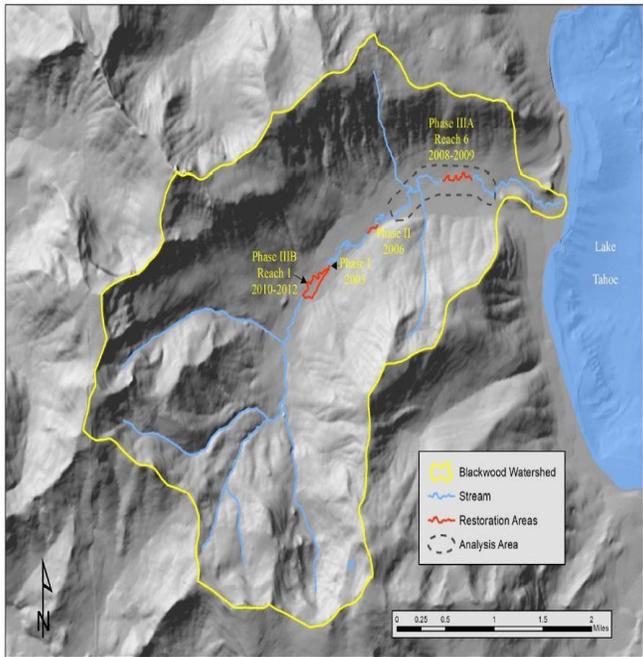


Waterbody: Blackwood Creek	TMDL: Bedded Sediment	Author: Taylor Currier February 18, 2015
---	------------------------------	--

Current Compliance with Sediment Target:
 Maybe...

Background Information



- *Date of approval:* October 2007 (Lahontan); July 11, 2008 (USEPA)
- *Basis for TMDL:* Starting in the late 1800's the Blackwood Creek watershed was used for sheep and cattle grazing, timber harvesting and gravel pit mining; all of which impaired the creek. During gravel mining the creek channel was modified causing an excess of sediment which led to bedded sediment pollution.
- *Project Implementer:* U.S. Forest Service, Lake Tahoe Basin Management Unit.
- *Targets:*
 1. The ecological status of meadow vegetation is late seral (50 percent or more of the relative cover of the herbaceous layer is late seral with high similarity to the potential natural community). A diversity of age classes of hardwood shrubs is present and regeneration is occurring. Vegetative rooting occurs throughout the soil profile; root masses stabilize streambanks against cutting action.
 2. Throughout the project area, the long term average channel sinuosity should be greater than or equal to 1.6 by year 20 following restoration.
 3. The Blackwood Creek stream restoration project should achieve 80 percent bank stability throughout the project area.
- *Attainment of TMDL:* Instream standards projected to occur within 20 years after final approval of TMDL (2028)

USFS Lake Tahoe Basin Management Unit Restoration Phases

Phase 1: Fish Ladder Removal
Replace an antiquated fish ladder with a sequence of step pools and riffles.
 Completed 2003

Phase 2: Barker Pass Road Crossing Replacement
Replaces the Barker Pass Road crossing with a clear span bridge and restores portions of the adjacent channel.
 Completed 2006

Phase 3A: Reach 6 Stream Channel Flood Plain Restoration
Constructed 2,000 feet of new flow path and re-occupied 1,400 feet of abandoned channel to decrease the slope and increase sinuosity. 13 rock-log flow deflection structures and 28 log-based floodplain roughness structures were installed.
 Completed 2008

Phase 3B: Fish Ladder Redesign
Removing the left bank flood berm and extending the grade control weirs cross-valley so that the channel will be free to adjust laterally or from flood and side channels.
 Completed 2012

Permits that include TMDL implementation measures:

NPDES construction activity storm water general permit No. R6T-2005-0007-62

Period of evaluation:

20 Years from TMDL: 2028

Annual Monitoring will be performed during construction activities associated with the Phase 3 restoration project.

Following Phase 3 completion, monitoring and reporting for TMDL purposes will be completed at five year intervals.

[Click here](#) for monitoring schedule

Indicator	Target	Evaluation Schedule	Source Reported	Compliance Comments	Status
Vegetation	<p>(Interim) An increasing trend by year five following restoration in the establishment and maintenance of vegetation along the stream channel and floodplains.</p> <p>(Long term) Ecological status of meadow vegetation is late seral (50% or more of the relative cover of the herbaceous layer is late seral with high similarity to the potential natural community). A diversity of age classes of hardwood shrubs is present and regeneration is occurring. Vegetative rooting occurs throughout the soil profile; root masses stabilize stream banks against cutting action.</p>	<p><i>All Phases</i>-photo points the season following implementation and at 5-year intervals and/or following major flood events</p> <p><i>All Phases</i>-aerial photos in 2001, 2007, and every five to ten years after project completion and/or major storm events.</p> <p><i>Phase 3A</i>-vegetation plots starting in 2010 at five year intervals. Pre-project monitoring in 2008.</p> <p><i>Phase 3B</i> – Pre-project monitoring in 2010.</p>	<p>Blackwood Creek Restoration Effectiveness Monitoring Plan – February 2010</p> <p>Blackwood Creek Reach 6 Restoration (Phase 3A) Effectiveness Monitoring Results – January 2014</p> <p>Blackwood Creek Stream Channel Restoration – December 2013</p>	<p>Phase 3A Reach 6 No quantitative post project effectiveness data is reported at this time. Visual observations and photos indicate that many of the willow stakes planted as part of restoration appear to be taking hold and graminoids and woody vegetation recruitment are beginning to appear in areas where fine sediment has deposited on the floodplain surfaces.</p> <p>Phase 3B Reach 1 1st year post project monitoring indicates that stream shade is 26%. USFS expects this value to increase over time.</p>	<p>USFS LTBMU does not recommend any corrective actions within reach 6 at this time.</p> <p>Reach 1 Phase 3B was recently completed and trends could not be determined from 1 year of post project monitoring.</p>
Channel Sinuosity	<p>(Interim) An increasing trend in channel sinuosity that is maintained following 25 year flood events.</p> <p>(Long term) Throughout the project area, the average channel sinuosity should be greater than or equal to 1.6</p>	<p><i>All Phases</i>-photo points the season following implementation and at 5-year intervals and/or following major flood events.</p> <p><i>All Phases</i>-aerial photos in 2001, 2007, and every five to ten years after project completion and/or major storm events.</p>	<p>Blackwood Creek Restoration Effectiveness Monitoring Plan – February 2010</p> <p>Blackwood Creek Reach 6 Restoration (Phase 3A) Effectiveness Monitoring Results – January 2014</p>	<p>Phase 3A Reach 6 The project area sinuosity is 2.1. The sinuosity over the entire length of Reach 6 is 1.87. Pre-project sinuosity was 1.25 in 2001.</p> <p>Current sinuosity exceeds the interim goal and long term goal.</p>	<p>Phase 3A currently exceeds TMDL standards</p>
Streambank stability	<p>The project should attain 80% bank stability throughout the project</p>	<p><i>Phase 1 and 2</i>-longitudinal profile surveys at five year intervals starting in 2009.</p> <p><i>Phase 3A</i>-stream channel condition inventory at five year intervals starting in 2010.</p>	<p>Blackwood Creek Restoration Effectiveness Monitoring Plan – February 2010</p> <p>Blackwood Creek Reach 6 Restoration (Phase 3A) Effectiveness Monitoring Results – January 2014</p> <p>Blackwood Creek Stream Channel Restoration – December 2013</p>	<p>Phase 3A Reach 6 USFS reports 95% bank stability in reach 6. The long term monitoring Stream Channel Condition Inventory (SCI) Reach represents 35% of the main stem of Blackwood Creek, including Reach 6. The bank stability is 87%</p> <p>Phase 3B Reach 1 98% of project reach has stable banks. Overall bank stability in Reach 1 is 89%.</p>	<p>Phase 3A & Phase 3B currently exceeds TMDL standards</p>

Monitoring Parameter	Monitoring Schedule	Source Reported	Compliance Comments
Channel and floodplain sediment storage	Sediment storage mapping and aerial photos in 2010 & 2019	Annual progress reports; geomorphic indicator trend report (5 years after project completion); TMDL attainment report (10 years after project completion); TMDL achievement report (projected to be 20 years after project completion) Blackwood Creek Reach 6 Restoration (Phase 3A) Effectiveness Monitoring Results – January 2014	The restored Reach 6 has been designed to result in overbank flow at 250 cubic feet per second. The reach experienced floodplain inundation for 61 days in the first three years post construction. Phase 3A: Measurements of sediment retained on the floodplain the first year after restoration indicated retention of 142 tons of silt and clay sized particles.
Groundwater elevations	Currently not included in draft <i>Blackwood Creek Restoration Effectiveness Monitoring Plan</i>		Forest Service will need to update draft <i>Blackwood Creek Restoration Effectiveness Monitoring Plan</i> to include monitoring on groundwater elevations to be in compliance with TMDL requirements
Vegetative cover	Evaluated as a numeric target: photo points, aerial photos, vegetation plots. Phase 3A evaluated with Vegetation Monitoring Plots in 2010, 2014 & 2019		Visual observations and photos indicate that many of the willow stakes planted as part of restoration appear to be taking hold and graminoids and woody vegetation recruitment are beginning to appear in areas where fine sediment has deposited on the floodplain surfaces.
Channel sinuosity	Evaluated as a numeric target: photo points, aerial photos. Evaluated on a 5-year basis with SCI, photopoints & aerial photos. 2010, 2014 & 2019		The project area sinuosity is 2.1. The sinuosity over the entire length of Reach 6 is 1.87. Pre-project sinuosity was 1.25 in 2001.
Channel complexity and diversity	Evaluated as a numeric target: longitudinal profile surveys, stream channel condition inventory on a 5 year basis. 2010, 2014 & 2019		Reach 6: The number of pools increased by over 300% in the restored reach between 2001 and 2011. The number of pools per 100 feet is 2.1. This is comparable to the reference reaches with 2.1 and 2.4
Erosion and sedimentation within and from the project area	Evaluated as a numeric target: sediment mapping with use of aerial photos		The overall bank stability for Reach 6 is 87%. This includes the restored area and the reference reaches upstream and downstream of the site. This is approximately 35% of the main stem of Blackwood Creek.
Channel dynamism	Evaluated as a numeric target: longitudinal profile surveys, stream channel condition inventory, water quality		Reach 6 Phase 3A: The Pool/riffle ratio increased between 2001 and 2011 in the restored reach. In 2001 the ratio was 0.54:1. In 2011 the ratio was 1.94:1. This is comparable to the reference reaches.
Terrestrial and aquatic habitat abundance and diversity	See Monitoring Schedule for macroinvertebrate sampling and vegetation plot monitoring. <i>The LTBMU has limited expertise in the field of macro invertebrate sampling and analysis. It is recommended that the LTBMU support and coordinate with the TRPA macro invertebrate monitoring effort for future macro-invertebrate sampling in this watershed, for better consistency, cost savings and efficiencies in data collection and analysis.</i>		The BMI analysis shows that the condition of the restored reach is comparable to the upstream and downstream reference reaches. None of the reaches are considered “poor” by the California State standards.

Monitoring Schedule

Monitoring Component	2004	2005	2006	2007	2009	2010	2011	2012	2014	2015	2017	2019	2020
Blackwood Creek Phase 1 - Fish Ladder													
Cross sections/longitudinal profiles	X	X	X		X				X				
Photopoints	X	X	X		X				X				
Blackwood Creek Phase 2 - Crossing Replacement													
Cross sections/longitudinal profiles				X				X			X		
Photopoints				X				X			X		
Blackwood Creek Phase 3A - Reach 6 Stream Channel Floodplain Restoration													
<i>Goal/Objective 1: Create stable channel geomorphology</i>													
SCI - including cross sections and longitudinal profiles						X			X			X	
Photopoints					X	X			X			X	
Aerial Photos						X						X	
Macroinvertebrate sampling						X	X		X		X	X	X
<i>Goal/Objective 2: Restore connective of stream channel active incised floodplain</i>													
Vegetation Monitoring Plots						X			X			X	
Photopoints					X	X						X	
Aerial Photos						X						X	
Sediment Storage Mapping						X						X	