

*Supplementary Information***The Hydro-Economic Interdependency of Cities: Virtual Water Connections of the Phoenix, Arizona Metropolitan Area.
Sustainability 2015, 7, 8522-8547****Richard R. Rushforth [†] and Benjamin L. Ruddell ^{†,*}**

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Table S1. Distances between PMA municipalities (km).

	Anthem	Apache Junction	Avondale	Buckeye	Cave Creek	Chandler	Gilbert	Glendale	Goodyear	Litchfield Park	Maricopa	Mesa	New River	Paradise Valley	Peoria	Phoenix	Queen Creek	San Tan Valley	Scottsdale	Sun Municipality	Sun Municipality West	Surprise	Tempe	Tolleson	Wickenburg
Anthem	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Apache Junction	105	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Avondale	67	86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Buckeye	90	114	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cave Creek	28	91	72	101	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chandler	87	42	64	93	69	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Gilbert	85	29	64	93	67	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Glendale	44	72	27	54	50	51	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Goodyear	68	86	0	24	74	66	66	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Litchfield Park	62	88	8	30	67	67	67	24	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maricopa	105	78	85	112	99	40	51	72	85	88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mesa	77	32	56	85	58	13	11	45	58	59	56	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New River	10	114	74	90	35	93	91	51	75	69	112	82	-	-	-	-	-	-	-	-	-	-	-	-	-
Paradise Valley	55	56	50	78	37	35	35	24	51	53	62	24	62	-	-	-	-	-	-	-	-	-	-	-	-
Peoria	44	78	26	54	50	58	58	6	27	21	78	50	51	51	-	-	-	-	-	-	-	-	-	-	-
Phoenix	8	56	29	58	51	35	35	16	30	32	56	30	58	58	22	-	-	-	-	-	-	-	-	-	-
Queen Creek	111	32	82	109	85	18	16	69	82	85	48	29	109	109	74	53	-	-	-	-	-	-	-	-	-
San Tan Valley	122	30	101	130	106	35	38	90	102	104	61	48	130	130	94	72	21	-	-	-	-	-	-	-	-
Scottsdale	65	48	45	74	46	29	29	34	46	48	58	18	72	8	38	21	46	67	-	-	-	-	-	-	-
Sun Municipality	43	93	26	54	48	72	70	11	27	22	91	62	50	50	3	35	88	110	53	-	-	-	-	-	-
Sun Municipality West	42	106	27	51	54	85	83	24	29	22	104	80	42	42	18	50	101	123	69	13	-	-	-	-	-
Surprise	53	102	22	46	54	82	82	21	22	16	101	72	48	48	14	46	98	120	69	10	8	-	-	-	-
Tempe	64	43	43	70	54	22	22	30	45	46	48	11	70	70	37	18	38	61	10	50	62	61	-	-	-
Tolleson	60	77	10	34	66	56	54	18	11	16	75	46	67	67	19	21	72	94	37	19	32	30	34	-	-
Wickenburg	72	160	80	93	85	139	139	72	78	72	160	130	72	72	64	104	155	178	122	61	53	54	117	86	-

Table S2. Virtual water flow associated with labor between cities ($V_{L,n \rightarrow m}$) (Million Cubic Meters, Mm^3).

	Anthem	Apache Junction	Avondale	Buckeye	Cave Creek	Chandler	Gilbert	Glendale	Goodyear	Litchfield Park	Maricopa	Mesa	New River	Paradise Valley	Peoria	Phoenix	Queen Creek	San Tan Valley	Scottsdale	Sun Municipality	Sun Municipality	Surprise	Tempe	Tolleson	Wickenburg
Anthem	0.32	0.00	0.01	0.00	0.01	0.05	0.04	0.04	0.01	0.00	0.00	0.08	0.95	0.01	0.57	0.67	0.00	0.00	0.15	0.10	0.01	0.01	0.07	0.00	0.00
Apache Junction	0.00	0.38	0.01	0.00	0.00	0.44	0.32	0.07	0.01	0.00	0.00	0.37	0.00	0.02	0.03	1.12	0.02	0.68	0.28	0.00	0.00	0.02	0.15	0.00	0.00
Avondale	0.01	0.00	0.64	0.23	0.00	0.16	0.13	0.54	0.37	0.00	0.00	0.30	0.00	0.04	0.77	2.35	0.00	0.01	0.60	0.13	0.04	0.39	0.32	0.00	0.00
Buckeye	0.00	0.00	0.06	0.32	0.00	0.11	0.09	0.10	0.25	0.00	0.00	0.20	0.00	0.03	0.04	1.59	0.00	0.01	0.36	0.01	0.00	0.57	0.17	0.00	0.00
Cave Creek	0.00	0.00	0.00	0.00	0.11	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.15	0.00	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.00
Chandler	0.02	0.03	0.08	0.01	0.01	6.34	2.29	0.48	0.06	0.00	0.11	2.46	0.01	0.04	0.20	7.28	0.28	0.36	2.36	0.03	0.00	0.11	0.59	0.01	0.00
Gilbert	0.02	0.18	0.07	0.01	0.00	0.92	3.89	0.43	0.06	0.00	0.01	2.17	0.01	0.04	0.18	1.07	0.79	0.31	2.09	0.02	0.00	0.10	2.89	0.01	0.00
Glendale	0.05	0.01	0.29	0.01	0.01	0.48	0.39	4.17	0.09	0.00	0.01	1.53	0.01	0.64	0.71	6.99	0.02	0.03	0.25	0.41	0.08	1.16	1.97	0.03	0.00
Goodyear	0.01	0.00	0.10	0.31	0.00	0.14	0.11	0.46	0.76	0.00	0.00	0.25	0.00	0.04	0.66	1.92	0.00	0.01	0.52	0.11	0.04	0.34	0.28	0.06	0.00
Litchfield Park	0.00	0.00	0.01	0.03	0.00	0.01	0.01	0.02	0.03	0.00	0.00	0.02	0.00	0.00	0.31	0.03	0.00	0.00	0.04	0.16	0.00	0.03	0.02	0.00	0.00
Maricopa	0.00	0.00	0.01	0.00	0.00	0.54	0.08	0.09	0.01	0.00	0.33	0.17	0.00	0.02	0.04	1.36	0.00	0.01	0.31	0.00	0.00	0.02	0.14	0.00	0.00
Mesa	0.04	1.14	0.15	0.02	0.01	1.94	4.26	0.80	0.12	0.00	0.02	13.4	0.02	0.98	0.37	12.9	0.27	0.06	6.43	0.05	0.01	0.21	3.33	0.01	0.00
New River	0.91	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.00	0.00	0.00	0.06	0.30	0.01	0.01	0.47	0.00	0.00	0.11	0.00	0.01	0.00	0.05	0.00	0.00
Paradise Valley	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.09	0.00	0.00	0.00	0.33	0.00	0.80	0.01	0.40	0.00	0.00	0.12	0.01	0.01	0.00	0.04	0.00	0.00
Peoria	0.03	0.01	0.19	0.01	0.00	0.32	0.27	0.48	0.06	0.00	0.01	0.60	0.01	0.09	2.30	4.75	0.01	0.02	0.17	0.25	0.05	1.72	0.08	0.02	0.00
Phoenix	0.64	0.09	2.14	0.05	0.49	6.38	1.35	4.51	0.54	0.00	0.08	5.55	0.06	2.27	4.54	69.3	0.10	0.21	13.7	0.13	0.02	0.40	3.62	0.09	0.03
Queen Creek	0.00	0.02	0.01	0.00	0.00	3.56	0.26	0.05	0.01	0.00	0.00	0.10	0.00	0.01	0.02	0.82	0.32	0.99	0.21	0.00	0.00	0.01	0.01	0.00	0.00
San Tan Valley	0.01	0.07	0.03	0.00	0.00	0.06	0.08	0.17	0.02	0.00	0.00	0.32	0.00	0.05	0.07	2.54	0.10	0.64	0.58	0.01	0.00	0.04	0.26	0.00	0.00
Scottsdale	0.02	0.03	0.13	0.01	0.03	2.52	1.96	0.15	0.10	0.00	0.01	5.63	0.01	0.34	0.10	6.71	0.09	0.03	16.0	0.02	0.00	0.10	0.54	0.00	0.00
Sun City	0.01	0.00	0.05	0.00	0.00	0.08	0.07	3.38	0.01	0.00	0.00	0.15	0.00	0.03	0.12	0.19	0.00	0.00	0.27	0.50	0.06	0.42	0.12	0.00	0.00
Sun City West	0.00	0.00	0.03	0.00	0.00	0.05	0.04	0.51	0.01	0.00	0.00	0.09	0.01	0.04	1.38	0.76	0.00	0.00	0.18	0.04	0.22	0.27	0.08	0.00	0.00
Surprise	0.01	0.01	0.82	0.56	0.00	0.25	0.20	2.46	0.65	0.00	0.01	0.46	0.07	0.21	0.37	5.08	0.01	0.02	0.84	0.19	0.18	1.94	0.38	0.04	0.00
Tempe	0.01	0.02	0.09	0.01	0.00	0.71	3.22	1.14	0.07	0.00	0.01	6.53	0.01	0.09	0.07	4.99	0.02	0.02	1.54	0.02	0.00	0.08	6.33	0.00	0.00
Tolleson	0.32	0.00	0.01	0.00	0.01	0.05	0.04	0.04	0.01	0.00	0.00	0.08	0.95	0.01	0.57	0.67	0.00	0.00	0.15	0.10	0.01	0.01	0.07	0.00	0.00
Wickenburg	0.00	0.38	0.01	0.00	0.00	0.44	0.32	0.07	0.01	0.00	0.00	0.37	0.00	0.02	0.03	1.12	0.02	0.68	0.28	0.00	0.00	0.02	0.15	0.00	0.00

Table S3. Commodity virtual water flows by city presented by ERA component (Million Cubic Meters, Mm³).

Municipality	E	U		V _{In}				V _{Out}			
	E _m	U _{urban}	U _{farm}	CF _{C,m} ^{import}	$\sum_{n,C} V_{C,n \rightarrow m}$	$\sum_{k,C} V_{C,k \rightarrow m}$	V _{In,m}	CF _{C,m} ^{export}	$\sum_{n,C} V_{C,m \rightarrow n}$	$\sum_{k,C} V_{C,m \rightarrow k}$	V _{Out,m}
	Net Water Footprint	Potable Deliveries	Agricultural Withdrawals	Circular (%)	Intra-PMA (%)	US (%)	Sum	Circular (%)	Intra-PMA (%)	US (%)	Sum
Mm ³											
Anthem	17	3.5	0.0	0.3 (1%)	8.5 (38%)	13.6 (60%)	23	0.3 (3%)	6.6 (74%)	2 (22%)	8.9
Apache Junction	42	16	12	0.4 (1%)	12.7 (33%)	25.4 (66%)	39	0.4 (2%)	15.1 (62%)	8.9 (37%)	24
Avondale	66	16	7.5	1 (1%)	27.9 (35%)	50.8 (64%)	80	1 (3%)	23.1 (61%)	13.9 (37%)	38
Buckeye	95	5.3	294	2 (4%)	14.5 (29%)	33.3 (67%)	50	2 (1%)	139.3 (55%)	112.6 (44%)	254
Cave Creek	7.1	2.1	3.1	0.1 (2%)	2.2 (39%)	3.2 (57%)	5.6	0.1 (3%)	2.2 (61%)	1.3 (36%)	3.6
Chandler	183	73	97	13.7 (5%)	89.5 (34%)	157 (60%)	260	13.7 (6%)	125.6 (51%)	108.4 (44%)	248
Gilbert	165	57	87	9 (4%)	76.5 (35%)	135.6 (61%)	221	9 (5%)	100.8 (50%)	90.2 (45%)	200
Glendale	236	59	31	7.5 (3%)	90.9 (35%)	161.9 (62%)	260	7.5 (7%)	63.8 (56%)	43 (38%)	114
Goodyear	63	10	44	1.2 (2%)	22.4 (34%)	42 (64%)	66	1.2 (2%)	33.2 (59%)	21.9 (39%)	56
Litchfield Park	28	14	46	0 (0%)	1.8 (30%)	4.2 (70%)	6.0	0 (0%)	21.7 (56%)	16.8 (44%)	39
Maricopa	39	6.6	96	0.8 (2%)	11.6 (29%)	27 (68%)	40	0.8 (1%)	55.7 (54%)	46.1 (45%)	103
Mesa	457	111	136	30 (6%)	160.4 (32%)	307.9 (62%)	498	30 (10%)	153.3 (53%)	104.4 (36%)	288
New River	8.0	2.6	0.0	0.3 (2%)	5.2 (39%)	7.8 (59%)	13	0.3 (4%)	5.1 (65%)	2.5 (32%)	7.9
Paradise Valley	26	13	8.2	0.8 (5%)	9.5 (63%)	4.6 (31%)	15	0.8 (8%)	6.3 (61%)	3.3 (32%)	10
Peoria	151	34	14	3.5 (2%)	60.3 (36%)	104.7 (62%)	169	3.5 (5%)	37 (57%)	24.8 (38%)	65
Phoenix	1485	376	144	191.5 (12%)	435.4 (26%)	1016.8 (62%)	1644	191.5 (28%)	231.4 (34%)	255.9 (38%)	679
Queen Creek	46	10	120	0.7 (3%)	9.2 (35%)	16.3 (62%)	26	0.7 (1%)	64.9 (59%)	45 (41%)	111
San Tan Valley	41	5.1	0.0	0.9 (1%)	24.3 (33%)	47.4 (65%)	73	0.9 (2%)	19.9 (55%)	15.7 (43%)	37

Table 3. Cont.

Municipality	E	U		V_{In}				V_{Out}			
	E_m	U_{urban}	U_{farm}	$CF_{C,m}^{import}$	$\sum_{n,C} V_{C,n \rightarrow m}$	$\sum_{k,C} V_{C,k \rightarrow m}$	$V_{In,m}$	$CF_{C,m}^{export}$	$\sum_{n,C} V_{C,m \rightarrow n}$	$\sum_{k,C} V_{C,m \rightarrow k}$	$V_{Out,m}$
	Net Water Footprint	Potable Deliveries	Agricultural Withdrawals	Circular (%)	Intra-PMA (%)	US (%)	Sum	Circular (%)	Intra-PMA (%)	US (%)	Sum
<i>Mm³</i>											
Scottsdale	281	103	16	18.3 (7%)	103.3 (42%)	126.3 (51%)	248	18.3 (21%)	54.8 (64%)	12.8 (15%)	86
Sun City	59	18	0.3	0.5 (1%)	14.9 (34%)	28 (64%)	44	0.5 (18%)	6.1 (218%)	-3.8 (-136%)	2.8
Sun City West	35	7.7	0.0	0.2 (1%)	9.3 (32%)	19.7 (67%)	29	0.2 (11%)	4.3 (226%)	-2.6 (-137%)	1.9
Surprise	123	28	9.5	1.8 (2%)	39.7 (34%)	76.1 (65%)	118	1.8 (6%)	26.9 (85%)	2.9 (9%)	32
Tempe	187	61	77	9.3 (5%)	68 (37%)	108.8 (58%)	186	9.3 (7%)	82.2 (60%)	45.7 (33%)	137
Tolleson	17	5.0	35	0.1 (1%)	2.4 (33%)	4.7 (65%)	7.2	0.1 (0%)	18.9 (62%)	11.6 (38%)	31
Wickenburg	9.8	2.0	8.8	0.6 (8%)	2.3 (31%)	4.5 (61%)	7.4	0.6 (7%)	4.8 (56%)	3 (35%)	8.5
Total Flow	3868	1040	1286	295	1303	2528	4125	295	1303	986	2584

Table S4. Virtual water imports, exports and net flows associated with PMA commodity flow (n = PMA).

Municipality	Metropolitan Area Flow				Net Metropolitan Area Flow		U_{urban}
	V_{In}	$V_{C,In, PMA}$	V_{Out}	$V_{C,Out, PMA}$	E_m	$E_{m,PMA}$	
		(% of V_{In})		(% of V_{Out})	(V_{In}/V_{Out})		
	Thousand m^3						
Anthem	22,475	6721 (30%)	8901	3821 (43%)	13,574 (2.5)	2900	3518
Apache Junction	38,489	11,437 (30%)	24,301	11,480 (47%)	14,188 (1.6)	−43	16,014
Avondale	79,655	23,563 (30%)	37,969	16,770 (44%)	41,686 (2.1)	6,793	16,371
Buckeye	49,785	13,274 (27%)	253,893	135,873 (54%)	204,107 (0.2)	−122,599	5274
Cave Creek	5567	1667 (30%)	3612	1847 (51%)	1955 (1.5)	−180	2128
Chandler	260,173	70,715 (27%)	247,697	108,836 (44%)	12,476 (1.1)	−38,121	73,272
Gilbert	221,084	61,247 (28%)	199,937	89,509 (45%)	21,147 (1.1)	−28,262	57,013
Glendale	260,350	74,795 (29%)	114,282	48,971 (43%)	146,068 (2.3)	25,824	59,348
Goodyear	65,594	19,223 (29%)	56,327	28,000 (50%)	9267 (1.2)	−8,777	10,220
Litchfield Park	5975	1762 (29%)	38,470	20,973 (55%)	32,495 (0.2)	−19,211	14,271
Maricopa	39,456	11,324 (29%)	102,632	52,909 (52%)	63,176 (0.4)	−41,585	6566
Mesa	498,330	132,920 (27%)	287,654	120,506 (42%)	210,675 (1.7)	12,414	110,839
New River	13,273	3970 (30%)	7877	3389 (43%)	5396 (1.7)	581	2554
Paradise Valley	14,960	4468 (30%)	10,380	5237 (50%)	4580 (1.4)	−769	12,966
Peoria	168,553	49,352 (29%)	65,266	28,322 (43%)	103,287 (2.6)	21,030	33,769
Phoenix	1,643,805	370,888 (23%)	678,790	184,446 (27%)	965,015 (2.4)	186,442	376,218
Queen Creek	26,133	7464 (29%)	110,529	58,783 (53%)	−84,397 (0.2)	−51,319	10,186
San Tan Valley	72,640	21,511 (30%)	36,538	15,493 (42%)	36,103 (2)	6019	5082
Scottsdale	247,975	72,063 (29%)	85,862	36,261 (42%)	162,114 (2.9)	35,802	102,886
Sun City	43,457	13,022 (30%)	2755	1209 (44%)	40,702 (15.8)	11,814	18,367
Sun City West	29,240	8765 (30%)	1891	811 (43%)	27,348 (15.5)	7954	7659
Surprise	117,620	34,865 (30%)	31,658	14,155 (45%)	85,962 (3.7)	20,711	27,547
Tempe	186,060	52,808 (28%)	137,220	63,567 (46%)	48,841 (1.4)	−10,759	61,258
Tolleson	7239	2142 (30%)	30,631	16,524 (54%)	23,393 (0.2)	−14,381	5047
Wickenburg	7387	2208 (30%)	8458	4484 (53%)	1071 (0.9)	−2276	2028
Total Flow	4,125,275	1,072,174	2,583,530	1,072,174	1,541,745	0	1,040,401

Table S5. Virtual inflows and outflows by commodity.

SCTG Commodity Code	Description	Metropolitan Area			Per Capita		
		$V_{C,In}$	$V_{C,Out}$	E_C	Import	Export	Net Import
		(Thousand m ³)	(Thousand m ³)	(Thousand m ³)	Commodity Flow (m ³ per capita)	Commodity Flow (m ³ per capita)	Commodity Flow (m ³ per capita)
1	Live animals/fish*	256	1604	-1348	0.07029431	0.44	-0.37
2	Cereal grains	516,881	76,348	440,533	142.02	20.98	121.04
3	Other ag prods.	1,461,388	547,476	913,912	401.54	150.43	251.11
4	Animal feed	724,881	397,863	327,018	199.17	109.32	89.85
5	Meat/seafood	41,283	11,608	29,675	11.34	3.19	8.15
6	Milled grain prods.	1,053,797	1,282,106	-228,309	289.55	352.28	-62.73
7	Other foodstuffs	17,774	845	16,929	4.88	0.23	4.65
8	Alcoholic beverages	5170	180	4990	1.42	0.05	1.37
9	Tobacco prods.	1037	34	1003	0.28	0.01	0.27
10	Building stone	5589	21,094	-15,505	1.54	5.79	-4.25
11	Natural sands	1903	7162	-5259	0.52	1.97	-1.45
12	Gravel	1055	40	1015	0.29	0.01	0.28
13	Nonmetallic minerals	3645	7244	-3599	1	1.99	-0.99
14	Metallic ores	4208	15	4193	1.16	0.00	1.16
15	Coal	14	51	-37	0	0.01	-0.01
16	Crude petroleum	0	0	0	0	0.00	0.00
17	Gasoline	8421	433	7988	2.31	0.12	2.19
18	Fuel oils	3846	230	3616	1.06	0.06	1.00
19	Coal-n.e.c.	31,061	213,543	-182,482	8.53	58.68	-50.15
20	Basic chemicals	4397	245	4152	1.21	0.07	1.14
21	Pharmaceuticals	15,271	1739	13,532	4.2	0.48	3.72
22	Fertilizers	1067	42	1025	0.29	0.01	0.28

Table S5. Cont.

SCTG Commodity Code	Description	Metropolitan Area			Per Capita		
		$V_{C,in}$	$V_{C,out}$	E_C	Import	Export	Net Import
		(Thousand m ³)	(Thousand m ³)	(Thousand m ³)	Commodity Flow (m ³ per capita)	Commodity Flow (m ³ per capita)	Commodity Flow (m ³ per capita)
23	Chemical prods.	5118	230	4888	1.41	0.06	1.35
24	Plastics/rubber	4804	241	4563	1.32	0.07	1.25
25	Logs	182	8	174	0.05	0.00	0.05
26	Wood prods.	6094	266	5828	1.67	0.07	1.60
27	Newsprint/paper	1654	80	1574	0.45	0.02	0.43
28	Paper articles	3389	214	3175	0.93	0.06	0.87
29	Printed prods.	2610	106	2504	0.72	0.03	0.69
30	Textiles/leather	8760	239	8521	2.41	0.07	2.34
31	Nonmetal min. prods.	9559	348	9211	2.63	0.10	2.53
32	Base metals	8429	333	8096	2.32	0.09	2.23
33	Articles-base metal	13,352	599	12,753	3.67	0.16	3.51
34	Machinery	54,307	2294	52,013	14.92	0.63	14.29
35	Electronics	21,756	2269	19,487	5.98	0.62	5.36
36	Motorized vehicles	17,841	633	17,208	4.9	0.17	4.73
37	Transport equip.	4493	320	4173	1.23	0.09	1.14
38	Precision instruments	4562	249	4313	1.25	0.07	1.18
39	Furniture	5664	198	5466	1.56	0.05	1.51
40	Misc. mfg. prods.	10,894	810	10,084	2.99	0.22	2.77
41	Waste/scrap	2333	83	2250	0.64	0.02	0.62
43	Mixed freight	27,107	1530	25,577	7.45	0.42	7.03
99	Unknown	9424	2581	6843	3	1.00	2.00
	Total	4,125,276	2,585,782	1,539,494	26	17	10

* Bolded items indicate next export.

Table S6. The fraction of potable deliveries mobilized via labor within the PMA.

Municipality	Virtual Water of Labor Flows				U_m^{urban}	$\frac{V_{L,n \rightarrow m}}{U_{m,urban}}$	$\frac{V_{L,m \rightarrow n}}{U_{m,urban}}$
	$V_{L,n \rightarrow m}$	$V_{L,m \rightarrow n}$	CF_L	$E_{L,PMA}$			
	Thousand m ³						
Anthem	2114	3093	383	−979	3518	60%	77%
Apache Junction	2035	3960	382	−1925	16,014	10%	22%
Avondale	4940	7072	641	−2132	16,371	26%	39%
Buckeye	1581	3917	322	−2336	5274	24%	68%
Cave Creek	684	414	104	270	2128	27%	15%
Chandler	25,133	23,170	6440	1963	73,272	26%	23%
Gilbert	19,121	15,267	3886	3854	57,013	27%	20%
Glendale	20,324	19,340	4175	984	59,348	27%	26%
Goodyear	3938	6106	756	−2167	10,220	31%	52%
Litchfield Park	2	715	31	−713	14,271	0%	5%
Maricopa	630	3150	334	−2521	6566	4%	43%
Mesa	40,899	46,541	14,013	−5642	110,839	24%	29%
New River	1496	2022	306	−526	2554	47%	67%
Paradise Valley	5828	1850	308	3978	12,966	43%	12%
Peoria	13,263	11,458	2304	1805	33,769	32%	27%
Phoenix	133,834	116,343	69,309	17,490	376,218	17%	13%
Queen Creek	2037	6416	295	−4379	10,186	17%	60%
San Tan Valley	3440	5047	602	−1608	5082	56%	87%
Scottsdale	47,227	34,540	16,004	12,688	102,886	30%	18%
Sun City	2387	5470	523	−3083	18,367	10%	27%
Sun City West	746	3758	258	−3012	7659	6%	46%
Surprise	8945	14,731	1213	−5787	27,547	28%	49%
Tempe	21,483	25,009	6328	−3525	61,258	25%	30%
Tolleson	332	2738	57	−2406	5047	5%	53%
Wickenburg	619	910	571	−291	2028	2%	17%
Total	363,038	363,038	0	0	1,040,401	22%	22%

Table S7. The adjusted GPCD of PMA municipalities to reflect the flow virtual water associated with labor flow and commodity flow.

Municipality	E (Ag and Urban)	E (No Ag)	U		V _{In}				V _{Out}			
	E _m	E _{urban}	U _{urban}	U _{farm}	$CF_{C,m}^{import}$	$\sum_{n,C} V_{C,n \rightarrow m}$	$\sum_{k,C} V_{C,k \rightarrow m}$	V _{In,m}	$CF_{C,m}^{export}$	$\sum_{n,C} V_{C,m \rightarrow n}$	$\sum_{k,C} V_{C,m \rightarrow k}$	V _{Out,m}
	Net Water Footprint	Net Urban Water Footprint	Potable Deliveries	Agricultural Withdrawals	Circular (%)	Intra-PMA (%)	US (%)	Sum	Circular (%)	Intra-PMA (%)	US (%)	Sum
	<i>Virtual Water flow Adjusted GPCD</i>											
Anthem	620	642	128	0	11	310	496	839	11	241	73	325
Apache Junction	895	660	341	256	9	271	541	831	9	322	190	511
Avondale	679	597	165	77	10	287	523	823	10	238	143	391
Buckeye	1564	-3272	87	4841	33	239	548	823	33	2294	1854	4183
Cave Creek	1046	604	309	457	15	324	471	825	15	324	191	530
Chandler	577	268	230	306	43	282	495	819	43	396	342	781
Gilbert	612	289	211	323	33	284	503	820	33	374	334	742
Glendale	743	646	186	98	24	286	510	819	24	201	135	359
Goodyear	787	250	125	550	15	280	525	825	15	415	274	700
Litchfield Park	3842	-2607	1921	6312	0	247	576	823	0	2978	2305	5351
Maricopa	810	-1172	137	1995	17	241	561	831	17	1,157	958	2140
Mesa	752	528	183	224	49	264	507	819	49	252	172	474
New River	494	476	161	0	19	321	482	803	19	315	154	488
Paradise Valley	1425	986	712	449	44	521	252	822	44	345	181	548
Peoria	734	671	165	68	17	293	509	822	17	180	121	316
Phoenix	741	669	188	72	96	217	507	820	96	115	128	339
Queen Creek	1443	-2353	314	3765	22	289	511	816	22	2036	1412	3482
San Tan Valley	463	464	58	0	10	274	535	824	10	225	177	418
Scottsdale	929	876	341	53	61	342	418	820	61	181	42	284
Sun City	1113	1117	340	6	9	281	528	830	9	115	-72	53
Sun City West	981	976	216	0	6	261	552	813	6	121	-73	53

Table S7. Cont.

Municipality	E (Ag and Urban)	E (No Ag)	U		V _{In}				V _{Out}			
	E _m	E _{urban}	U _{urban}	U _{farm}	$CF_{C,m}^{import}$	$\sum_{n,C} V_{C,n \rightarrow m}$	$\sum_{k,C} V_{C,k \rightarrow m}$	$V_{In,m}$	$CF_{C,m}^{export}$	$\sum_{n,C} V_{C,m \rightarrow n}$	$\sum_{k,C} V_{C,m \rightarrow k}$	$V_{Out,m}$
	Net Water Footprint	Net Urban Water Footprint	Potable Deliveries	Agricultural Withdrawals	Circular (%)	Intra-PMA (%)	US (%)	Sum	Circular (%)	Intra-PMA (%)	US (%)	Sum
<i>Virtual Water flow Adjusted GPCD</i>												
Surprise	857	795	195	66	13	277	530	822	13	187	20	223
Tempe	824	485	269	339	41	300	479	820	41	362	201	604
Tolleson	1925	-2129	566	3964	11	272	532	815	11	2141	1314	3511
Wickenburg	1088	100	222	977	67	255	499	821	67	533	333	943

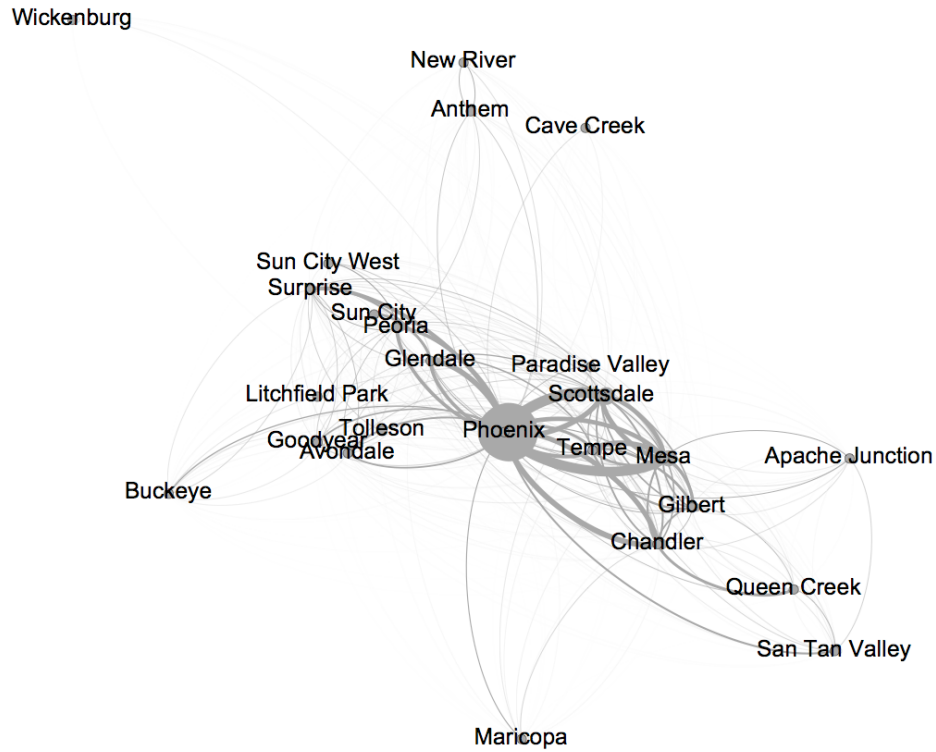


Figure S1. A network diagram of the virtual water flows associated with labor commuting between PMA municipalities ($V_{L,m \rightarrow n}$). This is a graphical representation of the data in Table S2. PMA municipalities are geo-located within the weighted, directed network.

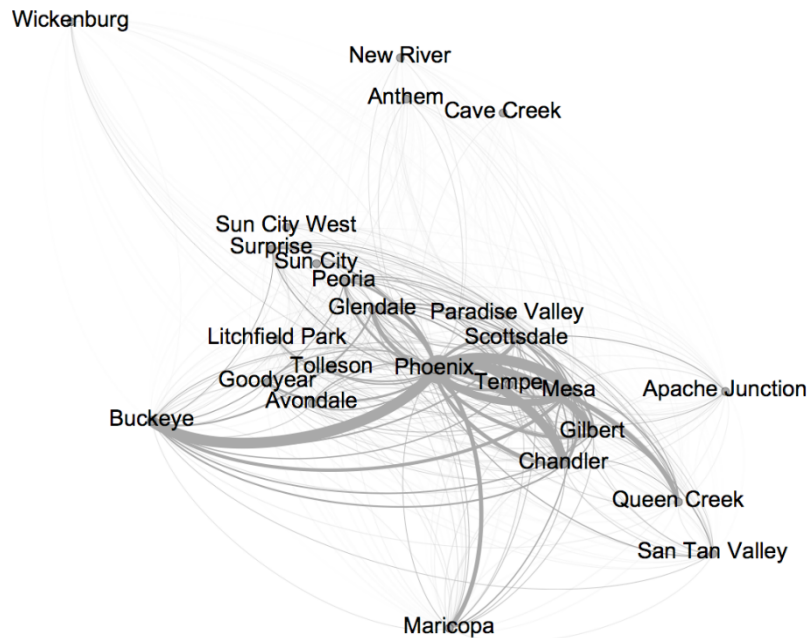


Figure S2. A network diagram of the virtual water flows associated with commodity flows between PMA municipalities ($V_{C,m \rightarrow n}$). The network diagram is a disaggregation of the data in Table S4. PMA municipalities are geo-located within the weighted, directed network.