2.0 BASELINE ASSESSMENT METHODS

Study Reaches

Conditions within the City Creek corridor were assessed between Pleasant Valley and Memory Grove (Figure 2.1). This study area extent was selected because the portion of the corridor from Pleasant Valley (picnic site #12) downstream receives the greatest amount of recreational use. Total above-ground channel length within the study area is approximately 3.1 miles. The width of the study area included the stream channel itself and the areas within 100 feet of the AHWL; on City Creek, the total width assessed was approximately 220 feet on average. For assessment purposes, the stream was divided into individual reaches, with each reach generally between 700 to 1,900 feet in length. Reach breaks were initially identified based on reaches previously established by Salt Lake County (the County); several of these County reaches were further subdivided at footbridge crossings, geologic breaks, or where significant changes in stream condition occurred. Twelve study reaches were established within the overall City Creek study area. Reach names and numbers were assigned based on established County watershed abbreviation and stream numbering conventions

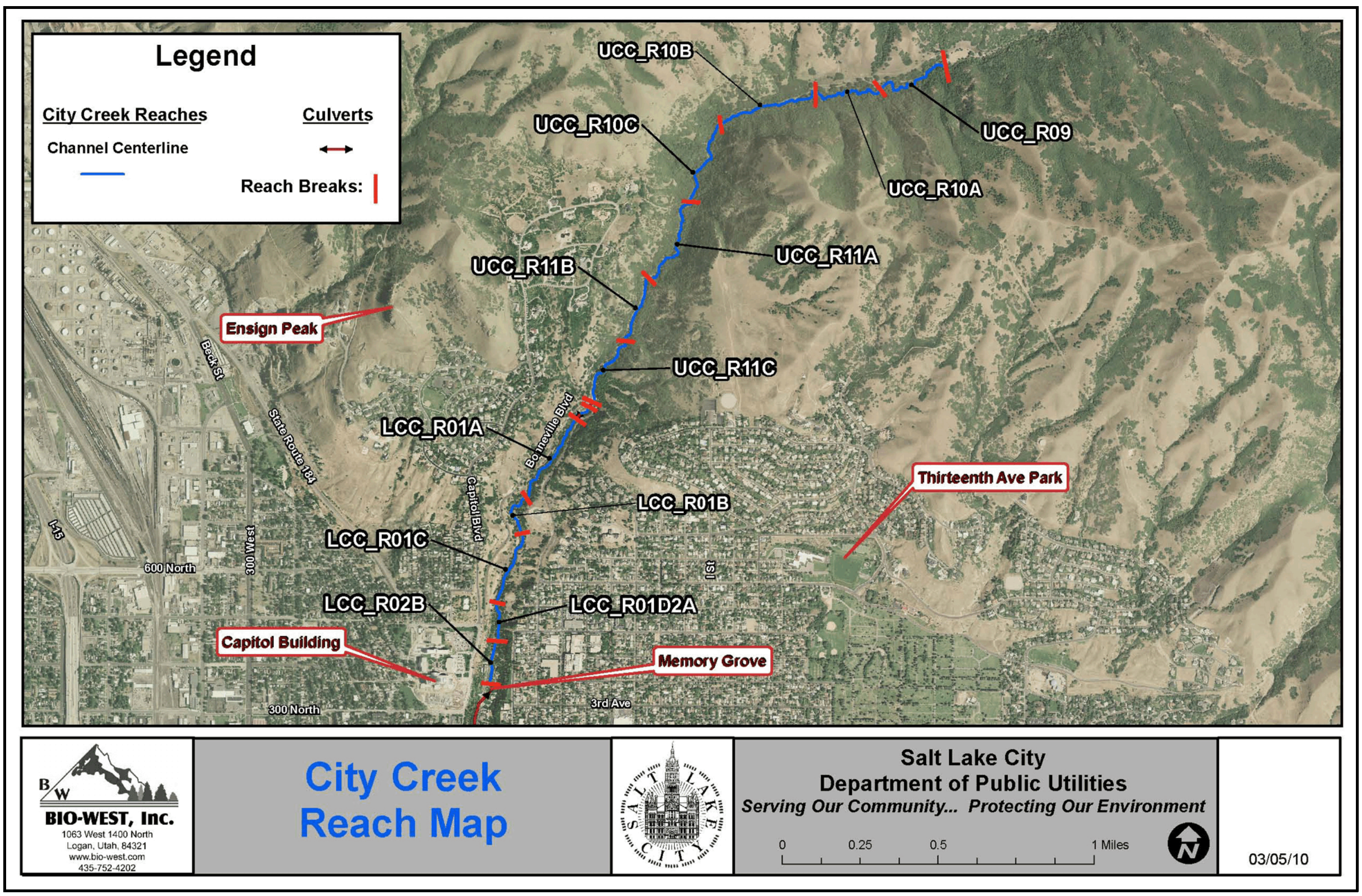


Figure 2.1. **City Creek reach map.**

(SLCO 2009). City Creek includes the upper City Creek (UCC) and lower City Creek (LCC) subwatersheds, with the break occurring at Bonneville Boulevard crossing. Within each subwatershed, reach numbers are assigned consecutively in an upstream to downstream direction, resulting in reach numbers such as LCC_R01 (lower City Creek Reach 1), LCC_R02, etc.

For the reaches that were subdivided, an alpha character was appended to the end of the number, resulting in numbers such as UCC_R10A, UCC_R10B, etc. Table 2.1 provides a complete list of the City Creek study reaches.

Stream Condition Assessment

For each study reach, stream condition was assessed using both qualitative and quantitative measures. Base maps (1 inch = 100 feet scale) for field use were prepared using 2006 aerial imagery (1-foot resolution color orthophotography) and light detection and ranging (LIDAR)-based elevation data (3 foot contour interval). Field data collection methods for this study were designed to compliment available stream condition information collected by Salt Lake County in 2007.

The County assessed 5 reaches within the City Creek study area, and for each reach completed components of a Level III Stream Inventory (Rosgen 1996). Information gathered included Rosgen (1996) stream type, estimates of riparian vegetation width and density, extent of artificial bank stabilization in the reach, visual estimates of streambed material size, and a qualitative channel stability evaluation (Pfankuch 1975). Detailed cross-section surveys were not completed as part of this County effort; rather, at one representative location within each reach, the bankfull channel was visually identified and estimates of bankfull width, depth, and entrenchment ratio were measured with a rod. Additional information on the County stream assessment methods can be found in the Salt Lake Countywide Water Quality Stewardship Plan (SLCO 2009).

The techniques used for the Salt Lake City RCS field evaluations provide an additional level of quantitative and site-specific data to supplement the available County information. Overall, the objective of the baseline stream condition assessment is to gather information on how well the riparian functions of aesthetics,

Table 2.1. Reach names.

REACH NUMBER	REACH DESCRIPTION	FIELD ASSESSMENT DATE
UCC_R09	Pleasant Valley	8/31/2009
UCC_R10A	Pipeline	8/31/2009
UCC_R10B	Eagles Rest	9/1/2009
UCC_R10C	Water Crest	9/1/2009
UCC_R11A	Elbow Turn	9/3/2009
UCC_R11B	Hidden Falls	9/3/2009
UCC_R11C	Guard Shack Gate Area	9/3/2009
LCC_R01A	Below Bonneville Boulevard	9/4/2009
LCC_R01B	Upper Freedom Trail Area	9/1/2009
LCC_R01C	Lower Freedom Trail Area	9/4/2009
LCC_R01D02A	Upper Memory Grove Park	9/4/2009
LCC_R02B	Lower Memory Grove Park	8/31/2009

floodplain storage, connectivity, organic matter inputs, stability, and conveyance are being met within the City Creek riparian corridor.

Field Data Collection

Field assessments were completed during low-flow conditions during late summer 2009 (Table 2.1). A standard Stream Assessment Data Form (Appendix A) was created to document observations and record data. This form was completed after walking the entire study reach. Additional site-specific field observations were collected by recording a point feature using a GPS device and data logger, and photographs of the GPS points were taken for reference. Notes were also created and stored with each GPS point. Spatial accuracy of the GPS data was somewhat limited due to tree canopy and steep bank conditions; it was typically approximately 10 meters.

Within each fully evaluated study reach, one representative riffle was selected as a cross-section location for quantitative data collection, and its position was recorded as a GPS point feature. At each selected riffle, the cross-sectional shape of the active channel was surveyed using an engineer's level, survey rod, and measuring tape. A pebble count (Wolman 1954) was also completed to characterize the size of the streambed material. During the pebble count, the number of rocks that were embedded (i.e., surrounded by fine sediment and difficult to pick up) was noted. Local streambed slope was determined by surveying the bed elevation at the nearest riffle upstream and downstream of the cross section and measuring the channel length between the points. Survey and pebble count data were entered into a spreadsheet and plotted to determine wetted width at low flow, local slope, median streambed-material particle size, and percent embeddedness.

During spring 2009 the cross section locations were established and water surface elevations were surveyed during high-flow conditions. General observations were noted on a field data sheet (Appendix A), and photos were taken to document conditions during spring runoff. High-flow data were overlaid onto the cross-section plots and used to develop a calibrated estimate of wetted width at the AHWL. To determine the streamflow magnitude representative of average annual high water conditions, mean daily flow data collected at Salt Lake County's gage in Memory Grove Park (Figure 2.1) were analyzed. The maximum 1-day flow was determined for each water year, and the average for the analysis period (1980–2005) was calculated to determine the

Types of Field Data Collected

Qualitative information on:

- streambed material
- streambank material
- water appearance/clarity
- extent of sediment deposits/bars
- frequency of undercut banks
- accessible flat floodplain surfaces
- amount of in-channel woody debris
- evidence of reach-scale streambed lowering

Presence and condition of:

- bed hardening or grade structures
- exposed pipe crossings (sewer, water, etc.)
- stream-crossing structures (culverts, bridges, etc.)
- in-channel structures (diversions, weirs, etc.)
- artificial bank treatments (rock, concrete, gabions, etc.)
- storm drain outfalls
- access trails
- significant trash areas
- vertical/severely eroding banks
- tributaries/springs/seeps

average annual high-flow value for City Creek.

Analyses Using Digital Data

To compliment the data collected in the field, several additional analyses were completed using 2006 LIDAR-based digital-elevation grid data (2-meter resolution) obtained from the City. Using slope and contour maps generated with ArcMap software to identify the low point of the channel, a new channel centerline alignment was digitized for the study area (Figure 2.2). Relative to previously available GIS stream-channel shapefiles, this new centerline file more closely follows the bends of the stream and provides more accurate information on total channel length. Using the profile tool in ArcMap, a longitudinal profile of the channel centerline was extracted and plotted for each reach to determine total reach length and reach-averaged streambed slope. Culvert lengths were also determined, and a comprehensive longitudinal profile plot of the full study area was generated by combining the reach profile and culvert length data.

The channel cross sections surveyed in the field included the active channel and bank areas within and immediately beyond the AHWL; however, in most reaches, the stream is entrenched below the surrounding terrain

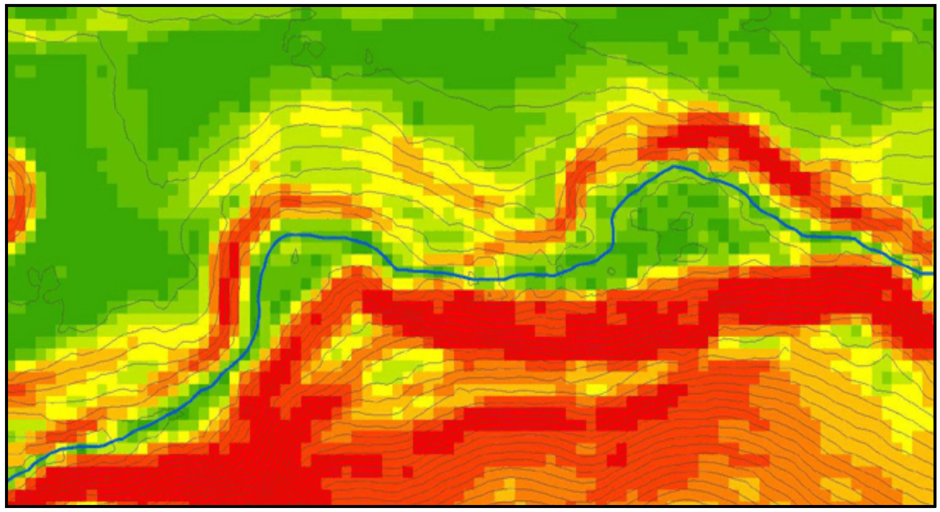


Figure 2.2. Using digital elevation data to draw the channel centerline.

and it was not practical to field survey the entire upper portions of the slopes. Therefore, these upper-slope sections were extrapolated using the digital-elevation grid data. At each cross-section location in ArcMap, the profile tool was used to draw a line section (typically about 100 feet long) perpendicular to the channel and spanning its entire inset width. Because the accuracy of the GPS-based cross-section position data is only about 10 meters, the expanded portions of the cross-section plots may represent conditions slightly upstream or downstream of the actual field-surveyed cross section and, therefore, should be used only as a general indication of the overall shape and degree of entrenchment within a given steam reach.

To assess the degree to which developed infrastructure is currently present within the riparian corridor, buffer coverages were generated in ArcMap extending 50 feet and 100 feet to each side of the approximate AHWL location. This effort required several steps. First, to determine the approximate AHWL location throughout the corridor, the high flow wetted width values surveyed at each cross section were evaluated, and the average of these values was calculated. This width was then added to the digitized channel centerline throughout the study area to establish the starting point for the buffer coverages.

Once generated, the 50- and 100-foot buffers were overlaid onto the aerial imagery, and the extent of infrastructure in each study reach was visually classified for both the right and left (facing downstream) sides of the channel. The infrastructure categories used were none, low (less than one-third of the reach length developed), moderate (one to two-thirds developed), and high (more than two-thirds developed). Infrastructure was considered to include buildings, parking lots, and roads; sidewalks and unpaved trails were not considered developed infrastructure for this analysis.

It is important to note that this approach is intended simply to provide a consistent way to assess the relative degree of development throughout the study area, not to create an accurate comprehensive map of the AHWL. The wetted width and location of the AHWL varies substantially within each reach, can change with time, and needs to be determined on a locally site-specific basis to be accurate.

Information Recorded on the Vegetation Data Form:

- species composition of canopy, shrub, and understory layers
- relative amount of woody debris on banks/floodplain
- invasive species presence/dominance
- evidence of active recruitment of riparian willows/cottonwoods
- notes/issues affecting vegetation quality

Such an effort is beyond the scope of this current study.

Vegetation Assessment

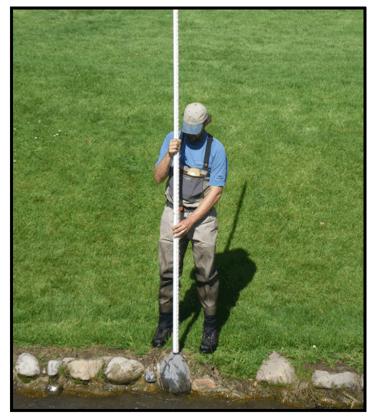
The objective of the vegetation assessment work on City Creek is to evaluate the lateral extent, species composition, structure, and general health of associated riparian vegetation communities found along the creek. As part of their channel-stability monitoring work, the County characterizes the overall riparian vegetation density and extent for each stream reach; however, no species-specific data are collected. Therefore, a focus of the RCS was to collect more detailed information on dominant vegetation species within the riparian corridor, including invasive species. The data collected through the vegetation assessment provide information on how well the riparian functions of shading, habitat, organic matter inputs, filtration, and stability are being met within the City Creek corridor.

Field Mapping

Riparian vegetation communities were delineated in the field on base maps (1 inch = 100 feet scale) prepared with available aerial imagery (1-foot resolution 2006 color orthophotography). Boundaries delineating individual vegetation polygons were placed where obvious demarcations between communities were found. Polygon boundaries did not necessarily match established stream reach boundaries. In some cases a single vegetation polygon spanned multiple stream reaches; in other cases a single

Examples of Vegetation Community Associations:

- Bigtooth Maple / Gambel Oak Forest
- Box Elder / Redosier Dogwood Forest
- Narrowleaf Cottonwood / Water Birch Woodland



stream reach contained multiple vegetation polygons. Vegetation mapping was completed in conjunction with the low-flow stream assessments in late summer 2009 (Table 2.1).

Information about each mapped polygon was recorded on a Riparian Vegetation Mapping Data Form developed for this study (Appendix A). To evaluate overall structural quality of the vegetation, overall percent cover was classified for canopy (plants >15 feet tall), shrub (plants 3–15 feet tall) and understory (plants < 3 feet tall) layers. This classification used the following coverage ranges: 0, 1–5%, 6–25%, 26–50%, 51–75%, and 76–100%+.

Vegetation Community Classifications

For each field-mapped vegetation polygon, species composition was recorded for all species that comprised 10% or more of the vegetation community. Species composition was recorded separately for each of the structural layers (canopy, shrub, understory). Each polygon was then classified as a specific vegetation community type based on the National Vegetation Classification for Utah, which is based on the National Vegetation Classification Standard and the Standardized National Vegetation Classification System (SNVCS) (USDI 1994).

Communities were characterized to the association level. Associations are often named for the dominant canopy or tallest species and the dominant species in the ground layer or shrub layer. In many single-layer communities either a single species is used in the name or co-dominant species may be used in the name.

Environmental features are sometimes used in the name of associations where the feature provides information that the dominant species alone would not. The physiognomic type is also often used in the name of associations.

Detailed descriptions of associations are found in the NatureServe Database (NatureServe 2008), which is the depository of vegetation community information for most state and national agencies and organizations, and follows the SNVCS. These attributions to an association were based on the collected species composition data and environmental characteristics of each mapped polygon.

In addition to assigning each vegetation polygon a community association, we also characterized each polygon with a simplified "dominant vegetation" type.

This classification was determined as follows. For all polygons with more than 25% total canopy (tree) cover, the tree species mapped as having the greatest percent cover was determined. If only one species was dominant, the species name was assigned as the dominant vegetation type (e.g., Box Elder). Where multiple species were equally dominant, a dual-species entry was assigned (e.g., Bigtooth Maple-Gambel Oak), or a general/grouped category (e.g., Introduced/Native Tree Mix) was assigned for combinations with few occurrences. For polygons with 25% or less total canopy cover, the total shrub cover and understory cover values were assessed, and the polygon was assigned either to an "Understory" or "Other Native Trees or Shrubs" category as appropriate.

Data Analysis

Field-mapped polygons were digitized into a GIS shapefile using ArcMap and attributed with dominant species cover and other data recorded on the Riparian Vegetation Mapping Data Form, as well as the assigned community association and dominant vegetation type. Polygons were also assigned an invasive species classification based on the combined mapped percent cover of species identified as weeds on the Utah Department of Agriculture's noxious weed list (UDAF 2008) and the Salt Lake City Watershed Division (V. Welsh 2009, pers. comm.) weed list. Introduced or ornamental species that have naturalized within the study area and are exhibiting invasive characteristics (e.g., self perpetuation, overtaking/ dominating native vegetation communities) were also included when determining the invasive species classification.

Invasive classification categories (Dewey and Andersen 2004) included none, low (1–5% cover), moderate (6–25% cover), high (26–50% cover), and majority (51–100% cover).

Watershed and Historical Information

The data collection effort for this study focused on gathering information on physical stream-channel conditions and riparian-vegetation characteristics. Detailed collection or analysis of data on water quality, hydrology, water rights, macroinvertebrates, or use of the corridor by wildlife was not the primary purpose of this study, although these items are all important aspects of riparian corridor condition. General information on these resources was summarized from available existing reports.

Summaries of overall watershed condition were also prepared from information included in the recently completed Salt Lake Countywide Water Quality Stewardship Plan (SLCO 2009). Supplemental information was obtained through discussions with City, County, and state agency staff as well as RCS Subcommittee members and public workshop attendees. Geologic information (Bryant 1990) was also reviewed to develop an understanding of the geologic setting affecting the different study reaches.

To obtain a better understanding of the City Creek corridor historic conditions, land use patterns, and channel changes through time, various sources of historical information were researched. The University of Utah Marriot Library, Utah State Historical Society, Daughters of Utah Pioneers, Sons of Utah Pioneers, and U.S. Geologic Survey offices were visited to review available historic photos, maps, aerial imagery, and journal accounts describing riparian corridor conditions. Historic newspaper articles mentioning the creek were also researched. More recent information regarding alterations to the creek was obtained through discussions with City, County, and state agency staff, and corridor residents, and by reviewing permit documents available at the County Flood Control office and through the Utah State Stream Alteration permit database (UDWRT 2009).