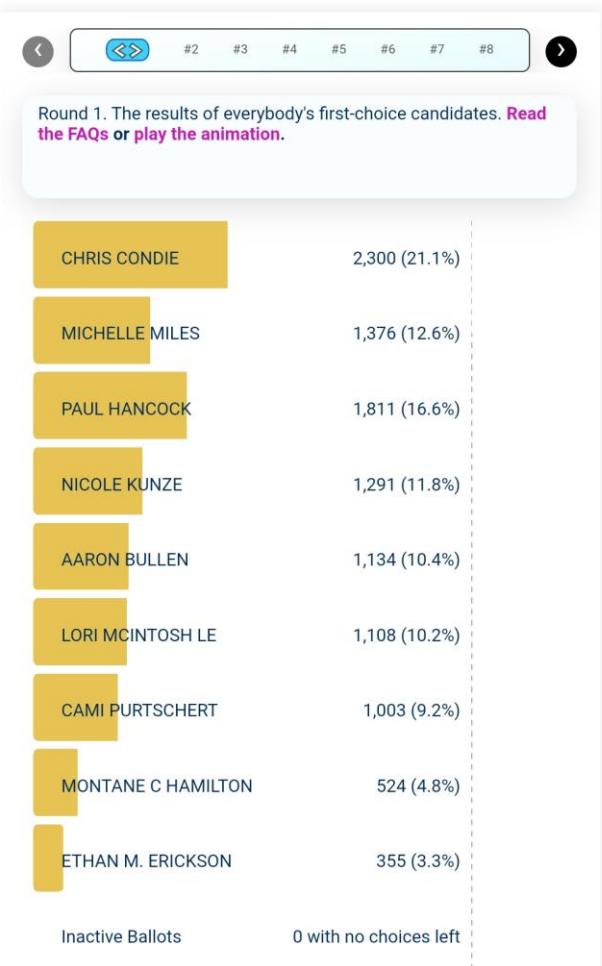# Moab

Complexity Favors the Well-Connected
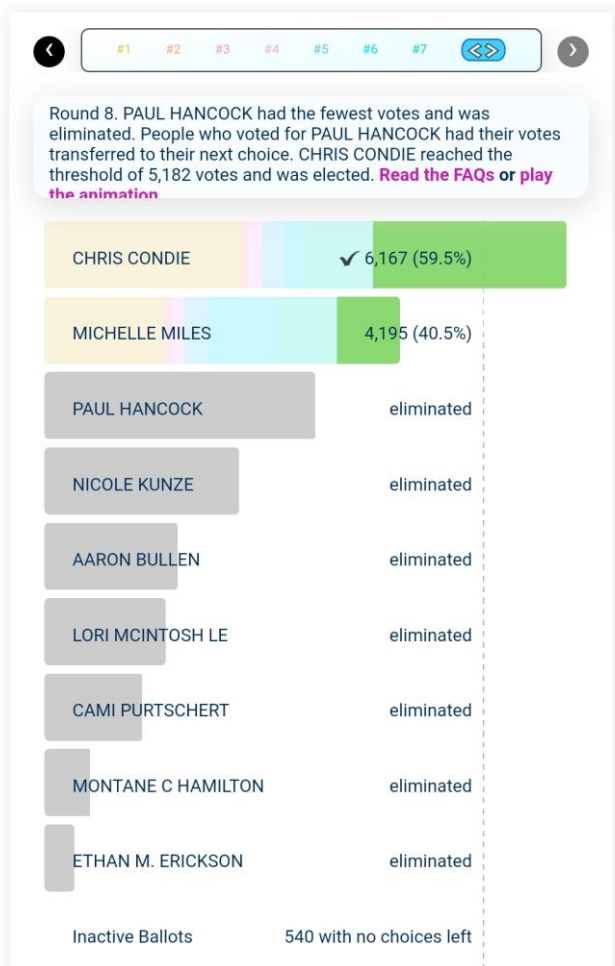
⠿RCVis

| Lehi City Council
Tuesday, November 2, 2021
The results of a ranked–choice voting election. | Download Raw Summary Data

‹ | **‹›** | #2 | #3 | #4 | #5 | #6 | #7 | #8 | ›

Round 1. The results of everybody's first-choice candidates. **Read the FAQs** or **play the animation**.

Candidate	Votes
CHRIS CONDIE	2,300 (21.1%)
MICHELLE MILES	1,376 (12.6%)
PAUL HANCOCK	1,811 (16.6%)
NICOLE KUNZE	1,291 (11.8%)
AARON BULLEN	1,134 (10.4%)
LORI MCINTOSH LE	1,108 (10.2%)
CAMI PURTSCHERT	1,003 (9.2%)
MONTANE C HAMILTON	524 (4.8%)
ETHAN M. ERICKSON	355 (3.3%)
Inactive Ballots	0 with no choices left

⠿RCVis

‹ | #1 | #2 | #3 | #4 | #5 | #6 | #7 | **‹›** | ›

Round 8. PAUL HANCOCK had the fewest votes and was eliminated. People who voted for PAUL HANCOCK had their votes transferred to their next choice. CHRIS CONDIE reached the threshold of 5,182 votes and was elected. **Read the FAQs** or **play the animation**.

Candidate	Votes
CHRIS CONDIE	✔ 6,167 (59.5%)
MICHELLE MILES	4,195 (40.5%)
PAUL HANCOCK	eliminated
NICOLE KUNZE	eliminated
AARON BULLEN	eliminated
LORI MCINTOSH LE	eliminated
CAMI PURTSCHERT	eliminated
MONTANE C HAMILTON	eliminated
ETHAN M. ERICKSON	eliminated
Inactive Ballots	540 with no choices left

1:25 · 62%
https://rcvis.com/v/21g_le_cc_
1:25 · 62%
https://rcvis.com/v/21g_le_cc_
1:25 · 62%
https://rcvis.com/v/21g_le_cc_
1:25 · 62%
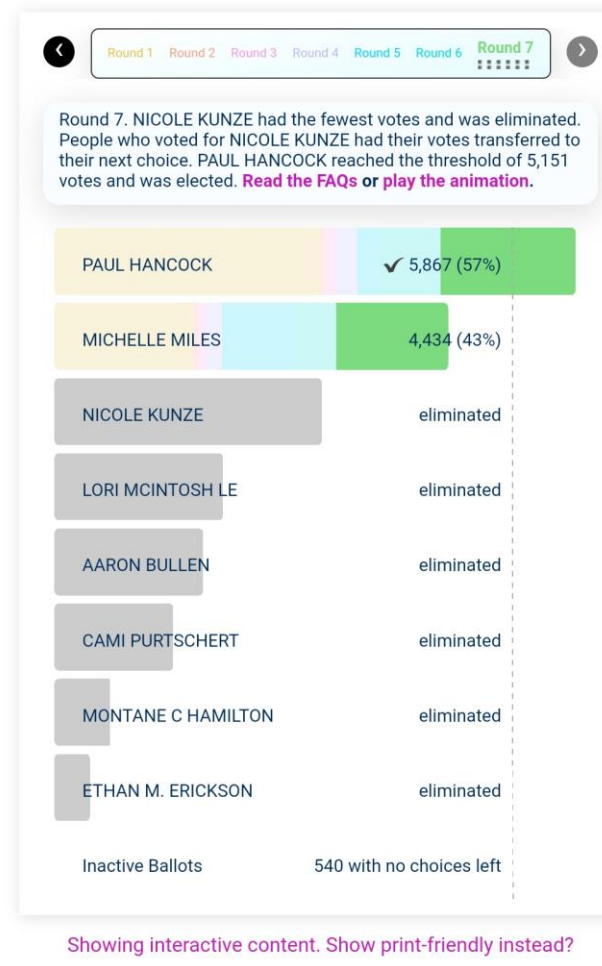https://rcvis.com/v/21g_le_cc_

RCVis

Panel 1

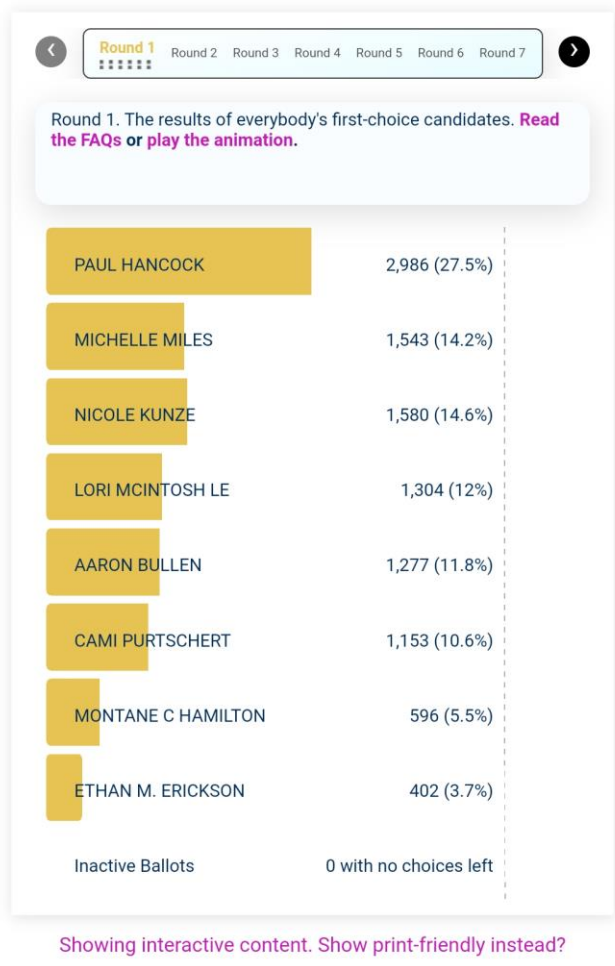# Lehi City Council
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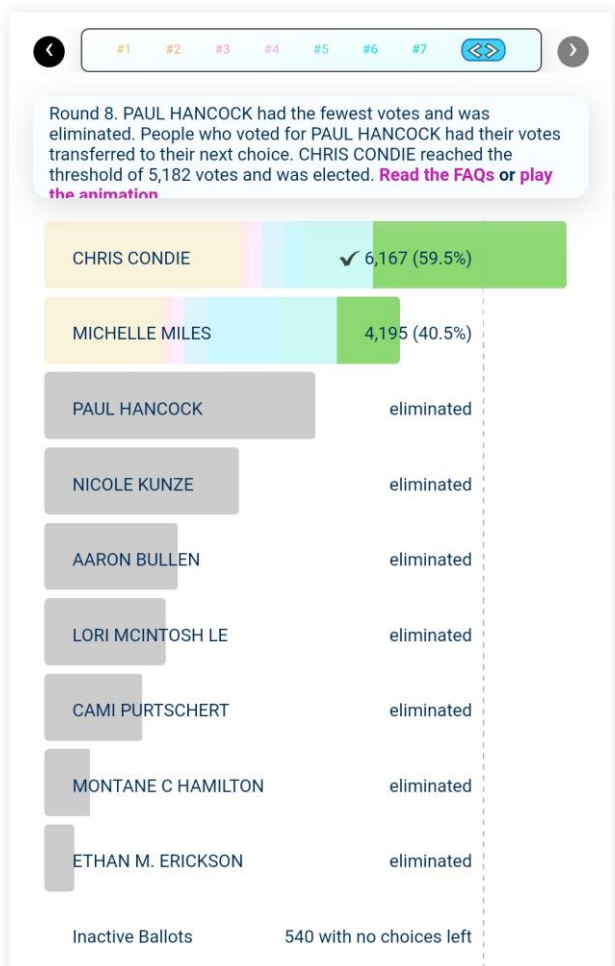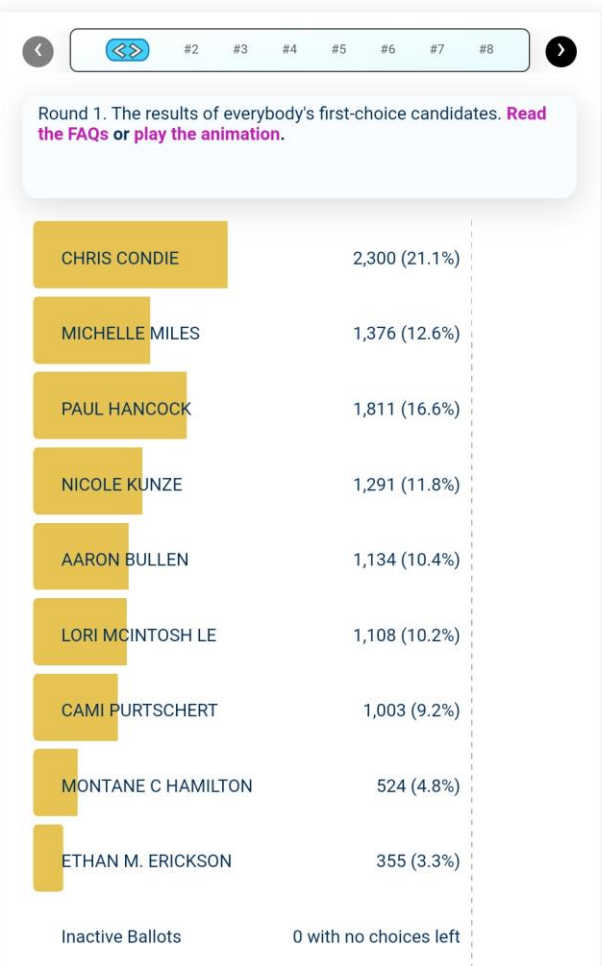#2 #3 #4 #5 #6 #7 #8

Round 1. The results of everybody's first-choice candidates. **Read the FAQs** or **play the animation.**

Candidate	Votes
CHRIS CONDIE	2,300 (21.1%)
MICHELLE MILES	1,376 (12.6%)
PAUL HANCOCK	1,811 (16.6%)
NICOLE KUNZE	1,291 (11.8%)
AARON BULLEN	1,134 (10.4%)
LORI MCINTOSH LE	1,108 (10.2%)
CAMI PURTSCHERT	1,003 (9.2%)
MONTANE C HAMILTON	524 (4.8%)
ETHAN M. ERICKSON	355 (3.3%)
Inactive Ballots	0 with no choices left

Panel 2

Lehi City Council
Tuesday, November 2, 2021
The results of a ranked–choice voting election. | Download Raw Summary Data

#1 #2 #3 #4 #5 #6 #7

Round 8. PAUL HANCOCK had the fewest votes and was eliminated. People who voted for PAUL HANCOCK had their votes transferred to their next choice. CHRIS CONDIE reached the threshold of 5,182 votes and was elected. **Read the FAQs** or **play the animation.**

Candidate	Votes
CHRIS CONDIE	✔ 6,167 (59.5%)
MICHELLE MILES	4,195 (40.5%)
PAUL HANCOCK	eliminated
NICOLE KUNZE	eliminated
AARON BULLEN	eliminated
LORI MCINTOSH LE	eliminated
CAMI PURTSCHERT	eliminated
MONTANE C HAMILTON	eliminated
ETHAN M. ERICKSON	eliminated
Inactive Ballots	540 with no choices left

Panel 3

Lehi City Council
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The results of a ranked–choice voting election. | Download Raw Summary Data

Round 1 | Round 2 | Round 3 | Round 4 | Round 5 | Round 6 | Round 7

Round 1. The results of everybody's first-choice candidates. **Read the FAQs** or **play the animation.**

Candidate	Votes
PAUL HANCOCK	2,986 (27.5%)
MICHELLE MILES	1,543 (14.2%)
NICOLE KUNZE	1,580 (14.6%)
LORI MCINTOSH LE	1,304 (12%)
AARON BULLEN	1,277 (11.8%)
CAMI PURTSCHERT	1,153 (10.6%)
MONTANE C HAMILTON	596 (5.5%)
ETHAN M. ERICKSON	402 (3.7%)
Inactive Ballots	0 with no choices left

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Panel 4

Lehi City Council
Tuesday, November 2, 2021
The results of a ranked–choice voting election. | Download Raw Summary Data

Round 1 | Round 2 | Round 3 | Round 4 | Round 5 | Round 6 | **Round 7**

Round 7. NICOLE KUNZE had the fewest votes and was eliminated. People who voted for NICOLE KUNZE had their votes transferred to their next choice. PAUL HANCOCK reached the threshold of 5,151 votes and was elected. **Read the FAQs** or **play the animation.**

Candidate	Votes
PAUL HANCOCK	✔ 5,867 (57%)
MICHELLE MILES	4,434 (43%)
NICOLE KUNZE	eliminated
LORI MCINTOSH LE	eliminated
AARON BULLEN	eliminated
CAMI PURTSCHERT	eliminated
MONTANE C HAMILTON	eliminated
ETHAN M. ERICKSON	eliminated
Inactive Ballots	540 with no choices left

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Race (Seat)	Plurality Disagreement	Failed Majority	2nd Winner Misidentification	Condorcet Failure	Reversal (partial)	Reversal (compl.)	Promoting NM	Demoting NM	Bottom Add	Bottom Remove	Loser Dropout	% Fields Read
Elk Ridge Mayor	·	·	·	·	·	·	·	·	·	·	·	63.1
Genola Council (1)	·	✓	·	·	·	·	·	·	·	·	·	65.4
Lehi Council (1)	·	·	✓	·	·	·	·	·	·	·	·	29.4
Lehi Council (2)	·	·	✓	·	·	·	·	·	·	·	·	31.0
Springville Mayor	·	·	·	·	·	·	·	·	·	·	·	62.5
Springville Council 4yr (1)	·	·	✓	·	·	·	·	·	·	·	·	32.9
Springville Council 4yr (2)	·	·	·	·	·	·	·	·	·	·	·	37.4
Springville Council 2yr	·	·	·	·	·	·	·	·	·	·	·	60.4
Vineyard Mayor	·	·	·	·	·	·	·	·	·	·	·	58.3
Vineyard Council (1)	·	✓	·	·	·	·	·	·	·	·	·	39.1
Vineyard Council (2)	✓	·	✓	·	·	·	·	·	·	·	·	49.8
Woodland Hills Mayor	·	·	·	·	·	·	·	·	·	·	·	66.8
Woodland Hills Council (1)	·	·	✓	·	·	·	·	·	·	·	·	50.6
Woodland Hills Council (2)	·	·	·	·	·	·	·	·	·	·	·	67.8
Moab Council (1)	·	✓✓	✓	✓	·	·	✓	·	✓	✓	✓	43.6
Moab Council (2)	·	·	✓	·	·	·	·	·	·	·	·	52.7

Table 2: Overview of the observed phenomena on the Utah County & Moab IRV data set. Note that Genola Council Seat 2 is excluded as it is not an IRV race (less than three candidates). "NM" stands for Non-Monotonicity.

"Failed Majority:" IRV winner tally <50% of initial ballots

"2nd Winner MisID:" Seat-1 race runner-up does not win Seat-2 race

"Condorcet Failure:" Candidate who defeats all others head-to-head loses the election

The Four Paradoxes (Promo/Demo NM, Bottom Add/Remove Participation Failures) are serious pathologies – all detected in Moab

"Fields Read" Average percentages of ballot entries that IRV actually "reads"

2nd Winner Misidentification

Moab City Council

Tuesday, November 2, 2021

The results of a ranked-choice voting election. | Download Raw Data

Candidate name	Round 1	Round 2	Round 3	Round 4
JASON TAYLOR	**38.5%** 699 votes	**38.7%** 703 votes	**45.6%** 811 votes	**51.5%** 901 votes
JOSIE KOVASH	**25.4%** 462 votes	**25.8%** 468 votes	**27.2%** 484 votes	**48.5%** 847 votes
LUKE WOJCIECHOWSKI	**25.0%** 455 votes	**25.2%** 458 votes	**27.2%** 483 votes	
MIKE MCCURDY	**9.9%** 179 votes	**10.2%** 186 votes		
ANTHONY CHARLES	**1.2%** 22 votes			
Inactive Ballots	**0** ballots	**2** ballots	**39** ballots	**69** ballots

Failed Majority

Total Ballots: 1856

Winner Count: 901

Total Percentage Win: 48.5%

Total Ballots Unspoiled: 1817

Winer Count: 901

Total Percentage Win: 49.5%

Condorcet Failure

Below table shows pairwise preference statistics in the Moab Seat 1 race. Each row corresponds to a candidate and each column to their opponent. The count in each cell is the number of preferences the row-candidate holds against the respective opponent. Column "wins" gives the number of head-to-head wins for each row-candidate.

	wins	AC	JT	JK	LW	MM	RF
AC	(1):	--	265	216	181	320	675
JT	(4):	1183	--	896	835	1098	1298
JK	(3):	1062	839	--	562	965	1122
LW	(5):	1191	914	758	--	1060	1250
MM	(2):	902	353	661	608	--	1056
RF	(0):	41	29	35	31	29	--

Condorcet Failure

The following are the preferential tallies for the (Condorcet) candidate Luke Wojciechowski, defeating all five opponents pairwise. As an example, the first line tells us that LW was preferred over AC 1191 times, while AC was preferred over LW 181 times.

```
LW   (1191)   >   AC   (181)
LW   (914)    >   JT   (835)
LW   (758)    >   JK   (562)
LW   (1060)   >   MM   (608)
LW   (1250)   >   RF   (31)
```

Recall that the IRV winner was JT.

Non-Monotonicity: More is Less/Less is More

These three vote changes that up-rank the original winner JT, cause him to lose:

```
Original ranking                          Manipulated ranking
MM > AC > JK > LW > JT          ==>       JT > MM > AC > JK > LW
MM > JK > JT > AC               ==>       JT > MM > JK > AC
MM > JK > LW > AC > RF > JT     ==>       JT > MM > JK > LW > AC > RF
```

The new winner is LW.

Non-Monotonicity: More is Less/Less is More

A.2 Participation Failure - Bottom Add

By adding these 765 identical new votes ranking LW bottom, the loser, LW, will win the election:

```
765:    AC > JT > JK > MM > RF > LW
```

A.3 Participation Failure - Bottom Remove

By removing these 3 existing votes that bottom-rank the winner, JT, he will lose the election:

```
Remove 1:    JK > LW > AC > MM > RF > JT
Remove 2:    JK > LW > AC > RF > MM > JT
```

The new winner is LW.

Ballot Statistics in Our Data Set

Race (Seat)	#Ballots	#Candidates	Average Length	#Discarded Ballots (%)		#Impure Ballots (%)	
Elk Ridge Mayor	1309	3	2.7	2	(0.2%)	5	(0.4%)
Genola Council (1)	337	3	2.6	56	(16.6%)	140	(41.5%)
Genola Council (2)	296	2*	2.0	97	(32.8%)	124	(41.9%)
Lehi Council (1)	10902	9	7.2	569	(5.2%)	575	(5.3%)
Lehi Council (2)	10841	8	6.4	630	(5.8%)	565	(5.2%)
Springville Mayor	6107	3	2.5	200	(3.3%)	48	(0.8%)
Springville Council 4yr (1)	6031	7	5.9	276	(4.6%)	273	(4.5%)
Springville Council 4yr (2)	5946	6	5.0	361	(6.1%)	269	(4.5%)
Springville Council 2yr	6040	3	2.7	267	(4.4%)	54	(0.9%)
Vineyard Mayor	1534	3	2.6	6	(0.4%)	7	(0.5%)
Vineyard Council (1)	1517	5	3.8	23	(1.5%)	13	(0.9%)
Vineyard Council (2)	1460	4	2.9	80	(5.5%)	11	(0.8%)
Woodland Hills Mayor	655	3	2.6	3	(0.5%)	3	(0.5%)
Woodland Hills Council (1)	645	4	3.4	13	(2.0%)	13	(2.0%)
Woodland Hills Council (2)	628	3	2.6	30	(4.8%)	13	(2.1%)
Moab Council (1)	1803	6	3.3	44	(2.4%)	528	(29.3%)
Moab Council (2)	1698	5	2.8	149	(8.8%)	489	(28.8%)

Ballots with over/undervote as first rank

Ballots with over/undervote at any but first rank

"Undervote" is a gap in the ranking
"Overvote" is caused by multiple candidates ranked at same position

Highlighted races: Discarded + Impure >= 10%

Table 1: Ballot statistics per race. A ballot is discarded if there is under/overvote at the first-rank position. An impure ballot is one that needed modification (truncation) to make it valid. *Note that the Genola City Council (2) has only two candidates and hence is not an IRV race.

Ballot Confusion

Moab Council 1: 2.4% Discarded + 29.3% Impure = 31.7% Errors
Moab Council 2: 8.8% Discarded + 28.8% Impure = 37.6 % Errors

Genola Council 1: 16.6 % Discarded + 41.5% Impure = 58.1% Errors
Genola Council 2: 32.8% Discarded + 41.9% Impure = 74.7% Errors