

Supplementary Materials: Assessment of Miscanthus Yield Potential from Strip-Mined Lands (SML) and Its Impacts on Stream Water Quality

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The table S1 and table S2 show the inventory of surface mined lands under permit for mining activities and various stages of post-mining activities in the U.S. and the state of Ohio respectively from 1977 to 2012. The compiled data presented in these two tables were acquired from annual reports published by Office of Surface Mining Reclamation and Enforcement (OSMRE) until 2012 (<https://www.osmre.gov/resources/annualReports.shtm>). For the state of Ohio, the SML inventory data from 2013 to 2015 were acquired from Ohio Department of Natural Resources (ODNR) (<http://minerals.ohiodnr.gov/portals/minerals/pdf/coal/>).

Table S1. Strip-mined lands stocks in the US from 1977 to 2012.

Year	Annual Stock of New Permits Issued (ha)	Annual Stock of Permit (ha)	Land Area under Phase I (ha)	Land Area under Phase II (ha)	Land Area under Phase III (ha)/Released Strip-Mined Lands (ha)
2012	72,642	1,892,077	17,188	12,021	18,213
2011	64,011	1,875,923	18,363	13,149	14,305
2010	70,794	1,831,324	24,654	20,340	20,336
2009	86,185	1,784,955	20,961	17,045	15,511
2008	61,827	1,803,085	22,019	14,300	19,768
2007	85,674	1,870,753	24,811	19,803	20,690
2006	77,586	1,785,923	20,209	16,981	20,031
2005	32,619	1,747,944	22,422	12,717	21,247
2004	47,289	1,733,788	21,228	15,225	20,277
2003	46,038	3,188,726	22,765	20,230	24,551
2002	46,934	2,358,606	22,005	20,965	29,719
2001	44,014	1,778,098	30,434	33,243	33,139
2000	30,750	NA	22,653	18,561	25,535
1999	22,559	1,911,904	20,448	21,188	29,453
1998	35,058	1,800,923	30,232	28,885	34,977
1997	46,136	1,679,964	4769	NA	32,910
1996	54,008	2,016,641	19,745	NA	19,745
1995	59,102	2,081,811	26,244	NA	26,244

1994	55,138	2,705,962	26,123	NA	26,123
1993	25,136	NA	406,848	NA	406,848
1977–1992	NA	NA	NA	NA	37,113
Total released strip-mined lands (Post-SMCRA law, 1977 till 2012)					896,736.44

Table S2. Strip-mined lands stocks in the state of Ohio from 1977 to 2012.

Year	Annual Stock of New Permit Issued (ha)	Surface Mining Permit in a Year (ha)	Total Area Disturbed (ha)	Area under Phase I (ha)	Area under Phase II (ha)	Area under Phase III/Released Strip-Mined Lands (ha)
2015	825	29,387	23,264	906	1609	1414
2014	1939	30,720	23,930	1262	2288	1521
2013	1593	29,568	24,616	2860	1490	1738
2012	1427	32,428	24,653	927	715	1036
2011	913	33,883	20,758	803	1215	1183
2010	1246	34,591	20,758	1054	879	1432
2009	1038	36,923	20,916	861	747	1130
2008	2432	38,984	20,909	1447	1077	1085
2007	2899	38,587	20,952	1078	1244	1402
2006	2038	37,401	20,462	1136	1785	1490
2005	1047	36,785	19,677	1512	1047	1134
2004	2115	37,247	NA	922	1020	2073
2003	885	37,162	NA	1486	896	1730
2002	1684	35,142	NA	1440	1495	2384
2001	3259	40,445	NA	2793	3121	3302
2000	3134	43,603	31,666	1111	1262	3062
1999	13,372	50,040	32,345	1781	2694	2093
1998	6181	50,810	32,018	2650	3672	2339
1997	3749	54,939	37,827	2111	3192	4261
1996	3050	54,992	37,004	1176	789	946
1995	5885	67,652	NA	NA	NA	3304
1994	5130	61,538	NA	NA	NA	3289
1993	2575	NA	NA	2645	4677	2632
1977–1992	NA	NA	NA	NA	NA	2718
Annual Average	2975	41,492	25,735	1522	1758	2029
Total released strip-mined lands (Post-SMCRA law, 1977)					48,700	

Table S3. SWAT management inputs for annual and perennial crops.

Crop Rotations	Year No	Date	Operations	Inputs	Crop Type
Corn-soybean crop rotation (annual)	1	15 April	Primary tillage (chisel plow)		Corn
	1	22 April	Fertilizer application	212 kg ha ⁻¹ , anhydrous ammonia	Corn
	1	24 April	Fertilizer application	67 kg ha ⁻¹ , P ₂ O ₅	Corn
	1	2 May	Pesticide application	2.2 kg ha ⁻¹ , Atrazine	Corn

Miscanthus (perennial)	1	5 May	Secondary tillage (offset disk plow)		Corn
	1	5 May	Planting		Corn
	1	14 October	Harvest		Corn
	2	10 May	Fertilizer application	56 kg ha ⁻¹ , P ₂ O ₅	Soybean
	2	7 October	Harvest		Soybean
	2	1 November	Primary tillage (chisel plow)		Soybean
	1	21 March	Herbicide application	3.5 kg ha ⁻¹ , Glyphosate	Miscanthus
	1	28 March	Primary tillage (Mould board plow)		Miscanthus
	1	30 March	Fertilizer application	115 kg ha ⁻¹ , urea	Miscanthus
	1	31 October	Harvest		Miscanthus
	2 to 20	15 April	Fertilizer application	*0/100/200 kg ha ⁻¹ , urea and 75 kg ha ⁻¹ , P ₂ O ₅	Miscanthus
	2 to 20	31 October	Harvest		Miscanthus

* Miscanthus yield was simulated with 3 levels of nitrogen applications: No nitrogen, 100 kg ha⁻¹ and 200 kg ha⁻¹.

Table S4. Stream-flow, nitrogen and sediment parameters and minimum, and maximum values used for calibration period using the SWAT-CUP.

Parameter	Method†	Min. value	Max. value	Parameter	Method†	Min. value	Max. value
<i>Flow parameters</i>				<i>Nitrate (NO₃-N) parameters</i>			
CN2.mgt	r	-0.2	0.2	RCN.bsn	v	0	15
SFTMP.bsn	v	-20	20	NPERCO.bsn	v	0	1
SURLAG.bsn	v	0.05	24	CDN.bsn	v	0	3
SMTMP.bsn	v	-20	20	SDNCO.bsn	v	0	1
TIMP.bsn	v	0.01	1	SHALLST_N.gw	v	0	1000
ESCO.bsn	v	0	1	N_UPDIS.bsn	v	0	100
EPCO.bsn	v	0	1	BC2_BSN.bsn	v	0.2	2
SMFMX.bsn	v	0	20	BC3_BSN.bsn	v	0.02	0.4
SMFMN.bsn	v	0	20	TRNSRCH.bsn	v	0	1
CH_N2.rte	v	0	0.3	RS3.swq	v	0	1
CH_N1.sub	v	0	0.5	HLIFE_NGW.gw	v	0	200
CH_K2.rte	v	0	130	HLIFE_NGW_BSN.bsn	v	0	500
CH_K1.sub	v	0	300	CMN.bsn	v	0.001	0.003
ALPHA_BF.gw	v	0	1	BC1.swq	v	0.1	1
GW_DELAY.gw	v	0	500	BC2.swq	v	0.2	2
GWQMN.gw	v	0	2000	BC3.swq	v	0.02	0.4
GW_REVAP.gw	v	0	0.2	Parameter	Method†	Min. value	Max. value
GW_SPYLD.gw	v	0	0.4	<i>Sediment and Phosphorous parameters</i>			
RCHRG_DP.gw	v	0	0.2	USLE_P.mgt	v	0	1
REVAPMN.gw	v	0	500	SPEXP.bsn	v	1	1.5
ALPHA_BNK.rte	v	0	1	SPCON.bsn	v	0.0001	0.01

ALPHA_BF.gw	r	-0.1	0.1	CH_COV1.rte	v	-0.05	0.6
SOL_AWC().sol	r	-0.2	0.4	CH_COV2.rte	v	-0.001	1
SOL_K().sol	r	-0.8	0.8	LAT_SED.hru	v	0	5000
SOL_BD(1).sol	r	-0.5	0.6	SLSOIL.hru	v	0	150
SNOCOVMX.bsn	v	0	500	USLE_P.mgt	r	-0.6	-0.1
				USLE_K().sol	v	0	0.65
				PRF_BSN.bsn	v	0	2
				PSP.bsn	v	0.01	0.7
				PHOSKD.bsn	v	100	200
				PPERCO.bsn	v	10	17.5
				ERORGP.hru	v	0	5

tr means the existing parameter value is multiplied by (1 + a given value) and v means the existing parameter value is replaced by a given value.

Table S5. SWAT input parameters included in the calibration process and their calibrated values and sensitivity statistics.

Variables	Parameters	Range	Calibrated Values	t-Stat	p-Value
	r_CN2.mgt	-0.2–0.2	-0.19	-19.91	0
	r_SOL_AWC().sol	-0.2–0.4	0.28	-13.54	0
	v_ALPHA_BNK.rte	0–1	0.57	-9.17	0
Flow	v_CH_K2.rte	0–130	55.34	32.68	0
	v_CH_N1.sub	0–0.5	0.11	25.53	0
	v_CH_N2.rte	0–0.3	0.10	39.37	0
	v_GW_REVAP.gw	0–0.2	0.19	-3.98	0
	v_RCHRG_DP.gw	0–0.2	0.01	-8.95	0
	v_SFTMP.bsn	-20–20	-11.40	-18.17	0
		v_ESCO.bsn	0–1	0.84	-2.76
Nitrate	v_NPERCO.bsn	0–1	0.87	-1.81	0.07
	v_RS3.swq	0–1	0.58	-1.40	0.161
	v_NPERCO.bsn	0–1	0.86	-1.81	0.07
	v_CDN.bsn	0–3	1.02	0.94	0.34
	v_SMFMN.bsn	0–20	12.75	-1.23	0.21
	v_SDNCO.bsn	0–1	0.87	1.11	0.26
	v_TRNSRCH.bsn	0–1	0.54	-6.38	0
Sediment	v_GW_REVAP.gw	0–0.2	0.19	2.95	0.003
	v_LAT_SED.hru	0–5000	9.49	-66.6	0
	v_SNOCOVMX.bsn	0–500	255.63	2.42	0.015
	v_USLE_K().sol	0–0.65	0.05	-7.58	0