Attachment 1

Data and Calculated Values of Water Temperatures and Flow Rates for a Hypothetical Bull Run Groundwater Augmentation Alternative

Data and Calculated Values of Water Temperatures and Flow Rates for a Hypothetical Groundwater Augmentation Alternative in the Lower Bull Run River (Based on 2000 Data)

Date	Max Air Temp at USGS (deg C)	Max Water Temp in Little Sandy River (deg C)	Flow in Lower Bull Run River (cfs)	Raw Water Temp from Res 2 (deg C)	Max Water Temp at Larson's Bridge (deg C)	Temp Change from Res 2 to Larson's (deg C)		Is Tmax in Little Sandy River > 16 C?	Tmax Target at Larson's Bridge (deg C)	Does the Tmax at Larson's Exceed Target?	Estimated Starting Tw Needed at Headworks to Match Target at Larson's	Is GW (if 14 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=14 C)	Is GW (if 13 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=13 C)	Is GW (if 10 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=10 C)
6/23/2000	20.2	14.6	33	10.1	16.5	6.4			16.0	Yes	9.6						
6/24/2000	20.2	14.0	35	10.1	15.2	5.1			16.0								
6/25/2000	29.0	16.2	37	10.1	17.9	7.8		Yes	16.2	Yes	8.4						
6/26/2000	31.3	17.1	41	10.1	17.9	7.8		Yes	17.1	Yes	9.3						
6/27/2000	32.6	18.1	21	10.3	20.2	9.9		Yes	18.1	Yes	8.2						
6/28/2000	30.1	18.6	24	10.4	19.9	9.5		Yes	18.6	Yes	9.1						
6/29/2000	27.0	18.4	20	10.4	20.2	9.8		Yes	18.4	Yes	8.6						
6/30/2000	20.4	17.0	25	10.4	17.9	7.5		Yes	17.0	Yes	9.5						
7/1/2000	17.2	14.9	21	10.5	15.5	5.0			16.0								
7/2/2000	15.7	13.4	21	10.5	14.3	3.8			16.0								
7/3/2000	14.1	12.6	21	10.6	13.6	3.0			16.0								
7/4/2000	16.0	12.4	21	10.6	13.8	3.2			16.0								
7/5/2000	21.1	14.4	21	10.7	17.3	6.6			16.0	Yes	9.4						
7/6/2000	20.9	15.9	21	10.7	18.1	7.4			16.0	Yes	8.6						
7/7/2000	24.6	16.8	21	10.8	19.2	8.4		Yes	16.8	Yes	8.4						
7/8/2000	17.6	14.3	21	10.9	14.3	3.4			16.0								
7/9/2000	19.2	15.2	22	10.9	15.7	4.8			16.0								
7/10/2000	21.8	16.0	21	11.1	17.8	6.7		Yes	16.0	Yes	9.3						
7/11/2000	20.6	14.9	22	11.2	16.3	5.1			16.0	Yes	10.9					Yes	5.5
7/12/2000	24.4	16.7	22	11.3	19.0	7.7		Yes	16.7	Yes	9.0						
7/13/2000	21.9	16.5	22	11.4	18.4	7.0		Yes	16.5	Yes	9.5						
7/14/2000	20.5	15.7	22	11.5	17.0	5.5			16.0	Yes	10.5					Yes	14.7
7/22/2000	18.1	16.7	26	12.6	19.0	6.4		Yes	16.7	Yes	10.3					Yes	23.5
7/23/2000	23.8	17.5	28	12.7	19.5	6.8		Yes	17.5	Yes	10.6					Yes	21.6
7/24/2000	26.5	17.8	29	12.8	19.7	6.9		Yes	17.8	Yes	10.9					Yes	19.9
7/25/2000	21.1	16.3	30	13.0	17.3	4.3		Yes	16.3	Yes	12.1					Yes	9.3
7/26/2000	22.4	16.8	30	13.0	18.2	5.2		Yes	16.8	Yes	11.6					Yes	14.2
7/27/2000	26.6	17.8	30	13.2	19.5	6.3		Yes	17.8	Yes	11.4					Yes	16.5
7/28/2000	25.3	17.9	30	13.3	19.2	5.9		Yes	17.9	Yes	12.0					Yes	11.6
7/29/2000	28.5	18.9	30	13.4	20.3	6.9		Yes	18.9	Yes	12.0					Yes	12.6
7/30/2000	29.1	19.2	30	13.5	20.2	6.7		Yes	19.2	Yes	12.6					Yes	8.1
7/31/2000	27.7	19.9	30	13.6	20.7	7.1		Yes	19.9	Yes	12.8					Yes	6.6
8/1/2000	24.5	19.2	30	13.8	19.9	6.1		Yes	19.2	Yes	13.2			Yes	23.6	Yes	5.0
8/2/2000	25.0	18.6	30	13.8	19.7	5.9		Yes	18.6	Yes	12.7					Yes	8.8
8/3/2000	26.0	18.4	30	13.9	19.9	6.0		Yes	18.4	Yes	12.5					Yes	11.1
8/4/2000	27.9	18.7	29	14.1	20.3	6.2		Yes	18.7	Yes	12.5					Yes	11.3
8/5/2000	27.3	18.9	30	14.3	20.5	6.2		Yes	18.9	Yes	12.7					Yes	11.1
8/6/2000	26.9	18.9	30	14.3	20.3	6.0		Yes	18.9	Yes	12.9					Yes	10.0
8/7/2000	25.2	18.6	30	14.5	20.3	5.8		Yes	18.6	Yes	12.7					Yes	11.7
8/8/2000	27.7	18.3	30	14.7	20.2	5.5		Yes	18.3	Yes	12.8					Yes	12.3
8/9/2000	25.4	18.4	30	14.8	19.9	5.1		Yes	18.4	Yes	13.4			Yes	24.0	Yes	9.0

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Date	Max Air Temp at USGS (deg C)	Max Water Temp in Little Sandy River (deg C)	Flow in Lower Bull Run River (cfs)	Raw Water Temp from Res 2 (deg C)	Max Water Temp at Larson's Bridge (deg C)	Temp Change from Res 2 to Larson's (deg C)		Is Tmax in Little Sandy River > 16 C?	Tmax Target at Larson's Bridge (deg C)	Does the Tmax at Larson's Exceed Target?	Estimated Starting Tw Needed at Headworks to Match Target at Larson's	Is GW (if 14 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=14 C)	Is GW (if 13 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=13 C)	Is GW (if 10 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=10 C)
8/10/2000	19.7	16.2	29	14.9	16.8	1.9		Yes	16.2	Yes	14.3	Yes	19.7	Yes	9.3	Yes	3.6
8/11/2000	20.4	16.3	29	14.9	18.9	4.0		Yes	16.3	Yes	12.4					Yes	15.0
8/12/2000	22.6	15.9	29	15.1	19.0	3.9			16.0	Yes	12.1					Yes	17.3
8/13/2000	21.3	15.9	29	15.3	19.4	4.1			16.0	Yes	11.9					Yes	18.4
8/14/2000	21.1	15.9	29	15.3	19.0	3.7			16.0	Yes	12.3					Yes	16.6
8/15/2000	21.2	15.6	29	15.4	19.0	3.6			16.0	Yes	12.4					Yes	16.3
8/18/2000	17.1	13.1	31	15.8	16.5	0.7			16.0	Yes	15.3	Yes	8.1	Yes	5.2	Yes	2.5
8/19/2000	18.0	13.8	32	15.8	17.6	1.8			16.0	Yes	14.2	Yes	28.3	Yes	18.2	Yes	8.8
8/20/2000	21.0	14.3	32	15.9	19.0	3.1			16.0	Yes	12.9					Yes	16.5
8/21/2000	25.3	14.9	33	16.0	19.7	3.7			16.0	Yes	12.3					Yes	20.3
8/23/2000	27.6	16.5	33	16.3	20.2	3.9		Yes	17.5	Yes	13.6			Yes	26.8	Yes	14.0
8/24/2000	20.9	15.2	33	16.4	18.2	1.8			16.0	Yes	14.2	Yes	30.7	Yes	21.6	Yes	11.5
8/25/2000	22.0	15.9	33	16.5	18.9	2.4			16.0	Yes	13.6			Yes	27.2	Yes	14.6
8/26/2000	19.8	15.4	33	16.6	18.1	1.5			16.0	Yes	14.5	Yes	26.3	Yes	19.0	Yes	10.4
8/27/2000	19.1	14.4	33	16.7	18.1	1.4			16.0	Yes	14.6	Yes	25.3	Yes	18.5	Yes	10.2
8/29/2000	23.8	14.4	35	16.8	19.0	2.2			16.0	Yes	13.8			Yes	28.0	Yes	15.6
8/30/2000	23.8	15.9	35	16.9	20.0	3.1			16.0	Yes	12.9					Yes	20.3
8/31/2000	15.1	13.8	35	16.9	17.0	0.1			16.0	Yes	16.0	Yes	11.5	Yes	8.5	Yes	4.8
9/1/2000	17.1	13.2	35	17.0	17.4	0.4			16.0	Yes	15.6	Yes	16.7	Yes	12.5	Yes	7.1
9/2/2000	13.5	12.4	35	17.0	17.0	-0.1			16.0	Yes	16.1	Yes	11.1	Yes	8.3	Yes	4.8
9/3/2000	15.1	12.3	34	17.0	17.3	0.3			16.0	Yes	15.7	Yes	14.4	Yes	10.8	Yes	6.2
9/4/2000	17.6	12.6	34	17.0	18.4	1.4			16.0	Yes	14.6	Yes	27.1	Yes	20.3	Yes	11.6
9/5/2000	17.8	12.9	33	17.0	18.2	1.2			16.0	Yes	14.8	Yes	24.5	Yes	18.4	Yes	10.5
9/6/2000	17.5	13.4	35	17.0	18.4	1.4			16.0	Yes	14.6	Yes	27.9	Yes	20.9	Yes	12.0
9/7/2000	19.6	12.7	34	17.0	18.4	1.4			16.0	Yes	14.6	Yes	27.5	Yes	20.6	Yes	11.7
9/8/2000	14.0	12.3	35	16.9	17.0	0.1			16.0	Yes	16.0	Yes	11.5	Yes	8.5	Yes	4.8
9/9/2000	17.4	12.6	35	16.9	18.1	1.2			16.0	Yes	14.8	Yes	25.0	Yes	18.6	Yes	10.5
9/10/2000	16.0	12.0	35	16.8	16.5	-0.3			16.0	Yes	16.3	Yes	5.9	Yes	4.3	Yes	2.4
9/11/2000	19.5	13.5	35	16.5	19.4	2.9			16.0	Yes	13.1			Yes	33.7	Yes	18.1
9/12/2000	23.1	14.0	35	16.1	18.9	2.8			16.0	Yes	13.2			Yes	32.5	Yes	16.5
9/13/2000	24.2	14.4	35	16.0	19.0	3.0			16.0	Yes	13.0					Yes	17.7
9/14/2000	27.9	15.9	35	16.1	19.4	3.3			16.0	Yes	12.7					Yes	19.3
9/15/2000	19.8	14.9	35	16.2	17.4	1.2			16.0	Yes	14.8	Yes	22.8	Yes	15.6	Yes	8.1
9/16/2000	20.7	14.9	35	16.3	17.4	1.1			16.0	Yes	14.9	Yes	21.8	Yes	15.2	Yes	7.9
9/17/2000	20.2	14.1	35	16.4	18.2	1.8			16.0	Yes	14.2	Yes	32.5	Yes	23.0	Yes	12.2
9/18/2000	23.1	14.1	35	16.4	18.6	2.2			16.0	Yes	13.8			Yes	26.4	Yes	14.0
9/19/2000	21.8	14.9	35	16.6	18.9	2.3			16.0	Yes	13.7			Yes	28.0	Yes	15.3
9/20/2000	18.8	14.1	35	16.4	17.4	1.0			16.0	Yes	15.0	Yes	20.9	Yes	14.7	Yes	7.8
9/21/2000	17.3	14.4	37	16.5	17.6	1.1			16.0	Yes	14.9	Yes	23.9	Yes	17.0	Yes	9.1
9/22/2000	15.4	12.7	35	16.8	15.5	-1.3			16.0								
9/23/2000	20.0	10.0	35	16.8	16.3	-0.5			16.0	Yes	16.5	Yes	4.0	Yes	2.9	Yes	1.6

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9/24/2000	22.8	10.3	35	16.0	16.3	0.3			16.0	Yes	15.7	Yes	5.6	Yes	3.7	Yes	1.9
9/25/2000	20.8	10.4	35	15.7	16.5	0.8			16.0	Yes	15.2	Yes	9.7	Yes	6.1	Yes	2.9
9/26/2000	21.9	10.6	35	15.6	16.6	1.0			16.0	Yes	15.0	Yes	13.8	Yes	8.5	Yes	3.9
9/27/2000	22.5	11.0	35	15.0	16.3	1.3			16.0	Yes	14.7	Yes	11.2	Yes	5.6	Yes	2.2
9/28/2000	18.0	11.5	35	14.6	15.7	1.1			16.0								
9/29/2000	19.6	12.4	35	14.4	15.8	1.4			16.0								
9/30/2000	17.4	12.6	35	14.4	15.2	0.8			16.0								
Min	13.5	10.0	20.0	10.1	13.6	-1.3			16.0		8.2		4.0		2.9		1.6
Mean	21.7	15.2	30.5	14.3	18.1	3.8			16.6		12.8		18.8		16.8		11.3
Max	32.6	19.9	41.0	17.0	20.7	9.9			19.9		16.5		32.5		33.7		23.5
Count	89.0	89.0	89.0	89.0	89.0	89.0			89.0		78.0		27.0		36.0		65.0

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7/6/2001	22.1	16.4	35	12.5	19.0	6.5		Yes	16.4	Yes	9.8						
7/7/2001	24.9	16.4	35	12.5	19.4	6.9		Yes	16.4	Yes	9.5						
7/8/2001	26.6	17.3	35	12.5	20.0	7.5		Yes	17.3	Yes	9.8						
7/9/2001	28.4	17.8	35	12.6	20.5	7.9		Yes	17.8	Yes	9.9						
7/10/2001	25.9	17.6	35	12.7	19.2	6.5		Yes	17.6	Yes	11.1					Yes	20.4
7/11/2001	25.2	18.1	35	12.7	19.8	7.1		Yes	18.1	Yes	11.0					Yes	22.4
7/12/2001	25.7	18.6	34	12.8	20.2	7.4		Yes	18.6	Yes	11.2					Yes	19.1
7/13/2001	23.4	17.8	34	12.9	19.7	6.8		Yes	17.8	Yes	11.0					Yes	22.3
7/14/2001	21.6	16.2	34	13.0	18.2	5.2		Yes	16.2	Yes	11.0					Yes	22.9
7/15/2001	16.4	13.7	34	13.0	14.9	1.9			16.0								
7/16/2001	14.2	12.6	35	13.1	14.4	1.3			16.0								
6/11/2001		19.9	268	11.4	11.9	0.5		Yes	19.9								
7/17/2001	16.6	12.9	35	13.1	15.2	2.1			16.0								
7/18/2001	17.0	12.9	35	13.1	15.5	2.4			16.0								
7/19/2001	21.1	14.8	35	13.1	17.7	4.6			16.0	Yes	11.4					Yes	19.6
7/20/2001	15.9	12.8	33	13.3	14.4	1.1			16.0								
7/21/2001	19.6	14.6	33	13.3	16.9	3.6			16.0	Yes	12.4					Yes	9.4
7/22/2001	22.6	16.4	33	13.4	19.7	6.3		Yes	16.4	Yes	10.1					Yes	32.2
7/23/2001	23.5	16.8	33	13.4	19.2	5.8		Yes	16.8	Yes	11.0					Yes	22.9
7/24/2001	23.1	17.6	33	13.4	19.5	6.1		Yes	17.6	Yes	11.5					Yes	18.4
7/25/2001	24.0	17.9	33	13.5	20.2	6.7		Yes	17.9	Yes	11.3					Yes	20.9
7/26/2001	23.7	17.5	32	13.5	19.8	6.3		Yes	17.5	Yes	11.1					Yes	21.8
7/27/2001	22.8	17.0	30	13.6	19.5	5.9		Yes	17.0	Yes	11.1					Yes	21.1
7/28/2001	15.9	14.3	30	13.6	15.7	2.1			16.0								
7/29/2001	15.9	13.4	32	13.6	15.2	1.6			16.0								
7/30/2001	16.8	13.1	32	13.7	15.8	2.1			16.0								
7/31/2001	19.5	14.9	30	13.7	18.2	4.5			16.0	Yes	11.5					Yes	18.0
8/1/2001	23.5	15.6	30	13.7	18.9	5.2			16.0	Yes	10.8					Yes	23.3
8/2/2001	24.9	16.8	30	13.8	20.0	6.2		Yes	16.8	Yes	10.6					Yes	25.0
8/3/2001	20.6	15.1	30	13.9	16.9	3.0			16.0	Yes	13.0					Yes	7.2
8/4/2001	19.5	14.6	30	14.0	16.3	2.3			16.0	Yes	13.7			Yes	9.3	Yes	2.3
8/5/2001	26.6	16.8	31	14.0	20.0	6.0		Yes	16.8	Yes	10.8					Yes	24.6
8/6/2001	25.9	17.6	32	14.1	20.2	6.1		Yes	17.6	Yes	11.6					Yes	19.8
8/7/2001	25.2	18.1	30	14.4	20.7	6.3		Yes	18.1	Yes	11.9					Yes	17.3
8/8/2001	27.2	17.9	30	13.8	20.5	6.7		Yes	17.9	Yes	11.3					Yes	20.1
8/9/2001	31.9	18.8	34	13.5	20.8	7.3		Yes	18.8	Yes	11.4					Yes	20.0
8/10/2001	28.6	18.9	41	13.5	19.8	6.3		Yes	18.9	Yes	12.6					Yes	10.9
8/11/2001	26.3	18.6	42	13.4	19.4	6.0		Yes	18.6	Yes	12.6					Yes	9.5
8/12/2001	27.8	18.1	43	13.5	18.4	4.9		Yes	18.1	Yes	13.2			Yes	23.2	Yes	3.3
8/13/2001	25.2	18.8	39	13.6	19.4	5.8		Yes	18.8	Yes	13.0					Yes	6.6
8/14/2001	22.1	17.1	34	13.5	17.9	4.4		Yes	17.1	Yes	12.7					Yes	7.4

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8/15/2001	23.5	17.6	40	13.6	18.4	4.8		Yes	17.6	Yes	12.8					Yes	8.4
8/16/2001	18.3	15.9	34	13.6	16.2	2.6			16.0	Yes	13.5			Yes	8.5	Yes	1.4
8/17/2001	23.4	16.8	32	13.6	19.0	5.4		Yes	17.8	Yes	12.4					Yes	10.7
8/18/2001	19.8	15.7	31	13.7	16.9	3.2			16.0	Yes	12.8					Yes	7.9
8/19/2001	22.0	15.9	31	13.7	18.5	4.8			16.0	Yes	11.2					Yes	21.3
8/20/2001	21.5	15.6	31	13.8	18.4	4.6			16.0	Yes	11.4					Yes	19.4
8/21/2001	19.9	14.1	31	13.9	16.0	2.1			16.0								
8/22/2001	17.7	14.0	33	14.0	15.5	1.5			16.0								
8/23/2001	16.0	13.7	33	14.1	15.7	1.6			16.0								
8/24/2001	20.3	14.9	32	14.1	18.4	4.3			16.0	Yes	11.7					Yes	18.6
8/25/2001	23.7	15.1	31	14.2	18.5	4.3			16.0	Yes	11.7					Yes	18.7
8/26/2001	24.6	16.0	31	14.2	19.2	5.0		Yes	17.0	Yes	12.1					Yes	15.9
8/27/2001	22.9	15.9	31	14.4	19.0	4.6			16.0	Yes	11.4					Yes	21.3
8/28/2001	24.2	16.5	31	14.5	19.2	4.7		Yes	17.5	Yes	12.8					Yes	11.6
8/29/2001	23.7	16.2	31	14.6	19.0	4.4		Yes	17.2	Yes	12.8					Yes	12.3
8/30/2001	24.5	16.5	31	14.7	19.5	4.8		Yes	17.5	Yes	12.7					Yes	13.3
8/31/2001	22.2	16.2	31	14.8	19.0	4.2		Yes	17.2	Yes	13.0					Yes	11.8
9/1/2001	18.0	14.8	31	14.9	16.5	1.6			16.0	Yes	14.4	Yes	16.2	Yes	7.7	Yes	3.0
9/2/2001	22.5	15.4	31	15.0	18.1	3.1			16.0	Yes	12.9					Yes	12.8
9/3/2001	20.4	14.9	31	15.1	17.7	2.6			16.0	Yes	13.4			Yes	25.7	Yes	10.6
9/4/2001	20.4	14.5	31	15.1	17.1	2.0			16.0	Yes	14.0			Yes	16.2	Yes	6.7
9/5/2001	17.2	13.5	31	15.3	16.6	1.3			16.0	Yes	14.7	Yes	15.0	Yes	8.5	Yes	3.7
9/6/2001	17.5	13.4	31	15.3	17.1	1.8			16.0	Yes	14.2	Yes	26.2	Yes	14.8	Yes	6.4
9/7/2001	21.1	13.8	30	14.5	17.9	3.4			16.0	Yes	12.6					Yes	12.7
9/8/2001	25.6	13.5	30	14.3	17.6	3.3			16.0	Yes	12.7					Yes	11.0
9/9/2001	24.0	13.5	30	14.5	17.6	3.1			16.0	Yes	12.9					Yes	10.5
9/10/2001	22.4	13.7	30	14.7	17.7	3.0			16.0	Yes	13.0					Yes	11.1
9/11/2001	24.2	14.0	30	15.0	18.1	3.1			16.0	Yes	12.9					Yes	12.4
9/12/2001	24.3	14.6	30	15.3	18.5	3.2			16.0	Yes	12.8					Yes	14.4
9/13/2001	24.3	14.8	30	15.5	18.4	2.9			16.0	Yes	13.1			Yes	28.6	Yes	13.0
9/14/2001	25.1	15.4	30	15.6	18.7	3.1			16.0	Yes	12.9					Yes	14.5
9/15/2001	25.0	16.4	31	15.6	19.4	3.8		Yes	17.4	Yes	13.6			Yes	23.8	Yes	11.1
9/16/2001	21.1	15.3	31	15.7	18.2	2.5			16.0	Yes	13.5			Yes	25.5	Yes	12.1
9/17/2001	18.8	13.8	30	15.8	17.6	1.8			16.0	Yes	14.2	Yes	26.3	Yes	16.9	Yes	8.2
9/18/2001	15.5	12.9	30	15.9	16.2	0.2			16.0	Yes	15.8	Yes	2.4	Yes	1.6	Yes	0.8
9/19/2001	17.8	13.1	31	16.0	17.3	1.3			16.0	Yes	14.7	Yes	19.5	Yes	13.0	Yes	6.5
9/20/2001	20.4	12.0	32	16.1	17.1	1.0			16.0	Yes	15.0	Yes	16.8	Yes	11.4	Yes	5.8
9/21/2001	22.0	12.0	31	16.2	17.3	1.1			16.0	Yes	14.9	Yes	17.8	Yes	12.2	Yes	6.3
9/22/2001	23.6	12.5	31	16.3	17.9	1.6			16.0	Yes	14.4	Yes	25.6	Yes	17.8	Yes	9.3
9/23/2001	22.9	12.9	31	16.4	18.1	1.7			16.0	Yes	14.3	Yes	26.6	Yes	18.8	Yes	10.0
9/24/2001	22.9	13.2	31	16.5	18.2	1.7			16.0	Yes	14.3	Yes	27.5	Yes	19.7	Yes	10.6

Data and Calculated Values of Water Temperatures and Flow Rates for a Hypothetical Groundwater Augmentation Alternative in the Lower Bull Run River (Based on 2001 Data)

Date	Max Air Temp at USGS (deg C)	Max Water Temp in Little Sandy River (deg C)	Flow in Lower Bull Run River (cfs)	Raw Water Temp from Res 2 (deg C)	Max Water Temp at Larson's Bridge (deg C)	Temp Change from Res 2 to Larson's (deg C)		Is Tmax in Little Sandy River > 16 C?	Tmax Target at Larson's Bridge (deg C)	Does the Tmax at Larson's Exceed Target?	Estimated Starting Tw Needed at Headworks to Match Target at Larson's	Is GW (if 14 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=14 C)	Is GW (if 13 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=13 C)	Is GW (if 10 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=10 C)
9/25/2001	13.3	12.5	32	16.7	16.2	-0.6			16.0	Yes	16.6	Yes	1.8	Yes	1.3	Yes	0.7
9/26/2001	14.5	12.1	31	16.7	15.8	-0.9			16.0								
Min	13.3	12.0	30.0	11.4	11.9	-0.9			16.0		9.5		1.8		1.3		0.7
Mean	21.9	15.4	35.2	14.2	18.0	3.8			16.7		12.5		18.5		15.2		13.5
Max	31.9	19.9	268.0	16.7	20.8	7.9			19.9		16.6		27.5		28.6		32.2
Count	83.0	84.0	84.0	84.0	84.0	84.0			84.0		71.0		12.0		20.0		67.0

Data and Calculated Values of Water Temperatures and Flow Rates for a Hypothetical Groundwater Augmentation Alternative in the Lower Bull Run River (Based on 2003 Data)

Date	Max Air Temp at USGS (deg C)	Max Water Temp in Little Sandy River (deg C)	Flow in Lower Bull Run River (cfs)	Raw Water Temp from Res 2 (deg C)	Max Water Temp at Larson's Bridge (deg C)	Temp Change from Res 2 to Larson's (deg C)		Is Tmax in Little Sandy River > 16 C?	Tmax Target at Larson's Bridge (deg C)	Does the Tmax at Larson's Exceed Target?	Estimated Starting Tw Needed at Headworks to Match Target at Larson's	Is GW (if 14 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=14 C)	Is GW (if 13 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=13 C)	Is GW (if 10 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=10 C)
6/20/2003	12.3		51.0	12.3	14	1.7			16.0								
6/21/2003	13.4		46.0	12.5	14.8	2.3			16.0								
6/22/2003	12.8		65.0	12.8	13.6	0.8			16.0								
6/23/2003	13.3		67.0	13	13.8	0.8			16.0								
6/24/2003	19		37.0	13.2	17.9	4.7			16.0	Yes	11.3					Yes	22.0
6/25/2003	23.9		39.0	13.4	19.7	6.3			16.0	Yes	9.7						
6/26/2003	27.1		40.0	13.6	20.5	6.9			16.0	Yes	9.1						
6/27/2003	27.4		43.0	13.8	20.7	6.9			16.0	Yes	9.1						
6/28/2003	34		49.0	13.9	21.2	7.3			16.0	Yes	8.7						
6/29/2003	29.4		49.0	14	20.5	6.5			16.0	Yes	9.5						
6/30/2003	21.7		49.0	14.1	18.6	4.5			16.0	Yes	11.5					Yes	31.1
7/1/2003	19.5		41.0	14.2	17.6	3.4			16.0	Yes	12.6					Yes	15.6
7/2/2003	21.8		33.0	14.3	20	5.7			16.0	Yes	10.3					Yes	30.7
7/3/2003	22.7		23.0	14.4	20.7	6.3			16.0	Yes	9.7						
7/4/2003	23.6		33.0	14.5	21	6.5			16.0	Yes	9.5						
7/5/2003	21.2		33.0	14.3	20.7	6.4			16.0	Yes	9.6						
7/6/2003	22.8		33.0	14.1	20.8	6.7			16.0	Yes	9.3						
7/7/2003	24.7		37.0	14	20.8	6.8			16.0	Yes	9.2						
7/8/2003	21.3	16.1	37.0	14	17.8	3.8		Yes	16.1	Yes	12.3					Yes	15.4
7/9/2003	28.1	18.4	37.0	14	21.1	7.1		Yes	18.4	Yes	11.3					Yes	25.3
7/10/2003	29	19.2	39.0	14	21.3	7.3		Yes	19.2	Yes	11.9					Yes	20.7
7/11/2003	26.2	19.3	36.0	14.1	21.2	7.1		Yes	19.3	Yes	12.2					Yes	16.3
7/12/2003	26.7	19.2	24.0	14.1	21.1	7.0		Yes	19.2	Yes	12.2					Yes	11.2
7/13/2003	22.9	17.7	23.0	14.2	20.3	6.1		Yes	17.7	Yes	11.6					Yes	14.1
7/14/2003	25.4	19.0	35.0	14.3	21.4	7.1		Yes	19.0	Yes	11.9					Yes	19.4
7/15/2003	24.6	19.0	35.0	14.5	21	6.5		Yes	19.0	Yes	12.5					Yes	15.4
7/16/2003	22.5	18.5	35.0	14.6	20.1	5.5		Yes	18.5	Yes	13.0			Yes	34.1	Yes	11.9
7/17/2003	26.4	18.5	35.0	14.7	21.2	6.5		Yes	18.5	Yes	12.0					Yes	19.8
7/18/2003	28.6	19.0	40.0	14.3	21.1	6.8		Yes	19.0	Yes	12.2					Yes	19.3
7/19/2003	29.4	19.3	40.0	14	21.1	7.1		Yes	19.3	Yes	12.2					Yes	17.6
7/20/2003	29.1	19.8	40.0	13.8	21.2	7.4		Yes	19.8	Yes	12.4					Yes	14.4
7/21/2003	31	20.8	40.0	13.6	21.4	7.8		Yes	20.8	Yes	13.0			Yes	39.3	Yes	6.6
7/22/2003	29.2	20.8	40.0	13.6	21.1	7.5		Yes	20.8	Yes	13.3			Yes	19.3	Yes	3.2
7/23/2003	25.5	19.8	39.0	13.5	20.3	6.8		Yes	19.8	Yes	13.0			Yes	36.7	Yes	5.2
7/24/2003	23.5	18.4	39.0	13.5	19.5	6.0		Yes	18.4	Yes	12.4					Yes	12.6
7/25/2003	23.7	18.4	39.0	13.5	19.8	6.3		Yes	18.4	Yes	12.1					Yes	15.9
7/26/2003	24.6	18.4	39.0	13.6	20.1	6.5		Yes	18.4	Yes	11.9					Yes	18.7
7/27/2003	28.9	18.4	39.0	13.7	20.4	6.7		Yes	18.4	Yes	11.7					Yes	21.4
7/28/2003	32.6	19.7	39.0	13.9	21	7.1		Yes	19.7	Yes	12.6					Yes	13.3
7/29/2003	33.8	20.0	46.0	14.1	20.7	6.6		Yes	20.0	Yes	13.4			Yes	29.7	Yes	8.0
7/30/2003	32.5	20.2	46.0	14.2	20.8	6.6		Yes	20.2	Yes	13.6			Yes	24.5	Yes	7.0
7/31/2003	27.1	19.8	43.0	14.3	20.5	6.2		Yes	19.8	Yes	13.6			Yes	22.2	Yes	6.7

Data and Calculated Values of Water Temperatures and Flow Rates for a Hypothetical Groundwater Augmentation Alternative in the Lower Bull Run River (Based on 2003 Data)

Date	Max Air Temp at USGS (deg C)	Max Water Temp in Little Sandy River (deg C)	Flow in Lower Bull Run River (cfs)	Raw Water Temp from Res 2 (deg C)	Max Water Temp at Larson's Bridge (deg C)	Temp Change from Res 2 to Larson's (deg C)		Is Tmax in Little Sandy River > 16 C?	Tmax Target at Larson's Bridge (deg C)	Does the Tmax at Larson's Exceed Target?	Estimated Starting Tw Needed at Headworks to Match Target at Larson's	Is GW (if 14 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=14 C)	Is GW (if 13 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=13 C)	Is GW (if 10 C) Less than the Starting Tw; use GW?	Estimated GW Flow (cfs) Needed to Achieve Target Tw (GW=10 C)
8/1/2003	25.5	18.4	37.0	14.4	19.775	5.4		Yes	18.4	Yes	13.0					Yes	11.8
8/2/2003	20.1	16.8	34.0	14.6	17.115	2.5		Yes	16.8	Yes	14.3	Yes	19.0	Yes	7.1	Yes	2.5
8/3/2003	21.2	16.5	29.0	14.6	17.755	3.2		Yes	16.5	Yes	13.3			Yes	23.5	Yes	8.2
8/4/2003	27.2	18.1	26.0	14.7	20.825	6.1		Yes	18.1	Yes	11.9					Yes	15.3
8/5/2003	22.1	17.6	26.0	14.8	19.45	4.7		Yes	17.6	Yes	12.9					Yes	10.2
8/6/2003	23.7	17.9	28.0	14.9	20.415	5.5		Yes	17.9	Yes	12.4					Yes	14.4
8/7/2003	24.4	18.4	30.0	15	20.91	5.9		Yes	18.4	Yes	12.5					Yes	15.2
8/8/2003	23.5	18.1	31.0	15.1	20.5	5.4		Yes	18.1	Yes	12.7					Yes	14.8
8/9/2003	23.8	17.9	29.0	15.2	20.255	5.1		Yes	17.9	Yes	12.8					Yes	13.2
8/10/2003	23.3	16.9	29.0	15.2	19.37	4.2		Yes	16.9	Yes	12.8					Yes	13.6
8/11/2003	22.6	16.3	29.0	15.3	19.045	3.7		Yes	16.3	Yes	12.6					Yes	15.0
8/12/2003	23.4	17.7	29.0	15.4	20.335	4.9		Yes	17.7	Yes	12.8					Yes	14.0
8/13/2003	25.3	17.3	31.0	15.4	20.335	4.9		Yes	17.3	Yes	12.3					Yes	17.7
8/14/2003	31.5	17.7	38.0	15.6	20.7	5.1		Yes	17.7	Yes	12.6					Yes	20.2
8/15/2003	22.3	17.3	37.0	15.8	19.1	3.3		Yes	17.3	Yes	14.0			Yes	24.3	Yes	11.7
8/16/2003	23.1	17.6	34.0	15.8	20.5	4.7		Yes	18.6	Yes	13.9			Yes	23.4	Yes	11.3
8/17/2003	27	17.7	37.0	15.9	20.9	5.0		Yes	18.7	Yes	13.7			Yes	27.7	Yes	13.6
8/18/2003	27.6	18.1	39.0	16	21	5.0		Yes	19.1	Yes	14.1	Yes	37.8	Yes	25.2	Yes	12.6
8/19/2003	23.5	17.1	43.0	16.1	19.5	3.4		Yes	18.1	Yes	14.7	Yes	28.9	Yes	19.6	Yes	9.9
8/20/2003	26.6	16.3	43.0	16.2	20	3.8		Yes	17.3	Yes	13.5			Yes	36.3	Yes	18.7
8/21/2003	27.9	16.6	43.0	16.3	20.3	4.0		Yes	17.6	Yes	13.6			Yes	34.9	Yes	18.3
8/22/2003	18.6	15.4	33.0	16.4	17.7	1.3			16.0	Yes	14.7	Yes	23.4	Yes	16.5	Yes	8.8
8/23/2003	21.7	15.5	31.0	16.4	19.4	3.0			16.0	Yes	13.0					Yes	16.5
8/24/2003	25.7	15.4	33.0	16.5	20	3.5			16.0	Yes	12.5					Yes	20.3
8/25/2003	28.6	15.8	37.0	16.7	20.4	3.7			16.0	Yes	12.3					Yes	24.3
8/26/2003	20	14.7	30.0	16.9	18.1	1.2			16.0	Yes	14.8	Yes	21.7	Yes	16.2	Yes	9.1
8/27/2003	20.6	15.8	31.0	17	19.6	2.6			16.0	Yes	13.4			Yes	27.9	Yes	15.9
8/28/2003	25.4	15.2	33.0	17	19.7	2.7			16.0	Yes	13.3			Yes	30.5	Yes	17.4
8/29/2003	26.9	16.0	37.0	17.2	20.6	3.4			16.0	Yes	12.6					Yes	23.6
8/30/2003	29.9	16.3	42.0	17.3	20.8	3.5		Yes	17.3	Yes	13.8			Yes	34.2	Yes	20.1
8/31/2003	25.2	16.1	46.0	17.4	20.3	2.9		Yes	17.1	Yes	14.2	Yes	42.8	Yes	33.0	Yes	19.6
9/1/2003	24.6	15.4	50.0	17.5	20	2.5			16.0	Yes	13.5			Yes	44.4	Yes	26.7
9/2/2003	30.4	15.8	54.0	17.6	20.5	2.9			16.0	Yes	13.1			Yes	52.8	Yes	32.0
9/3/2003	30.7	16.8	70.0	17.7	20.3	2.6		Yes	17.8	Yes	15.2	Yes	47.7	Yes	37.5	Yes	22.9
9/4/2003	30.7	17.6	78.0	17.9	20.8	2.9		Yes	18.6	Yes	15.7	Yes	44.6	Yes	35.5	Yes	22.0
9/5/2003	29.5	17.3	78.0	18	20.8	2.8		Yes	18.3	Yes	15.5	Yes	49.5	Yes	39.6	Yes	24.8
9/6/2003	23.6	16.5	30.0	18.1	20.3	2.2		Yes	17.5	Yes	15.3	Yes	20.8	Yes	16.7	Yes	10.5
9/7/2003	20	15.7	28.0	18.1	19.2	1.1			16.0	Yes	14.9	Yes	21.9	Yes	17.6	Yes	11.1
9/8/2003	14.9	13.9	32.0	18.1	18.1	0.0			16.0	Yes	16.0	Yes	16.4	Yes	13.2	Yes	8.3
9/9/2003	15	12.6	32.0	18.2	17.2	-1.0			16.0	Yes	17.0	Yes	9.1	Yes	7.4	Yes	4.7
9/10/2003	15.9	12.9	33.0	18.2	17.6	-0.6			16.0	Yes	16.6	Yes	12.6	Yes	10.2	Yes	6.4
9/11/2003	17.7	12.7	29.0	17.9	17.8	-0.1			16.0	Yes	16.1	Yes	13.4	Yes	10.7	Yes	6.6

Data and Calculated Values of Water Temperatures and Flow Rates for a Hypothetical Groundwater Augmentation Alternative in the Lower Bull Run River (Based on 2003 Data)

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9/12/2003	16.3	13.3	22.0	16.3	18.3	2.0			16.0	Yes	14.0			Yes	15.3	Yes	8.0
9/13/2003	20.9	12.6	19.0	16.1	17.9	1.8			16.0	Yes	14.2	Yes	17.2	Yes	11.6	Yes	5.9
9/14/2003	20.5	12.2	18.0	16.3	17.1	0.8			16.0	Yes	15.2	Yes	8.6	Yes	6.0	Yes	3.1
9/15/2003	15.5	11.9	18.0	16.4	16.6	0.2			16.0	Yes	15.8	Yes	4.5	Yes	3.2	Yes	1.7
9/16/2003	13.8	11.5	18.0	16.6	15.6	-1.0			16.0								
9/17/2003	13.1	11.0	18.0	16.6	16.7	0.1			16.0	Yes	15.9	Yes	4.8	Yes	3.5	Yes	1.9
9/18/2003	18	11.3	18.0	16.7	16.7	0.0			16.0	Yes	16.0	Yes	4.7	Yes	3.4	Yes	1.9
9/19/2003	15.2	11.8	18.0	16.7	16.3	-0.4			16.0	Yes	16.4	Yes	2.0	Yes	1.5	Yes	0.8
9/20/2003	16.7	11.5	18.0	16.7	16.9	0.2			16.0	Yes	15.8	Yes	6.0	Yes	4.4	Yes	2.4
9/21/2003	19.7	11.2	18.0	16.6	16.9	0.3			16.0	Yes	15.7	Yes	6.2	Yes	4.5	Yes	2.5
9/22/2003	20.6	11.5	18.0	16.4	17.1	0.7			16.0	Yes	15.3	Yes	8.3	Yes	5.8	Yes	3.1
9/23/2003	20	11.8	17.0	16.4	17.2	0.8			16.0	Yes	15.2	Yes	8.5	Yes	6.0	Yes	3.2
9/24/2003	21.7	11.9	17.0	16.5	17.4	0.9			16.0	Yes	15.1	Yes	9.5	Yes	6.8	Yes	3.7
Min	12.3	11.0	17.0	12.3	13.6	-1.0			16.0		8.7		2.0		1.5		0.8
Mean	23.6	16.5	35.9	15.3	19.4	4.1			17.2		13.1		18.8		21.0		13.5
Max	34.0	20.8	78.0	18.2	21.4	7.8			20.8		17.0		49.5		52.8		32.0
Count	97.0	79.0	97.0	97.0	97.0	97.0			97.0		92.0		26.0		45.0		82.0