3.0 BASELINE ASSESSMENT RESULTS

Watershed Conditions

Size and Land Use

Parleys Creek lies between Emigration Creek to the north and Mill Creek to the south (Figure 3.1). The upper subwatershed, located in Parleys Canyon above the Interstate 215 crossing, drains 33,272 acres of wooded mountainous terrain. Upper Parleys Creek flows 10.8 miles and its two major headwater tributaries, Mountain Dell Canyon and Lambs Canyon, flow for 6.2 miles and 5.3 miles respectively (SLCO 2009). Approximately 4 of the 10.8 miles of upper Parleys Creek has been piped to accommodate freeway construction. The majority of the upper subwatershed is forested, with less than 10% of the area developed and an estimated overall impervious cover of

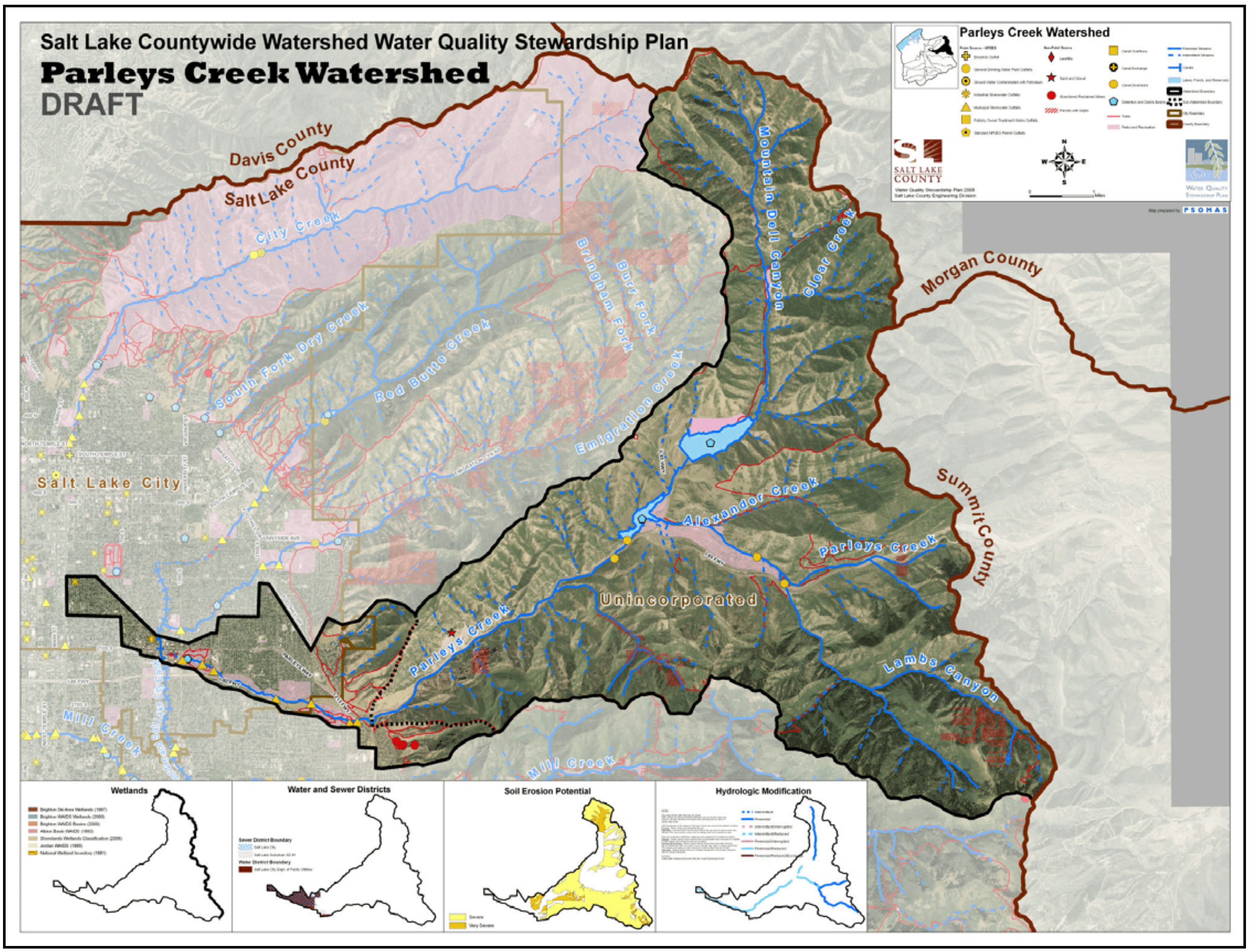

Figure 3.1. Parleys Creek watershed (map from SLCO 2009).

11.5% (SLCO 2009). Much of the subwatershed lies within the Wastach National Forest and is managed primarily for low-impact recreation. The areas above the Mountain Dell/Parleys Creek confluence receive protection as a Salt Lake City water supply watershed. Other significant land uses in the upper watershed include residential cabins in Lambs and Mount Aire Canyons, the City-owned Mountain Dell Golf Course, gravel mining, and transportation. Parleys Creek parallels Interstate 80 throughout the study area.

The lower Parleys Creek sub-watershed is much smaller, draining 4,112 acres of primarily forested, residential and park areas below the canyon mouth. Lower Parleys Creek flows approximately 3.3 miles; of this length about 0.7 miles has been piped to accommodate road crossings. An additional 3.7 miles of lower Parleys Creek west of the RCS study area is conveyed in engineered conduits to the Jordan River (Figure 1.1). Estimated existing impervious cover is 28.9% within the lower sub-watershed; this value is predicted to reach 32.5% by 2030 as a result of additional commercial development (SLCO 2009). More than 60% of the lower Parleys Creek subwatershed lies within the City's municipal boundaries.

Hydrology

The hydrology of Parleys Creek is altered by the water storage and flow regulation operations of Mountain Dell and Little Dell Reservoirs. Originally completed in 1917, Mountain Dell Dam is a 3,000 acre-foot storage facility located at the confluence of Parleys Creek and Mountain Dell Canyon (Figure 3.1, SLCC 2010). Little Dell Dam, located just upstream of Mountain Dell Reservoir, was constructed in 1993 and impounds a 20,500 acre-foot reservoir designed for flood control, water supply, and recreation (SLCC 2009). The City's Parleys Water Treatment Plant (PWTP) is located just downstream of Mountain Dell Dam, and diverts water from the reservoir to the municipal water delivery system (SLCO 2009).

Flows are not typically released out of Mountain Dell Dam except when the reservoir fills during spring runoff, and during base flow periods the stream dries up for some distance below the dam until gains from groundwater resupply surface flow. Within the lower subwatershed, some additional flow regulation capacity is provided by the 140 acre-foot pond in Sugar House Park.

Parleys Creek's hydrology is characterized by a distinct springtime peak typical of snowmelt-driven systems. Based on analysis of flow data recorded at the County gage near Suicide Rock from 1980-2005, mean annual flow is 14.4 cfs, average monthly flow is highest in May (Figure 3.2), and base flows average about 2 cfs. Peak daily

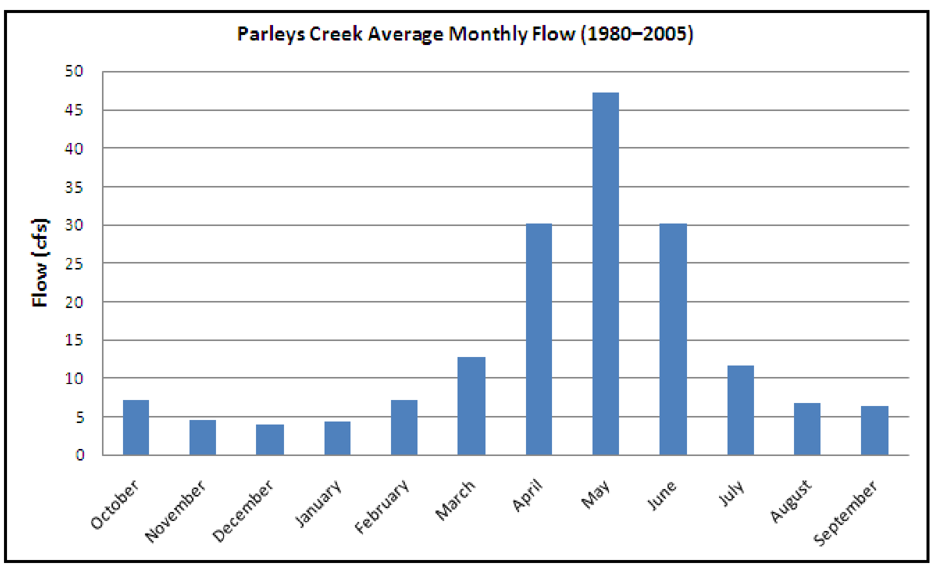

Figure 3.2. Monthly flows at Salt Lake County's gage at Suicide Rock.

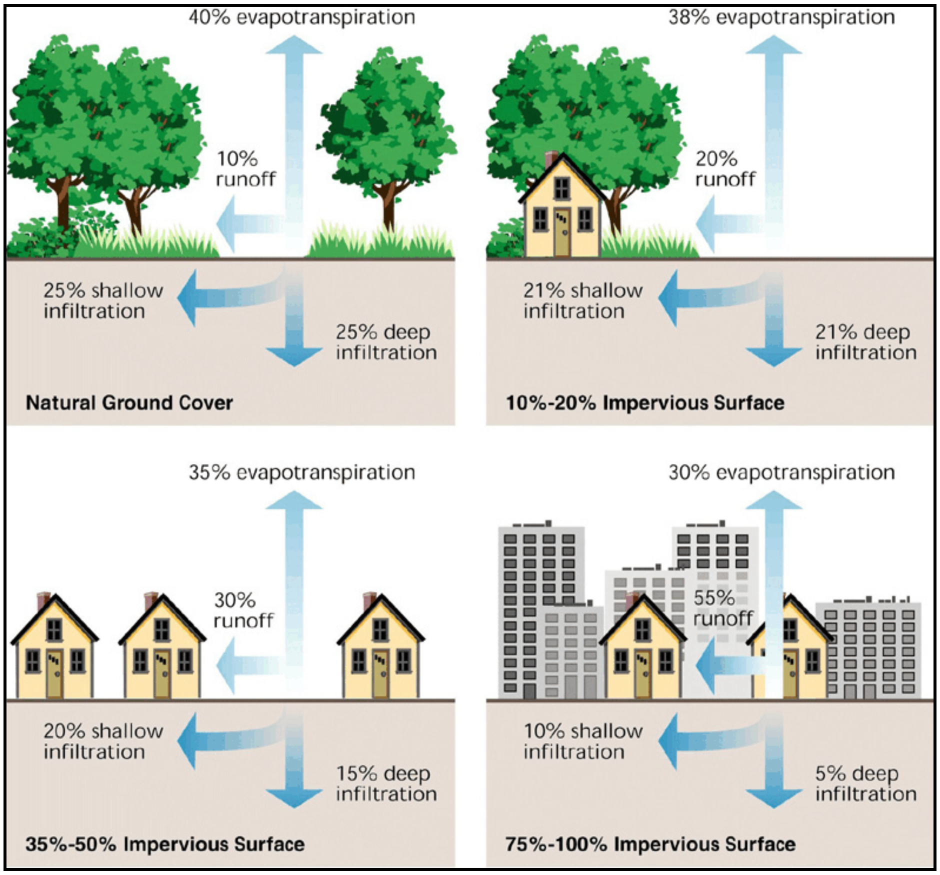

Figure 3.3. Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface runoff. Diagram and caption text from FISRWG 1998.

flow occurs on May 12th on average (SLCO 2009), and average annual high flow is 105 cfs based on analysis of the 1980-2005 time period. Since completion of Little Dell Dam, however, high flows have been more substantially regulated, with an average annual high flow value of 75 cfs for the 1993–2005 time period.

Average annual precipitation ranges from 22 to 42 inches in the upper subwatershed, and from 11 to 22 inches in the lower subwatershed (SLCO 2009). Above the PWTP Parleys Creek is classified as having perennial flow; below the PWTP the creek is classified as "perennial-reduced", indicating that flows are artificially reduced by the stream diversions for municipal water supply.

Because of natural alluvial deposition patterns, Wasatch mountain streams including Parleys Creek also naturally lose some surface flow to groundwater where the canyons transition to the valley. Within the RCS study area, Parleys Creek flows through areas mapped as primary and secondary groundwater recharge zones, and studies have estimated losses to groundwater to range from about 1.4 to 7 cfs (SLCO 2009).

Urbanization and development throughout the watershed have affected surface water-groundwater patterns. As more of the watershed has been converted to impervious surfaces, a greater proportion of storm water runs off as surface flow rather than infiltrating into the ground, leaving less groundwater available to supply baseflow to the creek during the summer dry period (Figure 3.3). No streamflow gage exists at the downstream end of the study area, so no quantitative data are available to characterize hydrology after the creek flows through the most urbanized portion of watershed downstream from the Suicide Rock gage. However, field observations during storm events suggest that flows in the lower reaches of the creek can be quite "flashy", with rapid, brief rises in flow during storms. This is a common hydrologic pattern in urbanized systems (Figure 3.4).

No storage reservoirs are present on lower Parleys Creek within the RCS study area, but the Sugar House Park pond serves as an on-line debris basin facility that traps the majority of coarse sediment loads. It is estimated that the pond was last dredged in the early 1990s. Since that time, a significant volume of sediment has accumulated in the pond, reducing pond depth and capacity (L. Hemphill 2010, pers. comm.). The County regularly removes debris from the grated culvert inlet at the downstream end of reach LPC_R03 (Figure 2.1) and from a debris grate located about 500 feet upstream from that inlet. A new County debris basin facility is proposed in this area as part of the draft Comprehensive Use and Management Plan for Parleys Historic Nature Park (MGB&A et al. 2010a).

Below: Parleys Creek debris grate.

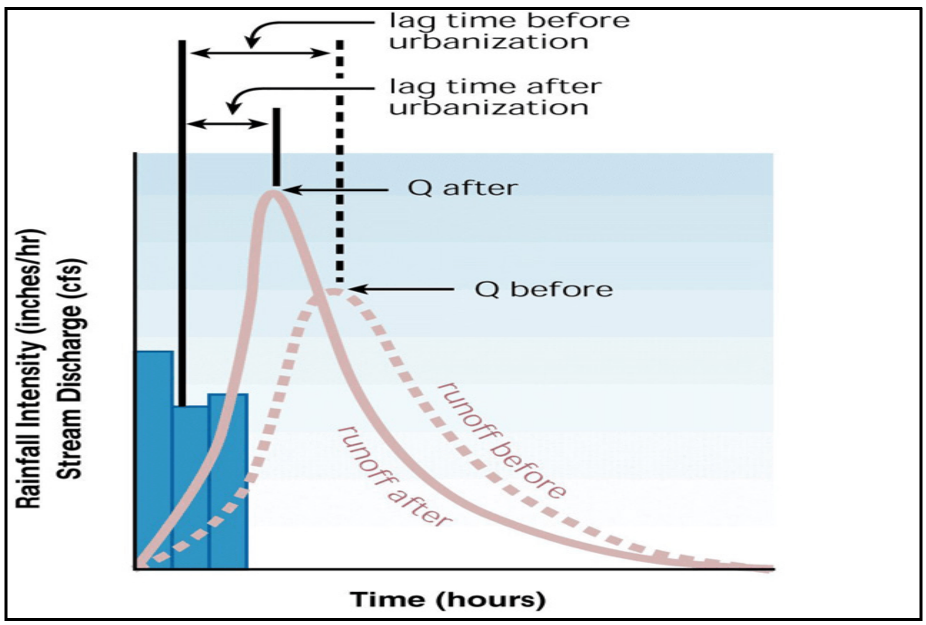

Figure 3.4. A comparison of hydrographs before and after urbanization. The discharge curve is higher and steeper for urban streams than for natural streams. Diagram and caption text from FISRWG 1998.

Water Quality

Above Mountain Dell Reservoir, Parleys Creek's beneficial use classifications as designated by the Utah Division of Water Quality (DWQ) include 1C (high quality drinking water), 2B (secondary contact recreation), and 3A (cold water fishery). In this upper segment, the creek's water quality is good and fully supports all of its beneficial uses (DWQ 2006). Below Mountain Dell Reservoir, the designated beneficial uses include 2B and 3A; in this segment Parleys Creek is listed as impaired and only partially supporting its 3A use due to habitat alterations (DWQ 2006).

Parleys Creek is not currently listed by DWQ as exceeding state standards for any specific water quality constituents at this time. However, the creek is subject to a variety of potential contamination sources and fish kills have been documented in the stream below Suicide Rock as recently as 2007 (Prettyman 2007). Within the Sugar House Park pond, outbreaks of avian botulism and bacteria concerns have been problems in recent years (L. Hemphill 2010, pers. comm.). Within Parleys Canyon in the wintertime, UDOT regularly salts the six lanes of

Interstate 80, and these road salts wash directly into Parleys Creek via storm drains that do not provide any water quality treatment. The Parleys Canyon section of I-80 is a major trucking route, and accidents occasionally involve spills that have the potential to contaminate the nearby creek. Sediment inputs associated with poorly stabilized highway fill slopes, unprotected/broken storm drain outlets, and dust tracked out from the gravel pit also have potential water quality impacts. Septic systems for the residential cabins in the upper watershed are another potential pollution source, particularly for nutrients and bacteria. Within the RCS study area, potential nonpoint source pollutants include fertilizers and herbicides from golf courses and managed parks, erosion from unprotected slopes and storm drains, urban runoff (e.g., automotive fluids), and waste from wildlife (e.g., deer, ducks, geese) and pets.

Table 3.1 summarizes the existing water quality stations on Parleys Creek within the RCS study area. To help inform ongoing TMDL studies on the Jordan River, several new E.coli monitoring stations (STORET numbers 4992235-4992260) have been recently established on Parleys Creek by DWQ. Monthly E. coli and flow measurements have been collected in cooperation with Westminster College. The data from these newer sites have not yet gone through quality assurance/control procedures and have not been released to the public or comprehensively analyzed. Bacteriological data are also collected independently by DPU at three sites on Parleys Creek; a scatter plot of the DPU E.coli data is provided in Figure 3.5. Results are highly variable, and occasional high spikes that exceed the acute state 2B standard (668 CFU/100 mL) have been documented at all three monitoring sites. No obvious spatial or temporal trends are apparent, and the duration of each observed spike is not known. As additional data are collected and analyzed and as DWQ's new E.coli work group becomes more established, it is anticipated that a better understanding of bacteriological contamination sources will develop.

Geology and Soils

The geology of the upper Parleys Creek subwatershed varies by tributary canyon. Lambs Canyon and the lower reaches of Parleys Canyon flow primarily through Twin Creek Limestone, Nugget Sandstone, and several members of the Ankareh formation. Above the Lambs Canyon confluence, upper Parleys Creek is dominated by the Jurassic Pruess Sandstone formation and alluvial material. Mountain Dell canyon flows through the Kelvin Formation and alluvial deposits (Bryant 1990). Approximately 50 to 86.2% of the soils in the upper Parleys Creek sub-watershed have severe to very severe soil erosion potential (SLCO 2009).

Once it exits the canyon, lower Parleys Creek flows through a series of Pleistocene Lake Bonneville deposits ranging from finer-grained silt and clay deposits to coarser sand and gravel deposits (Bryant 1990). Artificial fill material, primarily associated with Interstate 80, also borders the stream in several of the lower reaches. In the lower sub-watershed, 20 to 35% of the soils have severe to very severe erosion potential (SLCO 2009).

After Lake Bonneville receded approximately 16,000 years ago, it left a series of old shoreline deposits that now form prominent "benches" along the edges of Salt Lake Valley. To reach its modern base level at the Jordan River, Parleys Creek had to carve through these deposits. Evidence of this process is seen in the tall slopes that extend up to the Bonneville bench levels on the south side of the corridor within Parleys Historic Nature Park. Relative to the other smaller creeks in the City, lower Parleys Creek has carved a relatively broad floodplain and shows a lesser degree of geologic confinement. However, various human-induced alterations to the creek—including channel straightening, installation of road

Table 3.1. Summary of water quality data collection efforts on Parleys Creek within the study area.

STORET OR SITE CODE	SITE NAME	SAMPLING ENTITY	PERIOD OF RECORD	SAMPLING FREQUENCY	PARAMETERS SAMPLED			
					Physical/ Chemical	Nutrients	Metals	Bacteria
4992230	Parleys Canyon Creek at mouth	Utah Division of Water Quality	1999–2007 (nearly continuous)	monthly	X	X	X	
4992235	Parleys: above Parleys historic nature preserve	Utah Division of Water Quality/ Westminster	2007 (partial), September 2009–present	monthly	X [a]			E. coli
4992240	Parleys: below Parleys historic nature preserve	Utah Division of Water Quality/ Westminster	2007 (partial), September 2009–present	monthly	X [a]			E. coli
4992245	Parleys: top of Sugar House Park	Utah Division of Water Quality/ Westminster	2007 (partial), September 2009–present	monthly	X [a]			E. coli
4992250	Parleys: above Sugar House Pond	Utah Division of Water Quality/ Westminster	2007 (partial), September 2009–present	monthly	X [a]			E. coli
4992255	Parleys: Hidden Hollow	Utah Division of Water Quality/ Westminster	2007 (partial), September 2009–present	monthly	X [a]			E. coli
N/A [b]	Parleys: Tanner Park (at bridge between LPC_R02 and LPC_R03)	Salt Lake City Department of Public Utilities	June 2006–present	monthly		nitrates		E. coli, T. coliform
N/A [b]	Parleys: Sugar House Park	Salt Lake City Department of Public Utilities	June 2006–present	monthly		nitrates		E. coli, T. coliform
N/A [b]	Parleys: Hidden Hollow	Salt Lake City Department of Public Utilities	June 2006–present	monthly		nitrates		E. coli, T. coliform
4992070	1300 South storm drain at mouth	Utah Division of Water Quality	2008–present (partial)	monthly during summer 2009	X	X		E. coli, T. coliform
PC4	Parleys Creek at canyon mouth (in UPC_R16A)	Salt Lake County	April 2010–present	monthly	X			E. coli, T. coliform

[a] Flow data only.
[b] Not applicable.

crossing culverts, fill placement, and bank hardening—have caused increases in channel slope and entrenchment in some areas.

Fish, Birds, and Wildlife

Parleys Creek is a stream of special significance for native Bonneville cutthroat trout, the state fish of Utah and a state-designated special status species that evolved as the top predator within ancient Lake Bonneville. The upper portions of Parleys Creek and its tributaries within the canyon support a core

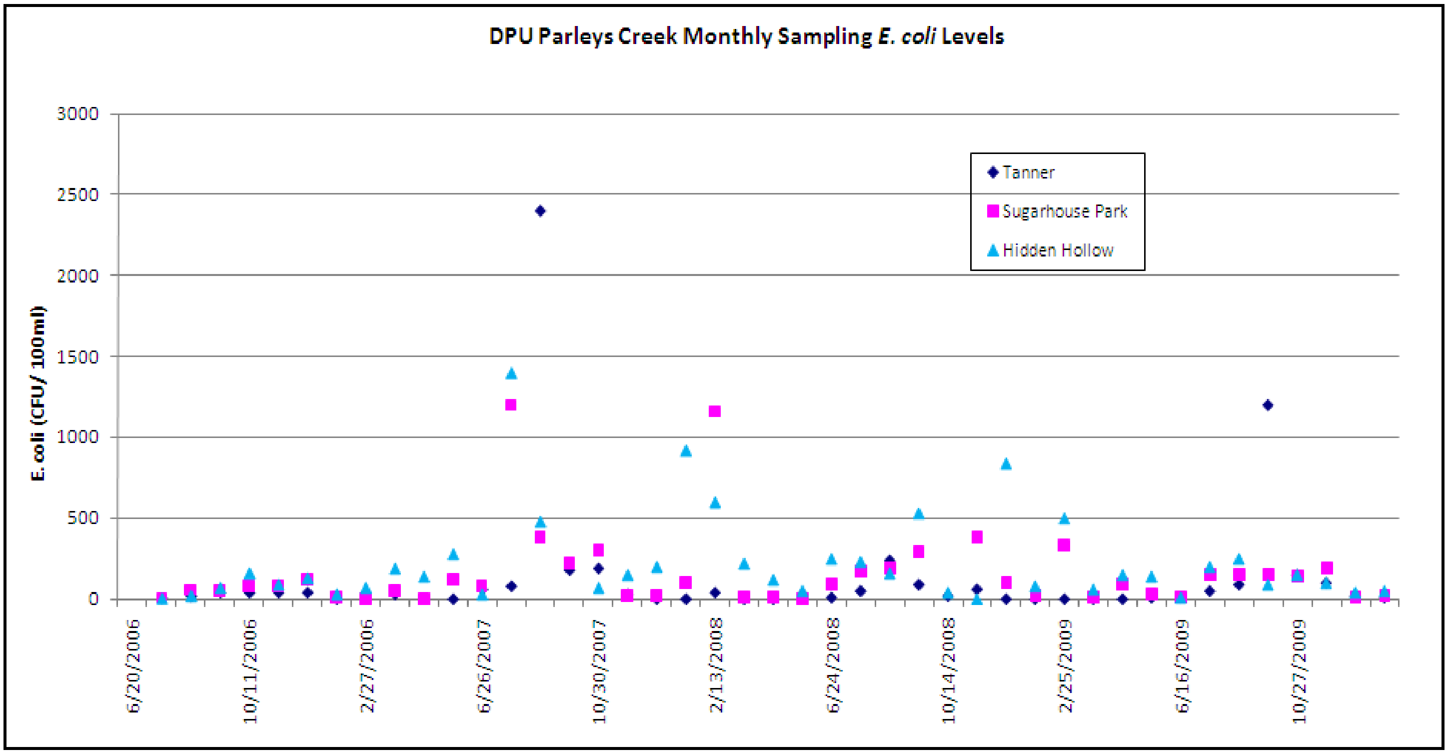

Figure 3.5. Scatter plot of Salt Lake City Department of Public Utilities (DPU) E. coli sampling results for Parleys Creek. The acute (single sample) E. coli standard set by the State of Utah for secondary contact recreation is 668 colony-forming units per 100 milliliters.

population of Bonneville cutthroat trout. Core populations are of particular significance because they are believed to represent the pure, pre-settlement genetic character of the species (Lentsch et al. 2000). Bonneville cutthroat trout from the Parleys watershed have been harvested and used as a brood stock source to reestablish populations in other areas and promote statewide recovery of the species. In addition to cutthroat trout, introduced brook trout populations are also present in Little Dell Reservoir.

Quantitative data on fish populations within the lower, urban portion of Parleys Creek within the RCS study area are limited. Fisheries surveys in these lower reaches have documented Bonneville cutthroat trout populations that are the offspring of Mountain Dell and Little Dell brood stock (D. Wiley 2010, pers. comm.) During the RCS field assessments, trout (species unknown) were observed in several study reaches. Rainbow trout and carp are included in a list of wildlife sightings within Hidden Hollow (reach LPC_R06) from the 1990s (MGB&A 1998).

The Parleys Creek riparian corridor is home to a wide variety of bird species. During the Audubon Society's 2005 Christmas bird count, a total of 28 different bird species were observed within the Parley's Gulch survey area, which includes reaches LPC_R01, LPC_R02, LPC_R03 and several golf courses (Carr 2009). The "eBird" list for this same area lists sightings of 65 different species between 2002 and 2009, including hawks, owls, woodpeckers, and a wide variety of songbirds (eBird 2010). Two of the observed species (green-tailed towhee and Virginia warbler) are included on the 2008 list of birds of conservation concern (USFWS 2008). Numerous geese and domesticated ducks frequent the portions of Parleys Creek within the Country Club golf course and in Sugar House Park. Scientific surveys of wildlife populations are not available for the Parleys Creek RCS study area. However, mammals including deer, foxes, mice, muskrats, rock squirrels, and racoons are known to occur within the corridor (MGB&A et al. 2010b, MGB&A 1998).

Historical Conditions and Current Trends

Parleys Creek History

Parleys Canyon holds a prominent place in Utah's history, as it became an important travel route shortly after Mormon pioneers entered Salt Lake Valley in 1847. The Parleys Canyon travel route, originally known as the Golden Pass Toll Road, was constructed by Parley P. Pratt, the pioneer for whom Parleys Creek is named. Although detailed descriptions, drawings, and photos specific to the riparian corridor are limited, available information suggests that the riparian corridor at that time was vegetated with thick, tall grasses and clumps of scrub oak and willows (Figure 3.6). Pioneers also describe having difficulties traversing a broad marsh area with tall grass at the convergence of Parleys, Emigration, and Red Butte Creeks (Dixon 1997).

Although limited, these available historical descriptions suggest that 160 years ago the overall vegetation density, grass cover, and shrub cover along Parleys Creek was substantially greater than it is today. Fish, including native cutthroat trout, were initially described as plentiful, but the fisheries of the canyon streams were quickly depleted due to heavy fishing pressure. Inmates of the first Utah state prison, located in what is now Sugar House Park, were put to work building ponds to raise fish to resupply the streams (Figure 3.6).

Alterations to the Riparian Corridor

Over the last 160 years, the various activities associated with development and population growth in Salt Lake Valley have resulted in significant alterations to the stream channel and riparian conditions of Parleys Creek. Among other factors, systematic programs to clear debris from channels and remove beaver populations have likely contributed to the currently reduced vegetation density relative to historical conditions. When beaver were more common, their dams increased inundated streamside habitat area, elevated the water table, reduced flood velocities and erosion, and trapped sediment and nutrients (Gardner et al. 1999). As beaver populations decreased, the "checks" on sediment and water created by beaver dams also decreased,

Historical activities that have altered riparian corridor conditions:

- mining and quarrying for sandstone and gravel
- logging and timber harvest
- beaver trapping and removal
- channel clearing and debris removal
- construction of water-storage reservoirs
- flow diversion for irrigation and drinking water
- railroad and freeway construction
- road and stream crossing construction
- residential and commercial development
- introduction of invasive, nonnative plants
- piping of the creek in underground conduits
- channel relocation/ straightening
- bank armoring
- placement of fill within floodplain areas
- in-channel pond construction

resulting in greater flow velocities and streambed down-cutting. The control and reduction of beaver populations throughout the west has profoundly altered stream channel, floodplain, and riparian vegetation conditions (Wohl 2000).

Many of the direct alterations to Parleys Creek have occurred in order to accommodate transportation development associated with population growth. Significant road improvement projects of various types occurred nearly every decade along what is now the Interstate 80 corridor, requiring numerous creek realignments and piping projects (Figure 3.6). Within the lower subwatershed, one of the most significant direct changes to the creek was the construction of the 1300 South conduit, which converted the open-channel portions of Parleys, Emigration, and Red Butte creeks west of 1100 East to an underground pipe system. The exact date of conduit construction is not known, but housing stock located over the conduit system dates to about the late 1920's, suggesting that construction was complete prior to that time. No creek channel can be seen west of 1100 East in 1938 air photos of Salt Lake City.

In some portions of the RCS study area, the channel alignment of Parleys Creek has changed dramatically since 1938. Significant channel straightening and bend realignment is evident within the areas now occupied by the Country Club golf course (Figures 3.7 and 3.8). In contrast, the modern channel alignment within the area that is now Parleys Historic Nature Park appears similar to the 1938 alignment. In the 1938 photograph, the channel in this area appears to already have been realigned to accommodate a gravel mining operation in the area now occupied by the BMX bike course (Figure 3.7). Comparison of current channel position with the 1938 alignment also illustrates the increase in the length and number of culvert pipes within the corridor. The 1938 photo shows a continuous open stream channel between 1300 East and 2000 East (Bowman and Beisner 2008); today this stretch of stream is interrupted by five different culvert crossings. The construction of culvert crossings and piping of portions of Parleys Creek facilitated urban growth but also reduced total channel length, resulting in greater channel slope and higher stream velocities. The culverts have also disrupted the connectivity of the riparian corridor by creating barriers to fish and wildlife migration.

Urban Channel Adjustments

Urbanized streams have been found to undergo a sequence of typical channel adjustments in response to changes in hydrology and sediment supply (Wolman 1967, Riley 1998, Colosimo and Wilcock 2007). Studies of urban channel adjustment generally identify two main stages of adjustment: an early depositional phase and a later, fully urbanized phase. The early phase occurs during initial development, when active construction leads to increased fine sediment supply, increased bar deposits, and reduced channel size. The late/fully urbanized phase occurs after construction activities are essentially complete and the watershed has become stable with a high percentage of impervious surface area, and runoff magnitudes and volumes have correspondingly increased. Channels in the “late urbanized” phase are typically enlarged relative to their original form due to an oversupply of water relative to sediment supply. These channels have few bar deposits and are commonly downcut (incised) with reduced floodplain access (Figure 3.9). Several of the reaches of Parleys Creek that were assessed exhibit some characteristics of the “late urbanized” phase, such as low bank erosion/root scour.

Other influences such as localized sediment inputs from eroding storm drain outfalls or sediment deposition within constructed ponds modify conditions from this generalized “late urbanized” channel condition. Existing channel conditions within the Parleys Creek corridor reflect a complex response to a variety of

Figure 3.6 Parleys Creek historical timeline.

Parleys Creek supports early industrial development in Salt Lake valley, including a tannery, distillery, adobe brick factory, sand/gravel pit, and as many as 20 mills (woolens, sugar, paper). Canyon streams are heavily fished; state prison inmates construct ponds to raise fish to replenish the streams.[1]

1853

Utah's first state prison is built on Parleys Creek in what is now Sugar House Park.[1]

1879-1892

Salt Lake City constructs the 1.6 million-gallon Parleys Canyon Reservoir near Suicide Rock. The reservoir was used as a settling basin to treat municipal water supplied to downtown Salt Lake City via Parleys Lower Conduit.[3]

1889

A railroad through Parleys Canyon is completed, facilitating transport of supplies to silver mines in Park City.[2]

1900

Salt Lake City gains water rights to Parleys Creek after claiming stables and livestock yards were contaminating the water; through water right exchanges, farmers along Parleys Creek were provided with Utah Lake water supplied via the Jordan and Salt Lake City Canal.[1]

1962-1973

U.S. Highway 40 redesignated as Interstate 80 in Parleys Canyon; extensive fill is deposited at the mouth of Parleys Canyon to accommodate the present interchange between Foothill Boulevard, Wasatch Boulevard, and Interstate 80 in the vicinity of Suicide Rock; further major blasting work completed within the lower canyon as part of I-80 redesign.[2]

1975

Citizens begin efforts with the City to acquire land in Parleys Hollow to establish a publicly owned park.[5]

1983

Major flooding results in damages estimated at $10 million to Parleys, Emigration, and Red Butte Creeks.[1]

1995

Genetically pure Bonneville cutthroat trout are documented in Mt. Dell Creek.[6]

1996-1998

An unused portion of Parleys Water Treatment Plant is used to hatch and raise a pure strain of Bonneville cutthroat trout to supply fry for re-establishment efforts state wide.[6]

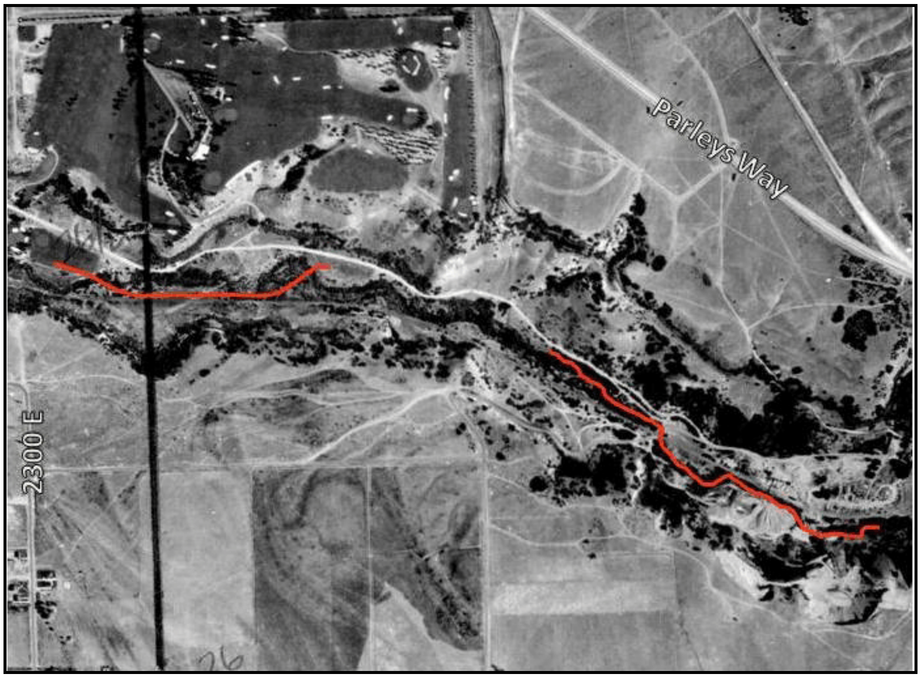

Figure 3.7. 1938 aerial photo of Parleys Creek east of 2300 East. The photo is overlaid with 2006 channel alignment in red; gaps in the line indicate underground culverts.

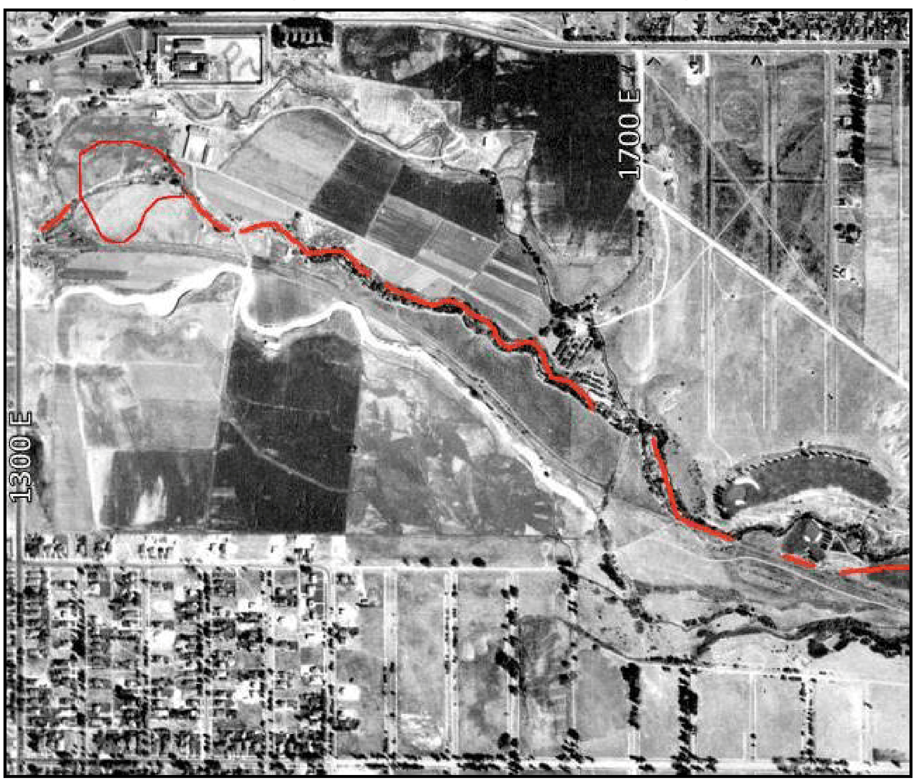

Figure 3.8. 1938 aerial photo of Parleys Creek near 1700 East. The photo is overlaid with 2006 channel alignment in red; gaps in the line indicate underground culverts.

historical and ongoing alterations throughout the watershed.

Recent and Anticipated Future Trends

Within the lower Parleys Creek sub-watershed, land use predictions for 2030 indicate a increase in impervious cover from 28.9 to 32.5% and a 6.7% loss of open space. Most of this change is associated with an expected increase in the amount of commercial land use (SLCO 2009). No impervious surface cover increase is predicted for the upper subwatershed.

Climate change is another factor that can be anticipated to affect the Parleys Creek riparian corridor. Climate projections for the southwest region of the United States show increased temperatures, reduced mountain snowpack, a 10–20% decrease in annual runoff volume, reduced springtime precipitation amounts, and anticipated water supply shortages (Karl et al. 2009). The risk of drought, as well as the risk of flooding, are expected to increase. The changes in temperature will likely result in a shift in vegetation communities, and altered precipitation patterns will influence stream hydrology and channel conditions. The timing of snowmelt runoff is expected to occur earlier in the spring, with an anticipated reduction in summertime base flows (Karl et al. 2009). It is difficult to predict specific changes to Parleys Creek with certainty, but recorded annual stream flow volumes on Parleys Creek already show a declining trend between 1970 and 2006 (L. Alserda 2009, pers. comm., Figure 3.10). This trend is anticipated to continue into the future (Karl et al. 2009).

Stream and Vegetation Conditions

Stream Channel Characteristics

Salt Lake County has classified Parleys Creek within the RCS study area as moderately entrenched, meaning the channel is somewhat vertically confined. Composite stream stability ratings for the area were good to fair during County stream assessments completed in 2007 and 2008. During these assessments, the County classified Parleys Creek as Rosgen (1996) stream type B3 in reaches UPC_R16 and LPC_R01; stream type B4 in reaches LPC_R02 and LPC_R03; and stream type F3-4 in the remaining reaches downstream (K. Collins 2009, pers. comm.). County bankfull width estimates for the stream reaches in lower Parleys Creek ranged from 9 feet to 19 feet, with an average value of 14 feet. The estimate for reach UPC_R16 was 16 feet (K. Collins 2009, pers. comm.).

Results of RCS field surveys and GIS analyses further illustrate the

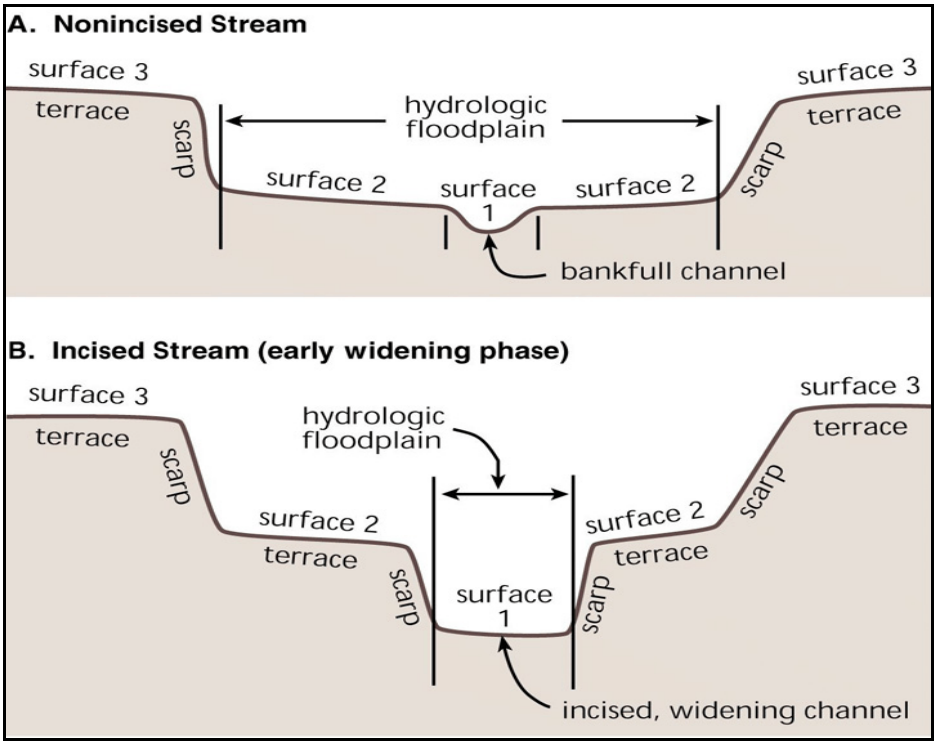

Figure 3.9. **Illustration of streambed lowering (incision) process common on urbanized streams. Following initial incision (B), the channel may continue to incise and widen until new equilibrium channel/floodplain geometry is reached, posing a potential risk to urban development on terrace surfaces adjacent to the channel. Diagram from FISRWG 1998.**

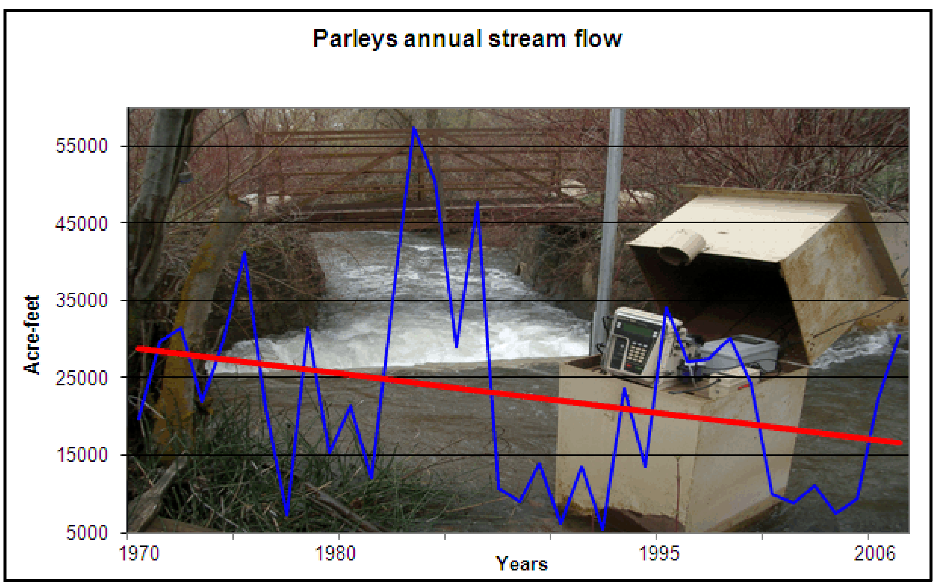

Figure 3.10. **Plot of temporal trends in annual stream flow at Parleys Creek gage. Plot provided by the Salt Lake City Department of Public Utilities.**

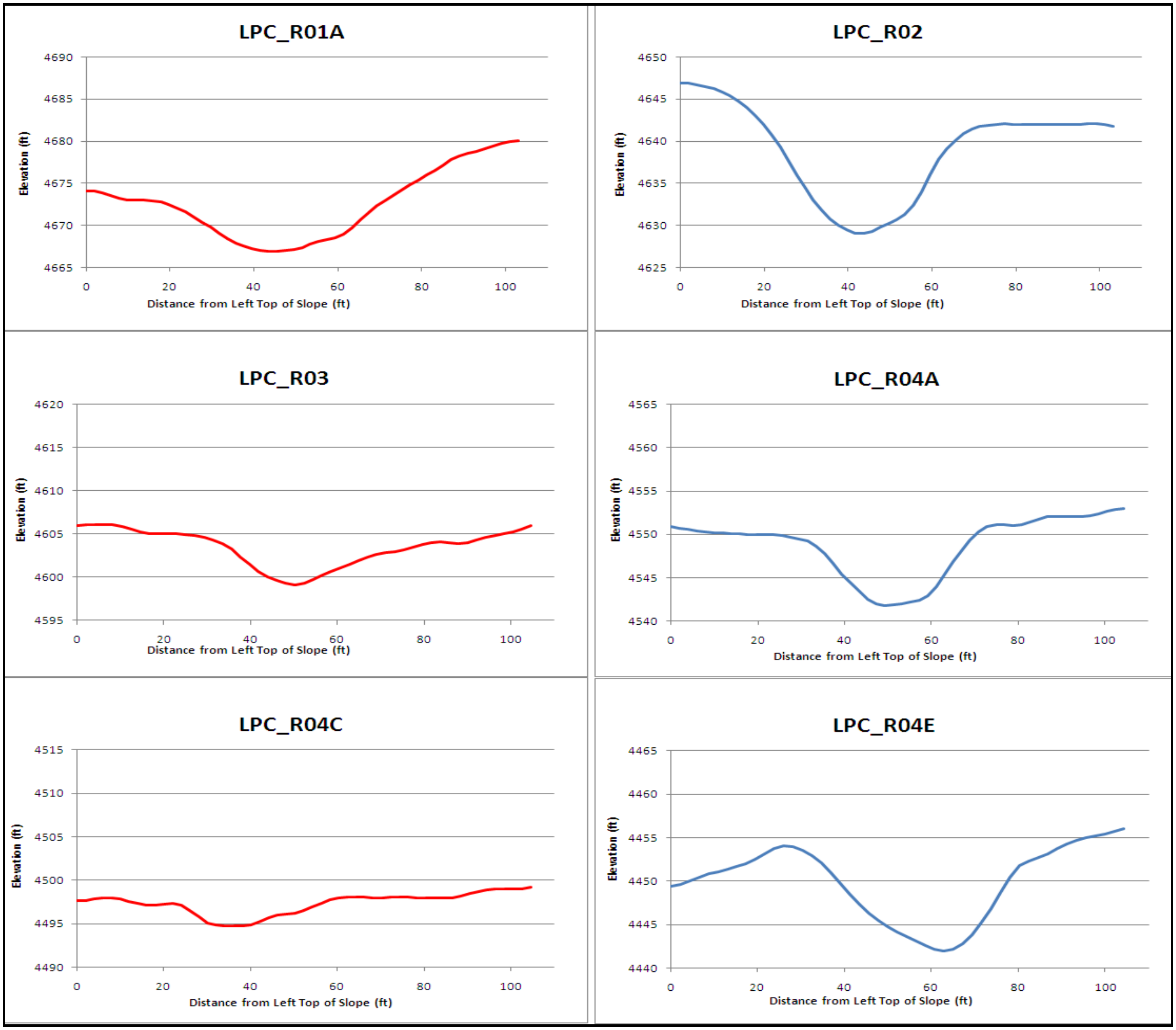

Figure 3.11. Cross-section plots extrapolated from digital elevation data. Plots on left (in red) exhibit less vertical confinement and include relatively well-developed active floodplain surfaces. Plots on right (in blue) exhibit a greater degree of vertical confinement between tall, steep side slopes.

fact that the Parleys Creek channel is moderately entrenched and in some areas inset between tall, steep slopes (Figure 3.11). However, the extent of vertical confinement varies, and in some locations the channel shape is wider and includes broader, flatter bank and floodplain surfaces (Figure 3.11). These areas are important because they allow water to spread out horizontally during flood events, dissipating velocity and reducing erosion potential.

Surveyed channel width values are quite variable, ranging from about 5 to 27 feet at low flow, with an average value of 14 feet (Table 3.2). During the spring runoff period, field surveys were conducted at a streamflow of 67 cfs, which is close to the 1993-2005 average annual high flow value of 75 cfs. Width at this high flow value varies from about 13 to 28 feet, with an average of 19 feet. In some locations, such as LPC_R04A, channel width has been directly affected by installed bank hardening measures.

Channel slope, as determined for each stream reach from digital elevation data, varies from 1% to 3.7% within the RCS study area, with an average value of 1.8% (Figure 3.12, Table 3.2). Parleys Creek does not show any obvious consistent spatial trends

Table 3.2. Summary of streambed material, channel geometry, and slope data.

REACH NUMBER	MEASURED VALUES AT RIFFLE CROSS SECTION							REACH DATA	
	STREAMBED MATERIAL SIZE DATA				CHANNEL GEOMETRY				
	D16 (mm) [a]	D50 (mm) [a]	D84 (mm) [a]	Percent Embedded	Low Flow Wetted Width (ft) [b]	Wetted Width (ft) [b] at 67 cfs [c]	Local Slope (ft/ft) [d]	Reach Slope (ft/ft) [d]	Reach Length (ft) [b]
UPC_R16A	8	41	124	26	12.5	14.9	0.017	0.017	667
UPC_R16B	5	24	140	36	11.8	15.0	0.021	0.037	832
LPC_R01A	10	36	117	18	16.0	19.6	0.046	0.027	1487
LPC_R01B	-	-	-	-	-	-	-	0.020	221
LPC_R02	20	57	135	16	14.9	18.9	0.011	0.019	1659
LPC_R03	12	36	106	11	16.1	20.4	0.007	0.010	815
LPC_R04A	12	54	147	9	9.2	17.6	0.008	0.017	1681
LPC_R04B	8	36	101	21	18.2	22.6	0.007	0.013	1748
LPC_R04C	13	29	56	1	4.9	17.5	0.018	0.012	1285
LPC_R04D	-	-	-	-	5.4	13.0	0.015	0.015	1661
LPC_R04E	7	37	115	8	11.2	15.3	0.004	0.016	731
LPC_R05A	10	36	96	18	27.4	28.0	0.014	0.013	619
LPC_R05B	9	32	72	21	15.2	17.7	0.004	0.011	793
LPC_R05C	16	31	64	3	22.0	24.3	0.020	0.015	1147
LPC_R05D	16	66	157	24	14.0	19.0	0.036	0.026	176
LPC_R06	<2	51	135	11	16.1 [e]	21.1 [e]	0.037	0.023	803
averages	11	40	112	16	14.2	18.8	0.018	0.018	1020

[a] The 16th, 50th, and 84th percentile values of the particle size distribution, in millimeters.
[b] Feet.
[c] Cubic feet per second.
[d] Feet per feet.
[e] Estimated wetted width.

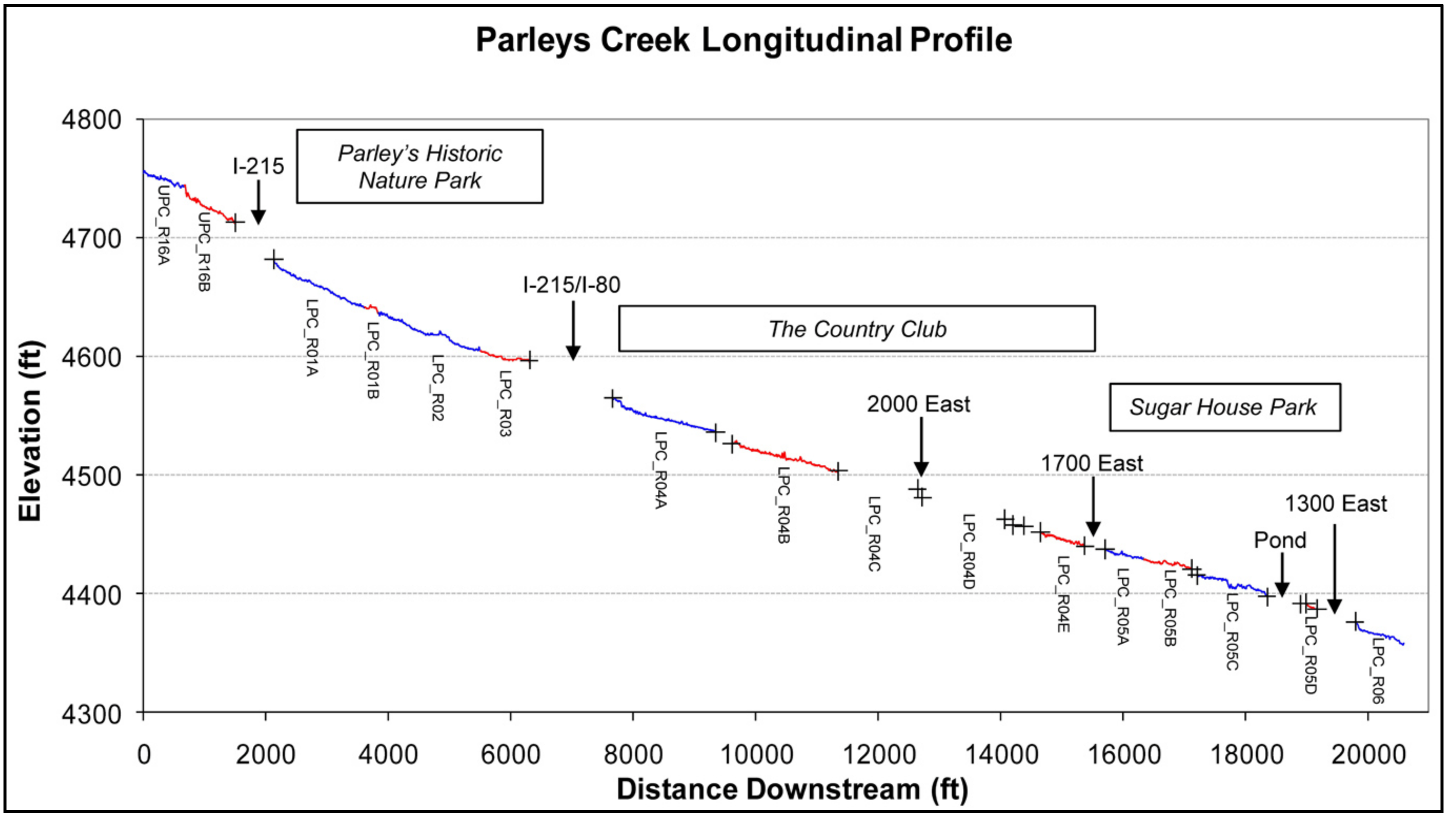

Figure 3.12. Longitudinal profile plot of Parleys Creek streambed based on 2006 digital elevation data. Black cross marks indicate culvert inlets and outlets; red and blue lines indicate open channel stream sections. Data are not shown for reaches LPC_R04C or LPC_R04D because they have been altered by post-2006 channel modifications.

in gradient through the study area. Historically, channel gradient would have shifted to a flatter, less confined, more sinuous channel type in the flatter valley area west of 1100 East; however, this portion of the creek is now piped underground in the 1300 South conduit.

Median (D50) streambed particle size at the measured cross sections ranges from 24 to 66 millimeters (mm), indicating that medium- and large-sized gravel are the dominant substrate sizes in riffle areas of Parleys Creek (Table 3.2). At most of the cross section riffles, medium or fine gravel comprises the D16 particle size, and cobble-sized material comprises the D84 particle size (Table 3.2). Embeddedness values are highly variable. In flatter-gradient portions of the channel such as run and pool areas, particle sizes are smaller, with sand and silt often dominant. No consistent upstream-to-downstream trends are evident in the pebble count results; rather, bed material size and embeddedness appear to be largely a function of local factors such as sediment inputs from erosion areas, composition of bank material, and the presence or proximity of artificial rip rap or boulder material.

Vegetation Characteristics

Table 3.3 lists all plant species noted on the data forms during the study area mapping effort. Species are identified by their common and scientific names, mapping code, wetland indicator status (USFWS 1988), and whether the species is native to Utah or introduced (NRCS 2009). A total of 86 different species were noted during the Parleys Creek mapping work,

Table 3.3. Plant species noted during Parleys Creek mapping work.

SCIENTIFIC NAME	COMMON NAME	WETLAND INDICATOR STATUS	NATIVE TO UTAH OR INTRODUCED
Acer grandidentatum	bigtooth maple	not listed	native
Achillea millefolium	common yarrow	facultative upland	native
Acer negundo	boxelder	facultative wetland	native
Aegilops cylindrica	jointed goatgrass	not listed	introduced
Agropyron cristatum	crested wheatgrass	not listed	introduced
Agrostis gigantea	redtop	no indicator	introduced
Ailanthus altissima	tree of heaven	no indicator	introduced
Ambrosia artemisiifolia	annual ragweed	facultative upland	native
Artemisia ludoviciana	white sagebrush	facultative upland	native
Arctium minus	lesser burdock	not listed	introduced
Artemisia tridentata	big sagebrush	not listed	native
Carduus nutans	nodding plumeless thistle	not listed	introduced
Cirsium arvense	Canada thistle	facultative upland	introduced
Conium maculatum	poison hemlock	facultative wetland	introduced
Centaurea solstitialis	yellow star-thistle	not listed	introduced
Cirsium vulgare	bull thistle	facultative	introduced
Convolvulus arvensis	field bindweed	not listed	introduced
Chrysanthemum leucanthemum	oxeye daisy	not listed	introduced
Betula occidentalis	water birch	facultative wetland	native
Bromus arvensis	field brome	not listed	introduced
Bromus inermis	smooth brome	not listed	native
Bromus tectorum	cheatgrass	not listed	introduced
Catabrosa aquatica	water whorlgrass	obligate wetland	native
Cardaria draba	whitetop	no indicator	introduced
Cercocarpus ledifolius	curl-leaf mountain mahogany	not listed	introduced
Chenopodium album	lambsquarters	facultative upland	native
Chrysothamnus viscidiflorus	yellow rabbitbrush	not listed	native
Cichorium intybus	chicory	not listed	introduced
Cornus sericea	redosier dogwood	facultative wetland	native
Cynoglossum officinale	gypsyflower (houndstongue)	not designated	introduced
Dactylis glomerata	orchardgrass	facultative upland	introduced
Elaeagnus angustifolia	Russian olive	facultative	introduced
Elymus repens	quackgrass	facultative upland	introduced
Equisetum arvense	field horsetail	facultative upland	native
Ericameria nauseosa	rubber rabbitbrush	not listed	native
Euphorbia myrsinites	myrtle spurge	not listed	introduced
Fraxinus pennsylvanica	green ash	facultative wetland	native
Gleditsia triacanthos	honeylocust	facultative	native
Grindelia squarrosa	qurlycup gumweed	facultative upland	native
Gutierrezia sarothrae	broom snakeweed	not listed	native
Helianthus annuus	common sunflower	facultative upland	native
Hedera helix	English ivy	not listed	introduced
Hordeum jubatum	foxtail barley	facultative	native

Table 3.3. Plant species noted during Parleys Creek mapping work (cont.).

SCIENTIFIC NAME	COMMON NAME	WETLAND INDICATOR STATUS	NATIVE TO UTAH OR INTRODUCED
Juniperus osteosperma	Utah juniper	not listed	native
Lactuca serriola	prickly lettuce	facultative upland	introduced
Lonicera involucrata	twinberry honeysuckle	facultative	native
Lonicera tatarica	tatarian honeysuckle	no occurrence	introduced
Mahonia repens	creeping barberry	not listed	native
Mentha arvensis	wild mint	facultative wetland	native
Melilotus officinalis	yellow sweetclover	facultative upland	introduced
Medicago sativa	alfalfa	not listed	introduced
Melica spectabilis	purple oniongrass	obligate upland	native
Onopordum acanthium	scotch cottonthistle	not listed	introduced
Parthenocissus quinquefolia	Virginia creeper	no occurrence	native
Phalaris arundinacea	reed canarygrass	obligate wetland	native
Phragmites australis	common reed	facultative wetland	native
Pinus nigra	Austrian pine	not listed	introduced
Pinus ponderosa	ponderosa pine	facultative upland	native
Populus angustifolia	narrowleaf cottonwood	facultative	native
Poa bulbosa	bulbous bluegrass	not listed	introduced
Populus deltoides	eastern cottonwood	facultative wetland	native
Poa pratensis	Kentucky bluegrass	facultative upland	introduced
Poa secunda	sandberg bluegrass	not listed	native
Prunus virgniana	chokecherry	facultative upland	native
Pseudoroegneria spicata	bluebunch wheatgrass	obligate upland	native
Quercus gambelii	Gambel oak	not listed	native
Rhus glabra	smooth sumac	not listed	native
Rhus trilobata	skunkbush sumac	no indicator	native
Rosa woodsii	Woods' rose	facultative	native
Rumex crispis	curly dock	facultative wetland	introduced
Salix exigua	narrowleaf willow	obligate wetland	native
Salix fragilis	crack willow	facultative	introduced
Schoenoplectus acutus	hardstem bulrush	obligate wetland	native
Secal cereale	cereale rye	not listed	introduced
Sisymbrium altissimum	tall tumblemustard	facultative upland	introduced
Solanum dulcamara	climbing nightshade	facultative	introduced
Solidago missouriensis	Missouri goldenrod	not listed	native
Symphyotrichum eatonii	Eaton's aster	facultative	native
Symphoricarpos occidentalis	western snowberry	no occurrence	native
Tamarix ramosissima	saltcedar	facultative wetland	introduced
Tetradymia canescens	spineless horsebrush	not listed	native
Thinopyrum intermedium	intermediate wheatgrass	not listed	introduced
Toxicodendron rydbergii	western poison ivy	facultative upland	native
Typha	cattail	not listed	no status
Ulmus pumila	Siberian elm	not listed	introduced
Vinca major	bigleaf periwinkle	not listed	introduced

with about half of the species being native to Utah. As seen in Table 3.4, most of the nonnative species within the corridor occur in the canopy and understory vegetation layers, while the shrub layer is dominated almost entirely by native species. Box elder (*Acer negundo*) and cottonwood (*Populus* sp.) are the most common native trees along the stream-side areas of Parleys Creek, with Gambel oak common on upper slope areas. Siberian elm (*Ulmus pumila*), an introduced invasive tree, is also very common in the study area and comprises the dominant canopy species in some reaches (Table 3.4). Common shrub species include narrowleaf willow (*Salix exigua*) and redosier dogwood, (*Cornus sericea*) with Woods' rose (*Rosa woodsii*) and skunkbush sumac (*Rhus trilobata*) common on upper portions of slopes. The understory vegetation layer shows the greatest species variety. Virginia creeper (*Parthenocissus quinquefolia*) is the most common native understory species in stream-side areas, with intermediate wheatgrass and ragweed (*Ambrosia* sp.) common on upper slopes. Introduced orchardgrass and Kentucky bluegrass dominate the understory cover in a number of the stream reaches within the Country Club and Sugar House Park. Common invasive understory species include lesser burdock (*Arctium minus*) and cheatgrass (*Bromus tectorum*) (Table 3.4).

Canopy (tree) cover is generally high throughout the study area (Table 3.5) although near-stream tree cover is limited in portions of the Country Club golf course. Because of the generally high-quality tree cover within the Parleys Creek riparian corridor, the riparian functions of shading and water-temperature control are met to a high degree. Thirty-seven percent of the overall mapped area has greater than 25% cover in all three vegetation layers (canopy, shrub, understory); these areas are particularly effective at providing the riparian functions of nutrient filtration and sediment trapping. Invasive weeds are a significant problem in all study reaches and in 66% of the overall mapped area (Table 3.5).

Dominant canopy species/ vegetation types in the study area:

- box elder
- cottonwood
- Gambel oak
- introduced/native tree mix
- other native trees or shrubs
- Russian olive
- Siberian elm
- understory

Issues Affecting Riparian Functions

During the baseline assessment work, several common issues were observed to be affecting and limiting riparian functions in the Parleys Creek corridor. These issues are discussed by function below.

Aesthetics

Although many visually appealing portions of Parleys Creek exist, the presence of trash and debris degrades corridor aesthetics in a number of locations. Common types of trash include miscellaneous small items such as bottles, cans, food wrappers, ropes, tarps, etc. These items are common in the more accessible stream reaches that are used for recreation. Another common category of trash is remnant/obsolete pieces of infrastructure such as pieces of concrete and asphalt, old pipes and barrels, broken fencing, obsolete erosion control devices such as failing silt fence, etc. In some instances the concrete and asphalt pieces are associated with poorly designed bank stabilization efforts. A total of 78 individual litter areas were

Table 3.4. **List of mapped canopy, shrub, and understory plant species found in each assessed stream reach.**

PLANT SPECIES			UPC_R16A	UPC_R16B	LPC_R01A	LPC_R01B	LPC_R02	LPC_R03	LPC_R04A	LPC_R04B	LPC_R04C	LPC_R04D	LPC_R04E	LPC_R05A	LPC_R05B	LPC_R05C	LPC_R05D	LPC_R06
	Common Name	Scientific Name																
CANOPY	Bigtooth maple	*Acer grandidentatum*	X	X					X	X	X	X				X		X
	Boxelder	*Acer negundo*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Water birch	*Betula occidentalis*	X	X					X	X	X	X						
	Curl-leaf mountain mahogany	*Cercocarpus ledifolius*																X
	Green ash	*Fraxinus pennsylvanica*			X								X	X		X		X
	Honeylocust	*Gleditsia triacanthos*					X		X									
	Utah juniper	*Juniperus osteosperma*																X
	Austrian pine [a]	*Pinus nigra* [a]										X						
	Ponderosa pine	*Pinus ponderosa*								X	X	X						
	Narrowleaf cottonwood	*Populus angustifolia*	X	X	X		X	X	X	X		X	X	X	X	X	X	X
	Eastern cottonwood	*Populus deltoides*	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Gambel oak	*Quercus gambelii*	X	X	X	X	X	X	X	X	X		X		X			X
	Smooth sumac	*Rhus glabra*			X	X	X		X									X
	Siberian elm [b]	*Ulmus pumila* [b]	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X
	Saltcedar [b]	*Tamarix Ramosissima* [b]									X							
	Tree of heaven [c]	Ailanthus altissima [c]	X		X		X					X						X
	Russian olive [b]	*Elaeagnus angustifolia* [b]		X	X		X		X		X	X	X	X			X	X
SHRUB	White sagebrush	*Artemisia ludoviciana*																X
	Big sagebrush	*Artemisia tridentata*	X	X	X	X	X		X									
	Yellow rabbitbrush	*Chrysothamnus viscidiflorus*	X	X					X		X							X
	Redosier dogwood	*Cornus sericea*	X	X	X	X	X		X	X	X		X	X	X			X
	Rubber rabbitbrush	*Ericameria nauseosa*			X		X		X									
	Twinberry honeysuckle	*Lonicera involucrata*					X	X										
	Tatarian honeysuckle [a]	*Lonicera tatarica* [a]							X	X	X	X	X					
	Chokecherry	*Prunus virgniana*	X	X	X		X	X				X	X					X
	Skunkbush sumac	*Rhus trilobata*	X		X	X	X	X	X	X	X		X	X		X		X
	Woods' rose	*Rosa woodsii*	X	X	X	X	X		X	X	X	X	X	X	X		X	X
	Narrowleaf willow	*Salix exigua*	X	X	X		X	X	X		X	X	X	X	X	X	X	X
	Crack willow [a]	*Salix fragilis* [a]							X	X	X			X	X	X		
	Western snowberry	*Symphoricarpos occidentalis*									X							
	Cattail	*Typha*									X	X						

Table 3.4. List of mapped canopy, shrub, and understory plant species found in each assessed stream reach (cont.).

PLANT SPECIES			UPC_R16A	UPC_R16B	LPC_R01A	LPC_R01B	LPC_R02	LPC_R03	LPC_R04A	LPC_R04B	LPC_R04C	LPC_R04D	LPC_R04E	LPC_R05A	LPC_R05B	LPC_R05C	LPC_R05D	LPC_R06
	Common Name	Scientific Name																
UNDERSTORY	Common yarrow	*Achillea millefolium*																X
	Crested wheatgrass [a]	*Agropyron cristatum* [a]	X	X					X		X	X						
	Redtop [a]	*Agrostis gigantea* [a]							X	X	X	X	X					
	Annual ragweed	*Ambrosia artemisiifolia*	X	X	X	X	X		X		X	X					X	
	Field brome [a]	*Bromus arvensis* [a]							X				X					
	Smooth brome	*Bromus inermis*									X							
	Water whorlgrass	*Catabrosa aquatica*	X		X							X	X		X			
	Lambsquarters [a]	*Chenopodium album* [a]										X						
	Chicory [a]	*Cichorium intybus* [a]						X					X					X
	Orchardgrass [a]	*Dactylis glomerata* [a]							X	X	X	X	X	X	X	X	X	
	Field horsetail	*Equisetum arvense*		X														
	Curlycup gumweed	*Grindelia squarrosa*	X	X					X									
	Broom snakeweed	*Gutierrezia sarothrae*	X	X														
	Common sunflower	*Helianthus annuus*					X			X								
	Foxtail barley	*Hordeum jubatum*					X	X										
	Prickly lettuce [a]	*Lactuca serriola* [a]										X	X		X			
	Creeping barberry	*Mahonia repens*	X															
	Alfalfa [a]	*Medicago sativa* [a]			X							X						X
	Purple oniongrass	*Melica spectabilis*					X											
	Yellow sweetclover [a]	*Melilotus officinalis* [a]			X	X	X	X	X	X	X							X
	Wild mint	*Mentha arvensis*							X	X	X	X		X				
	Virginia creeper	*Parthenocissus quinquefolia*	X	X	X	X	X		X	X	X	X		X	X	X		X
	Reed canarygrass	*Phalaris arundinacea*					X			X		X						
	Common reed	*Phragmites australis*								X	X							X
	Sandberg bluegrass	*Poa secunda*										X						
	Bulbous bluegrass [a]	*Poa bulbosa* [a]	X		X									X				
	Kentucky bluegrass [a]	*Poa pratensis* [a]							X	X	X	X			X	X		X
	Bluebunch wheatgrass	*Pseudoroegneria spicata*							X									X
	Curly dock [a]	*Rumex crispis* [a]			X													
	Hardstem bulrush	*Schoenoplectus acutus*											X					
	Cereale rye [a]	*Secal cereale* [a]			X	X	X											
	Tall tumblemustard [a]	*Sisymbrium altissimum* [a]									X							
	Climbing nightshade [a]	*Solanum dulcamara* [a]								X			X	X	X	X		
	Missouri goldenrod	*Solidago missouriensis*							X		X							

Table 3.4. List of mapped canopy, shrub, and understory plant species found in each assessed stream reach (cont.).

PLANT SPECIES			UPC_R16A	UPC_R16B	LPC_R01A	LPC_R01B	LPC_R02	LPC_R03	LPC_R04A	LPC_R04B	LPC_R04C	LPC_R04D	LPC_R04E	LPC_R05A	LPC_R05B	LPC_R05C	LPC_R05D	LPC_R06
	Common Name	Scientific Name																
UNDERSTORY	Eaton's aster	*Symphyotrichum eatonii*	X	X														
	Spineless horsebrush	*Tetradymia canescens*		X														
	Intermediate wheatgrass	*Thinopyrum intermedium*			X		X		X	X	X	X	X					X
	Western poison ivy	*Toxicodendron rydbergii*	X	X	X		X		X				X					X
	Jointed goatgrass [b]	*Aegilops cylindrica* [b]			X	X	X	X										
	Scotch cottonthistle [b]	*Onopordum acanthium* [b]			X	X	X	X			X	X	X					
	Myrtle spurge [b]	*Euphorbia myrsinites* [b]	X	X	X													
	Quackgrass [b]	*Elymus repens* [b]									X	X			X			
	Lesser burdock [b]	*Arctium minus* [b]	X	X			X	X	X	X	X	X	X	X	X	X	X	X
	Cheatgrass [b]	*Bromus tectorum* [b]	X	X	X		X		X	X	X	X	X					
	Whitetop [b]	*Cardaria draba* [b]	X	X			X	X	X		X		X					
	Houndstongue (Gypsyflower) [b]	*Cynoglossum officinale* [b]		X	X		X	X	X	X								X
	Bigleaf periwinkle [c]	*Vinca major* [c]							X		X							
	English ivy [c]	*Hedera helix* [c]												X	X			X
	Musk thistle [b]	*Cardus nutans* [b]			X										X			
	Canada thistle [b]	*Cirsium arvense* [b]							X	X	X	X			X		X	
	Poison hemlock [b]	*Conium maculatum* [b]									X							
	Yellow star-thistle [b]	*Centaurea solstitialis* [b]										X	X					
	Bull thistle [b]	*Cirsium vulgare* [b]											X					
	Field bindweed [b]	*Convovulus ssp.* [b] *Chrysanthemum*																X
	Oxeye daisy [b]	*Chrysanthemum leucanthemum* [b]																X

[a] Species not native to Utah.
[b] State- or city-listed, nonnative, noxious weed species.
[c] Nonnative, invasive species.

mapped in the study area during the RCS baseline assessment work. Road noise associated with the proximity of Interstate 80 also impacts the aesthetics of the Parleys Creek corridor. Graffiti is also common in reaches that have concrete headwalls at culvert inlets or outlets.

Wildlife Habitat and Connectivity

A wide range of native bird and mammal species rely on native insects as a key food source (Tallamy 2009). These insects must share an evolutionary history with plants in order to recognize them and use them as a food source. Therefore, healthy native plant communities are necessary for a riparian corridor to function to its maximum potential in terms of wildlife habitat. As discussed above, invasive nonnative plant species are a concern in all of the study reaches within the Parleys

Table 3.5. Percent cover and invasive species class for mapped vegetation polygons.

REACH	POLYGON NUMBER	PERCENT CANOPY COVER [a]	PERCENT SHRUB COVER [a]	PERCENT UNDERSTORY COVER [a]	INVASIVE SPECIES CLASS
LPC_R01A	1	N/A	N/A	N/A	none
LPC_R01A	2	6–25	26–50	76–100+	high
LPC_R01A	3	76–100+	76–100+	0	low
LPC_R01A	4	76–100+	51–75	0	none
LPC_R01A	5	6–25	6–25	76–100+	low
LPC_R01A/R01B/R02	6	76–100+	51–75	0	none
LPC_R01A	7	0	76–100+	0	none
LPC_R01A	8	6–25	26–50	51–75	low
LPC_R01A	9	0	6–25	76–100+	majority
LPC_R01A	10	26–50	51–75	26–50	low
LPC_R01A	11	0	6–25	76–100+	moderate
LPC_R01A	12	0	0	76–100+	high
LPC_R01A	13	76–100+	76–100+	0	low
LPC_R01A	14	76–100+	6–25	0	none
LPC_R01A	15	76–100+	26–50	6–25	moderate
LPC_R01A	16	76–100+	51–75	26–50	moderate
LPC_R01A	17	76–100+	26–50	0	low
LPC_R01A/R01B	18	26–50	26–50	76–100+	high
LPC_R01B/R02	19	51–75	26–50	76–100+	majority
LPC_R01B/R02	20	76–100+	51–75	1–5	none
LPC_R02	21	76–100+	6–25	51–75	high
LPC_R02	22	76–100+	6–25	26–50	high
LPC_R02	23	51–75	26–50	26–50	moderate
LPC_R02	24	76–100+	76–100+	6–25	none
LPC_R02	25	76–100+	51–75	1–5	moderate
LPC_R02/R03	26	6–25	6–25	76–100+	majority
LPC_R02	27	76–100+	26–50	0	none
LPC_R02	28	51–75	51–75	76–100+	majority
LPC_R02	29	76–100+	76–100+	6–25	moderate
LPC_R02	30	76–100+	26–50	26–50	high
LPC_R02	31	6–25	26–50	76–100+	none
LPC_R03	32	76–100+	6–25	6–25	moderate
LPC_R03	33	76–100+	26–50	26–50	high
LPC_R03	34	76–100+	0	0	none
LPC_R04A	35	26–50	0	76–100+	none
LPC_R04A	36	6–25	51–75	1–5	moderate
LPC_R04A	37	76–100+	26–50	51–75	high
LPC_R04A	38	76–100+	51–75	51–75	high

Table 3.5. Percent cover and invasive species class for mapped vegetation polygons (cont.).

REACH	POLYGON NUMBER	PERCENT CANOPY COVER [a]	PERCENT SHRUB COVER [a]	PERCENT UNDERSTORY COVER [a]	INVASIVE SPECIES CLASS
LPC_R04A	39	76–100+	51–75	51–75	high
LPC_R04A	40	51–75	6–25	51–75	high
LPC_R04A	41	76–100+	26–50	26–50	moderate
LPC_R04A	42	6–25	51–75	51–75	low
LPC_R04A	43	76–100+	51–75	26–50	none
LPC_R04A	44	76–100+	26–50	0	moderate
LPC_R04A	45	26–50	6–25	76–100+	majority
LPC_R04A	46	76–100+	26–50	26–50	high
LPC_R04A	47	51–75	26–50	6–25	moderate
LPC_R04A	48	76–100+	26–50	51–75	high
LPC_R04A	49	1–5	0	76–100+	none
LPC_R04B	50	51–75	26–50	51–75	moderate
LPC_R04B	51	6–25	0	6–25	none
LPC_R04B	52	26–50	6–25	1–5	moderate
LPC_R04B	53	76–100+	26–50	51–75	high
LPC_R04B	54	51–75	26–50	76–100+	high
LPC_R04B	55	26–50	6–25	51–75	high
LPC_R04B	56	0	1–5	76–100+	none
LPC_R04B/R04C	57	26–50	6–25	76–100+	high
LPC_R04C	58	26–50	26–50	51–75	high
LPC_R04B	59	0	0	76–100+	none
LPC_R04B	60	0	0	76–100+	none
LPC_R04C	61	26–50	6–25	51–75	moderate
LPC_R04C	62	0	6–25	51–75	moderate
LPC_R04C	63	26–50	6–25	76–100+	majority
LPC_R04C	64	0	6–25	51–75	moderate
LPC_R04C	65	6–25	6–25	76–100+	none
LPC_R04C	66	51–75	26–50	26–50	majority
LPC_R04C	67	51–75	26–50	51–75	majority
LPC_R04C	68	51–75	51–75	51–75	high
LPC_R04C	69	26–50	26–50	51–75	high
LPC_R04C	70	0	0	51–75	none
LPC_R04D	71	51–75	51–75	76–100+	high
LPC_R04D	72	6–25	0	76–100+	none
LPC_R04D	73	6–25	1–5	76–100+	high
LPC_R04D	74	1–5	1–5	51–75	moderate
LPC_R04D	75	0	6–25	76–100+	low
LPC_R04D	76	76–100+	51–75	26–50	moderate
LPC_R04D	77	26–50	6–25	51–75	moderate

Table 3.5. Percent cover and invasive species class for mapped vegetation polygons (cont.).

REACH	POLYGON NUMBER	PERCENT CANOPY COVER [a]	PERCENT SHRUB COVER [a]	PERCENT UNDERSTORY COVER [a]	INVASIVE SPECIES CLASS
LPC_R04D	78	26–50	26–50	51–75	moderate
LPC_R04D	79	0	6–25	51–75	moderate
LPC_R04E	80	0	6–25	51–75	moderate
LPC_R04E	81	26–50	6–25	76–100+	high
LPC_R04E	82	6–25	0	76–100+	high
LPC_R04E	83	51–75	51–75	26–50	high
LPC_R04E	84	51–75	51–75	76–100+	high
LPC_R04E	85	26–50	26–50	76–100+	majority
LPC_R04A	86	51–75	26–50	51–75	high
LPC_R05A	87	76–100+	26–50	26–50	high
LPC_R05A	88	51–75	26–50	26–50	high
LPC_R05A/R05B	89	26–50	51–75	26–50	moderate
LPC_R05B	90	76–100+	51–75	26–50	high
LPC_R05B	91	51–75	51–75	6–25	moderate
LPC_R05B	92	26–50	51–75	51–75	moderate
LPC_R05D	93	76–100+	51–75	26–50	high
UPC_R16A	94	51–75	51–75	6–25	moderate
UPC_R16A	95	26–50	76–100+	6–25	none
UPC_R16A	96	51–75	26–50	26–50	none
UPC_R16A	97	51–75	51–75	26–50	moderate
UPC_R16A	98	51–75	26–50	26–50	high
UPC_R16A	99	26–50	51–75	6–25	moderate
UPC_R16A/R16B	100	51–75	51–75	6–25	moderate
UPC_R16B	101	6–25	51–75	26–50	moderate
UPC_R16B	102	1–5	6–25	26–50	moderate
UPC_R16B	103	26–50	51–75	26–50	low
UPC_R16B	104	26–50	26–50	26–50	high
UPC_R16B	105	6–25	26–50	51–75	high
UPC_R16B	106	26–50	51–75	26–50	moderate
UPC_R16B	107	26–50	26–50	26–50	moderate
LPC_R05C	108	51–75	6–25	76–100+	moderate
LPC_R05C	109	51–75	51–75	51–75	moderate
LPC_R05C	110	51–75	26–50	51–75	moderate
LPC_R06	111	76–100+	26–50	26–50	high
LPC_R06	112	51–75	51–75	51–75	high
LPC_R06	113	26–50	6–25	76–100+	moderate
LPC_R06	114	51–75	26–50	6–25	moderate
LPC_R06	115	26–50	26–50	76–100+	low
LPC_R06	116	26–50	26–50	51–75	none

[a] N/A = not applicable.

Invasive plants of concern in the study area:

- oxeye daisy
- yellow star-thistle
- musk thistle
- whitetop
- poison hemlock
- Canada thistle
- houndstongue
- saltcedar
- quackgrass
- myrtle spurge
- Scotch thistle
- bull thistle
- common burdock
- Russian olive
- Siberian elm
- tree of heaven
- jointed goatgrass
- field bindweed
- English ivy
- periwinkle vine
- cheatgrass

Creek corridor, and significantly affect the composition of the understory and canopy vegetation layers. In some areas invasive species comprise the majority plant cover within a vegetative layer, limiting the ability of native plants to thrive and support native insects, birds, and wildlife. A lack of understory and shrub cover in some reaches also limits habitat quality in terms of structural diversity, which is particularly important for bird populations.

Another issue that affects wildlife habitat in terms of riparian connectivity is the presence of stream crossing culverts. A total of nine major road crossing culvert pipes are present within the study area (Figure 3.12, Table 3.6). Several of these culverts impede or block fish passage due to their long length and high flow velocities. This limits the ability of fish populations to use Parleys Creek as a continuous travel corridor. Within the RCS study area, a total length of 0.75 mile of stream is contained in culvert pipes, limiting the overall length of open-channel stream channel available as aquatic habitat. The longest continuous segments of stream in the study area include the 4,200-foot-long segment within Parleys Historic Nature Park and a 3,000-foot-long segment encompassing study reaches LPC_R04B and LPC_R04C within the Country Club golf course.

Factors limiting shrub and understory cover:

- oversteepened slopes
- inadequate revegetation efforts following construction or fill placement
- soil compaction from heavy foot traffic
- poorly controlled runoff from upland areas

Nutrient Filtration and Sediment Trapping

Several areas within the Parleys Creek corridor lack the dense near-stream understory cover that is needed to maximize the ability of the riparian corridor to filter sediment, nutrients, and pollutants from storm runoff. In some areas, understory cover is high but the community is dominated by invasive weeds or mowed turf. These types of cover do not serve the filtration function as well as tall, dense, deep-rooted native grass communities would. Another factor limiting the filtration function in portions of Parleys Creek is the design of storm drain outfalls. In many areas, pipes discharge directly into the main flow of the stream, eliminating the opportunity for runoff to be filtered by riparian vegetation.

Table 3.6. Size and condition of stream crossing culverts in the study area.

CROSSING LOCATION AND DESCRIPTION	REACH NUMBER(S)	CROSSING LENGTH (feet)	VERTICAL DROP FROM INLET TO OUTLET [a] (feet)	CROSSING TYPE	ESTIMATED CROSSING SIZE OR PIPE DIAMETER [b] (feet)	INLET CONDITION	OUTLET CONDITION
Flume and pedestrian bridge	bottom of UPC_R16A	-	-	concrete bridge over concrete walls/floor	9 H x 25 L	fair	good
Interstate 215	between UPC_R16B and LPC_R01A	625	33	round corrugated metal pipe with concrete on bottom	8	good	good; tailwater pool present
Wood footbridge in Parleys Park	LPC_R02	-	-	wooden full-span bridge	-	N/A [c]	N/A [c]
Parleys Park - main bridge	between LPC_R02 and LPC_R03	-	-	concrete box culvert	6 H x 16 L	good	good
Interstate 80	between LPC_R03 and LPC_R04A	1359	33	round pipe	6	fair - grated with metal; evidence of periodic clogging	good; deep plunge pool at outlet
Country Club - access road and tee area	between LPC_R04A and LPC_R04B	264	9	round pipe	7.5	fair	fair; deep tailwater pool present; bare bank areas
Country Club - trail crossing	LPC_R04B	-	-	concrete footbridge and wingwalls	25 L x 4.5 H x 6.5 W	fair	fair
Country Club - utility pipe/golf cart crossing	LPC_R04B	-	-	concrete bridge with concrete piers	30 L x 6 H x 12.5 W	good; piers in channel at banks	good
Country Club - golf cart crossing	LPC_R04B	-	-	stone bridge with three arch openings	side arches: 1.5 H x 5 W center arch: 5 H x 8 W	good	good
Country Club - golf cart crossing	between LPC_R04B and LPC_R04C	-	-	metal/wood plank bridge with concrete wingwalls	28 L x 5 H x 12 W	good	good
Country Club - access road	LPC_R04C	-	-	concrete box culvert	35 L x 5 H x 33 W	fair/poor - concrete is cracked/ degraded; scour at footing	fair- concrete is cracked/degraded
Country Club - obsolete bridge	LPC_R04C	-	-	steel beam bridge with concrete wingwalls	25 L x 5.5 H x 8 W	good	good

Table 3.6. Size and condition of stream crossing culverts in the study area (cont.).

CROSSING LOCATION AND DESCRIPTION	REACH NUMBER(S)	CROSSING LENGTH (feet)	VERTICAL DROP FROM INLET TO OUTLET [a] (feet)	CROSSING TYPE	ESTIMATED CROSSING SIZE OR PIPE DIAMETER [b] (feet)	INLET CONDITION	OUTLET CONDITION
2000 East	between LPC_R04C and LPC_R04D	103	3	metal pipe (squashed) with concrete headwalls and sill	7 H x 8 W	good	fair; minor erosion behind headwall and minor scour below sill
Country Club - golf cart crossing	LPC_R04D	-	-	wood planks on top of concrete supports	35 L x 4.5 H x 14 W	good; concrete supports in floodplain	good
Country Club - piped section near Interstate 80	between LPC_R04D and LPC_R04E	134	6	round metal pipe with gabion headwall	7.5	poor; partly blocked by sediment and debris	fair; no scour evident
Country Club - recently piped section near Interstate 80	in LPC_R04E	262	6	round metal pipe with gabion headwalls and concrete sill	7	good; gabion walls limit bank vegetation	good; gabion walls limit bank vegetation
1700 East	between LPC_R04E and LPC_R05A	322	6	round metal pipe in concrete	7	good; graffiti art on headwall	good; minor erosion left bank; graffiti on headwall
Sugar House Park - blue footbridge	LPC_R05A	-	-	full-span steel pedestrian bridge	54 L x 4.4 H x 8 W	good	good
Sugar House Park - eastern road crossing	between LPC_R05B and LPC_R05C	85	3	round concrete pipe with concrete headwalls	4	fair	fair - some scour and undercutting of armored banks
Sugar House Park - footbridge	LPC_R05C	-	-	concrete bridge across stone block wingwalls	16 L x 12 W x 7 H	fair; wingwalls confine channel to 10-foot width	fair
Sugar House Park - western road crossing	between pond and LPC_R05D	80	3	round concrete pipe with concrete headwall	5.5	underwater in pond	fair; deep scour pool present
1300 East	between LPC_R05D and LPC_R06	682	12	concrete box culvert	8 H x 8 W	multiple metal grates	good; deep tailwater pool present
Hidden Hollow	LPC_R06	-	-	full-span steel pedestrian bridge	40 L x 12 H x 8 'W	good	good
Hidden Hollow	LPC_R06	-	-	full-span steel pedestrian bridge	100 L x 25 H x 8 W	good	good
Downstream end of Hidden Hollow	LPC_R06	-	-	concrete box culvert	5 H x 8 W	ponded; requires frequent removal of debris from metal grates	N/A [c]

[a] Estimated streambed elevation change between inlet and outlet based on digital elevation data.
[b] H = height, L = length, W = width.
[c] Not applicable.

Stream Stability

A number of different issues were noted as affecting stream stability within the Parleys Creek riparian corridor. Specific issues are discussed in the subsections below.

Fill Encroachment

Poorly vegetated fill slopes associated with freeway and trail construction, commercial development, flood control dredging, and historic land uses affect stability in various parts of the riparian corridor. Because these slopes lack vegetation and the associated resistive strength it provides, they are vulnerable to erosion during flood events. Fill slopes also restrict floodplain width and laterally confine high flows, causing increased flow velocities and shear stress on streambanks. Fill encroachment also limits the ability of floodplain surfaces to act as sponges to absorb flood water.

Storm Drain Outfalls

Erosion was observed at various storm drain pipe outfalls within the study area. These outfalls deliver storm water runoff to the creek from streets, freeways, gutters, and rooftops. The outfalls often lack adequate outlet protection to dissipate runoff velocities and protect against erosion. In cases where outlet protection is provided, stabilized conveyance channels are often lacking between the protected outlet and the main Parleys Creek channel, and evidence of rill erosion in these areas is common. In some cases pipes protrude into the bed of the channel, creating flow obstructions that have hydraulic and potential stability effects. Of a total of 38 mapped outfall locations within the study area, 22 are recommended for improvements to resolve erosion problems or improve filtration of runoff.

Top left: Soil compaction from heavy foot traffic in Parleys Park. Top right: Unprotected fill slope in Hidden Hollow. Bottom left: Bank scalloping from lack of woody riparian vegetation in Sugar House Park. Bottom right: Low bank/root zone erosion in Sugar House Park.

Bank Erosion

Lateral erosion of streambanks is a natural process in stream channels, which are dynamic systems. Erosion and sediment transport are necessary for the creation and maintenance of important habitat features such as scour pools, undercut banks, and spawning gravels. Deposition of sediment on floodplain areas is also important, as it provides fresh substrate for the growth of willow and cottonwood seedlings that are needed to maintain native riparian forests. However, excessive amounts of erosion or deposition can degrade habitat and water quality and threaten infrastructure and homes.

Several types of bank erosion were observed in the study area. Low bank erosion/root zone scour is particularly evident in the

downstream half of the study area below reach LPC_R04B. This type of erosion is associated with high impervious cover and the resulting flashy urban hydrology that produces frequent, erosive runoff events during storms. In some areas, it appears that streambed lowering may also be contributing to low bank erosion by causing the toe of the slope to become undermined. In some reaches, tall, vertical bare banks are present where the creek has migrated laterally into historic or more recent fill material. Bank "scalloping" is another type of erosion observed in the Parleys Creek corridor; this type of erosion involves the development of widened sections of bank where woody shrubs or trees are lacking, and is common in park areas where grass is mowed to the edge of the streambank.