

## Appendix 7B

### Collision Probabilities of Selected Species

Note: The collision probability refers to the predicted probability of a bird being hit when it makes a transit through the turbine rotor. The actual collision risk of a bird species was calculated by multiplying this collision probability by the number of bird transits predicted based on the field survey data. Section 7 – Avifauna, contains the actual collision risk calculations.

**Collision Probability Calculation for Black-naped Tern (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
							Upwind:		Downwind:		
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	contribution		
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Pitch (degrees)	95										
Bird Length	0.3 m	0.025	0.575	4.52	2.03	0.19	0.00024	3.83	0.36	0.00045	
Wingspan	0.23 m	0.075	0.575	1.51	2.19	0.21	0.00154	2.79	0.26	0.00196	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.90	2.85	0.27	0.00334	3.29	0.31	0.00386	
		0.175	0.860	0.65	3.50	0.33	0.00575	3.88	0.36	0.00638	
Bird speed	9.6 m/sec	0.225	0.994	0.50	4.05	0.38	0.00855	4.40	0.41	0.00928	
Rotor Diam	90 m	0.275	0.947	0.41	3.90	0.37	0.01007	4.17	0.39	0.01076	
Rotation Period	3.33 sec	0.325	0.899	0.35	3.74	0.35	0.01140	3.95	0.37	0.01206	
		0.375	0.851	0.30	3.57	0.33	0.01256	3.75	0.35	0.01319	
		0.425	0.804	0.27	3.40	0.32	0.01355	3.54	0.33	0.01413	
		0.475	0.756	0.24	3.22	0.30	0.01435	3.34	0.31	0.01491	
Bird aspect ratio: $\beta$	1.30	0.525	0.708	0.22	3.04	0.29	0.01498	3.15	0.30	0.01550	
		0.575	0.660	0.20	2.86	0.27	0.01544	2.95	0.28	0.01592	
		0.625	0.613	0.18	2.68	0.25	0.01571	2.76	0.26	0.01616	
		0.675	0.565	0.17	2.50	0.23	0.01581	2.56	0.24	0.01623	
		0.725	0.517	0.16	2.31	0.22	0.01574	2.37	0.22	0.01612	
		0.775	0.470	0.15	2.13	0.20	0.01548	2.18	0.20	0.01583	
		0.825	0.422	0.14	1.94	0.18	0.01506	1.98	0.19	0.01536	
		0.875	0.374	0.13	1.76	0.17	0.01445	1.79	0.17	0.01472	
		0.925	0.327	0.12	1.57	0.15	0.01367	1.60	0.15	0.01391	
		0.975	0.279	0.12	1.39	0.13	0.01271	1.41	0.13	0.01291	
		<b>Overall p(collision)</b>									
		=					<b>Upwind</b>	<b>23.0%</b>	<b>Downwind</b>	<b>24.0%</b>	
							<b>Average</b>	<b>23.5%</b>			

**Collision Probability Calculation for Black-naped Tern (Scenario B)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius								
							Upwind:		Downwind:	
No of Blades	3	r/R	c/C	$\alpha$	collide		contribution	collide		contribution
Max. Chord Width	4.067 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r
Pitch (degrees)	90									
Bird Length	0.3 m	0.025	0.575	5.05	3.08	0.19	0.00024	3.08	0.19	0.00024
Wingspan	0.23 m	0.075	0.575	1.68	2.59	0.16	0.00122	2.59	0.16	0.00122
F: Flapping (0) or gliding (+1)	1	0.125	0.702	1.01	3.15	0.20	0.00248	3.15	0.20	0.00248
		0.175	0.860	0.72	3.80	0.24	0.00419	3.80	0.24	0.00419
Bird speed	9.6 m/sec	0.225	0.994	0.56	4.34	0.27	0.00616	4.34	0.27	0.00616
Rotor Diam	120 m	0.275	0.947	0.46	4.15	0.26	0.00719	4.15	0.26	0.00719
Rotation Period	4.96 sec	0.325	0.899	0.39	3.96	0.25	0.00810	3.96	0.25	0.00810
		0.375	0.851	0.34	3.76	0.24	0.00889	3.76	0.24	0.00889
		0.425	0.804	0.30	3.57	0.22	0.00955	3.57	0.22	0.00955
		0.475	0.756	0.27	3.37	0.21	0.01010	3.37	0.21	0.01010
Bird aspect ratio: $\beta$	1.30	0.525	0.708	0.24	3.18	0.20	0.01052	3.18	0.20	0.01052
		0.575	0.660	0.22	2.99	0.19	0.01082	2.99	0.19	0.01082
		0.625	0.613	0.20	2.79	0.18	0.01099	2.79	0.18	0.01099
		0.675	0.565	0.19	2.60	0.16	0.01105	2.60	0.16	0.01105
		0.725	0.517	0.17	2.40	0.15	0.01098	2.40	0.15	0.01098
		0.775	0.470	0.16	2.21	0.14	0.01079	2.21	0.14	0.01079
		0.825	0.422	0.15	2.02	0.13	0.01048	2.02	0.13	0.01048
		0.875	0.374	0.14	1.82	0.11	0.01004	1.82	0.11	0.01004
		0.925	0.327	0.14	1.63	0.10	0.00949	1.63	0.10	0.00949
		0.975	0.279	0.13	1.43	0.09	0.00881	1.43	0.09	0.00881
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>16.2%</b>	<b>Downwind</b>	<b>16.2%</b>	
							<b>Average</b>	<b>16.2%</b>		

**Collision Probability Calculation for Bridled Tern (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
		Upwind:					Downwind:				
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	check area		
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	total
Pitch (degrees)	95										
Bird Length	0.38 m	0.025	0.575	2.36	3.08	0.55	0.00069	4.01	0.72	0.00090	0.00125
Wingspan	0.85 m	0.075	0.575	0.79	2.54	0.46	0.00343	2.85	0.51	0.00385	0.0075
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.47	2.91	0.52	0.00655	3.14	0.57	0.00706	0.0125
		0.175	0.860	0.34	3.67	0.66	0.01158	3.87	0.70	0.01221	0.0175
Bird speed	5 m/sec	0.225	0.994	0.26	4.21	0.76	0.01708	4.39	0.79	0.01781	0.0225
Rotor Diam	90 m	0.275	0.947	0.21	4.04	0.73	0.02004	4.18	0.75	0.02073	0.0275
Rotation Period	3.33 sec	0.325	0.899	0.18	3.87	0.70	0.02266	3.98	0.72	0.02332	0.0325
		0.375	0.851	0.16	3.69	0.67	0.02495	3.78	0.68	0.02557	0.0375
		0.425	0.804	0.14	3.51	0.63	0.02689	3.59	0.65	0.02748	0.0425
		0.475	0.756	0.12	3.33	0.60	0.02850	3.39	0.61	0.02905	0.0475
Bird aspect ratio: $\beta$	0.45	0.525	0.708	0.11	3.15	0.57	0.02976	3.20	0.58	0.03028	0.0525
		0.575	0.660	0.10	2.96	0.53	0.03069	3.01	0.54	0.03117	0.0575
		0.625	0.613	0.09	2.78	0.50	0.03128	2.82	0.51	0.03173	0.0625
		0.675	0.565	0.09	2.59	0.47	0.03153	2.63	0.47	0.03194	0.0675
		0.725	0.517	0.08	2.41	0.43	0.03144	2.44	0.44	0.03181	0.0725
		0.775	0.470	0.08	2.22	0.40	0.03101	2.25	0.40	0.03135	0.0775
		0.825	0.422	0.07	2.03	0.37	0.03024	2.05	0.37	0.03055	0.0825
		0.875	0.374	0.07	1.85	0.33	0.02913	1.87	0.34	0.02940	0.0875
		0.925	0.327	0.06	1.66	0.30	0.02768	1.68	0.30	0.02792	0.0925
		0.975	0.279	0.06	1.47	0.27	0.02590	1.49	0.27	0.02610	0.0975
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>46.1%</b>	<b>Downwind</b>	<b>47.0%</b>	<b>1.00</b>	
						<b>Average</b>	<b>46.6%</b>				

**Collision Probability Calculation for Bridled Tern (Scenario B)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
		Upwind:					Downwind:				
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	check area		
Max. Chord Width	4.067 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	total
Pitch (degrees)	90										
Bird Length	0.38 m	0.025	0.575	2.63	3.76	0.46	0.00057	3.76	0.46	0.00057	0.00125
Wingspan	0.85 m	0.075	0.575	0.88	2.81	0.34	0.00255	2.81	0.34	0.00255	0.0075
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.53	3.14	0.38	0.00474	3.14	0.38	0.00474	0.0125
		0.175	0.860	0.38	3.88	0.47	0.00821	3.88	0.47	0.00821	0.0175
Bird speed	5 m/sec	0.225	0.994	0.29	4.42	0.54	0.01204	4.42	0.54	0.01204	0.0225
Rotor Diam	120 m	0.275	0.947	0.24	4.23	0.51	0.01407	4.23	0.51	0.01407	0.0275
Rotation Period	4.96 sec	0.325	0.899	0.20	4.04	0.49	0.01587	4.04	0.49	0.01587	0.0325
		0.375	0.851	0.18	3.84	0.46	0.01743	3.84	0.46	0.01743	0.0375
		0.425	0.804	0.15	3.65	0.44	0.01876	3.65	0.44	0.01876	0.0425
		0.475	0.756	0.14	3.45	0.42	0.01985	3.45	0.42	0.01985	0.0475
Bird aspect ratio: $\beta$	0.45	0.525	0.708	0.13	3.26	0.39	0.02070	3.26	0.39	0.02070	0.0525
		0.575	0.660	0.11	3.07	0.37	0.02133	3.07	0.37	0.02133	0.0575
		0.625	0.613	0.11	2.87	0.35	0.02171	2.87	0.35	0.02171	0.0625
		0.675	0.565	0.10	2.68	0.32	0.02187	2.68	0.32	0.02187	0.0675
		0.725	0.517	0.09	2.48	0.30	0.02179	2.48	0.30	0.02179	0.0725
		0.775	0.470	0.08	2.29	0.28	0.02147	2.29	0.28	0.02147	0.0775
		0.825	0.422	0.08	2.10	0.25	0.02092	2.10	0.25	0.02092	0.0825
		0.875	0.374	0.08	1.90	0.23	0.02013	1.90	0.23	0.02013	0.0875
		0.925	0.327	0.07	1.71	0.21	0.01911	1.71	0.21	0.01911	0.0925
		0.975	0.279	0.07	1.51	0.18	0.01786	1.51	0.18	0.01786	0.0975
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>32.1%</b>	<b>Downwind</b>	<b>32.1%</b>	<b>1.00</b>	
						<b>Average</b>	<b>32.1%</b>				

**Collision Probability Calculation for Red-necked Phalarope (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
							Upwind:		Downwind:		
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution		collide	contribution		
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Pitch (degrees)	95										
Bird Length	0.2 m	0.025	0.575	2.45	2.37	0.41	0.00051	3.35	0.58	0.00072	
Wingspan	0.38 m	0.075	0.575	0.82	2.30	0.40	0.00299	2.63	0.46	0.00341	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.49	2.85	0.49	0.00617	3.09	0.53	0.00668	
		0.175	0.860	0.35	3.49	0.60	0.01058	3.70	0.64	0.01121	
Bird speed	5.2 m/sec	0.225	0.994	0.27	4.03	0.70	0.01571	4.22	0.73	0.01643	
Rotor Diam	90 m	0.275	0.947	0.22	3.86	0.67	0.01840	4.01	0.69	0.01909	
Rotation Period	3.33 sec	0.325	0.899	0.19	3.69	0.64	0.02076	3.80	0.66	0.02142	
		0.375	0.851	0.16	3.51	0.61	0.02280	3.61	0.62	0.02343	
		0.425	0.804	0.14	3.33	0.58	0.02452	3.41	0.59	0.02511	
		0.475	0.756	0.13	3.15	0.55	0.02591	3.22	0.56	0.02646	
Bird aspect ratio: $\beta$	0.53	0.525	0.708	0.12	2.97	0.51	0.02697	3.02	0.52	0.02749	
		0.575	0.660	0.11	2.78	0.48	0.02771	2.83	0.49	0.02819	
		0.625	0.613	0.10	2.60	0.45	0.02812	2.64	0.46	0.02856	
		0.675	0.565	0.09	2.41	0.42	0.02820	2.45	0.42	0.02861	
		0.725	0.517	0.08	2.23	0.39	0.02796	2.26	0.39	0.02834	
		0.775	0.470	0.08	2.04	0.35	0.02739	2.07	0.36	0.02773	
		0.825	0.422	0.07	1.85	0.32	0.02650	1.88	0.32	0.02680	
		0.875	0.374	0.07	1.67	0.29	0.02528	1.69	0.29	0.02555	
		0.925	0.327	0.07	1.48	0.26	0.02373	1.50	0.26	0.02397	
		0.975	0.279	0.06	1.29	0.22	0.02186	1.31	0.23	0.02206	
<b>Overall p(collision)</b>											
=						<b>Upwind</b>	<b>41.2%</b>	<b>Downwind</b>	<b>42.1%</b>		
						<b>Average</b>	<b>41.7%</b>				

**Collision Probability Calculation for Red-necked Phalarope (Scenario B)**

K: [1D or [3D] (0 or 1)		Calculation of alpha and p(collision) as a function of radius									
No of Blades		Upwind:					Downwind:				
Max. Chord Width	4.067 m	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	collide	contribution	
Pitch (degrees)	90	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Bird Length	0.2 m	0.025	0.575	2.74	3.00	0.35	0.00044	3.00	0.35	0.00044	
Wingspan	0.38 m	0.075	0.575	0.91	2.56	0.30	0.00223	2.56	0.30	0.00223	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.55	2.99	0.35	0.00434	2.99	0.35	0.00434	
		0.175	0.860	0.39	3.70	0.43	0.00753	3.70	0.43	0.00753	
Bird speed	5.2 m/sec	0.225	0.994	0.30	4.24	0.49	0.01111	4.24	0.49	0.01111	
Rotor Diam	120 m	0.275	0.947	0.25	4.05	0.47	0.01295	4.05	0.47	0.01295	
Rotation Period	4.96 sec	0.325	0.899	0.21	3.86	0.45	0.01458	3.86	0.45	0.01458	
		0.375	0.851	0.18	3.66	0.43	0.01597	3.66	0.43	0.01597	
		0.425	0.804	0.16	3.47	0.40	0.01714	3.47	0.40	0.01714	
		0.475	0.756	0.14	3.27	0.38	0.01809	3.27	0.38	0.01809	
Bird aspect ratio: $\beta$	0.53	0.525	0.708	0.13	3.08	0.36	0.01881	3.08	0.36	0.01881	
		0.575	0.660	0.12	2.89	0.34	0.01930	2.89	0.34	0.01930	
		0.625	0.613	0.11	2.69	0.31	0.01957	2.69	0.31	0.01957	
		0.675	0.565	0.10	2.50	0.29	0.01961	2.50	0.29	0.01961	
		0.725	0.517	0.09	2.30	0.27	0.01943	2.30	0.27	0.01943	
		0.775	0.470	0.09	2.11	0.25	0.01902	2.11	0.25	0.01902	
		0.825	0.422	0.08	1.92	0.22	0.01839	1.92	0.22	0.01839	
		0.875	0.374	0.08	1.72	0.20	0.01753	1.72	0.20	0.01753	
		0.925	0.327	0.07	1.53	0.18	0.01644	1.53	0.18	0.01644	
		0.975	0.279	0.07	1.33	0.16	0.01513	1.33	0.16	0.01513	
		<b>Overall p(collision)</b>					<b>Upwind</b>		<b>Downwind</b>		
		<b>=</b>					<b>28.8%</b>		<b>28.8%</b>		
							<b>Average</b>		<b>28.8%</b>		

**Collision Probability Calculation for Cattle Egret (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
							Upwind:		Downwind:		
No of Blades	3	r/R	c/C	$\alpha$	collide			collide			
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	contribution from radius r	length	p(collision)	contribution from radius r	
Pitch (degrees)	95										
Bird Length	0.53 m	0.025	0.575	3.39	3.69	0.46	0.00058	5.04	0.63	0.00079	
Wingspan	0.97 m	0.075	0.575	1.13	2.74	0.34	0.00257	3.19	0.40	0.00299	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.68	3.02	0.38	0.00473	3.35	0.42	0.00524	
		0.175	0.860	0.48	3.78	0.47	0.00828	4.07	0.51	0.00891	
Bird speed	7.2 m/sec	0.225	0.994	0.38	4.32	0.54	0.01217	4.58	0.57	0.01290	
Rotor Diam	90 m	0.275	0.947	0.31	4.16	0.52	0.01433	4.37	0.55	0.01502	
Rotation Period	3.33 sec	0.325	0.899	0.26	4.00	0.50	0.01625	4.16	0.52	0.01691	
		0.375	0.851	0.23	3.82	0.48	0.01793	3.95	0.49	0.01856	
		0.425	0.804	0.20	3.64	0.46	0.01938	3.76	0.47	0.01997	
		0.475	0.756	0.18	3.47	0.43	0.02060	3.56	0.45	0.02115	
Bird aspect ratio: $\beta$	0.55	0.525	0.708	0.16	3.28	0.41	0.02157	3.36	0.42	0.02209	
		0.575	0.660	0.15	3.10	0.39	0.02232	3.17	0.40	0.02280	
		0.625	0.613	0.14	2.92	0.37	0.02282	2.98	0.37	0.02327	
		0.675	0.565	0.13	2.73	0.34	0.02310	2.78	0.35	0.02351	
		0.725	0.517	0.12	2.55	0.32	0.02313	2.59	0.32	0.02351	
		0.775	0.470	0.11	2.37	0.30	0.02293	2.40	0.30	0.02328	
		0.825	0.422	0.10	2.18	0.27	0.02250	2.21	0.28	0.02281	
		0.875	0.374	0.10	1.99	0.25	0.02183	2.02	0.25	0.02210	
		0.925	0.327	0.09	1.81	0.23	0.02092	1.83	0.23	0.02116	
		0.975	0.279	0.09	1.62	0.20	0.01978	1.64	0.21	0.01999	
		<b>Overall p(collision)</b>									
		=					<b>Upwind</b>	<b>33.8%</b>	<b>Downwind</b>	<b>34.7%</b>	
							<b>Average</b>	<b>34.2%</b>			



**Collision Probability Calculation for Cattle Egret (Scenario B)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
		Upwind:					Downwind:				
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	collide	contribution	
Max. Chord Width	4.067 m	radius	chord	alpha	length	p(collision)	length	p(collision)	length	p(collision)	
Pitch (degrees)	90						from radius r		from radius r		
Bird Length	0.53 m	0.025	0.575	3.79	4.68	0.39	0.00049	4.68	0.39	0.00049	
Wingspan	0.97 m	0.075	0.575	1.26	3.12	0.26	0.00196	3.12	0.26	0.00196	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.76	3.32	0.28	0.00349	3.32	0.28	0.00349	
		0.175	0.860	0.54	4.03	0.34	0.00592	4.03	0.34	0.00592	
Bird speed	7.2 m/sec	0.225	0.994	0.42	4.57	0.38	0.00865	4.57	0.38	0.00865	
Rotor Diam	120 m	0.275	0.947	0.34	4.38	0.37	0.01012	4.38	0.37	0.01012	
Rotation Period	4.96 sec	0.325	0.899	0.29	4.19	0.35	0.01143	4.19	0.35	0.01143	
		0.375	0.851	0.25	3.99	0.34	0.01258	3.99	0.34	0.01258	
		0.425	0.804	0.22	3.80	0.32	0.01356	3.80	0.32	0.01356	
		0.475	0.756	0.20	3.60	0.30	0.01438	3.60	0.30	0.01438	
Bird aspect ratio: $\beta$	0.55	0.525	0.708	0.18	3.41	0.29	0.01504	3.41	0.29	0.01504	
		0.575	0.660	0.16	3.22	0.27	0.01553	3.22	0.27	0.01553	
		0.625	0.613	0.15	3.02	0.25	0.01587	3.02	0.25	0.01587	
		0.675	0.565	0.14	2.83	0.24	0.01604	2.83	0.24	0.01604	
		0.725	0.517	0.13	2.63	0.22	0.01604	2.63	0.22	0.01604	
		0.775	0.470	0.12	2.44	0.20	0.01589	2.44	0.20	0.01589	
		0.825	0.422	0.11	2.25	0.19	0.01557	2.25	0.19	0.01557	
		0.875	0.374	0.11	2.05	0.17	0.01508	2.05	0.17	0.01508	
		0.925	0.327	0.10	1.86	0.16	0.01444	1.86	0.16	0.01444	
		0.975	0.279	0.10	1.66	0.14	0.01363	1.66	0.14	0.01363	
		<b>Overall p(collision)</b>				<b>=</b>		<b>Upwind</b>	<b>23.6%</b>	<b>Downwind</b>	<b>23.6%</b>
						<b>Average</b>		<b>23.6%</b>			

**Collision Probability Calculation for Aleutian Tern (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
		Upwind:					Downwind:				
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	contribution	contribution	
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	length	p(collision)	length	p(collision)	
Pitch (degrees)	95						from radius r		from radius r		
Bird Length	0.38 m	0.025	0.575	2.59	3.09	0.51	0.00063	4.12	0.67	0.00084	
Wingspan	0.81 m	0.075	0.575	0.86	2.54	0.42	0.00312	2.89	0.47	0.00354	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.52	2.91	0.48	0.00596	3.16	0.52	0.00647	
		0.175	0.860	0.37	3.66	0.60	0.01050	3.88	0.64	0.01113	
Bird speed	5.5 m/sec	0.225	0.994	0.29	4.20	0.69	0.01549	4.40	0.72	0.01622	
Rotor Diam	90 m	0.275	0.947	0.24	4.04	0.66	0.01819	4.19	0.69	0.01888	
Rotation Period	3.33 sec	0.325	0.899	0.20	3.86	0.63	0.02057	3.99	0.65	0.02123	
		0.375	0.851	0.17	3.69	0.60	0.02265	3.79	0.62	0.02327	
		0.425	0.804	0.15	3.51	0.57	0.02442	3.59	0.59	0.02501	
		0.475	0.756	0.14	3.33	0.54	0.02588	3.40	0.56	0.02643	
Bird aspect ratio: $\beta$	0.47	0.525	0.708	0.12	3.14	0.51	0.02703	3.20	0.52	0.02755	
		0.575	0.660	0.11	2.96	0.48	0.02788	3.01	0.49	0.02836	
		0.625	0.613	0.10	2.78	0.45	0.02841	2.82	0.46	0.02886	
		0.675	0.565	0.10	2.59	0.42	0.02864	2.63	0.43	0.02905	
		0.725	0.517	0.09	2.40	0.39	0.02856	2.44	0.40	0.02894	
		0.775	0.470	0.08	2.22	0.36	0.02817	2.25	0.37	0.02852	
		0.825	0.422	0.08	2.03	0.33	0.02747	2.06	0.34	0.02778	
		0.875	0.374	0.07	1.85	0.30	0.02647	1.87	0.31	0.02674	
		0.925	0.327	0.07	1.66	0.27	0.02516	1.68	0.27	0.02540	
		0.975	0.279	0.07	1.47	0.24	0.02353	1.49	0.24	0.02374	
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>41.9%</b>	<b>Downwind</b>	<b>42.8%</b>		
						<b>Average</b>	<b>42.3%</b>				

**Collision Probability Calculation for Aleutian Tern (Scenario B)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
							Upwind:		Downwind:		
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	contribution		
Max. Chord Width	4.067 m	radius	chord	alpha	length	p(collision)	length	p(collision)	length	from radius r	
Pitch (degrees)	90										
Bird Length	0.38 m	0.025	0.575	2.89	3.83	0.42	0.00053	3.83	0.42	0.00053	
Wingspan	0.81 m	0.075	0.575	0.96	2.84	0.31	0.00234	2.84	0.31	0.00234	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.58	3.15	0.35	0.00433	3.15	0.35	0.00433	
		0.175	0.860	0.41	3.88	0.43	0.00746	3.88	0.43	0.00746	
Bird speed	5.5 m/sec	0.225	0.994	0.32	4.42	0.49	0.01095	4.42	0.49	0.01095	
Rotor Diam	120 m	0.275	0.947	0.26	4.23	0.47	0.01279	4.23	0.47	0.01279	
Rotation Period	4.96 sec	0.325	0.899	0.22	4.04	0.44	0.01442	4.04	0.44	0.01442	
		0.375	0.851	0.19	3.84	0.42	0.01584	3.84	0.42	0.01584	
		0.425	0.804	0.17	3.65	0.40	0.01705	3.65	0.40	0.01705	
		0.475	0.756	0.15	3.45	0.38	0.01804	3.45	0.38	0.01804	
Bird aspect ratio: $\beta$	0.47	0.525	0.708	0.14	3.26	0.36	0.01882	3.26	0.36	0.01882	
		0.575	0.660	0.13	3.07	0.34	0.01939	3.07	0.34	0.01939	
		0.625	0.613	0.12	2.87	0.32	0.01974	2.87	0.32	0.01974	
		0.675	0.565	0.11	2.68	0.29	0.01988	2.68	0.29	0.01988	
		0.725	0.517	0.10	2.48	0.27	0.01981	2.48	0.27	0.01981	
		0.775	0.470	0.09	2.29	0.25	0.01952	2.29	0.25	0.01952	
		0.825	0.422	0.09	2.10	0.23	0.01902	2.10	0.23	0.01902	
		0.875	0.374	0.08	1.90	0.21	0.01830	1.90	0.21	0.01830	
		0.925	0.327	0.08	1.71	0.19	0.01738	1.71	0.19	0.01738	
		0.975	0.279	0.07	1.51	0.17	0.01623	1.51	0.17	0.01623	
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>29.2%</b>	<b>Downwind</b>	<b>29.2%</b>		
								<b>Average</b>	<b>29.2%</b>		

**Collision Probability Calculation for White-winged Black Tern (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
							Upwind:		Downwind:		
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution			
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Pitch (degrees)	95										
Bird Length	0.23 m	0.025	0.575	2.26	2.70	0.51	0.00063	3.60	0.67	0.00084	
Wingspan	0.61 m	0.075	0.575	0.75	2.41	0.45	0.00339	2.71	0.51	0.00382	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.45	2.83	0.53	0.00665	3.05	0.57	0.00716	
		0.175	0.860	0.32	3.53	0.66	0.01159	3.72	0.70	0.01221	
Bird speed	4.8 m/sec	0.225	0.994	0.25	4.07	0.76	0.01717	4.24	0.80	0.01790	
Rotor Diam	90 m	0.275	0.947	0.21	3.90	0.73	0.02012	4.03	0.76	0.02081	
Rotation Period	3.33 sec	0.325	0.899	0.17	3.72	0.70	0.02271	3.83	0.72	0.02336	
		0.375	0.851	0.15	3.54	0.67	0.02494	3.63	0.68	0.02557	
		0.425	0.804	0.13	3.36	0.63	0.02683	3.44	0.65	0.02741	
		0.475	0.756	0.12	3.18	0.60	0.02836	3.24	0.61	0.02891	
Bird aspect ratio: $\beta$	0.38	0.525	0.708	0.11	3.00	0.56	0.02953	3.05	0.57	0.03005	
		0.575	0.660	0.10	2.81	0.53	0.03036	2.86	0.54	0.03084	
		0.625	0.613	0.09	2.63	0.49	0.03083	2.67	0.50	0.03128	
		0.675	0.565	0.08	2.44	0.46	0.03095	2.48	0.46	0.03136	
		0.725	0.517	0.08	2.26	0.42	0.03071	2.28	0.43	0.03109	
		0.775	0.470	0.07	2.07	0.39	0.03012	2.09	0.39	0.03047	
		0.825	0.422	0.07	1.88	0.35	0.02918	1.90	0.36	0.02949	
		0.875	0.374	0.06	1.70	0.32	0.02789	1.71	0.32	0.02816	
		0.925	0.327	0.06	1.51	0.28	0.02624	1.53	0.29	0.02648	
		0.975	0.279	0.06	1.32	0.25	0.02424	1.34	0.25	0.02444	
		<b>Overall p(collision)</b>									
		<b>=</b>				<b>Upwind</b>		<b>45.2%</b>		<b>Downwind</b>	
						<b>Average</b>		<b>45.7%</b>			

**Collision Probability Calculation for White-winged Black Tern (Scenario B)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
		Upwind:					Downwind:				
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	collide	contribution	
Max. Chord Width	4.067 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Pitch (degrees)	90										
Bird Length	0.23 m	0.025	0.575	2.53	3.32	0.42	0.00052	3.32	0.42	0.00052	
Wingspan	0.61 m	0.075	0.575	0.84	2.67	0.34	0.00252	2.67	0.34	0.00252	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.51	3.05	0.38	0.00480	3.05	0.38	0.00480	
		0.175	0.860	0.36	3.73	0.47	0.00822	3.73	0.47	0.00822	
Bird speed	4.8 m/sec	0.225	0.994	0.28	4.27	0.54	0.01212	4.27	0.54	0.01212	
Rotor Diam	120 m	0.275	0.947	0.23	4.08	0.51	0.01414	4.08	0.51	0.01414	
Rotation Period	4.96 sec	0.325	0.899	0.19	3.89	0.49	0.01591	3.89	0.49	0.01591	
		0.375	0.851	0.17	3.69	0.47	0.01745	3.69	0.47	0.01745	
		0.425	0.804	0.15	3.50	0.44	0.01873	3.50	0.44	0.01873	
		0.475	0.756	0.13	3.30	0.42	0.01978	3.30	0.42	0.01978	
Bird aspect ratio: $\beta$	0.38	0.525	0.708	0.12	3.11	0.39	0.02057	3.11	0.39	0.02057	
		0.575	0.660	0.11	2.92	0.37	0.02113	2.92	0.37	0.02113	
		0.625	0.613	0.10	2.72	0.34	0.02144	2.72	0.34	0.02144	
		0.675	0.565	0.09	2.53	0.32	0.02150	2.53	0.32	0.02150	
		0.725	0.517	0.09	2.33	0.29	0.02132	2.33	0.29	0.02132	
		0.775	0.470	0.08	2.14	0.27	0.02090	2.14	0.27	0.02090	
		0.825	0.422	0.08	1.95	0.25	0.02023	1.95	0.25	0.02023	
		0.875	0.374	0.07	1.75	0.22	0.01932	1.75	0.22	0.01932	
		0.925	0.327	0.07	1.56	0.20	0.01816	1.56	0.20	0.01816	
		0.975	0.279	0.06	1.36	0.17	0.01676	1.36	0.17	0.01676	
		<b>Overall p(collision)</b>				<b>Upwind</b>		<b>Downwind</b>			
		<b>=</b>				<b>31.6%</b>		<b>31.6%</b>			
						<b>Average</b>		<b>31.6%</b>			

**Collision Probability Calculation for Black-tailed Gull (Scenario A)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
		Upwind:					Downwind:				
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution	collide	contribution	collide	contribution	
Max. Chord Width	3.96 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Pitch (degrees)	95										
Bird Length	0.48 m	0.025	0.575	3.72	4.47	0.51	0.00064	5.94	0.68	0.00085	
Wingspan	1.24 m	0.075	0.575	1.24	3.00	0.34	0.00257	3.49	0.40	0.00299	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.74	3.17	0.36	0.00453	3.54	0.40	0.00504	
		0.175	0.860	0.53	3.65	0.42	0.00729	3.97	0.45	0.00792	
Bird speed	7.9 m/sec	0.225	0.994	0.41	4.11	0.47	0.01054	4.39	0.50	0.01127	
Rotor Diam	90 m	0.275	0.947	0.34	4.10	0.47	0.01287	4.33	0.49	0.01356	
Rotation Period	3.33 sec	0.325	0.899	0.29	3.94	0.45	0.01459	4.12	0.47	0.01525	
		0.375	0.851	0.25	3.77	0.43	0.01610	3.91	0.45	0.01673	
		0.425	0.804	0.22	3.59	0.41	0.01740	3.71	0.42	0.01798	
		0.475	0.756	0.20	3.41	0.39	0.01847	3.51	0.40	0.01903	
Bird aspect ratio: $\beta$	0.39	0.525	0.708	0.18	3.23	0.37	0.01934	3.32	0.38	0.01986	
		0.575	0.660	0.16	3.05	0.35	0.01999	3.12	0.36	0.02047	
		0.625	0.613	0.15	2.87	0.33	0.02043	2.93	0.33	0.02087	
		0.675	0.565	0.14	2.68	0.31	0.02065	2.74	0.31	0.02106	
		0.725	0.517	0.13	2.50	0.28	0.02065	2.54	0.29	0.02103	
		0.775	0.470	0.12	2.31	0.26	0.02044	2.35	0.27	0.02079	
		0.825	0.422	0.11	2.13	0.24	0.02002	2.16	0.25	0.02033	
		0.875	0.374	0.11	1.94	0.22	0.01938	1.97	0.22	0.01966	
		0.925	0.327	0.10	1.76	0.20	0.01853	1.78	0.20	0.01877	
		0.975	0.279	0.10	1.57	0.18	0.01747	1.59	0.18	0.01767	
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>30.2%</b>	<b>Downwind</b>	<b>31.1%</b>		
						<b>Average</b>	<b>30.7%</b>				

**Collision Probability Calculation for Black-tailed Gull (Scenario B)**

K: [1D or [3D] (0 or 1)	1	Calculation of alpha and p(collision) as a function of radius									
							Upwind:		Downwind:		
No of Blades	3	r/R	c/C	$\alpha$	collide	contribution		collide	contribution		
Max. Chord Width	4.067 m	radius	chord	alpha	length	p(collision)	from radius r	length	p(collision)	from radius r	
Pitch (degrees)	90										
Bird Length	0.48 m	0.025	0.575	4.16	5.62	0.43	0.00054	5.62	0.43	0.00054	
Wingspan	1.24 m	0.075	0.575	1.39	3.43	0.26	0.00197	3.43	0.26	0.00197	
F: Flapping (0) or gliding (+1)	1	0.125	0.702	0.83	3.51	0.27	0.00336	3.51	0.27	0.00336	
		0.175	0.860	0.59	3.97	0.30	0.00531	3.97	0.30	0.00531	
Bird speed	7.9 m/sec	0.225	0.994	0.46	4.41	0.34	0.00759	4.41	0.34	0.00759	
Rotor Diam	120 m	0.275	0.947	0.38	4.33	0.33	0.00912	4.33	0.33	0.00912	
Rotation Period	4.96 sec	0.325	0.899	0.32	4.14	0.32	0.01029	4.14	0.32	0.01029	
		0.375	0.851	0.28	3.94	0.30	0.01132	3.94	0.30	0.01132	
		0.425	0.804	0.24	3.75	0.29	0.01220	3.75	0.29	0.01220	
		0.475	0.756	0.22	3.55	0.27	0.01292	3.55	0.27	0.01292	
Bird aspect ratio: $\beta$	0.39	0.525	0.708	0.20	3.36	0.26	0.01351	3.36	0.26	0.01351	
		0.575	0.660	0.18	3.17	0.24	0.01394	3.17	0.24	0.01394	
		0.625	0.613	0.17	2.97	0.23	0.01422	2.97	0.23	0.01422	
		0.675	0.565	0.15	2.78	0.21	0.01436	2.78	0.21	0.01436	
		0.725	0.517	0.14	2.58	0.20	0.01434	2.58	0.20	0.01434	
		0.775	0.470	0.13	2.39	0.18	0.01418	2.39	0.18	0.01418	
		0.825	0.422	0.13	2.20	0.17	0.01387	2.20	0.17	0.01387	
		0.875	0.374	0.12	2.00	0.15	0.01341	2.00	0.15	0.01341	
		0.925	0.327	0.11	1.81	0.14	0.01280	1.81	0.14	0.01280	
		0.975	0.279	0.11	1.61	0.12	0.01205	1.61	0.12	0.01205	
<b>Overall p(collision) =</b>						<b>Upwind</b>	<b>21.1%</b>	<b>Downwind</b>	<b>21.1%</b>		
								<b>Average</b>	<b>21.1%</b>		