Density Analysis Report

Run Density Analysis System

2025-09-15 09:11:50

Improved Per-Event Density Analysis Report

Generated: 2025-09-15 09:11:50

Analysis Period: 2025-09-15

Time Bin Size: 30 seconds

Total Segments: 22

Processed Segments: 22

Skipped Segments: 0

Quick Reference

Units: - Areal density = persons per square meter (p/m²) - Linear density = persons per meter of course width (p/m) - Flow = persons per minute per meter (p/min/m)

Terminology: - **gte** = greater-than-or-equal-to; thresholds are applied inclusively - **LOS** = Level of Service (A=Free Flow, B=Comfortable, C=Moderate, D=Dense, E=Very Dense, F=Extremely Dense)

Color Coding: [GREEN] Green (A-B), [YELLOW] Yellow (C-D), [RED] Red (E-F)

Executive Summary

Segment	Label	Key Takeaway	LOS
A1	Start to Queen/Regent	High release flow - monitor for surges	[GREEN] A
A2	Queen/Regent to WSB mid-point	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
A3	WSB mid-point to Friel	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
B1	Friel to 10K Turn	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
B2	10K Turn to Friel	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
B3	10K Turn to Friel	Low density (0.00 p/m²) - comfortable flow	[GREEN] A

Segment	Label	Key Takeaway	LOS
D1	10K Turn to Full Turn Blake (Out)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
D2	Full Turn Blake to 10K Turn (Return)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
F1	Friel to Station Rd.	[WARNING] Supply > Capacity - risk of congestion	[GREEN] A
G1	Full Loop around QS to Trail/Aberdeen	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
H1	Trail/Aberdeen to/from Station Rd	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
I1	Station Rd to Bridge/Mill	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
J1	Bridge/Mill to Half Turn (Outbound)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
J2	Half Turn to Full Turn (Out)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
J3	Full Turn to Half Turn (Return)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
J4	Half Turn to Bridge/Mill	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
J5	Half Turn to Bridge/Mill (Slow Half)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
K1	Bridge/Mill to Station Rd	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
L1	Trail/Aberdeen to/from Station Rd	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
L2	Station Rd to Trail/Aberdeen	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
M1	Trail/Aberdeen to Finish (Full to Loop)	Low density (0.00 p/m²) - comfortable flow	[GREEN] A
M2	Trail/Aberdeen to Finish	Low density (0.00 p/m²) - comfortable flow	[GREEN] A

Full details in per-segment sections below.

Methodology

Units: Density thresholds use *runners/m²* (areal density). Flow thresholds use *runners/min/m* (throughput per meter of width).

Notes: - `gte` means greater-than-or-equal; used in trigger conditions (e.g., density_gte, flow_gte). - Start (A1) uses the start_corral schema; other segments use on-course schemas. - Effective width must reflect any reserved emergency lane at A1.

Event Start Times

Event	Start Time	Total Participants
Full	07:00:00	368
10K	07:20:00	618
Half	07:40:00	912
Total	-	**1,898**

Segment A1 — Start to Queen/Regent

Metrics

Metric	Value	Units
Density	0.20	p/m²
Flow Rate	182	p/min/m
LOS	[GREEN] A (Start Corral)	—

Note: LOS here uses start-corral thresholds, not Fruin. Flow-rate governs safety. |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Start corral release; managed pulses and lane discipline. • At LOS A (Free Flow - Excellent conditions, no restrictions needed). • Flow of 182 p/min/m is within acceptable range.

Operational Notes

Access: • Maintain clear emergency lane as planned (effective width reflects this).

Medical: • SJA roving team staged within 400 m during start window.

Traffic: • Marshal at funnel entry to maintain cadence and signage compliance.

[BOOK] Definitions:

• Density = persons per square meter (p/m²). • Linear Density = persons per meter (p/m). • Flow Rate = persons per minute per meter (p/min/m). • Flow Supply = total persons per minute through segment. • Flow Capacity = maximum theoretical flow rate. • Flow Utilization = percentage of capacity being used. • `gte` = greater-than-or-equal-to (thresholds are inclusive).

Segment A2 — Queen/Regent to WSB mid-point

Metrics

Metric	Value	Units
Density	0.20	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment A3 — WSB mid-point to Friel

Metrics

Metric	Value	Units
Density	0.19	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment B1 — Friel to 10K Turn

Metrics

Metric	Value	Units
Density	0.30	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment B2 — 10K Turn to Friel

Metrics

Metric	Value	Units
Density	0.03	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment B3 — 10K Turn to Friel

Metrics

Metric	Value	Units
Density	0.20	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment D1 — 10K Turn to Full Turn Blake (Out)

Metrics

Metric	Value	Units
Density	0.05	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment D2 — Full Turn Blake to 10K Turn (Return)

Metrics

Metric	Value	Units
Density	0.04	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment F1 — Friel to Station Rd.

Metrics

Metric	Value	Units
Density	0.03	p/m²
Linear Density	0.10	p/m
Flow Rate	555	p/min/m
Flow (Supply)	1666	p/min
Flow (Capacity)	180	p/min
Flow Utilization	308.5%	—
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[WARNING] **Overload**: Flow utilization exceeds 200% - consider flow management.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed). • Flow of 555 p/min/m exceeds critical threshold (400 p/min/m). • **Flow Overload**: Supply (1666 p/min) exceeds capacity (180 p/min) by 309%. • Consider implementing flow metering or temporary holds upstream.

Mitigations Fired

• Create short hold at upstream feeder • Establish overtake lane if feasible

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Segment G1 — Full Loop around QS to Trail/Aberdeen

Metrics

Metric	Value	Units
Density	0.02	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment H1 — Trail/Aberdeen to/from Station Rd

Metrics

Metric	Value	Units
Density	0.03	p/m²
Linear Density	0.05	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment I1 — Station Rd to Bridge/Mill

Metrics

Metric	Value	Units
Density	0.02	p/m²
Linear Density	0.05	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment J1 — Bridge/Mill to Half Turn (Outbound)

Metrics

Metric	Value	Units
Density	0.02	p/m²
Linear Density	0.03	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment J2 — Half Turn to Full Turn (Out)

Metrics

Metric	Value	Units
Density	0.03	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment J3 — Full Turn to Half Turn (Return)

Metrics

Metric	Value	Units
Density	0.03	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment J4 — Half Turn to Bridge/Mill

Metrics

Metric	Value	Units
Density	0.02	p/m²
Linear Density	0.02	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment J5 — Half Turn to Bridge/Mill (Slow Half)

Metrics

Metric	Value	Units
Density	0.02	p/m²
Linear Density	0.02	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment K1 — Bridge/Mill to Station Rd

Metrics

Metric	Value	Units
Density	0.01	p/m²
Linear Density	0.02	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment L1 — Trail/Aberdeen to/from Station Rd

Metrics

Metric	Value	Units
Density	0.04	p/m²
Linear Density	0.05	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment L2 — Station Rd to Trail/Aberdeen

Metrics

Metric	Value	Units
Density	0.01	p/m²
Linear Density	0.02	p/m
LOS	[GREEN] A (On Course Narrow)	—

Note: LOS uses Fruin thresholds (linear density). |

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Narrow segment with potential bottlenecks. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment M1 — Trail/Aberdeen to Finish (Full to Loop)

Metrics

Metric	Value	Units
Density	0.01	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Segment M2 — Trail/Aberdeen to Finish

Metrics

Metric	Value	Units
Density	0.02	p/m²
LOS	[GREEN] A (On Course Open)	—

Key Takeaways

[CHECK] **Stable**: Density and flow within acceptable ranges.

Operational Implications

• Unidirectional running flow. • At LOS A (Free Flow - Excellent conditions, no restrictions needed).

Appendix

Detailed Definitions

- **gte**: Greater than or equal to (used in trigger conditions like density_gte, flow_gte)
- **TOT**: Time Over Threshold (seconds above E/F LOS thresholds)
- **LOS**: Level of Service (A=Free Flow, B=Comfortable, C=Moderate, D=Dense, E=Very Dense, F=Extremely Dense)
- **Experienced Density**: What runners actually experience (includes co-present runners from other events)
- **Self Density**: Only that event's runners (not shown in this report)
- **Active Window**: Time period when the event has runners present in the segment

- **Ops Box**: Operational guidance for race marshals and organizers
- **Triggered Actions**: Safety alerts and operational responses when density/flow thresholds are exceeded

Level of Service Thresholds

LOS	Areal Density (runners/m²)	Crowd Density (runners/m)	Description
A	0.00 - 0.36	0.00 - 0.20	Free Flow
B	0.36 - 0.54	0.20 - 0.40	Comfortable
C	0.54 - 0.72	0.40 - 0.60	Moderate
D	0.72 - 1.08	0.60 - 0.80	Dense
E	1.08 - 1.63	0.80 - 1.00	Very Dense
F	1.63+	1.00+	Extremely Dense