

Citizens' Oversight Projects (COPs)

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Letter to Shawn K. Brom, San Diego ROV, RE: RIVERI

REF: M2062

VERIFYING ELECTIONS using IMAGES FROM ELECTION SCANNERS

1 — BACK UP: Election machines create scanned images of all ballots and create "cast vote records" with a record of each vote. Save these offsite in case of disaster or seizure.

2 — CHECK IMAGES: Compare a sample of images against the paper ballot sheets to be sure the scanning is going well.

3 — 100% RECONCILIATION of ALL CONTESTS: Provide ballot images and cast vote records to an independent contractor to exhaustively reconcile them.

Greetings:

There is a great deal of apprehension about the upcoming election in November. The Federal administration has pursued many changes including possible filtering and control of mail ballots. There have been seizures by the FBI and even the Riverside sheriff's department involving ballots and other election data. Experts agree that no computer system is absolutely secure, malicious attacks are possible given access.

There is also concern about the authority of the U.S. Congress over elections involving congressional offices, and whether that authority could penetrate the state and county authority that is normally in place. If that occurs, direct seizures could capture ballots and other election data, creating the possibility that election results could be announced without the public or other independent parties ever having an opportunity to examine the underlying ballot data.

We are approaching you because of these concerns, and because we have solutions to how we can work together to improve the verification of election results. In the longer term, with new statutes, these methods can reduce the cost and effort required for auditing and other post-election reviews.

Public Expectations for Election Verification

There is a difference between what the public expects election officials to do and how election officials carry out their responsibilities. The public is deeply concerned about the quality of our elections. Many people do not trust the outcomes.

Only 45% of California Democrats and 16% of California Republicans were “[very confident](#)” that the 6/2/26 primary would be fair, secure and accurate. Only 25-29% of other parties, Latinos, Blacks, and Asian/Pacific were “very confident”. Some others were “somewhat confident”, which is faint praise for selecting our government.

We believe the public wants election officials to take every reasonable step to make sure the results are accurate, rather than cutting corners to save relatively small amounts of time or money.

This difference in viewpoint was exemplified by the disagreement between Citizens Oversight and the San Diego County Registrar of Voters following the 2016 election. At that time, later-processed vote-by-mail ballots were not being included in the 1% manual tally. We requested that eight additional batches be included to sample those later-processed ballots. This would not have been particularly difficult, but the Registrar's office, then under the direction of Michael Vu, resisted our request. We ultimately took the matter to court and won the case.

Honestly, we thought that the office would just do the additional eight batches.

Afterward, Mr. Vu and other election officials, working through the California Association of Clerks and Election Officials (CACEO), modified an existing bill, AB 840, to change the focus of the 1% Manual Tally so it was required to only include ballots from the "semi-final canvass", and that was further defined to omit those later-processed mail ballots. The practical effect was significant. Vote-by-mail ballots processed after the semifinal official canvass, including many mail ballots received during Election Day, could be excluded from the 1% manual tally.

We do want to acknowledge and thank you for the steps you took in the last election to increase the number of these ballots included in the manual tally. As we understand it, approximately two-thirds of the later-processed ballots are now included. That is a substantial step in the right direction.

The larger issue is the difference in viewpoint. The public wants election officials to take all reasonable steps to establish that election results are accurate. When verification procedures

are minimized because they require additional time, effort, or expense, then public confidence declines. We have moved past this prior disagreement and want to progress election integrity within your jurisdiction given our aligned viewpoints.

Authority During the Canvass

California Elections Code §15302 states that the official canvass “shall include, but not be limited to,” the steps that follow. This language gives election officials authority to go beyond the specifically listed steps and take reasonable additional steps to make sure the canvass is accurate and trustworthy before certification.

We also note that subsection (d) requires a reconciliation of ballots and votes recorded by the vote counting system. This reconciliation takes a broader view of the election records to determine whether the results produced by the voting system are consistent with the other records of the election, including the number of ballots received and processed and associated chain-of-custody records.

We believe this step can also include additional forms of reconciliation, such as checking the number of ballot images against the number of cast vote records and determining whether the votes represented by these different records reconcile.

This step used to be impossible, and is now practical. Modern voting systems in San Diego and most of the US create ballot images that are then image-processed to evaluate the selections of each voter. The reconciliation of these ballot images with the cast-vote records essentially checks the actions of the voting system with meticulous detail. It is available, is cost-effective, and honestly we believe it should be standard practice.

Preserving Election Records

One of our immediate concerns is the possibility of an outright seizure of election records. If the FBI or another federal agency were to seize the physical ballots and election data, perhaps in connection with congressional authority over congressional elections, the county could lose access to the records needed to independently verify the results. Even if the legality of such an action were disputed, the practical problem would remain if the records were taken.

To mitigate the loss of such crucial data we suggest that San Diego County make at least two regular, secure backups of its electronic election records, including ballot images, cast vote records, and other election data that can readily be archived. These backups could be placed on removable media and secured in separate safes or other secure locations under county control. (Liberty backup instructions are on pp.289 & 424 (pp.308 & 443 of pdf) in <https://votingsystems.cdn.sos.ca.gov/vendors/dominion/ds519/ds519use-proc.pdf>).

Preserving the data raises the next question: if the paper ballots became unavailable, how could the remaining electronic records be independently checked? There needs to be a way to

process the preserved ballot images independently and compare that interpretation with the cast vote records and reported results. We have a solution to help San Diego County.

A Better Reconciliation

Ballot images have important characteristics that make them useful for this purpose. There is only one original paper ballot, and it can potentially be marked, damaged, lost, destroyed, or removed. Ballot images can be copied, backed up, stored in multiple secure locations, and independently analyzed. Once copies have been securely preserved, changes to one copy can be detected by comparison with the others and through cryptographic hashes.

We understand that California places restrictions on ballot images and that there may also be privacy and ballot-secrecy concerns. We want to make sure those concerns are properly addressed. At the same time, San Francisco has made ballot images available for its elections over many years, demonstrating that transparency can be provided while still respecting privacy.

When ballot images are saved, we are pushing for the creation of cryptographic hashes that can be used to detect any changes to those images. This is a step your staff can accomplish as these files are created. (The Windows command is: `certutil -hashfile c:\path\filename SHA256`)

AuditEngine and Exhaustive Reconciliation

We have a mature election software solution “AuditEngine”, piloted in many counties across the country that can help SDC with the upcoming election. We propose the following:

We describe the AuditEngine process as an **Exhaustive Reconciliation of Images (ERI)**. AuditEngine analyzes 100% of the available ballot images and creates an independent interpretation of the votes on each ballot. Where corresponding cast vote records are available from the voting system, these records can be compared ballot by ballot.

The resulting **Ballot Image Reconciliation Report** identifies differences between the independent interpretation and the voting system records so election officials can investigate them. It also provides contest-level information showing the number and nature of reconciliation differences and whether they could be sufficient to affect a reported outcome.

This provides broader coverage than examining selected batches. Every ballot image and every contest represented on those images is examined. It can also reveal patterns associated with ballot styles, scanners, batches, particular contests, or configuration problems.

For the upcoming election, we are proposing an exploratory pilot. Initially, we are not proposing that this replace the 1% manual tally or any other currently required procedure. Yet, if the 1% Manual Tally is eventually replaced, this process is definitely a win both in cost and quality.

Random Image Verification

We also want to explore pairing the exhaustive reconciliation with **Random Image Verification (RIV)**. RIV provides an independent check that the electronic ballot images being analyzed accurately represent the original paper ballots.

One approach would operate while ballots are being scanned. At independently selected random times, perhaps triggered by a random signal, a scanning operator would stop and pull the ballot sheet out, then photograph both sides of that sheet. Also the operator would snap a picture of the current position in the batch, the tabulator and batch id.. One verification sample for every 20,000 ballot sheets processed, which would produce roughly 150 samples based on recent San Diego elections, will check any alteration of images for very close contests. This might be only a couple of samples per shift, per operator.

After scanning, each photograph would be matched with its stored ballot image. The matching could largely be automated, producing a report showing both the photographs and the ballot images to verify the fidelity of that scanned image. The report of this comparison can be provided also by AuditEngine.

A second approach would work in the opposite direction. After scanning, a ballot image would be randomly selected and the corresponding physical ballot retrieved from storage. This is likely more cumbersome than briefly interrupting scanning for a moment to take photos.

RIVERI

We call the combination of these procedures **RIVERI: Random Image Verification with Exhaustive Reconciliation of Images**.

RIVERI creates a verification chain from the physical ballot, to the ballot image, to an independent interpretation, to the voting system's cast vote record and reported results. It can identify ordinary interpretation and scanning errors, ballot-style and configuration errors, and systematic discrepancies affecting particular contests or groups of ballots. The random paper comparison provides an independent check that the images faithfully represent the physical ballots.

This methodology could also provide a means of independently reconstructing and checking election results if the original ballots or working election-system records became unavailable following a seizure.

This method is far more comprehensive than the 1% manual tally or other approaches, and it can be completed a day or two after receiving the ballot images and cast vote records, during the canvass period, so that any issues can be corrected prior to certification. There are multiple vendors that can perform a ballot image audit, so here, I am speaking about the service that Audit Engine can provide.

For your staff, the overhead is minimal, simply exporting the ballot images and cast vote records and uploading to our secure cloud server. Thereafter, we use an AI agent to actually run the multiple stages of the ERI portion. The process can be conceptualized to four major phases:

1. checking the input data and extracting metadata about each ballot
2. mapping: creating the map of ovals on hand-marked ballots and what they mean
3. vote extraction: mark sensing and "reading" human readable portions of BMD ballots
4. Comparison and reporting.

Proposal for the November Election

We ask San Diego County to work with Citizens Oversight on a RIVERI pilot during the upcoming election.

We would like the county to provide Citizens Oversight with the ballot images and corresponding cast vote records as soon as practicable during the canvass period. We expect to be able to process the data through AuditEngine within a day or two and provide the Registrar with a Ballot Image Reconciliation Report while the canvass is still underway. We would also like to work with your office to test practical methods for Random Image Verification.

We can coordinate our pilot so it can occur once nearly all of the ballots are processed by the voting system, but we can work with some missing ballots, such as provisionals.

San Diego is particularly well suited for this pilot because ballots are centrally scanned, including ballots originating at voting locations. The scanning and batch structure should make it possible to associate selected physical ballots with their corresponding images.

Citizens Oversight has also asked Secretaries of State throughout the states and territories to adopt election-data backup procedures. A successful implementation in San Diego could provide a useful model for other jurisdictions.

For this election, RIVERI would supplement the existing statutory procedures. In the longer term, we believe this approach should be evaluated as a possible alternative to the 1% manual tally. The manual tally is labor-intensive, does not examine every ballot or every contest to the same degree, and concerns about the work involved have contributed to ballots being excluded from the process.

RIVERI examines every available ballot image and every contest represented on those images, while retaining a randomized connection back to the physical paper ballots. It has the potential to provide substantially broader verification with less manual effort.

We would like to work with the San Diego County Registrar of Voters to implement this pilot in the upcoming election. We are providing a separate RIVERI fact sheet describing the proposed process in greater detail.

Thank you for considering this proposal.

Raymond Lutz

A handwritten signature in black ink, appearing to read 'Ray Lutz', with a stylized flourish at the end.

Executive Director, Citizens Oversight

(This proposal was initiated in conjunction with Smart Elections, CA)

P.S. THESE PROCEDURES will ensure protection of the recorded votes, and offer added verification and increased transparency and voter confidence by making the copies of the ballots (the evidence) available for independent tabulation.

RIVERI Implementation Guide

Dominion/Liberty Vote Voting Systems

Election Office Actions

Backups of Election data. Liberty/Dominion backup instructions on pp.289 & 424 (pp.308 & 443 of pdf) <https://votingsystems.cdn.sos.ca.gov/vendors/dominion/ds519/ds519use-proc.pdf>

Please note that the Backups as specified by Dominion/Liberty Vote create a backup of the entire database. Exports for RIVERI require ONLY the ballot images and cast vote record exports. Backups should be made as soon as possible and regularly throughout the canvass period, not just at the end, to address possible seizure, earthquake or other disaster.

Ballot Images and Cast Vote Records for reconciliation. After all (or nearly all) ballots have been scanned and processed, but within the canvass period (before certification, if possible):

1. Export the ballot images and CVRs and create ZIP archives.
2. Create hash values for the data files.
3. Upload the zip archives into AuditEngine using the link we provide OR provide a thumbdrive to the contractor.

See: https://auditengine.org/docs/user-guide/dom_exporting_guide/
and: https://auditengine.org/docs/user-guide/sending_data/

Results Link. We need a link to the official election results as of the time the ballot images and CVRs are uploaded. This provides an outside reference for the reported results and the number of voters and cast vote records expected.

Starting RIVERI. After these items are uploaded, all you need to do is launch RIVERI. Our AI agent will begin processing the election immediately and provide feedback when appropriate.

Ballot Design Tips for Best Results

QR Codes Not Read. We do not read QR codes as a matter of policy. Because the ballot style and precinct information may be encoded in the QR code, we need this information printed in human-readable form on the face of the ballot. Otherwise, we must rely on the CVR for this metadata.

BMD Ballot Style. On Dominion BMD ballot images, it is preferable to have the ballot style and precinct printed on the face of the ballot summary sheet in bold text large enough to be reliably read. The style designator should uniquely identify which contests appear on that ballot, and is equivalent to the `ballot_type_id` commonly used.

Precinct. If you would also like the precinct to be available to RIVERI, print the precinct identifier on the face of the BMD ballot as well.

Consistent Contest Names. It is helpful to use consistent contest names throughout, since Dominion/LV BMD ballots allow longer contest names that can be identical to those on full-face ballots. Keeping consistent names can eliminate sources of errors.

Use complete contest names. Not just "Mayor" but "Mayor, Townname", for example.

Avoid gray background, inverted text, and icons: Scanned images are not clear if you use gray backgrounds, inverted text (white characters on black background), or icons, such as hands pointing, etc. These become hard to read because the black pixels tend to expand in the scans.

Avoid landscape orientation and grid-ballots: Although AuditEngine can handle landscape orientation and grid ballots, they are problematic for many reasons. stick with portrait orientation with three columns with contest names followed by options.

Left Ovals: Although AuditEngine can work with right-side ovals, there are technical reasons to stay with left-side ovals. From our review of many elections, we think right ovals can be confusing as they may be associated with the next column.

Use "Or Write-in" not just "Write-in". It is a common voter mistake for voters to mark a listed candidate AND write in the same name in the write-in box. Using "Or Write-in" implies that you don't have to do both to reduce this voter mistake.

Consider making "strikeouts" a supported option. Some counties, like Broomfield County, CO have adopted a standard option for voters to strike out an accidental double vote.

Print the County Name in a consistent place. Sometimes ballots are delivered to the wrong county and this can be detected when the images are analyzed.

Requirements of Reconciliation Software

Although we specifically are recommending the use of AuditEngine, the analysis software should have the following attributes:

1. Process all images and cast-vote records.
2. Check whether any images are exact duplicates, which can occur if multiple uploaded for the same data is accidentally performed.
3. Use an independent mapping approach that does not use any data from the voting system and provide proofs that can be inspected by the human eye.
4. Exhaustively process all ballots to create an independent record for each ballot.
5. Process any ballots from BMD systems by "reading" human-readable text rather than by using QR codes or barcodes.

6. Compare the voting system results in the form of ballot-level cast vote record (CVR) data with the independently generated results from the audit system based on ballot images from the voting system on a ballot-by-ballot level.
7. Report on the detailed results of each contest to allow detailed review of any contest with a high number of variances.

The benefits of an ERI over the 1% manual tally

If we find that RIVERI is acceptable for auditing the results, state statutes should be revised to allow it as an alternative to the 1% Manual Tally.

Criteria	Exhaustive Image Reconciliation (ERI)	1% Manual tally
Independently conducted	Yes	No. Conducted by the election office staff. (Recognized as an auditing deficiency).
Scope	100% of images checked against CVR data.	About 1% of ballots checked against batch aggregate totals, randomly chosen from the "semi-final canvass", excluding mail ballots not processed on election day and after, unless they are explicitly added.
Contests Checked	100% of contests checked in all precincts and all ballot types.	No guarantee that all contests are sufficiently checked if batch-mode is used, otherwise, one precinct per contest is checked.
Duplicate Uploads	Repeated ballot image check will catch repeated uploads.	Batches of ballots will be checked against the data for that batch. Will not detect additional image data that exists for the same batch.
Configuration Errors	Will be detected during the mapping process which includes human-eye review of each ballot style.	May be caught if the sample happens to include ballots with that error, but not guaranteed.
Hacked Images	Random Image Verification (RIV) will detect if even one image is sampled with a hack. Otherwise, hash values will detect subsequent modification.	If the image was hacked to create an incorrect CVR for that ballot, it would be detected if sampled but would be hard to find in the aggregated batches and may not be noticed.