to be "secured" by publishing signed hash digests of the image files as soon as possible after the images are created (while not necessarily releasing the image data at the same time, as it may be inappropriate to do so prior to election day). This makes it infeasible to change the images without the possibility of detection. It also means that the paper ballots cannot be changed without the possibility of detection, and it eliminates the question of whether a mark was added to a paper ballot to invalidate the ballot. Just such a question could not be answered recently in Virginia where only one vote determined the winner of the 94th district seat in the House of Delegates[2].

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2    https://www.cnn.com/2017/12/21/politics/virginia-house-of-delegates-one-vote-yancey-simonds/index.html

After ballot images are created and secured, auditing solutions (proposed and existing) use software to completely reprocess all ballot images, without statistical sampling. This means the results are good down to the ballot. The method has predictable overhead, in that all contests can be exhaustively reviewed. However, it can also be done by hand. Teams of volunteers can inspect the ballots over the internet thereby eliminating any concept that the audit itself is corrupted.

## Image Validation

To be a risk-limiting audit, it is necessary to also review some paper ballots and compare the images with those ballots. This is called *Image Validation*. Statistical sampling as the images are created is one way to insure the images are a faithful representation of the ballots. It is best done after the images are secured, and by a separate team that reviews the images, compares with the originals, and collects data about the fidelity of the images produced.

## Comprehensive Risk should be used to compare methods

It is important when comparing the various audit procedures, to consider the *comprehensive risk*. Sampled RLA procedures include many steps, rely on random samples and random numbers that are honestly drawn, and rely on honest reporting, for example. Each step may increase the risk that the audit can be defeated and requires rigorous adherence to procedures to mitigate that risk.

When considering the comprehensive risk, BIRLAs include far fewer risk elements than the statistical approaches considered by the RLA pilot. The document "Comprehensive Risk Estimation of Election Audits" (attached) evaluates and compares the various audits with regard to comprehensive risk. BIRLAs have far fewer risk elements, and they provide for redundant and competitive audits which can detect other types of risk that would normally be unique to BIRLAs.

With BIRLAs, the most common hacking and error scenarios are detectable with 0% sampling risk even without image validation. For example, if the tabulation were to be modified, if voter intent was incorrectly evaluated, or if there are common systemic machine errors after the images are created and secured, these are all detected by a ballot image audit without image validation. The single weakness that would require that paper be inspected is if the images are modified after scanning in but prior to securing them. This risk step is identified as C2 in the companion comprehensive risk analysis paper and is mitigated by image validation.

The really big reason we like Ballot Image Audits is their transparency when ballot images are provided to the public. For example, Dane County, WI has been providing ballot images of their elections on their website for several years[3]. We know publicly available ballot images is our most important weapon against stolen elections and supports voter confidence in the result, because anyone can check it.

Maryland utilized ballot image audits and has compared them with batch comparison and ballot comparison audits, and they find that there are distinct advantages to performing ballot image audits. Their evaluation resulted in a powerpoint presentation, which is attached. We certainly suggest that Rhode

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3    https://elections.countyofdane.com/Election-Auditing

Island consult directly with Maryland to learn the results of their audit trials. We do not believe what Maryland did was perfect in terms of reducing all risk elements, specifically in terms of validating images and perhaps publishing ballots.

The Rhode Island's RLA pilot report recommends that RI use the Ballot Comparison audit. This will require that you rescan all the ballots in order to make a cast-vote record for every ballot so it can be compared with the paper ballot. The equipment being used will create ballot images.
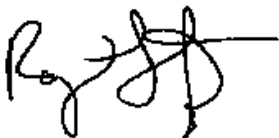
## Our Recommendation

We recommend that you keep these ballot images regardless of any other procedure you might use, and that you properly secure them, and publish them. Furthermore, we recommend that you simply do a BIRLA, probably using the services of Clear Ballot or other public domain software that may become available, instead of going through the very risky and burdensome process of doing the conventional RLAs. As images are created, sampling the ballots and comparing them with the paper will validate the images and reduce and limit the only remaining risk element.

To further assist in your review of this option, the following attachments are provided:
1. "Comprehensive Risk Estimation of Election Audits" – Ray Lutz, CitizensOversight (2019-08-15)
2. Presentation slides by Maryland in their review of options including BIRLA.
3. The presentation by Steven Rosenfeld which elucidates the power of such an audit for finding problems and improving your confidence of an election that is complete and accurate, can be viewed at this link: https://youtu.be/JXABSh5w_Xw?t=3076

If you would like me to present or discuss this with your staff, I would be happy to visit, discuss this via web conferencing, or by phone.

Sincerely,

Raymond Lutz
Executive Director, Citizens' Oversight Projects

P.S. This letter and links to references and attachments can be found at this URL:
http://copswiki.org/Common/M1914