





## Risk Limiting Audits: Kentucky Pilot Project



9.00 arm - 5.00 pm 9.00 arm - 5.00 pm Motored of 9.00 arm - 8.00 c Applicagnes for

Jennifer Morrell The Elections Group October 25, 2022 7.00am-10.00pm

Note that as long as you are in the polling station, as we a queue outside, before 10,00pm you will be entitled to apply for a ballot paper Slimming World Here at the CASCA Centre Every Wednesday

# Why audit elections?

Detect voting system errors

- human error
- misconfiguration
- manipulation
- Provide accountability to voters
- Deter fraudulent activity
- Assure votes were issued, counted, and reported accurately

 Provide feedback for process improvement

#### Why RLA?

An RLA is nationally recognized as a reliable method to...

- Validate the integrity of your voting equipment
- Verify the accuracy of your results
- Detect and correct outcome changing errors in vote tabulation
- Audit efficiently!

#### Risk-Limiting Audit

#### A risk-limiting audit (RLA) is...

- a post-election tabulation audit
- that examines a random sample of voted ballots
- to provide a statistical level of confidence
- that the outcome of the election is correct

**Risk-Limiting Audits** All ballots, from every precinct, have an equally likely chance of being selected for audit.

The audit is designed to escalate to additional rounds of auditing, and ultimately a full hand recount, if discrepancies are discovered.

#### **Traditional Audits**

Only ballots in the selected precincts are audited.

The audit concludes after the designated number of ballots has been reviewed and counted, regardless of discrepancies.

### Kentucky RLA Pilot Working Group

- Anderson County
- Fayette County
- Henderson County
- Johnson County
- Kenton County
- Madison County

- Kentucky Board of Elections
- Kentucky Secretary of State Staff
- Election Systems & Software
- Hart InterCivic
- Harp Enterprises
- Trey Grayson

### **Target contest:**

Last Westing States

201

A ballot contest selected to determine the initial sample size in an RLA

the state of the s

state Contrat Committeewoman. 4th District adverse and 14) Alexander "Alexi" Glannoutlas des ..... No. Westwood Diverse, 198 (51) Irin V. Martinez write-in State Central Committeeman, HOAD DOP INSCIDE 4th District Membro, Comisión Central Estatat. Governor Gobernador 4." Dto. Vote for One + Vote por Uno Vote for One . Vote por Uno (11) Pat Quinn (53) Ricardo Muñoz (54) Antonio "Tony" Munoz (12) Daniel W. Hynes (55) Humberto "Berto" Ramirez write-in Voto por escrito State Representative, Lieutenant Governor 39th District Teniente Gobernador Representante Estatal, 39.º Dto. Vote for One . Vote por Uno Vote for One . Vote por Uno (17) Arthur L. Turner (71) Maria Antonia "Toni" Berrios (18) Terry Link (19) Rickey R. Hendon

Bill) Maureen Kally (90) Todd Connor (02) Kari K. Stoele write-in VINI DOF 4000MD write-In volió por edoria write-in voto por escritrix President of County Board Presidente de la Mesa del Condado Vote for One . Vote por Uno (95) Toni Preckwinkle (96) Terrence J. O'Brien (97) Dorothy A. Brown (98) Todd H. Stroger

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in Marthdoorn Many Orthonord

#### **Risk limit:**

The maximum possible chance that your audit will fail to detect and correct an incorrect election outcome



#### Sample size:

The number of ballots inspected during the RLA



## **Ballot Polling**

20

# Pre-Audit Ballot Tracking and Organization



**Ballot** accounting provides a way to consistently and accurately record the number of ballots in your possession at a given point in time and document any changes.

### Why Ballot Accounting Matters

- Ballot reconciliation and chain of custody are the foundation of your audit's paper trail.
- Way to ensure votes have not been dropped, lost, or added as a result of human error or a failure of voting equipment.
- Ensures the ballot record remains complete and intact from the moment ballots are cast through the audit.
- Evidence the ballot record is trustworthy!

	А	В	С	D	E
1	County	Scanner Name	Batch #	<b>Total Ballots</b>	<b>Container Name</b>
2	Adams	3	12	10	TC-5
3	Adams	3	13	10	TC-5
4	Adams	3	14	10	TC-5
5	Adams	3	15	10	TC-5
6	Adams	3	16	10	TC-5
7					

- A ballot manifest is a log that documents how many ballot cards your voting system scanned and where they are located.
- It can be a simple spreadsheet or paper log
- It should always be created independent of the voting system.

#### FIGURE 6: MANIFEST AND LABEL FOR POLLING PLACE WITH A SINGLE SCANNER.

BALLOT MANIFEST									
Polling Location	Ballot Box ID	<b>Total Ballots</b>							
North Library	60	984							
Corner Church	7	422							
Civic Center	25	1,167							

Precint #: North Library Ballot Box: 60	
Total Ballots: 984	
Seal # <i>A95162</i>	
Poll Worker Initials: <i>TP</i> Poll Worker Initials: <i>JM</i>	

#### **BALLOT MANIFEST**

$\frac{03}{10} = \frac{16}{100} = \frac{100}{100} = 1$	Scanner Name	e Batch #	Total Ballots in Batch	Conta	iner Name	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	03	16	100	TC-5		
$O_3$ 19       100       TC-5 $O_3$ 20       99       TC-5         CONTAINER NAME: TC-5         Scanner ID: 3       Batch #: 18         Name: Haley         O3       16       100         O3       16       100         O3       16       100         O3       18       98         JOD       -       3       =       98       03       19       100         IOD       -       3       =       98       03       20       99       100	03	17	100	TC-5		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	03	18	98	TC-5		
CONTAINTR NAME: TC-5Scanner ID: 3Batch #: 18O316Aame: HaleyO316O316O316O316O316O318O318O319IO0O319O319O320O320O320O320O320O320O320O320O320O320	03	19	100	TC-5		
Scanner ID: 3Batch #: 18Name: Haley $03$ 16100Beginning CountFinal Count $03$ 1898100-3=98 $03$ 19100 $03$ 2099 $03$ 100 $03$ 100	03	20	99	TC-5		
Scanner ID: 3Batch #: 18Name: Haley $03$ 16100Beginning CountRemoved for DuplicationFinal Count $03$ 1898100 $3$ $=$ 98 $03$ 19100100 $3$ $=$ 98 $03$ 2099						
Scanner ID: 3       Batch #: 18         Name: Haley       O3       16       100         Beginning Count       Removed for Duplication       Final Count       O3       18       98         100       -       3       =       98       O3       19       100         03       19       100       O3       20       99						
Name: Haley Beginning Count 100 - $3$ = $9803$ $17$ $10003$ $18$ $9803$ $19$ $10003$ $19$ $10003$ $20$ $99$	allot Scanning					Tatal Dallata
Removed for DuplicationFinal Count $03$ $17$ $100$ 100-3=98 $03$ 189800-3=98 $03$ 19 $100$ 032099 $03$ 2099		atch #: 18			Batch	Total Ballots
100 - 3 = 98 $03 = 100$ $03 = 100$ $03 = 20 = 99$	canner ID: 3 B	atch #: 18		nner Name	Batch Number 16	100
100 - 3 = 98 $03 = 20 99$	canner ID: 3 B lame: Haley <b>Removed for</b>			nner Name 03 03	Batch Number 16 17	100 100
Scanner count verified? TOTAL BALLOTS: 497	canner ID: 3 B lame: Haley eginning Count Duplication	Final Count		nner Name 03 03 03	Batch Number 16 1 1 18	100 100 98
	canner ID: 3 B lame: Haley eginning Count Duplication	Final Count		nner Name 03 03 03 03	Batch Number 16 17 18 19	100 100 98 100
	canner ID: 3 B lame: Haley eginning Count 100 - 3	Final Count		nner Name 03 03 03 03 03 03 TOTA	Batch Number 16 17 18 19 20 L BALLOTS:	100 100 98 100 99

County Name	Batch	Total Number of Ballots
Madison	Central Count - Mail - Scanner 20378	162
Madison	Central Count - Absentee Walk-ins - Scanner 20379	15
Madison	Vote Center 1 - 101	150
Madison	Vote Center 1 - 102	206
Madison	Vote Center 1 - 103	172
Madison	Vote Center 2 - 121	100
Madison	Vote Center 3 - 123	194
Madison	Vote Center 3 - 124	167
Madison	Vote Center 4 - 131	25
Madison	Vote Center 4 - 132	61
Madison	Precinct 19 - 161	219
Madison	Precinct 24 - 182	132

RLA Pilot Ballot Manifest

### RLAs can be made easier with software

- $\circ$   $\,$  Perform the math calculations  $\,$
- $\circ$   $\,$  Determine the starting sample size
- Randomly select ballots for audit
- $\circ$  Account for discrepancies
- $\circ$  Calculate when the risk limit has been met
- $\circ$  Determine when the audit can stop

### KY RLA pilot will use a spreadsheet

	A	В	С	D	E	F	G
1	Sample size estimate						
2	Votes for reported winner	50000			helper ca	culations	
3	Votes for reported runner-up	40000			pW2	0.5555555	
4	Desired chance of 1st-round completion	90%			pL2	0.4444444	
5	risk limit	10%			plus	0.105360	
6					minus	-0.117783	
7	Total ballots (from manifest)	142811			threshold	2.302585	
3	Diluted margin	0.070022			Z	-1.281551	
Э	BRAVO sample size (est.)	1153			d	0.246913	
0					f	10.31885	
1	P value estimate				g	0.027720	
2	Sample votes for reported winner	400			q_a	0.000768	
3	Sample votes for reported runner-up	325			q_b	-0.977607	
4					q_c	106.4786	
5	BRAVO p value	2.097%			radical	0.792740	
6							
7							
8							
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6							
	+	ed and Siz		Sampl		anifest 👻	

#### Performing the Audit

County Name	Batch	Total Numb Ballots	per of
Madison	Central Count - Mail - Scanner 20378	162	
Madison	Central Count - Absentee Walk-ins - Scanner 20379	15	
Madison	Vote Center 1 - 101	150	
Madison	Vote Center 1 - 102	206	
Madison	Vote Center 1 - 103	172	
Madison	Vote Center 2 - 121	100	All

Ballot manifest and summary results report sent to BOE Unofficial Results Adams County, June 2019 Special Election, Jun 11, 2019 All Precincts, All Districts, All <u>ScanStations</u>, All Contests, All Boxes Total Ballots Cast: 50, Registered Voters: 172, Overall Turnout: 29.0%

Choice All Precincts

Best Coffee Chain (Vote for 1)

50 ballots (0 overvotes, 1 blank voted), 172 registered voters, turnout 29.0%

Vote %

Starbucks	15	30%	
Peet's	4	8%	
Dunkin	12	24%	
Caribou	7	14%	
Seattle's Best	9	18%	
Tully's	2	4%	
McDonalds	0	0%	
Write-in	1	2%	
Total	50	100%	

Votes

 Random sampling, dice rolling, and pseudorandom number generators...

#### **Retrieve Ballots**

	Audited Ba	llots			Audited Ba	llots			Audited Ba	llots	
	RLA Demonst	ration			RLA Demonst	ration			RLA Demonst	ration	
<b>Container Name</b>	Scanner Name	Batch #	Ballot	<b>Container Name</b>	Scanner Name	Batch #	Ballot	Container Name	Scanner Name	Batch #	Ballot
Α	1	1	1	В	2	1	3	С	3	1	3
А	1	2	4	В	2	2	1	С	3	2	5
А	1	3	2	В	2	3	3	С	3	3	2
А	1	4	3	В	2	4	2	С	3	4	4
А	1	5	2	В	2	5	4	С	3	5	3
D	1	6	1	E	2	6	5	F	3	6	2
D	1	7	5	E	2	7	2	F	3	6	5
D	1	8	3	E	2	8	3	F	3	7	4
D	1	9	2	E	2	9	1	F	3	8	1
D	1	10	4	E	2	10	2	F	3	8	3
G	1	11	2	Н	2	11	3	I	3	11	3
G	1	12	1	Н	2	12	4	I	3	12	4
G	1	13	2	Н	2	13	2	I	3	13	3
G	1	14	3	Н	2	14	1	I	3	14	2
G	1	15	4	Н	2	15	1	I	3	15	1

#### Tally Ballots

Favorite Toy Story Character	Batch	Ballot #	TOTAL																		
Во Реер														1							TOTAL
Buzz Lightyear																					
Mr. Potato Head																					
Rex																					
Slinky																					
Woody																					
Vrite-Ins:																					
Overvotes:																					
Undervotes:																					

# Completing the audit

- Audit board inputs are compared to summary results
- Determine if the risk limit is satisfied or need for additional rounds of auditing

	A	В	С	D	E	F	G
1	Sample size estimate						
2	Votes for reported winner	50000			helper ca	lculations	
3	Votes for reported runner-up	40000			pW2	0.5555555	
4	Desired chance of 1st-round completion				pL2	0.444444	
5	risk limit	10%			plus	0.105360	
6		20/0			minus	-0.117783	
7	Total ballots (from manifest)	142811				2.302585	
8	Diluted margin	0.070022			Z	-1.281551	
9	BRAVO sample size (est.)	1153			d	0.246913	
10					f	10.31885	
11	P value estimate				g	0.027720	
12	Sample votes for reported winner	400			g_a	0.000768	
13	Sample votes for reported winner-up	325			q_a q_b	-0.977607	
14	sample votes for reported runner-up	525			q_c	106.4786	
15	BRAVO p value	2.097%			radical	0.792740	
16	biarto p talac	2.03770			Turunoun	0.702740.	
17							
18							
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#### **RLA Pilot Goals**

- Provide county officials with a hands-on experience to learn how RLAs work
- Become familiar with RLA terms and procedures
- Develop an RLA method that works in Kentucky
- Develop RLA procedures and a ballot manifest that works in every county

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