

LAKE VERMILION METAL and ANION ANALYSES in Surface Water

METAL/ANION →			Al	As*	B	Ca	Chloride	Cd*	Co	Cu*	Fe	Hg*	K	Mg	Mn	Na	Ni*	Nitrates	P (TP)	Pb*	Sulphate
			ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	ng/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L
Ideal			<200	<340	< 0.5	< 20	<120	< 0.72	<1.8	< 1.3	< 1.0	< 144	< 164	< 1,000	< 0.05	< 250	< 52	< 10	< 0.0305	<0.065	< 600
			<10 drink						drink								continuous	drink		<0.015 drink	< 10 rice
LOCATION	Date	Collector																			
Pike Bay, sw Hoodoo Pt	8.18.1983	MPCA																<0.01	0.05		
Pike Bay, sw Hoodoo Pt	8.17.1993	MPCA																	0.059		
Big Bay, near Spider Island	2008	CLMP+																	20.0?		14.8
Trout Lake portage																					9.6
Frazer Bay, near 36 island																					12.7
Niles Bay, near Zups point																					12.5
Pike Bay							8.8												2.8?		10.6
Wakemup Bay, near Comet island																					6.8
unknown, by Gary Whitenack	5.30.14	VLA																			3.2 - 58.9
Big Bay, between Spider & Stonich	summer 2015	?																< 0.05	0.012		10.45 ave
Big Bay, between Spider & Stonich	5.08 - 9.15	?																			13.21 ave
Armstrong Bay	8.7.16	VLA ?				13.3															
Mud Creek Bay						13.0															
East Two Rivers/Tower harbor	7.31.17	VLA ?				26.9															
East Two Rivers/Tower harbor	8.16-10.16	NRRI				27.5 ave															
Hoodoo Pt						13.8															
West Two Rivers						19.0															
Pike Bay, sw Hoodoo Pt	7.7.15	MPCA																	0.023		
Cable Bay, east end	9.15.18	VLA				11.0															
East Two Rivers, Iron Ore bar bridge						28.5															
Pike River, above dam						15.9															
Pike River, below dam, under bridge						15.0															
Pike River, entering Pike Bay						15.9															
Stuntz Bay, north end						11.5															
Stuntz Bay, south end						11.1															
Trout River, as it empties into Vermilion						4.9															
West Two Rivers, south side of bridge						10.8															
Pike Bay, near Hoodoo, west of marked sunken island	7.1.19	MPCA																	0.023		10.9 ave
Pike Bay, east of Whiskey island	6.19 - 7.19	MPCA																	0.026		10.9 ave
Big Bay, nnnw of Storich & sw of Spider	6.19 - 7.19	MPCA																	0.017		9.5 ave
Wakemup Bay, ese Center island	6.19 - 7.19	MPCA																			3.85 ave

LAKE VERMILION METAL and ANION ANALYSES in Surface Water

METAL/ANION →		Zn*	Alkalinity	Chl-a	Coliform	DO	pH	Secchi	TDS	TSS	GPS Location
		mg/L	mg/L	mg/L	cfu	mg/L	pH	feet	mg/L	mg/L	
Ideal		< 0.12	> 5 (20-200 typical)	< 20	0 drink	> 5.5 fish	6.5 - 8.5	varies	< 500	< 1,200 drink	
LOCATION	Date										
Pike Bay, sw Hoodoo Pt	8.18.1983			0.016		7.5	7.3	2.10			
Pike Bay, sw Hoodoo Pt	8.17.1993			0.00256			7.36	1.3			
Big Bay, near Spider Island	2008		33?	6.8?			7.2	6.6		3.0	
Trout Lake portage											
Frazer Bay, near 36 island											
Niles Bay, near Zups point											
Pike Bay			21?	3.2?			6.8	1.1		3.1	
Wakemup Bay, near Comet island											
unknown, by Gary Whitenack	5.30.14										
Big Bay, between Spider & Stonich	summer 2015			9.52		0.59 ?				1.2	
Big Bay, between Spider & Stonich	5.08 - 9.15										
Armstrong Bay	8.7.16						7.8				
Mud Creek Bay							7.7				
East Two Rivers/Tower harbor	7.31.17										
East Two Rivers/Tower harbor	8.16-10.16										
Hoodoo Pt											
West Two Rivers											
Pike Bay, sw Hoodoo Pt	7.7.15					7.57	8.02	4			
Cable Bay, east end	9.15.18						7.8				
East Two Rivers, Iron Ore bar bridge							7.5				
Pike River, above dam							8.0				
Pike River, below dam, under bridge							7.9				
Pike River, entering Pike Bay							7.9				
Stuntz Bay, north end							7.7				
Stuntz Bay, south end							7.7				
Trout River, as it empties into Vermilion							7.4				
West Two Rivers, south side of bridge							7.1				
Pike Bay, near Hoodoo, west of marked sunken island	7.1.19					8.63		5			
Pike Bay, east of Whiskey island	6.19 - 7.19					7.26					
Big Bay, nnw of Storich & sw of Spide	6.19 - 7.19			3.6				7.5			
Wakemup Bay, ese Center island	6.19 - 7.19										

LAKE VERMILION METAL and ANION ANALYSES in Surface Water

METAL/ANION →			Al	As*	B	Ca	Chloride	Cd*	Co	Cu*	Fe	Hg*	K	Mg	Mn	Na	Ni*	Nitrates	P (TP)	Pb*	Sulphate
			ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	ng/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L
Ideal			<200	<340	< 0.5	< 20	<120	< 0.72	<1.8	< 1.3	< 1.0	< 144	< 164	< 1,000	< 0.05	< 250	< 52	< 10	< 0.0305	<0.065	< 600
			<10 drink						drink								continuous	drink		<0.015 drink	< 10 rice
LOCATION	Date	Collector																			
Big Bay, Spider Island, sw edge	8.3.20	DNR				11.6								5.68					0.023		12.1
Trout Lake portage, sw side						9.6								4.33					0.020		7.9
Frazer Bay, nw of Breezy Pt						10.4								4.75					0.020		9.2
Niles Bay, mid-bay						9.0								4.01					0.040		7.2
Wakemup Bay, nw of Center Island																			0.027		4.6
East Two Rivers, Tower harbor, southside dock	9.25.20	VLA				49.2															
East Two Rivers, Iron Ore bar bridge, west						49.5															
East Two Rivers, snowmobile bridge south of Mesabi trail						46.2															
Pike River, east Hwy 169 & Wahsten bridge	9.29.20	MPCA																			
Pike Bay, sw Hoodoo Pt	10.8.20	MPCA																			
East Two Rivers, Tower harbor, southside dock	10.19.20	VLA				32.8															
East Two Rivers, Iron Ore bar bridge, west side						31.7															
East Two Rivers, snowmobile bridge south of Mesabi trail						31.9															
East Two Rivers, snowmobile bridge Mesabi Tr/Junction Rd						31.2															
Soudan monument culvert,draining Soudan mine & local storm run-off						127.0															
Tower waste water pond #3						57.9															
(dry, but snowing)																					
East Two Rivers, Tower harbor, southside dock	4.12.21	VLA				13.7															
East Two Rivers, snowmobile bridge south of Mesabi trail						13.2															
East Two Rivers, snowmobile bridge Mesabi Tr/Junction Rd						13.5															
Soudan monument culvert,draining Soudan mine & local storm run-off						23.6															
Tower waste water pond #3						55.2															
(after sevral days rain & melting snow)																					
East Two Rivers, Tower harbor, southside dock	6.18.21	VLA				39.1															
East Two Rivers, snowmobile bridge south of Mesabi trail						42.9															
East Two Rivers, snowmobile bridge Mesabi Tr/Junction Rd						37.3															
Soudan monument culvert,draining Soudan mine & local storm run-off						242.0															
Tower waste water pond #3						57.8															
Pike River, entrance to Pike Bay						18.7															
East Two Rivers, Tower harbor, by culvert	8.4.21	VLA				38.2							0.88	4.68	.0540	11.6					
East Two Rivers, Your Boat Club dock						35.5															
East Two Rivers, midway between YBC & Pike Bay ent						22.7															
East Two Rivers, at Pike Bay entrance						16.9															
Big Bay, between Potato & Birch islands						11.4							1.36	5.48	0.041	4.73					
Wakemup Bay, Camp Vermilion dock						6.6							0.93	2.64	0.037	2.83					

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METAL/ANION →		Zn*	Alkalinity	Chl-a	Coliform	DO	pH	Secchi	TDS	TSS	GPS Location
		mg/L	mg/L	mg/L	cfu	mg/L	pH	feet	mg/L	mg/L	
Ideal		< 0.12	> 5 (20-200 typical)	< 20	0 drink	> 5.5 fish	6.5 - 8.5	varies	< 500	< 1,200 drink	
LOCATION	Date										
Big Bay, Spider Island, sw edge	8.3.20		43	0.0117			7.45	7.0	100		
Trout Lake portage, sw side			35	0.0131			7.39	6.0	82		
Frazer Bay, nw of Breezy Pt			38	0.0119			7.69	7.0	104		
Niles Bay, mid-bay			35	0.0196			7.77	6.0	76		
Wakemup Bay, nw of Center Island			26	0.0224				5.0	68		
East Two Rivers, Tower harbor, southside dock	9.25.20						7.7				
East Two Rivers, Iron Ore bar bridge, west							7.7				
East Two Rivers, snowmobile bridge south of Mesabi trail							7.7				
Pike River, east Hwy 169 & Wahsten bridge	9.29.20					7.37	7.62				
Pike Bay, sw Hoodoo Pt	10.8.20							5.0			
East Two Rivers, Tower harbor, southside dock	10.19.20						7.24				
East Two Rivers, Iron Ore bar bridge, west side							7.24				
East Two Rivers, snowmobile bridge south of Mesabi trail							7.34				
East Two Rivers, snowmobile bridge Mesabi Tr/Junction Rd							7.35				
Soudan monument culvert,draining Soudan mine & local storm ru							7.31				
Tower waste water pond #3 (dry, but snowing)							8.34				
East Two Rivers, Tower harbor, southside dock	4.12.21						6.98				
East Two Rivers, snowmobile bridge south of Mesabi trail							7.06				
East Two Rivers, snowmobile bridge Mesabi Tr/Junction Rd							7.23				
Soudan monument culvert,draining Soudan mine & local storm ru							8.17				
Tower waste water pond #3 (after sevral days rain & melting snow)							7.62				
East Two Rivers, Tower harbor, southside dock	6.18.21						7.9				
East Two Rivers, snowmobile bridge south of Mesabi trail							8.0				
East Two Rivers, snowmobile bridge Mesabi Tr/Junction Rd							7.7				
Soudan monument culvert,draining Soudan mine & local storm ru							7.8				
Tower waste water pond #3							8.2				
Pike River, entrance to Pike Bay							7.9				
East Two Rivers, Tower harbor, by culvert	8.4.21						?				
East Two Rivers, Your Boat Club dock							6.8				
East Two Rivers, midway between YBC & Pike Bay ent							7.0				
East Two Rivers, at Pike Bay entrance							6.9				
Big Bay, between Potato & Birch islands											
Wakemup Bay, Camp Vermilion dock											

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METAL/ANION →			Al	As*	B	Ca	Chloride	Cd*	Co	Cu*	Fe	Hg*	K	Mg	Mn	Na	Ni*	Nitrates	P (TP)	Pb*	Sulphate
			ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	ng/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L
Ideal			<200	<340	<0.5	<20	<120	<0.72	<1.8	<1.3	<1.0	<144	<164	<1,000	<0.05	<250	<52	<10	<0.0305	<0.065	<600
			<10 drink						drink								continuous	drink		<0.015 drink	<10 rice
LOCATION	Date	Collector																			
(drought conditions)																					
Soudan Mine, required by MPCA (March, June, Sept, Dec) (results averaged)	2021	Mine	7.55						0.685	6E-05	0.0155				3E-04						
(March, June, Sept)	2022		16.4			124 (9.4.22)			0.067	4E-05	0.0319				0.001						
Big Bay, near Spider Island	8.10.21	DNR				12.4								6.08							11.3
Trout Lake portage		(Sta. 1-5)				10.8								4.94							9.14
Frazer Bay, near 36 island						11.3								5.14							9.46
Niles Bay, near Zups point						9.7								4.26							7.45
Wakemup Bay, near Comet island						6.9								2.78							4.93
Lake Riley, Eden Prairie/Chanhassen for reference - one of worst AIS lakes in Twin Cities	8.9.21 - 10.25.21	MPCA					102 - 110														
E2 Rivers, east Tower harbor by culve	10.25.21	VLA				43.4					0.705	< 2.0	0.882	5.60	0.264	9.39		< 0.20	< 1.0		13.8
E2 Rivers by YourBoatClub (YBC) dock						41.7	30.9				0.662	< 2.0	1.15	5.31	0.302	8.8		< 0.20	< 1.0		12.9
Soudan Monument culvert						369.0	27.3				1.33	< 2.0	8.81	63.5	0.453	191		< 0.20	< 1.0		121.0
Pike River dam, under Hwy 77 bridge (water level up 8" from drought)						18.4	890				0.616	< 2.0	2.52	17.1	0.276	8.81		< 0.20	< 1.0		44.8
							18.5														
Soudan monument culvert, draining Soudan mine	5.11.22	VLA				61.7				0.43					0.14						
E2 River, Mesabi Tr west of Junction Rd		record high				14.7				<0.01					0.04						
E2 River, Tower harbor		water				15.7				<0.01					0.05						
E2 River, YBC dock		1359.66'				14.8				<0.01					0.05						
Pike River dam, under Hwy 77 bridge		(5.23.22)				6.5	5.3			<0.01					0.05						13.4
Tower waste water pond #3	6.29.22	VLA	50	<2.0	0.115	58.8	87.8	<0.0001	<0.50	<0.0050	0.319	1.03	6.13	8.44	0.208	53.6	<5.0	0.26	1.53	<0.0005	9.9
Soudan monument culvert, draining Soudan mine & local storm ru		water level	599	<2.0	<0.100	159.0	368.00	<0.0001	15.6	0.4660	1.64	57.2	5.52	31.7	0.284	72.4	36.6	0.650	0.012	0.000917	94.8
E2 River, Mesabi Tr west of Junction Rd		1358.35'	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
E2 River, Tower Harbor			50	<2.0	<0.100	24.8	7.38	<0.0001	<0.50	<0.0050	0.541	1.17	<0.50	2.82	0.11	4.34	<5.0	<0.03	0.214	<0.0005	1.9
E2 River, YBC dock			50	<2.0	<0.100	24.5	7.67	<0.0001	<0.50	<0.0050	0.565	0.99	<0.50	2.79	0.137	4.00	<5.0	<0.03	0.029	<0.0005	1.9
E2 River, entrance to Pike Bay			82	<2.0	<0.100	23.2	8.35	<0.0001	<0.50	<0.0050	0.727	1.67	<0.50	3.49	0.139	4.61	<5.0	<0.03	0.033	<0.0005	3.2
W2 River, near Hwy 169 bridge			103	<2.0	<0.100	19.8	6.74	<0.0001	<0.50	<0.0050	1.90	3.71	3.21	2.05	0.133	3.21	<5.0	0.04	0.035	<0.0005	3.0
Pike River, below dam under Hwy 77 bridge			182	<2.0	<0.100	15.3	16	<0.0001	0.70	<0.0050	3.25	5.19	2.03	14.9	0.360	9.80	<5.0	0.08	0.047	<0.0005	18.9
Stuntz Bay			<50	<2.0	<0.100	11.2	8.85	<0.0001	<0.50	<0.0050	0.138	1.42	1.15	5.26	0.042	5.35	<5.0	<0.03	0.023	<0.0005	13.3
Cable Bay			<50	<2.0	<0.100	12.7	8.89	<0.0001	<0.50	<0.0050	0.134	1.37	1.25	5.81	0.028	5.76	<5.0	<0.03	0.027	<0.0005	13.5
Big Bay, near Spider Island "hole"			<50	<2.0	<0.100	9.5	8.87	<0.0001	<0.50	<0.0050	<0.100	1.23	1.25	4.08	0.013	5.76	<5.0	<0.03	0.027	<0.0005	13.5
Trout River, as it empties into Ver.			<50	<2.0	<0.100	3.9	3.85	<0.0001	<0.50	<0.0050	<0.100	1.06	0.82	2.99	<0.010	3.22	<5.0	<0.03	0.013	<0.0005	6.4
Frazer Bay, nw Breezy Pt			<50	<2.0	<0.100	9.7	7.54	<0.0001	<0.50	<0.0050	<0.100	0.74	0.98	3.1	<0.010	3.29	<5.0	<0.03	0.015	<0.0005	10.8
Niles Bay, mid bay			<50	<2.0	<0.100	11.5	6.91	<0.0001	<0.50	<0.0050	<0.100	0.66	0.99	5.41	0.011	4.39	<5.0	<0.03	0.015	<0.0005	8.5
Wakemup Bay, nw of Center Island			<50	<2.0	<0.100	6.5	4.53	<0.0001	<0.50	<0.0050	<0.100	0.63	0.91	2.59	<0.010	3.30	<5.0	<0.03	0.014	<0.0005	4.0
Black Bay, mid bay			234	<2.0	<0.100	3.5	2.34	<0.0001	<0.50	<0.0050	0.765	4.48	0.85	1.27	0.045	2.20	<5.0	<0.03	0.082	<0.0005	1.4

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METAL/ANION →		Zn*	Alkalinity	Chl-a	Coliform	DO	pH	Secchi	TDS	TSS	GPS Location
		mg/L	mg/L	mg/L	cfu	mg/L	pH	feet	mg/L	mg/L	
Ideal		< 0.12	> 5 (20-200 typical)	< 20	0 drink	> 5.5 fish	6.5 - 8.5	varies	< 500	< 1,200 drink	
LOCATION	Date										
(drought conditions)											
Soudan Mine, required by MPCA (March, June, Sept, Dec) (results averaged)	2021						7.2			0.5	47.81.09N, 92.73.67W?
(March, June, Sept)	2022						7.22			7.22	
Big Bay, near Spider Island	8.10.21		42	19.9			8.00		132		
Trout Lake portage			37	12.7			8.25		90		
Frazer Bay, near 36 island			38	15.6			8.14		88		
Niles Bay, near Zups point			33	17.6			7.83		76		
Wakemup Bay, near Comet island			24	13.4			7.64		56		
Lake Riley, Eden Prairie/Chanhassen for reference - one of worst AIS lakes in Twin Cities	8.9.21 - 10.25.21					0.62	7.1 - 8.03	4.9	391		
E2 Rivers, east Tower harbor by culve	10.25.21						6.6				
E2 Rivers by YourBoatClub (YBC) dock							6.7				
Soudan Monument culvert							7.1				
Pike River dam, under Hwy 77 bridge (water level up 8" from drought)							6.8				
Soudan monument culvert, draining Soudan mine	5.11.22						8.9				
E2 River, Mesabi Tr west of Junction Rd							8.1				
E2 River, Tower harbor							7.7				
E2 River, YBC dock							7.7				
Pike River dam, under Hwy 77 bridge											
Tower waste water pond #3	6.29.22	<0.0200	167	NA			7.6	x	344	< 2.0	47.48.50N, 92.15.25W
Soudan monument culvert, draining Soudan mine & local stom ru		0.0433	74	NA			7.6	NA	1110	12.2	47.48.49N, 92.14.26W
E2 River, Mesabi Tr west of Junction Rd		x	x	x	x	x	x	x	x	x	x
E2 River, Tower Harbor		<0.0200	81	< 1.67			7.5	7.5	118	< 1.4	47.48.14 N, 92.16.52W
E2 River, YBC dock		<0.0200	10	< 1.25			7.4	B	120	< 1.4	47.48.19 N, 92.17.18W
E2 River, entrance to Pike Bay		<0.0200	68	6.01	Pike Bay		6.6	4.5	108	2.6	47.45.29 N, 92.17.39W
W2 River, near Hwy 169 bridge		<0.0200	56	NA			6.4	NA	132	2.2	47.45.29 N, 92.17.39W
Pike River, below dam under Hwy 77 bridge		<0.0200	74	NA			7.5	NA	210	2.8	47.45.29 N, 92.17.39W
Stuntz Bay		<0.0200	43	10.7			7.5	5.0	96	2.8	47.49.51N, 92.14.32W
Cable Bay		<0.0200	43	7.68			7.4	6.0	98	1.9	47.50.45N, 92.12.03W
Big Bay, near Spider Island "hole"		<0.0200	37	6.69			7.4	7.5	94	< 1.4	47.52.00N, 92.17.28W
Trout River, as it empties into Ver.		<0.0200	31	7.34			6.8	13.0	50	< 2.0	47.54.51N, 92.19.34W
Frazer Bay, nw Breezy Pt		<0.0200	56	8.01			7.6	9.0	82	< 2.0	? N, 92.27.24W
Niles Bay, mid bay		<0.0200	43	7.48			7.4	8.5	66	< 2.0	47.53.32N, 92.30.32W
Wakemup Bay, nw of Center Island		<0.0200	31	3.34			6.8	12.0	50	< 1.4	47.55.23N, 92.36.49W
Black Bay, mid bay		<0.0200	25	6.94			6.2	2.0	68	< 1.4	47.57.30N, 92.28.28W

LAKE VERMILION METAL and ANION ANALYSES in Surface Water

METAL/ANION →			Al	As*	B	Ca	Chloride	Cd*	Co	Cu*	Fe	Hg*	K	Mg	Mn	Na	Ni*	Nitrates	P (TP)	Pb*	Sulphate	
			ug/L	ug/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	ng/L	mg/L	mg/L	mg/L	mg/L	ug/L	mg/L	mg/L	mg/L	mg/L	
Ideal			<200	<340	< 0.5	< 20	<120	< 0.72	<1.8	< 1.3	< 1.0	< 144	< 164	< 1,000	< 0.05	< 250	< 52	< 10	< 0.0305	<0.065	< 600	
			<10 drink						drink								continuous	drink		<0.015 drink	< 10 rice	
LOCATION	Date	Collector																				
Wolf Bay, near Vermilion dam			< 50	< 2.0	<0.100	9.8	7.03	<0.0001	< 0.50	<0.0050	<0.100	0.58	1.01	4.28	0.017	4.55	< 5.0	< 0.03	0.017	<0.0005	8.9	
Soudan Monument culvert	9.13.2022	VLA				327.0	860.0			0.4	4.52										105.0	
E2 River, Tower Harbor		water level				32.1	19.9			< 0.01	0.50											1.8
E2 River, YBC dock		1357.31'				32.0	15.1			< 0.01	0.43											1.9
E2 River, entrance to Pike Bay						19.0	12.9			< 0.01	0.93											9.2
Pike River, below dam under Hwy 77 bridge											3.14											17.1
Pike River, entrance to Pike Bay											2.50											15.4
Stuntz Bay						12.0																
Cable Bay						12.0																

