20 Mural Street, Unit 10
Richmond Hill, Ontario
L4B 1K3

Tel: (905) 889 - 8100
Fax: (905) 889 - 6616
e-mail: jsw@idirect.com

JSW+ Associates

Memorandum

To: Heinz Vogt (SMV Architects)

From: Lawrence Rutledge (JSW+)

Project: 401 March Road – Derailment Protection

Project No: 14-32

Date: January 15, 2015

Subject: Section 'E-E' Derailment at the curb line of March Road

---

As a result of the discussions with the City of Ottawa and their rail operator on November 18, 2014 at Ottawa City Hall, JSW+ Associates and Golder Associates prepared and modelled a derailment at a new location called section 'E-E'. The location of this section is at the south bound curb line of March Road (see the attached plan) for a west bound travelling train at 40 km/hr. The City's rail operator also requested that the derailed train consist of 1 locomotive (at 263,000 lbs) and 7 freight cars (200,000 lbs each).

The reason for the selection of this location, in addition to the other locations already assessed, was that the rail operator believed that this location would likely be the most susceptible to a potential derailment. The tracks are at a level crossing and therefore the tracks are more prone to having debris or ice build-up at this type of location.

Attached to this memo is Golders Associates January 15, 2015 letter explaining the assumption that they used when modeling the derailment at section 'E-E'. It should be noted that the for the locomotive and rail cars that they assumed no cutting into the ground by the trains bogies (wheel assemble) and that the train would not accordion, but continue in a straight line. Therefore the assessed travel distance by the model of the derailed train is conservative, in that the result is further than what would be realistically expected.

Golder Associates

January 15, 2015 Project No. 12-1321-0069.2000

Mr. Lawrence Rutledge
Johnson Sustronk Weinstein + Associates
10, 20 Mural Street
Richmond Hill, ON L4B 1K3

RE: IMPACT CRASH ATTENUATION ANALYSIS - 401 MARCH ROAD – REVISION 2

Dear Mr. Rutledge,

Further to your email request dated November 21, 2014 Golder Associates Ltd. (Golder) has carried out a crash attenuation analysis for the proposed development at 401 March Road, Kanata, in the City of Ottawa, Ontario. The objective of the analysis was to assess the distance a single locomotive with seven freight cars might travel in an event of a train derailment at a speed of 40 km/h.

Based on information provided to Golder by Johnson Sustronk Weinstein + Associates (JSW + A), the analysis was undertaken on the basis of the following assumptions:

- The construction of the swale and drive through lane consists of a fill compacted to provide an internal friction angle of 30° to 35° for clayey soils and granular road base, respectively.
- The locomotive and freight cars would act as a single composite train car.
- The train would be travelling westbound only.
- The train would derail and immediately travel at an angle of 22° to the tracks.
- No deflection of the train off the berm are accounted for and the full energy is applied directly to the berm.
- The cross-section of the train is constant, axles and wheels are not considered in the analysis.
- The train at section E-E (see Appendix A as provided by JSW + A) will undergo sliding and will impact the 0.5 m high retaining wall, then the sloped berm of height 1.15 m and continue traveling through the berm of 1.15 m until it stops.

The following case of direct impact was analyzed:

- A composite train comprising a locomotive car weighing 119,295 kg pulling seven freight cars each weighing 90,719 kg which does not articulate at the joints of the cars.

CANADA'S BEST MANAGED COMPANIES
Platinum member

Golder Associates Ltd.
102, 2535 - 3rd Avenue S.E., Calgary, Alberta, Canada T2A 7W5
Tel: +1 (403) 299 5600 Fax: +1 (403) 299 5606 www.golder.com
Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

Golder, Golder Associates and the GA globe design are trademarks of Golder Associates Corporation.

Our analysis determined that a composite train travelling at an initial speed of 11.1 m/s (40 km/hour), derailed at Section E-E, would have a distance of penetration of about 32 m beyond the property line along Section E-E. The fugitive train will slide for approximately 33 m within the railway right-of-way where it intercepts the beginning of the berm just outside the property line. It will then travel through the berm for approximately 7 m to the property line. The fugitive train is estimated to travel a total of 72 m from the tracks along Section E-E towards the Gas Bar Convenience Store. Significant damage to the proposed road and landscaping are anticipated in the event of a derailment. The train will come to rest on a landscaped area to the east of the Gas Bar Convenience Store and attention should be paid to the potential damage to the hydrocarbon storage tanks in this area.

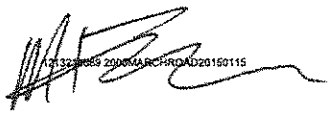
Details of the attenuation analysis are attached in Appendix B.

We trust that this report meets your present requirements. Please contact the undersigned if you have any questions or need further information.

Yours truly,

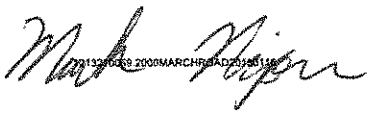
GOLDER ASSOCIATES LTD.

Prepared by:



Matt Ryans, E.I.T. (AB)
Geotechnical Engineer

Reviewed by:



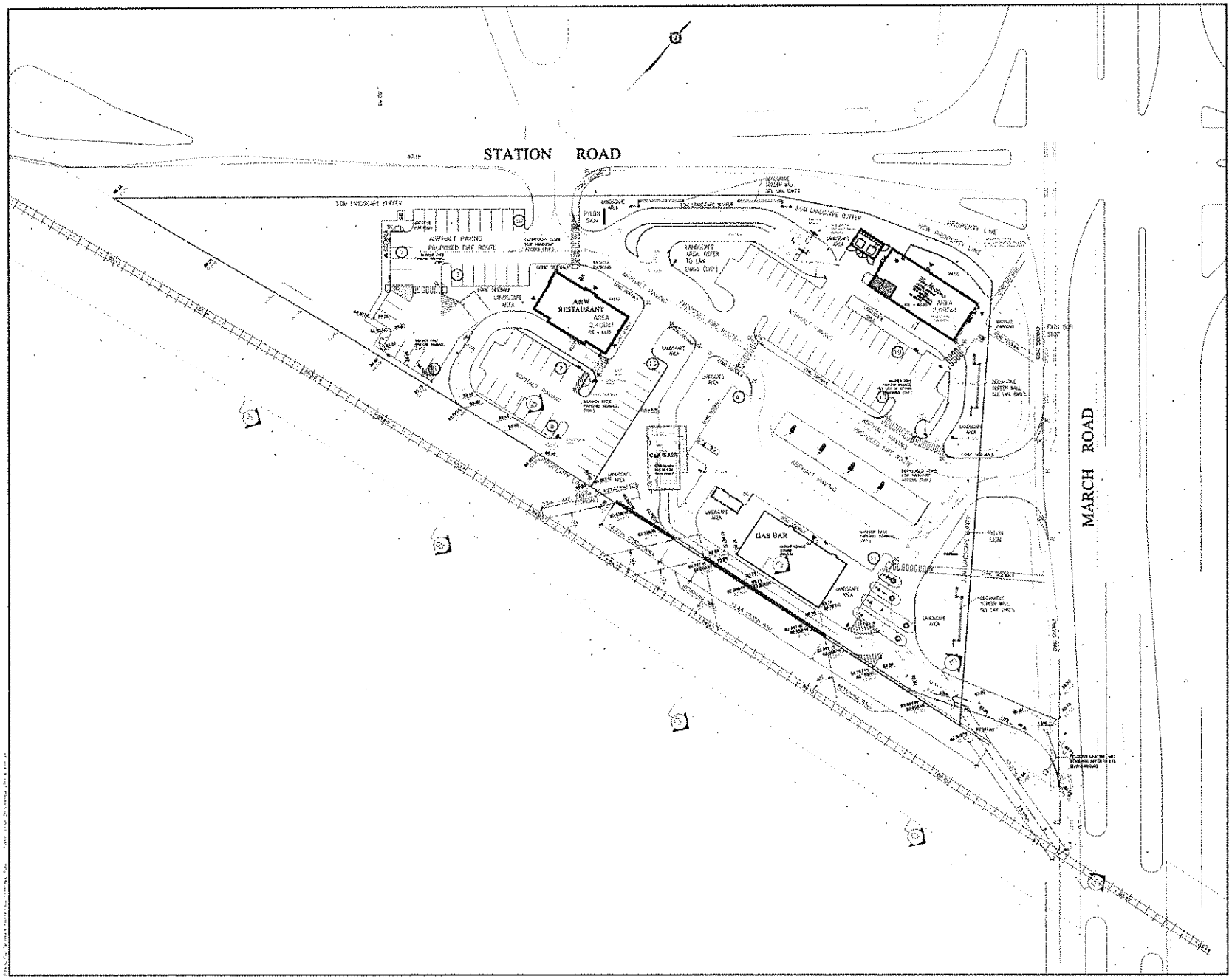
Mark Nixon, M.Sc., P.Eng.(AB)
Associate, Geotechnical Engineer

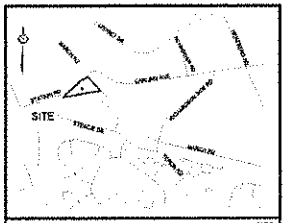
MR/MN/mes
Attachments: Appendix A – Crash Wall Analyses
Appendix B – Figure 401 March Road provided by JSW + Associates

\\golder.gds\calgary\active_2012\1321\12-1321-0069 jsw 1051 ellesemere road\phase 2000 - march road\new section - november 27 2014\memo\rev 2\march road letter - january 15 2015.docx

APPENDIX A

Figures 401 March Road provided by JSW + Associates





KEY PLAN

NTS

ELEVATION NOTE

1. ELEVATIONS SHOWN HEREON ARE REFERRED TO GEODETIC DATUM CONTOUR
2. CONTOUR INTERVAL IS 0.25 METRE.

NOTES

FOR LOCATION OF SECTIONS A,B,C,D AND E REFER TO REPORT FIG-1, FIG-2 AND FIG-3

SURVEY CREDIT

1. TOPOGRAPHICAL DETAIL WAS DERIVED BY DIGITAL PHOTOGRAMMETRIC COMPILATION USING 1:2400 AERIAL PHOTOGRAPHY DATED NOVEMBER 14, 1998 BY FARRIMO, MOFFAT & MUSSELMAN LIMITED ONTARIO LAND SURVEYORS, KANATA, ONTARIO

JSW+ associates

CIVIL ENGINEERS LANDSCAPE ARCHITECTS PLANNERS

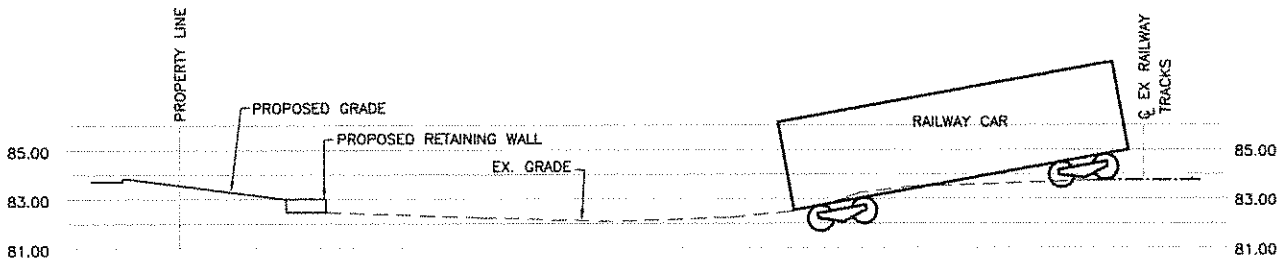
STARBANK DEVELOPMENTS
401 CORP.

401 MARCH ROAD

KANATA, ONTARIO

DERAILMENT PROTECTION PLAN

Scale	1:400		
Designed	L.R.	Checked	M.S.
Drawn	P.G.	Date	NOVEMBER 2014
Job No.	14-32	Drawing No.	DP-1



SECTION E–E

SCALE 1:200

JSW+ associates	
Title: SECTION E	
Scale 1:200	
Designed L.R.	Checked B.S.
Drawn W.G.	Date NOVEMBER 2014
Job No. 14-32	Drawing No. FIG-3

Drawing File: Derailment Plan(rev-Nov17-14).dwg (Figure (3)) Plotted: Friday, 21 November 2014 @ 4:24 pm

APPENDIX B

Crash Wall Analyses

Proj: 12-1321-0059 2000
Crash wall analyses
401 March Road Kanata

Train Crash - direct impact at 90 degree to berm
Composite Train - 754,324 kg @ 48 km/hour

Variable Retarding Force

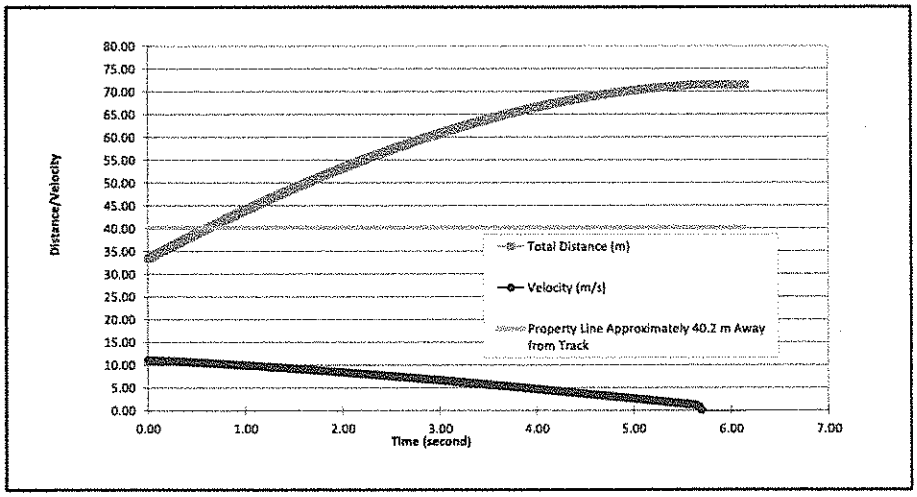
Unit	1	2	3
Unit Weight (kN/m3)	18	18	18
Train width (m)	3	3	3

Berm & Wall Sections

Berm Length (m)	100		
kp	3.00	3.69	3.69
Cohesion (kPa)	0	0	0
Train Mass (kg)	754324.1		
Initial Velocity (kph)	48.00		
Initial Velocity (m/s)	13.33		
Train length (m)	160		
contact stress (kPa)	15.42		
sliding dist	33.4		
sliding resistance (kN)	687		

Side/bottom Shear

Friction Angle	30	35	35
Interface Friction Angle	24	28	28
Coefficient for Interface	0.8	0.8	0.8
ko	0.500	0.427	0.427
Effective Width (m)	3		
Average Berm Height (m)			
Ext of passive zone (m)	100.0		
Initial energy (kJ)	69563		
Geogrid (i.TDS) kN/m	0		
Spacing (m)	0		



Time (s)	h at n (m)	Acceleration (No units)	Δ Dist (m)	Penetration Distance (m)	Distance from Track (m)	Velocity (m/s)	Kp Zone 1	Kp Zone 2	Kp Zone 3	Resistance Forces kp (kN)	Resistance Forces Friction (kN)	Resistance Forces Σ Resist (kN)	Energy Incre Energy (kJ)	Energy Σ Energy (kJ)
0.00	0.50	0.00	0.00	0.00	33.40	11.11	0.00			0.00	687.37	687.37	0.00	0.00
0.01	0.50	0.00	0.11	0.11	33.51	11.11	20.24			20.24	689.29	709.53	78.84	78.84
0.02	0.50	0.09	0.11	0.22	33.62	11.10	20.24			20.24	691.21	711.45	79.02	157.85
0.03	0.50	0.10	0.11	0.33	33.73	11.09	20.24			20.24	693.13	713.37	79.16	237.02
0.04	0.50	0.10	0.11	0.44	33.84	11.08	20.24			20.24	695.05	715.28	79.31	316.33
0.05	0.50	0.10	0.11	0.55	33.95	11.07	20.24			20.24	696.96	717.20	79.45	395.78
0.06	0.50	0.10	0.11	0.67	34.07	11.06	20.24			20.24	698.88	719.12	79.60	475.38
0.07	0.50	0.10	0.11	0.78	34.18	11.05	20.24			20.24	700.79	721.03	79.74	555.12
0.08	0.50	0.10	0.11	0.89	34.29	11.05	20.24			20.24	702.70	722.94	79.88	635.01
0.09	0.50	0.10	0.11	1.00	34.40	11.04	20.24			20.24	704.61	724.85	80.03	715.03
0.10	0.50	0.10	0.11	1.11	34.51	11.03	20.24			20.24	706.52	726.76	80.17	795.20
0.11	0.50	0.10	0.11	1.22	34.62	11.02	20.24			20.24	708.43	728.68	80.31	875.51
0.12	0.50	0.10	0.11	1.33	34.73	11.01	20.24			20.24	710.33	730.57	80.45	955.96
0.13	0.50	0.10	0.11	1.44	34.84	11.00	20.24			20.24	712.23	732.47	80.59	1036.54
0.14	0.50	0.10	0.11	1.55	34.95	10.99	20.24			20.24	714.14	734.37	80.72	1117.27
0.15	0.50	0.10	0.11	1.66	35.06	10.98	20.24			20.24	716.04	736.27	80.86	1198.13
0.16	0.51	0.10	0.11	1.77	35.17	10.97		25.97		25.97	718.01	743.98	81.64	1279.77
0.17	0.52	0.10	0.11	1.88	35.28	10.96		27.08		27.08	720.00	747.07	81.93	1361.67
0.18	0.53	0.10	0.11	1.99	35.39	10.95		28.20		28.20	721.99	750.19	82.17	1443.84
0.19	0.54	0.10	0.11	2.10	35.50	10.94		29.35		29.35	723.99	753.34	82.44	1526.28
0.20	0.55	0.10	0.11	2.21	35.61	10.93		30.52		30.52	726.01	756.53	82.72	1609.00
0.21	0.56	0.10	0.11	2.31	35.71	10.92		31.71		31.71	728.03	759.75	82.98	1691.99
0.22	0.58	0.10	0.11	2.42	35.82	10.91		32.92		32.92	730.07	763.00	83.27	1775.26
0.23	0.59	0.10	0.11	2.53	35.93	10.90		34.16		34.16	732.12	766.28	83.55	1858.81
0.24	0.60	0.10	0.11	2.64	36.04	10.89		35.42		35.42	734.18	769.59	83.83	1942.64
0.25	0.61	0.10	0.11	2.75	36.15	10.88		36.69		36.69	736.25	772.94	84.12	2026.76
0.26	0.62	0.10	0.11	2.86	36.26	10.87		37.99		37.99	738.33	776.32	84.41	2111.17
0.27	0.63	0.10	0.11	2.97	36.37	10.86		39.31		39.31	740.42	779.74	84.70	2195.88
0.28	0.64	0.10	0.11	3.08	36.48	10.85		40.66		40.66	742.53	783.19	85.00	2280.87
0.29	0.65	0.11	0.11	3.18	36.58	10.84		42.02		42.02	744.65	786.67	85.29	2366.16
0.30	0.66	0.11	0.11	3.29	36.69	10.83		43.40		43.40	746.78	790.18	85.59	2451.76
0.31	0.67	0.11	0.11	3.40	36.80	10.82		44.81		44.81	748.93	793.74	85.89	2537.65
0.32	0.68	0.11	0.11	3.51	36.91	10.81		46.24		46.24	751.08	797.32	86.20	2623.85
0.33	0.69	0.11	0.11	3.62	37.02	10.80		47.68		47.68	753.26	800.94	86.51	2710.35
0.34	0.70	0.11	0.11	3.73	37.13	10.78		49.15		49.15	755.44	804.59	86.82	2797.17
0.35	0.71	0.11	0.11	3.83	37.23	10.77		50.64		50.64	757.64	808.28	87.13	2884.30
0.36	0.72	0.11	0.11	3.94	37.34	10.76		52.15		52.15	759.86	812.01	87.44	2971.74
0.37	0.73	0.11	0.11	4.05	37.45	10.75		53.68		53.68	762.08	815.77	87.76	3059.50
0.38	0.74	0.11	0.11	4.16	37.56	10.74		55.23		55.23	764.33	819.56	88.08	3147.58
0.39	0.76	0.11	0.11	4.26	37.66	10.73		56.80		56.80	766.58	823.39	88.40	3235.99
0.40	0.77	0.11	0.11	4.37	37.77	10.72		58.40		58.40	768.86	827.25	88.73	3324.71
0.41	0.78	0.11	0.11	4.48	37.88	10.71		60.01		60.01	771.15	831.15	89.06	3413.77
0.42	0.79	0.11	0.11	4.59	37.99	10.70		61.64		61.64	773.45	835.09	89.39	3503.16
0.43	0.80	0.11	0.11	4.69	38.09	10.69		63.29		63.29	775.77	839.06	89.72	3592.88
0.44	0.81	0.11	0.11	4.80	38.20	10.68		64.97		64.97	778.11	843.07	90.06	3682.93
0.45	0.82	0.11	0.11	4.90	38.30	10.67		66.66		66.66	780.46	847.12	90.39	3773.33
0.46	0.83	0.11	0.11	5.01	38.41	10.65		68.37		68.37	782.83	851.20	90.73	3864.06
0.47	0.84	0.11	0.11	5.12	38.52	10.64		70.10		70.10	785.21	855.32	91.08	3955.14
0.48	0.85	0.12	0.11	5.22	38.62	10.63		71.86		71.86	787.62	859.47	91.42	4046.56
0.49	0.86	0.12	0.11	5.33	38.73	10.62		73.63		73.63	790.04	863.67	91.77	4138.33
0.50	0.87	0.12	0.11	5.44	38.84	10.61		75.42		75.42	792.47	867.89	92.12	4230.46
0.51	0.88	0.12	0.11	5.54	38.94	10.60		77.23		77.23	794.93	872.16	92.48	4322.93
0.52	0.89	0.12	0.11	5.65	39.05	10.59		79.06		79.06	797.40	876.45	92.83	4415.76
0.53	0.90	0.12	0.11	5.75	39.15	10.57		80.91		80.91	799.89	880.80	93.19	4508.95
0.54	0.91	0.12	0.11	5.86	39.26	10.56		82.78		82.78	802.40	885.18	93.55	4602.50
0.55	0.92	0.12	0.11	5.97	39.37	10.55		84.67		84.67	804.92	889.60	93.91	4696.41
0.56	0.93	0.12	0.11	6.07	39.47	10.54		86.58		86.58	807.47	894.05	94.28	4790.69
0.57	0.94	0.12	0.11	6.18	39.58	10.53		88.51		88.51	810.03	898.54	94.65	4885.34
0.58	0.95	0.12	0.11	6.28	39.68	10.52		90.46		90.46	812.61	903.07	95.02	4980.35
0.59	0.96	0.12	0.11	6.39	39.79	10.50		92.42		92.42	815.21	907.63	95.39	5075.74
0.60	0.97	0.12	0.10	6.49	39.89	10.49		94.41		94.41	817.83	912.24	95.76	5171.51
0.61	0.98	0.12	0.10	6.60	40.00	10.48		96.41		96.41	820.47	916.88	96.14	5267.65
0.62	0.99	0.12	0.10	6.70	40.10	10.47		98.43		98.43	823.13	921.56	96.52	5364.17
0.63	1.00	0.12	0.10	6.81	40.21	10.46		100.47		100.47	825.81	926.28	96.90	5461.07
0.64	1.01	0.12	0.10	6.91	40.31	10.44		102.53		102.53	828.51	931.04	97.29	5558.36
0.65	1.03	0.13	0.10	7.01	40.41	10.43		104.61		104.61	831.23	935.83	97.67	5656.03
0.66	1.04	0.13	0.10	7.12	40.52	10.42		106.70		106.70	833.96	940.67	98.06	5754.09
0.67	1.05	0.13	0.10	7.22	40.62	10.41		108.82		108.82	836.72	945.54	98.45	5852.55
0.68	1.06	0.13	0.10	7.33	40.73	10.39		110.95		110.95	839.50	950.45	98.85	5951.39
0.69	1.07	0.13	0.10	7.43	40.83	10.38		113.10		113.10	842.30	955.40	99.24	6050.63
0.70	1.08	0.13	0.10	7.53	40.93	10.37		115.27		115.27	845.12	960.39	99.64	6150.27
0.71	1.09	0.13	0.10	7.64	41.04	10.36		117.45		117.45	847.97	965.42	100.04	6250.31
0.72	1.10	0.13	0.10	7.74	41.14	10.34		119.66		119.66	850.83	970.48	100.44	6350.75
0.73	1.11	0.13	0.10	7.85	41.25	10.33		121.88		121.88	853.71	975.59	100.84	6451.59
0.74	1.12	0.13	0.10	7.95	41.35	10.32		124.12		124.12	856.62	980.73	101.25	6552.84
0.75	1.13	0.13	0.10	8.05	41.45	10.30		126.37		126.37	859.55	985.92	101.66	6654.50
0.76	1.14	0.13	0.10	8.16	41.55	10.29		128.65		128.65	862.49	991.14	102.07	6756.57

Time (s)	h at n (m)	Acceleration (No units)	Δ Dist (m)	Penetration Distance (m)	Distance from Track (m)	Velocity (m/s)	Kp Zone 1	Kp Zone 2	Kp Zone 3	kp (kN)	Friction (kN)	Σ Resist (kN)	Incre Energy (kJ)	Σ Energy (kJ)
0.77	1.15	0.13	0.10	8.26	41.66	10.28	130.94			130.94	865.47	996.40	102.48	6859.05
0.78	1.15	0.13	0.10	8.36	41.76	10.27	131.67			131.67	867.93	999.59	102.68	6961.73
0.79	1.15	0.13	0.10	8.46	41.86	10.25		131.67		131.67	870.14	1001.81	102.77	7064.50
0.80	1.15	0.14	0.10	8.57	41.97	10.24		131.67		131.67	872.35	1004.02	102.87	7167.37
0.81	1.15	0.14	0.10	8.67	42.07	10.23		131.67		131.67	874.56	1006.23	102.96	7270.33
0.82	1.15	0.14	0.10	8.77	42.17	10.21		131.67		131.67	876.77	1008.44	103.05	7373.38
0.83	1.15	0.14	0.10	8.87	42.27	10.20		131.67		131.67	878.98	1010.64	103.14	7476.52
0.84	1.15	0.14	0.10	8.97	42.37	10.18		131.67		131.67	881.18	1012.84	103.23	7579.75
0.85	1.15	0.14	0.10	9.08	42.48	10.17		131.67		131.67	883.37	1015.04	103.32	7683.07
0.86	1.15	0.14	0.10	9.18	42.58	10.15		131.67		131.67	885.57	1017.24	103.41	7786.48
0.87	1.15	0.14	0.10	9.28	42.68	10.15		131.67		131.67	887.76	1019.43	103.49	7889.97
0.88	1.15	0.14	0.10	9.38	42.78	10.13		131.67		131.67	889.95	1021.62	103.58	7993.55
0.89	1.15	0.14	0.10	9.48	42.88	10.12		131.67		131.67	892.14	1023.81	103.66	8097.21
0.90	1.15	0.14	0.10	9.58	42.98	10.10		131.67		131.67	894.32	1025.99	103.74	8200.96
0.91	1.15	0.14	0.10	9.68	43.08	10.09		131.67		131.67	896.50	1028.17	103.82	8304.78
0.92	1.15	0.14	0.10	9.78	43.18	10.08		131.67		131.67	898.68	1030.35	103.90	8408.68
0.93	1.15	0.14	0.10	9.89	43.29	10.06		131.67		131.67	900.86	1032.52	103.98	8512.67
0.94	1.15	0.14	0.10	9.99	43.39	10.05		131.67		131.67	903.03	1034.70	104.06	8616.73
0.95	1.15	0.14	0.10	10.09	43.49	10.04		131.67		131.67	905.20	1036.87	104.14	8720.86
0.96	1.15	0.14	0.10	10.19	43.59	10.02		131.67		131.67	907.36	1039.03	104.21	8825.08
0.97	1.15	0.14	0.10	10.29	43.69	10.01		131.67		131.67	909.53	1041.19	104.29	8929.36
0.98	1.15	0.14	0.10	10.39	43.79	10.00		131.67		131.67	911.69	1043.36	104.36	9033.72
0.99	1.15	0.14	0.10	10.49	43.89	9.98		131.67		131.67	913.85	1045.51	104.43	9138.15
1.00	1.15	0.14	0.10	10.59	43.99	9.97		131.67		131.67	916.00	1047.67	104.50	9242.65
1.01	1.15	0.14	0.10	10.69	44.09	9.95		131.67		131.67	918.15	1049.82	104.57	9347.22
1.02	1.15	0.14	0.10	10.79	44.19	9.94		131.67		131.67	920.30	1051.97	104.64	9451.86
1.03	1.15	0.14	0.10	10.88	44.28	9.93		131.67		131.67	922.44	1054.11	104.71	9556.57
1.04	1.15	0.14	0.10	10.98	44.38	9.91		131.67		131.67	924.59	1056.25	104.77	9661.34
1.05	1.15	0.14	0.10	11.08	44.48	9.90		131.67		131.67	926.73	1058.39	104.84	9766.17
1.06	1.15	0.14	0.10	11.18	44.58	9.88		131.67		131.67	928.86	1060.53	104.90	9871.07
1.07	1.15	0.14	0.10	11.28	44.68	9.87		131.67		131.67	931.00	1062.66	104.96	9976.03
1.08	1.15	0.14	0.10	11.38	44.78	9.86		131.67		131.67	933.13	1064.79	105.02	10081.05
1.09	1.15	0.14	0.10	11.48	44.88	9.84		131.67		131.67	935.25	1066.92	105.08	10186.13
1.10	1.15	0.14	0.10	11.58	44.98	9.83		131.67		131.67	937.38	1069.04	105.14	10291.27
1.11	1.15	0.14	0.10	11.67	45.07	9.81		131.67		131.67	939.50	1071.16	105.20	10396.47
1.12	1.15	0.14	0.10	11.77	45.17	9.80		131.67		131.67	941.62	1073.28	105.25	10501.72
1.13	1.15	0.14	0.10	11.87	45.27	9.79		131.67		131.67	943.73	1075.40	105.31	10607.03
1.14	1.15	0.15	0.10	11.97	45.37	9.77		131.67		131.67	945.84	1077.51	105.36	10712.39
1.15	1.15	0.15	0.10	12.07	45.47	9.76		131.67		131.67	947.95	1079.62	105.41	10817.80
1.16	1.15	0.15	0.10	12.16	45.56	9.74		131.67		131.67	950.06	1081.72	105.46	10923.27
1.17	1.15	0.15	0.10	12.26	45.66	9.73		131.67		131.67	952.16	1083.83	105.51	11028.78
1.18	1.15	0.15	0.10	12.36	45.76	9.71		131.67		131.67	954.26	1085.93	105.56	11134.35
1.19	1.15	0.15	0.10	12.45	45.85	9.70		131.67		131.67	956.36	1088.02	105.61	11239.96
1.20	1.15	0.15	0.10	12.55	45.95	9.69		131.67		131.67	958.45	1090.12	105.66	11345.62
1.21	1.15	0.15	0.10	12.65	46.05	9.67		131.67		131.67	960.54	1092.21	105.70	11451.32
1.22	1.15	0.15	0.10	12.75	46.15	9.66		131.67		131.67	962.63	1094.29	105.75	11557.07
1.23	1.15	0.15	0.10	12.84	46.24	9.64		131.67		131.67	964.71	1096.38	105.79	11662.86
1.24	1.15	0.15	0.10	12.94	46.34	9.63		131.67		131.67	966.79	1098.46	105.83	11768.69
1.25	1.15	0.15	0.10	13.03	46.43	9.61		131.67		131.67	968.87	1100.54	105.87	11874.56
1.26	1.15	0.15	0.10	13.13	46.53	9.60		131.67		131.67	970.94	1102.61	105.91	11980.47
1.27	1.15	0.15	0.10	13.23	46.63	9.58		131.67		131.67	973.01	1104.68	105.95	12086.42
1.28	1.15	0.15	0.10	13.32	46.72	9.57		131.67		131.67	975.08	1106.75	105.99	12192.40
1.29	1.15	0.15	0.10	13.42	46.82	9.55		131.67		131.67	977.15	1108.81	106.02	12298.43
1.30	1.15	0.15	0.10	13.51	46.91	9.54		131.67		131.67	979.21	1110.88	106.06	12404.48
1.31	1.15	0.15	0.10	13.61	47.01	9.52		131.67		131.67	981.27	1112.94	106.09	12510.57
1.32	1.15	0.15	0.10	13.70	47.10	9.51		131.67		131.67	983.32	1114.99	106.12	12616.69
1.33	1.15	0.15	0.10	13.80	47.20	9.50		131.67		131.67	985.38	1117.04	106.15	12722.84
1.34	1.15	0.15	0.09	13.89	47.29	9.48		131.67		131.67	987.42	1119.09	106.18	12829.02
1.35	1.15	0.15	0.09	13.99	47.39	9.47		131.67		131.67	989.47	1121.14	106.21	12935.23
1.36	1.15	0.15	0.09	14.08	47.48	9.45		131.67		131.67	991.51	1123.18	106.24	13041.47
1.37	1.15	0.15	0.09	14.18	47.58	9.44		131.67		131.67	993.55	1125.22	106.26	13147.73
1.38	1.15	0.15	0.09	14.27	47.67	9.42		131.67		131.67	995.59	1127.26	106.29	13254.01
1.39	1.15	0.15	0.09	14.37	47.77	9.41		131.67		131.67	997.62	1129.29	106.31	13360.32
1.40	1.15	0.15	0.09	14.46	47.86	9.39		131.67		131.67	999.65	1131.32	106.33	13466.65
1.41	1.15	0.15	0.09	14.55	47.95	9.38		131.67		131.67	1001.68	1133.35	106.35	13573.01
1.42	1.15	0.15	0.09	14.65	48.05	9.36		131.67		131.67	1003.70	1135.37	106.37	13679.38
1.43	1.15	0.15	0.09	14.74	48.14	9.35		131.67		131.67	1005.72	1137.39	106.39	13785.77
1.44	1.15	0.15	0.09	14.83	48.23	9.33		131.67		131.67	1007.74	1139.41	106.41	13892.18
1.45	1.15	0.15	0.09	14.93	48.33	9.32		131.67		131.67	1009.75	1141.42	106.42	13998.60
1.46	1.15	0.15	0.09	15.02	48.42	9.30		131.67		131.67	1011.76	1143.43	106.44	14105.04
1.47	1.15	0.15	0.09	15.11	48.51	9.29		131.67		131.67	1013.77	1145.44	106.45	14211.50
1.48	1.15	0.15	0.09	15.21	48.61	9.27		131.67		131.67	1015.78	1147.44	106.47	14317.96
1.49	1.15	0.15	0.09	15.30	48.70	9.26		131.67		131.67	1017.78	1149.44	106.48	14424.44
1.50	1.15	0.16	0.09	15.39	48.79	9.24		131.67		131.67	1019.77	1151.44	106.49	14530.92
1.51	1.15	0.16	0.09	15.48	48.88	9.23		131.67		131.67	1021.77	1153.43	106.50	14637.42
1.52	1.15	0.16	0.09	15.58	48.98	9.21		131.67		131.67	1023.76	1155.43	106.50	14743.92
1.53	1.15	0.16	0.09	15.67	49.07	9.19		131.67		131.67	1025.75	1157.41	106.51	14850.43
1.54	1.15	0.16	0.09	15.76	49.16	9.18		131.67		131.67	1027.73	1159.40	106.51	14956.95
1.55	1.15	0.16	0.09	15.85	49.25	9.16		131.67		131.67	1029.71	1161.38	106.52	15063.47
1.56	1.15	0.16	0.09	15.94	49.34	9.15		131.67		131.67	1031.69	1163.36	106.52	15169.99
1.57	1.15	0.16	0.09	16.03	49.43	9.13		131.67		131.67	1033.66	1165.33	106.52	15276.51
1.58	1.15	0.16	0.09	16.13	49.53	9.12		131.67		131.67	1035.63	1167.30	106.52	15383.03
1.59	1.15	0.16	0.09	16.22	49.62	9.10		131.67		131.67	1037.60	1169.27	106.52	15489.56
1.60	1.15	0.16	0.09	16.31	49.71	9.09		131.67		131.67	1039.56	1171.23	106.52	15596.08
1.61	1.15	0.16	0.09	16.40	49.80	9.07		131.67		131.67	1041.53	1173.19	106.52	15702.59
1.62	1.15	0.16	0.09	16.49	49.89	9.06		131.67		131.67	1043.48	1175.15	106.51	15809.10
1.63	1.15	0.16	0.09	16.58	49.98	9.04		131.67		131.67	1045.44	1177.10	106.51	15915.61
1.64	1.15	0.16	0.09	16.67	50.07	9.02		131.67		131.67	1047.39	1179.06	106.50	16022.11
1.65	1.15	0.16	0.09	16.76	50.16	9.01		131.67		131.67	1049.34	1181.00	106.49	16128.60
1.66	1.15	0.16	0.09	16.85	50.25	8.99		131.67		131.67	1051.28	1182.95	106.48	16235.08
1.67	1.15	0.16	0.09	16.94	50.34	8.98		131.67		131.67	1053.22	1184.89	106.47	16341.55
1.68	1.15	0.16	0.09	17.03	50.43	8.96		131.67		131.67	1055.16	1186.82	106.46	16448.01
1.69	1.15	0.16	0.09	17.12	50.52	8.95		131.67		131.67	1057.09	1188.76	106.45	16554.46
1.70	1.15	0.16	0.09	17.21	50.61	8.93		131.67		131.67	1059.02	1190.69	106.43	16660.89
1.71	1.15	0.16	0.09	17.30	50.70	8.92		131.67		131.67	1060.95	1192.62	106.42	16767.30
1.72	1.15	0.16	0.09	17.39	50.79	8.90		131.67		131.67	1062.87	1194.54	106.40	16873.70
1.73	1.15	0.16	0.09	17.48	50.88	8.88		131.67		131.67	1064.79	1196.46	106.38	16980.09
1.74	1.15	0.16	0.09	17.56	50.96	8.87		131.67		131.67	1066.71	1198.38	106.36	17086.45
1.75	1.15	0.16	0.09	17.65	51.05	8.85		131.67		131.67	1068.62	1200.29	106.34	17192.79
1.76	1.15	0.16	0.09	17.74	51.14	8.84		131.67		131.67	1070.53	1202.20	106.32	17299.11
1.77	1.15	0.16	0.09	17.83	51.23	8.82		131.67		131.67	1072.44	1204.11	106.30	17405.41
1.78	1.15	0.16	0.09	17.92	51.32	8.80		131.67		131.67	1074.34	1206.01	106.27	17511.68
1.79	1.15	0.16	0.09	18.01	51.41	8.79		131.67		131.67	1076.24	1207.91	106.25	17617.93
1.80	1.15	0.16	0.09	18.09	51.49	8.77		131.67		131.67	1078.14	1209.81	106.22	17724.15
1.81	1.15	0.16	0.09	18.18	51.58	8.75		131.67		131.67	1080.03	1211.70	106.19	17830.34
1.82	1.15	0.16	0.09	18.27	51.67	8.74		131.67		131.67	1081.92	1213.59	106.16	17936.51
1.83	1.15	0.16	0.09	18.36	51.76	8.72		131.67		131.67	1083.81	1215.47	106.13	18042.64
1.84	1.15	0.16	0.09	18.44	51.84	8.71		131.67		131.67	1085.69	1217.36	106.10	18148.75
1.85	1.15	0.16	0.09	18.53	51.93	8.69		131.67		131.67	1087.57	1219.24	106.07	18254.82
1.86	1.15	0.16	0.09	18.62	52.02	8.68		131.67		131.67	1089.44	1221.11	106.04	18360.85
1.87	1.15	0.16	0.09	18.70	52.10	8.66		131.67		131.67	1091.32	1222.98	106.00	18466.86
1.88	1.15	0.17	0.09	18.79	52.19	8.64		131.67		131.67	1093.18	1224.85	105.97	18572.82
1.89	1.15	0.17	0.09	18.88	52.28	8.63		131.67		131.67	1095.05	1226.72	105.93	18678.75
1.90	1.15	0.17	0.09	18.96	52.36	8.61		131.67		131.67	1096.91	1228.58	105.89	18784.64
1.91	1.15	0.17	0.09	19.05	52.45	8.59		131.67		131.67	1098.77	1230.44	105.85	18890.48
1.92	1.15	0.17	0.09	19.13	52.53	8.58		131.67		131.67	1100.62	1232.29	105.81	18996.30
1.93	1.15	0.17	0.09	19.22	52.62	8.56		131.67		131.67	1102.47	1234.14	105.77	19102.07
1.94	1.15	0.17	0.09	19.31	52.71	8.55		131.67		131.67	1104.32	1235.99	105.72	19207.79

Time (s)	h at n (m)	Acceleration (No units)	Δ Dist (m)	Penetration Distance (m)	Distance from Track (m)	Velocity (m/s)	Kp Zone 1	Kp Zone 2	Kp Zone 3	kp (kN)	Friction (kN)	Σ Restist (kN)	Incre Energy (kJ)	Σ Energy (kJ)
1.95	1.15	0.17	0.09	19.39	52.79	8.53			131.67	131.67	1105.17	1237.83	105.68	19313.47
1.96	1.15	0.17	0.09	19.48	52.88	8.51			131.67	131.67	1108.01	1239.67	105.83	19419.10
1.97	1.15	0.17	0.09	19.56	52.96	8.50			131.67	131.67	1109.84	1241.51	105.99	19524.89
1.98	1.15	0.17	0.08	19.65	53.05	8.48			131.67	131.67	1111.68	1243.34	105.84	19630.23
1.99	1.15	0.17	0.09	19.73	53.13	8.46			131.67	131.67	1113.51	1245.17	105.49	19735.71
2.00	1.15	0.17	0.08	19.82	53.22	8.45			131.67	131.67	1115.33	1247.00	105.44	19841.15
2.01	1.15	0.17	0.09	19.90	53.30	8.43			131.67	131.67	1117.15	1248.82	105.39	19946.54
2.02	1.15	0.17	0.08	19.98	53.38	8.41			131.67	131.67	1118.97	1250.64	105.33	20051.87
2.03	1.15	0.17	0.08	20.07	53.47	8.40			131.67	131.67	1120.79	1252.46	105.28	20157.15
2.04	1.15	0.17	0.08	20.15	53.55	8.38			131.67	131.67	1122.60	1254.27	105.22	20262.37
2.05	1.15	0.17	0.08	20.24	53.64	8.36			131.67	131.67	1124.41	1256.08	105.17	20367.54
2.06	1.15	0.17	0.08	20.32	53.72	8.35			131.67	131.67	1126.21	1257.88	105.11	20472.64
2.07	1.15	0.17	0.08	20.40	53.80	8.33			131.67	131.67	1128.01	1259.68	105.05	20577.69
2.08	1.15	0.17	0.08	20.49	53.89	8.31			131.67	131.67	1129.81	1261.48	104.99	20682.68
2.09	1.15	0.17	0.09	20.57	53.97	8.30			131.67	131.67	1131.61	1263.27	104.93	20787.61
2.10	1.15	0.17	0.08	20.66	54.05	8.28			131.67	131.67	1133.40	1265.08	104.86	20892.47
2.11	1.15	0.17	0.08	20.73	54.13	8.26			131.67	131.67	1135.18	1266.85	104.80	20997.27
2.12	1.15	0.17	0.08	20.82	54.22	8.25			131.67	131.67	1136.97	1268.63	104.74	21102.01
2.13	1.15	0.17	0.08	20.90	54.30	8.23			131.67	131.67	1138.74	1270.41	104.67	21206.68
2.14	1.15	0.17	0.08	20.98	54.38	8.21			131.67	131.67	1140.52	1272.19	104.60	21311.28
2.15	1.15	0.17	0.08	21.06	54.46	8.20			131.67	131.67	1142.29	1273.96	104.53	21415.81
2.16	1.15	0.17	0.08	21.15	54.55	8.18			131.67	131.67	1144.06	1275.73	104.46	21520.28
2.17	1.15	0.17	0.08	21.23	54.63	8.16			131.67	131.67	1145.83	1277.49	104.39	21624.67
2.18	1.15	0.17	0.08	21.31	54.71	8.15			131.67	131.67	1147.59	1279.25	104.32	21728.99
2.19	1.15	0.17	0.08	21.39	54.79	8.13			131.67	131.67	1149.34	1281.01	104.25	21833.23
2.20	1.15	0.17	0.08	21.47	54.87	8.11			131.67	131.67	1151.10	1282.77	104.17	21937.41
2.21	1.15	0.17	0.08	21.55	54.95	8.10			131.67	131.67	1152.85	1284.52	104.10	22041.50
2.22	1.15	0.17	0.08	21.63	55.03	8.08			131.67	131.67	1154.60	1286.26	104.02	22145.52
2.23	1.15	0.17	0.08	21.71	55.11	8.06			131.67	131.67	1156.34	1288.01	103.94	22249.46
2.24	1.15	0.17	0.08	21.79	55.19	8.04			131.67	131.67	1158.08	1289.74	103.86	22353.32
2.25	1.15	0.17	0.08	21.88	55.28	8.03			131.67	131.67	1159.81	1291.48	103.78	22457.10
2.26	1.15	0.17	0.08	21.96	55.36	8.01			131.67	131.67	1161.54	1293.21	103.70	22560.80
2.27	1.15	0.17	0.08	22.04	55.44	7.99			131.67	131.67	1163.27	1294.94	103.62	22664.41
2.28	1.15	0.17	0.08	22.12	55.52	7.98			131.67	131.67	1165.00	1296.66	103.53	22767.95
2.29	1.15	0.17	0.08	22.19	55.59	7.96			131.67	131.67	1166.72	1298.39	103.45	22871.39
2.30	1.15	0.18	0.08	22.27	55.67	7.94			131.67	131.67	1168.44	1300.10	103.36	22974.75
2.31	1.15	0.18	0.08	22.35	55.75	7.92			131.67	131.67	1170.15	1301.82	103.27	23078.02
2.32	1.15	0.18	0.08	22.43	55.83	7.91			131.67	131.67	1171.86	1303.53	103.18	23181.21
2.33	1.15	0.18	0.08	22.51	55.91	7.89			131.67	131.67	1173.56	1305.23	103.09	23284.30
2.34	1.15	0.18	0.08	22.59	55.99	7.87			131.67	131.67	1175.27	1306.93	103.00	23387.30
2.35	1.15	0.18	0.08	22.67	56.07	7.86			131.67	131.67	1176.96	1308.63	102.91	23490.21
2.36	1.15	0.18	0.08	22.75	56.15	7.84			131.67	131.67	1178.66	1310.33	102.82	23593.03
2.37	1.15	0.18	0.08	22.83	56.23	7.82			131.67	131.67	1180.35	1312.02	102.72	23695.75
2.38	1.15	0.18	0.08	22.90	56.30	7.80			131.67	131.67	1182.04	1313.70	102.62	23798.37
2.39	1.15	0.18	0.08	22.98	56.38	7.79			131.67	131.67	1183.72	1315.39	102.53	23900.90
2.40	1.15	0.18	0.08	23.06	56.46	7.77			131.67	131.67	1185.40	1317.07	102.43	24003.33
2.41	1.15	0.18	0.08	23.14	56.54	7.75			131.67	131.67	1187.08	1318.74	102.33	24105.66
2.42	1.15	0.18	0.08	23.21	56.61	7.73			131.67	131.67	1188.75	1320.42	102.23	24207.89
2.43	1.15	0.18	0.08	23.29	56.69	7.72			131.67	131.67	1190.42	1322.08	102.13	24310.01
2.44	1.15	0.18	0.08	23.37	56.77	7.70			131.67	131.67	1192.08	1323.75	102.02	24412.04
2.45	1.15	0.18	0.08	23.45	56.85	7.68			131.67	131.67	1193.74	1325.41	101.92	24513.96
2.46	1.15	0.18	0.08	23.52	56.92	7.66			131.67	131.67	1195.40	1327.07	101.81	24615.77
2.47	1.15	0.18	0.08	23.60	57.00	7.65			131.67	131.67	1197.05	1328.72	101.71	24717.48
2.48	1.15	0.18	0.08	23.68	57.08	7.63			131.67	131.67	1198.70	1330.37	101.60	24819.08
2.49	1.15	0.18	0.08	23.75	57.15	7.61			131.67	131.67	1200.35	1332.01	101.49	24920.57
2.50	1.15	0.18	0.08	23.83	57.23	7.59			131.67	131.67	1201.99	1333.66	101.38	25021.96
2.51	1.15	0.18	0.08	23.90	57.30	7.58			131.67	131.67	1203.63	1335.29	101.27	25123.23
2.52	1.15	0.18	0.08	23.98	57.38	7.56			131.67	131.67	1205.26	1336.93	101.16	25224.39
2.53	1.15	0.18	0.08	24.06	57.46	7.54			131.67	131.67	1206.89	1338.56	101.05	25325.43
2.54	1.15	0.18	0.08	24.13	57.53	7.52			131.67	131.67	1208.52	1340.19	100.93	25426.36
2.55	1.15	0.18	0.08	24.21	57.61	7.50			131.67	131.67	1210.14	1341.81	100.81	25527.18
2.56	1.15	0.18	0.07	24.28	57.68	7.49			131.67	131.67	1211.76	1343.43	100.70	25627.87
2.57	1.15	0.18	0.07	24.36	57.76	7.47			131.67	131.67	1213.37	1345.04	100.58	25728.45
2.58	1.15	0.18	0.07	24.43	57.83	7.45			131.67	131.67	1214.99	1346.65	100.46	25828.91
2.59	1.15	0.18	0.07	24.50	57.90	7.43			131.67	131.67	1216.59	1348.26	100.34	25929.25
2.60	1.15	0.18	0.07	24.58	57.98	7.42			131.67	131.67	1218.20	1349.86	100.22	26029.47
2.61	1.15	0.18	0.07	24.65	58.05	7.40			131.67	131.67	1219.80	1351.46	100.10	26129.57
2.62	1.15	0.18	0.07	24.73	58.13	7.38			131.67	131.67	1221.39	1353.06	99.97	26229.54
2.63	1.15	0.18	0.07	24.80	58.20	7.36			131.67	131.67	1222.98	1354.65	99.85	26329.39
2.64	1.15	0.18	0.07	24.87	58.27	7.34			131.67	131.67	1224.57	1356.24	99.72	26429.11
2.65	1.15	0.19	0.07	24.95	58.35	7.33			131.67	131.67	1226.16	1357.82	99.59	26528.70
2.66	1.15	0.18	0.07	25.02	58.42	7.31			131.67	131.67	1227.74	1359.40	99.47	26628.17
2.67	1.15	0.18	0.07	25.09	58.49	7.29			131.67	131.67	1229.31	1360.98	99.34	26727.50
2.68	1.15	0.18	0.07	25.17	58.57	7.27			131.67	131.67	1230.88	1362.55	99.21	26826.71
2.69	1.15	0.18	0.07	25.24	58.64	7.25			131.67	131.67	1232.45	1364.12	99.07	26925.78
2.70	1.15	0.18	0.07	25.31	58.71	7.24			131.67	131.67	1234.02	1365.69	98.94	27024.72
2.71	1.15	0.18	0.07	25.38	58.78	7.22			131.67	131.67	1235.58	1367.25	98.81	27123.53
2.72	1.15	0.18	0.07	25.46	58.86	7.20			131.67	131.67	1237.14	1368.80	98.67	27222.20
2.73	1.15	0.18	0.07	25.53	58.93	7.18			131.67	131.67	1238.69	1370.36	98.54	27320.74
2.74	1.15	0.18	0.07	25.60	59.00	7.16			131.67	131.67	1240.24	1371.90	98.40	27419.14
2.75	1.15	0.19	0.07	25.67	59.07	7.15			131.67	131.67	1241.78	1373.45	98.26	27517.40
2.76	1.15	0.19	0.07	25.74	59.14	7.13			131.67	131.67	1243.32	1374.99	98.12	27615.52
2.77	1.15	0.19	0.07	25.81	59.21	7.11			131.67	131.67	1244.86	1376.53	97.98	27713.49
2.78	1.15	0.19	0.07	25.88	59.28	7.09			131.67	131.67	1246.39	1378.06	97.84	27811.33
2.79	1.15	0.19	0.07	25.95	59.35	7.07			131.67	131.67	1247.92	1379.59	97.69	27909.02
2.80	1.15	0.19	0.07	26.03	59.43	7.05			131.67	131.67	1249.45	1381.12	97.55	28006.57
2.81	1.15	0.19	0.07	26.10	59.50	7.04			131.67	131.67	1250.97	1382.64	97.40	28103.98
2.82	1.15	0.19	0.07	26.17	59.57	7.02			131.67	131.67	1252.49	1384.16	97.26	28201.24
2.83	1.15	0.19	0.07	26.24	59.64	7.00			131.67	131.67	1254.00	1385.67	97.11	28298.35
2.84	1.15	0.19	0.07	26.31	59.71	6.98			131.67	131.67	1255.51	1387.18	96.96	28395.31
2.85	1.15	0.19	0.07	26.38	59.78	6.96			131.67	131.67	1257.02	1388.68	96.81	28492.12
2.86	1.15	0.19	0.07	26.45	59.85	6.94			131.67	131.67	1258.52	1390.19	96.66	28588.78
2.87	1.15	0.19	0.07	26.51	59.91	6.93			131.67	131.67	1260.02	1391.68	96.51	28685.28
2.88	1.15	0.19	0.07	26.58	59.98	6.91			131.67	131.67	1261.51	1393.18	96.36	28781.65
2.89	1.15	0.19	0.07	26.65	60.05	6.89			131.67	131.67	1263.00	1394.67	96.20	28877.85
2.90	1.15	0.19	0.07	26.72	60.12	6.87			131.67	131.67	1264.49	1396.15	96.05	28973.90
2.91	1.15	0.19	0.07	26.79	60.19	6.85			131.67	131.67	1265.97	1397.63	95.89	29069.79
2.92	1.15	0.19	0.07	26.86	60.26	6.83			131.67	131.67	1267.45	1399.11	95.73	29165.52
2.93	1.15	0.19	0.07	26.93	60.33	6.81			131.67	131.67	1268.92	1400.59	95.57	29261.10
2.94	1.15	0.19	0.07	27.00	60.40	6.80			131.67	131.67	1270.39	1402.06	95.42	29356.51
2.95	1.15	0.19	0.07	27.06	60.46	6.78			131.67	131.67	1271.85	1403.52	95.25	29451.77
2.96	1.15	0.19	0.07	27.13	60.53	6.76			131.67	131.67	1273.32	1404.98	95.09	29546.86
2.97	1.15	0.19	0.07	27.20	60.60	6.74			131.67	131.67	1274.77	1406.44	94.93	29641.79
2.98	1.15	0.19	0.07	27.27	60.67	6.72			131.67	131.67	1276.23	1407.90	94.77	29736.56
2.99	1.15	0.19	0.07	27.33	60.73	6.70			131.67	131.67	1277.68	1409.34	94.60	29831.16
3.00	1.15	0.19	0.07	27.40	60.80	6.68			131.67	131.67	1279.12	1410.79	94.43	29925.59
3.01	1.15	0.19	0.07	27.47	60.87	6.67			131.67	131.67	1280.57	1412.23	94.27	30019.86
3.02	1.15	0.19	0.07	27.53	60.93	6.65			131.67	131.67	1282.00	1413.67	94.10	30113.96
3.03	1.15	0.19	0.07	27.60	61.00	6.63			131.67	131.67	1283.44	1415.10	93.93	30207.89
3.04	1.15	0.19	0.07	27.67	61.07	6.61			131.67	131.67	1284.87	1416.53	93.76	30301.65
3.05	1.15	0.19	0.07	27.73	61.13	6.59			131.67	131.67	1286.29	1417.96	93.59	30395.24
3.06	1.15	0.19	0.07	27.80	61.20	6.57			131.67	131.67	1287.71	1419.38	93.42	30488.66
3.07	1.15	0.19	0.07	27.86	61.26	6.55			131.67	131.67	1289.13	1420.80	93.24	30581.89
3.08	1.15	0.19	0.07	27.93	61.33	6.53			131.67	131.67	1290.54	1422.21	93.07	30674.96
3.09	1.15	0.19	0.07	27.99	61.39	6.52			131.67	131.67	1291.95	1423.62	92.89	30767.85
3.10	1.15	0.19	0.07	28.06	61.46	6.50			131.67	131.67	1293.36	1425.02	92.71	30860.56
3.11	1.15	0.19	0.06	28.12	61.52	6.48			131.67	131.67	1294.76	1426.43	92.54	30953.10
3.12	1.15	0.19	0.06	28.19	61.59	6.46			131.67	131.67	1296.16	1427.82	92.36	31045.46

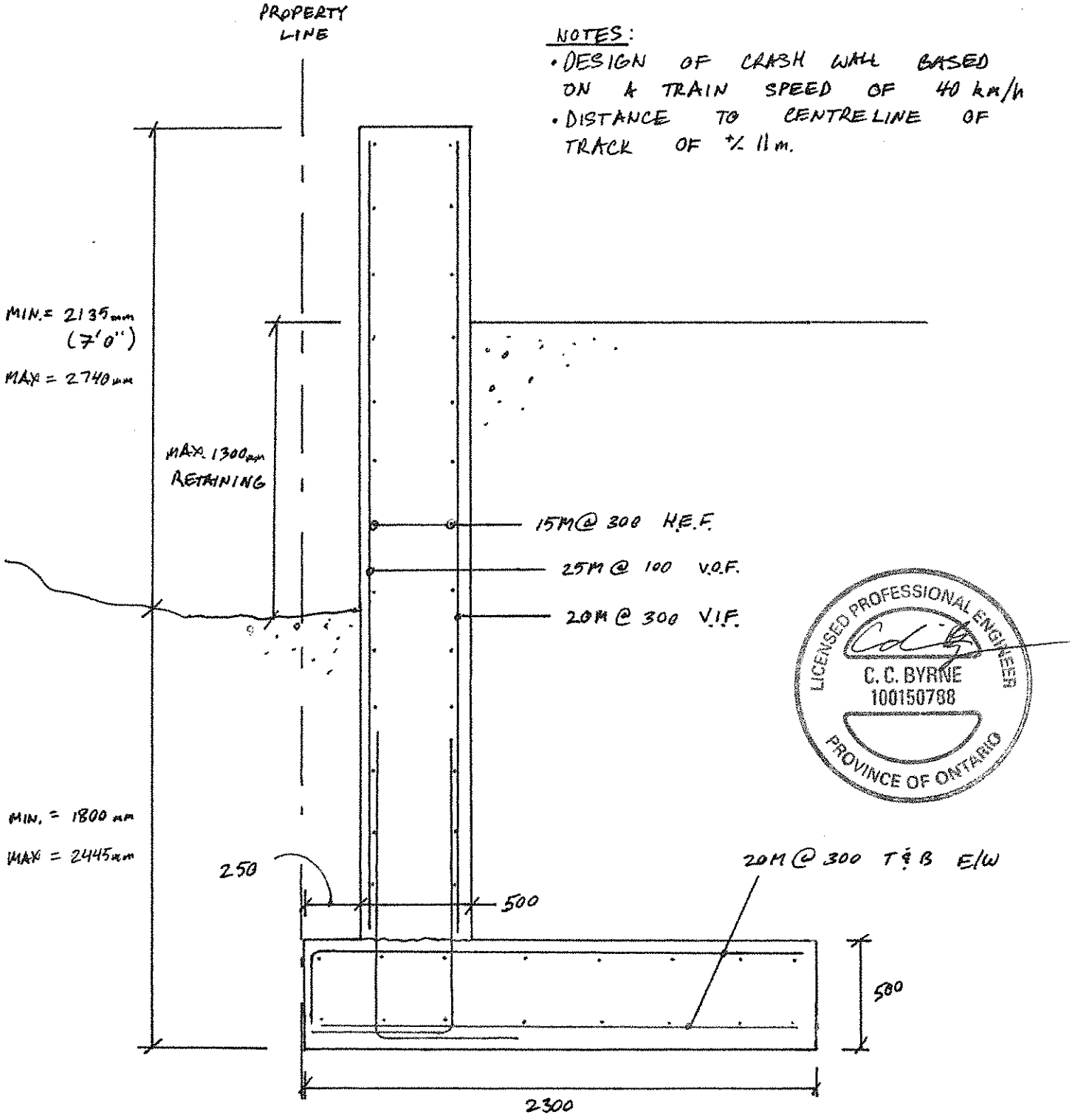
Time (s)	h at n (m)	Acceleration (No units)	Δ Dist (m)	Penetration Distance (m)	Distance from Track (m)	Velocity (m/s)	Kp Zone 1	Kp Zone 2	Kp Zone 3	kp (kN)	Friction (kN)	Σ Restst (kN)	Incre Energy (kJ)	Σ Energy (kJ)
3.13	1.15	0.19	0.06	28.25	81.65	6.44			131.67	131.67	1297.55	1429.22	92.18	31137.64
3.14	1.15	0.19	0.06	28.32	81.72	6.42			131.67	131.67	1298.94	1430.60	92.09	31229.63
3.15	1.15	0.19	0.06	28.38	81.78	6.40			131.67	131.67	1300.32	1431.99	91.81	31321.45
3.16	1.15	0.19	0.06	28.45	81.85	6.38			131.67	131.67	1301.70	1433.37	91.63	31413.08
3.17	1.15	0.19	0.06	28.51	81.91	6.36			131.67	131.67	1303.08	1434.75	91.45	31504.52
3.18	1.15	0.19	0.06	28.57	81.97	6.35			131.67	131.67	1304.45	1436.12	91.26	31595.78
3.19	1.15	0.19	0.06	28.64	82.04	6.33			131.67	131.67	1305.82	1437.49	91.07	31686.85
3.20	1.15	0.19	0.06	28.70	82.10	6.31			131.67	131.67	1307.18	1438.85	90.89	31777.75
3.21	1.15	0.19	0.06	28.76	82.16	6.29			131.67	131.67	1308.54	1440.21	90.70	31868.45
3.22	1.15	0.19	0.06	28.82	82.22	6.27			131.67	131.67	1309.90	1441.57	90.51	31958.96
3.23	1.15	0.19	0.06	28.89	82.29	6.25			131.67	131.67	1311.25	1442.92	90.32	32049.28
3.24	1.15	0.19	0.06	28.95	82.35	6.23			131.67	131.67	1312.60	1444.27	90.13	32139.40
3.25	1.15	0.19	0.06	29.01	82.41	6.21			131.67	131.67	1313.94	1445.61	89.94	32229.34
3.26	1.15	0.20	0.06	29.07	82.47	6.19			131.67	131.67	1315.28	1446.95	89.74	32319.08
3.27	1.15	0.20	0.06	29.14	82.54	6.17			131.67	131.67	1316.62	1448.29	89.55	32408.63
3.28	1.15	0.20	0.06	29.20	82.60	6.15			131.67	131.67	1317.95	1449.62	89.35	32497.98
3.29	1.15	0.20	0.06	29.26	82.66	6.14			131.67	131.67	1319.28	1450.94	89.15	32587.13
3.30	1.15	0.20	0.06	29.32	82.72	6.12			131.67	131.67	1320.60	1452.27	88.96	32676.09
3.31	1.15	0.20	0.06	29.38	82.78	6.10			131.67	131.67	1321.92	1453.59	88.76	32764.85
3.32	1.15	0.20	0.06	29.44	82.84	6.08			131.67	131.67	1323.23	1454.90	88.56	32853.41
3.33	1.15	0.20	0.06	29.50	82.90	6.06			131.67	131.67	1324.54	1456.21	88.36	32941.77
3.34	1.15	0.20	0.06	29.56	82.96	6.04			131.67	131.67	1325.85	1457.52	88.16	33029.92
3.35	1.15	0.20	0.06	29.62	83.02	6.02			131.67	131.67	1327.15	1458.82	87.95	33117.88
3.36	1.15	0.20	0.06	29.68	83.08	6.00			131.67	131.67	1328.45	1460.12	87.75	33205.62
3.37	1.15	0.20	0.06	29.74	83.14	5.98			131.67	131.67	1329.74	1461.41	87.55	33293.17
3.38	1.15	0.20	0.06	29.80	83.20	5.96			131.67	131.67	1331.03	1462.70	87.34	33380.51
3.39	1.15	0.20	0.06	29.86	83.26	5.94			131.67	131.67	1332.32	1463.99	87.13	33467.64
3.40	1.15	0.20	0.06	29.92	83.32	5.92			131.67	131.67	1333.60	1465.27	86.92	33554.57
3.41	1.15	0.20	0.06	29.98	83.38	5.90			131.67	131.67	1334.88	1466.54	86.72	33641.28
3.42	1.15	0.20	0.06	30.04	83.44	5.88			131.67	131.67	1336.15	1467.82	86.51	33727.79
3.43	1.15	0.20	0.06	30.10	83.50	5.86			131.67	131.67	1337.42	1469.09	86.30	33814.08
3.44	1.15	0.20	0.06	30.16	83.56	5.84			131.67	131.67	1338.68	1470.35	86.08	33900.17
3.45	1.15	0.20	0.06	30.22	83.62	5.83			131.67	131.67	1339.94	1471.61	85.87	33986.04
3.46	1.15	0.20	0.06	30.27	83.67	5.81			131.67	131.67	1341.20	1472.87	85.66	34071.70
3.47	1.15	0.20	0.06	30.33	83.73	5.79			131.67	131.67	1342.45	1474.12	85.44	34157.14
3.48	1.15	0.20	0.06	30.39	83.79	5.77			131.67	131.67	1343.70	1475.37	85.23	34242.37
3.49	1.15	0.20	0.06	30.45	83.85	5.75			131.67	131.67	1344.94	1476.61	85.01	34327.38
3.50	1.15	0.20	0.06	30.50	83.90	5.73			131.67	131.67	1346.18	1477.85	84.79	34412.17
3.51	1.15	0.20	0.06	30.56	83.96	5.71			131.67	131.67	1347.42	1479.08	84.57	34496.74
3.52	1.15	0.20	0.06	30.62	84.02	5.69			131.67	131.67	1348.65	1480.31	84.35	34581.10
3.53	1.15	0.20	0.06	30.68	84.08	5.67			131.67	131.67	1349.87	1481.54	84.13	34665.23
3.54	1.15	0.20	0.06	30.73	84.13	5.65			131.67	131.67	1351.10	1482.76	83.91	34749.15
3.55	1.15	0.20	0.06	30.79	84.19	5.63			131.67	131.67	1352.31	1483.98	83.69	34832.84
3.56	1.15	0.20	0.06	30.84	84.24	5.61			131.67	131.67	1353.53	1485.19	83.47	34916.30
3.57	1.15	0.20	0.06	30.90	84.30	5.59			131.67	131.67	1354.74	1486.40	83.24	34999.55
3.58	1.15	0.20	0.06	30.96	84.36	5.57			131.67	131.67	1355.94	1487.61	83.02	35082.56
3.59	1.15	0.20	0.06	31.01	84.41	5.55			131.67	131.67	1357.14	1488.81	82.79	35165.36
3.60	1.15	0.20	0.06	31.07	84.47	5.53			131.67	131.67	1358.34	1490.01	82.56	35247.92
3.61	1.15	0.20	0.06	31.12	84.52	5.51			131.67	131.67	1359.53	1491.20	82.34	35330.26
3.62	1.15	0.20	0.06	31.18	84.58	5.49			131.67	131.67	1360.72	1492.39	82.11	35412.36
3.63	1.15	0.20	0.05	31.23	84.63	5.47			131.67	131.67	1361.90	1493.57	81.88	35494.24
3.64	1.15	0.20	0.05	31.29	84.69	5.45			131.67	131.67	1363.08	1494.75	81.65	35575.89
3.65	1.15	0.20	0.05	31.34	84.74	5.43			131.67	131.67	1364.26	1495.93	81.41	35657.30
3.66	1.15	0.20	0.05	31.40	84.80	5.41			131.67	131.67	1365.43	1497.10	81.18	35738.48
3.67	1.15	0.20	0.05	31.45	84.85	5.39			131.67	131.67	1366.60	1498.26	80.95	35819.43
3.68	1.15	0.20	0.05	31.50	84.90	5.37			131.67	131.67	1367.76	1499.43	80.71	35900.14
3.69	1.15	0.20	0.05	31.56	84.96	5.35			131.67	131.67	1368.92	1500.59	80.48	35980.62
3.70	1.15	0.20	0.05	31.61	85.01	5.33			131.67	131.67	1370.07	1501.74	80.24	36060.86
3.71	1.15	0.20	0.05	31.66	85.06	5.31			131.67	131.67	1371.22	1502.89	80.00	36140.86
3.72	1.15	0.20	0.05	31.72	85.12	5.29			131.67	131.67	1372.37	1504.03	79.77	36220.63
3.73	1.15	0.20	0.05	31.77	85.17	5.27			131.67	131.67	1373.51	1505.18	79.53	36300.15
3.74	1.15	0.20	0.05	31.82	85.22	5.25			131.67	131.67	1374.65	1506.31	79.29	36379.44
3.75	1.15	0.20	0.05	31.87	85.27	5.23			131.67	131.67	1375.78	1507.45	79.04	36458.49
3.76	1.15	0.20	0.05	31.93	85.33	5.21			131.67	131.67	1376.91	1508.57	78.80	36537.29
3.77	1.15	0.20	0.05	31.98	85.38	5.19			131.67	131.67	1378.03	1509.70	78.56	36615.85
3.78	1.15	0.20	0.05	32.03	85.43	5.17			131.67	131.67	1379.15	1510.82	78.32	36694.16
3.79	1.15	0.20	0.05	32.08	85.48	5.15			131.67	131.67	1380.26	1511.93	78.07	36772.23
3.80	1.15	0.20	0.05	32.13	85.53	5.13			131.67	131.67	1381.36	1513.04	77.83	36850.06
3.81	1.15	0.20	0.05	32.19	85.59	5.11			131.67	131.67	1382.46	1514.15	77.58	36927.64
3.82	1.15	0.20	0.05	32.24	85.64	5.09			131.67	131.67	1383.56	1515.25	77.33	37004.97
3.83	1.15	0.20	0.05	32.29	85.69	5.07			131.67	131.67	1384.66	1516.35	77.08	37082.06
3.84	1.15	0.20	0.05	32.34	85.74	5.05			131.67	131.67	1385.76	1517.44	76.83	37158.89
3.85	1.15	0.20	0.05	32.39	85.79	5.03			131.67	131.67	1386.87	1518.53	76.58	37235.47
3.86	1.15	0.21	0.05	32.44	85.84	5.01			131.67	131.67	1387.95	1519.62	76.33	37311.81
3.87	1.15	0.21	0.05	32.49	85.89	4.99			131.67	131.67	1389.03	1520.70	76.08	37387.89
3.88	1.15	0.21	0.05	32.54	85.94	4.97			131.67	131.67	1390.11	1521.77	75.83	37463.72
3.89	1.15	0.21	0.05	32.59	85.99	4.95			131.67	131.67	1391.18	1522.85	75.58	37539.30
3.90	1.15	0.21	0.05	32.64	86.04	4.93			131.67	131.67	1392.25	1523.91	75.32	37614.62
3.91	1.15	0.21	0.05	32.69	86.09	4.91			131.67	131.67	1393.31	1524.98	75.07	37689.68
3.92	1.15	0.21	0.05	32.74	86.14	4.89			131.67	131.67	1394.37	1526.04	74.81	37764.49
3.93	1.15	0.21	0.05	32.78	86.18	4.87			131.67	131.67	1395.42	1527.09	74.55	37839.05
3.94	1.15	0.21	0.05	32.83	86.23	4.85			131.67	131.67	1396.47	1528.14	74.30	37913.34
3.95	1.15	0.21	0.05	32.88	86.28	4.83			131.67	131.67	1397.52	1529.19	74.04	37987.38
3.96	1.15	0.21	0.05	32.93	86.33	4.81			131.67	131.67	1398.56	1530.23	73.78	38061.16
3.97	1.15	0.21	0.05	32.98	86.38	4.79			131.67	131.67	1399.60	1531.28	73.52	38134.67
3.98	1.15	0.21	0.05	33.03	86.43	4.77			131.67	131.67	1400.63	1532.30	73.26	38207.93
3.99	1.15	0.21	0.05	33.07	86.47	4.75			131.67	131.67	1401.66	1533.32	72.99	38280.92
4.00	1.15	0.21	0.05	33.12	86.52	4.73			131.67	131.67	1402.68	1534.35	72.73	38353.65
4.01	1.15	0.21	0.05	33.17	86.57	4.71			131.67	131.67	1403.70	1535.37	72.47	38426.12
4.02	1.15	0.21	0.05	33.21	86.61	4.69			131.67	131.67	1404.71	1536.38	72.20	38498.32
4.03	1.15	0.21	0.05	33.26	86.66	4.67			131.67	131.67	1405.73	1537.39	71.94	38570.26
4.04	1.15	0.21	0.05	33.31	86.71	4.65			131.67	131.67	1406.73	1538.40	71.67	38641.93
4.05	1.15	0.21	0.05	33.35	86.75	4.63			131.67	131.67	1407.73	1539.40	71.40	38713.34
4.06	1.15	0.21	0.05	33.40	86.80	4.61			131.67	131.67	1408.73	1540.40	71.14	38784.47
4.07	1.15	0.21	0.05	33.45	86.85	4.59			131.67	131.67	1409.72	1541.39	70.87	38855.34
4.08	1.15	0.21	0.05	33.49	86.89	4.57			131.67	131.67	1410.71	1542.38	70.60	38925.94
4.09	1.15	0.21	0.05	33.54	86.94	4.55			131.67	131.67	1411.70	1543.36	70.33	38996.27
4.10	1.15	0.21	0.05	33.58	86.98	4.53			131.67	131.67	1412.68	1544.34	70.06	39066.33
4.11	1.15	0.21	0.05	33.63	87.03	4.51			131.67	131.67	1413.65	1545.32	69.79	39136.11
4.12	1.15	0.21	0.04	33.67	87.07	4.49			131.67	131.67	1414.62	1546.29	69.51	39205.63
4.13	1.15	0.21	0.04	33.72	87.12	4.46			131.67	131.67	1415.59	1547.26	69.24	39274.88
4.14	1.15	0.21	0.04	33.76	87.16	4.44			131.67	131.67	1416.55	1548.22	68.97	39343.85
4.15	1.15	0.21	0.04	33.81	87.21	4.42			131.67	131.67	1417.51	1549.18	68.69	39412.52
4.16	1.15	0.21	0.04	33.85	87.25	4.40			131.67	131.67	1418.46	1550.13	68.41	39480.93
4.17	1.15	0.21	0.04	33.90	87.30	4.38			131.67	131.67	1419.41	1551.08	68.14	39549.07
4.18	1.15	0.21	0.04	33.94	87.34	4.36			131.67	131.67	1420.35	1552.02	67.86	39616.93
4.19	1.15	0.21	0.04	33.98	87.38	4.34			131.67	131.67	1421.29	1552.96	67.58	39684.52
4.20	1.15	0.21	0.04	34.03	87.43	4.32			131.67	131.67	1422.23	1553.90	67.30	39751.82
4.21	1.15	0.21	0.04	34.07	87.47	4.30			131.67	131.67	1423.16	1554.83	67.02	39818.84
4.22	1.15	0.21	0.04	34.11	87.51	4.28			131.67	131.67	1424.09	1555.76	66.74	39885.59
4.23	1.15	0.21	0.04	34.15	87.55	4.26			131.67	131.67	1425.01	1556.68	66.46	39952.05
4.24	1.15	0.21	0.04	34.20	87.60	4.24			131.67	131.67	1425.93	1557.59	66.18	40018.23
4.25	1.15	0.21	0.04	34.24	87.64	4.22			131.67	131.67	1426.84	1558.51	65.90	40084.13
4.26	1.15	0.21	0.04	34.28	87.68	4.20			131.67	131.67	1427.75	1559.42	65.61	40149.74
4.27	1.15	0.21	0.04	34.32	87.72	4.18			131.67	131.67	1428.65	1560.32	65.33	40215.07
4.28	1.15	0.21	0.04	34.36	87.76	4.16			131.67	131.67	1429.55	1561.22	65.04	40280.11
4.29	1.15	0.21	0.04	34.41	87.81	4.14			131.67	131.67	1430.45	1562.12	64.76	40344.87
4.30	1.15	0.21	0.04	34.45	87.85	4.11			131.67	131.67	1431.34	1563.01	64.47	40409.35

Time (s)	h at n (m)	Acceleration (No units)	Δ Dist (m)	Penetration Distance (m)	Distance from Track (m)	Velocity (m/s)	Kp Zone 1	Kp Zone 2	Kp Zone 3	kp (kN)	Friction (kN)	Σ Resist (kN)	Incre Energy (kJ)	Σ Energy (kJ)
4.31	1.15	0.21	0.04	34.49	67.89	4.09			131.67	131.67	1432.23	1563.89	64.19	40473.53
4.32	1.15	0.21	0.04	34.53	67.93	4.07			131.67	131.67	1433.11	1564.78	63.90	40537.43
4.33	1.15	0.21	0.04	34.57	67.97	4.05			131.67	131.67	1433.99	1565.65	63.61	40601.04
4.34	1.15	0.21	0.04	34.61	68.01	4.03			131.67	131.67	1434.86	1566.53	63.32	40664.36
4.35	1.15	0.21	0.04	34.65	68.05	4.01			131.67	131.67	1435.73	1567.39	63.03	40727.39
4.36	1.15	0.21	0.04	34.69	68.09	3.99			131.67	131.67	1436.59	1568.26	62.74	40790.12
4.37	1.15	0.21	0.04	34.73	68.13	3.97			131.67	131.67	1437.45	1569.12	62.45	40852.57
4.38	1.15	0.21	0.04	34.77	68.17	3.95			131.67	131.67	1438.31	1569.97	62.15	40914.73
4.39	1.15	0.21	0.04	34.81	68.21	3.93			131.67	131.67	1439.16	1570.82	61.86	40976.59
4.40	1.15	0.21	0.04	34.85	68.25	3.91			131.67	131.67	1440.00	1571.67	61.57	41038.16
4.41	1.15	0.21	0.04	34.89	68.29	3.89			131.67	131.67	1440.84	1572.51	61.27	41099.43
4.42	1.15	0.21	0.04	34.93	68.33	3.87			131.67	131.67	1441.68	1573.35	60.98	41160.41
4.43	1.15	0.21	0.04	34.96	68.36	3.84			131.67	131.67	1442.51	1574.18	60.68	41221.09
4.44	1.15	0.21	0.04	35.00	68.40	3.82			131.67	131.67	1443.34	1575.01	60.39	41281.48
4.45	1.15	0.21	0.04	35.04	68.44	3.80			131.67	131.67	1444.16	1575.83	60.09	41341.58
4.46	1.15	0.21	0.04	35.08	68.48	3.78			131.67	131.67	1444.98	1576.65	59.79	41401.36
4.47	1.15	0.21	0.04	35.12	68.52	3.76			131.67	131.67	1445.80	1577.47	59.49	41460.85
4.48	1.15	0.21	0.04	35.15	68.55	3.74			131.67	131.67	1446.61	1578.28	59.19	41520.04
4.49	1.15	0.21	0.04	35.19	68.59	3.72			131.67	131.67	1447.41	1579.08	58.88	41578.93
4.50	1.15	0.21	0.04	35.23	68.63	3.70			131.67	131.67	1448.21	1579.88	58.59	41637.53
4.51	1.15	0.21	0.04	35.27	68.67	3.68			131.67	131.67	1449.01	1580.68	58.29	41695.82
4.52	1.15	0.21	0.04	35.30	68.70	3.66			131.67	131.67	1449.80	1581.47	57.99	41753.81
4.53	1.15	0.21	0.04	35.34	68.74	3.64			131.67	131.67	1450.59	1582.26	57.69	41811.49
4.54	1.15	0.21	0.04	35.38	68.78	3.61			131.67	131.67	1451.37	1583.04	57.36	41868.86
4.55	1.15	0.21	0.04	35.41	68.81	3.59			131.67	131.67	1452.15	1583.82	57.08	41925.96
4.56	1.15	0.21	0.04	35.45	68.85	3.57			131.67	131.67	1452.93	1584.59	56.77	41982.73
4.57	1.15	0.21	0.04	35.48	68.88	3.55			131.67	131.67	1453.69	1585.36	56.47	42039.20
4.58	1.15	0.21	0.04	35.52	68.92	3.53			131.67	131.67	1454.46	1586.13	56.16	42095.37
4.59	1.15	0.21	0.04	35.55	68.95	3.51			131.67	131.67	1455.22	1586.89	55.86	42151.22
4.60	1.15	0.21	0.03	35.59	68.99	3.49			131.67	131.67	1455.98	1587.64	55.55	42206.77
4.61	1.15	0.21	0.03	35.62	69.02	3.47			131.67	131.67	1456.73	1588.39	55.24	42262.02
4.62	1.15	0.21	0.03	35.66	69.06	3.45			131.67	131.67	1457.47	1589.14	54.93	42316.95
4.63	1.15	0.21	0.03	35.69	69.09	3.43			131.67	131.67	1458.22	1589.88	54.62	42371.57
4.64	1.15	0.21	0.03	35.73	69.13	3.40			131.67	131.67	1458.95	1590.62	54.32	42425.89
4.65	1.15	0.21	0.03	35.76	69.16	3.38			131.67	131.67	1459.69	1591.35	54.00	42479.89
4.66	1.15	0.21	0.03	35.79	69.19	3.36			131.67	131.67	1460.41	1592.08	53.69	42533.59
4.67	1.15	0.22	0.03	35.83	69.23	3.34			131.67	131.67	1461.14	1592.81	53.38	42586.97
4.68	1.15	0.22	0.03	35.86	69.26	3.32			131.67	131.67	1461.86	1593.52	53.07	42640.04
4.69	1.15	0.22	0.03	35.89	69.29	3.30			131.67	131.67	1462.57	1594.24	52.76	42692.80
4.70	1.15	0.22	0.03	35.93	69.33	3.28			131.67	131.67	1463.28	1594.95	52.44	42745.24
4.71	1.15	0.22	0.03	35.96	69.36	3.26			131.67	131.67	1463.99	1595.65	52.13	42797.37
4.72	1.15	0.22	0.03	35.99	69.39	3.24			131.67	131.67	1464.69	1596.36	51.82	42849.19
4.73	1.15	0.22	0.03	36.02	69.42	3.21			131.67	131.67	1465.39	1597.05	51.50	42900.69
4.74	1.15	0.22	0.03	36.06	69.46	3.19			131.67	131.67	1466.08	1597.74	51.18	42951.87
4.75	1.15	0.22	0.03	36.09	69.49	3.17			131.67	131.67	1466.76	1598.43	50.87	43002.74
4.76	1.15	0.22	0.03	36.12	69.52	3.15			131.67	131.67	1467.45	1599.11	50.55	43053.29
4.77	1.15	0.22	0.03	36.15	69.55	3.13			131.67	131.67	1468.13	1599.79	50.23	43103.53
4.78	1.15	0.22	0.03	36.18	69.58	3.11			131.67	131.67	1468.80	1600.47	49.92	43153.44
4.79	1.15	0.22	0.03	36.21	69.61	3.09			131.67	131.67	1469.47	1601.14	49.60	43203.04
4.80	1.15	0.22	0.03	36.24	69.64	3.07			131.67	131.67	1470.13	1601.80	49.28	43252.32
4.81	1.15	0.22	0.03	36.27	69.67	3.04			131.67	131.67	1470.79	1602.46	48.96	43301.28
4.82	1.15	0.22	0.03	36.30	69.70	3.02			131.67	131.67	1471.45	1603.11	48.64	43349.92
4.83	1.15	0.22	0.03	36.33	69.73	3.00			131.67	131.67	1472.10	1603.77	48.32	43398.23
4.84	1.15	0.22	0.03	36.36	69.76	2.98			131.67	131.67	1472.74	1604.41	48.00	43446.23
4.85	1.15	0.22	0.03	36.39	69.79	2.96			131.67	131.67	1473.39	1605.05	47.67	43493.90
4.86	1.15	0.22	0.03	36.42	69.82	2.94			131.67	131.67	1474.02	1605.69	47.35	43541.25
4.87	1.15	0.22	0.03	36.45	69.85	2.92			131.67	131.67	1474.65	1606.32	47.03	43588.28
4.88	1.15	0.22	0.03	36.48	69.88	2.90			131.67	131.67	1475.28	1606.95	46.70	43634.99
4.89	1.15	0.22	0.03	36.51	69.91	2.87			131.67	131.67	1475.91	1607.57	46.38	43681.37
4.90	1.15	0.22	0.03	36.54	69.94	2.85			131.67	131.67	1476.52	1608.19	46.06	43727.42
4.91	1.15	0.22	0.03	36.57	69.97	2.83			131.67	131.67	1477.14	1608.81	45.73	43773.15
4.92	1.15	0.22	0.03	36.60	70.00	2.81			131.67	131.67	1477.75	1609.41	45.40	43818.56
4.93	1.15	0.22	0.03	36.62	70.02	2.79			131.67	131.67	1478.35	1610.02	45.08	43863.64
4.94	1.15	0.22	0.03	36.65	70.05	2.77			131.67	131.67	1478.95	1610.62	44.75	43908.39
4.95	1.15	0.22	0.03	36.68	70.08	2.75			131.67	131.67	1479.55	1611.21	44.42	43952.81
4.96	1.15	0.22	0.03	36.71	70.11	2.73			131.67	131.67	1480.14	1611.81	44.10	43996.91
4.97	1.15	0.22	0.03	36.73	70.13	2.70			131.67	131.67	1480.72	1612.39	43.77	44040.68
4.98	1.15	0.22	0.03	36.76	70.16	2.68			131.67	131.67	1481.31	1612.97	43.44	44084.12
4.99	1.15	0.22	0.03	36.79	70.19	2.66			131.67	131.67	1481.88	1613.55	43.11	44127.23
5.00	1.15	0.22	0.03	36.81	70.21	2.64			131.67	131.67	1482.46	1614.12	42.78	44170.01
5.01	1.15	0.22	0.03	36.84	70.24	2.62			131.67	131.67	1483.02	1614.69	42.45	44212.46
5.02	1.15	0.22	0.03	36.87	70.27	2.60			131.67	131.67	1483.59	1615.25	42.12	44254.58
5.03	1.15	0.22	0.03	36.89	70.29	2.58			131.67	131.67	1484.15	1615.81	41.79	44296.37
5.04	1.15	0.22	0.03	36.92	70.32	2.55			131.67	131.67	1484.70	1616.37	41.46	44337.83
5.05	1.15	0.22	0.03	36.94	70.34	2.53			131.67	131.67	1485.25	1616.92	41.12	44378.95
5.06	1.15	0.22	0.03	36.97	70.37	2.51			131.67	131.67	1485.79	1617.46	40.79	44419.74
5.07	1.15	0.22	0.03	36.99	70.39	2.49			131.67	131.67	1486.33	1618.00	40.45	44460.20
5.08	1.15	0.22	0.02	37.02	70.42	2.47			131.67	131.67	1486.87	1618.54	40.12	44500.32
5.09	1.15	0.22	0.02	37.04	70.44	2.45			131.67	131.67	1487.40	1619.07	39.79	44540.11
5.10	1.15	0.22	0.02	37.07	70.47	2.43			131.67	131.67	1487.93	1619.59	39.45	44579.57
5.11	1.15	0.22	0.02	37.09	70.49	2.40			131.67	131.67	1488.45	1620.11	39.12	44618.69
5.12	1.15	0.22	0.02	37.12	70.52	2.38			131.67	131.67	1488.96	1620.63	38.79	44657.48
5.13	1.15	0.22	0.02	37.14	70.54	2.36			131.67	131.67	1489.48	1621.14	38.45	44695.93
5.14	1.15	0.22	0.02	37.16	70.56	2.34			131.67	131.67	1489.98	1621.65	38.11	44734.04
5.15	1.15	0.22	0.02	37.19	70.59	2.32			131.67	131.67	1490.49	1622.15	37.78	44771.82
5.16	1.15	0.22	0.02	37.21	70.61	2.30			131.67	131.67	1490.99	1622.65	37.44	44809.26
5.17	1.15	0.22	0.02	37.23	70.63	2.28			131.67	131.67	1491.48	1623.15	37.10	44846.36
5.18	1.15	0.22	0.02	37.25	70.65	2.25			131.67	131.67	1491.97	1623.64	36.76	44883.12
5.19	1.15	0.22	0.02	37.28	70.68	2.23			131.67	131.67	1492.45	1624.12	36.43	44919.55
5.20	1.15	0.22	0.02	37.30	70.70	2.21			131.67	131.67	1492.93	1624.60	36.09	44955.63
5.21	1.15	0.22	0.02	37.32	70.72	2.19			131.67	131.67	1493.41	1625.07	35.75	44991.38
5.22	1.15	0.22	0.02	37.34	70.74	2.17			131.67	131.67	1493.88	1625.54	35.41	45026.79
5.23	1.15	0.22	0.02	37.36	70.76	2.15			131.67	131.67	1494.34	1626.01	35.07	45061.86
5.24	1.15	0.22	0.02	37.39	70.79	2.12			131.67	131.67	1494.80	1626.47	34.73	45096.58
5.25	1.15	0.22	0.02	37.41	70.81	2.10			131.67	131.67	1495.26	1626.93	34.39	45130.97
5.26	1.15	0.22	0.02	37.43	70.83	2.08			131.67	131.67	1495.71	1627.38	34.04	45165.01
5.27	1.15	0.22	0.02	37.45	70.85	2.06			131.67	131.67	1496.16	1627.83	33.70	45198.72
5.28	1.15	0.22	0.02	37.47	70.87	2.04			131.67	131.67	1496.60	1628.27	33.36	45232.08
5.29	1.15	0.22	0.02	37.49	70.89	2.02			131.67	131.67	1497.04	1628.71	33.02	45265.10
5.30	1.15	0.22	0.02	37.51	70.91	1.99			131.67	131.67	1497.47	1629.14	32.66	45297.77
5.31	1.15	0.22	0.02	37.53	70.93	1.97			131.67	131.67	1497.90	1629.57	32.33	45330.11
5.32	1.15	0.22	0.02	37.55	70.95	1.95			131.67	131.67	1498.33	1629.99	31.98	45362.10
5.33	1.15	0.22	0.02	37.57	70.97	1.93			131.67	131.67	1498.75	1630.41	31.65	45393.74
5.34	1.15	0.22	0.02	37.59	70.99	1.91			131.67	131.67	1499.16	1630.83	31.30	45425.04
5.35	1.15	0.22	0.02	37.61	71.01	1.89			131.67	131.67	1499.57	1631.24	30.96	45456.00
5.36	1.15	0.22	0.02	37.63	71.03	1.87			131.67	131.67	1499.97	1631.64	30.61	45486.61
5.37	1.15	0.22	0.02	37.64	71.04	1.84			131.67	131.67	1500.38	1632.04	30.27	45516.87
5.38	1.15	0.22	0.02	37.66	71.06	1.82			131.67	131.67	1500.77	1632.44	29.92	45546.79
5.39	1.15	0.22	0.02	37.68	71.08	1.80			131.67	131.67	1501.16	1632.83	29.57	45576.37
5.40	1.15	0.22	0.02	37.70	71.10	1.78			131.67	131.67	1501.55	1633.22	29.23	45605.60
5.41	1.15	0.22	0.02	37.72	71.12	1.76			131.67	131.67	1501.93	1633.60	28.88	45634.48
5.42	1.15	0.22	0.02	37.73	71.13	1.74			131.67	131.67	1502.31	1633.97	28.53	45663.01
5.43	1.15	0.22	0.02	37.75	71.15	1.71			131.67	131.67	1502.68	1634.35	28.19	45691.20
5.44	1.15	0.22	0.02	37.77	71.17	1.69			131.67	131.67	1503.05	1634.72	27.84	45719.04
5.45	1.15	0.22	0.02	37.78	71.18	1.67			131.67	131.67	1503.41	1635.08	27.49	45746.53
5.46	1.15	0.22	0.02	37.80	71.20	1.65			131.67	131.67	1503.77	1635.44	27.14	45773.67
5.47	1.15	0.22	0.02	37.82	71.22	1.63			131.67	131.67	1504.12	1635.79	26.79	45800.46
5.48	1.15	0.22	0.02	37.83	71.23	1.61			131.67	131.67	1504.47	1636.14	26.44	45826.91

Time (s)	h st n (m)	Acceleration (No units)	Δ Dist (m)	Penetration Distance (m)	Distance from Track (m)	Velocity (m/s)	Kp Zone 1	Kp Zone 2	Kp Zone 3	kp (kN)	Friction (kN)	Σ Resist (kN)	Incrs Energy (kJ)	Σ Energy (kJ)
5.49	1.15	0.22	0.02	37.85	71.25	1.58			131.67	131.67	1504.62	1636.48	26.10	45853.00
5.50	1.15	0.22	0.02	37.87	71.27	1.56			131.67	131.67	1505.16	1636.82	25.75	45878.75
5.51	1.15	0.22	0.02	37.88	71.28	1.54			131.67	131.67	1505.49	1637.15	25.40	45904.14
5.52	1.15	0.22	0.02	37.90	71.30	1.52			131.67	131.67	1505.82	1637.49	25.05	45929.19
5.53	1.15	0.22	0.02	37.91	71.31	1.50			131.67	131.67	1506.15	1637.81	24.70	45953.89
5.54	1.15	0.22	0.01	37.93	71.33	1.48			131.67	131.67	1506.47	1638.14	24.34	45978.23
5.55	1.15	0.22	0.01	37.94	71.34	1.45			131.67	131.67	1506.78	1638.45	23.99	46002.22
5.56	1.15	0.22	0.01	37.96	71.36	1.43			131.67	131.67	1507.10	1638.76	23.64	46025.87
5.57	1.15	0.22	0.01	37.97	71.37	1.41			131.67	131.67	1507.40	1639.07	23.29	46049.16
5.58	1.15	0.22	0.01	37.98	71.38	1.39			131.67	131.67	1507.71	1639.37	22.94	46072.10
5.59	1.15	0.22	0.01	38.00	71.40	1.37			131.67	131.67	1508.00	1639.67	22.58	46094.68
5.60	1.15	0.22	0.01	38.01	71.41	1.34			131.67	131.67	1508.30	1639.98	22.23	46116.92
5.61	2.15	0.22	0.01	38.02	71.42	1.32			460.21	460.21	2011.62	2471.83	32.98	46149.89
5.62	3.15	0.22	0.01	38.04	71.44	1.30			887.88	887.88	2820.26	3808.13	49.97	46199.87
5.63	4.15	0.33	0.01	38.05	71.45	1.27			1714.66	1714.66	3934.51	5649.17	72.60	46272.46
5.64	5.15	0.51	0.01	38.06	71.46	1.22			2640.56	2640.56	5354.64	7995.21	99.42	46371.88
5.65	6.15	0.76	0.01	38.07	71.47	1.14			3765.58	3765.58	7080.87	10846.46	126.07	46498.95
5.66	7.15	1.09	0.01	38.09	71.49	1.04			5089.72	5089.72	9113.34	14203.07	154.85	46654.80
5.67	8.15	1.47	0.01	38.09	71.49	0.89			6812.98	6812.98	11452.07	18265.05	174.40	46829.21
5.68	9.15	1.92	0.01	38.10	71.50	0.71			8335.36	8335.36	14096.80	22432.26	179.32	47008.53
5.69	10.15	2.44	0.01	38.11	71.51	0.47			10256.85	10256.85	17047.50	27304.35	159.86	47168.38
5.70	11.15	3.03	0.00	38.11	71.51	0.17			12377.47	12377.47	20303.21	32680.68	103.62	47272.01
5.71	12.15	3.69	0.00	38.11	71.51	-0.19			14697.20	14697.20	23863.06	38560.26	0.00	47272.01

Read Jones Christoffersen
Consulting Engineers

Project	401 MARCH ROAD	Job Number	111874.0001
Date	31 OCT 14	Page	1 of 1
Designer	CB		



LICENSED PROFESSIONAL ENGINEER
C. C. BYRNE
100150788
PROVINCE OF ONTARIO

SECTION AT CRASH WALL
(1 : 25)