

**ROBERT WELLNITZ – SITE 23  
STREAMBANK STABILIZATION PROJECT**

**NEOSHO RIVER  
LYON COUNTY KANSAS**



**PROJECT DESIGN AND REPORT**

**by**

**T H E  
WATERSHED  
I N S T I T U T E**

## **BACKGROUND**

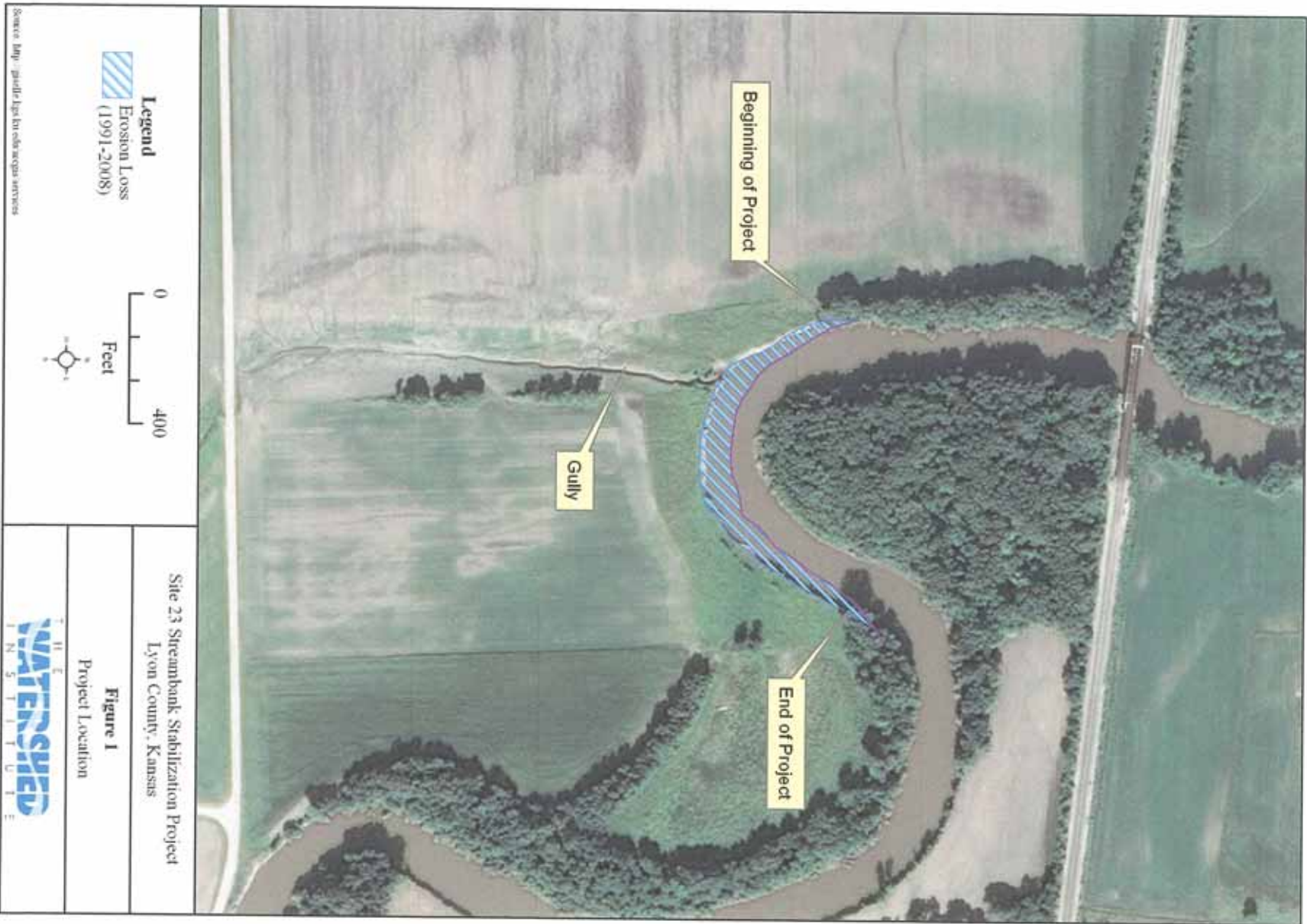
The Kansas Water Office (KWO) submitted this streambank stabilization project to Kansas Department of Health and Environment (KDHE) and was approved for funding as part of the American Recovery and Reinvestment Act (ARRA) of 2009. Watershed Institute, Inc. (TWI) staff started the survey on August 21, 2009 and finished on August 24, 2009. At the time of the survey, the Neosho River was at base flow with an average gage height of 1.35 feet. TWI designed rock structures to stabilize 1,484 feet of eroding streambank (see Figure 1). This project has experienced accelerated streambank erosion due to near-vertical banks and no mature riparian corridor. In addition, a large gully discharged at the site that began at the county road (see Figure 1). TWI's survey incorporated this feature as part of the streambank stabilization survey. Based on aerial photo interpretation from 1991 and 2008 aerial photographs, TWI calculated an average streambank erosion rate of 3.6 feet per year. A photolog is included in Appendix A documenting the project at various stages.

## **DESIGN**

The stabilization design consisted of 4 stream bars, 6 rock vanes, 1 rock chute, and 1,110 feet of longitudinal peaked stone toe protection (LPSTP). The streambanks were comprised of silty loam and silty clay and there was little surface protection along the entire eroding bank. The design called for shaping 1,350 feet of the total 1,484 feet of eroding streambank to a 3 foot horizontal to 1-foot vertical slope. In addition, a 12-foot wide bench was also designed approximately 10-feet above the base flow water elevation. The elevation of the bench is approximately the elevation of a small berm on the left descending bank. After bank shaping, TWI's design included constructing a small berm along the top-of-bank to direct surface runoff around the graded slope or to the rock chute. This will reduce the potential for rill and gully erosion on the graded slope. This berm is not to exceed 1 foot high. Following construction, the sloped area is to be seeded and mulched to help prevent erosion.

TWI also designed an earthen structure to direct overland flow to the Neosho River and south along a drainage ditch. Prior to the late 1990s, overland flow naturally flowed south along a drainage ditch. After several large runoff events, the water course changed causing water to flow north towards the Neosho River. This caused accelerated gully erosion as water dropped into the Neosho River. TWI designed a rock chute to provide overland flow a stable path to the Neosho River.

TWI did issue a change order to the design prior to construction. Both the earthen berm and rock chute were omitted. The change order instructed the contractor to use the excavated material to reconstruct the bank to its original height at the gully. Also, the gully was to be filled and graded so that overland flow will flow towards the south, away from the stabilization project. A design addendum is included in Appendix B.



## PERMITS

TWI completed a U.S. Army Corps of Engineers (USACE) 404 permit, a Kansas Department of Agriculture Division of Water Resources (DWR) Stream Obstruction Permit, a KDHE Notice of Intent for Authorization to Discharge Stormwater Runoff from Construction Activities, and a Lyon County Floodplain Development Permit. The contractor began construction after all regulatory agencies issued their respective permits. Table 1 includes the permit number and the issue dates.

Table 1: Construction Permits

Permit	Date Issued	Permit Number
USACE 404	1/29/2010	NWK-2009-01998
DWR Stream Obstruction	12/04/09	CLY-0079
KDHE NOI	11/20/09	S-NE-50-0010 KSR106495
Lyon County Floodplain	12/18/2010	F2009052

## CONSTRUCTION

Ebert Construction began work on September 6, 2010 and finished the week of October 3, 2010. TWI made six site visits during the construction phase. Details from each site visit are found in Appendix C. Ebert Construction had 201 loads of limestone shot rock delivered for placement. This equated to 4,274 tons. The scale ticket summary is provided in Appendix D.

## STREAMBANK VEGETATION AND MULCHING

Ebert Construction is planning to seed and mulch the project this fall once planting conditions become favorable. TWI has instructed Ebert Construction not seed below the bench. The willow cuttings will be planted during dormancy.

## CHECK OUT

TWI completed the check-out survey on October 15, 2010. TWI used a Leica TCR 407 total station to complete the check-out survey. TWI recorded survey points periodically along the right bank, floodplain bench, and berm to capture the bank shaping. TWI also collected survey points on each stream barb, rock vane, and LPSTP. The survey file and accompanying legend are attached as Appendix E.

TWI created a set of “As-Built” drawings from the total station check-out survey. The design drawings show the location of each structure in relation to the designed location in plan view. It also shows the finished channel slope in relation to the preconstruction bank condition. A set of

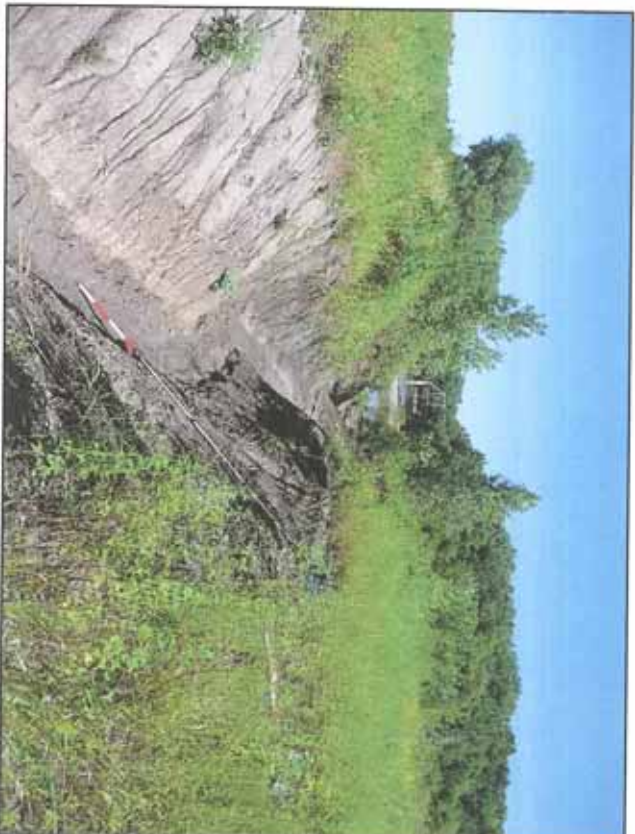
As-Built Drawings is attached at the end of this document. TWI determined the contractor moved 20,093 cubic yards of dirt to complete the bank shaping (see Table 3). A quantity summary is included in Table 2.

**Table 2: Quantity Summary Table**

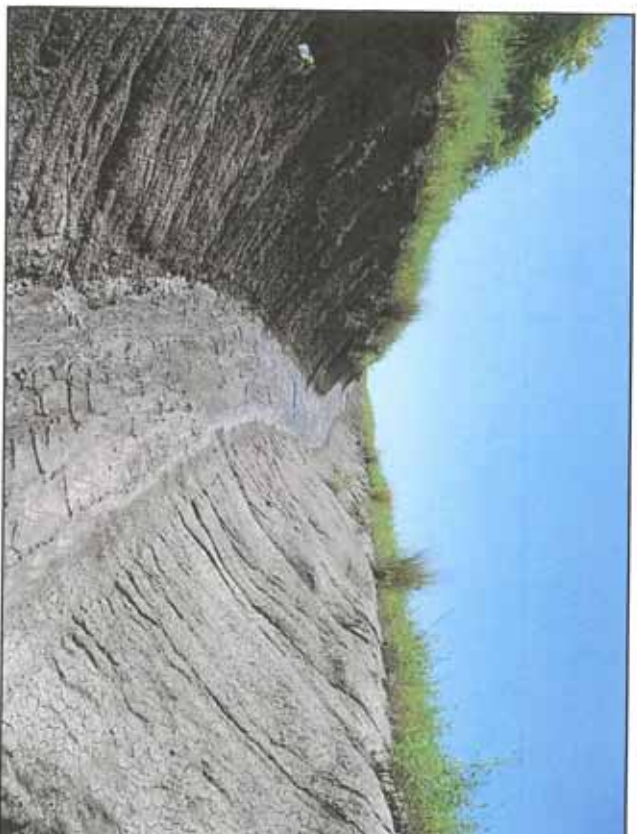
<b>Material</b>	<b>Designed Quantity</b>	<b>Applied Quantity</b>	<b>Units</b>
Limestone Shot Rock	4,167	4,272	Tons
Soil Moving	17,437	20,093	Cubic Yards

*APPENDIX A*  
*PHOTOLOG*

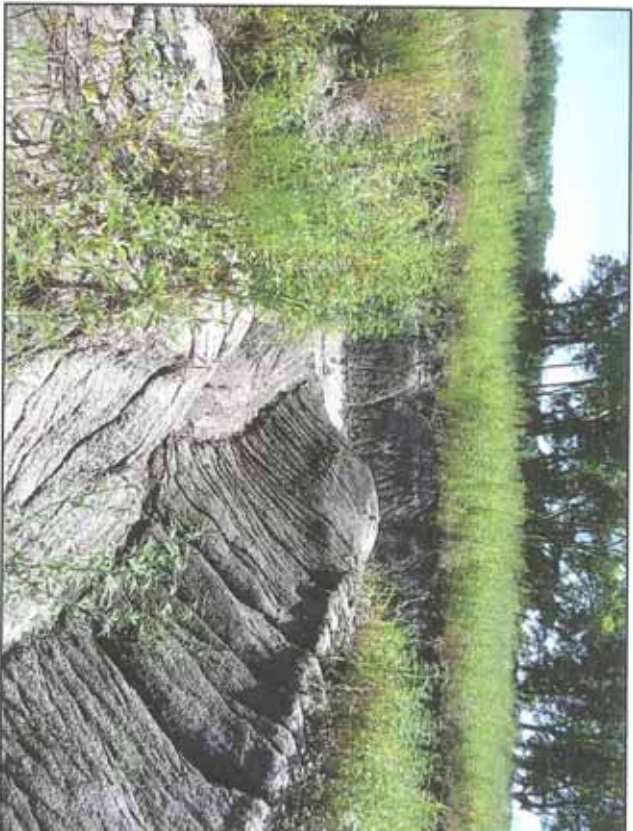
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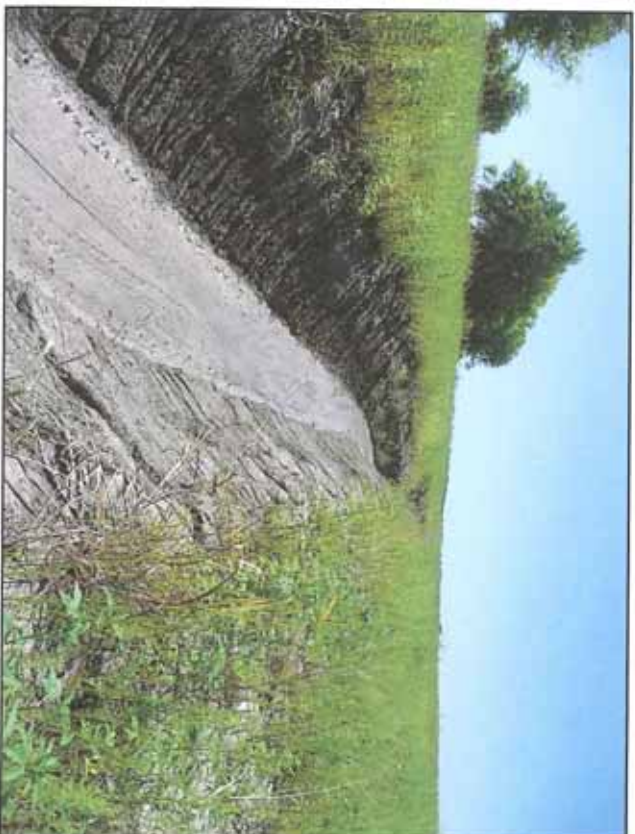
Robert Wellnitz Site 23 Streambank Stabilization Project Direction: North		DESCRIPTION	Gully Erosion	1
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	August 21, 2009



Robert Wellnitz Site 23 Streambank Stabilization Project Direction: South		DESCRIPTION	Gully Erosion	2
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	August 21, 2009



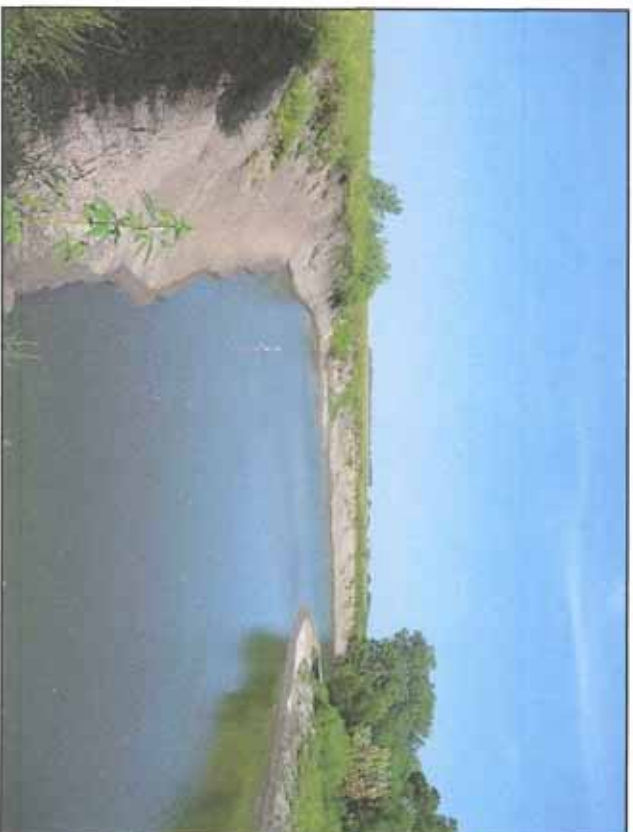
Robert Wehnitz Site 23 Streambank Stabilization Project Direction: East		Gully Erosion	3
DESCRIPTION	LOCATION	Neosho River, Lyon County	Date August 21, 2009
PHOTOGRAPHER	PHOTOGRAPHER		
		Brook Emmert	



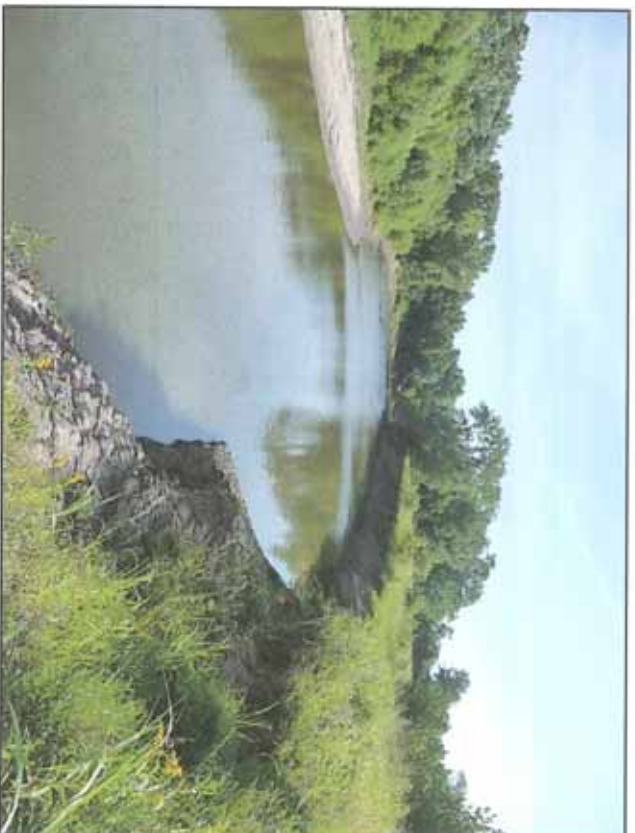
Robert Wehnitz Site 23 Streambank Stabilization Project Direction: South		Gully Erosion	4
DESCRIPTION	LOCATION	Neosho River, Lyon County	Date August 21, 2009
PHOTOGRAPHER	PHOTOGRAPHER		
		Brook Emmert	



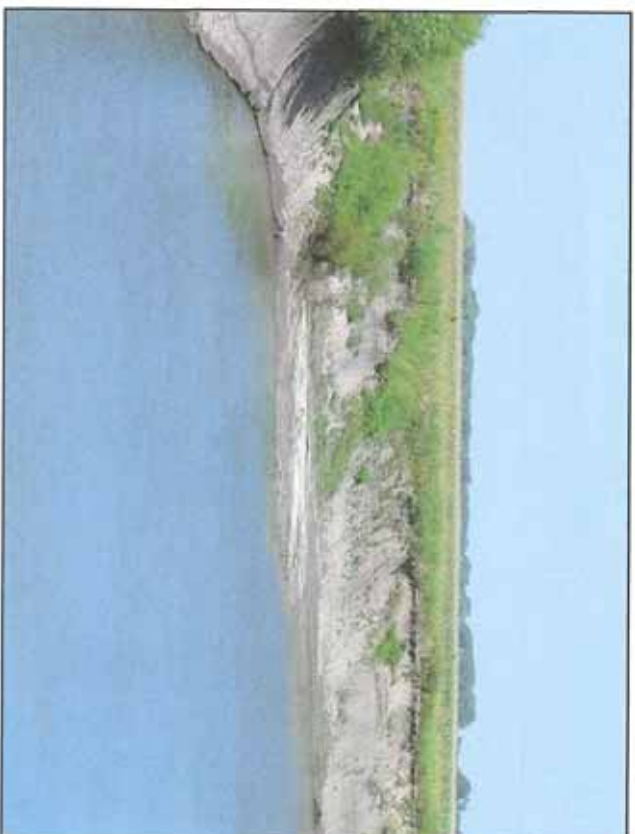
Robert Wehnitz Site 23 Streambank Stabilization Project Direction: South		DESCRIPTION	Gully Erosion	5
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	August 21, 2009



Robert Wehnitz Site 23 Streambank Stabilization Project Direction: West		DESCRIPTION	Right Bank Erosion	6
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	August 24, 2009



Robert Wehnitz Site 23 Streambank Stabilization Project		Right Bank Erosion	7
DESCRIPTION	LOCATION	Neosho River, Lyon County	Date August 24, 2009
PHOTOGRAPHER			
Direction: Northeast		Brock Emmert	



Robert Wehnitz Site 23 Streambank Stabilization Project		Right Bank Erosion and Gully Delta	8
DESCRIPTION	LOCATION	Neosho River, Lyon County	Date August 24, 2009
PHOTOGRAPHER			
Direction: West		Brock Emmert	



Robert Wellnitz Site 23 Streambank Stabilization Project		Right Bank and LPSTP Construction	9
Direction: Northeast		Neosho River, Lyon County	Date
DESCRIPTION	LOCATION	PHOTOGRAPHER	Sept. 27, 2009



Robert Wellnitz Site 23 Streambank Stabilization Project		Right Bank and Bench Construction	10
Direction: East		Neosho River, Lyon County	Date
DESCRIPTION	LOCATION	PHOTOGRAPHER	Sept. 27, 2009



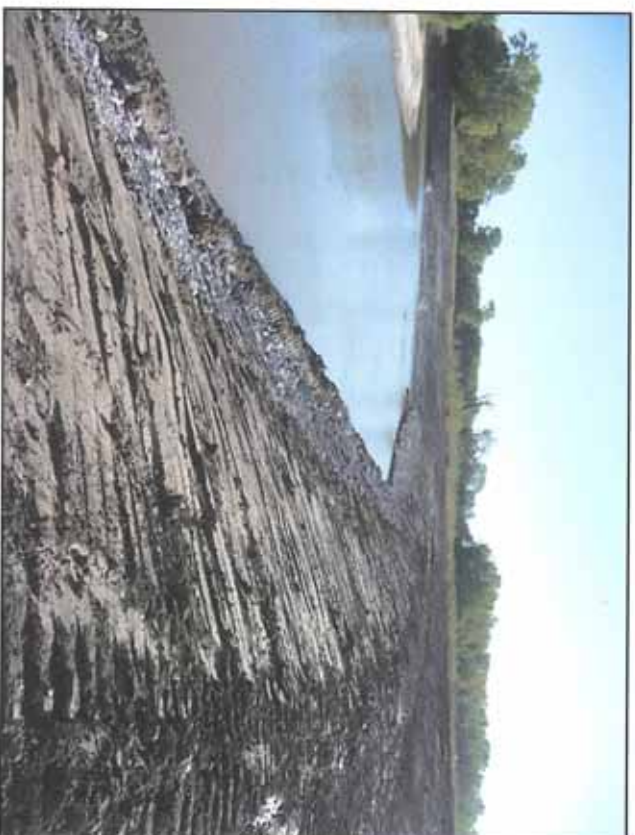
<b>Robert Wehnitz Site 23 Streambank Stabilization Project</b> Direction: Northeast		<b>DESCRIPTION</b> Right Bank, Bench and LPSTP Construction	<b>11</b>
<b>LOCATION</b> Neosho River, Lyon County		<b>PHOTOGRAPHER</b> Brock Emmert	<b>Date</b> Oct. 4, 2010
<b>PHOTOGRAPHER</b> Brock Emmert			



<b>Robert Wehnitz Site 23 Streambank Stabilization Project</b> Direction: East		<b>DESCRIPTION</b> Right Bank and Berm Construction	<b>12</b>
<b>LOCATION</b> Neosho River, Lyon County		<b>PHOTOGRAPHER</b> Brock Emmert	<b>Date</b> Oct. 4, 2010
<b>PHOTOGRAPHER</b> Brock Emmert			



Robert Wehnitz Site 23 Streambank Stabilization Project		DESCRIPTION	Right Bank and Bench Construction	13
Direction: Northwest		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	Oct. 4, 2010



Robert Wehnitz Site 23 Streambank Stabilization Project		DESCRIPTION	Right Bank, Bench and LPSTP Construction	14
Direction: East		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	Oct. 15, 2010



Robert Wehritz Site 23 Streambank Stabilization Project Direction: East		DESCRIPTION	LPSTP and Vane 2 Construction	15
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	Oct. 15, 2010



Robert Wehritz Site 23 Streambank Stabilization Project Direction: East		DESCRIPTION	Right Bank and LPSTP Construction	16
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brock Emmert	Oct. 15, 2010



Robert Welnitz Site 23 Streambank Stabilization Project Direction: North		DESCRIPTION	LPSTP, Bench, Vane 4 and Vane 5 Construction	17
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brook Emmert	Oct. 15, 2010



Robert Welnitz Site 23 Streambank Stabilization Project Direction: Southwest		DESCRIPTION	LPSTP and Vane 4 Construction	18
		LOCATION	Neosho River, Lyon County	Date
		PHOTOGRAPHER	Brook Emmert	Oct. 15, 2010

***APPENDIX B***  
***DESIGN ADDENDUM***

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**KDHE ARRA PROJECT  
NEOSHO RIVER – SITE 23**

**STREAMBANK STABILIZATION PROJECT**

**ADDENDUM NO. 1**

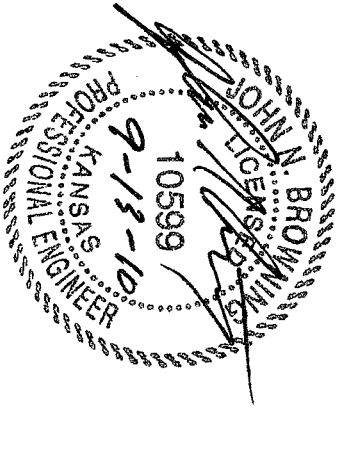
**SEPTEMBER 13, 2010**

The contractors for the above reference project shall take note of the following changes, additions, deletions, clarifications to the Plans that shall become a part of and have precedence over anything shown or described in the Contract Documents and shall be taken into consideration and be included with Contract Documents for the reference project.

**DRAWINGS**

**DKAWING C02:** Keeter to Kock Curve #1. This structure shall be removed. The contractor shall place the excavated rock along the bank toe and fill in eroded area with excavated material. The contractor shall shape the bank to match surrounding bank shaping grade.

**DKAWING C02:** Keeter to Earth Berm. This structure and subsequent grading information shall be removed. The contractor shall fill gully erosion ditch with excavated bank material directing overland flow to south, away from the Neosho River.



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John N. Browning, P.E.

*APPENDIX C*

*TWI FIELD NOTES*

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**APPENDIX C**  
**TWI Field Notes**  
**Site 23 Streambank Stabilization Project**

**August 21, 2009**

TWI staff—Brook Emmert, Ryan McCurdy, Chris Mammoliti, Trebor Besser, and Randy Clear—began the topographic survey and geomorphology data collection using a Leica TCR407 total station.

**August 24, 2009**

TWI staff—Brook Emmert, Ryan McCurdy, Chris Mammoliti, Trebor Besser, and Randy Clear—finished the topographic survey and geomorphology data collection using a Leica TCR 407 total station.

**August 31, 2010**

TWI staff—Brook Emmert, and Ryan McCurdy—met with Ebert Construction and construction staked top of bank catch points. Based on total station survey data, the project did not lose much bank. TWI and Ebert Construction discussed placing the Longitudinal Peaked Stone Toe Protection (LPSTP) back into the bank so the contractor can work in dry conditions. TWI agreed with the approach as rock placement would be easier for the contractor and would not change the design approach. To accommodate this strategy, TWI moved the catch point stakes back 2 feet at stations 1+50, 7+00, 8+00, 12+00, 12+50, and 13+00.

**September, 13 2010**

TWI staff—Brook Emmert—met with Ebert Construction and the landowner. TWI discussed with them possible design alternatives to the rock chute design. All parties agreed to reconstruct the right top of bank at the gully and to use the excavated material to fill the gully feature. Ebert Construction then will grade the gully area so that overland flow will flow south towards the county road. TWI followed up with the engineer and drafted a design addendum.

**September 27, 2010**

TWI staff—Brook Emmert and Ryan McCurdy—arrived on-site to oversee construction. Ebert Construction has completed rock placement from the downstream extent to station 8+00. Ebert Construction informed TWI that there will be a small rock overage as a section around station 10+00 required more rock to adequately build the LPSTP. TWI also surveyed in spot elevations along the gully to verify elevations for Ebert Construction. Based on the elevation data, it is likely that water will pond north of the county road bridge as elevations are slightly higher south of the bridge. TWI discussed the situation with the landowner, and it was agreed to continue as planned.

**October 4, 2010**

TWI staff—Brook Emmert and Ryan McCurdy—arrived on-site to oversee construction. Ebert Construction is placing rock for stream barb 1. TWI noticed some bank toe erosion between rock vane 5 and 6 and instructed the contractor to add rock along the bank toe to further stabilize the area. Finally, TWI staked the catch point at station 5+00.

**October 6, 2010**

TWI staff—Brock Emmert—arrived on-site to oversee construction per the contractor's request. Ebert Construction wanted to verify the elevation of the floodplain bench. A section of the project (10+00 – 13+00) contained materials that were saturated and unstable. As a result, Ebert Construction left the floodplain bench elevation higher than the design. TWI approved the elevation and instructed Ebert to gradually lower the elevation once bank conditions became favorable. Overall, the bench will likely be higher than designed.

**October 7, 2010**

TWI staff—Brock Emmert and Ryan McCurdy—arrived on-site to oversee construction. Ebert Construction is building LPSTP around station 2+50.

**October 11, 2010**

TWI staff—Brock Emmert, Chris Mammoliti, and Ryan McCurdy—arrived on-site to complete a final walk-through. TWI approves the rock placement and bank shaping work and will schedule the check-out survey.

**October 15, 2010**

TWI staff—Brock Emmert, Chris Mammoliti, and Ryan McCurdy—arrived on-site and completed the As-Built survey using a Leica TCR407 total station.

***APPENDIX D***

***ROCK HAULING SUMMARY***

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Site 23 Rock Quantity Summary

Date	Quarry	Product	Ticket #	Gross	Tare	Net	Tons
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253744	60,400	25,480	34,920	17.46
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253747	60,900	25,480	35,420	17.71
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253750	58,500	25,480	33,020	16.51
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253756	56,000	25,480	30,520	15.26
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253760	59,500	25,480	34,020	17.01
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253763	62,100	25,480	36,620	18.31
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253766	62,200	25,480	36,720	18.36
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253769	58,800	25,480	33,320	16.66
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253774	55,800	25,480	30,320	15.16
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253743	78,400	31,900	46,500	23.25
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253746	76,400	31,900	44,500	22.25
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253749	78,900	31,900	47,000	23.50
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253755	76,200	31,900	44,300	22.15
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253759	79,300	31,900	47,400	23.70
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253762	78,900	31,900	47,000	23.50
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253764	85,200	31,900	53,300	26.65
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253768	80,800	31,000	49,800	24.90
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253771	77,500	31,900	45,600	22.80
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253770	80,300	34,400	45,900	22.95
8/25/2010	Harshman Construction L.L.C.	Shot Rock	253767	81,700	34,400	47,300	23.65
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253802	79,900	34,400	45,500	22.75
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253799	80,600	34,400	46,200	23.10
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253796	81,700	34,400	47,300	23.65
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253793	78,000	34,401	43,599	21.80
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253790	78,400	34,400	44,000	22.00
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253787	78,000	34,400	43,600	21.80
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253784	81,000	34,400	46,600	23.30
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253781	81,800	34,400	47,400	23.70
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253778	78,700	34,400	44,300	22.15
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253779	79,500	31,900	47,600	23.80
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253782	81,700	31,900	49,800	24.90
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253785	80,000	31,900	48,100	24.05
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253788	81,500	31,900	49,600	24.80
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253791	80,600	31,900	48,700	24.35
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253794	80,000	31,900	48,100	24.05
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253797	80,900	31,900	49,000	24.50
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253800	78,700	31,900	46,800	23.40
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253803	79,400	31,900	47,500	23.75
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253780	59,700	25,480	34,220	17.11
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253783	60,700	25,480	35,220	17.61
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253786	60,600	25,480	35,120	17.56
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253789	59,400	25,480	33,920	16.96
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253792	59,000	25,480	33,520	16.76
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253795	59,400	25,480	33,920	16.96
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253798	55,700	25,480	30,220	15.11

Site 23 Rock Quantity Summary

Date	Quarry	Product	Ticket #	Gross	Tare	Net	Tons
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253801	56,400	25,480	30,920	15.46
8/26/2010	Harshman Construction L.L.C.	Shot Rock	83564	83,800	31,900	51,900	25.95
8/26/2010	Harshman Construction L.L.C.	Shot Rock	253805	60,500	25,480	35,020	17.51
8/27/2010	Harshman Construction L.L.C.	Shot Rock	253810	57,500	25,480	32,020	16.01
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83554	62,200	25,480	36,720	18.36
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83557	60,100	25,480	34,620	17.31
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83560	59,000	25,480	33,520	16.76
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83563	56,200	25,480	30,720	15.36
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83566	56,200	25,480	30,720	15.36
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83569	60,900	25,480	35,420	17.71
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83572	57,900	25,480	32,420	16.21
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83575	61,100	25,480	35,620	17.81
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83574	80,600	34,400	46,200	23.10
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83571	81,900	34,400	47,500	23.75
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83568	81,300	34,400	46,900	23.45
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83565	84,700	34,400	50,300	25.15
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83562	79,800	34,401	45,399	22.70
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83559	80,300	34,400	45,900	22.95
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83556	81,500	34,400	47,100	23.55
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83552	84,500	34,400	50,100	25.05
8/27/2010	Harshman Construction L.L.C.	Shot Rock	253809	82,900	34,400	48,500	24.25
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83573	85,200	31,900	53,300	26.65
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83551	82,900	31,900	51,000	25.50
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83555	80,600	31,900	48,700	24.35
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83558	79,800	31,900	47,900	23.95
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83561	80,400	31,900	48,500	24.25
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83567	82,200	31,900	50,300	25.15
8/27/2010	Harshman Construction L.L.C.	Shot Rock	83570	81,300	31,900	49,400	24.70
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71304	62,400	25,500	36,900	18.45
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71306	60,700	21,900	38,800	19.40
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71307	62,170	21,840	40,330	20.17
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71309	83,800	32,000	51,800	25.90
9/28/2010	Harshman Construction L.L.C.	Shot Rock	731318	86,300	32,000	54,300	27.15
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71317	59,030	21,840	37,190	18.60
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71312	84,000	34,200	49,800	24.90
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71314	63,000	25,500	37,500	18.75
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71315	61,800	21,900	39,900	19.95
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340304	84,400	34,200	50,200	25.10
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340306	62,800	25,500	37,300	18.65
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340307	56,600	21,900	34,700	17.35
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71302	80,000	32,000	48,000	24.00
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71301	59,500	21,840	37,660	18.83
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71303	81,700	34,200	47,500	23.75
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340292	56,400	21,900	34,500	17.25
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340290	82,600	34,200	48,400	24.20

Site 23 Rock Quantity Summary

Date	Quarry	Product	Ticket #	Gross	Tare	Net	Tons
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340291	57,600	25,500	32,100	16.05
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340294	54,700	21,840	32,860	16.43
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340293	81,700	32,000	49,700	24.85
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340297	84,600	34,200	50,400	25.20
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340298	57,100	25,500	31,600	15.80
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340299	59,700	21,900	37,800	18.90
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340300	56,780	21,840	34,940	17.47
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340301	83,200	32,000	51,200	25.60
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340281	55,620	21,840	33,780	16.89
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340283	80,600	34,200	46,400	23.20
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340284	59,000	25,500	33,500	16.75
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340285	54,900	21,900	33,000	16.50
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340286	80,600	32,000	48,600	24.30
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340287	54,830	21,840	32,990	16.50
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340276	83,200	34,200	49,000	24.50
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340277	55,400	25,500	29,900	14.95
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340279	58,100	21,900	36,200	18.10
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340278	84,200	32,000	52,200	26.10
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340264	84,300	34,200	50,100	25.05
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340267	60,800	25,500	35,300	17.65
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340265	82,800	32,000	50,800	25.40
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340268	61,600	21,900	39,700	19.85
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340271	59,000	25,500	33,500	16.75
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340270	84,200	34,200	50,000	25.00
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340272	83,200	32,000	51,200	25.60
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340274	56,400	21,900	34,500	17.25
9/28/2010	Harshman Construction L.L.C.	Shot Rock	340275	57,490	21,840	35,650	17.83
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71323	58,900	25,500	33,400	16.70
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71324	60,300	21,900	38,400	19.20
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71322	84,200	34,200	50,000	25.00
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71332	56,400	21,900	34,500	17.25
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71331	56,000	25,500	30,500	15.25
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71330	80,200	34,200	46,000	23.00
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71325	56,970	21,840	35,130	17.57
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71327	80,800	32,000	48,800	24.40
9/28/2010	Harshman Construction L.L.C.	Shot Rock	71333	59,790	21,840	37,950	18.98
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71343	56,000	25,500	30,500	15.25
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71338	83,300	34,200	49,100	24.55
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71342	84,500	34,200	50,300	25.15
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71339	58,600	25,500	33,100	16.55
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71348	84,500	34,200	50,300	25.15
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71350	60,600	25,500	35,100	17.55
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71354	80,300	32,000	48,300	24.15
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71356	81,300	34,200	47,100	23.55
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71360	76,800	32,000	44,800	22.40

Site 23 Rock Quantity Summary

Date	Quarry	Product	Ticket #	Gross	Tare	Net	Tons
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71365	80,900	34,200	46,700	23.35
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71369	79,800	32,000	47,800	23.90
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71373	81,500	34,200	47,300	23.65
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71374	60,000	25,500	34,500	17.25
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71380	84,300	34,200	50,100	25.05
9/29/2010	Harshman Construction L.L.C.	Shot Rock	71378	82,000	32,000	50,000	25.00
9/29/52010	Harshman Construction L.L.C.	Shot Rock	71382	55,200	25,500	29,700	14.85
9/30/2010	Harshman Construction L.L.C.	Shot Rock	71347	80,000	32,000	48,000	24.00
9/30/2010	Harshman Construction L.L.C.	Shot Rock	71340	81,200	32,000	49,200	24.60
9/30/2010	Harshman Construction L.L.C.	Shot Rock	340269	57,810	21,840	35,970	17.99
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83608	81,600	31,900	49,700	24.85
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83605	82,800	31,900	50,900	25.45
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83602	78,900	31,900	47,000	23.50
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83599	81,200	31,900	49,300	24.65
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83595	82,100	31,900	50,200	25.10
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83593	79,600	31,900	47,700	23.85
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83590	84,000	31,900	52,100	26.05
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83587	84,200	31,900	52,300	26.15
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83585	80,300	31,900	48,400	24.20
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83609	82,100	34,400	47,700	23.85
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83606	81,600	34,400	47,200	23.60
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83603	78,900	34,400	44,500	22.25
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83600	83,700	34,400	49,300	24.65
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83597	80,300	34,400	45,900	22.95
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83594	79,900	34,400	45,500	22.75
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83591	80,800	34,400	46,400	23.20
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83588	82,400	34,400	48,000	24.00
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83582	81,200	34,400	46,800	23.40
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83584	55,400	25,480	29,920	14.96
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83586	61,500	25,480	36,020	18.01
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83589	58,300	25,480	32,820	16.41
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83592	60,600	25,480	35,120	17.56
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83596	57,800	25,480	32,320	16.16
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83598	60,000	25,480	34,520	17.26
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83601	59,200	25,480	33,720	16.86
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83604	60,100	25,480	34,620	17.31
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83607	59,900	25,480	34,420	17.21
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83610	60,600	25,480	35,120	17.56
8/30/2010	Harshman Construction L.L.C.	Shot Rock	83613	61,800	25,480	36,320	18.16
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83612	80,500	31,900	48,600	24.30
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83627	81,200	34,400	46,800	23.40
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83611	84,200	34,400	49,800	24.90
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83614	82,800	34,400	48,400	24.20
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83617	83,500	34,400	49,100	24.55
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83620	83,700	34,400	49,300	24.65

Site 23 Rock Quantity Summary

Date	Quarry	Product	Ticket #	Gross	Tare	Net	Tons
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83623	80,700	34,400	46,300	23.15
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83630	81,600	34,400	47,200	23.60
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83633	83,400	34,400	49,000	24.50
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83636	80,300	34,400	45,900	22.95
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83641	79,800	34,400	45,400	22.70
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83615	81,700	31,900	49,800	24.90
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83618	81,700	31,900	49,800	24.90
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83621	85,300	31,900	53,400	26.70
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83625	78,000	31,900	46,100	23.05
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83628	83,000	31,900	51,100	25.55
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83631	85,400	31,900	53,500	26.75
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83634	83,800	31,900	51,900	25.95
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83637	83,200	31,900	51,300	25.65
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83640	59,700	25,480	34,220	17.11
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83635	59,700	25,480	34,220	17.11
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83632	58,000	25,480	32,520	16.26
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83629	62,300	25,480	36,820	18.41
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83626	59,800	25,480	34,320	17.16
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83622	55,800	25,480	30,320	15.16
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83619	59,000	25,480	33,520	16.76
8/31/2010	Harshman Construction L.L.C.	Shot Rock	83616	56,200	25,480	30,720	15.36
<b>TOTAL</b>						<b>4,274</b>	

*APPENDIX E*

*AS-BUILT SURVEY INFORMATION*

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**Survey Note Abbreviations and Definitions**  
**Robert Wellnitz Site 23 As-Built Survey**

Abbreviation	Definition
BNC	Floodplain Bench
EV1	Edge of Vane / Vane Number
G	Ground
LPSTP	Longitudinal Peaked Stone Toe Protection
RC	Rock Chute
REW	Right Edge of Water
RTB	Right Top of Bank
STB1	Stream Barb / Barb Number
TB	Top of Berm
TS	Total Station
TV	Top of Vane
V2K	Vane / Vane Number / Key

**Robert Welnitz Site 23 Asbuilt Survey Data**

<b>Point Number</b>	<b>Northing</b>	<b>Easting</b>	<b>Elevation</b>	<b>Description</b>
2000	4806.01	5100.55	1101.09	TS
2001	5265.28	4926.74	1100.53	G
2002	5264.19	4937.43	1101.26	TB
2003	5263.74	4943.79	1101.25	TB
2004	5264.01	4948.20	1100.22	RTB
2005	5231.59	4922.57	1100.96	G
2006	5230.24	4931.83	1102.16	TB
2007	5230.66	4939.90	1101.75	TB
2008	5230.66	4945.10	1101.01	RTB
2009	5199.36	4920.79	1100.62	G
2010	5198.61	4929.05	1101.75	TB
2011	5197.25	4937.24	1101.83	TB
2012	5197.16	4943.87	1100.75	RTB
2013	5197.86	4960.59	1092.80	RB
2014	5201.34	4976.54	1084.22	LPSTP
2015	5203.14	4982.61	1080.83	REW
2016	5223.93	4971.79	1084.54	TV1
2017	5221.93	4961.48	1090.77	V1K
2018	5239.05	4974.17	1080.99	EV1
2019	5259.83	4984.50	1077.44	EV1
2020	5223.47	4978.45	1081.19	EV1
2021	5142.23	4982.88	1084.87	LPSTP
2022	5143.29	4990.31	1080.89	REW
2023	5140.50	4963.75	1092.64	RB
2024	5138.59	4939.81	1100.42	RTB
2025	5138.04	4934.42	1101.56	TB
2026	5137.82	4928.75	1101.63	TB
2027	5137.56	4918.94	1100.14	G
2028	5065.89	4924.53	1100.51	G
2029	5066.83	4932.81	1101.56	TB
2030	5067.06	4940.24	1101.40	TB
2031	5067.74	4945.09	1100.80	RTB
2032	5070.59	4965.45	1094.87	BNC
2033	5072.10	4973.06	1094.03	BNC
2034	5070.72	4987.41	1088.88	RB
2035	5069.47	5000.13	1084.20	TV2
2036	5079.08	5004.07	1080.82	EV2
2037	5101.71	5016.18	1077.90	EV2
2038	5064.33	5007.40	1080.83	EV2
2039	5013.13	5016.64	1080.98	REW
2040	5010.59	5009.16	1084.37	LPSTP
2041	5004.81	4994.21	1091.82	BNC
2042	5000.45	4984.08	1092.05	BNC
2043	4989.84	4959.31	1100.74	RTB
2044	4988.04	4955.97	1101.57	TB

**Robert Wellnitz Site 23 Asbuilt Survey Data**

<b>Point Number</b>	<b>Northing</b>	<b>Easting</b>	<b>Elevation</b>	<b>Description</b>
2045	4984.68	4948.23	1101.66	TB
2046	4978.70	4933.44	1100.00	G
2047	4862.45	4995.25	1098.79	G
2048	4871.76	5008.73	1100.11	TB
2049	4877.05	5014.76	1100.19	TB
2050	4879.36	5017.26	1099.71	RTB
2051	4895.98	5039.76	1092.11	BNC
2052	4904.04	5051.29	1091.22	BNC
2053	4917.78	5065.16	1085.10	TV3
2054	4938.23	5057.88	1081.74	EV3
2055	4966.74	5057.60	1081.55	EV3
2056	4920.35	5076.21	1081.06	EV3
2057	4878.78	5125.73	1080.95	LPSTP
2058	4871.62	5122.91	1084.40	LPSTP
2059	4854.11	5111.90	1092.27	BNC
2060	4844.16	5105.79	1092.10	BNC
2061	4817.20	5090.13	1100.59	RTB
2062	4815.03	5088.96	1101.05	TB
2063	4808.88	5084.91	1100.96	TB
2064	4786.73	5071.31	1099.62	G
2065	4761.18	5128.21	1099.65	G
2066	4779.20	5137.52	1100.94	TB
2067	4785.93	5141.22	1100.93	TB
2068	4817.74	5154.05	1092.71	BNC
2069	4829.49	5158.94	1092.47	BNC
2070	4849.90	5164.59	1084.70	LPSTP
2071	4863.83	5160.15	1080.73	STB1
2072	4855.41	5175.60	1080.75	STB1
2073	4831.23	5232.64	1080.89	REW
2074	4821.62	5230.31	1085.57	LPSTP
2075	4803.24	5223.83	1092.63	BNC
2076	4790.77	5219.42	1092.97	BNC
2077	4761.40	5208.09	1100.55	RTB
2078	4753.00	5204.94	1101.01	TB
2079	4742.24	5198.64	1099.19	G
2080	4725.84	5267.81	1099.41	G
2081	4737.66	5270.54	1101.37	TB
2082	4743.86	5272.48	1101.36	TB
2083	4775.52	5277.33	1092.90	BNC
2084	4788.01	5279.79	1092.70	BNC
2085	4810.95	5279.89	1085.01	LPSTP
2086	4821.20	5274.27	1081.47	STB2
2087	4818.62	5287.44	1081.26	STB2
2088	4805.98	5352.14	1080.57	REW
2089	4793.61	5349.50	1085.97	LPSTP

**Robert Wellnitz Site 23 Asbuilt Survey Data**

<b>Point Number</b>	<b>Northing</b>	<b>Easting</b>	<b>Elevation</b>	<b>Description</b>
2090	4773.80	5345.98	1092.80	BNC
2091	4761.93	5343.80	1093.08	BNC
2092	4735.59	5338.41	1100.73	RTB
2093	4732.07	5338.67	1101.31	TB
2094	4726.84	5338.74	1101.42	TB
2095	4713.80	5337.91	1099.33	G
2096	4716.95	5430.80	1099.08	G
2097	4729.40	5429.69	1101.00	TB
2098	4735.44	5429.32	1101.01	TB
2099	4765.26	5425.53	1093.29	BNC
2100	4777.18	5421.82	1093.19	BNC
2101	4796.80	5415.30	1086.17	LPSTP
2102	4807.53	5405.18	1081.58	STB3
2103	4812.05	5419.80	1080.75	STB3
2104	4819.53	5460.61	1080.85	REW
2105	4803.76	5463.30	1086.42	LPSTP
2106	4786.20	5464.22	1092.94	BNC
2107	4773.62	5466.13	1093.11	BNC
2108	4745.65	5470.87	1100.03	RTB
2109	4743.23	5472.12	1100.47	TB
2110	4737.71	5474.59	1100.40	TB
2111	4724.95	5478.08	1098.64	G
2112	4740.42	5529.72	1098.10	G
2113	4753.29	5525.47	1099.82	TB
2114	4758.96	5524.20	1099.86	TB
2115	4784.68	5518.31	1092.84	BNC
2116	4796.97	5515.66	1092.32	BNC
2117	4813.57	5511.47	1085.74	LPSTP
2118	4821.24	5499.51	1082.11	ST4
2119	4825.69	5516.03	1080.96	ST4
2120	4855.70	5571.14	1080.60	REW
2121	4846.08	5578.84	1084.92	LPSTP
2122	4832.59	5588.56	1092.47	BNC
2123	4822.78	5595.60	1092.48	BNC
2124	4804.69	5609.60	1098.21	RTB
2125	4802.08	5611.23	1098.87	TB
2126	4798.59	5614.53	1098.84	TB
2127	4787.50	5623.18	1096.94	G
2128	4842.00	5695.74	1095.86	G
2129	4853.16	5684.08	1098.07	TB
2130	4858.74	5679.14	1097.99	TB
2131	4861.04	5677.08	1097.69	RTB
2132	4880.61	5655.80	1090.66	BNC
2133	4887.92	5647.98	1090.39	BNC
2134	4896.28	5637.59	1085.90	TV4

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Point Number	Northing	Easting	Elevation	Description
2135	4891.62	5615.99	1080.79	EV4
2136	4887.71	5592.06	1078.99	EV4
2137	4908.10	5634.48	1080.83	EV4
2138	4957.77	5676.28	1080.78	REW
2139	4948.56	5685.45	1085.28	LPSTP
2140	4938.84	5696.38	1091.11	BNC
2141	4932.12	5705.34	1091.52	BNC
2142	4914.94	5725.94	1098.78	RTB
2143	4913.87	5728.68	1099.17	TB
2144	4910.54	5733.71	1099.04	TB
2145	4899.55	5747.42	1096.18	G
2146	4961.06	5795.53	1098.82	G
2147	4969.04	5782.39	1100.53	TB
2148	4974.70	5773.35	1099.95	TB
2149	4980.62	5765.27	1098.37	RTB
2150	4994.02	5748.49	1090.93	BNC
2151	5011.35	5747.35	1085.61	TV5
2152	5012.33	5740.52	1084.22	TV5
2153	5001.80	5719.45	1081.07	EV5
2154	4997.44	5702.51	1077.99	EV5
2155	5019.52	5739.55	1080.74	EV5
2156	5061.39	5773.66	1080.88	REW
2157	5048.00	5788.44	1092.22	RB
2158	5112.02	5811.24	1080.80	EV6
2159	5110.42	5797.96	1078.65	EV6
2160	5121.05	5814.79	1080.70	EV6
2161	5120.82	5822.59	1082.69	TV6
2162	5128.12	5840.72	1084.70	V6K
2163	5112.91	5845.23	1099.88	RTB
2164	5109.88	5852.35	1100.85	TB
2165	5108.00	5855.65	1101.32	TB
2166	5105.12	5859.97	1101.06	G
2167	5103.35	5865.04	1100.14	G
2168	5043.62	5844.89	1099.88	G
2169	5048.61	5834.79	1100.96	TB
2170	5052.91	5824.40	1100.81	TB
2171	5058.02	5812.31	1099.49	RTB
2172	5064.36	5798.04	1091.11	RB