

Results of Simulations

Case 1 : No Development on the Khan or Swakop Rivers

Case 2: Von Bach and Swakoppoort Dams Exist

Case 3 : Von Bach and Swakoppoort Dams Exist plus KARS

APPENDIX E

Results of Analyses

Case 1 - Statistics	Sediment Transport Characteristics			
	Case 1 - Farm Zone - Swakopmund	Case 1 - Sediment Load - Swakop Delta : Average /	Case 1 - Silt Load : Swakop Delta: Average/yr	Case 1 - Proportion of Sediment load from Khan Af
Trials	200	200	200	200
Mean	76.21%	1.79	1.04	17.11
Median	76.77%	1.76	1.06	15.45
Mode	---	0.56	0.29	7.42
Standard Deviation	4.53%	0.31	0.09	55.06
Variance	0.21%	0.08	-0.07	0.86
Skewness	-0.78	1.90	1.83	2.95
Kurtosis	4.21	0.31	0.28	0.43
Coef. of Variability	0.06	2.93	1.58	40.03
Range Minimum	59.55%	2.19	1.15	34.34
Range Maximum	87.27%	0.04	0.02	0.52
Range Width	27.72%			
Mean Std. Error	0.32%			
Case 2 - Statistics	Case 2 - Farm Zone - Swakopmund	Case 2 - Sediment Load - Swakop Delta : Average /	Case 2 - Silt Load : Swakop Delta: Average/yr	Case 2 - Proportion of Sediment load from Khan Af
Trials	200	200	200	200
Mean	68.31%	1.09	0.33	25.70
Median	69.45%	1.05	0.24	25.45
Mode	---	0.30	0.21	9.92
Standard Deviation	7.28%	0.09	0.04	98.35
Variance	0.53%	0.05	0.61	0.37
Skewness	-0.39	1.96	2.01	2.67
Kurtosis	2.43	0.28	0.65	0.39
Coef. of Variability	0.11	0.46	0.07	7.57
Range Minimum	47.84%	1.80	0.83	53.20
Range Maximum	84.16%	1.34	0.76	45.62
Range Width	36.32%	0.02	0.01	0.70
Mean Std. Error	0.51%			
Case 3 - Statistics	Case 3 - Farm Zone - Swakopmund	Case 3 - Sediment Load - Swakop Delta : Average /	Case 3 - Silt Load : Swakop Delta: Average/yr	Case 3 - Proportion of Sediment load from Khan Af
Trials	200	200	200	200
Mean	67.12%	1.01	0.35	23.73
Median	67.90%	0.97	0.33	22.99
Mode	---	0.30	0.21	9.57
Standard Deviation	7.32%	0.09	0.04	91.50
Variance	0.54%	0.35	0.39	0.52
Skewness	-0.47	2.10	1.90	2.80
Kurtosis	3.05	0.29	0.60	0.40
Coef. of Variability	0.11	0.44	0.06	6.83
Range Minimum	43.53%	1.71	0.84	49.87
Range Maximum	81.53%	1.27	0.79	43.04
Range Width	38.00%	0.02	0.01	0.68
Mean Std. Error	0.52%			

Result of Simulations to Estimate the Effect of Removal of Exotic Species and/or Indigenous but Invasive Species.

*Both Simulations have been conducted for Case 1
20 % Reduction in the Evapotranspiration Rate Assumed*

Case 1: Full Evapotranspiration also

Statistics	Sdev : Depth WT : Mine Front	median : Depth WT : Mine Front	Average: TDS : Mine Front	Max : TDS : Mine Front	Min : TDS : Mine Front	Sdev: TDS : Mine Front	median: TDS : Mine Front	Max : TDS : Farms	Min : TDS : Farms
Trials	200	200	200	200	200	200	200	200	200
Mean	2.83	10.29	1 964.90	4 703.31	-1 416.60	1 459.79	2 239.62	68271	2373
Median	2.88	10.29	1 888.56	4 650.07	-1 349.35	1 480.92	2 162.72	61228	2363
Mode	---	10.29	---	---	---	---	---	---	---
Standard Deviation	0.23	0.00	414.44	708.07	502.16	214.32	579.76	72174	362
Variance	0.05	0.00	171 758.35	501 367.60	252 162.34	45 933.93	336 115.88	5209073452	131081
Skewness	-1.46	13.93	0.37	2.47	-0.73	0.34	4.37	4.37	0.00
Kurtosis	6.06	196.03	2.50	2.47	0.35	2.52	2.34	25.22	2.36
Coeff. of Variability	0.08	0.00	0.21	0.15	-0.35	0.15	0.26	1.06	0.15
Range Minimum	1.83	10.29	1 152.91	3 194.90	-3 272.58	905.76	1 105.50	9901	1450
Range Maximum	3.26	10.34	3 022.50	6 596.73	-476.37	1 962.71	3 868.08	551862	3169
Range Width	1.43	0.05	1 869.59	3 401.83	2 796.21	1 056.95	2 562.58	541961	1719
Mean Std. Error	0.02	0.00	29.31	50.07	35.51	15.15	40.99	5103.47	25.60

Statistics	Sdev : Depth WT : Mine Front	median : Depth WT : Mine Front	Average: TDS : Mine Front	Max : TDS : Mine Front	Min : TDS : Mine Front	Sdev: TDS : Mine Front	median: TDS : Mine Front	Max : TDS : Farms	Min : TDS : Farms
Trials	50	50	50	50	50	50	50	50	50
Mean	2.86	10.29	1 919.38	4 650.81	-1 360.91	1 433.39	2 145.97	23477	2242
Median	2.92	10.29	1 897.93	4 581.28	-1 144.27	1 410.73	2 055.76	12575	2221
Mode	---	10.29	---	---	---	---	---	---	---
Standard Deviation	0.21	0.00	381.52	783.82	624.59	236.90	526.45	20783	322
Variance	0.04	0.00	145 556.96	614 377.10	390 117.87	56 120.12	277 144.90	431931133	103653
Skewness	-0.72	0.00	0.61	0.22	-1.08	0.25	0.50	1.22	0.18
Kurtosis	2.40	+Infinity	3.49	2.36	3.05	2.37	2.51	2.95	2.29
Coeff. of Variability	0.07	0.00	0.20	0.17	-0.46	0.17	0.25	0.89	0.14
Range Minimum	2.38	10.29	1 224.68	3 196.24	-2 879.93	969.96	1 308.71	7570	1669
Range Maximum	3.15	10.29	3 071.25	6 443.62	-574.18	1 987.56	3 523.49	78404	2932
Range Width	0.77	0.00	1 846.56	3 247.38	2 305.75	1 017.60	2 214.78	70834	1263
Mean Std. Error	0.03	0.00	53.95	110.85	88.33	33.50	74.45	2939.15	45.53

Case 1: Analysis with 80% Evapot

Case 1: Full Evapotranspiration also

Statistics	Sdev: TDS : Farms	median : TDS : Farms	Amelb - Usakos	Usakos - Khan Dam	Khan Dam - Mine Front	Mine Front - Confluence	Swakoppoort- DorstRiver	DorstRiver- Confluence	Confluence - Farm Zone
Trials	200	200	200	200	200	200	200	200	200
Mean	12628	5558	95.07%	81.60%	27.54%	61.19%	50.95%	77.13%	76.59%
Median	11589	5285	95.66%	82.44%	27.56%	62.39%	50.97%	77.11%	76.91%
Mode	---	---	---	---	---	---	---	---	---
Standard Deviation	10725	1900	2.67%	3.16%	1.63%	5.29%	7.70%	4.73%	6.13%
Variance	115036035	3609613	0.07%	0.10%	0.03%	0.28%	0.59%	0.22%	0.38%
Skewness	3.31	3.87	-0.86	-1.40	-0.33	-1.12	-0.32	-0.39	-0.53
Kurtosis	20.76	33.31	2.92	6.53	3.37	4.17	3.12	3.11	2.94
Coeff. of Variability	0.85	0.34	0.03	0.04	0.06	0.09	0.15	0.06	0.08
Range Minimum	1323	2839	87.56%	64.93%	22.66%	42.26%	27.98%	60.59%	56.08%
Range Maximum	91117	22569	99.39%	87.06%	32.46%	71.69%	87.51%	86.42%	87.94%
Range Width	89794	19730	11.82%	22.15%	9.81%	29.43%	39.53%	25.83%	31.86%
Mean Std. Error	758.41	134.34	0.19%	0.22%	0.11%	0.37%	0.54%	0.33%	0.43%

Statistics	Sdev: TDS : Farms	median : TDS : Farms	Amelb - Usakos	Usakos - Khan Dam	Khan Dam - Mine Front	Mine Front - Confluence	Swakoppoort- DorstRiver	DorstRiver- Confluence	Confluence - Farm Zone
Trials	50	50	50	50	50	50	50	50	50
Mean	3879	4469	95.28%	82.29%	27.70%	62.13%	57.48%	80.71%	81.82%
Median	2259	4342	95.45%	83.07%	27.84%	62.57%	57.97%	80.74%	81.83%
Mode	---	---	---	---	---	---	---	---	---
Standard Deviation	3184	857	2.21%	2.67%	1.48%	3.98%	6.90%	3.38%	4.96%
Variance	10135327	734695	0.05%	0.07%	0.02%	0.16%	0.48%	0.11%	0.25%
Skewness	1.16	0.70	-0.93	-1.50	-0.24	-0.67	-0.57	-0.30	-0.27
Kurtosis	2.76	3.37	4.66	5.01	2.25	3.42	3.23	2.57	2.30
Coeff. of Variability	0.82	0.19	0.02	0.03	0.05	0.06	0.12	0.04	0.06
Range Minimum	1316	3164	87.56%	73.09%	24.81%	51.31%	38.04%	71.61%	71.33%
Range Maximum	12170	7166	99.52%	85.41%	30.46%	70.55%	70.99%	87.59%	80.61%
Range Width	10854	4002	11.96%	12.32%	5.65%	19.24%	32.95%	15.98%	19.28%
Mean Std. Error	450.23	121.22	0.31%	0.38%	0.21%	0.56%	0.98%	0.48%	0.70%

Case 1: Full Evapotranspiration also

Statistics	Farm Zone	Farm Zone - Swakopmund	Sediment Load - Swakop Delta : Average /	Silt Load : Swakop Delta: Average/yr	Proportion of Sediment load from Khan Af	Ameib - Usukos : Evapotranspiration	Usukos - Khan Dam : Evapotranspiration	Khan Dam - Mine Front : Evapotranspirati	Mine Front to Swakop Confluence : Evapot
Trials	200	200	200	200	200	200	200	200	200
Mean	49.40%	75.14%	1.14	0.35	22.06	0.72	1.06	0.06	0.47
Median	49.45%	75.89%	1.11	0.29	21.02	0.72	1.08	0.06	0.45
Mode	***	***	***	***	***	***	***	***	***
Standard Deviation	8.83%	6.77%	0.34	0.22	8.61	0.14	0.21	0.01	0.08
Variance	0.78%	0.46%	0.11	0.05	74.08	0.02	0.04	0.00	0.03
Skewness	-0.19	-0.38	0.14	0.51	0.35	0.04	-0.05	-0.07	-0.15
Kurtosis	2.56	2.64	2.07	1.96	2.39	1.75	1.86	1.82	2.16
Coeff. of Variability	0.18	0.09	0.30	0.64	0.39	0.19	0.20	0.20	0.19
Range Minimum	23.83%	54.61%	0.50	0.06	6.59	0.46	0.66	0.04	0.25
Range Maximum	68.24%	89.24%	1.88	0.86	43.32	0.97	1.45	0.09	0.61
Range Width	44.41%	34.63%	1.38	0.80	37.33	0.51	0.79	0.05	0.37
Mean Std. Error	0.62%	0.48%	0.02	0.02	0.61	0.01	0.01	0.00	0.01

Statistics	Farm Zone	Farm Zone - Swakopmund	Sediment Load - Swakop Delta : Average /	Silt Load : Swakop Delta: Average/yr	Proportion of Sediment load from Khan Af	Ameib - Usukos : Evapotranspiration	Usukos - Khan Dam : Evapotranspiration	Khan Dam - Mine Front : Evapotranspirati	Mine Front to Swakop Confluence : Evapot
Trials	50	50	50	50	50	50	50	50	50
Mean	55.95%	80.57%	1.24	0.40	19.61	0.70	0.84	0.05	0.33
Median	56.82%	80.93%	1.22	0.39	19.00	0.69	0.86	0.05	0.32
Mode	***	***	***	***	***	***	***	***	***
Standard Deviation	6.48%	4.73%	0.32	0.25	9.08	0.13	0.15	0.01	0.07
Variance	0.42%	0.22%	0.10	0.06	82.53	0.02	0.02	0.00	0.00
Skewness	0.13	-0.34	0.10	0.28	0.58	0.17	-0.07	-0.02	0.27
Kurtosis	2.18	2.64	2.29	1.57	2.70	2.10	2.00	2.34	1.51
Coeff. of Variability	0.12	0.06	0.26	0.63	0.46	0.18	0.18	0.15	0.21
Range Minimum	43.94%	69.83%	0.59	0.07	7.12	0.47	0.95	0.03	0.22
Range Maximum	70.50%	90.20%	1.85	0.86	44.94	0.94	1.12	0.06	0.45
Range Width	26.56%	20.37%	1.26	0.80	37.82	0.48	0.58	0.03	0.24
Mean Std. Error	0.92%	0.67%	0.05	0.04	1.28	0.02	0.02	0.00	0.01

Case 1: Full Evapotranspiration also

Statistics	Swakoppoort - DorstRivier : Evapotranspi	Dorstrivier - Confluence : Evapotranspira	Confluence- Farm Zone : Evapotranspirati	Farm Zone : Evapotranspiration	Ameib - Usukos : Base Flow	Usukos - Khan Dam : Base Flow	Khan Dam - Mine Front : Base Flow	Mine Front - Confluence : Base Flow	Swakoppoort - DorstRivier : Base Flow
Trials	200	200	200	200	200	200	200	200	200
Mean	5.06	6.40	3.49	1.54	0.39	0.39	0.21	0.43	0.24
Median	5.03	6.38	3.49	1.55	0.38	0.39	0.21	0.44	0.24
Mode	***	***	***	***	***	***	***	***	***
Standard Deviation	0.65	1.05	0.52	0.29	0.02	0.01	0.01	0.04	0.04
Variance	0.42	1.11	0.27	0.08	0.00	0.00	0.00	0.00	0.00
Skewness	0.04	0.00	0.14	0.14	-0.05	-0.19	-0.78	-1.18	-0.31
Kurtosis	2.04	1.86	2.13	2.68	2.55	2.55	4.15	4.33	3.12
Coeff. of Variability	0.13	0.16	0.15	0.19	0.06	0.04	0.04	0.08	0.15
Range Minimum	3.64	4.23	2.39	0.77	0.33	0.35	0.17	0.31	0.13
Range Maximum	6.38	8.33	4.77	2.28	0.43	0.42	0.23	0.50	0.31
Range Width	2.74	4.10	2.38	1.51	0.11	0.07	0.06	0.20	0.18
Mean Std. Error	0.05	0.07	0.04	0.02	0.00	0.00	0.00	0.00	0.00

Statistics	Swakoppoort - DorstRivier : Evapotranspi	Dorstrivier - Confluence : Evapotranspira	Confluence- Farm Zone : Evapotranspirati	Farm Zone : Evapotranspiration	Ameib - Usukos : Base Flow	Usukos - Khan Dam : Base Flow	Khan Dam - Mine Front : Base Flow	Mine Front - Confluence : Base Flow	Swakoppoort - DorstRivier : Base Flow
Trials	50	50	50	50	50	50	50	50	50
Mean	4.43	5.44	3.05	1.28	0.39	0.40	0.22	0.44	0.27
Median	4.45	5.58	3.11	1.27	0.39	0.40	0.22	0.45	0.27
Mode	***	***	***	***	***	***	***	***	***
Standard Deviation	0.59	0.84	0.44	0.25	0.02	0.01	0.01	0.03	0.03
Variance	0.34	0.71	0.19	0.06	0.00	0.00	0.00	0.00	0.00
Skewness	-0.33	-0.24	-0.24	-0.09	-0.01	-0.22	-0.91	-0.74	-0.57
Kurtosis	2.38	2.17	1.93	1.97	2.25	2.62	3.84	3.55	3.23
Coeff. of Variability	0.13	0.16	0.14	0.20	0.05	0.03	0.03	0.06	0.12
Range Minimum	2.84	3.69	2.22	0.73	0.35	0.36	0.19	0.37	0.18
Range Maximum	5.47	6.99	3.85	1.70	0.43	0.42	0.23	0.60	0.33
Range Width	2.63	3.30	1.64	0.97	0.08	0.06	0.04	0.13	0.15
Mean Std. Error	0.08	0.12	0.06	0.04	0.00	0.00	0.00	0.00	0.00

Case 1: Analysis with 80% Evapot

Case 1: Full Evapotranspiration also

Statistics	Dorstrivier- Confluence : Base Flow	Confluence- Farm Zone : Base Flow	Farm Zone : Base Flow	Ameib - Usukos : Recharge	Usukos - Khan Dam : Recharge	Khan Dam - Mine Front : Recharge	Mine Front to Swakop Confluence : Rechar	Swakoppoort - Dorstrivier : Recharge	Dorstrivier- Confluence : Recharge
Trials	200	200	200	200	200	200	200	200	200
Mean	1.10	1.87	1.25	0.08	0.89	0.63	0.81	4.23	7.73
Median	1.11	1.87	1.26	0.08	0.90	0.61	0.84	4.24	7.78
Mode	***	***	***	***	***	***	***	***	***
Standard Deviation	0.07	0.08	0.13	0.03	0.05	0.16	0.12	0.58	1.01
Variance	0.00	0.01	0.02	0.00	0.00	0.01	0.01	0.33	1.02
Skewness	-0.45	-0.56	-0.16	-0.38	-1.30	0.26	-0.66	-0.29	-0.10
Kurtosis	2.82	3.80	2.82	2.33	6.81	2.97	2.58	2.60	2.50
Coeff. of Variability	0.06	0.11	0.08	0.32	0.05	0.32	0.14	0.13	0.13
Range Minimum	0.91	1.58	0.87	0.02	0.64	0.23	0.45	2.55	4.46
Range Maximum	1.24	2.03	1.56	0.13	0.99	1.10	0.99	5.43	9.89
Range Width	0.33	0.45	0.68	0.11	0.35	0.87	0.53	2.89	5.43
Mean Std. Error	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.04	0.07

Statistics	Dorstrivier- Confluence : Base Flow	Confluence- Farm Zone : Base Flow	Farm Zone : Base Flow	Ameib - Usukos : Recharge	Usukos - Khan Dam : Recharge	Khan Dam - Mine Front : Recharge	Mine Front to Swakop Confluence : Recharge	Swakoppoort - Dorstrivier : Recharge	Dorstrivier- Confluence : Recharge
Trials	50	50	50	50	50	50	50	50	50
Mean	1.17	1.96	1.38	0.08	0.91	0.62	0.82	3.89	6.90
Median	1.17	1.96	1.38	0.08	0.91	0.63	0.86	3.88	6.97
Mode	***	***	***	***	***	***	***	***	***
Standard Deviation	0.05	0.06	0.10	0.03	0.05	0.13	0.10	0.53	0.83
Variance	0.00	0.00	0.01	0.00	0.00	0.02	0.01	0.28	0.69
Skewness	-0.39	-0.12	-0.11	-0.38	-1.24	0.00	-0.43	-0.51	-0.24
Kurtosis	3.60	2.83	1.97	2.81	4.94	2.28	2.06	3.13	2.36
Coeff. of Variability	0.05	0.03	0.07	0.31	0.05	0.22	0.12	0.14	0.12
Range Minimum	1.02	1.83	1.19	0.01	0.76	0.33	0.60	2.56	5.11
Range Maximum	1.29	2.08	1.56	0.13	0.99	0.87	1.00	4.95	8.48
Range Width	0.27	0.25	0.37	0.12	0.24	0.54	0.40	2.38	3.36
Mean Std. Error	0.01	0.01	0.01	0.00	0.01	0.02	0.01	0.07	0.12

Case 1: Full Evapotranspiration also

Statistics	Confluence- Farm Zone : Recharge	Farm Zone : Recharge	Khan Dam to Mine Front : Art Recharge	Ameib - Usukos : Boreholes	Usukos - Khan Dam : Boreholes	Khan Dam - Mine Front : Boreholes	Mine Front to Swakop Confluence : Boreho	Swakoppoort - Dorstrivier : Boreholes	Dorstrivier- Confluence : Boreholes
Trials	200	200	200	200	200	200	200	200	200
Mean	2.08	1.75	0.04	0.12	0.00	1.06	0.00	0.13	0.00
Median	2.04	1.71	0.01	0.12	0.00	1.04	0.00	0.13	0.00
Mode	***	***	0.00	0.12	0.00	***	0.00	0.15	0.00
Standard Deviation	0.48	0.42	0.09	0.00	0.00	0.16	0.00	0.02	0.00
Variance	0.23	0.18	0.01	0.00	0.00	0.02	0.00	0.00	0.00
Skewness	0.32	0.33	2.64	0.00	0.00	-0.10	0.00	-0.40	0.00
Kurtosis	2.62	2.82	9.65	+Infinity	+Infinity	2.81	+Infinity	2.72	+Infinity
Coeff. of Variability	0.23	0.24	1.91	0.00	0.00	0.15	+Infinity	0.17	+Infinity
Range Minimum	1.07	0.63	0.00	0.12	0.00	0.62	0.00	0.07	0.00
Range Maximum	3.34	2.94	0.43	0.12	0.00	1.46	0.00	0.17	0.00
Range Width	2.27	2.31	0.43	0.00	0.00	0.83	0.00	0.10	0.00
Mean Std. Error	0.03	0.03	0.01	0.00	0.00	0.01	0.00	0.00	0.00

Statistics	Confluence- Farm Zone : Recharge	Farm Zone : Recharge	Khan Dam to Mine Front : Art Recharge	Ameib - Usukos : Boreholes	Usukos - Khan Dam : Boreholes	Khan Dam - Mine Front : Boreholes	Mine Front to Swakop Confluence : Boreho	Swakoppoort - Dorstrivier : Boreholes	Dorstrivier- Confluence : Boreholes
Trials	50	50	50	50	50	50	50	50	50
Mean	1.64	1.64	0.07	0.12	0.00	1.07	0.00	0.15	0.00
Median	1.64	1.68	0.01	0.12	0.00	1.07	0.00	0.15	0.00
Mode	***	***	0.00	0.12	0.00	***	0.00	0.17	0.00
Standard Deviation	0.38	0.36	0.10	0.00	0.00	0.12	0.00	0.02	0.00
Variance	0.15	0.13	0.01	0.00	0.00	0.01	0.00	0.00	0.00
Skewness	0.04	-0.32	1.49	0.00	0.00	-0.32	0.00	-1.26	0.00
Kurtosis	2.24	2.18	3.90	+Infinity	+Infinity	2.22	+Infinity	4.46	+Infinity
Coeff. of Variability	0.23	0.22	1.45	0.00	0.00	0.11	+Infinity	0.12	+Infinity
Range Minimum	0.84	0.80	0.00	0.12	0.00	0.83	0.00	0.09	0.00
Range Maximum	2.48	2.32	0.34	0.12	0.00	1.27	0.00	0.17	0.00
Range Width	1.64	1.51	0.34	0.00	0.00	0.44	0.00	0.08	0.00
Mean Std. Error	0.05	0.05	0.01	0.00	0.00	0.02	0.00	0.00	0.00

Case 1: Full Evapotranspiration also

Statistics	Confluence. Farm Zone : Boreholes	Farm Zone : Boreholes
Trials	200	200
Mean	0.00	0.06
Median	0.00	0.06
Mode	0.00	0.06
Standard Deviation	0.00	0.02
Variance	0.00	0.00
Skewness	0.00	0.03
Kurtosis	+ Infinity	1.85
Coeff. of Variability	+ Infinity	0.35
Range Minimum	0.00	0.03
Range Maximum	0.00	0.09
Range Width	0.00	0.06
Mean Std. Error	0.00	0.00

Case 1: Analysis with 80% Evapot

Statistics	Confluence. Farm Zone : Boreholes	Farm Zone : Boreholes
Trials	50	50
Mean	0.00	0.07
Median	0.00	0.07
Mode	0.00	0.07
Standard Deviation	0.00	0.02
Variance	0.00	0.00
Skewness	0.00	-0.46
Kurtosis	+ Infinity	2.06
Coeff. of Variability	+ Infinity	0.28
Range Minimum	0.00	0.03
Range Maximum	0.00	0.09
Range Width	0.00	0.06
Mean Std. Error	0.00	0.00