THERMAL DISPERSION MODELING FOR NON-CONTACT COOLING WATER DISCHARGES FROM THE DRILL SHIP THE POLAR PIONEER

BURGER FIELD

LOCATED OFFSHORE CHUKCHI SEA, ALASKA

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July 16, 2014

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Report No.	Discharge_009_SO8_Polar_Pioneer

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EXECUTIVE SUMMARY

The primary goal of this environmental numeric modeling was to conduct an assessments of the temperature associated with the non-contact cooling water discharges from the drilling operations to be performed by the drill ship **Polar Pioneer** in the burger field, located in the Chuckchi Sea, by SHELL Alaska Venture. The drill ship Polar Pioneer will discharge approximately **21,385.33** barrels (bbls) per day (bbls/day) of the non-contact cooling water from a single outlet located on this drill ship. This constitutes the discharge described in the Permit No.: **AKG-28-8100** as **Discharge 009** (non-contact cooling water).

Numeric modeling for the thermal dispersion were conducted using the **US EPA Visual Plumes Model** to characterize the temperature associated with the non-contact cooling water discharges (**Discharge 009)** both for the mean and maximum currents speed from the drilling operations to be conducted in the burger field by the drill rig Polar Pioneer. This provides a sensitivity analysis of the numeric model results to the model input parameter: currents speed. The numeric simulation was conducted for the single point discharge source from the drill rig Polar Pioneer. The non-contact cooling water is discharged out of a single **16.0** inch (outer diameter) discharge caisson that runs down the starboard # 4 column of the drill ship Polar Pioneer. The discharge caisson is approximately **9.0** meters (m) below the sea surface while at the drilling draft.

The thermal dispersion simulations were performed using the effluent and ambient data for the planned drilling period. The planned drilling period is within the open water season of July thru October. The direction of the discharge was assumed to be aligned with the ambient flow direction for the modeling purpose since the current bends the plume in the direction of flow (Frick 2003).

The potential impact assessments of the excess temperature of **0.05** degrees Celsius (°C) on the ambient water quality based on the US EPA Visual Plumes thermal dispersion numeric simulations both for the mean and maximum currents speed indicate that the discharge plume sinks deeper into the ambient and also wider at mean currents. It travels slightly farther at the maximum currents. The higher ambient flow velocity induces enhanced mixing of the plume at the maximum currents. Hence, the plume cools to within **0.05** °C of the ambient significantly sooner after the cessation of the discharge at the maximum currents speed than at the mean currents speed. The areas affected by the excess temperature of **0.05** ^{o}C at the maximum currents speed is significantly less than that at the mean currents speed. Therefore, mean currents speed represents the worst case scenario.

The potential impact assessments of the excess temperature of **0.05** °C on the ambient water quality based on the US EPA Visual Plumes thermal dispersion numeric simulation are: maximum plume depth is **2.0** m; maximum plume width is **68.0** m; maximum distance from the source is **355** m; maximum duration is **78.0** minutes; and the total area affected is **1.4** hectares (ha). These estimates indicate **low** impacts on the ambient water quality from the temperature associated with the **Discharge 009** (non-contact cooling water) of approximately **21,385.33** bbls/day from the single outlet located on the drill ship.

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Table of Acronyms

bbls	Barrels
bbls/day	Barrels per day
bbls/hour	Barrels per hour
°C	Degrees Celsius
gal	Gallons
gals/day	Gallons per day
ha	Hectares
kg/m^3	Kilograms per cubic meter
m	Meters
m^2	Square meters
m/s	Meters per second
psu	Practical salinity scale unit
σ_T	Density of seawater

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Section 1: Introduction

This technical report describes the assessments of the temperature associated with the non-contact cooling water discharges during the drilling operations to be performed by the drill ship **Polar Pioneer** in the burger field, located in the Chuckchi Sea, by SHELL Alaska Venture. The drill ship Polar Pioneer will discharge approximately **21,385.33** barrels (bbls) per day (bbls/day) of the non-contact cooling water from a single outlet located on this drill ship. This constitutes the discharge described in the Permit No.: **AKG-28-8100** as **Discharge 009** (non-contact cooling water).

Numeric simulations for the thermal dispersion were conducted using the **US EPA Visual Plumes Model** to characterize the temperature associated with the non-contact cooling water discharges (**Discharge 009)** both at the mean and maximum currents speeds during the drilling operations to be conducted in the burger field by the drill rig Polar Pioneer. This provides a sensitivity analysis of the numeric model results to the model input parameter: currents speed. The location of the burger field in the Chukchi Sea is presented in **Figure 1**. The numeric simulations were conducted for the single point discharge source from the drill rig Polar Pioneer. The non-contact cooling water is discharged out of a single **16.0** inch (outer diameter) discharge caisson that runs down the starboard # **4** column of the drill ship Polar Pioneer as listed in **Table 1**. The internal diameter of the non-contact cooling water discharge caisson is **15.25** inches based on a **0.75** inches of the total wall thickness.

Figure 1-1: Location of the Burger Field

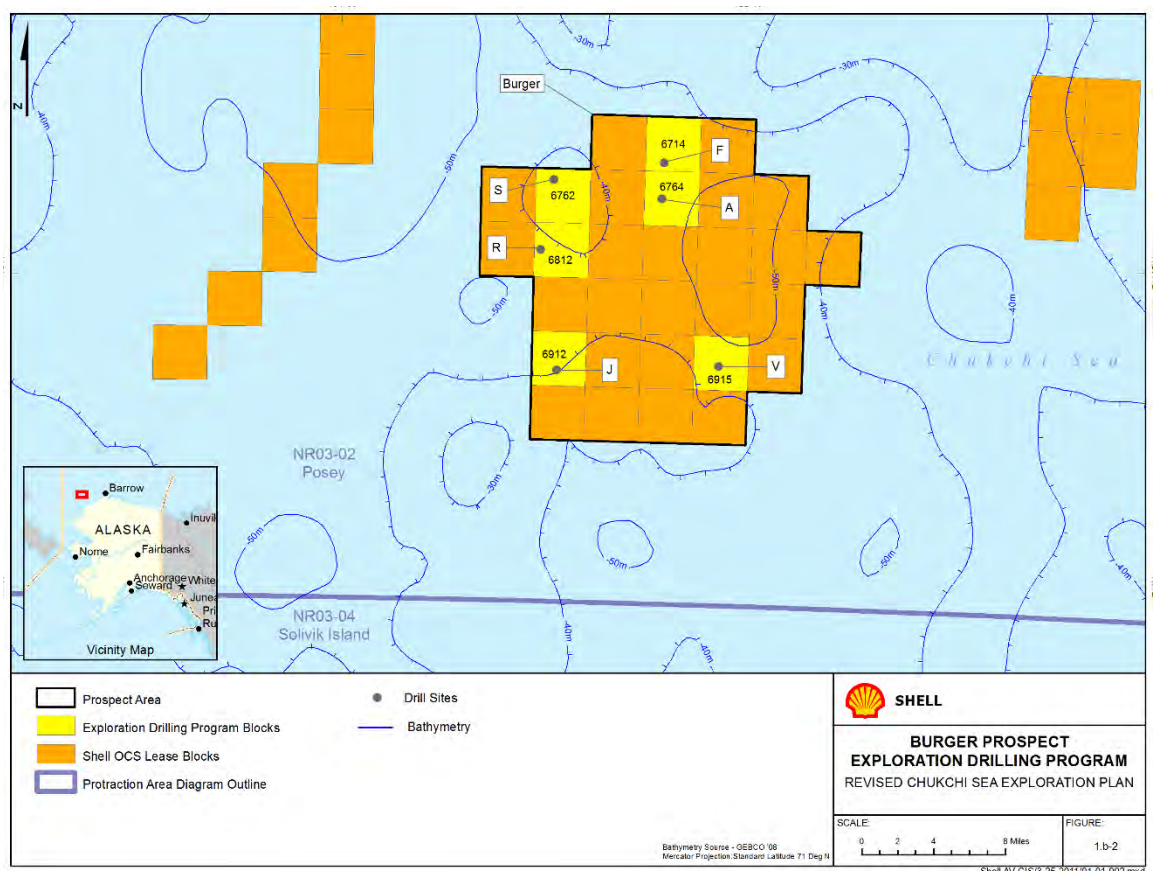

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Table 1: Non-Contact Cooling Water Discharge (009) from the Drill Rig Polar Pioneer

Discharge Type	Discharge Number	Discharge Source		Maximum Volume Discharged		Discharge Duration, hours/day	Discharge Caisson		Effluent Characteristics	
		Description	Location	gals/day	bbls/day		Internal Diameter (inches)	Outlet/Port Depth (m)	Temp (°C)	Salinity (psu)
Non-Contact Cooling Water	009	Drill Ship Polar Pioneer	Starboard # 4	898,184	21,385.33	24	15.25	9.00	13.33	30

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1.1 The US EPA Visual Plumes Model

The **Visual Plumes** is a mixing zone model developed by the US EPA's Ecosystems Research Division, National Exposure Research Laboratory (Frick **2003**). The **PDS** module of the Visual Plumes model was used for the numeric simulation of the thermal dispersion for the point discharge listed in Table **1**. The PDS is a three-dimensional plume model that applies to the point discharges to the water bodies. The PDS module provides simulations for the temperature and dilution over a wide range of discharge conditions. It is an Eulerian integral flux model for the surface discharge into a moving ambient body of water that includes the effects of the surface heat transfer. The initial discharge momentum causes the plume to penetrate the ambient at the same time that the current bends the plume in the direction of flow (Frick **2003**).

1.2 Effluent Data

The estimated volumes of the non-contact cooling water discharges from the Polar Pioneer is **21**,**385**.**33** bbls/day as listed in Table **1**. The duration of the discharge is **24** hours per day. The temperature of the effluent to be discharged is **13**.**33** degrees Celsius (°C) as presented in Table **1**. The salinity of the effluent is **30** Practical Salinity Scale Unit (psu). The discharge pipe internal diameter is **15**.**25** inches. The discharge occurs approximately at **9**.**0** m below the sea surface for the modeling purpose.

1.3 Ambient Data

The ambient water depth at the prospect well Burger J within the burger field location in the Chukchi Sea is **43**.**9** meters (m). The mean and maximum currents speed are approximately **0**.**07** and **0**.**25** meters per second (m/sec), respectively with a prevailing direction of flow to the east for the planned drilling period. The temperature of the ambient water varies from **4** °C at the surface stratum to - **0**.**5** °C at the bottom stratum, with a significant stratification occurring at **15** m depth. The salinity of the ambient water varies from **30** psu at the surface stratum to **32** psu at the bottom stratum, with a significant stratification occurring at **15** m depth.

Table 2: Ambient Data for the Burger Field, Chukchi Sea

Water Depth	Temperature	Salinity	Mean Currents		Maximum Currents	
m	°C	Psu	Speed (m/s)	Direction	Speed (m/s)	Direction
0	4.0	30	0.07	to the East	0.25	to the East
43.9-45.7	-0.5	32	0.07	to the East	0.25	to the East

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Section 2: Thermal Dispersion Modeling

Thermal dispersion numeric simulations were performed for the one point discharge source listed below. The non-contact cooling water discharges was modeled using the **US EPA Visual Plumes** model as described in **Section 1**. The modeling results are described in details in **Section 3**. **Section 4** presents the summary and conclusion. **Section 5** lists the references cited in this report. Appendices **A and B** describe the model input data and outputs.

The point non-contact cooling water discharge (**Discharge 009**) sources is:

1. 16.0-inch discharge caisson located at starboard # 4 of the drill ship Polar Pioneer.

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Section 3: Thermal Dispersion Modeling – Polar Pioneer

3.1 Non-contact Cooling Water Discharges from the 16.0-inch Discharge Caisson

The total volume of the non-contact cooling water discharges from the drill ship Polar Pioneer, from a **16**-inch discharge caisson located at starboard # **4** is approximately **21,385.33** bbls/day. The duration of the discharge is **24** hours/day. The temperature and salinity of the effluent are **13.33** °C and **30** psu, respectively. The discharge occurs at **9.0** below the sea surface. The direction of the discharge is assumed to be aligned with the ambient flow direction for the modeling purpose since the current bends the plume in the direction of flow (Frick **2003**). Thermal dispersion numeric simulations were performed both for the mean and maximum currents. The model results both for the mean and maximum currents are described below.

3.2 Non-contact Cooling Water Discharges at Mean Currents

The Visual Plumes model results at the mean currents for: ambient and plume properties; plume path; plume trajectory; plume dilution; and plume temperature decay are presented in **Figures 3-1, 3-2, 3-3, 3-4,** and **3-5** respectively. **Figures 3-6** and **3-7** present the duration of the excess temperature and the area affected.

Figure 3-1: Ambient and Plume Properties – 16.0-inch Discharge Caisson at Mean Currents

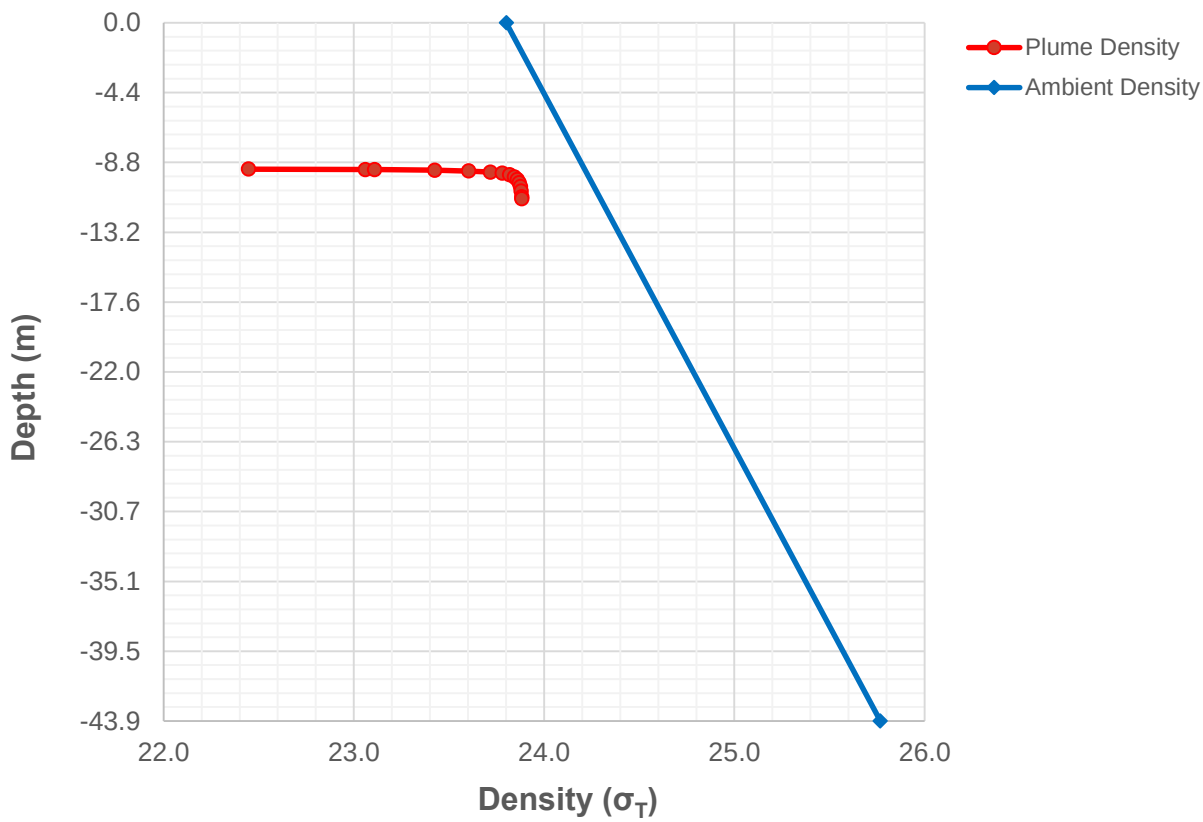

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Figure 3-1 presents the ambient and plume densities (σ_T) versus the depth of water from the sea surface. The ambient density (σ_T) varies from **23.80** kg/m^3 at the surface to **25.77** kg/m^3 at the bottom. As seen above, the thermal plume is released at **9.0** m below the sea surface and the initial discharge momentum causes the effluent (σ_T = **22.45** - **23.88** kg/m^3) plume to sink into the ambient to a depth of approximately **2.0** m. **Figure 3-2** presents the width of the plume. The maximum width of the plume is approximately **68** m at a distance of approximately **350** m from the source. The plume trajectory presented in **Figure 3-3** also shows that the plume reaches a depth of **2.0** m at a distance of approximately **350** m from the source and attains an average dilution factor of **400** as seen in **Figure 3-4**. The plume center line dilution factor is **200**. The plume temperature decay presented in **Figure 3-5** shows that it has cooled to within **0.05** ^{o}C of the ambient temperature (**3.1** ^{o}C at a depth of **11** m from the sea surface) at a distance of approximately **350** m from the source. It takes approximately **78** minutes after the cessation of the discharge for the plume to cool to within **0.05** °C of the ambient as presented in **Figure 3-6**. The area affected by the excess temperature of **0.05** °C or higher is limited to **14,000** square meters approximately as seen in **Figure 3-7.** Based on these findings, the impact of this release of the non-contact cooling water on the ambient is low and limited to an area of **1.4** hectares only.

Figure 3-2: Plume Path – 16.0-inch Discharge Caisson at Mean Currents

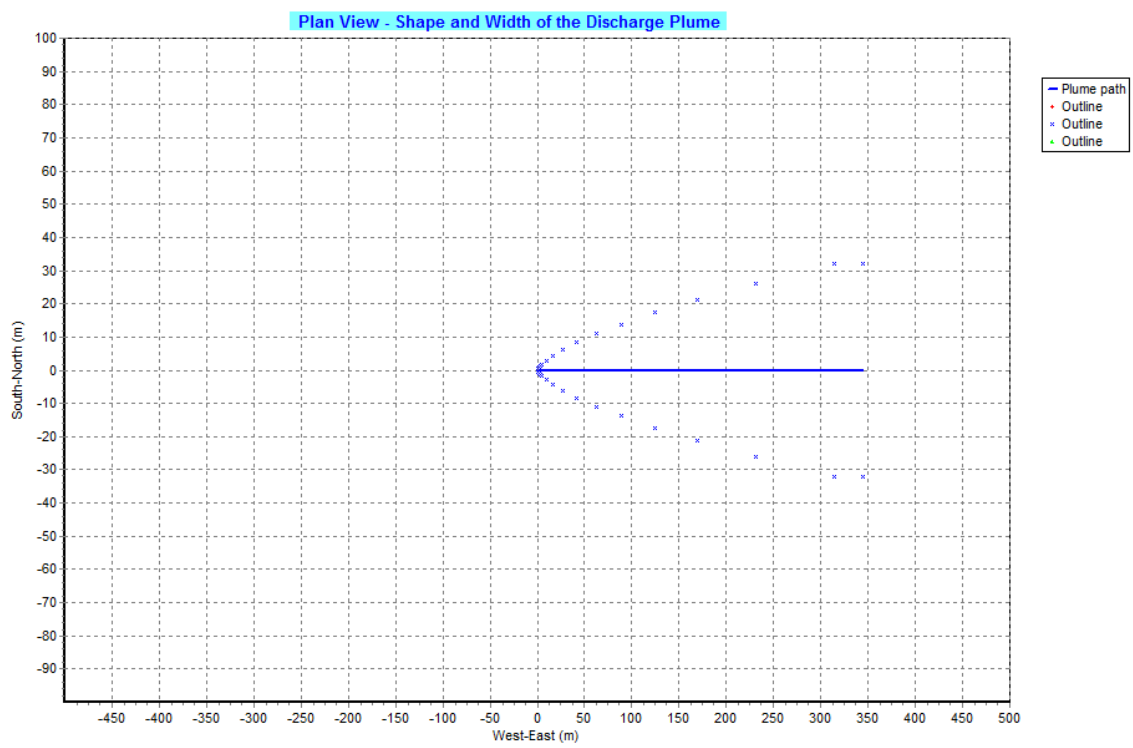

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Figure 3-3: Plume Trajectory – 16.0-inch Discharge Caisson at Mean Currents

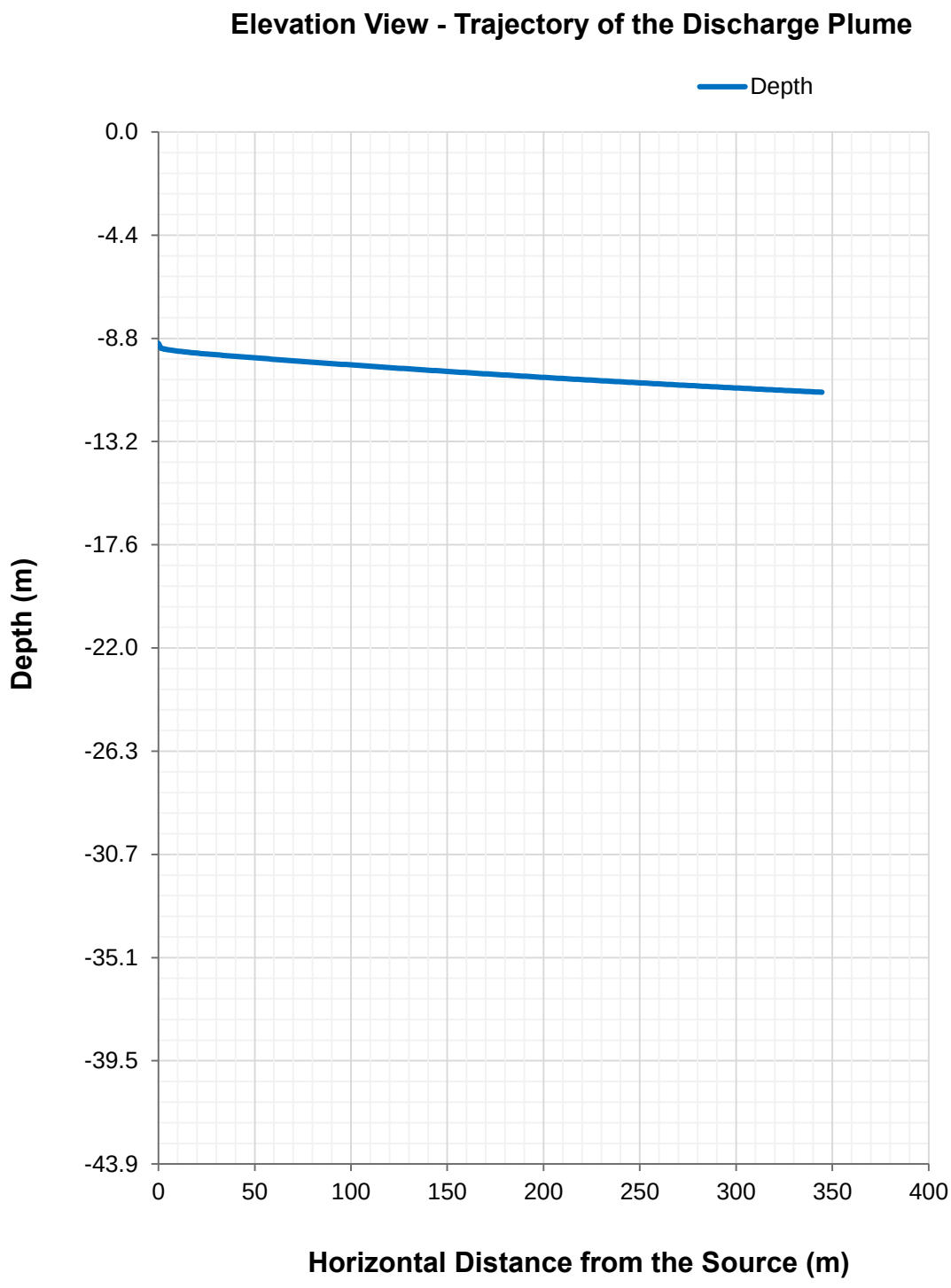

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Figure 3-4: Plume Dilution – 16.0-inch Discharge Caisson at Mean Currents

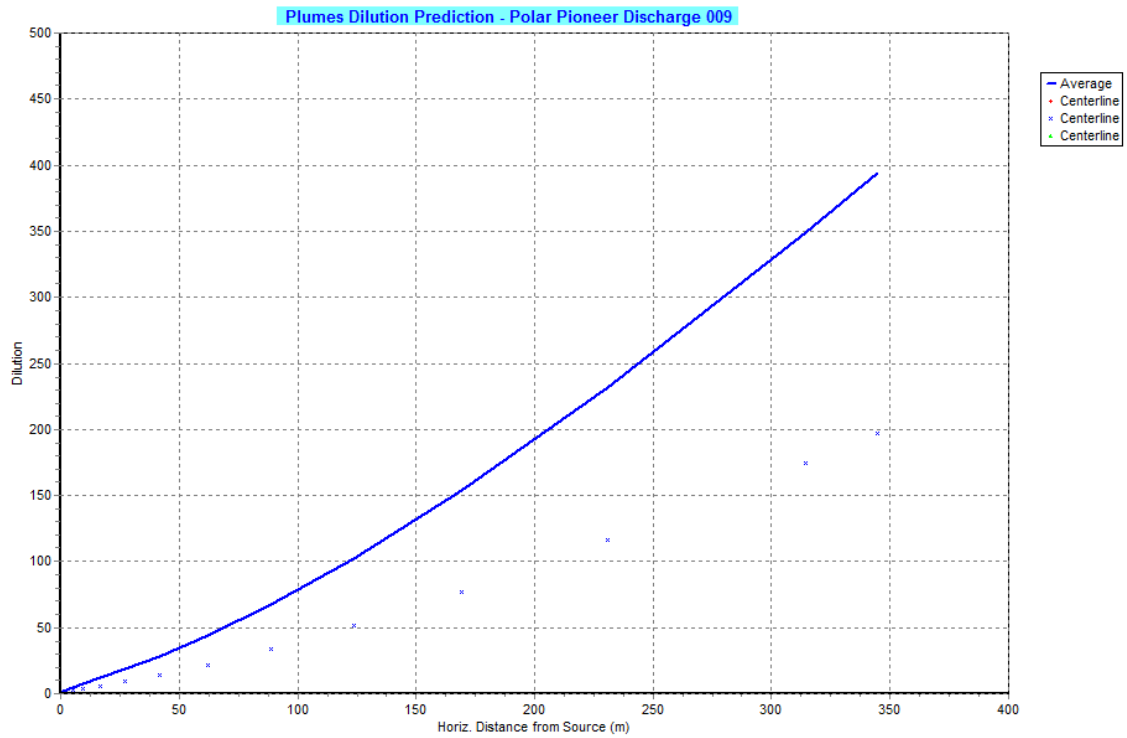

Figure 3-5: Plume Temperature Decay – 16.0-inch Discharge Caisson at Mean Currents

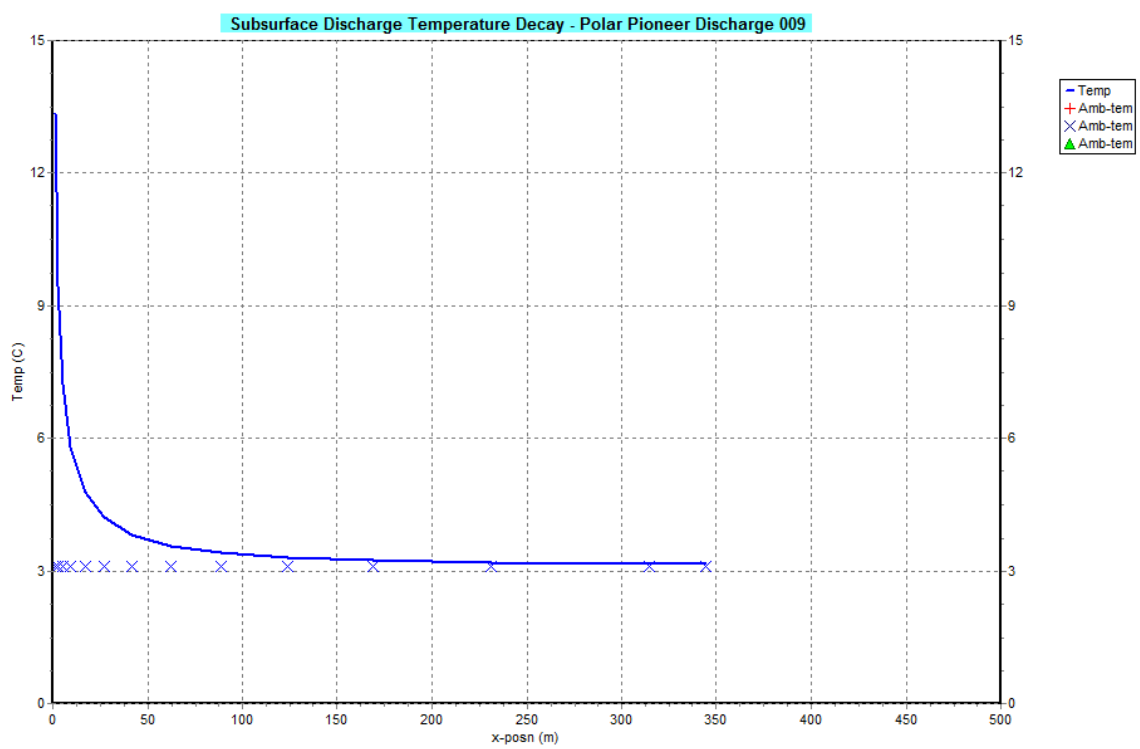

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Figure 3-6: Duration of Excess Temperature – 16.0-inch Discharge Caisson at Mean Currents

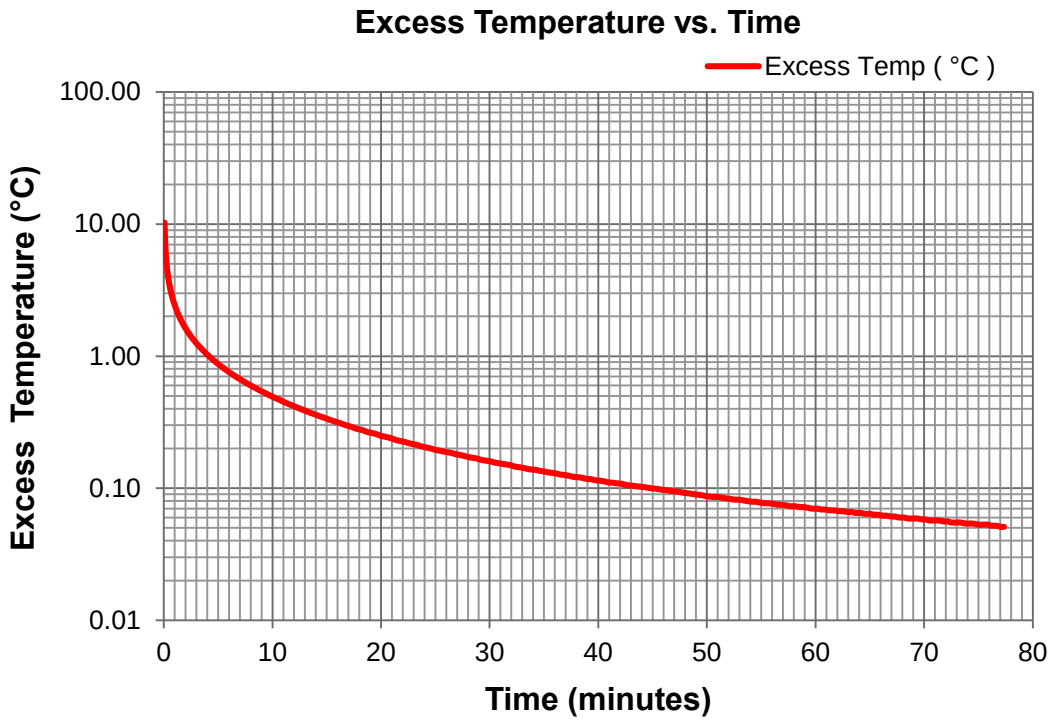
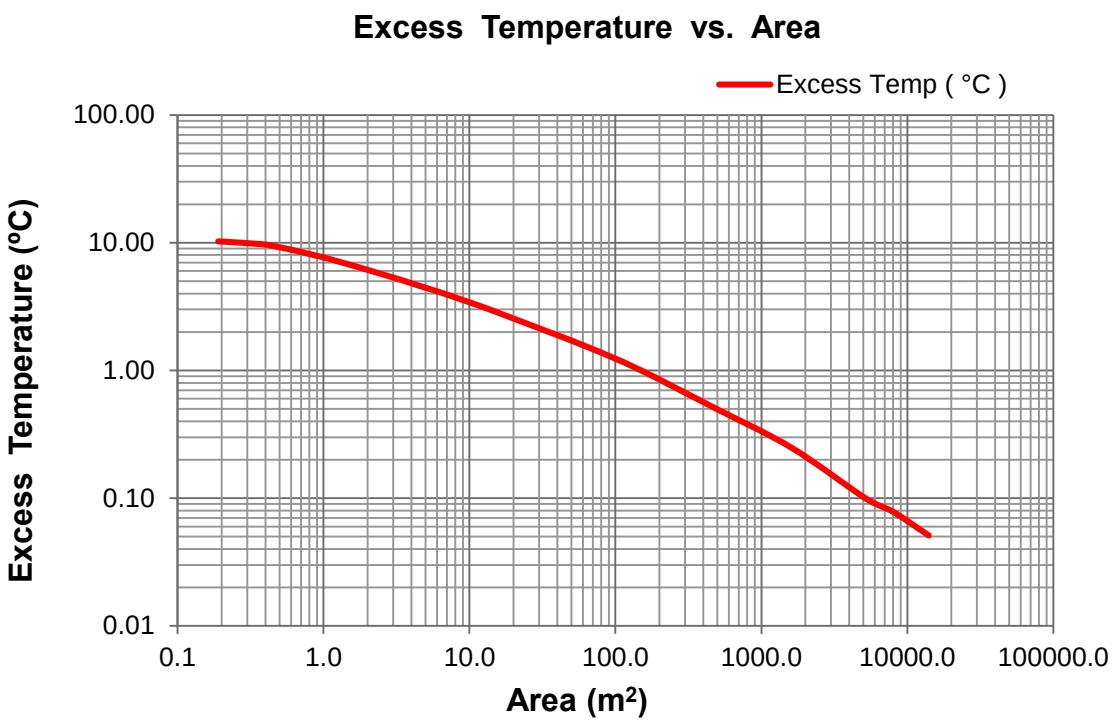


Figure 3-7: Area Affected by Excess Temperature – 16.0-inch Discharge Caisson at Mean Currents



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3.3 Non-contact Cooling Water Discharges at Maximum Currents

The Visual Plumes model results at the maximum currents for: ambient and plume properties; plume path; plume trajectory; plume dilution; and plume temperature decay are presented in **Figures 3-8, 3-9, 3-10, 3-11,** and **3-12** respectively. **Figures 3-13** and **3-14** present the duration of the excess temperature and the area affected.

Figure 3-8: Ambient and Plume Properties – 16.0-inch Discharge Caisson at Maximum Currents

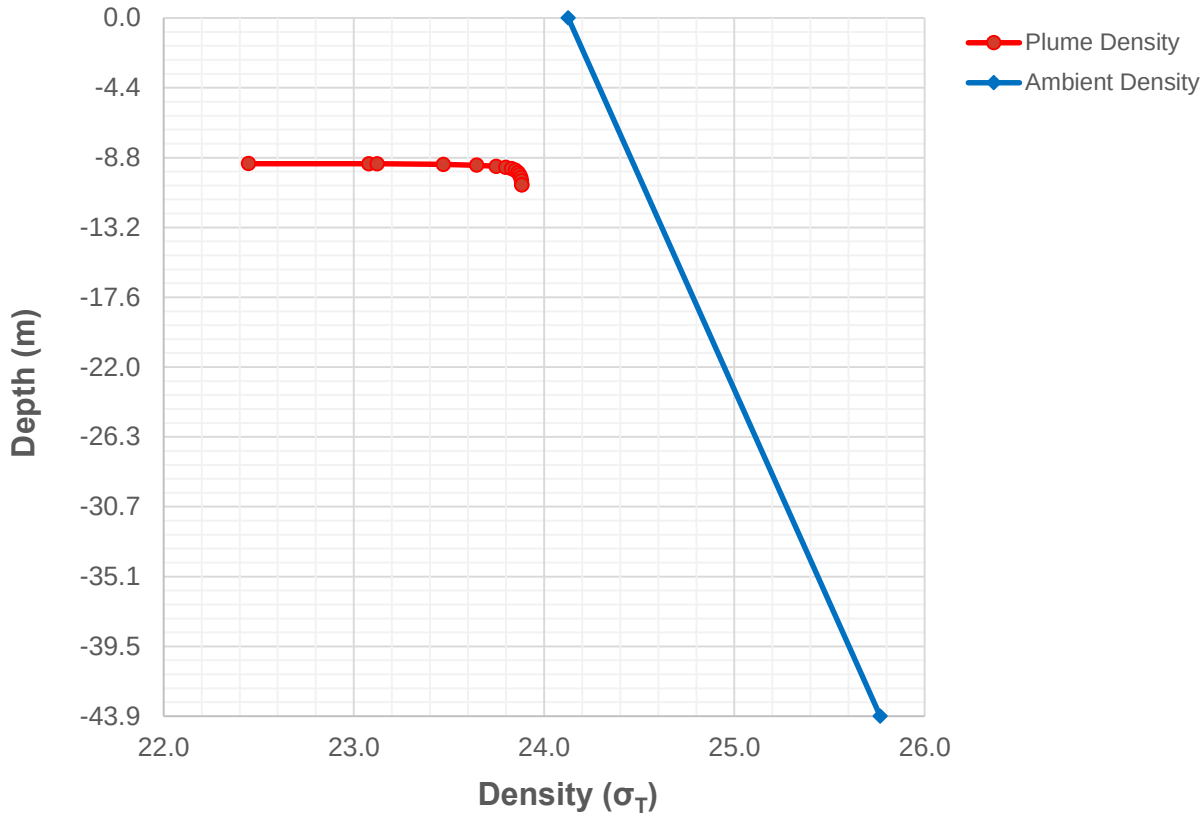

Figure 3-8 presents the ambient and plume densities (σ_T) versus the depth of water from the sea surface. The ambient density (σ_T) varies from **23.80** kg/m^3 at the surface to **25.77** kg/m^3 at the bottom. As seen above, the thermal plume is released at **9.0** m below the sea surface and the initial discharge momentum causes the effluent (σ_T = **22.45** - **23.88** kg/m^3) plume to sink into the ambient to a depth of approximately **1.5** m. **Figure 3-9** presents the width of the plume. The maximum width of the plume is approximately **27** m at a distance of approximately **355** m from the source. The plume trajectory presented in **Figure 3-10** also shows that the plume reaches a depth of **1.5** m at a distance of approximately **355** m from the source and attains an average dilution factor of **400** as seen in **Figure 3-11**. The plume center line dilution factor is **200**. The plume temperature decay presented in **Figure 3-12** shows that it has cooled to within **0.05** ^{o}C of the ambient temperature (**3.1** ^{o}C at a depth of **11** m from the sea surface) at a distance of approximately **355** m from the source. It takes approximately **23** minutes after the cessation of the discharge for the plume to cool to within **0.05** °C of the ambient as presented in **Figure 3-13**. The area affected by the excess temperature of **0.05** °C or higher is limited to **6,000** square meters approximately as seen in **Figure 3-14.** Based on these findings, the impact of this

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release of the non-contact cooling water on the ambient is low and limited to an area of **0.6** hectares only.

Figure 3-9: Plume Path – 16.0-inch Discharge Caisson at Maximum Currents

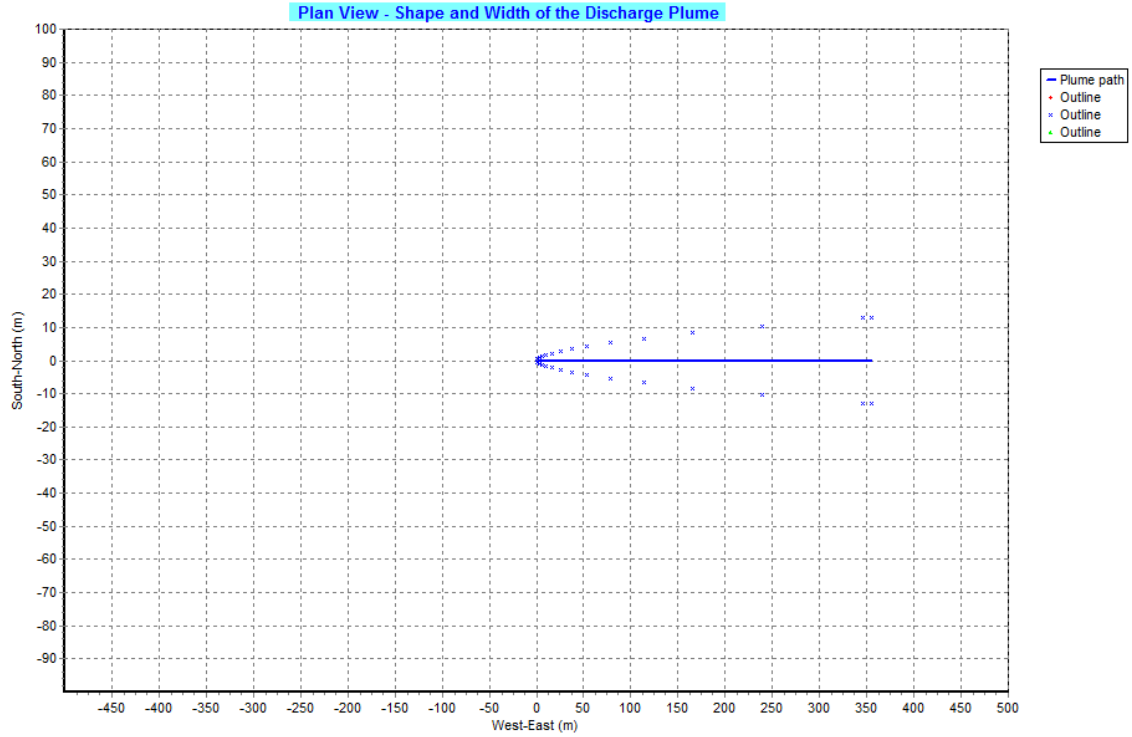

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Figure 3-10: Plume Trajectory – 16.0-inch Discharge Caisson at Maximum Currents

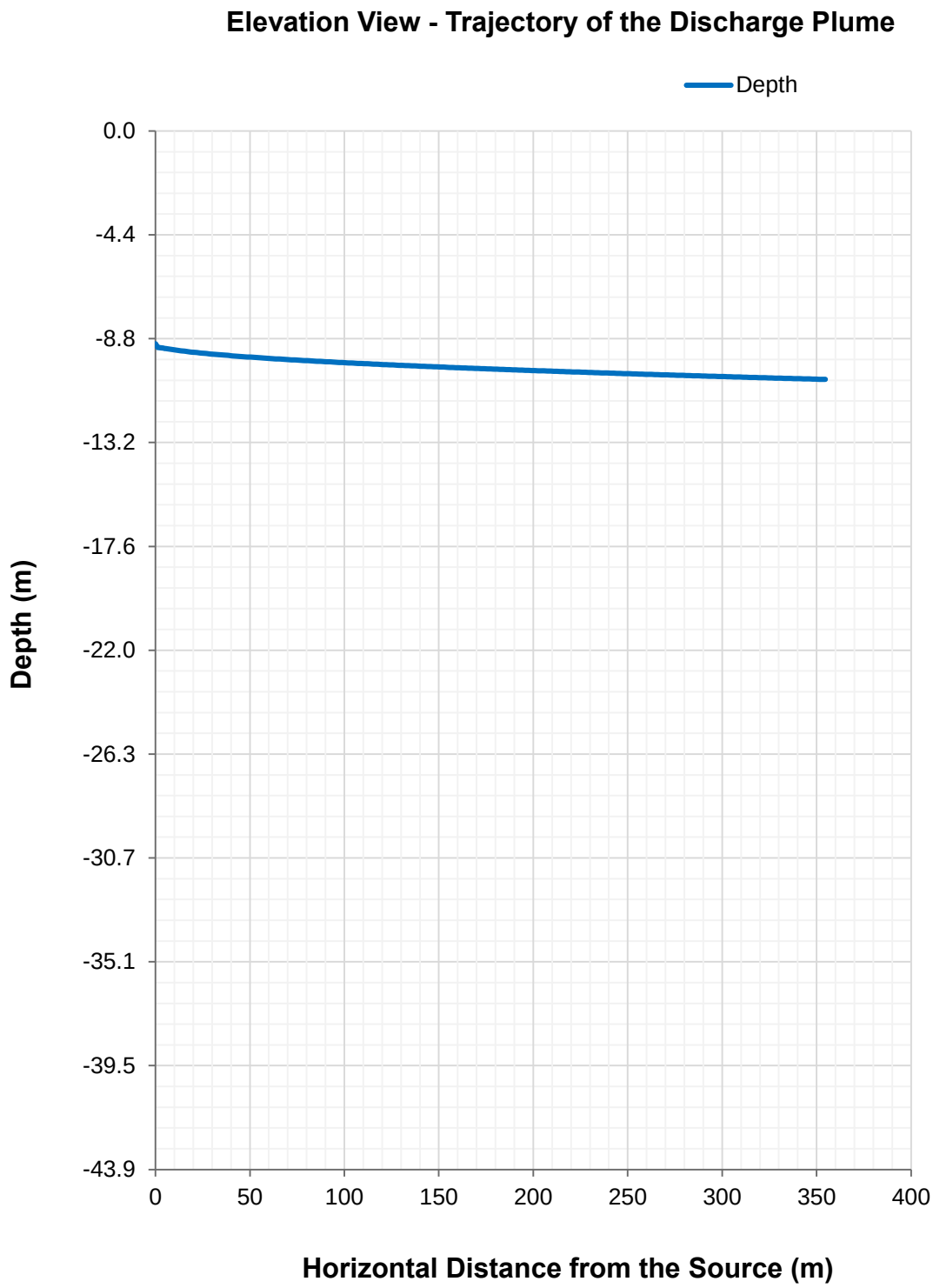

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Figure 3-11: Plume Dilution – 16.0-inch Discharge Caisson at Maximum Currents

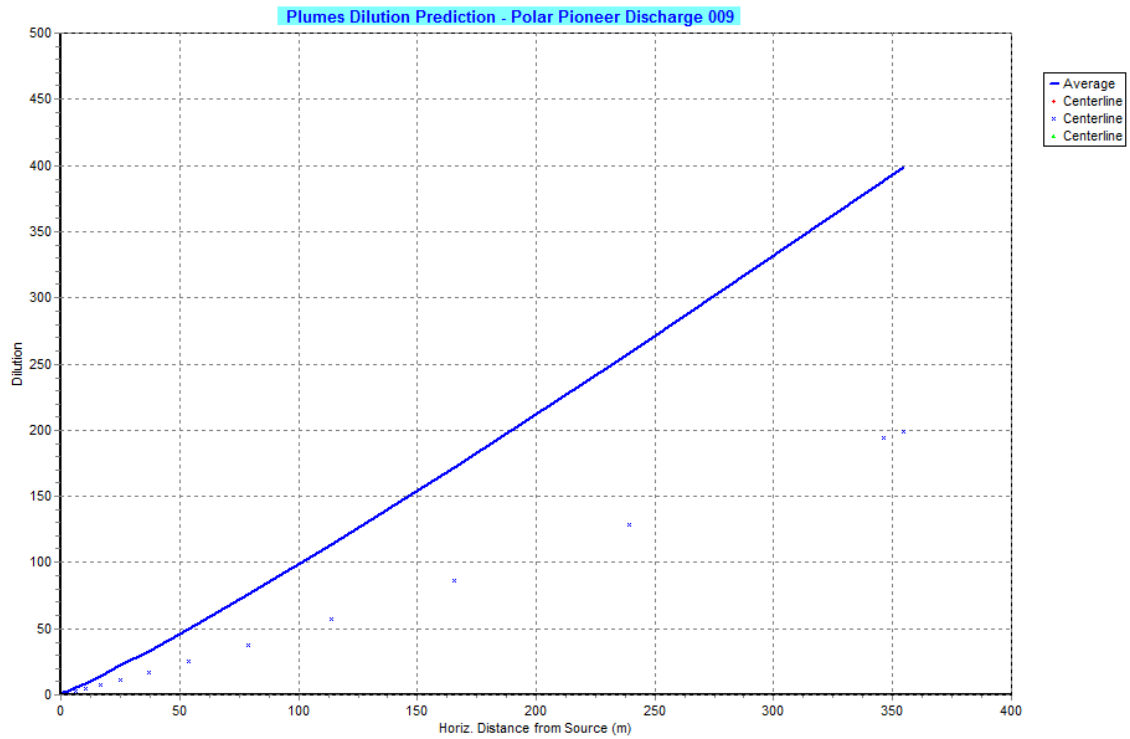

Figure 3-12: Plume Temperature Decay – 16.0-inch Discharge Caisson at Maximum Currents

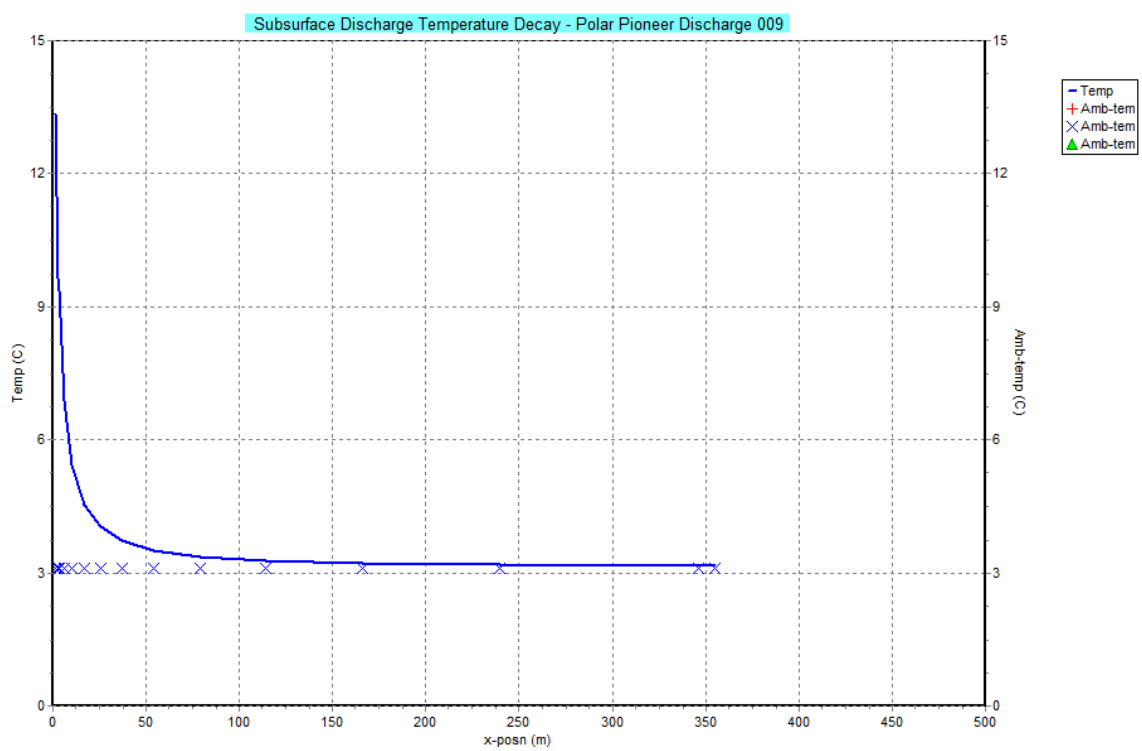

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Figure 3-13: Duration of Excess Temperature – 16.0-inch Discharge Caisson at Maximum Currents

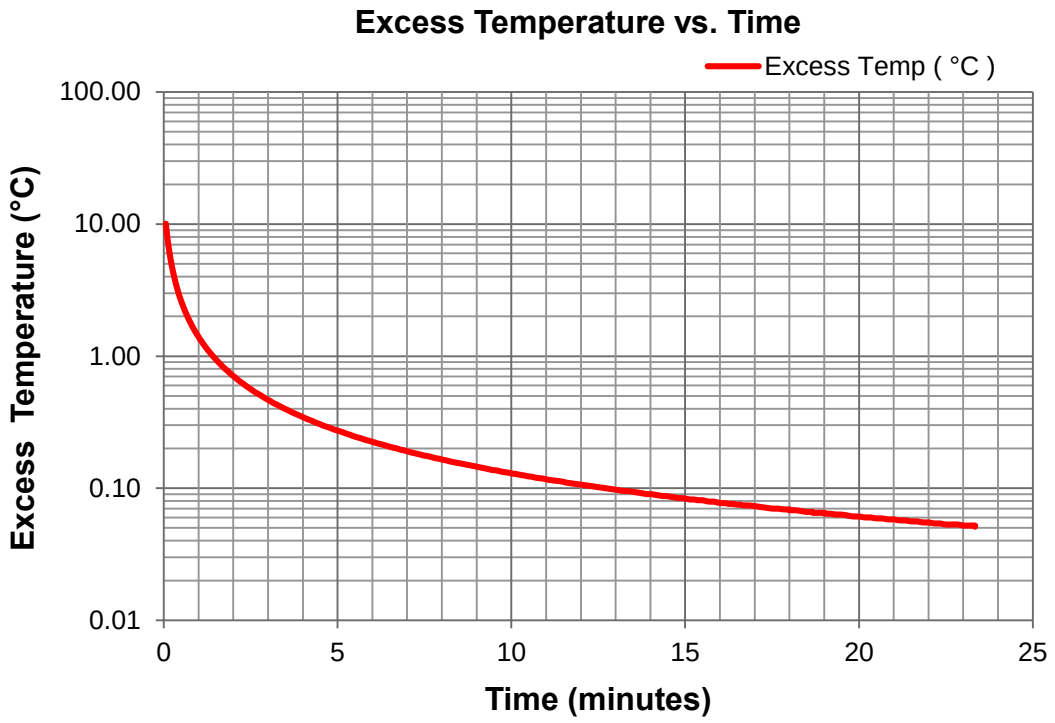
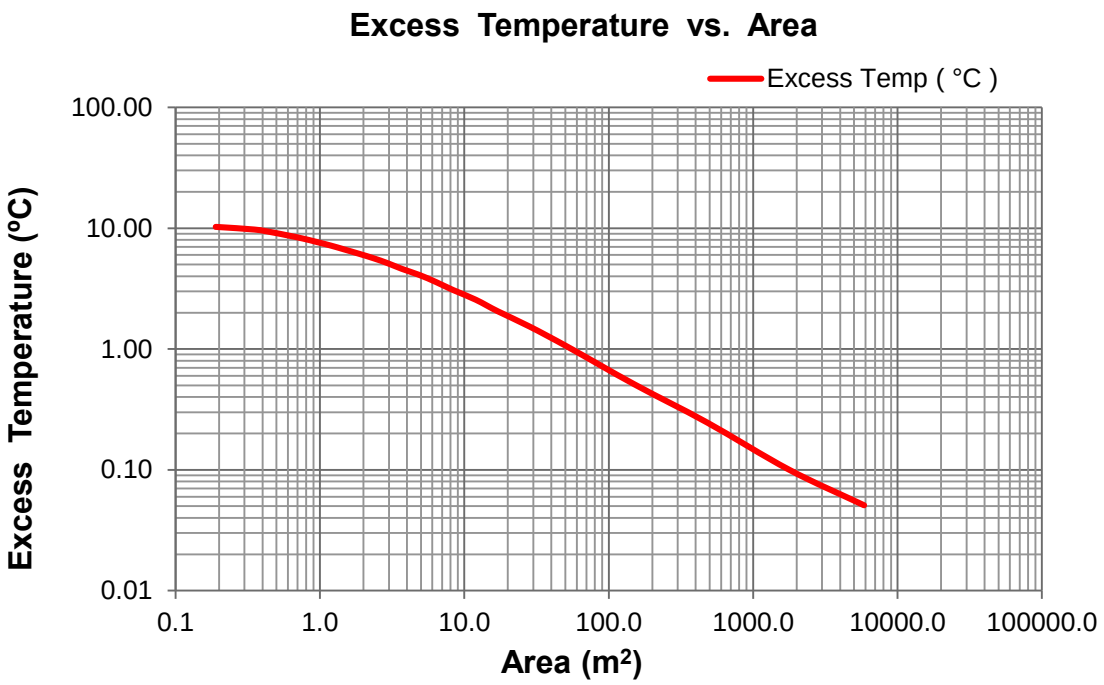


Figure 3-14: Area Affected by Excess Temperature – 16.0-inch Discharge Caisson at Maximum Currents



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Section 4: Summary and Conclusion

4.1 Objective

The primary goal of this environmental numeric modeling was to conduct an assessments of the temperature associated with the non-contact cooling water discharges from the drilling operations to be performed by the drill ship **Polar Pioneer** in the burger field, located in the Chuckchi Sea, by SHELL Alaska Venture. The drill ship Polar Pioneer will discharge approximately **21,385.33** bbls/day of the non-contact cooling water from a single outlet located on this drill ship. This constitutes the discharge described in the Permit No.: **AKG-28-8100** as **Discharge 009** (non-contact cooling water).

4.2 Modeling Assessments

Numeric simulations for the thermal dispersion were conducted using the **US EPA Visual Plumes Model** to characterize the temperature associated with the non-contact cooling water discharges (**Discharge 009)** both for the mean and maximum currents speed during the drilling operations to be conducted in the burger field by the drill rig Polar Pioneer. This provides a sensitivity analysis of the numeric model results to the model input parameter: currents speed. The numeric simulation was conducted for the single point discharge source from the drill rig Polar Pioneer. The non-contact cooling water is discharged out of a single **16.0** inch (outer diameter) discharge caisson that runs down the starboard # 4 column of the drill ship Polar Pioneer. The discharge caisson is approximately **9.0** m below the sea surface while at the drilling draft.

The thermal dispersion simulations were performed using the effluent and ambient data for the planned drilling period. The planned drilling period is within the open water season of July thru October. The direction of the discharge was assumed to be aligned with the ambient flow direction for the modeling purpose since the current bends the plume in the direction of flow (Frick 2003).

The potential impact assessments of the excess temperature of **0.05** °C on the ambient water quality based on the US EPA Visual Plumes thermal dispersion numeric simulations both for the mean and maximum currents speed are presented in **Table 3**. The discharge plume sinks deeper into the ambient and also wider at mean currents. It travels slightly farther at the maximum currents. The higher ambient flow velocity induces enhanced mixing of the plume at the maximum currents. Hence, the plume cools to within **0.05** °C of the ambient significantly sooner after the cessation of the discharge at the maximum currents speed than at the mean currents speed. The areas affected by the excess temperature of **0.05** ^{O}C at the maximum currents speed is also significantly less than that at the mean currents speed. Therefore, mean currents speed represents the worst case scenario.

The potential impact assessments of the excess temperature of **0.05** °C on the ambient water quality based on the US EPA Visual Plumes thermal dispersion numeric simulation are presented in **Table 3**. The estimates are: maximum plume depth is **2.0** m; maximum plume width is **68.0** m; maximum distance from the source is **355** m; maximum duration is **78.0** minutes; and the total area affected is **1.4** hectares (ha). These estimates indicate **low** impacts on the ambient water quality from the temperature associated with the **Discharge 009** (non-contact cooling water) of approximately **21,385.33** bbls/day from the single outlet located on the drill ship.

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Table 3: Impact Assessments of the Discharge 009 on the Ambient Water Quality

Discharge Type (Number)	Discharge Source		Volume Discharged (bbls/day)	Discharge Duration (hours/day)	Discharge Caisson		Effluent Properties		Impact Assessments on the Ambient Water Quality based on the US EPA Visual Plumes Model Predictions							
	Description	Location			Internal Diameter (inches)	Outlet/Port Depth (m)	Temp (°C)	Salinity (psu)	Excess Temperature (°C)	Currents Speed	Plume Depth (m)	Plume Width (m)	Distance from Source (m)	Duration (minutes)	Affected Area (m^2)	Impacts
Non-Contact Cooling Water (009)	Drill Ship Polar Pioneer	Starboard # 4	21,385.33	24	15.25	9.0	13.3	30	0.05	Mean	2.0	68.0	350.0	78.0	14,000	Low
										Maximum	1.5	27.0	355.0	23.0	6,000	
Total Discharge =			21,385.33				bbls/day;		Maximum Area Affected =					1.40	Hectares	Low

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Section 5: References

Frick, W.E., et al., 2003. Dilution Models for Effluent Discharges, 4th Edition (Visual Plumes): US EPA's Ecosystems Research Division, National Exposure Research Laboratory, U.S. Environmental Protection Agency, Athens, Georgia.

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APPENDICES

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Appendix A: Model Input Data

Table A.1: Input Data for Discharge 009 from Polar Pioneer, the Burger Field, Chukchi Sea

Discharge Type	Discharge Number	Discharge Source		Maximum Volume Discharged		Discharge Duration, hours/day	Discharge Caisson		Effluent Characteristics	
		Description	Location	gals/day	bbls/day		Internal Diameter (inches)	Outlet/Port Depth (m)	Temp (°C)	Salinity (psu)
Non-Contact Cooling Water	009	Drill Ship Polar Pioneer	Starboard # 4	898,184	21,385.33	24	15.25	9.00	13.33	30

Table A.2: Input Data for the Ambient, July – October, the Burger Field, Chukchi Sea

Water Depth	Temperature	Salinity	Mean Currents		Maximum Currents	
m	°C	Psu	Speed (m/s)	Direction	Speed (m/s)	Direction
0	4	30	0.07	to the East	0.25	to the East
43.9-45.7	-0.5	32	0.07	to the East	0.25	to the East

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Appendix B: Model Outputs for the 16.0-inch Discharge Caisson

Table B.1: Visual Plumes Model Output for the 16.0-inch Discharge Caisson at Mean Currents

PDSWIN	FLOATING	WARM	WATER	JETS	--	June	1999PAGE		
1	:	case	#						
AMBIENT	CONDITIONS	:	TEMP.	TA=	3.1	DEG.	C	0.07	M/S
HEAT	CONVECTION	=	2						
DISCHARGE	CONDITIONS	:	TEMP.	=	13.3	C;			
DEPTH	=	0.34	M.	;	WIDTH	=	0.33		
ANGLE	0	DEG	;	DISCHARGE	RATE	=	0.04		
DISCHARGE	DENSIMENTRIC	FROUDE	NO.	=	3.65				

X(M.)	Y(M.)	EX.TEMP (DEG. C)	TIME (SEC.)	Q/Q0 (DILU.)	QM/Q0	DEPTH (M.)	WIDTH (M.)
1.17	0	10.253	3.33E+00	2	1	0.2	1.2
1.22	0	10.037	3.48E+00	2.04	1.02	0.2	1.24
1.27	0	9.832	3.63E+00	2.09	1.04	0.2	1.28
1.33	0	9.635	3.79E+00	2.13	1.06	0.2	1.32
1.38	0	9.446	3.94E+00	2.17	1.09	0.2	1.36
1.43	0	9.266	4.10E+00	2.21	1.11	0.2	1.4
1.48	0	9.093	4.27E+00	2.26	1.13	0.2	1.44
1.59	0	8.766	4.60E+00	2.34	1.17	0.2	1.51
1.69	0	8.465	4.95E+00	2.42	1.21	0.21	1.59
1.8	0	8.185	5.30E+00	2.5	1.25	0.21	1.66
1.9	0	7.926	5.66E+00	2.59	1.29	0.21	1.73
2.11	0	7.457	6.42E+00	2.75	1.37	0.22	1.87
2.32	0	7.047	7.20E+00	2.91	1.45	0.22	2.01
2.53	0	6.684	8.03E+00	3.07	1.53	0.23	2.14
2.74	0	6.362	8.89E+00	3.22	1.61	0.23	2.28
2.95	0	6.073	9.77E+00	3.38	1.69	0.23	2.41
3.15	0	5.812	1.07E+01	3.53	1.76	0.24	2.53
3.36	0	5.576	1.16E+01	3.68	1.84	0.24	2.66
3.57	0	5.361	1.26E+01	3.82	1.91	0.25	2.78
3.99	0	4.983	1.47E+01	4.11	2.06	0.25	3.03
4.41	0	4.661	1.68E+01	4.4	2.2	0.26	3.26
4.83	0	4.382	1.90E+01	4.68	2.34	0.27	3.5
5.24	0	4.139	2.14E+01	4.95	2.48	0.27	3.72
6.08	0	3.732	2.63E+01	5.49	2.75	0.28	4.16
6.92	0	3.405	3.15E+01	6.02	3.01	0.29	4.58

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7.75	0	3.134	3.71E+01	6.54	3.27	0.3	4.99
8.59	0	2.904	4.29E+01	7.06	3.53	0.31	5.38
9.42	0	2.708	4.89E+01	7.57	3.78	0.32	5.77
10.26	0	2.537	5.52E+01	8.08	4.04	0.33	6.14
11.93	0	2.252	6.84E+01	9.1	4.55	0.34	6.86
13.6	0	2.027	8.24E+01	10.12	5.06	0.36	7.54
15.27	0	1.842	9.70E+01	11.13	5.56	0.37	8.2
16.95	0	1.688	1.12E+02	12.14	6.07	0.39	8.84
18.62	0	1.557	1.28E+02	13.16	6.58	0.4	9.46
20.29	0	1.444	1.44E+02	14.19	7.1	0.41	10.05
21.96	0	1.345	1.61E+02	15.23	7.61	0.43	10.63
23.63	0	1.259	1.78E+02	16.27	8.14	0.44	11.2
25.31	0	1.182	1.96E+02	17.33	8.66	0.45	11.75
26.98	0	1.113	2.14E+02	18.39	9.2	0.46	12.29
28.65	0	1.051	2.32E+02	19.47	9.73	0.47	12.82
30.32	0	0.996	2.50E+02	20.56	10.28	0.48	13.33
31.99	0	0.945	2.69E+02	21.66	10.83	0.49	13.84
33.66	0	0.898	2.88E+02	22.77	11.39	0.51	14.33
35.34	0	0.856	3.07E+02	23.9	11.95	0.52	14.82
37.01	0	0.817	3.27E+02	25.04	12.52	0.53	15.3
38.68	0	0.781	3.46E+02	26.19	13.1	0.54	15.77
40.35	0	0.747	3.66E+02	27.36	13.68	0.55	16.24
42.02	0	0.716	3.86E+02	28.54	14.27	0.56	16.7
43.69	0	0.687	4.07E+02	29.74	14.87	0.57	17.15
45.37	0	0.66	4.27E+02	30.94	15.47	0.58	17.6
47.04	0	0.635	4.48E+02	32.17	16.08	0.59	18.04
48.71	0	0.612	4.68E+02	33.4	16.7	0.6	18.47
50.38	0	0.59	4.89E+02	34.66	17.33	0.61	18.9
52.05	0	0.569	5.10E+02	35.92	17.96	0.62	19.32
53.73	0	0.549	5.31E+02	37.2	18.6	0.63	19.74
55.4	0	0.531	5.53E+02	38.49	19.25	0.64	20.16
57.07	0	0.513	5.74E+02	39.8	19.9	0.65	20.57
58.74	0	0.496	5.96E+02	41.12	20.56	0.67	20.97
60.41	0	0.481	6.17E+02	42.45	21.23	0.68	21.38
62.08	0	0.466	6.39E+02	43.8	21.9	0.69	21.77
63.76	0	0.452	6.60E+02	45.16	22.58	0.7	22.17
65.43	0	0.438	6.82E+02	46.54	23.27	0.71	22.56
67.1	0	0.426	7.04E+02	47.92	23.96	0.72	22.95
68.77	0	0.414	7.26E+02	49.33	24.66	0.73	23.33
70.44	0	0.402	7.48E+02	50.74	25.37	0.74	23.71
72.12	0	0.391	7.71E+02	52.17	26.08	0.75	24.09
73.79	0	0.38	7.93E+02	53.61	26.8	0.76	24.47
75.46	0	0.37	8.15E+02	55.06	27.53	0.77	24.84

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77.13	0	0.361	8.37E+02	56.53	28.26	0.78	25.21
78.8	0	0.351	8.60E+02	58.01	29	0.79	25.57
80.47	0	0.343	8.82E+02	59.5	29.75	0.8	25.94
82.15	0	0.334	9.05E+02	61	30.5	0.81	26.3
83.82	0	0.326	9.27E+02	62.52	31.26	0.82	26.66
85.49	0	0.318	9.50E+02	64.05	32.02	0.83	27.01
87.16	0	0.311	9.73E+02	65.59	32.79	0.84	27.37
88.83	0	0.303	9.95E+02	67.14	33.57	0.85	27.72
90.5	0	0.296	1.02E+03	68.7	34.35	0.86	28.07
92.18	0	0.29	1.04E+03	70.28	35.14	0.87	28.41
93.85	0	0.283	1.06E+03	71.86	35.93	0.88	28.76
95.52	0	0.277	1.09E+03	73.46	36.73	0.89	29.1
97.19	0	0.271	1.11E+03	75.07	37.54	0.89	29.44
98.86	0	0.265	1.13E+03	76.69	38.35	0.9	29.78
100.54	0	0.26	1.16E+03	78.32	39.16	0.91	30.12
102.21	0	0.255	1.18E+03	79.97	39.98	0.92	30.45
103.88	0	0.249	1.20E+03	81.62	40.81	0.93	30.78
105.55	0	0.244	1.23E+03	83.28	41.64	0.94	31.11
107.22	0	0.24	1.25E+03	84.96	42.48	0.95	31.44
108.89	0	0.235	1.27E+03	86.64	43.32	0.96	31.77
110.57	0	0.23	1.29E+03	88.34	44.17	0.97	32.1
112.24	0	0.226	1.32E+03	90.04	45.02	0.98	32.42
113.91	0	0.222	1.34E+03	91.76	45.88	0.99	32.74
115.58	0	0.218	1.36E+03	93.48	46.74	1	33.06
117.25	0	0.214	1.39E+03	95.22	47.61	1.01	33.38
118.92	0	0.21	1.41E+03	96.96	48.48	1.02	33.7
120.6	0	0.206	1.43E+03	98.72	49.36	1.03	34.02
122.27	0	0.202	1.46E+03	100.48	50.24	1.04	34.33
123.94	0	0.199	1.48E+03	102.26	51.13	1.05	34.64
125.61	0	0.195	1.50E+03	104.04	52.02	1.06	34.96
127.28	0	0.192	1.53E+03	105.83	52.92	1.06	35.27
128.96	0	0.189	1.55E+03	107.64	53.82	1.07	35.58
130.63	0	0.186	1.58E+03	109.45	54.72	1.08	35.88
132.3	0	0.183	1.60E+03	111.27	55.63	1.09	36.19
133.97	0	0.18	1.62E+03	113.1	56.55	1.1	36.49
135.64	0	0.177	1.65E+03	114.93	57.47	1.11	36.8
137.31	0	0.174	1.67E+03	116.78	58.39	1.12	37.1
138.99	0	0.171	1.69E+03	118.63	59.32	1.13	37.4
140.66	0	0.169	1.72E+03	120.5	60.25	1.14	37.7
142.33	0	0.166	1.74E+03	122.37	61.18	1.15	38
144	0	0.163	1.76E+03	124.25	62.12	1.15	38.3
145.67	0	0.161	1.79E+03	126.14	63.07	1.16	38.59
147.34	0	0.159	1.81E+03	128.04	64.02	1.17	38.89

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149.02	0	0.156	1.83E+03	129.94	64.97	1.18	39.18
150.69	0	0.154	1.86E+03	131.85	65.93	1.19	39.48
152.36	0	0.152	1.88E+03	133.77	66.89	1.2	39.77
154.03	0	0.15	1.91E+03	135.7	67.85	1.21	40.06
155.7	0	0.147	1.93E+03	137.64	68.82	1.22	40.35
157.38	0	0.145	1.95E+03	139.58	69.79	1.23	40.64
159.05	0	0.143	1.98E+03	141.53	70.77	1.23	40.92
160.72	0	0.141	2.00E+03	143.49	71.75	1.24	41.21
162.39	0	0.139	2.02E+03	145.46	72.73	1.25	41.49
164.06	0	0.138	2.05E+03	147.43	73.72	1.26	41.78
165.73	0	0.136	2.07E+03	149.42	74.71	1.27	42.06
167.41	0	0.134	2.10E+03	151.4	75.7	1.28	42.34
169.08	0	0.132	2.12E+03	153.4	76.7	1.29	42.63
170.75	0	0.131	2.14E+03	155.4	77.7	1.29	42.91
172.42	0	0.129	2.17E+03	157.41	78.71	1.3	43.19
174.09	0	0.127	2.19E+03	159.43	79.71	1.31	43.46
175.76	0	0.126	2.21E+03	161.45	80.73	1.32	43.74
177.44	0	0.124	2.24E+03	163.48	81.74	1.33	44.02
179.11	0	0.122	2.26E+03	165.52	82.76	1.34	44.3
180.78	0	0.121	2.29E+03	167.57	83.78	1.34	44.57
182.45	0	0.12	2.31E+03	169.62	84.81	1.35	44.84
184.12	0	0.118	2.33E+03	171.67	85.84	1.36	45.12
185.8	0	0.117	2.36E+03	173.74	86.87	1.37	45.39
187.47	0	0.115	2.38E+03	175.81	87.9	1.38	45.66
189.14	0	0.114	2.41E+03	177.89	88.94	1.39	45.93
190.81	0	0.113	2.43E+03	179.97	89.99	1.39	46.2
192.48	0	0.111	2.45E+03	182.06	91.03	1.4	46.47
194.15	0	0.11	2.48E+03	184.16	92.08	1.41	46.74
195.83	0	0.109	2.50E+03	186.26	93.13	1.42	47.01
197.5	0	0.108	2.53E+03	188.37	94.19	1.43	47.28
199.17	0	0.106	2.55E+03	190.49	95.24	1.44	47.54
200.84	0	0.105	2.57E+03	192.61	96.31	1.44	47.81
202.51	0	0.104	2.60E+03	194.74	97.37	1.45	48.07
204.19	0	0.103	2.62E+03	196.87	98.44	1.46	48.34
205.86	0	0.102	2.65E+03	199.02	99.51	1.47	48.6
207.53	0	0.101	2.67E+03	201.16	100.58	1.48	48.86
209.2	0	0.1	2.69E+03	203.32	101.66	1.48	49.12
210.87	0	0.099	2.72E+03	205.47	102.74	1.49	49.39
212.54	0	0.098	2.74E+03	207.64	103.82	1.5	49.65
214.22	0	0.097	2.76E+03	209.81	104.9	1.51	49.91
215.89	0	0.096	2.79E+03	211.99	105.99	1.52	50.17
217.56	0	0.095	2.81E+03	214.17	107.08	1.52	50.42
219.23	0	0.094	2.84E+03	216.36	108.18	1.53	50.68

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220.9	0	0.093	2.86E+03	218.55	109.28	1.54	50.94
222.57	0	0.092	2.88E+03	220.75	110.37	1.55	51.2
224.25	0	0.091	2.91E+03	222.95	111.48	1.55	51.45
225.92	0	0.09	2.93E+03	225.17	112.58	1.56	51.71
227.59	0	0.089	2.96E+03	227.38	113.69	1.57	51.96
229.26	0	0.088	2.98E+03	229.6	114.8	1.58	52.22
230.93	0	0.087	3.00E+03	231.83	115.91	1.59	52.47
232.61	0	0.086	3.03E+03	234.06	117.03	1.59	52.72
234.28	0	0.086	3.05E+03	236.3	118.15	1.6	52.98
235.95	0	0.085	3.08E+03	238.54	119.27	1.61	53.23
237.62	0	0.084	3.10E+03	240.79	120.4	1.62	53.48
239.29	0	0.083	3.13E+03	243.04	121.52	1.62	53.73
240.96	0	0.082	3.15E+03	245.3	122.65	1.63	53.98
242.64	0	0.082	3.17E+03	247.57	123.78	1.64	54.23
244.31	0	0.081	3.20E+03	249.83	124.92	1.65	54.48
245.98	0	0.08	3.22E+03	252.11	126.05	1.65	54.73
247.65	0	0.079	3.25E+03	254.39	127.19	1.66	54.97
249.32	0	0.079	3.27E+03	256.67	128.34	1.67	55.22
250.99	0	0.078	3.29E+03	258.96	129.48	1.68	55.47
252.67	0	0.077	3.32E+03	261.25	130.63	1.68	55.71
254.34	0	0.077	3.34E+03	263.55	131.78	1.69	55.96
256.01	0	0.076	3.37E+03	265.86	132.93	1.7	56.21
257.68	0	0.075	3.39E+03	268.16	134.08	1.71	56.45
259.35	0	0.075	3.41E+03	270.48	135.24	1.71	56.69
261.03	0	0.074	3.44E+03	272.79	136.4	1.72	56.94
262.7	0	0.073	3.46E+03	275.12	137.56	1.73	57.18
264.37	0	0.073	3.49E+03	277.44	138.72	1.74	57.42
266.04	0	0.072	3.51E+03	279.78	139.89	1.74	57.66
267.71	0	0.072	3.53E+03	282.11	141.06	1.75	57.91
269.38	0	0.071	3.56E+03	284.45	142.23	1.76	58.15
271.06	0	0.07	3.58E+03	286.8	143.4	1.77	58.39
272.73	0	0.07	3.61E+03	289.15	144.57	1.77	58.63
274.4	0	0.069	3.63E+03	291.5	145.75	1.78	58.87
276.07	0	0.069	3.65E+03	293.86	146.93	1.79	59.1
277.74	0	0.068	3.68E+03	296.23	148.11	1.79	59.34
279.41	0	0.068	3.70E+03	298.59	149.3	1.8	59.58
281.09	0	0.067	3.73E+03	300.97	150.48	1.81	59.82
282.76	0	0.067	3.75E+03	303.34	151.67	1.82	60.05
284.43	0	0.066	3.78E+03	305.72	152.86	1.82	60.29
286.1	0	0.066	3.80E+03	308.11	154.05	1.83	60.53
287.77	0	0.065	3.82E+03	310.5	155.25	1.84	60.76
289.45	0	0.065	3.85E+03	312.89	156.45	1.84	61
291.12	0	0.064	3.87E+03	315.29	157.64	1.85	61.23

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292.79	0	0.064	3.90E+03	317.69	158.85	1.86	61.47
294.46	0	0.063	3.92E+03	320.1	160.05	1.87	61.7
296.13	0	0.063	3.94E+03	322.51	161.25	1.87	61.93
297.8	0	0.062	3.97E+03	324.92	162.46	1.88	62.16
299.48	0	0.062	3.99E+03	327.34	163.67	1.89	62.4
301.15	0	0.061	4.02E+03	329.76	164.88	1.89	62.63
302.82	0	0.061	4.04E+03	332.19	166.09	1.9	62.86
304.49	0	0.06	4.06E+03	334.62	167.31	1.91	63.09
306.16	0	0.06	4.09E+03	337.05	168.53	1.91	63.32
307.83	0	0.059	4.11E+03	339.49	169.75	1.92	63.55
309.51	0	0.059	4.14E+03	341.93	170.97	1.93	63.78
311.18	0	0.059	4.16E+03	344.38	172.19	1.94	64.01
312.85	0	0.058	4.19E+03	346.83	173.41	1.94	64.24
314.52	0	0.058	4.21E+03	349.28	174.64	1.95	64.47
316.19	0	0.057	4.23E+03	351.74	175.87	1.96	64.69
317.87	0	0.057	4.26E+03	354.2	177.1	1.96	64.92
319.54	0	0.057	4.28E+03	356.67	178.33	1.97	65.15
321.21	0	0.056	4.31E+03	359.14	179.57	1.98	65.38
322.88	0	0.056	4.33E+03	361.61	180.8	1.98	65.6
324.55	0	0.055	4.35E+03	364.09	182.04	1.99	65.83
326.22	0	0.055	4.38E+03	366.57	183.28	2	66.05
327.9	0	0.055	4.40E+03	369.05	184.52	2	66.28
329.57	0	0.054	4.43E+03	371.54	185.77	2.01	66.5
331.24	0	0.054	4.45E+03	374.03	187.01	2.02	66.73
332.91	0	0.054	4.47E+03	376.52	188.26	2.02	66.95
334.58	0	0.053	4.50E+03	379.02	189.51	2.03	67.17
336.26	0	0.053	4.52E+03	381.52	190.76	2.04	67.4
337.93	0	0.053	4.55E+03	384.03	192.01	2.04	67.62
339.6	0	0.052	4.57E+03	386.54	193.27	2.05	67.84
341.27	0	0.052	4.60E+03	389.05	194.52	2.06	68.06
342.94	0	0.051	4.62E+03	391.57	195.78	2.06	68.29
344.61	0	0.051	4.64E+03	394.08	197.04	2.07	68.51

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A R E A S OF E X S S
1 : case #

EXC. TEMP. (DEG. C)	AREA (SQ. M)
0.051	1.40E+04
0.078	8.00E+03
0.1	5.14E+03
0.249	1.60E+03
0.51	4.75E+02
1.03	1.42E+02
1.54	6.30E+01
2.05	3.30E+01
2.56	1.98E+01
3.08	1.29E+01
3.59	8.79E+00
4.1	6.23E+00
4.61	4.50E+00
5.13	3.36E+00
5.64	2.55E+00
6.15	1.98E+00
6.66	1.56E+00
7.18	1.23E+00
7.69	9.93E-01
8.2	7.82E-01
8.71	6.30E-01
9.23	4.95E-01
9.74	3.75E-01
10.25	1.90E-01

(DEG. C) AREA (SQ. M)

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Table B.2: Visual Plumes Model Output for the 16.0-inch Discharge Caisson at Maximum Currents

PDSWIN FLOATING WARM WATER JETS -- June 1999PAGE 1
1 : case #
AMBIENT CONDITIONS : TEMP. TA= 3.1 DEG. C
HEAT CONVECTION = 2
,; VEL. 0.25 M/S
DISCHARGE CONDITIONS : TEMP. = 13.3 C; DEPTH = 0.34 M.
ANGLE 0 DEG ; DISCHARGE RATE = 0.04 CU-M/S
DISCHARGE DENSIMENTRIC FROUDE NO. = 3.65
; WIDTH = 0.33 M.

X(M.)	Y(M.)	EX.TEMP (DEG. C)	TIME (SEC.)	Q/Q0 (DILU.)	QM/Q0	DEPTH (M.)	WIDTH (M.)
1.17	0	10.253	3.30E+00	2	1	0.16	1
1.22	0	10.099	3.45E+00	2.03	1.02	0.16	1.02
1.27	0	9.948	3.59E+00	2.06	1.03	0.16	1.05
1.33	0	9.802	3.74E+00	2.09	1.05	0.16	1.07
1.38	0	9.659	3.89E+00	2.12	1.06	0.16	1.09
1.43	0	9.52	4.04E+00	2.15	1.08	0.16	1.11
1.48	0	9.383	4.19E+00	2.19	1.09	0.16	1.13
1.59	0	9.12	4.49E+00	2.25	1.12	0.16	1.17
1.69	0	8.869	4.80E+00	2.31	1.16	0.16	1.2
1.8	0	8.629	5.10E+00	2.38	1.19	0.16	1.24
1.9	0	8.399	5.41E+00	2.44	1.22	0.16	1.28
2.11	0	7.968	6.04E+00	2.57	1.29	0.16	1.35
2.32	0	7.572	6.67E+00	2.71	1.35	0.17	1.41
2.53	0	7.208	7.31E+00	2.84	1.42	0.17	1.48
2.74	0	6.873	7.96E+00	2.98	1.49	0.17	1.54
2.95	0	6.562	8.61E+00	3.12	1.56	0.17	1.6
3.15	0	6.275	9.27E+00	3.27	1.63	0.17	1.66
3.36	0	6.009	9.94E+00	3.41	1.71	0.18	1.72
3.57	0	5.762	1.06E+01	3.56	1.78	0.18	1.78
3.99	0	5.318	1.20E+01	3.85	1.93	0.18	1.88
4.41	0	4.932	1.34E+01	4.16	2.08	0.19	1.99
4.83	0	4.592	1.48E+01	4.46	2.23	0.2	2.09
5.24	0	4.293	1.62E+01	4.78	2.39	0.2	2.19
6.08	0	3.789	1.91E+01	5.41	2.7	0.21	2.37

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6.92	0	3.384	2.20E+01	6.06	3.03	0.22	2.55
7.75	0	3.052	2.49E+01	6.72	3.36	0.23	2.72
8.59	0	2.775	2.79E+01	7.39	3.69	0.24	2.89
10.26	0	2.344	3.40E+01	8.75	4.38	0.26	3.19
11.93	0	2.023	4.02E+01	10.15	5.07	0.28	3.48
13.6	0	1.775	4.64E+01	11.57	5.79	0.3	3.76
15.27	0	1.578	5.27E+01	13.01	6.51	0.31	4.02
16.95	0	1.419	5.91E+01	14.48	7.24	0.33	4.28
18.62	0	1.287	6.54E+01	15.96	7.98	0.35	4.52
20.29	0	1.176	7.18E+01	17.46	8.73	0.36	4.76
21.96	0	1.082	7.82E+01	18.98	9.49	0.37	4.98
23.63	0	1.001	8.47E+01	20.51	10.25	0.39	5.2
25.31	0	0.931	9.12E+01	22.05	11.03	0.4	5.42
26.98	0	0.87	9.76E+01	23.61	11.8	0.41	5.63
28.65	0	0.815	1.04E+02	25.17	12.59	0.43	5.83
30.32	0	0.767	1.11E+02	26.75	13.38	0.44	6.03
31.99	0	0.724	1.17E+02	28.34	14.17	0.45	6.23
33.66	0	0.685	1.24E+02	29.94	14.97	0.46	6.42
35.34	0	0.65	1.30E+02	31.55	15.77	0.47	6.61
37.01	0	0.619	1.37E+02	33.17	16.58	0.48	6.79
38.68	0	0.59	1.43E+02	34.79	17.4	0.49	6.98
40.35	0	0.563	1.50E+02	36.43	18.21	0.51	7.16
42.02	0	0.539	1.56E+02	38.07	19.03	0.52	7.33
43.69	0	0.517	1.63E+02	39.72	19.86	0.53	7.5
45.37	0	0.496	1.70E+02	41.37	20.69	0.54	7.67
47.04	0	0.477	1.76E+02	43.04	21.52	0.55	7.84
48.71	0	0.459	1.83E+02	44.71	22.35	0.56	8.01
50.38	0	0.442	1.89E+02	46.38	23.19	0.56	8.17
52.05	0	0.427	1.96E+02	48.07	24.03	0.57	8.33
53.73	0	0.412	2.03E+02	49.76	24.88	0.58	8.49
55.4	0	0.399	2.09E+02	51.45	25.73	0.59	8.65
57.07	0	0.386	2.16E+02	53.15	26.58	0.6	8.81
58.74	0	0.374	2.22E+02	54.86	27.43	0.61	8.96
60.41	0	0.363	2.29E+02	56.57	28.29	0.62	9.11
62.08	0	0.352	2.36E+02	58.29	29.14	0.63	9.26
63.76	0	0.342	2.42E+02	60.01	30.01	0.64	9.41
65.43	0	0.332	2.49E+02	61.74	30.87	0.64	9.56
67.1	0	0.323	2.56E+02	63.47	31.74	0.65	9.71
68.77	0	0.314	2.62E+02	65.21	32.6	0.66	9.85
70.44	0	0.306	2.69E+02	66.95	33.48	0.67	9.99
72.12	0	0.298	2.75E+02	68.7	34.35	0.68	10.14
73.79	0	0.291	2.82E+02	70.45	35.22	0.68	10.28
75.46	0	0.284	2.89E+02	72.2	36.1	0.69	10.42

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77.13	0	0.277	2.95E+02	73.96	36.98	0.7	10.56
78.8	0	0.271	3.02E+02	75.73	37.86	0.71	10.69
80.47	0	0.265	3.09E+02	77.5	38.75	0.71	10.83
82.15	0	0.259	3.15E+02	79.27	39.63	0.72	10.96
83.82	0	0.253	3.22E+02	81.04	40.52	0.73	11.1
85.49	0	0.247	3.28E+02	82.82	41.41	0.74	11.23
87.16	0	0.242	3.35E+02	84.61	42.3	0.74	11.36
88.83	0	0.237	3.42E+02	86.4	43.2	0.75	11.49
90.5	0	0.232	3.48E+02	88.19	44.09	0.76	11.62
92.18	0	0.228	3.55E+02	89.98	44.99	0.76	11.75
93.85	0	0.223	3.62E+02	91.78	45.89	0.77	11.88
95.52	0	0.219	3.68E+02	93.58	46.79	0.78	12.01
97.19	0	0.215	3.75E+02	95.39	47.69	0.79	12.13
98.86	0	0.211	3.82E+02	97.2	48.6	0.79	12.26
100.54	0	0.207	3.88E+02	99.01	49.5	0.8	12.38
102.21	0	0.203	3.95E+02	100.83	50.41	0.81	12.51
103.88	0	0.2	4.02E+02	102.64	51.32	0.81	12.63
105.55	0	0.196	4.08E+02	104.47	52.23	0.82	12.75
107.22	0	0.193	4.15E+02	106.29	53.15	0.83	12.87
108.89	0	0.189	4.22E+02	108.12	54.06	0.83	12.99
110.57	0	0.186	4.28E+02	109.95	54.98	0.84	13.11
112.24	0	0.183	4.35E+02	111.78	55.89	0.84	13.23
113.91	0	0.18	4.42E+02	113.62	56.81	0.85	13.35
115.58	0	0.177	4.48E+02	115.46	57.73	0.86	13.47
117.25	0	0.175	4.55E+02	117.31	58.65	0.86	13.59
118.92	0	0.172	4.62E+02	119.15	59.58	0.87	13.7
120.6	0	0.169	4.68E+02	121	60.5	0.88	13.82
122.27	0	0.167	4.75E+02	122.85	61.43	0.88	13.94
123.94	0	0.164	4.82E+02	124.71	62.35	0.89	14.05
125.61	0	0.162	4.88E+02	126.56	63.28	0.89	14.16
127.28	0	0.159	4.95E+02	128.42	64.21	0.9	14.28
128.96	0	0.157	5.01E+02	130.29	65.14	0.91	14.39
130.63	0	0.155	5.08E+02	132.15	66.08	0.91	14.5
132.3	0	0.153	5.15E+02	134.02	67.01	0.92	14.62
133.97	0	0.151	5.21E+02	135.89	67.94	0.92	14.73
135.64	0	0.149	5.28E+02	137.76	68.88	0.93	14.84
137.31	0	0.147	5.35E+02	139.64	69.82	0.93	14.95
138.99	0	0.145	5.41E+02	141.51	70.76	0.94	15.06
140.66	0	0.143	5.48E+02	143.39	71.7	0.95	15.17
142.33	0	0.141	5.55E+02	145.28	72.64	0.95	15.28
144	0	0.139	5.61E+02	147.16	73.58	0.96	15.38
145.67	0	0.137	5.68E+02	149.05	74.52	0.96	15.49
147.34	0	0.136	5.75E+02	150.94	75.47	0.97	15.6

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149.02	0	0.134	5.81E+02	152.83	76.41	0.97	15.71
150.69	0	0.132	5.88E+02	154.72	77.36	0.98	15.81
152.36	0	0.131	5.95E+02	156.62	78.31	0.98	15.92
154.03	0	0.129	6.01E+02	158.52	79.26	0.99	16.02
155.7	0	0.128	6.08E+02	160.42	80.21	1	16.13
157.38	0	0.126	6.15E+02	162.32	81.16	1	16.23
159.05	0	0.125	6.21E+02	164.23	82.11	1.01	16.34
160.72	0	0.123	6.28E+02	166.14	83.07	1.01	16.44
162.39	0	0.122	6.35E+02	168.04	84.02	1.02	16.54
164.06	0	0.12	6.42E+02	169.96	84.98	1.02	16.65
165.73	0	0.119	6.48E+02	171.87	85.94	1.03	16.75
167.41	0	0.118	6.55E+02	173.79	86.89	1.03	16.85
169.08	0	0.116	6.62E+02	175.7	87.85	1.04	16.95
170.75	0	0.115	6.68E+02	177.62	88.81	1.04	17.05
172.42	0	0.114	6.75E+02	179.55	89.77	1.05	17.16
174.09	0	0.113	6.82E+02	181.47	90.73	1.05	17.26
175.76	0	0.112	6.88E+02	183.4	91.7	1.06	17.36
177.44	0	0.11	6.95E+02	185.32	92.66	1.06	17.46
179.11	0	0.109	7.02E+02	187.25	93.63	1.07	17.56
180.78	0	0.108	7.08E+02	189.19	94.59	1.07	17.65
182.45	0	0.107	7.15E+02	191.12	95.56	1.08	17.75
184.12	0	0.106	7.22E+02	193.06	96.53	1.08	17.85
185.8	0	0.105	7.28E+02	194.99	97.5	1.09	17.95
187.47	0	0.104	7.35E+02	196.93	98.47	1.09	18.05
189.14	0	0.103	7.42E+02	198.87	99.44	1.1	18.14
190.81	0	0.102	7.48E+02	200.82	100.41	1.1	18.24
192.48	0	0.101	7.55E+02	202.76	101.38	1.11	18.34
194.15	0	0.1	7.62E+02	204.71	102.35	1.11	18.43
195.83	0	0.099	7.68E+02	206.66	103.33	1.12	18.53
197.5	0	0.098	7.75E+02	208.61	104.3	1.12	18.63
199.17	0	0.097	7.82E+02	210.56	105.28	1.13	18.72
200.84	0	0.096	7.88E+02	212.51	106.26	1.13	18.82
202.51	0	0.095	7.95E+02	214.47	107.23	1.14	18.91
204.19	0	0.095	8.02E+02	216.43	108.21	1.14	19.01
205.86	0	0.094	8.08E+02	218.39	109.19	1.14	19.1
207.53	0	0.093	8.15E+02	220.35	110.17	1.15	19.19
209.2	0	0.092	8.22E+02	222.31	111.15	1.15	19.29
210.87	0	0.091	8.28E+02	224.27	112.14	1.16	19.38
212.54	0	0.09	8.35E+02	226.24	113.12	1.16	19.47
214.22	0	0.09	8.42E+02	228.21	114.1	1.17	19.57
215.89	0	0.089	8.48E+02	230.18	115.09	1.17	19.66
217.56	0	0.088	8.55E+02	232.15	116.07	1.18	19.75
219.23	0	0.087	8.62E+02	234.12	117.06	1.18	19.84

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220.9	0	0.087	8.68E+02	236.09	118.05	1.19	19.93
222.57	0	0.086	8.75E+02	238.07	119.04	1.19	20.02
224.25	0	0.085	8.82E+02	240.05	120.02	1.19	20.12
225.92	0	0.084	8.88E+02	242.03	121.01	1.2	20.21
227.59	0	0.084	8.95E+02	244.01	122	1.2	20.3
229.26	0	0.083	9.02E+02	245.99	122.99	1.21	20.39
230.93	0	0.082	9.09E+02	247.97	123.99	1.21	20.48
232.61	0	0.082	9.15E+02	249.96	124.98	1.22	20.57
234.28	0	0.081	9.22E+02	251.94	125.97	1.22	20.66
235.95	0	0.081	9.29E+02	253.93	126.97	1.23	20.75
237.62	0	0.08	9.35E+02	255.92	127.96	1.23	20.83
239.29	0	0.079	9.42E+02	257.91	128.96	1.23	20.92
240.96	0	0.079	9.49E+02	259.91	129.95	1.24	21.01
242.64	0	0.078	9.55E+02	261.9	130.95	1.24	21.1
244.31	0	0.077	9.62E+02	263.9	131.95	1.25	21.19
245.98	0	0.077	9.69E+02	265.89	132.95	1.25	21.28
247.65	0	0.076	9.75E+02	267.89	133.95	1.26	21.36
249.32	0	0.076	9.82E+02	269.89	134.95	1.26	21.45
250.99	0	0.075	9.89E+02	271.89	135.95	1.26	21.54
252.67	0	0.075	9.95E+02	273.9	136.95	1.27	21.63
254.34	0	0.074	1.00E+03	275.9	137.95	1.27	21.71
256.01	0	0.074	1.01E+03	277.91	138.95	1.28	21.8
257.68	0	0.073	1.02E+03	279.91	139.96	1.28	21.88
259.35	0	0.073	1.02E+03	281.92	140.96	1.29	21.97
261.03	0	0.072	1.03E+03	283.93	141.97	1.29	22.06
262.7	0	0.071	1.04E+03	285.94	142.97	1.29	22.14
264.37	0	0.071	1.04E+03	287.96	143.98	1.3	22.23
266.04	0	0.07	1.05E+03	289.97	144.99	1.3	22.31
267.71	0	0.07	1.06E+03	291.99	145.99	1.31	22.4
269.38	0	0.07	1.06E+03	294	147	1.31	22.48
271.06	0	0.069	1.07E+03	296.02	148.01	1.31	22.57
272.73	0	0.069	1.08E+03	298.04	149.02	1.32	22.65
274.4	0	0.068	1.08E+03	300.06	150.03	1.32	22.74
276.07	0	0.068	1.09E+03	302.08	151.04	1.33	22.82
277.74	0	0.067	1.10E+03	304.11	152.05	1.33	22.9
279.41	0	0.067	1.10E+03	306.13	153.07	1.33	22.99
281.09	0	0.066	1.11E+03	308.16	154.08	1.34	23.07
282.76	0	0.066	1.12E+03	310.18	155.09	1.34	23.15
284.43	0	0.065	1.12E+03	312.21	156.11	1.35	23.24
286.1	0	0.065	1.13E+03	314.24	157.12	1.35	23.32
287.77	0	0.065	1.14E+03	316.27	158.14	1.35	23.4
289.45	0	0.064	1.14E+03	318.31	159.15	1.36	23.48
291.12	0	0.064	1.15E+03	320.34	160.17	1.36	23.57

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292.79	0	0.063	1.16E+03	322.38	161.19	1.37	23.65
294.46	0	0.063	1.16E+03	324.41	162.21	1.37	23.73
296.13	0	0.063	1.17E+03	326.45	163.22	1.37	23.81
297.8	0	0.062	1.18E+03	328.49	164.24	1.38	23.89
299.48	0	0.062	1.18E+03	330.53	165.26	1.38	23.97
301.15	0	0.061	1.19E+03	332.57	166.28	1.38	24.06
302.82	0	0.061	1.20E+03	334.61	167.31	1.39	24.14
304.49	0	0.061	1.20E+03	336.65	168.33	1.39	24.22
306.16	0	0.06	1.21E+03	338.7	169.35	1.4	24.3
307.83	0	0.06	1.22E+03	340.74	170.37	1.4	24.38
309.51	0	0.06	1.22E+03	342.79	171.4	1.4	24.46
311.18	0	0.059	1.23E+03	344.84	172.42	1.41	24.54
312.85	0	0.059	1.24E+03	346.89	173.44	1.41	24.62
314.52	0	0.059	1.24E+03	348.94	174.47	1.42	24.7
316.19	0	0.058	1.25E+03	350.99	175.5	1.42	24.78
317.87	0	0.058	1.26E+03	353.05	176.52	1.42	24.86
319.54	0	0.058	1.26E+03	355.1	177.55	1.43	24.94
321.21	0	0.057	1.27E+03	357.15	178.58	1.43	25.02
322.88	0	0.057	1.28E+03	359.21	179.61	1.43	25.1
324.55	0	0.057	1.28E+03	361.27	180.63	1.44	25.17
326.22	0	0.056	1.29E+03	363.33	181.66	1.44	25.25
327.9	0	0.056	1.30E+03	365.39	182.69	1.45	25.33
329.57	0	0.056	1.30E+03	367.45	183.72	1.45	25.41
331.24	0	0.055	1.31E+03	369.51	184.76	1.45	25.49
332.91	0	0.055	1.32E+03	371.57	185.79	1.46	25.57
334.58	0	0.055	1.32E+03	373.64	186.82	1.46	25.64
336.26	0	0.054	1.33E+03	375.7	187.85	1.46	25.72
337.93	0	0.054	1.34E+03	377.77	188.89	1.47	25.8
339.6	0	0.054	1.34E+03	379.84	189.92	1.47	25.88
341.27	0	0.053	1.35E+03	381.91	190.95	1.47	25.95
342.94	0	0.053	1.36E+03	383.98	191.99	1.48	26.03
344.61	0	0.053	1.36E+03	386.05	193.02	1.48	26.11
346.29	0	0.053	1.37E+03	388.12	194.06	1.48	26.18
347.96	0	0.052	1.38E+03	390.19	195.1	1.49	26.26
349.63	0	0.052	1.38E+03	392.27	196.13	1.49	26.34
351.3	0	0.052	1.39E+03	394.34	197.17	1.5	26.41
352.97	0	0.052	1.40E+03	396.42	198.21	1.5	26.49
354.64	0	0.051	1.40E+03	398.5	199.25	1.5	26.57

A R E A S OF E X C E S
1 : case #

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EXC. TEMP. (DEG. C)	AREA (SQ. M)
0.51	1.51E+02
1.03	5.30E+01
1.54	2.82E+01
2.05	1.71E+01
2.56	1.20E+01
3.08	8.36E+00
3.59	6.35E+00
4.1	4.89E+00
4.61	3.69E+00
5.13	2.95E+00
5.64	2.35E+00
6.15	1.86E+00
6.66	1.48E+00
7.18	1.19E+00
7.69	9.50E-01
8.2	7.64E-01
8.71	5.99E-01
9.23	4.68E-01
9.74	3.52E-01
10.25	1.90E-01

(DEG. C) AREA (SQ. M)

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