

Data Transmittal Report

CLEAR CREEK CONSULTANTS



To: Upper Clear Creek Watershed Association (UCCWA)
CC:
From: Mike Crouse
Date: 21-March-2016
Re: Stream Gaging Report 2015 – Clear Creek at Kermitts (Station CC-40)

Clear Creek Consultants (CCC) has been retained by UCCWA to operate and maintain the stream flow gaging station on Clear Creek above Johnson Gulch near Kermitts (Station CC-40). The UCCWA and others utilize streamflow data from this gage to assess water quality conditions in Clear Creek. From October 1994 to October 2005, the gage was operated by the U.S. Geological Survey and records were published in annual reports. CCC has operated the CC-40 gage and published the flow data since 2006. This report presents data collected at the gage from October 2014 to October 2015.

Data Collection Activities

A continuous recording Campbell Scientific data logger was used to measure a submersible pressure transducer to develop the stage height record for CC-40. The 15-minute average stream stage height was recorded during ice-free periods extending from approximately March to November. The transducer was calibrated using an electronic tape gage referenced to the base of the gage enclosure box. An outside staff gage mounted in the stream is also utilized as a stream stage height reference.

Continuous recording water quality probes were also operated at the CC-40 gage. A combination conductivity/temperature probe recorded in-stream temperature and conductivity (dissolved solids) conditions related to salt loading in Clear Creek (see attached data plot). An in-stream turbidity probe was used to monitor stream turbidity conditions related to suspended sediment loading (see attached data plot). These water quality parameters are recorded by the data logger as 15-minute average and daily maximum values. A tipping bucket rainfall intensity gauge was also operated at the CC-40 gage.

Operation of the CC-40 streamgage requires the development and maintenance of a discharge rating to define the relationship between stream stage height and discharge. Direct measurements of stream flow using a current meter are required each year to document this relationship at various seasonal flow rates. These measurements are compared to the discharge rating and, if necessary, shift adjustments are applied to maintain accuracy. Data collection methods and procedures used at the CC-40 streamgage follow standard USGS guidelines and protocols (USGS, 1982 – Measurement and Computation of Streamflow, Volumes 1 and 2).

Seven direct current meter discharge measurements were taken in 2015 to maintain the discharge rating. Measurement results are available upon request. These measurements were plotted on log-normal distribution using a computer program for comparison to the existing rating. Each year the discharge rating is evaluated to assess the accuracy of the rating in comparison to the direct measurements. Shifts are applied when appropriate to maintain accuracy.

The low-flow and medium discharge ratings were revised for 2015 and are designated as Rating No. 9. Three separate rating curves were developed and utilized for the CC-40 gage representing low flow (20-70 cfs), medium flow (70-300 cfs), and high flow (300-2,000 cfs). The streamflow rating table for CC-40 is attached.

The stage height record was compiled for review, plotted, and any necessary corrections were made based on field calibration measurements. The final stage height record was then imported into an Access database program for the computation of discharge and archiving. Water quality parameter data is also maintained in the Access database for CC-40. This data is available upon request.

The discharge rating equations were applied to the corrected stage height data for the computation of discharge. A stream flow calculator program was used within the Access database framework to compute the 15-minute discharge. Statistical output summaries from the database program include mean daily flow; mean hourly flow; and maximum and minimum instantaneous flow by month.


Results

The gage was audited approximately monthly during ice-free periods to check calibration against the gage reference points and make any necessary adjustments to maintain accuracy. Routine maintenance of the gage included removal of silt accumulated in the stilling well and instrument maintenance. The flow results are posted in real-time on the Clear Creek Watershed Foundation Web Site for rafters and other water users to obtain current stream flow conditions (www.clearcreekwater.org-flow.html).

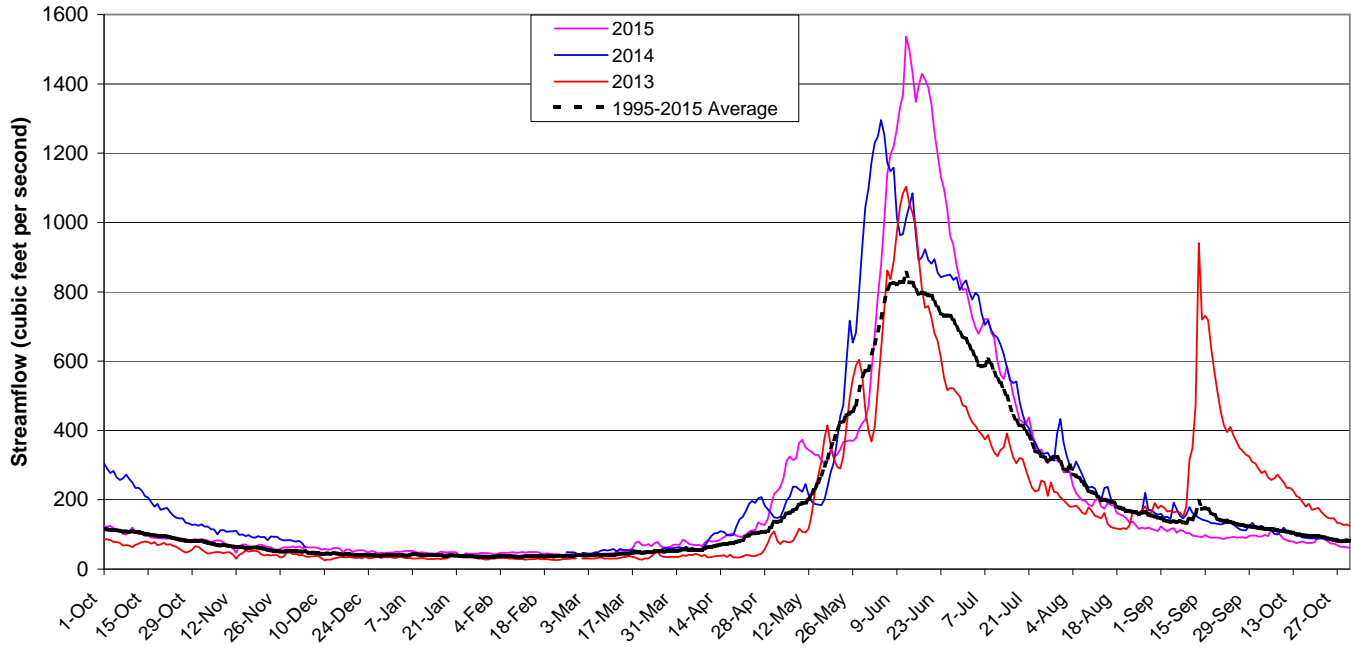
The CC-40 mean daily discharge results for October 2014 to October 2015 are presented in the attached table, along with the flow hydrograph. The gage is not operated over the winter months (November-March) because the gage is not accurate during heavy ice-cover conditions which occur each year at CC-40. Significant channel ice accumulation renders the flow rating useless during the winter. When possible, wintertime flows are estimated based on Clear Creek flows at the Golden USGS gage (CC-60) adjusted using the average flow ratio for the winter low-flow period.

Minimum Clear Creek flows occur in winter with maximum flows typically in June. Minimum flows typically range from 25 to 40 cfs at CC-40. Mean daily flows were near average in April and above average in May 2015. Peak snowmelt flows were above average in June and flow remained above average in July 2014. Flow was below average in September and October 2015.

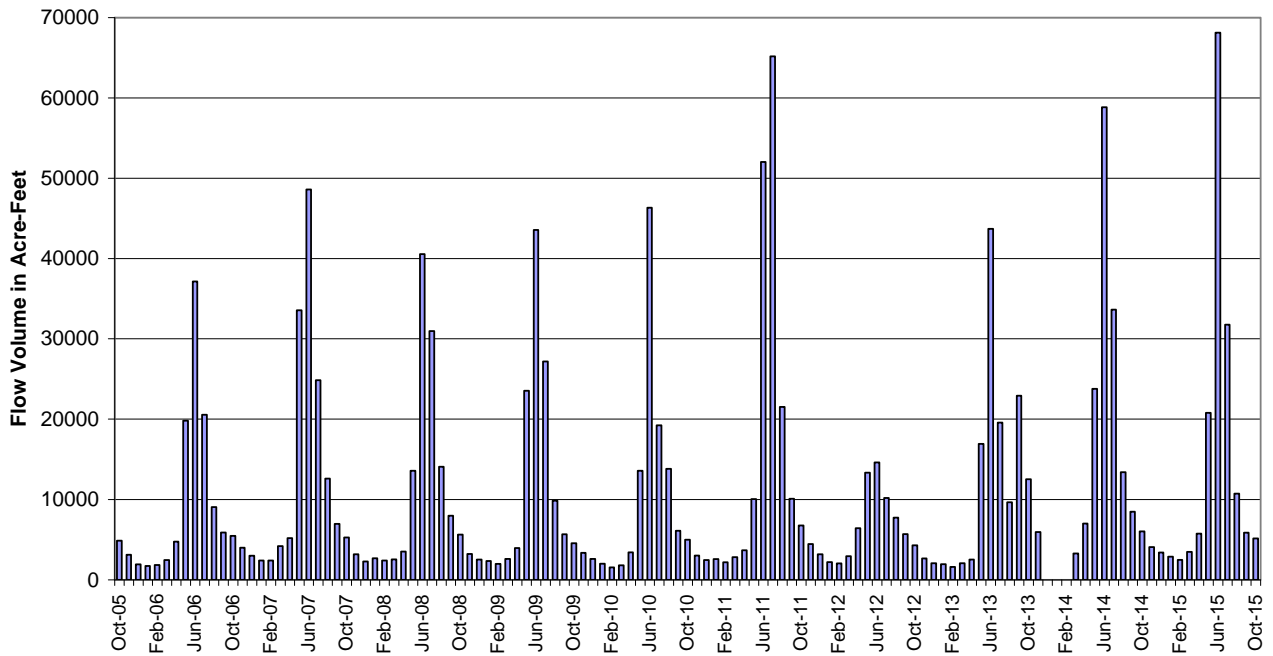
Data graphs for 2015 specific conductance, temperature, and turbidity at CC-40 are also attached. Daily precipitation data summary for the 2013-2015 seasonal monitoring period is also tabulated.

| CLEAR CREEK ABOVE JOHNSON GULCH NEAR KERMITTS | | | | | | | | | | | | | |
|---|-------------|-------------|-------------|---|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| WY 2015 | | | | | | | | | | | | | |
| Provisional Data - Subject to Revision | | | | | | | | | | | | | |
| LOCATION -- 0.5 mi upstream Johnson Gulch | | | | LATITUDE 39 44'47" LONGITUDE 105 26'08" | | | | | | | | | |
| GAGE DRAINAGE AREA -- 267 sq-mi | | | | GAGE ELEVATION -- 7210 ft-msl | | | | | | | | | |
| PERIOD OF RECORD -- October 1994 to Current Year | | | | | | | | | | | | | |
| DISCHARGE IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 2014 TO SEPTEMBER 2015 | | | | | | | | | | | | | |
| MEAN DAILY VALUES | | | | | | | | | | | | | |
| DAY | 2014 OCT | 2014 NOV | 2014 DEC | 2015 JAN | 2015 FEB | 2015 MAR | 2015 APR | 2015 MAY | 2015 JUN | 2015 JUL | 2015 AUG | 2015 SEP | 2015 OCT |
| 1 | 123 | 85.6 | 62 e | 48 e | 45 e | 39 e | 69.7 | 217 | 568 | 808 | 279 | 123 | 96.6 |
| 2 | 122 | 84.2 | 65 e | 50 e | 41 e | 39 e | 84.9 | 226 | 673 | 768 | 280 | 115 | 93.4 |
| 3 | 124 | 83.1 | 61 e | 49 e | 43 e | 38 e | 80.2 | 236 | 786 | 727 | 281 | 108 | 94.3 |
| 4 | 118 | 76.4 | 64 e | 51 e | 47 e | 37 e | 72.6 | 262 | 876 | 697 | 242 | 115 | 98.8 |
| 5 | 114 | 80.7 | 63 e | 53 e | 47 e | 36 e | 70.7 | 312 | 1003 | 679 | 219 | 118 | 95.0 |
| 6 | 112 | 82.3 | 63 e | 52 e | 47 e | 41 e | 68.2 | 325 | 1139 | 698 | 207 | 105 | 113 |
| 7 | 101 | 82.3 | 63 e | 53 e | 48 e | 43 e | 69.6 | 315 | 1196 | 721 | 198 | 113 | 120 |
| 8 | 100 | 76.2 | 61 e | 49 e | 49 e | 44 e | 66.6 | 319 | 1220 | 721 | 196 | 110 | 104 |
| 9 | 109 | 70.0 | 56 e | 47 e | 47 e | 45 e | 75.9 | 364 | 1271 | 683 | 186 | 103 | 97.0 |
| 10 | 119 | 69.6 | 58 e | 48 e | 48 e | 46 e | 83.8 | 373 | 1333 | 667 | 181 | 104 | 86.7 |
| 11 | 108 | 60 e | 57 e | 47 e | 50 e | 45.1 | 79.2 | 351 | 1368 | 601 | 196 | 96.3 | 82.9 |
| 12 | 102 | 47 e | 56 e | 45 e | 48 e | 49.9 | 80.5 | 343 | 1537 | 561 | 204 | 95.7 | 79.7 |
| 13 | 102 | 67 e | 61 e | 45 e | 49 e | 54.2 | 80.7 | 338 | 1498 | 548 | 180 | 93.3 | 79.6 |
| 14 | 95.5 | 70 e | 61 e | 44 e | 49 e | 54.2 | 85.7 | 329 | 1431 | 586 | 174 | 92.0 | 74.4 |
| 15 | 96.4 | 71 e | 59 e | 46 e | 49 e | 51.7 | 91.9 | 330 | 1349 | 550 | 191 | 98.5 | 77.6 |
| 16 | 90.6 | 66 e | 48 e | 50 e | 49 e | 55.1 | 98.3 | 315 | 1393 | 502 | 185 | 92.7 | 78.9 |
| 17 | 90.6 | 62 e | 56 e | 49 e | 45 e | 58.8 | 101 | 302 | 1430 | 468 | 183 | 90.5 | 75.4 |
| 18 | 88.8 | 63 e | 56 e | 48 e | 44 e | 76.3 | 103 | 311 | 1413 | 431 | 162 | 90.9 | 74.8 |
| 19 | 88.2 | 68 e | 50 e | 49 e | 46 e | 78.8 | 96.5 | 345 | 1390 | 425 | 157 | 91.2 | 75.8 |
| 20 | 88.1 | 70 e | 53 e | 49 e | 44 e | 69.2 | 92.8 | 325 | 1341 | 418 | 153 | 88.6 | 78.5 |
| 21 | 87.1 | 67 e | 54 e | 48 e | 43 e | 68.8 | 93.7 | 330 | 1260 | 437 | 146 | 87.1 | 97.9 |
| 22 | 90.6 | 65 e | 55 e | 38 e | 43 e | 71.9 | 99.0 | 345 | 1196 | 393 | 134 | 90.8 | 87.3 |
| 23 | 88.0 | 63 e | 52 e | 37 e | 41 e | 65.7 | 108 | 366 | 1131 | 358 | 137 | 91.1 | 85.9 |
| 24 | 90.0 | 57 e | 46 e | 45 e | 40 e | 74.8 | 111 | 369 | 1096 | 338 | 126 | 93.2 | 80.6 |
| 25 | 89.2 | 55 e | 52 e | 44 e | 42 e | 77.8 | 112 | 371 | 1038 | 345 | 116 | 90.9 | 74.1 |
| 26 | 87.6 | 58 e | 50 e | 43 e | 41 e | 66.2 | 135 | 369 | 962 | 320 | 120 | 91.0 | 73.0 |
| 27 | 87.1 | 63 e | 45 e | 44 e | 42 e | 62.1 | 128 | 378 | 935 | 305 | 117 | 91.7 | 68.3 |
| 28 | 80.2 | 62 e | 47 e | 45 e | 37 e | 62.1 | 128 | 403 | 876 | 326 | 120 | 89.6 | 63.9 |
| 29 | 84.6 | 63 e | 45 e | 47 e | | 64.6 | 145 | 420 | 835 | 314 | 116 | 95.5 | 64.2 |
| 30 | 86.5 | 65 e | 47 e | 46 e | | 69.7 | 184 | 432 | 806 | 314 | 112 | 96.8 | 62.3 |
| 31 | 84.7 | | 47 e | 46 e | | 70.2 | | 470 | | 305 | 110 | | 61.6 |
| TOTAL | 3048 | 2053 e | 1712 e | 1457 e | 1262 e | 1756 e | 2895 | 10491 | 34349 | 16015 | 5412 | 2962 | 2596 |
| MEAN | 98.3 | 68 e | 55 e | 47 e | 45 e | 57 e | 96.5 | 338 | 1145 | 517 | 175 | 98.7 | 83.8 |
| MAX | 124 | 86 e | 65 e | 53 e | 50 e | 79 e | 184 | 470 | 1537 | 808 | 281 | 123 | 120 |
| MIN | 80.2 | 47 e | 45 e | 37 e | 37 e | 36 e | 66.6 | 217 | 568 | 305 | 110 | 87.1 | 61.6 |
| AC-FT | 6,046 | 4,071 e | 3,396 e | 2,889 e | 2,502 e | 3,482 e | 5,742 | 20,810 | 68,131 | 31,766 | 10,734 | 5,876 | 5,150 |
| INSTANTANEOUS MEASUREMENTS | | | | | | | | | | | | | |
| MAX FLOW | 134 | | | | | | 200 | 543 | 1654 | 851 | 324 | 130 | 151 |
| DATE | 10-Oct | | | | | | 30-Apr | 31-May | 12-Jun | 1-Jul | 2-Aug | 2-Sep | 6-Oct |
| MIN FLOW | 66.9 | | | | | | 58.0 | 200 | 543 | 273 | 102 | 84.6 | 54.4 |
| DATE | 28-Oct | | | | | | 6-Apr | 1-May | 1-Jun | 31-Jul | 31-Aug | 21-Sep | 31-Oct |
| e = estimated during ice affected period using average ratio of CC-60 flow | | | | | | | | | | | | | |
| P = provisional data subject to revision NA = not available | | | | | | | | | | | | | |
|  Clear Creek Consultants | | | | | | | | | | | | | |

**Clear Creek Mean Daily Streamflow by Water Year
above Johnson Gulch near Kermitts (CC-40)**
Drainage Area = 267 square miles




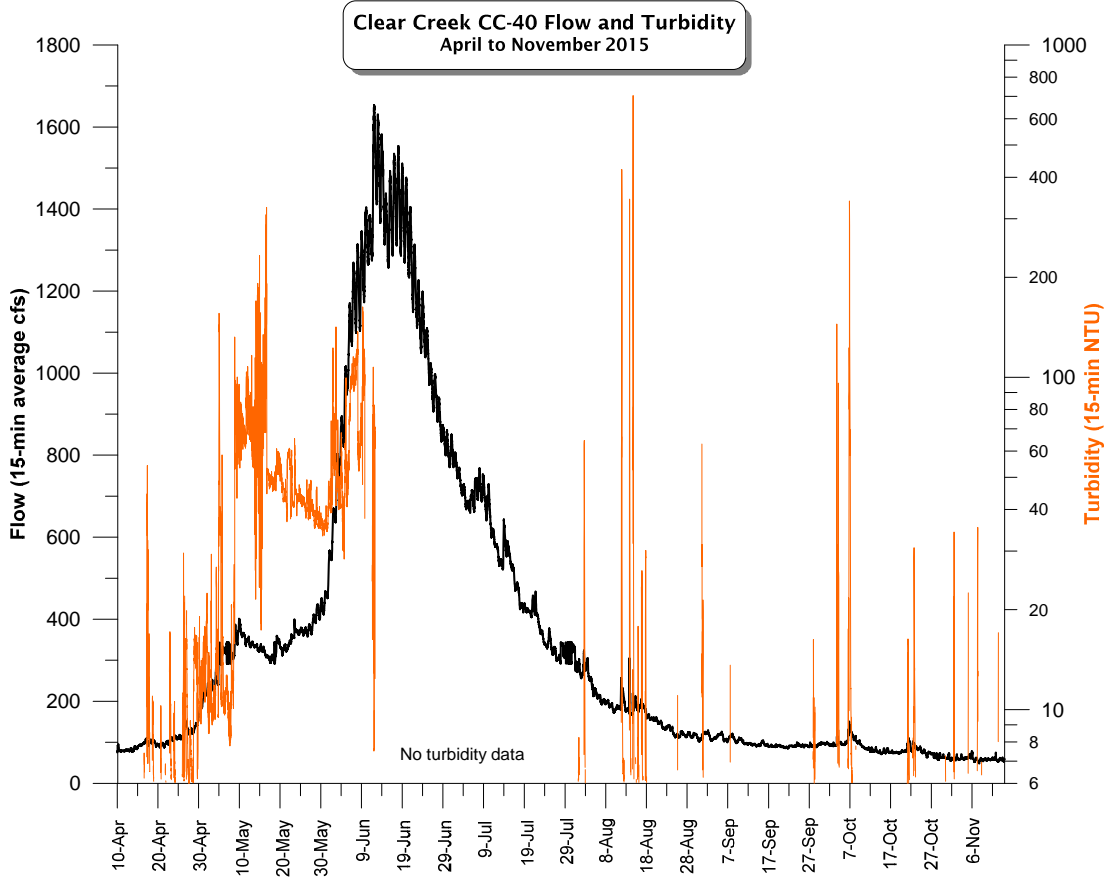
Clear Creek above Johnson Gulch near Kermitts (Station CC-40)
Monthly Flow Volume: 2006-2015



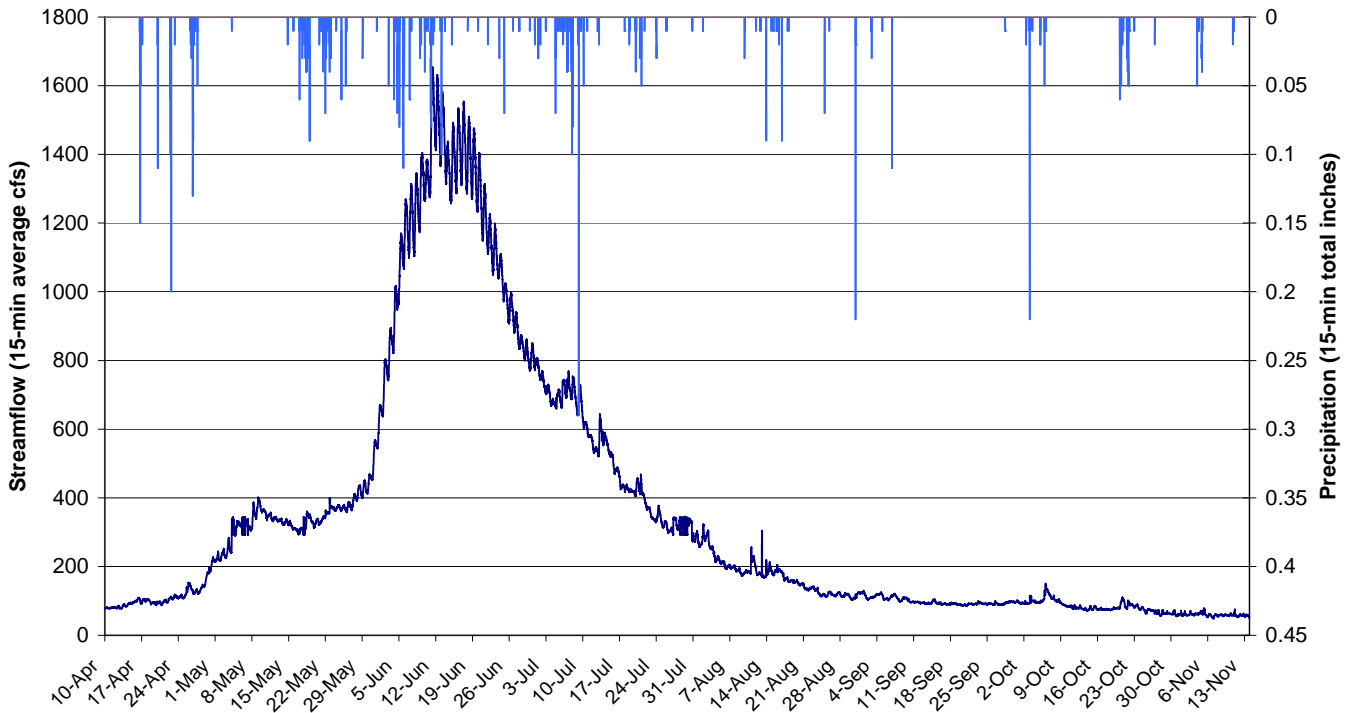
| CLEAR CREEK NEAR KERMITTS | |
|--|--------------------------------|
| PROVISIONAL STREAMFLOW RATING TABLE | |
| GAGE HEIGHT | STREAMFLOW |
| (feet) | (cubic feet per second) |
| 3.3 | 35 |
| 3.4 | 42 |
| 3.5 | 50 |
| 3.6 | 60 |
| 3.7 | 77 |
| 3.8 | 92 |
| 3.9 | 109 |
| 4.0 | 128 |
| 4.1 | 151 |
| 4.2 | 177 |
| 4.3 | 206 |
| 4.4 | 240 |
| 4.5 | 278 |
| 4.6 | 322 |
| 4.7 | 303 |
| 4.8 | 326 |
| 4.9 | 351 |
| 5.0 | 377 |
| 5.1 | 405 |
| 5.2 | 434 |
| 5.3 | 465 |
| 5.4 | 497 |
| 5.5 | 530 |
| 5.6 | 565 |
| 5.7 | 602 |
| 5.8 | 641 |
| 5.9 | 681 |
| 6.0 | 723 |
| 6.1 | 767 |
| 6.2 | 813 |
| 6.3 | 861 |
| 6.4 | 911 |
| 6.5 | 962 |
| 6.6 | 1016 |
| 6.7 | 1072 |
| 6.8 | 1131 |
| 6.9 | 1191 |
| 7.0 | 1254 |
| 7.1 | 1319 |
| 7.2 | 1386 |
| 7.3 | 1456 |
| 7.4 | 1529 |
| 7.5 | 1604 |

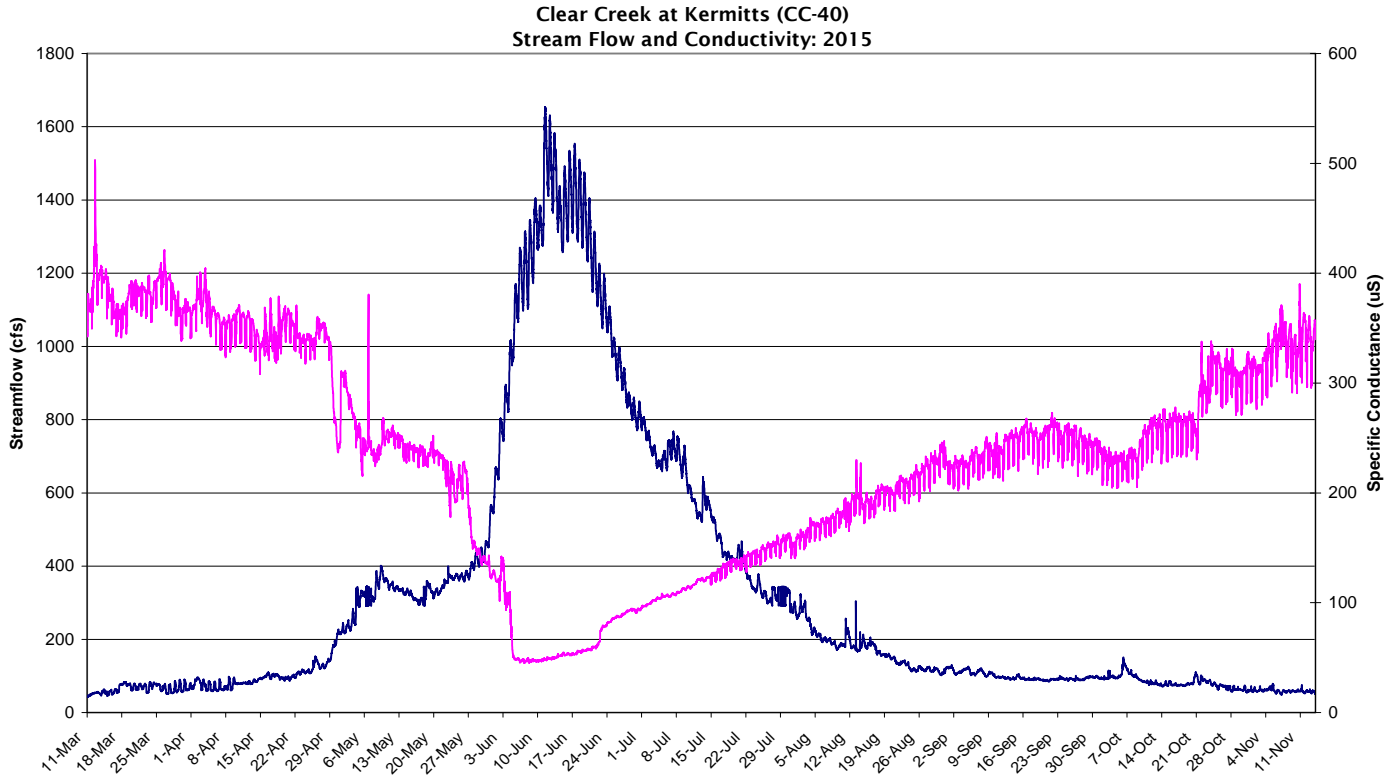
Streamgauge sponsored by the Upper Clear Creek Watershed Association

Operated by:  *Clear Creek Consultants*

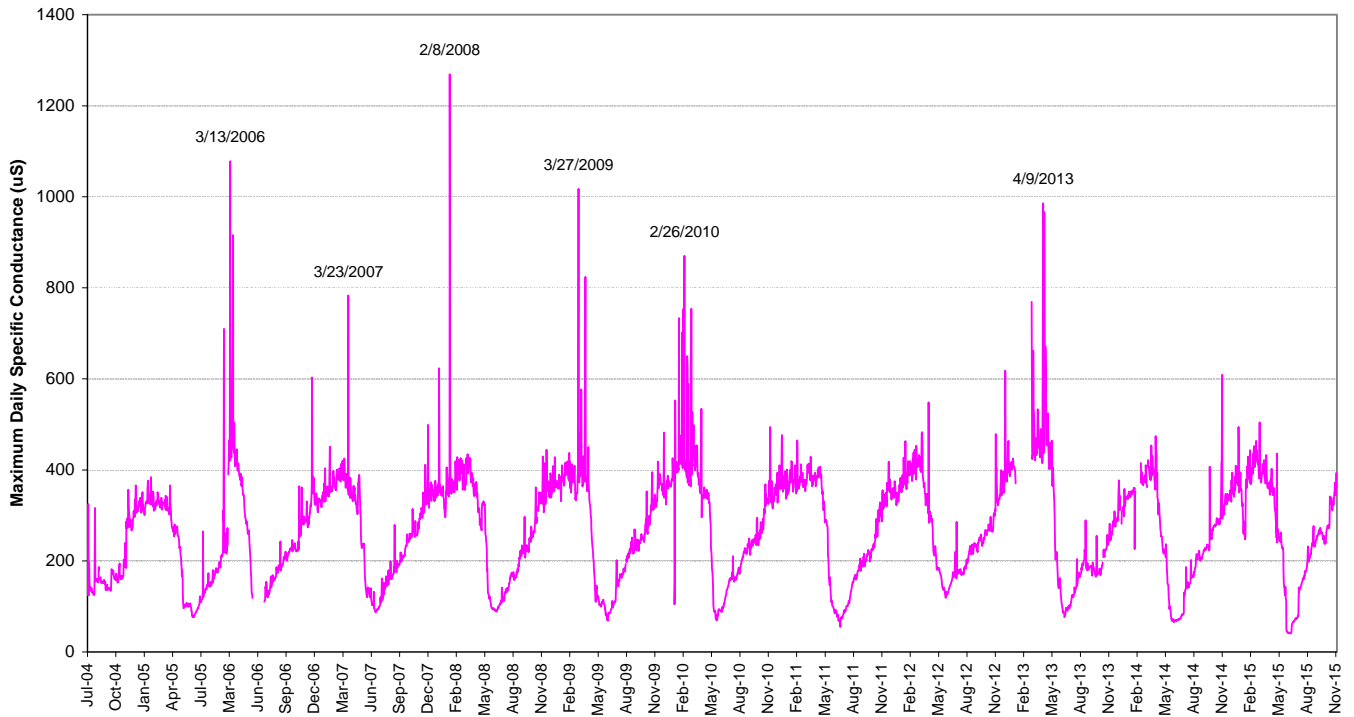


Clear Creek at Kermitts (CC-40) Stream Flow and Precipitation: 2015





**Clear Creek at Kermitts (CC-4) Maximum Specific Conductance
July 2004 to November 2015**



| DAILY RAINFALL RECORDS (inches) | | | | | | | | | | | | | | | | | | |
|--|------|-------------|-------------|-------------|-------------|-------------|------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| CLEAR CREEK STATION CC-4 (above Johnson Gulch) | | | | | | | | | | | | | | | | | | |
| Lat 39 44' 46.27" N Long 105 26' 9.19" W Elev. 7220 ft-MSL | | | | | | | | | | | | | | | | | | |
| YEARS: 2013, 2014, 2015 | | | | | | | | | | | | | | | | | | |
| DATE | 2013 | | | | | | 2014 | | | | | | 2015 | | | | | |
| | MAY | JUN | JUL | AUG | SEP | OCT | MAY | JUN | JUL | AUG | SEP | OCT | MAY | JUN | JUL | AUG | SEP | OCT |
| 1 | NA | 0 | 0 | 0.15 | 0.03 | 0 | NA | 0 | 0 | 0 | 0 | 0.12 | 0 | 0.01 | 0.03 | 0 | 0 | 0 |
| 2 | NA | 0 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.06 | 0.04 | 0 | 0 |
| 3 | NA | 0 | 0.12 | 0.1 | 0 | 0.02 | NA | 0 | 0.04 | 0 | 0 | 0 | 0 | 0.07 | 0.02 | 0 | 0.08 | 0.28 |
| 4 | NA | 0.25 | 0.11 | 0 | 0 | 0.44 | NA | 0 | 0.08 | 0 | 0.06 | 0.03 | 0.01 | 0.1 | 0 | 0 | 0 | 0.01 |
| 5 | NA | 0 | 0.11 | 0 | 0 | 0 | NA | 0 | 0.09 | 0.34 | 0.48 | 0 | 0 | 0.37 | 0.18 | 0 | 0.03 | 0.08 |
| 6 | NA | 0 | 0.2 | 0.06 | 0.1 | 0 | NA | 0.03 | 0 | 0 | 0 | 0.02 | 0 | 0.21 | 0.18 | 0 | 0 | 0.14 |
| 7 | NA | 0 | 0.07 | 0 | 0 | 0 | NA | 0.01 | 0.01 | 0.26 | 0 | 0 | 0 | 0.12 | 0.37 | 0 | 0.13 | 0 |
| 8 | NA | 0 | 0.07 | 0 | 0.05 | 0 | NA | 0.17 | 0 | 0 | 0 | 0 | 0 | 0.01 | 0.63 | 0 | 0 | 0 |
| 9 | NA | 0.01 | 0 | 0.01 | 1.67 | 0 | NA | 0 | 0.3 | 0.12 | 0 | 0.43 | 0 | 0.08 | 0.62 | 0 | 0 | 0 |
| 10 | NA | 0 | 0.27 | 0.01 | 1.08 | 0.19 | NA | 0 | 0 | 0 | 0.08 | 0.02 | 0 | 0.08 | 0.09 | 0.04 | 0 | 0 |
| 11 | NA | 0 | 0.56 | 0.04 | 0.36 | 0 | NA | 0.05 | 0.08 | 0 | 0.02 | 0 | 0 | 0.54 | 0.01 | 0 | 0 | 0 |
| 12 | NA | 0 | 0.04 | 0.27 | 2.3 | 0 | NA | 0 | 0.77 | 0 | 0.02 | 0 | 0 | 0.07 | 0 | 0.01 | 0 | 0 |
| 13 | NA | 0 | 0.56 | 0.22 | 0.01 | 0 | NA | 0 | 0.03 | 0.03 | 0 | 0.01 | 0 | 0.16 | 0.09 | 0.02 | 0 | 0 |
| 14 | 0 | 0.02 | 0.02 | 0.01 | 0.06 | 0.08 | NA | 0 | 0.02 | 0.24 | 0 | 0 | 0 | 0.01 | 0 | 0.19 | 0 | 0 |
| 15 | 0.05 | 0.02 | 0.08 | 0 | 0.57 | 0 | NA | 0 | 0.24 | 0.01 | 0 | 0 | 0.02 | 0.05 | 0 | 0.02 | 0 | 0 |
| 16 | 0 | 0 | 0 | 0 | 0 | 0.03 | NA | 0 | 0.26 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0.07 | 0 | 0 |
| 17 | 0 | 0.01 | 0 | 0 | 0 | 0 | NA | 0 | 0 | 0 | 0.01 | 0 | 0.09 | 0 | 0 | 0.15 | 0 | 0 |
| 18 | 0 | 0.03 | 0 | 0.03 | 0 | 0 | NA | 0.06 | 0 | 0.02 | 0 | 0 | 0.41 | 0.01 | 0.02 | 0.02 | 0 | 0 |
| 19 | 0 | 0.01 | 0.12 | 0 | 0 | 0 | NA | 0 | 0 | 0.07 | 0.07 | 0 | 0.93 | 0 | 0.04 | 0 | 0 | 0 |
| 20 | 0 | 0 | 0 | 0 | 0 | 0 | NA | 0.02 | 0.1 | 0.04 | 0 | 0 | 0 | 0.01 | 0.12 | 0 | 0 | 0.18 |
| 21 | 0 | 0 | 0 | 0 | 0 | 0 | 0.26 | 0 | 0 | 0 | 0.13 | 0.05 | 0.05 | 0 | 0.14 | 0 | 0 | 0.8 |
| 22 | 0.03 | 0 | 0.01 | 0.52 | 0.12 | 0 | 0.17 | 0.04 | 0 | 0.25 | 0.02 | 0 | 0.34 | 0.02 | 0 | 0 | 0 | 0.68 |
| 23 | 0 | 0 | 0 | 0.29 | 0.08 | 0 | 0.12 | 0.06 | 0.04 | 0.04 | 0 | 0 | 0.15 | 0 | 0 | 0 | 0 | 0.01 |
| 24 | 0 | 0.01 | 0.08 | 0.27 | 0 | 0 | 0.32 | 0.01 | 0 | 0 | 0 | 0 | 0.01 | 0.04 | 0.08 | 0 | 0 | 0 |
| 25 | 0 | 0 | 0.09 | 0.02 | 0 | 0 | 0.08 | 0 | 0.17 | 0.21 | 0 | 0 | 0.08 | 0.09 | 0 | 0.08 | 0 | 0 |
| 26 | 0 | 0 | 0.04 | 0.33 | 0.04 | 0 | 0 | 0.01 | 0.03 | 0.33 | 0 | 0 | 0.06 | 0 | 0.02 | 0.01 | 0 | 0 |
| 27 | 0 | 0 | 0.12 | 0 | 0.17 | 0 | 0 | 0 | 0.01 | 0.07 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0.04 |
| 28 | 0.02 | 0.17 | 0.09 | 0 | 0.01 | 0 | 0 | 0.04 | 0.01 | 0 | 0.07 | 0 | 0 | 0.02 | 0 | 0 | 0 | 0 |
| 29 | 0.05 | 0.27 | 0.11 | 0.04 | 0 | 0 | 0.03 | 0 | 0.2 | 0.03 | 0.42 | 0 | 0.06 | 0 | 0 | 0 | 0.02 | 0 |
| 30 | 0 | 0.04 | 0.03 | 0.01 | 0 | 0 | 0.19 | 0.01 | 0.62 | 0.02 | 0 | 0 | 0 | 0.01 | 0 | 0 | 0 | 0 |
| 31 | 0 | | 0.02 | 0.09 | | 0 | 0.01 | | 0.04 | 0.04 | | 0 | 0 | | 0.01 | 0.27 | | 0 |
| TOTAL | | 0.84 | 2.92 | 2.47 | 6.65 | 0.76 | | 0.51 | 3.14 | 2.12 | 1.38 | 0.68 | 2.22 | 2.09 | 2.71 | 0.92 | 0.26 | 2.22 |
| RainDays | | 11 | 22 | 18 | 15 | 5 | | 12 | 20 | 17 | 11 | 7 | 13 | 22 | 18 | 12 | 4 | 9 |
| MAX | | 0.27 | 0.56 | 0.52 | 2.30 | 0.44 | | 0.17 | 0.77 | 0.34 | 0.48 | 0.43 | 0.93 | 0.54 | 0.63 | 0.27 | 0.13 | 0.80 |
| X-2D | | 0.44 | 0.83 | 0.81 | 2.75 | 0.46 | | 0.18 | 0.85 | 0.54 | 0.54 | 0.45 | 1.34 | 0.62 | 1.25 | 0.27 | 0.13 | 1.48 |
| X-3D | | 0.48 | 1.16 | 1.08 | 3.74 | 0.46 | | 0.21 | 0.88 | 0.61 | 0.54 | 0.45 | 1.43 | 0.77 | 1.62 | 0.28 | 0.16 | 1.66 |
| DryDays | | 19 | 9 | 13 | 15 | 26 | | 18 | 11 | 14 | 19 | 24 | 18 | 8 | 13 | 19 | 26 | 22 |

NA No data collected at raingauge / Not available
* Rain gauge not present, P partial data