Appendix B. Water-Level, Discharge, and Water-Quality Data for Selected Monitoring Sites Within the Warm Springs Area Near Moapa, Nevada

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Muddy River

The following sites are included within this section:

09416000 Muddy River near Moapa, Nevada (1913–2004)
Big Wash Flume near Moapa, Nevada (1967–84)
09415950 Muddy River Power Diversion near Moapa, Nevada (1978–85)

09416000 Muddy River near Moapa, Nevada

The stream-gage at Muddy River near Moapa originally was established by the Muddy Valley Irrigation District (MVID) on July 1, 1913, at its present location upstream of Warm Springs Road (fig. B1). Water-level record and discharge measurements were collected by the MVID from July 1913 to September 1915 and from April 1916 to September 1918. The gage was reactivated in June of 1928 by the University of Nevada Agricultural Experiment Station (UNAES). Daily mean gage height and monthly discharge were collected by the UNAES from June 1928 to October 1931 and from April 1932 to July 1932. The Bureau of Reclamation (Reclamation) reactivated the gage October 21, 1944, and collected continuous streamflow data until October 1, 1948, when the operation of the gage became the responsibility of the U.S. Geological Survey. Flow is diverted about 100 ft upstream of the gage by the Nevada Power Company for use at the Reid Gardner Generating Station about 3 mi downstream of the gage (fig. 1). The hydraulic control for this site is the 10-ft concrete Cipolletti weir, which was installed by the USBR in 1944 just upstream from the Warm Springs Road crossing (fig. B2).

Daily mean discharges for the period of record are plotted on figure B3 and listed in table B1. Photographs of the bench and reference marks established for this gage on June 2, 2004, are shown in figure B4.

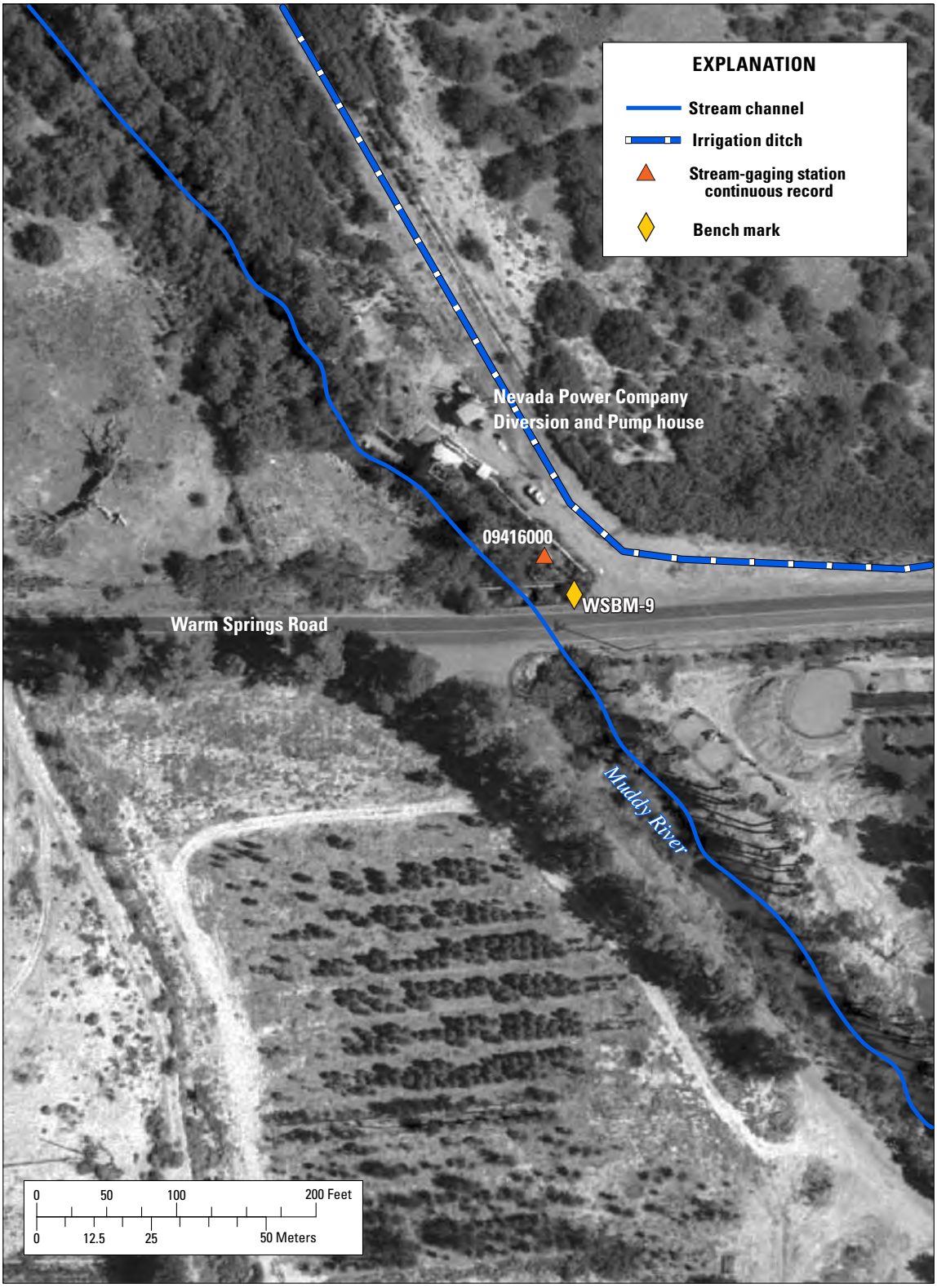

Figure B1. Location of Muddy River stream-gaging station (09416000), bench mark WSBM-9, and Nevada Power Company's diversion and pump house in the Warm Springs area near Moapa, Nevada.

Figure B2. View looking downstream of the Cipolletti weir upstream of Warm Springs Road at the Muddy River stream-gaging station (09416000) in the Warm Springs area near Moapa, Nevada. Photographed in June 2004 by D. Beck.

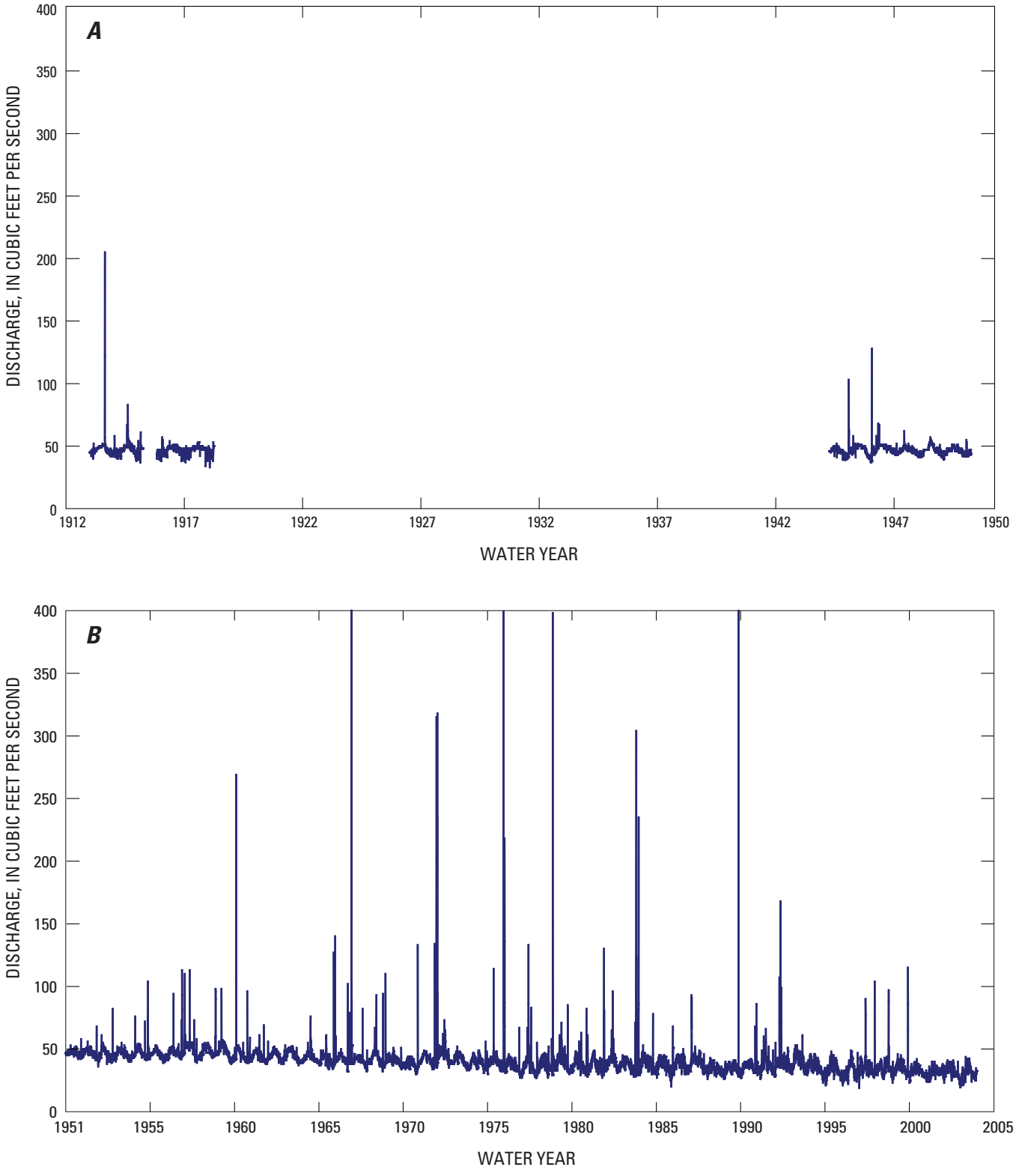

Figure B3. Daily mean discharges for stream-gaging station 09416000, Muddy River near Moapa, Nevada, for (*A*) water years 1913–15, 1916–18, and 1944–47, and (*B*) water years 1951–2004.

Table B1. Daily mean discharges for continuous-recording stream-gaging station 09416000 Muddy River near Moapa, Nevada, water years 1913–2004.

Table B1 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

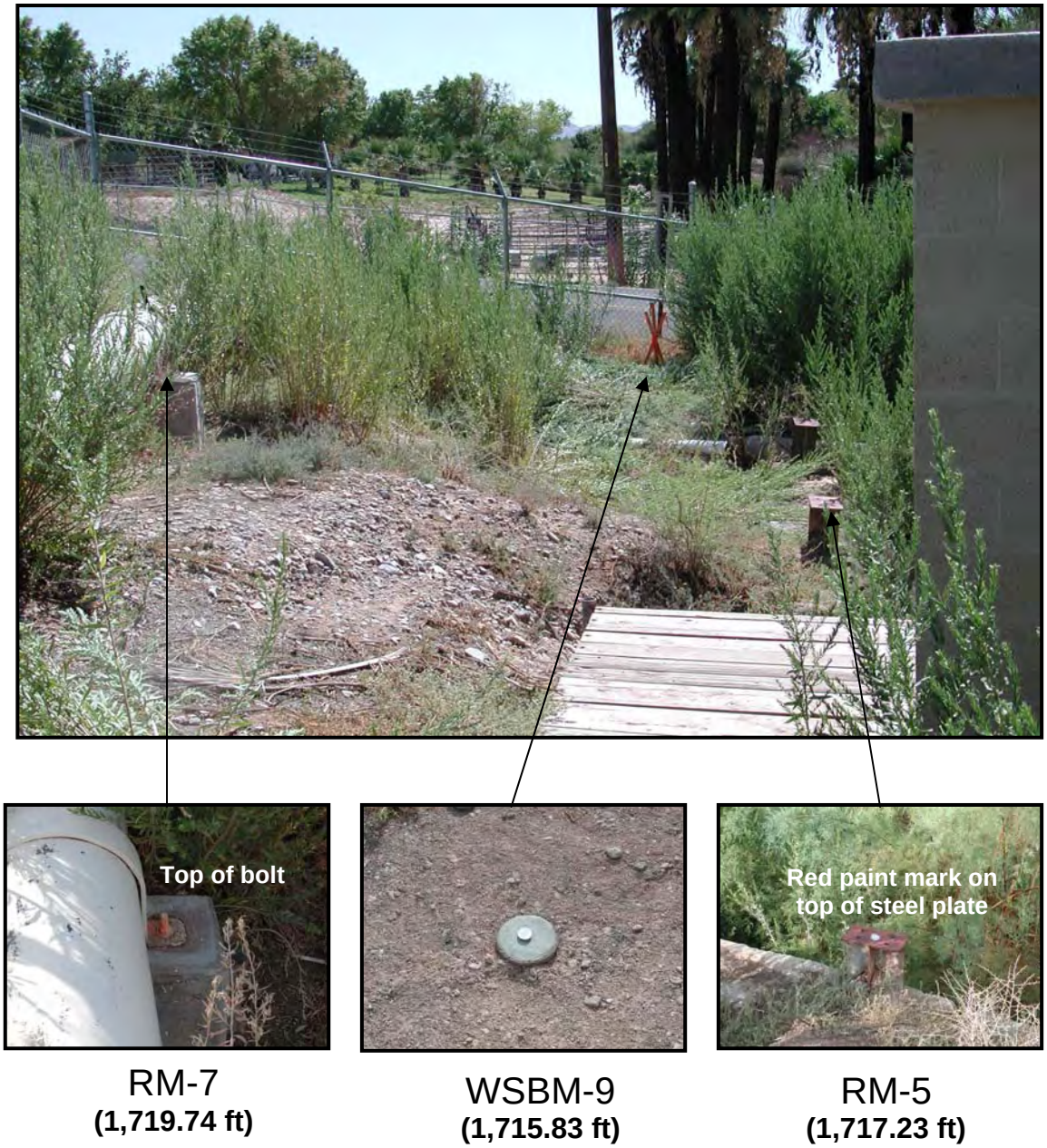

Figure B4. Location and elevation of bench mark WSBM-9 and reference marks RM-5 and RM-7 at stream-gaging station 09416000, Muddy River near Moapa, Nevada, June 2, 2004, elevation in feet above NGVD 88. Photographed by D. Beck.

Big Wash Flume near Moapa, Nevada

A 3-ft Parshall flume was installed on Big Wash (North Fork Muddy River) on October 11, 1967, by the Nevada Division of Water Resources (NDWR). The flume was located approximately 500 ft upstream of the confluence with South Fork Muddy River (fig. B5). The source of water in the river originates from springs and seeps located in the uppermost northwest drainage of the Warm Springs area.

Data provided by NDWR show that water levels in the flume were generally measured monthly from October 11, 1967 to July 18, 1984. Several gaps occur in the record, the largest two occurring from March 1969 to February 1974 and from May 1981 to March 1984. Information provided by NDWR did not indicate whether a new flume had been installed after any of these gaps, but the information did note that a 3-ft flume was in use for the entire period of record. The former flume site was visited by the U.S. Geological Survey on September 16, 2004, and a 3-ft steel Parshall flume was observed upside down on the south bank of the river (fig. B6).

As only water-level measurements were provided by NDWR, discharge rates were computed using a standard rating equation for the 3-ft Parshall flume (Leupold and Stevens, 1987). A plot of the computed discharges from October 1967 to July 1984 is shown in figure B7. A complete listing of the water-level measurements and computed discharges are included in table B2. Discharges computed from October 1967 to March 1969 are substantially less than the computed discharges for the remainder of the period. Although flow may have been bypassing the flume at that time, documentation was unavailable to verify it.

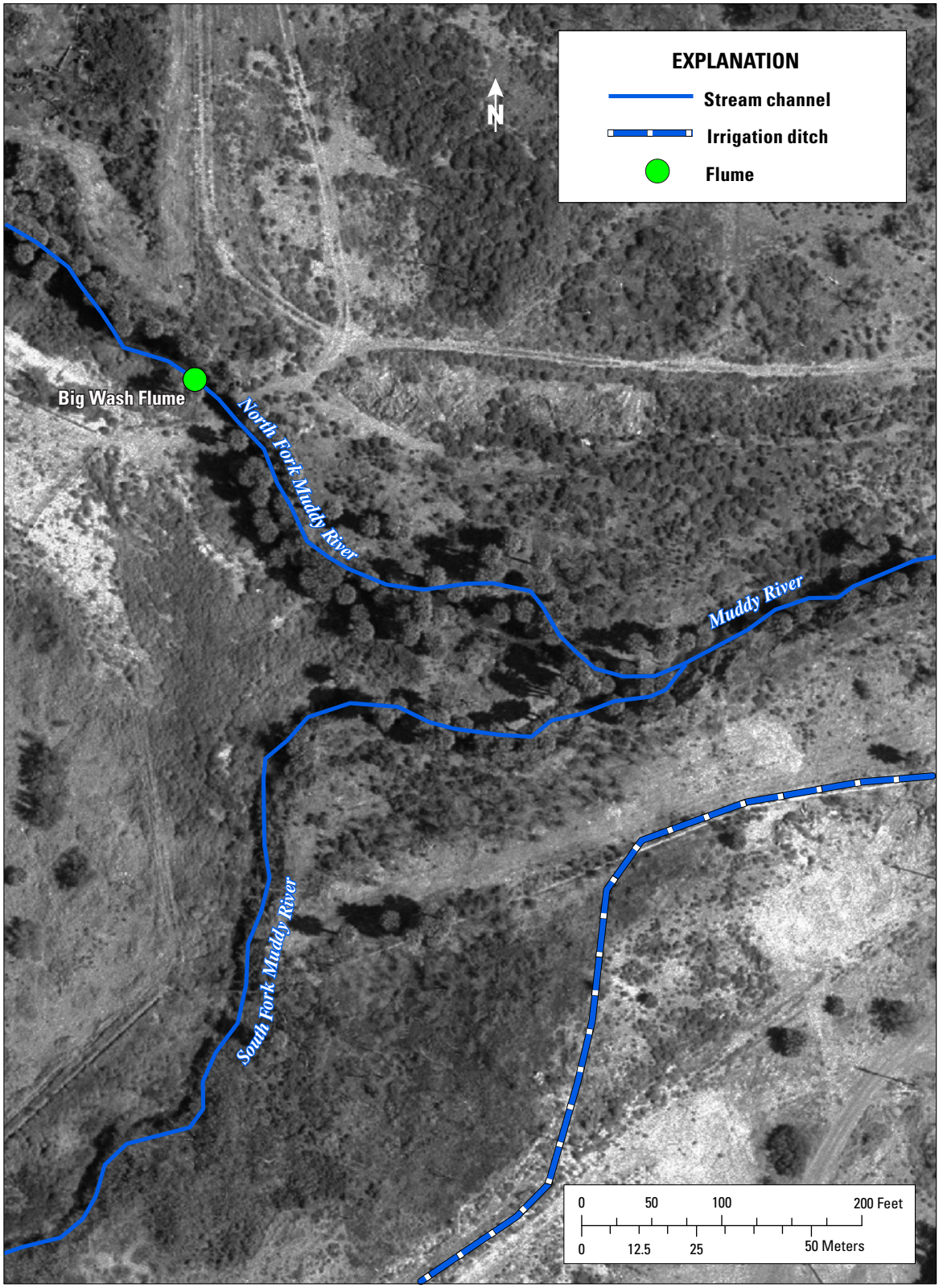

Figure B5. Location of former Big Wash flume site on the North Fork Muddy River in the Warm Springs area near Moapa, Nevada.

Figure B6. Former Big Wash flume on right bank of North Fork Muddy River in the Warm Springs area, near Moapa, Nevada. The flume is about 500 feet upstream of confluence with South Fork Muddy River. Photographed in September 2004 by D. Beck.

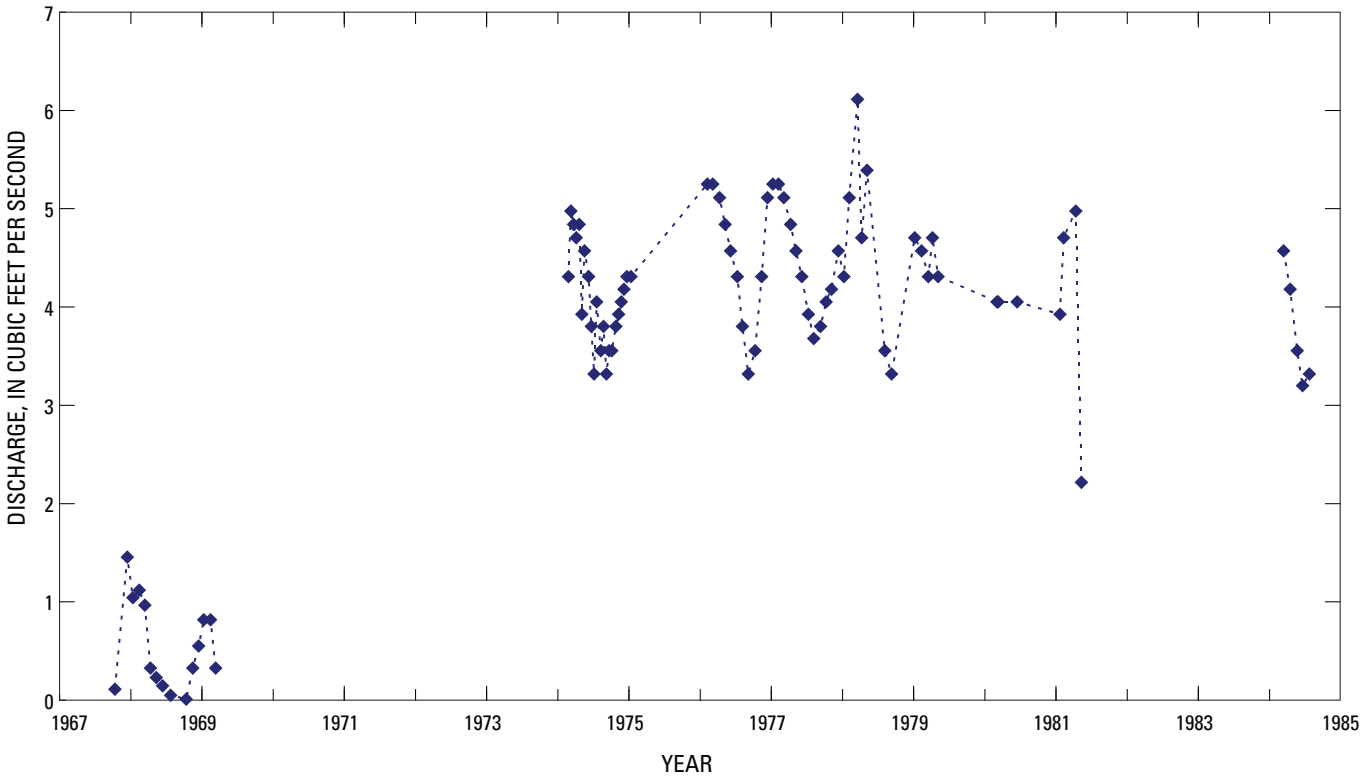

Figure B7. Instantaneous discharges for the Big Wash flume in the Warm Springs area near Moapa, Nevada, 1967–69, 1974–81, and 1984.

Table B2. Water levels and instantaneous discharges for Big Wash flume, near Moapa, Nevada, 1967–84.

Table B2 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

09415950 Muddy River Power Diversion and Pump House near Moapa, Nevada

In the early 1970s, the Nevada Power Company (NPC) constructed a diversion and pump house along the north bank of the Muddy River approximately 100 ft upstream of the U.S. Geological Survey (USGS) stream-gaging station at Warm Springs Road (fig. B1). Water is pumped directly from the stream and transmitted through a pipeline to the Reid Gardner Generating Station (fig. 1) about 3 mi southeast of the gage. The NPC provided the USGS with pumpage data from October 1, 1977, to September 30, 1985. Daily mean discharges for the period were computed and published in the USGS, Nevada District, annual data report series between water years1978 and 1986). See figure B8 and table B3 for a graph and a table, respectively, of the daily mean discharges. Annual mean daily discharge from the diversion for water years 1978 to 1985 was 3.45 ft^3/s.

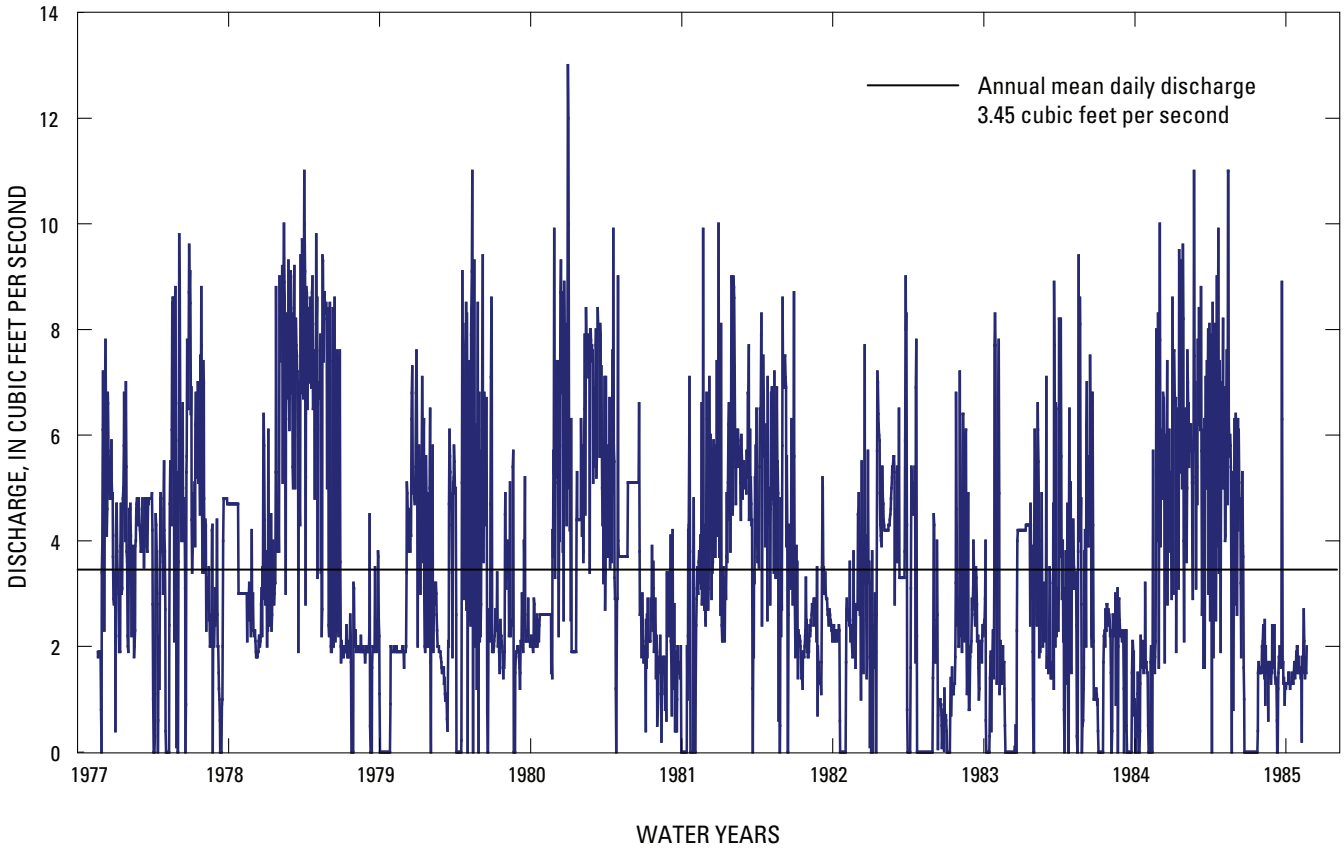

Figure B8. Daily mean discharges for the Muddy River power diversion in the Warm Springs area, near Moapa, Nevada, water years 1978–85. Pumping data was provided to U.S. Geological Survey by Nevada Power Company.

Table B3. Daily mean discharges for the Muddy River Power Diversion near Moapa, Nevada (09415950), water years 1978–85.

Table B3 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Plummer Springs Group

The following sites are included within this section:

364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada (1982–2004)
364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada (1987–2004)
364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada (1987–2004)
364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada (1994–2004)
Converse Consultant Water-Quality Site S1a (1997–2004)
Converse Consultant Water-Quality Slte S1b (1997–2004)
Converse Consultant Water-Quality Site S34 (1997–2004)
Converse Consultant Water-Quality Site S42 (1997–2004)
Converse Consultant Water-Quality Site S43 (1997–2004)
Converse Consultant Water-Quality Site-S44 (1997–2004)
Converse Consultant Water-Quality Site-S44a (1997–2004)
Converse Consultant Water-Quality Site S56 (1997–2004)

364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada

The partial-record stream-gaging station at Warm Springs East was established by the U.S. Geological Survey (USGS) on August 2, 1982, and is located about 70 ft downstream of the confluence with Plummer East tributary and about 180 ft upstream of Warm Springs Road (fig. B9). Flow in Warm Springs East is the combined discharge from all springs and seeps on that part of the Moapa Valley National Wildlife Refuge, formerly known as the Desert Oasis Warm Springs Resort. Periodic discharge measurements have been made by the USGS since 1982. Discharge measurements for the period of record are plotted in figure B10 and listed in table B4.

In October 1998, the U.S. Fish and Wildlife Service (FWS) installed a staff plate in the channel and made periodic discharge measurements through May 2002. The FWS discharge measurements are also plotted on figure B10 and are listed in table B5.

Photographs of the staff plate and bench mark, and of the reference mark established by the USGS at the Warm Springs East stream-gaging station on June 10, 2004, are shown in figure B11.

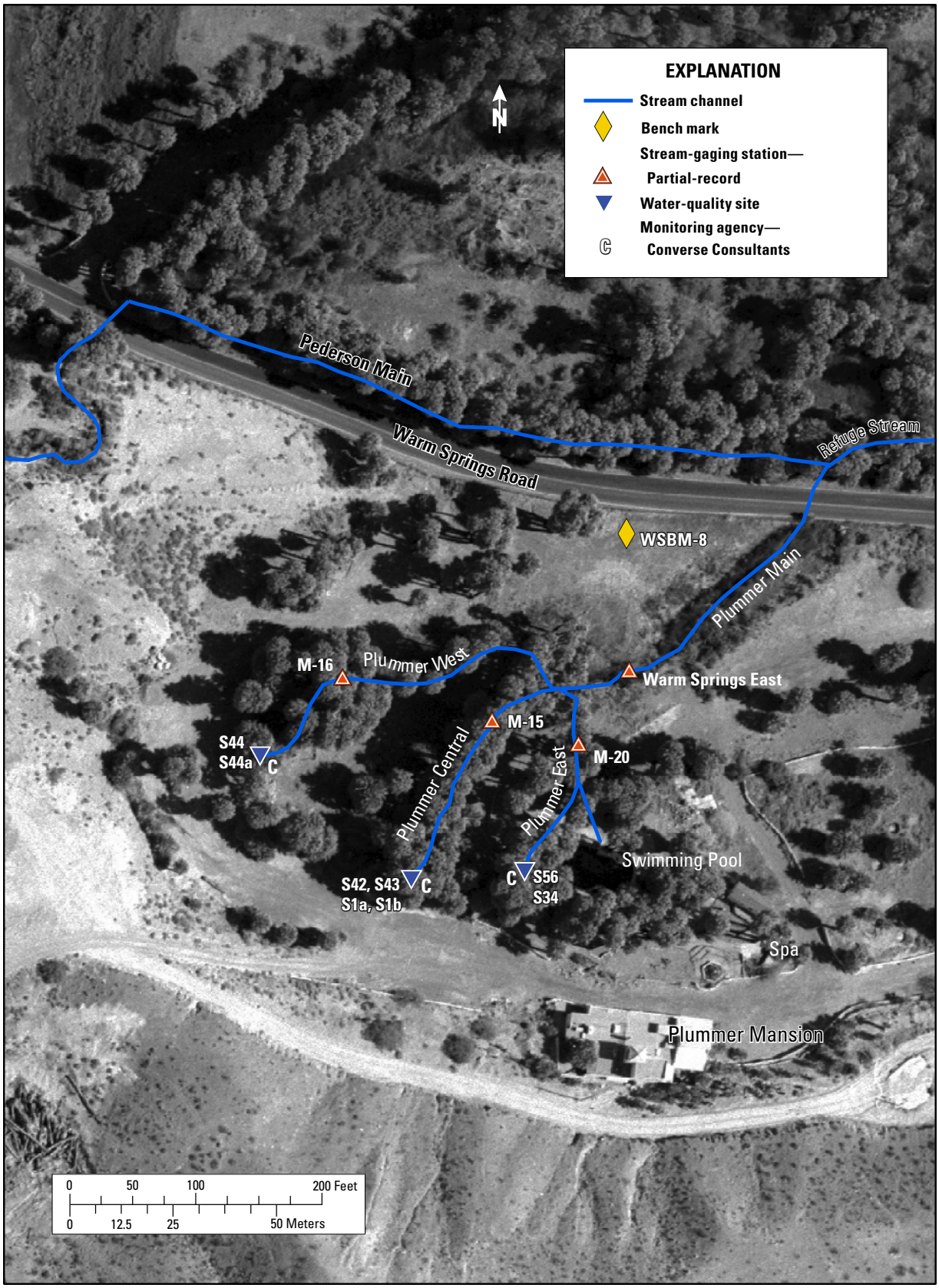

Figure B9. Location of Plummer Springs Group stream-gaging station, monitoring sites, and bench mark WSBM-8 in the Warm Springs area near Moapa, Nevada.

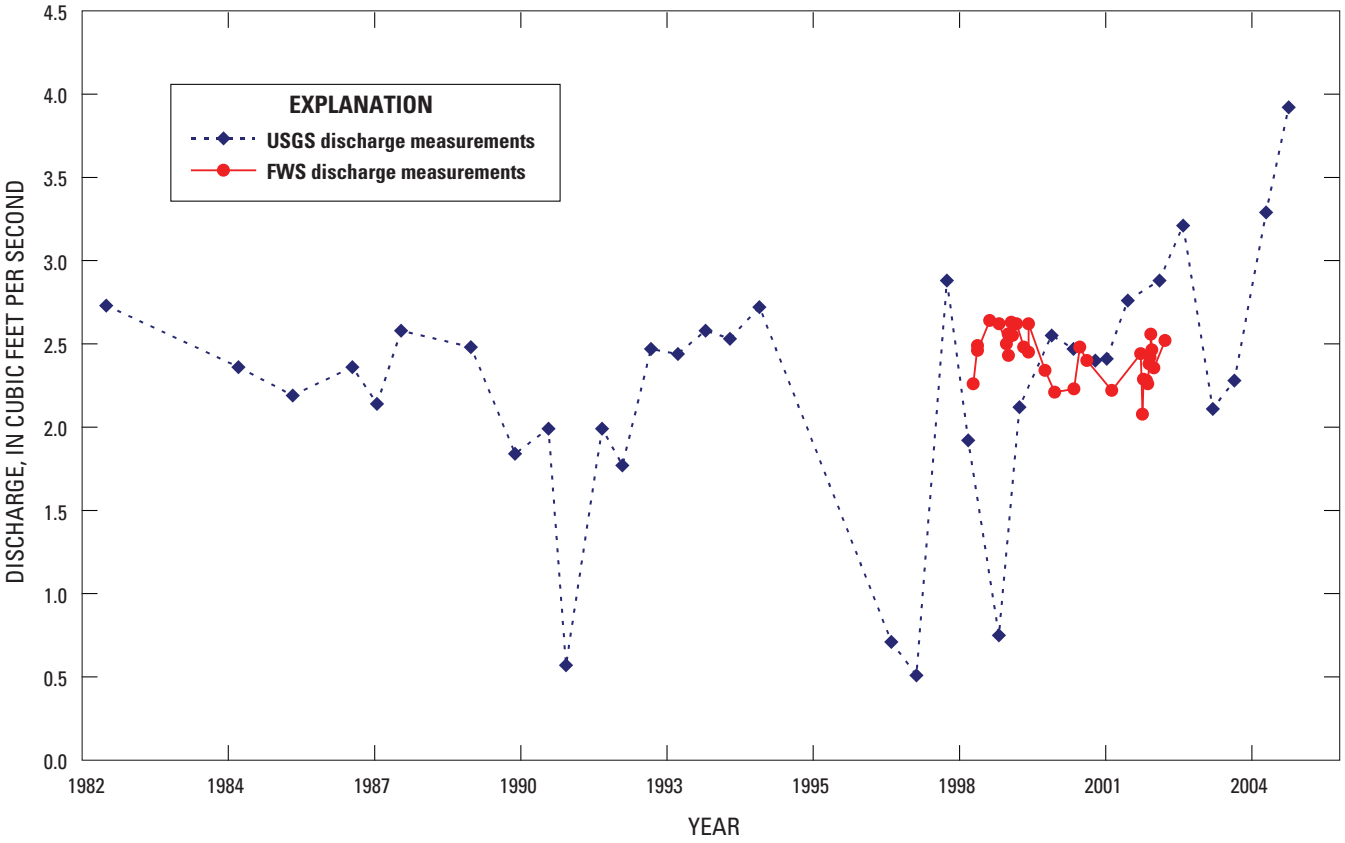

Figure B10. Periodic discharge measurements for partial-record stream-gaging station 364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada, 1982–2004. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) database, accessed 2005 at http://waterdata.usgs.gov and U.S. Fish and Wildlife Service (FWS).

Table B4. Periodic discharge measurements for partial-record stream-gaging station 364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada, 1982–2004.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B4 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B5. Periodic discharge measurements for partial-record stream-gaging station 364236114424301 Warm Springs East (Plummer Main) near Moapa, Nevada, 1998–2002.

[Data provided by U.S. Fish and Wildlife Service]

Table B5 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B11. Location of bench mark WSBM-8 and reference mark RM-1 for stream-gaging station 364236114424301 Warm Springs East near Moapa, Nevada. Photographed June 10, 2004 by D. Beck. Elevation bench and reference marks in feet above NAVD 88.

364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada

The partial-record gaging station at Muddy River Springs 15 (M-15) was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 40 ft upstream of the confluence with the Plummer West tributary (fig. B9). Discharge at Muddy River Springs 15 originates upstream from several springs just west of a large swimming pool that was installed by the former Desert Oasis Warm Springs Resort. The area is now part of the Moapa Valley National Wildlife Refuge managed by the U.S. Fish and Wildlife Service (FWS). The FWS removed many of the former resort's recreational facilities and currently is restoring the springs. Periodic discharge measurements have been made by the USGS since 1987. Discharge measurements for the period of record are plotted in figure B12 and listed in table B6.

Photographs of the staff plate and reference mark established for the Muddy River Springs 15 monitoring site on June 10, 2004, are included in figure B13.

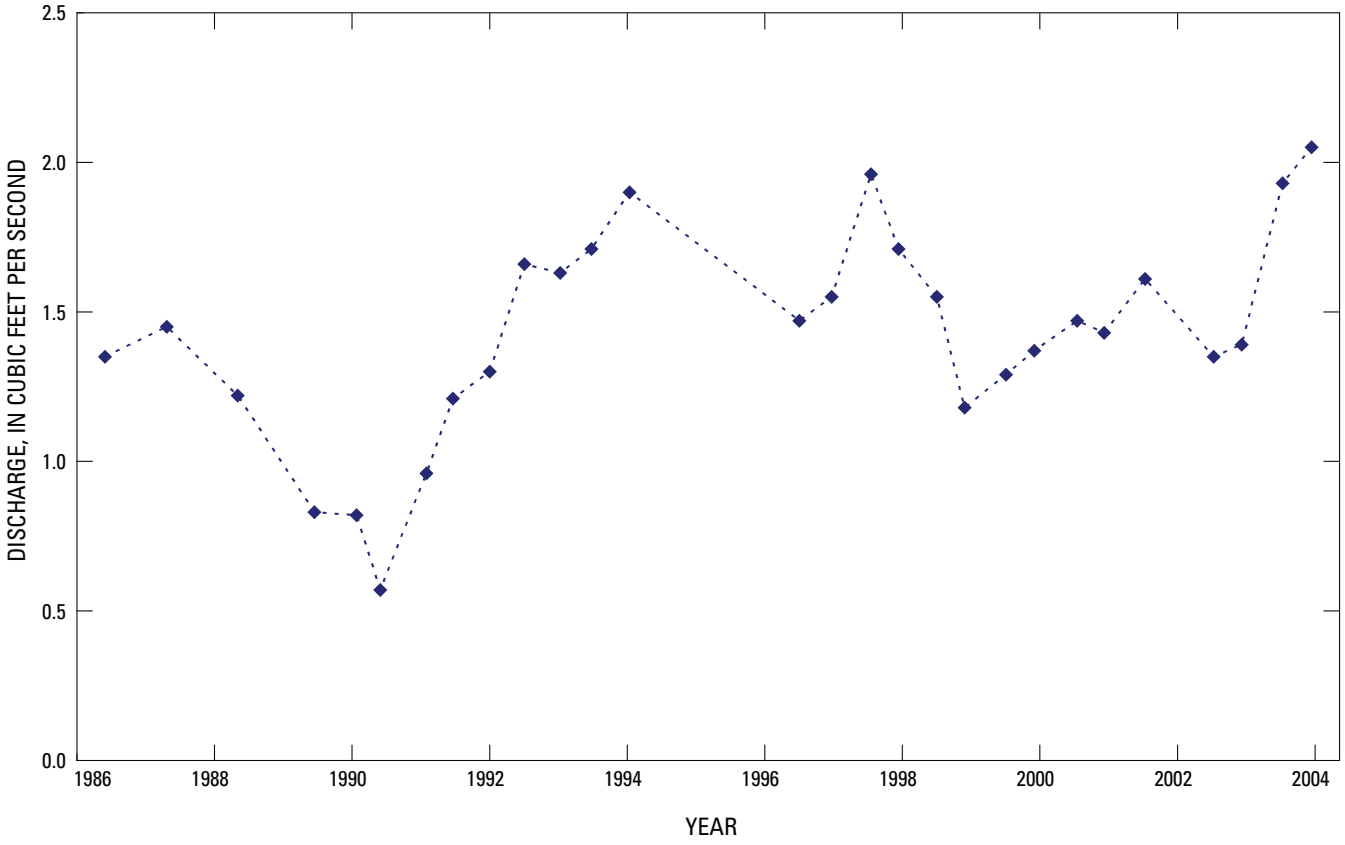

Figure B12. Periodic discharge measurements for partial-record stream-gaging station 364238114424401, Muddy River Springs 15 (M-15) near Moapa, Nevada, 1987–2004. Data from U.S. Geological Survey National Water Information System (NWIS) database, accessed 2005 at http://waterdata.usgs.gov.

Table B6. Periodic discharge measurements for partial-record stream-gaging station 364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada, 1987–2004.

Table B6 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Pond upstream of M-15

Figure B13. Location of staff plate and reference mark (RM-1) at station 364238114424401 Muddy River Springs 15 (M-15) near Moapa, Nevada, and view of upstream pond. Photographed June 10, 2004 by D. Beck.

364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada

The partial-record gaging station at Muddy River Springs 16 (M-16) was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 225 ft upstream of the confluence with the Plummer Central tributary (fig. B9). Discharge at Muddy River Springs 16 originates from a spring-fed pond just upstream of the gage. The area around the spring had previously been developed for trailers and recreational vehicles by the former Desert Oasis Warm Springs Resort. The area is now part of the Moapa Valley National Wildlife Refuge. U.S. Fish and Wildlife Service (FWS) has removed many of the resort's facilities and is currently restoring the springs. Periodic discharge measurements have been made by the USGS since 1987. Discharge measurements for the period of record are plotted in figure B14 and listed in table B7.

In March 1998, the FWS installed a 90-degree v-notch weir and staff plate in the channel. From 1998 to January 2002, FWS made periodic water-level measurements at the weir as well as two measurements of discharge. Discharges for the water-level measurements were computed using a standard weir rating (Rantz, 1982) and are plotted in figure B14. The computed and manual discharge measurements are listed in table B8.

Photographs of the FWS weir and staff plate and of the USGS reference mark established on June 10, 2004, are included in figure B15. On May 26, 2005, the weir, staff plate, and reference mark were observed to have been destroyed as a result of restoration work at the refuge.

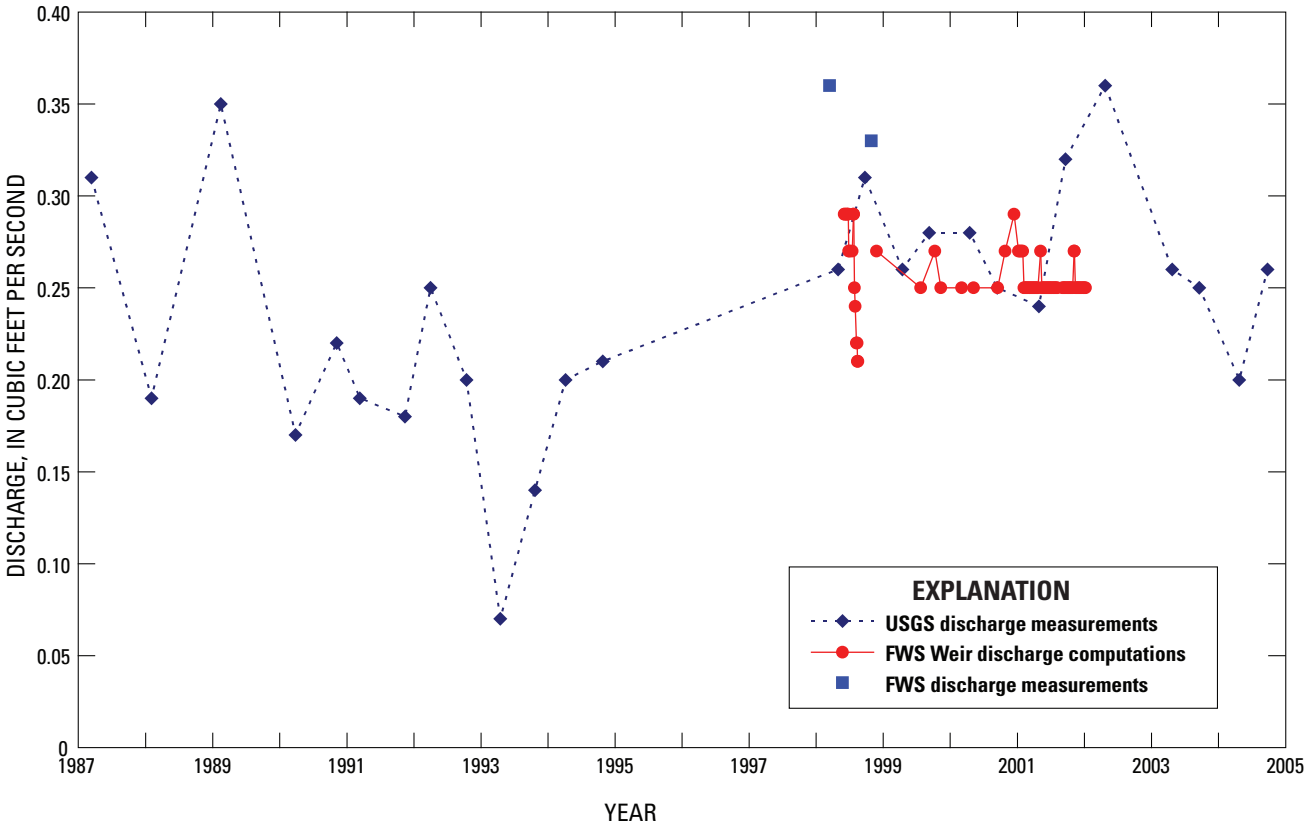

Figure B14. Periodic discharge measurements for partial-record stream-gaging station 364238114424201 Muddy River Springs (M-16) near Moapa, Nevada. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) database, accessed 2005, at http: //waterdata.usgs.gov, and U.S. Fish and Wildlife Service (FWS).

Table B7. Periodic discharge measurements for partial-record stream-gaging station 364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada, 1987–2004.

Table B7 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B8. Periodic discharge measurements and weir discharge computations for partial-record stream-gaging station 364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada, 1998–2002.

[Data from U.S. Fish and Wildlife Service]

Table B8 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

RM-1
(1,758.08 ft)

Figure B15. Location of U.S. Fish and Wildlife Service weir and staff plate, and reference mark (RM-1) at partial-record stream-gaging station 364238114424201 Muddy River Springs 16 (M-16) near Moapa, Nevada. Photographed June 10, 2004 by D. Beck. Elevation of RM-1 in feet above NAVD 88.

364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada

The partial-record gaging station at Muddy River Springs 20 (M-20) was established by the U.S. Geological Survey (USGS) on October 25, 1994, and is about 50 ft upstream of the confluence of Plummer East with the Plummer Main tributary (fig. B9). Flow at Muddy River Springs 20 originates upstream of several springs that had been used to fill a large swimming pool previously operated by the former Desert Oasis Warm Springs Resort. The area is now part of the Moapa Valley National Wildlife Refuge. The U.S. Fish and Wildlife Service (FWS) has removed many of the resort's recreational facilities and currently is restoring the springs. Periodic discharge measurements have been made by the USGS since 1994. Discharge measurements for the period of record are plotted in figure B16 and listed in table B9.

Photograph of the staff plate established for the Muddy River Springs 20 monitoring station on June 10, 2004, is included in figure B17. On May 26, 2005, the large swimming pool upstream of the gage was observed to have been removed as part of the restoration program at the refuge.

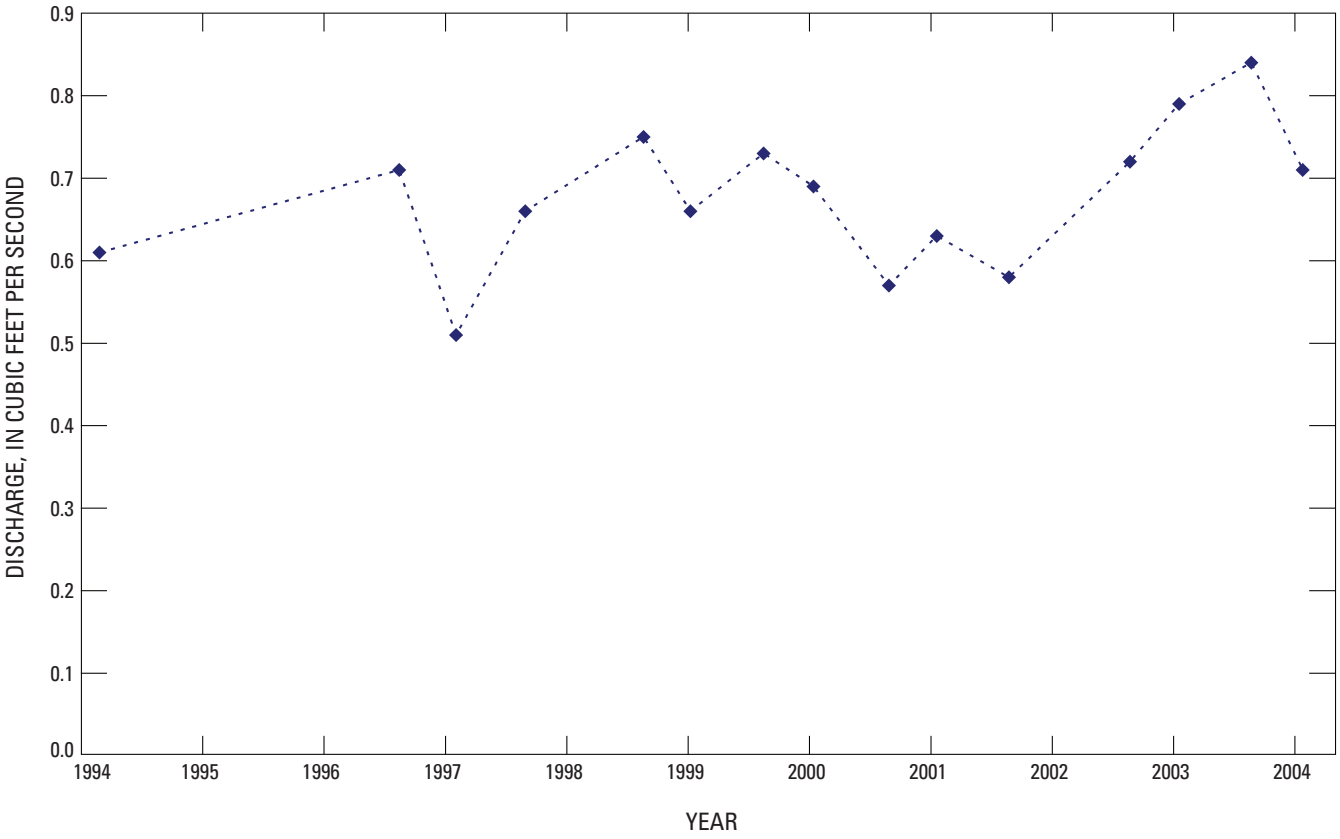

Figure B16. Periodic discharge measurements for partial-record stream-gaging station 364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada, 1994–2004. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov

Table B9. Periodic discharge measurement for partial-record stream-gaging station 364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada, 1994–2004.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B9 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Swimming pool upstream of M-20

Figure B17. Location of the staff plate at partial-record stream-gaging station 364238114424301 Muddy River Springs 20 (M-20) near Moapa, Nevada, and view of the spring-fed swimming pool upstream of the gage. Photographed June 10, 2004 by D. Beck.

Miscellaneous Water-Quality Sites in the Plummer Springs Group near Moapa, Nevada

Converse Consultants, on contract with Nevada Power Company, have been measuring water temperature and specific conductance at selected spring sites in the Warm Springs area since 1997. Eight springs were measured within the Plummer Springs Group on the Moapa Valley National Wildlife Refuge and were designated, by Converse Consultants (2004) as sites S1a, S1b, S34, S42, S43, S44, S44a, and S56. Sites S44 and S44a were tributary to Plummer West; sites S1a, S1b, S42, and S43 were tributary to Plummer Central; and sites S34 and S56 were tributary to Plummer East (fig. B9). Quarterly measurements have been made by Converse Consultants since April 1997. Water-temperature and specific-conductance measurements for the period of record are plotted in figures B18 through B25 and listed in tables B10 through B17.

By December 2004, restoration work on the springs within the refuge had destroyed all the sampling sites listed above. As a result, Converse Consultants are now measuring water temperature and specific conductance at the U.S. Geological Survey partial-record stations at Muddy River Springs 15, 16, and 20 (fig. B9).

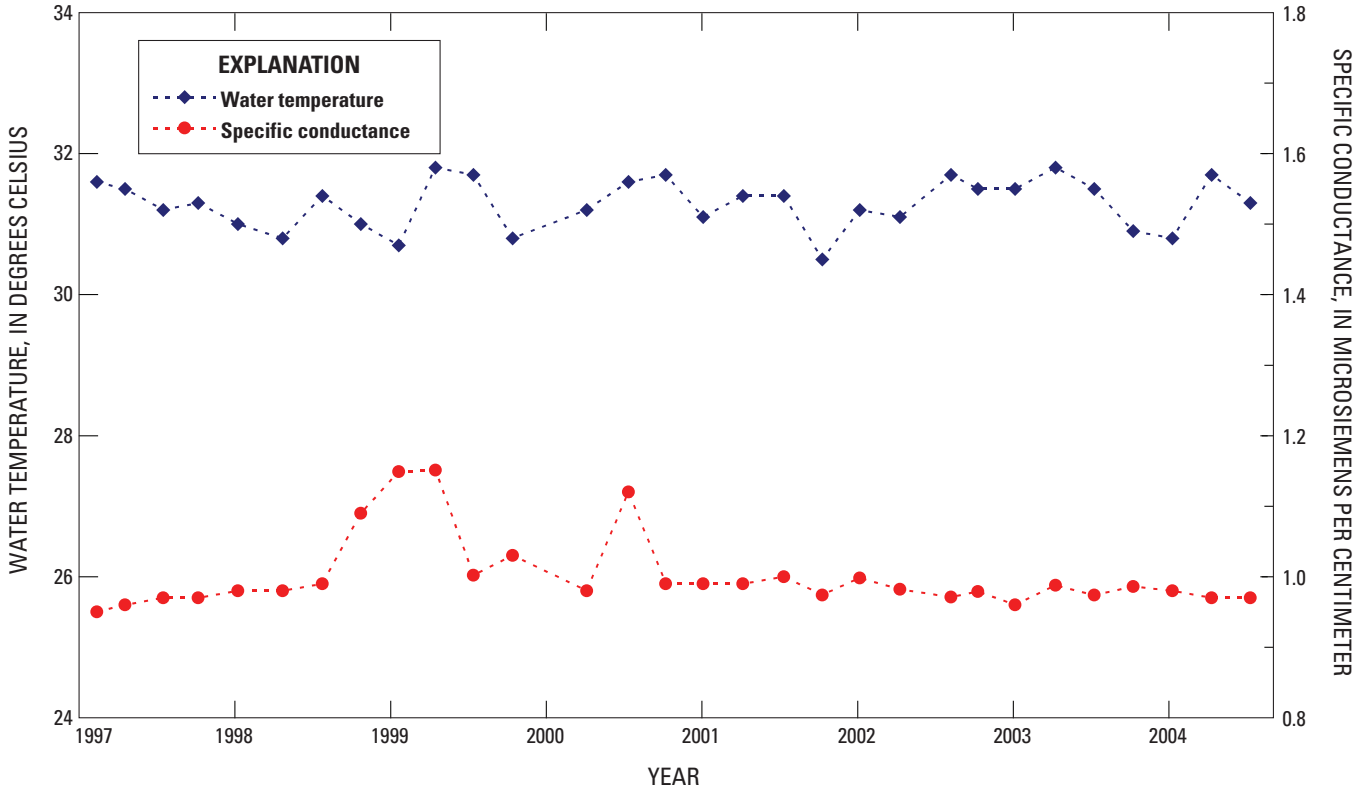

Figure B18. Water-temperature and specific-conductance measurements by Converse Consultants at site S1a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

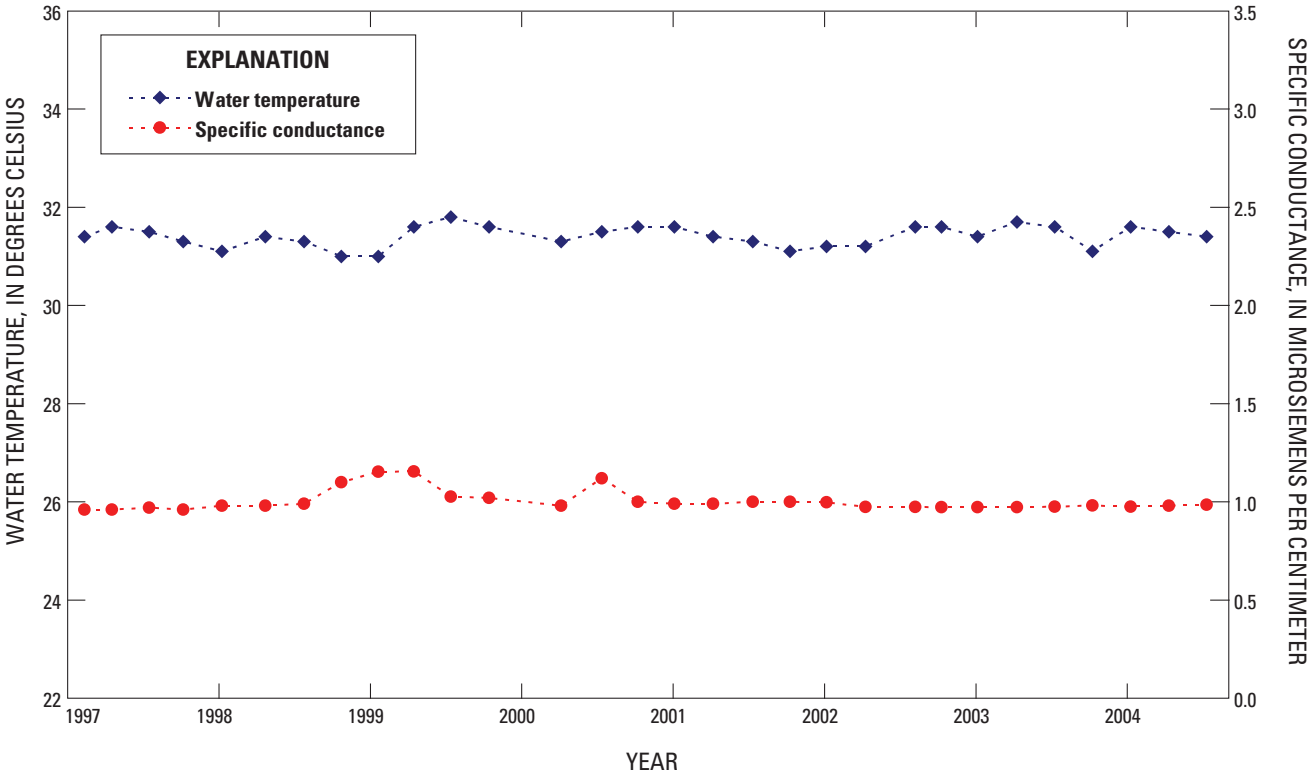

Figure B19. Water-temperature and specific-conductance measurements by Converse Consultants at site S1b in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

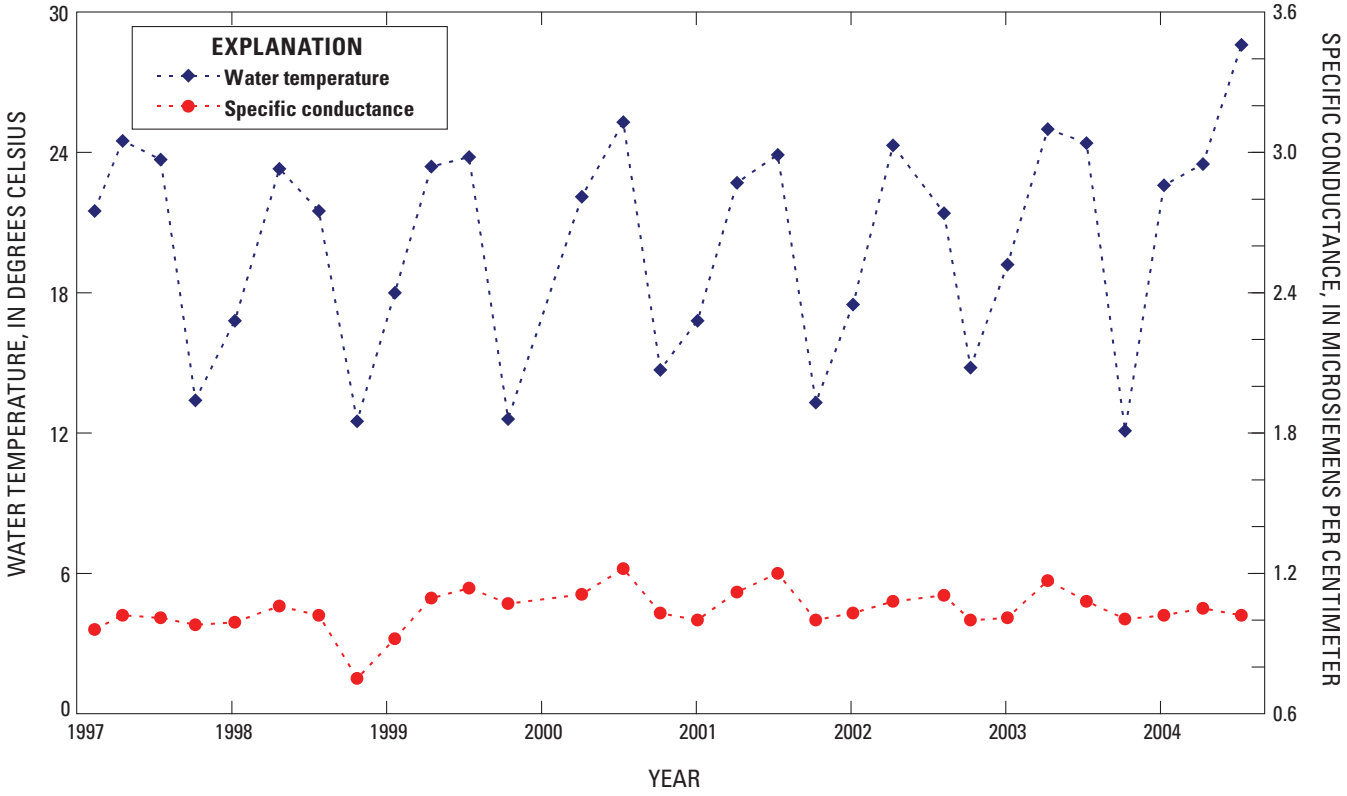

Figure B20. Water-temperature and specific-conductance measurements by Converse Consultants at site S34 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

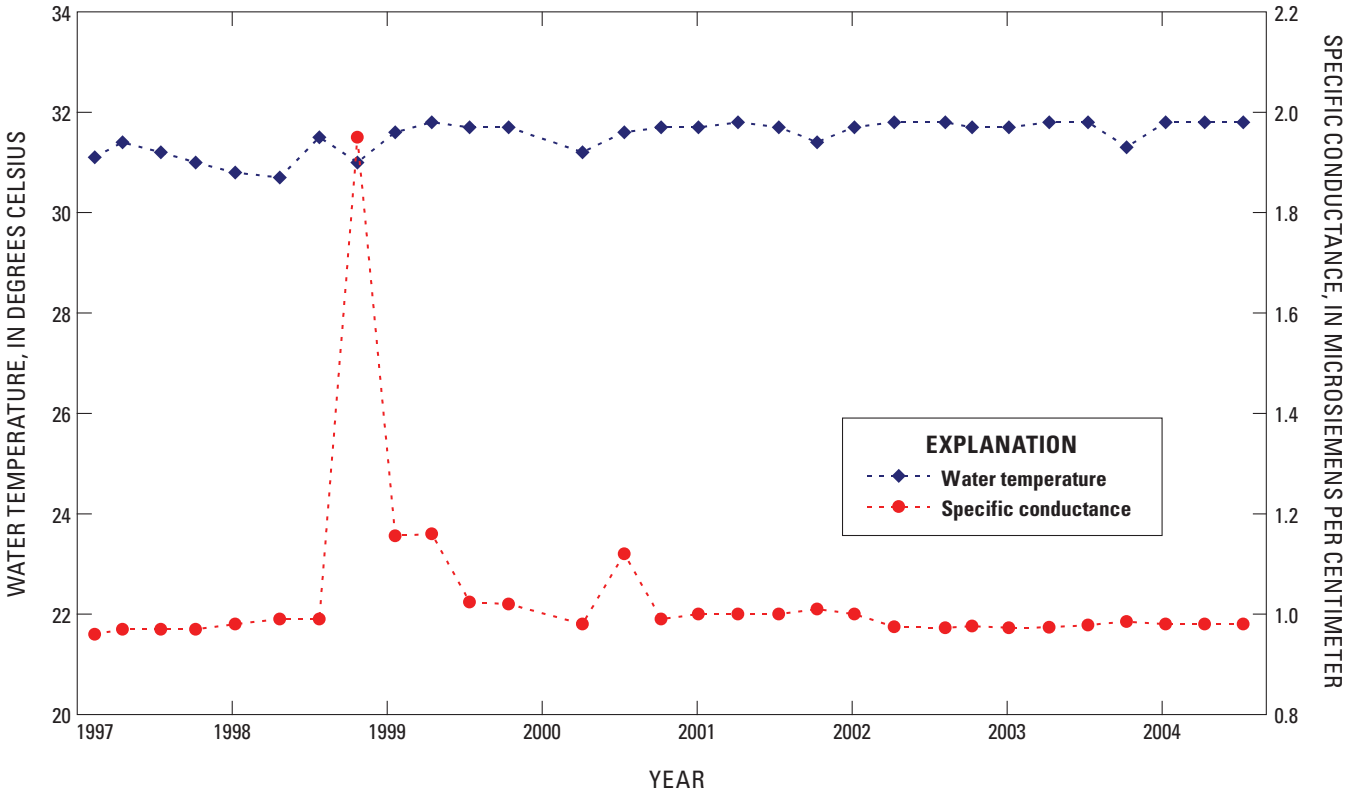

Figure B21. Water-temperature and specific-conductance measurements by Converse Consultants at site S42 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

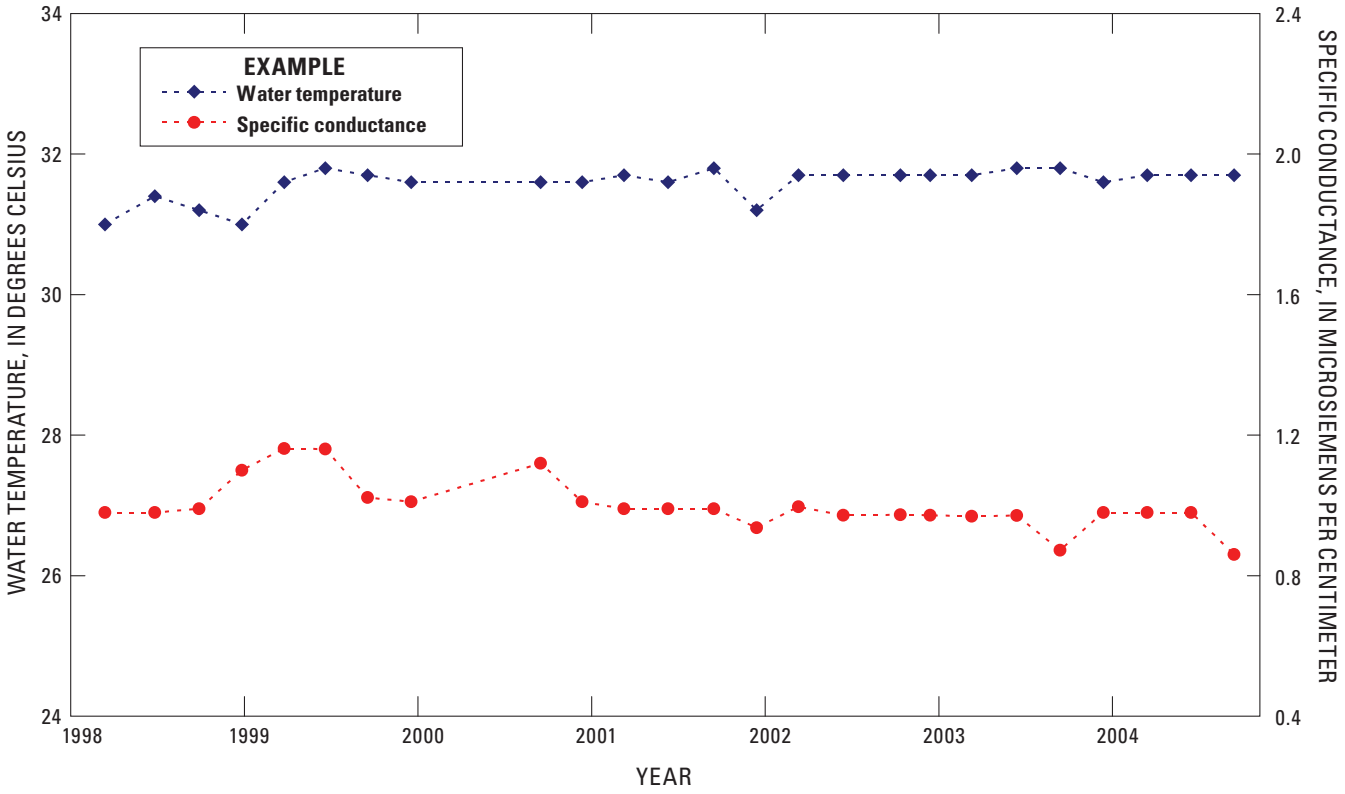

Figure B22. Water-temperature and specific-conductance measurements by Converse Consultants at site S43 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

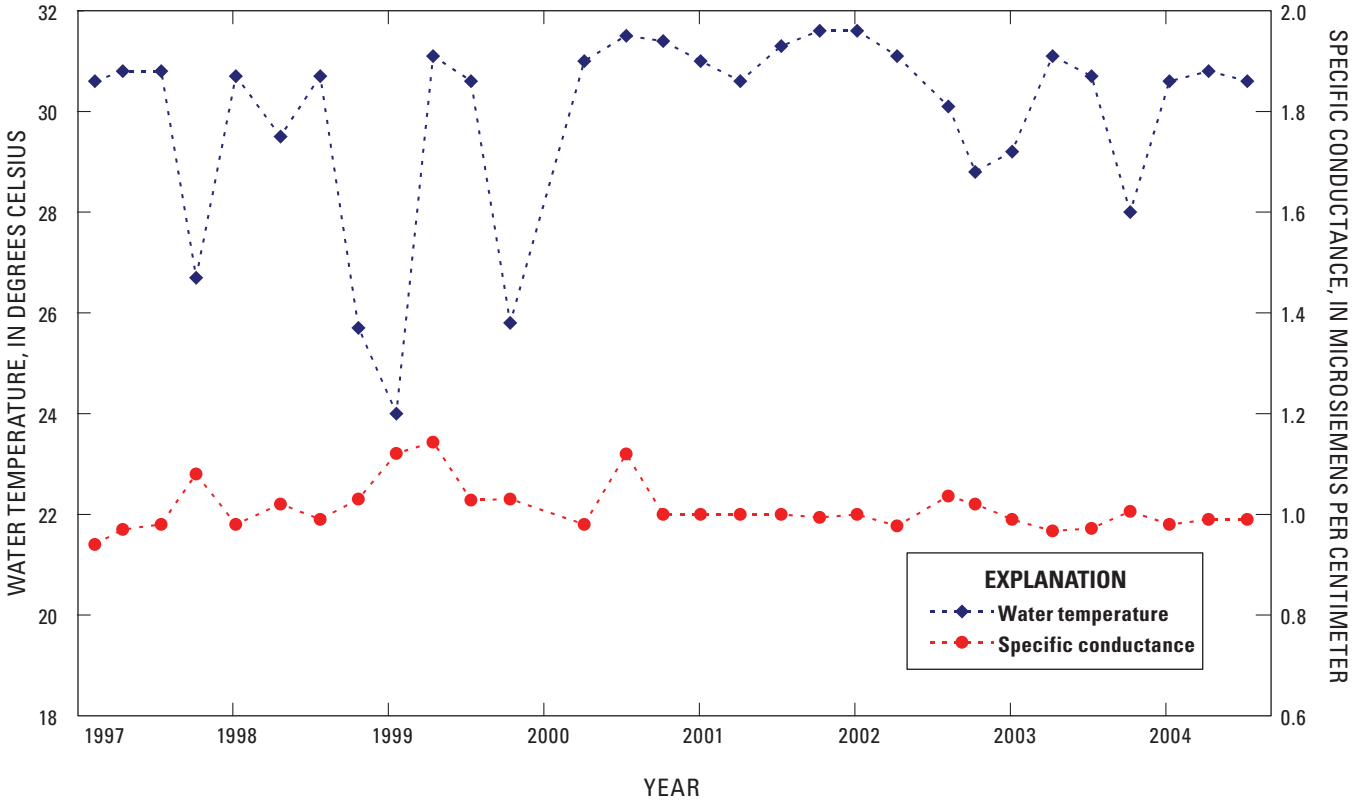

Figure B23. Water-temperature and specific-conductance measurements by Converse Consultants at site S44 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

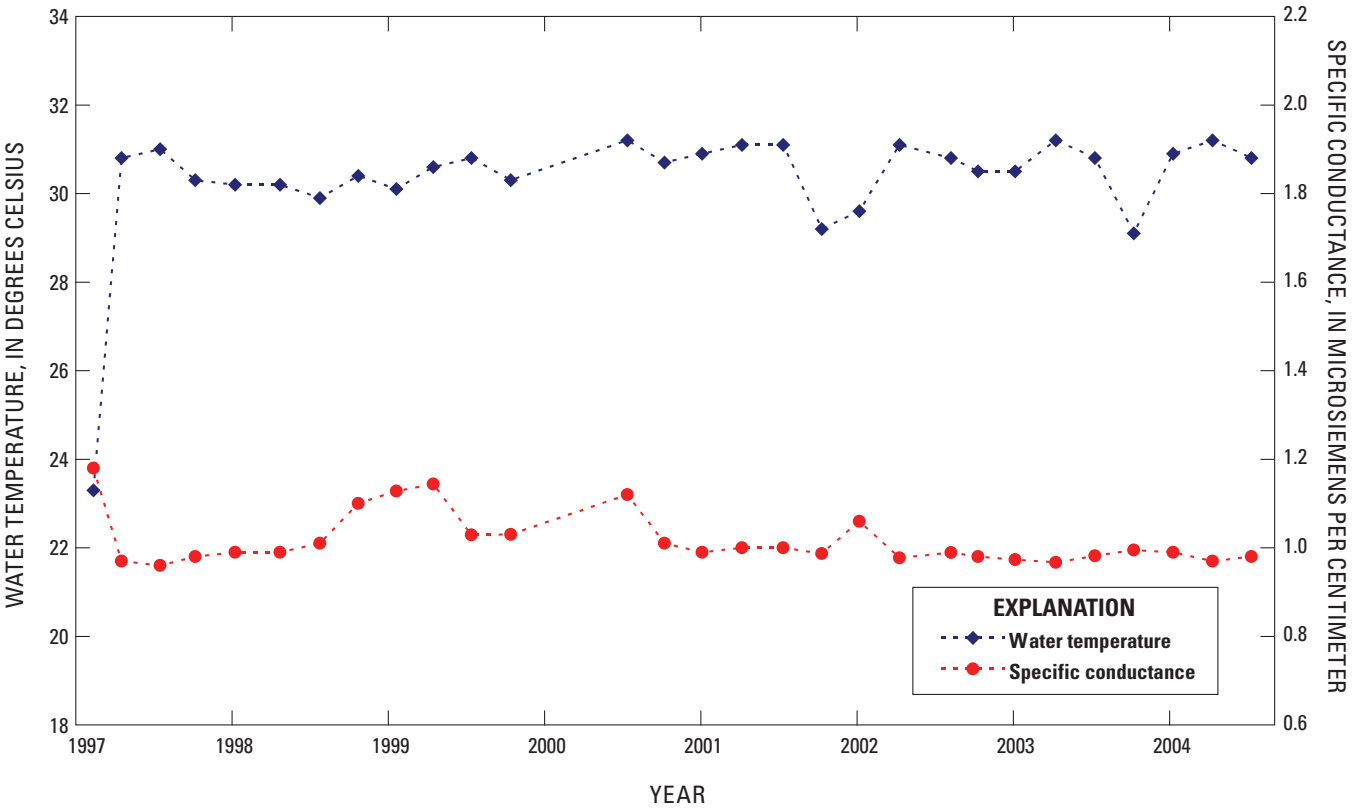

Figure B24. Water-temperature and specific-conductance measurements by Converse Consultants at site S44a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

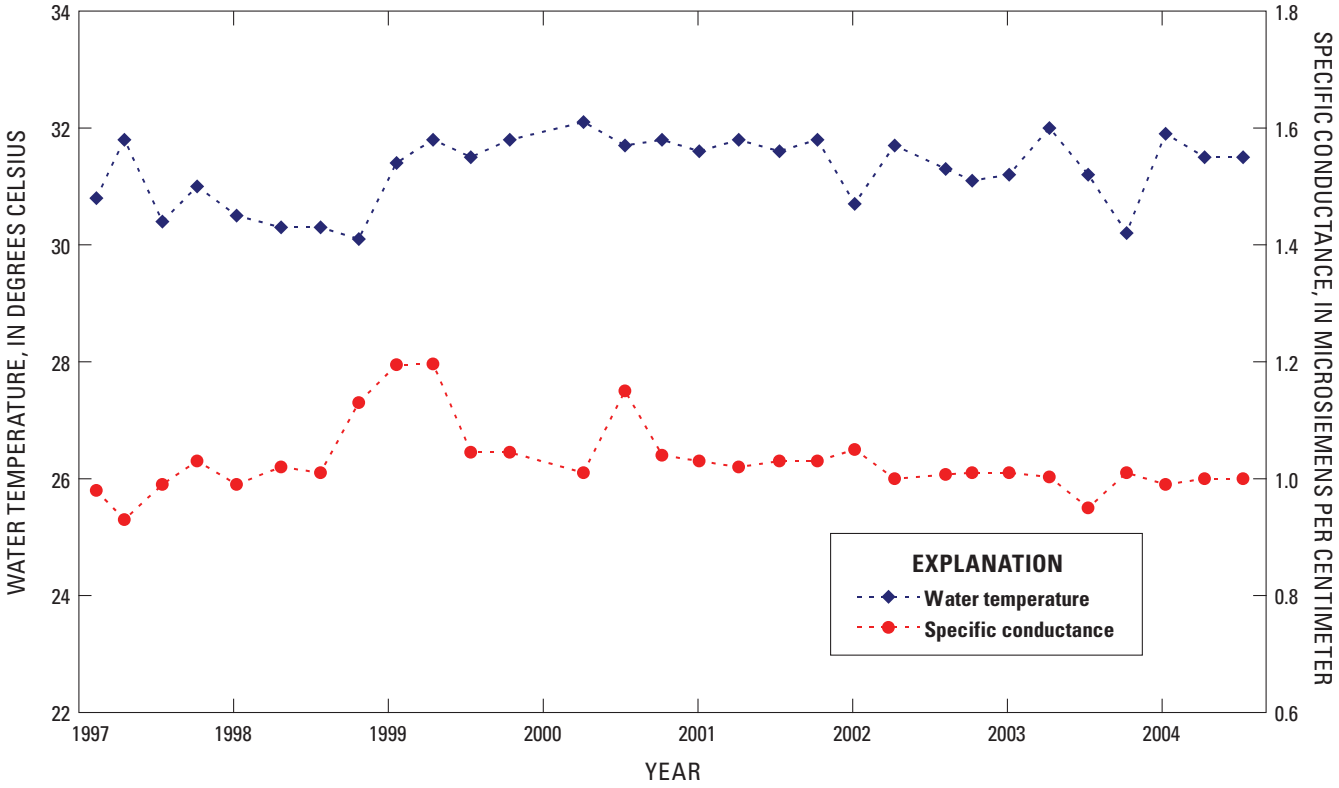

Figure B25. Water-temperature and specific-conductance measurements by Converse Consultants at site S56 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B10. Water-temperature and specific-conductance measurements by Converse Consultants at site S1a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B10 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B11. Water-temperature and specific-conductance measurements by Converse Consultants at site S1b in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B11 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B12. Water-temperature and specific-conductance measurements by Converse Consultants at site S34 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B12 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B13. Water-temperature and specific-conductance measurements by Converse Consultants at site S42 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B13 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B14. Water-temperature and specific-conductance measurements by Converse Consultants at site S43 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B14 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B15. Water-temperature and specific-conductance measurements by Converse Consultants at site S44 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B15 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B16. Water-temperature and specific-conductance measurements by Converse Consultants at site S44a in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B16 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B17. Water-temperature and specific-conductance measurements by Converse Consultants at site S56 in the Plummer Springs Group near Moapa, Nevada, 1997–2004.

Table B17 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Pederson Springs Group

The following sites are included within this section:

09415908 Pederson East Spring near Moapa, Nevada (2002–04)
09415910 Pederson Spring near Moapa, Nevada (1987–2004)
364235114425201 Muddy River Springs 11 (M-11) near Moapa, Nevada (1987–2004)
364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada (1987–2004)
364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada (1986–2004)
364235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada (1998–2004)
09415920 Warm Springs West near Moapa, Nevada (1967–2005)

09415908 Pederson East Spring near Moapa, Nevada

A continuous-record stream-gaging station was established by the U.S. Geological Survey (USGS) on Pederson East Spring on May 9, 2002. The hydraulic control is a 90-degree v-notch weir that was installed by the U.S. Fish and Wildlife Service in collaboration with the Southern Nevada Water Authority and the U.S. Bureau of Reclamation. Pederson East Spring is about 100 ft north of the Moapa Valley National Wildlife Refuge service road (fig. B26) and is part of a cluster of springs that drain to the northeast. Flow from Pederson East Spring joins with discharge from Pederson Spring about 200 ft downstream from the gage.

Daily mean discharges for the period of record are plotted on figure B27 and listed in table B18. Photographs of the gage and weir, and selected reference marks established for this gage on June 9, 2004, are shown in figure B28.

Water samples were collected at this site on January 12, and May 18, 2004, by the Desert Research Institute (DRI) and analyzed for major ions and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B19.

Figure B26. Location of Pederson Springs Group monitoring sites and bench marks WSBM-6 and WSBM-7 in the Warm Springs area near Moapa, Nevada.

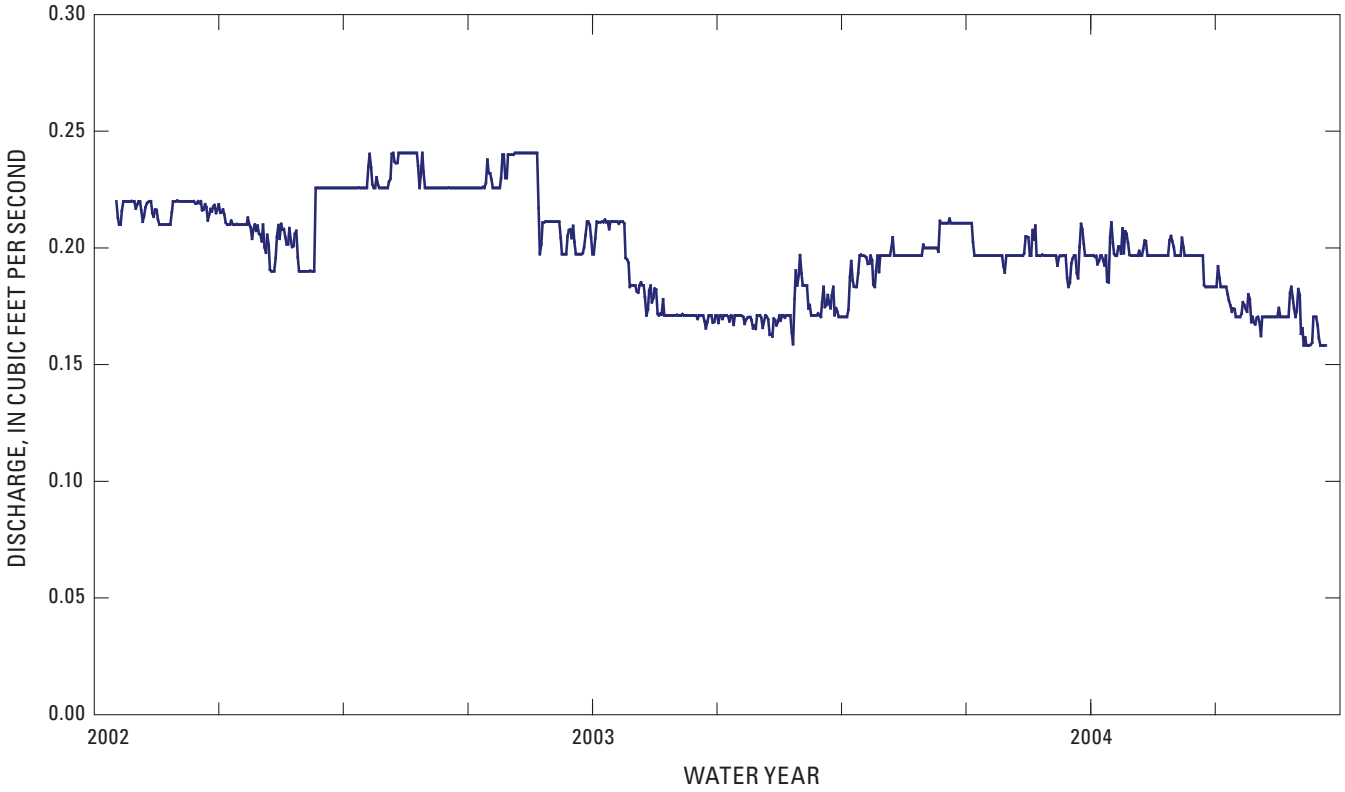


Figure B27. Daily mean discharges for continuous-record stream-gaging station 09415908 Pederson East Spring near Moapa, Nevada, water years 2002–04.

Table B18. Daily mean discharges for continuous-record stream-gaging station 09415908 Pederson East Spring near Moapa, Nevada, water years 2002–04.

Table B18 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B28. Location of staff plate and selected reference marks (RM) for station 09415908 Pederson East Spring in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

Table B19. Water-quality data collected by Desert Research Institute at continous-record stream-gaging station 09415908 Pederson East Spring near Moapa, Nevada, January 12 and May 18, 2004.

Table B19 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

09415910 Pederson Spring near Moapa, Nevada

A continuous-record stream-gaging station with 45 degree v-notch aluminum weir was established by the U.S. Geological Survey (USGS) on Pederson Spring on October 1, 1986. Pederson Spring is about 50 ft northeast of the Moapa Valley National Wildlife Refuge service road (fig. B26) and is part of a cluster of springs that drains to the northeast. Flow from Pederson Spring joins with discharge from Pederson East Spring about 250 ft downstream from the gage. Reclamation of the spring and an adjacent area by the U.S. Fish and Wildlife Service began in 2002; a new weir, with 45 degree v-notch, was installed on April 27, 2004 (fig. B29). The new weir was installed because water was leaking around the old weir and the gage was not measuring the flows accurately.

Daily mean discharges for the period of record are plotted on figure B30 and listed in table B20. Photographs of the gage and weir and of selected reference marks established for this gage on June 9, 2004, are shown in figure B31.

Water-quality data are available for this site from Converse Consultants and the USGS. Beginning April 22, 1997, Converse Consultants began quarterly water temperature and specific conductance measurements. Data collected from 1997 through December 2004 are plotted on figure B32 and listed in table B21.

Water samples were collected by the USGS on July 30, 2003, as part of the National Water-Quality Assessment Program. An extensive suite of analyses were made, and the results are listed in table B22.

A. **View of first weir being installed in 1986.**

B. **View of new weir installed in 2004.**

Figure B29. Looking downstream at continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada.

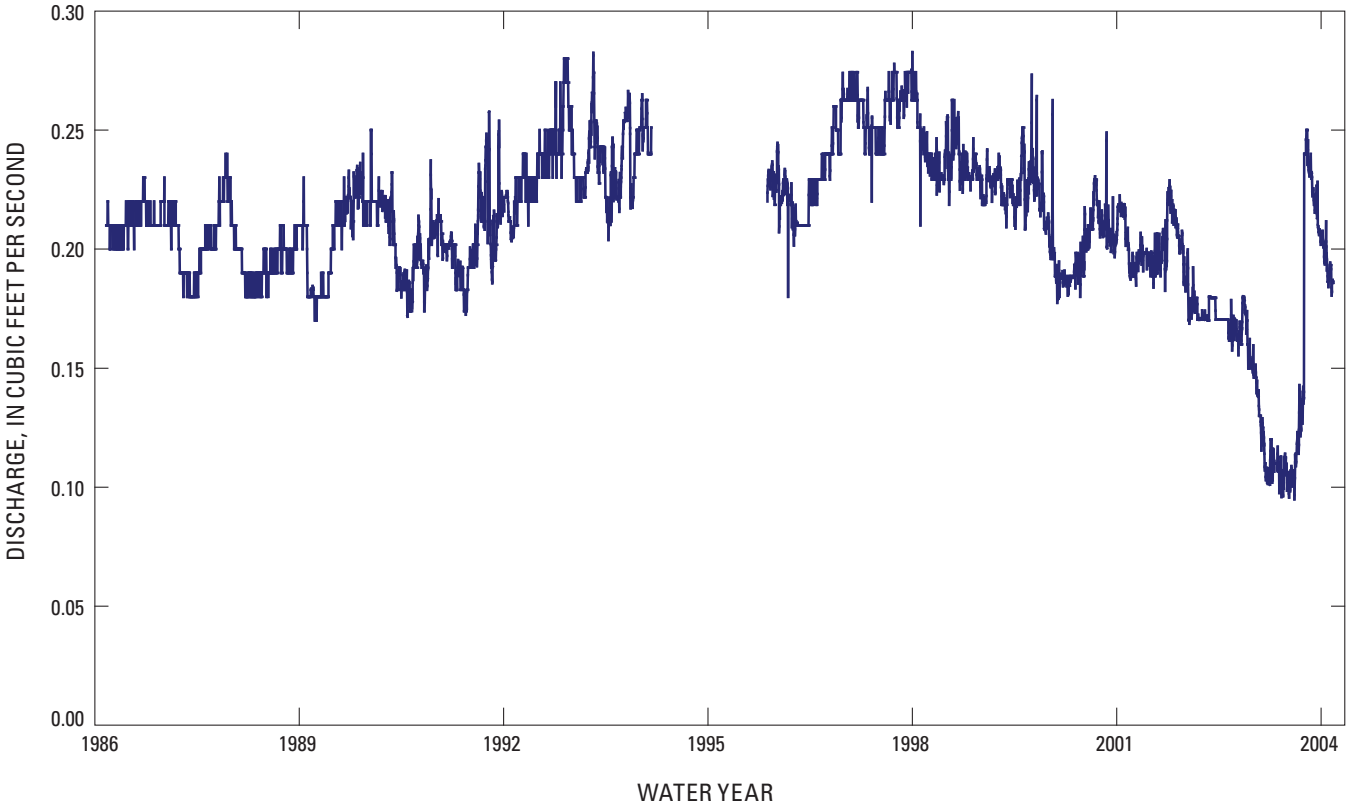


Figure B30. Daily mean discharges for continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada, water years 1987–2004.

Table B20. Daily mean discharges for continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada, water years 1987–2004.

Table B20 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

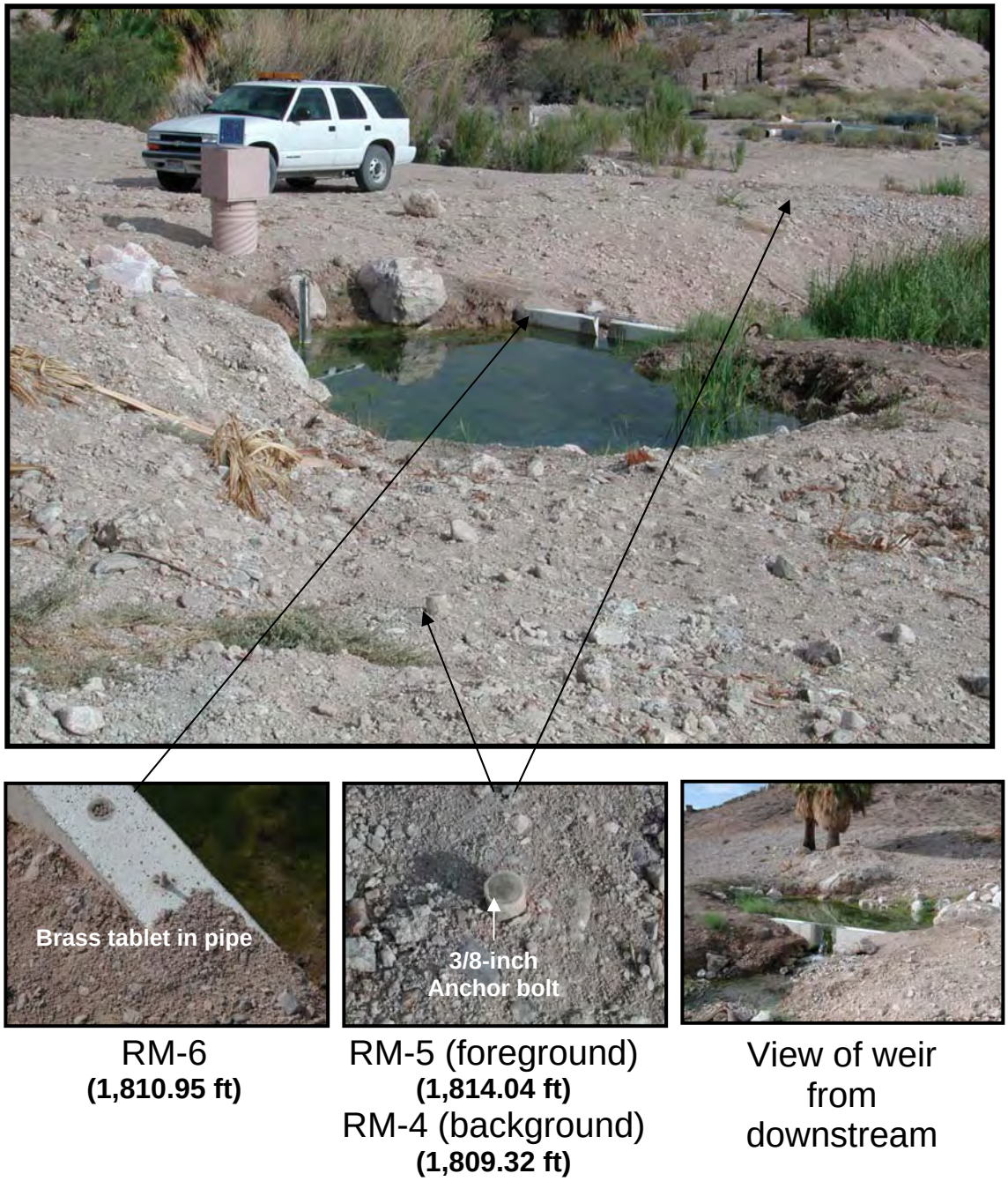


Figure B31. Location of selected reference marks (RM) at continuous-record stream-gaging station 09415910 Pederson Spring in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

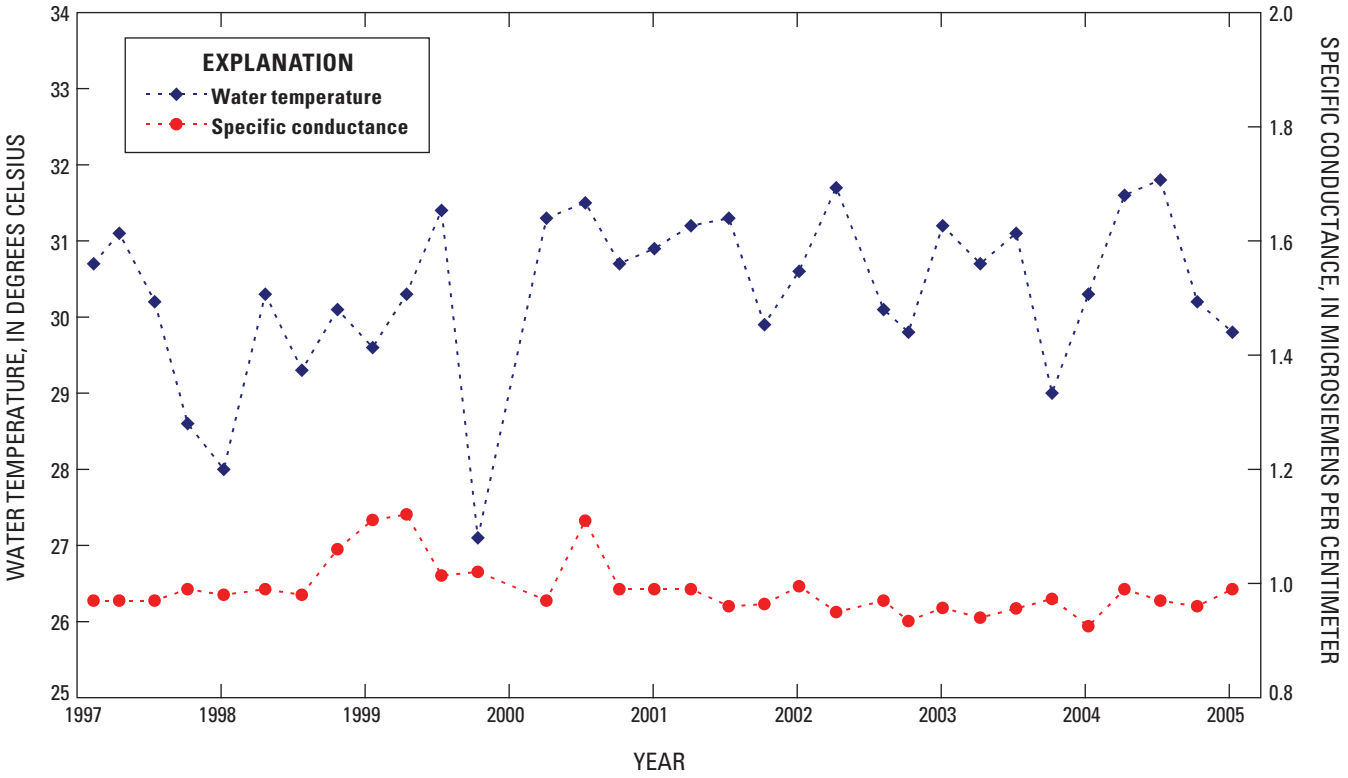


Figure B32. Water-temperature and specific-conductance measurements by Converse Consultants for station 09415910 Pederson Spring near Moapa, Nevada, 1997–2005.

Table B21. Water-temperature and specific-conductance measurements by Converse Consultants at station 09415910 Pederson Spring near Moapa, Nevada, 1997–2005.

Table B21 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B22. Water-quality data collected for continuous-record stream-gaging station 09415910 Pederson Spring near Moapa, Nevada, July 30, 2003.

Table B22 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

364235114425201 Muddy River Springs 11 (M-11) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 11 (M-11) was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 50 ft upstream of the main channel that drains the combined flow of Pederson and Pederson East spring tributaries (fig. B26). Discharge at Muddy River Springs 11 originates about 20 ft upstream and is part of a cluster of springs known as the Pederson Spring Group that drains to the northeast.

Periodic discharge measurements have been made by the USGS since March 1987. Discharge measurements for the period of record are plotted in figure B33 and listed in table B23. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 11 monitoring site on June 9, 2004, are included in figure B34.

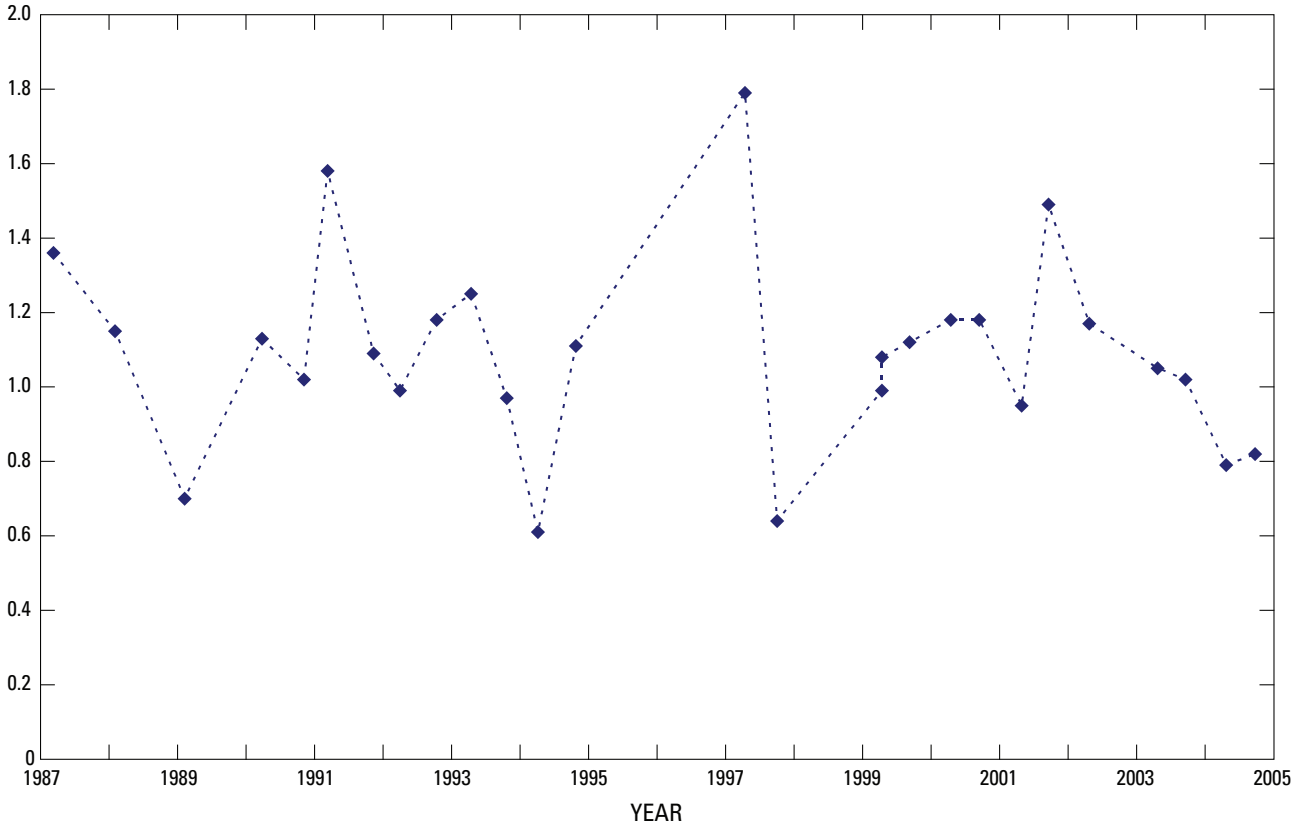


Figure B33. Periodic discharge measurements for partial-record stream-gaging station 364235114425201 Muddy River Springs 11 (M-11) near Moapa, Nevada, 1987–2004.

Table B23. Periodic discharge measurements for partial-record stream-gaging station 364235114425201 Muddy River Sprngs 11 (M-11) near Moapa, Nevada, 1987–2004.

Table B23 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B34. Location of staff plate and reference mark (RM-1) for partial-record stream-gaging station Muddy River Springs 11 (M-11) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet NAVD 88.

364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 12 was established by the U.S. Geological Survey (USGS) on March 12, 1987, and is about 150 ft upstream of the confluence with the main channel that drains the combined flows from Pederson and Pederson East Spring tributaries (fig. B26). Flow at Muddy River Springs 12 originates approximately 10 ft upstream and is part of a cluster of springs known as the Pederson Spring Group that drains to the northeast.

Periodic discharge measurements have been made by the USGS since March 1987. Discharge measurements for the period of record are plotted in figure B35 and listed in table B24. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 12 monitoring site on June 9, 2004, are included in figure B36.

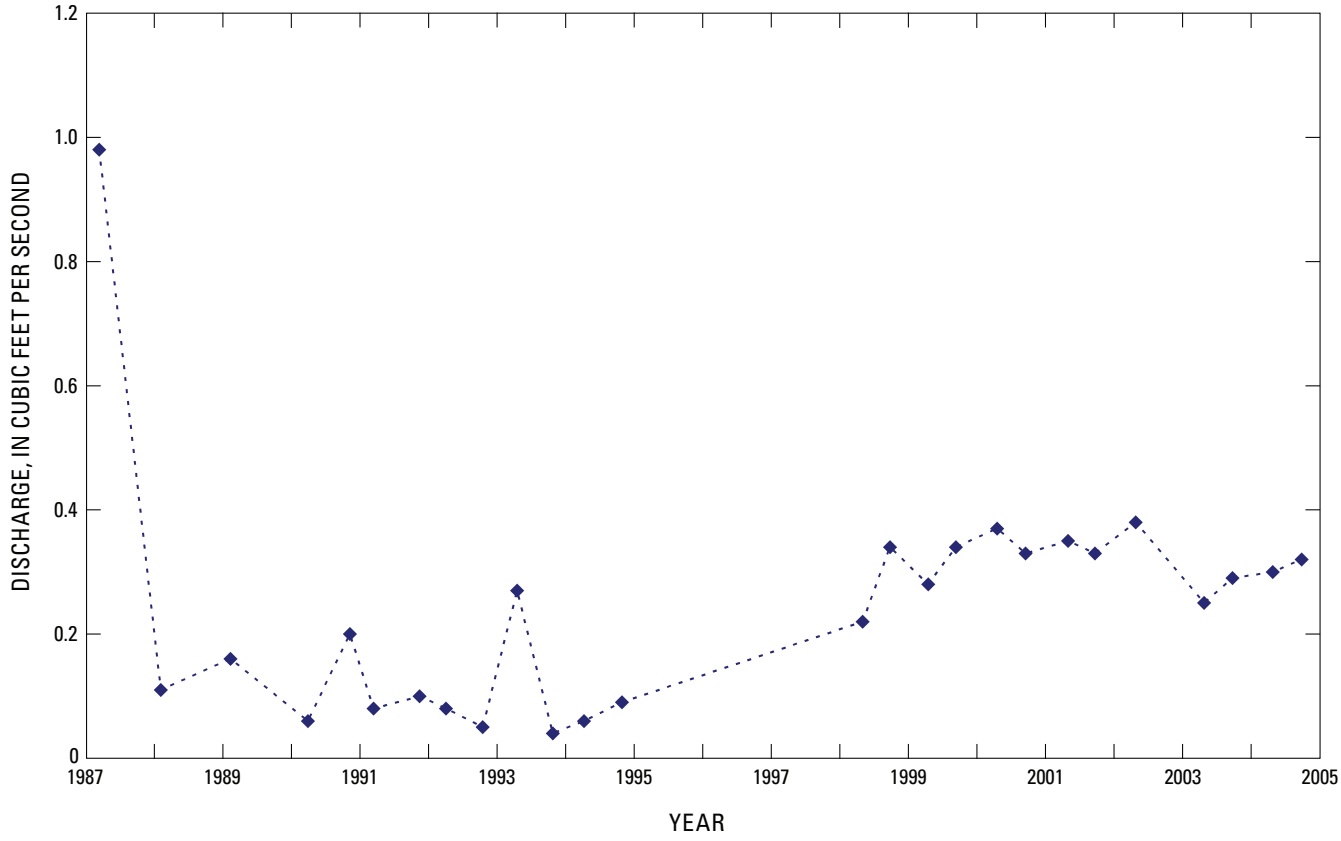
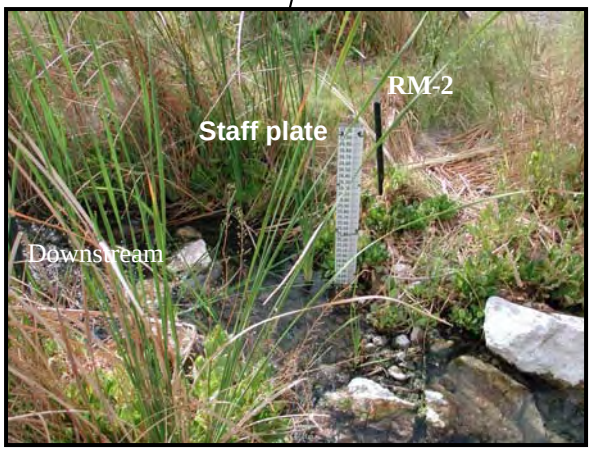


Figure B35. Periodic discharge measurements for partial-record stream-gaging station 364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada, 1987–2004.

Table B24. Periodic discharge measurements for partial-record stream-gaging station 364237114425401 Muddy River Springs 12 (M-12) near Moapa, Nevada, 1987–2004.

Table B24 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.



M-12
RM-2
(1,801.49 ft)

Figure B36. Location of staff plate and reference mark (RM-2) for partial-record stream-gaging station Muddy River Springs 12 (M-12) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 13 was established by the U.S. Geological Survey (USGS) on January 28, 1986, and is about 150 ft upstream of the confluence with the main channel that drains the combined flows from Pederson and Pederson East Spring tributaries (fig. B26). Flow at Muddy River Springs 13 originates approximately 25 ft upstream and is part of a cluster of springs known as the Pederson Spring Group that drains to the northeast.

Periodic discharge measurements have been made by the USGS since January 1986. Discharge measurements for the period of record are plotted in figure B37 and listed in table B25. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 13 monitoring site on June 9, 2004, are included in figure B38.

Water samples were collected at this site on January 12 and May 18, 2004, by Desert Research Institute (DRI) and analyzed for major ions, physical and chemical parameters (dissolved oxygen, pH, and water temperature), and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B26.

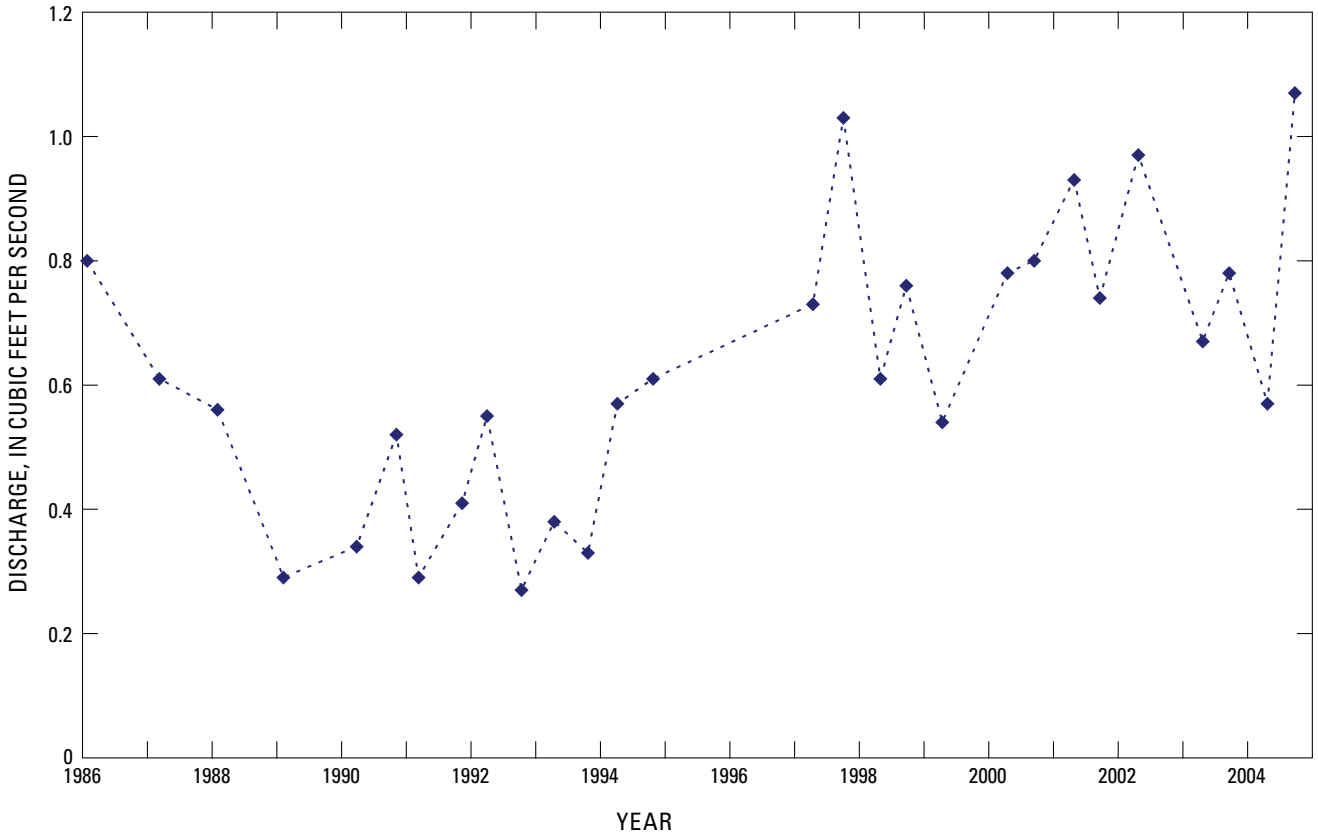
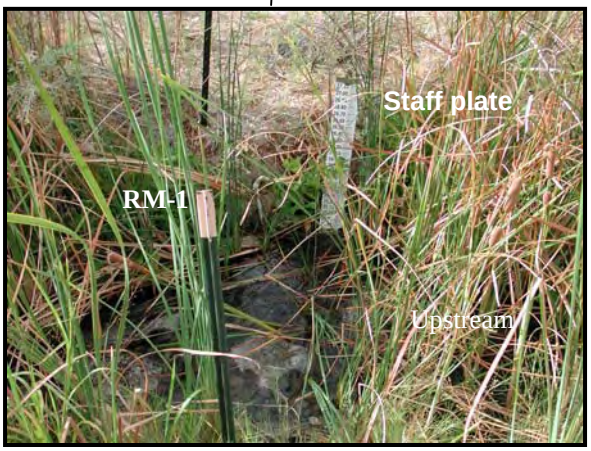


Figure B37. Periodic discharge measurements for stream-gaging station 364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada, 1986–2004.

Table B25. Periodic discharge measurements for partial-record stream-gaging station 36426114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada, 1986–2004.

Table B25 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.



M-13
RM-1
(1,802.83 ft)

Figure B38. Location of staff plate and reference mark (RM-1) for partial-record stream-gaging station Muddy River Springs 13 (M-13) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

Table B26. Water-quality data collected by Desert Research Institute at station 364236114425401 Muddy River Springs 13 (M-13) near Moapa, Nevada, January 12 and May 18, 2004.

Table B26 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

364235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada

The partial-record stream-gaging station at Muddy River Springs 19 (M-19) was established by the U.S. Geological Survey (USGS) on April 28, 1990, and is about 100 ft downstream from the Pederson East Spring gage (fig. B26). Flow at Muddy River Springs 19 originates from water discharging at the Pederson East Spring pool and from three other spring pools downstream of the gage. Flow at M-19 drains to the northeast and joins with flow from Pederson Spring approximately 50 ft downstream.

Periodic discharge measurements have been made by the USGS since April 1998. Discharge measurements for the period of record are plotted in figure B39 and listed in table B27. Photographs of the staff plate and a selected reference mark established for the Muddy River Springs 19 monitoring site on June 9, 2004, are included in figure B40.

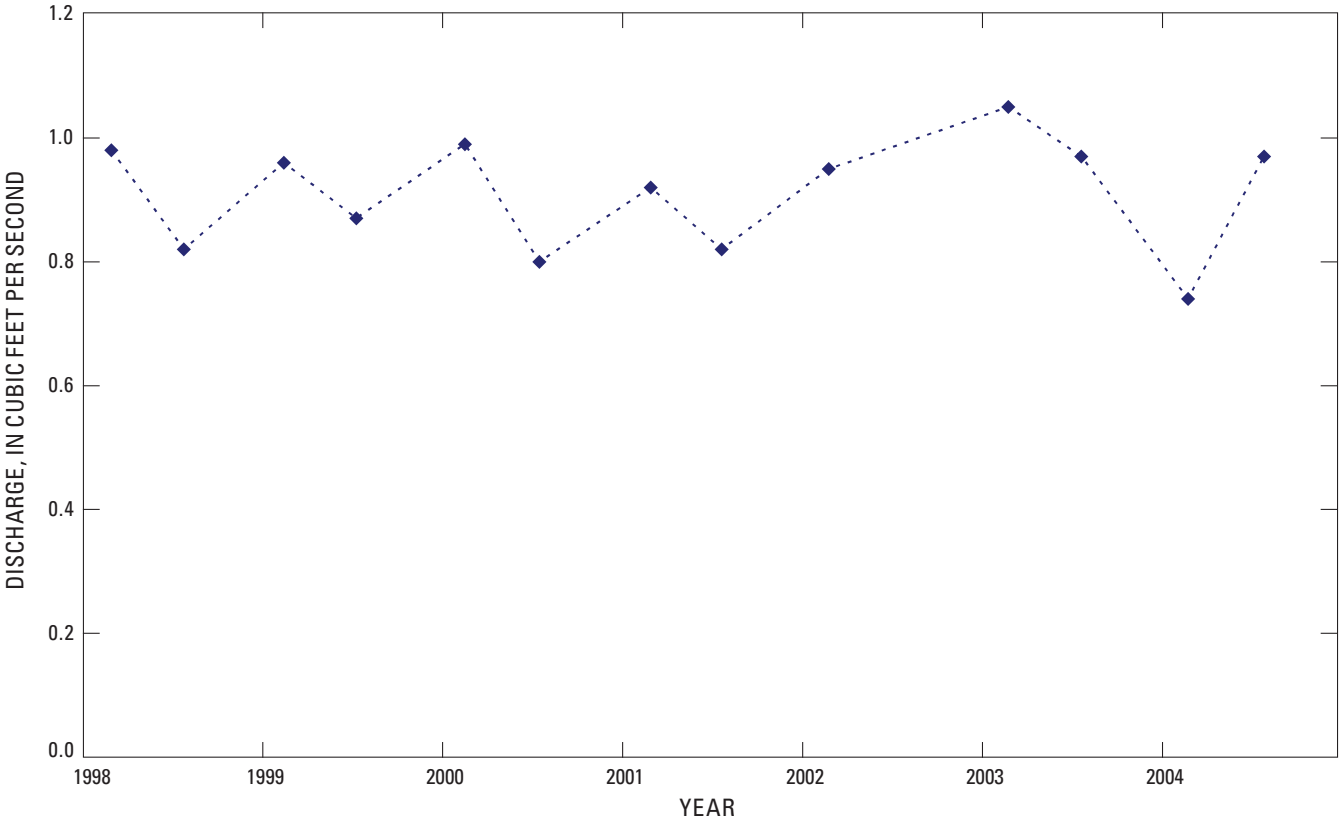


Figure B39. Periodic discharge measurements for partial-record stream-gaging station 3642235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada, 1998–2004.

Table B27. Periodic discharge measurements for partial-record stream-gaging station 364235114425301 Muddy River Springs 19 (M-19) near Moapa, Nevada, 1998–2004.

Table B27 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

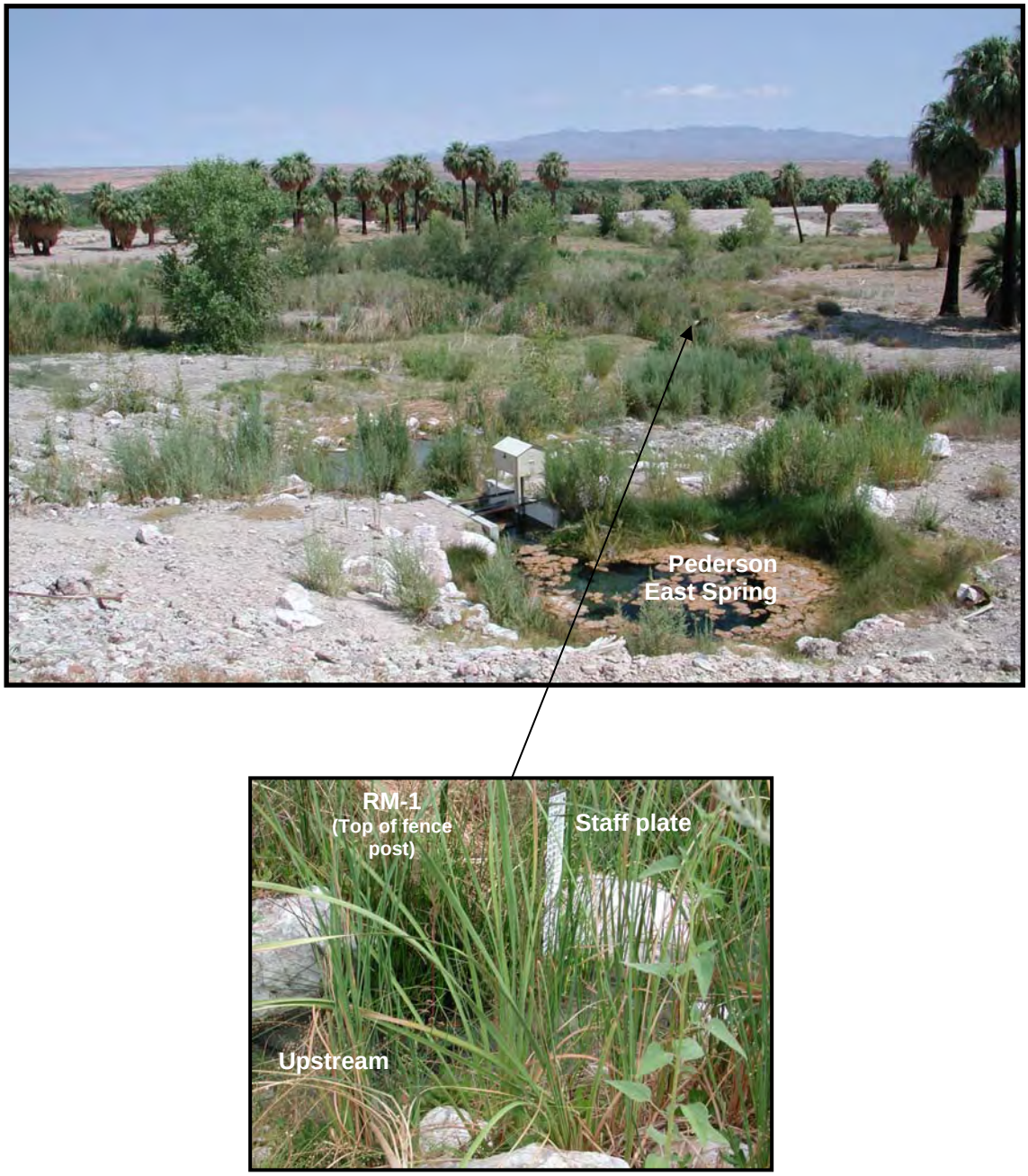


Figure B40. Location of staff plate and reference mark (RM-1) for partial-record stream-gaging station Muddy River Springs 19 (M-19) in the Moapa Valley National Wildlife Refuge near Moapa, Nevada. Photographed June 9, 2004 by D. Beck. Elevation in feet above NAVD 88.

09415920 Warm Springs West near Moapa, Nevada

A 1.5-foot (ft) Parshall flume was installed at the Warm Springs West stream-gaging station on September 20, 1967, by the Nevada Division of Water Resources (NDWR). Initially called the Pederson flume by NDWR, the exact location is unknown, but the flume is believed to have been installed in the vicinity of the current gage, just upstream of Warm Springs Road (fig. B41). At this site, the flume would have monitored the total flow discharging from all springs associated with the Pederson Spring Groups (fig. B26). Downstream from the flume, flow discharges under Warm Springs Road and then turns sharply to the east after exiting the culvert. About 0.1 mi below the culvert, flow merges with discharge draining the Plummer (Iverson) Spring Group.

Data provided by NDWR show that water levels at the Pederson flume generally were measured monthly from October 1967 to July 1981. A large gap in the record is evident from August 1971 to March 1974. Additional data provided by NDWR showed that a 1-ft Parshall flume, called the U.S. Fish and Wildlife Flume, was installed on May 6, 1981. The exact location of this flume also is unknown, but it is believed that it was near the location of the current gage. Water levels were concurrently measured at the Pederson and the Fish and Wildlife flumes during May, June, and July 1981. Water levels for the Fish and Wildlife Flume were measured daily from June 29, 1981, to September 27, 1981, and measured somewhat monthly from October 1981 to June 1986. Measurements were not available for July 1986 to July 1993 when a new 1-ft Parshall flume was installed. Monthly measurements resumed and continued though February 2005.

As only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 1.5-ft and 1-ft Parshall flumes (Leupold and Stevens, 1987). Plots of the computed discharges from October 1967 to February 2005 are shown in figure B42. Listings of the water-level measurements and computed discharges are included in table B28 for October 1967 to July 1981; table B29 for May 1981 to June 1986; and table B30 for July 1993 to February 2005. Computed discharges from March 1974, after the large gap in record, until July 1981 are significantly lower than all other computed discharges. Although not noted in the records received from NDWR, the drop in discharge probably was the result of flow bypassing the flume.

A continuous-stage recorder was installed by the U.S. Geological Survey (USGS) on August 22, 1985, and maintained through September 30, 1994. The gage was reactivated in June 1996 and is routinely maintained as part of the current monitoring network. Daily mean discharges computed for the period of record have been included on the plot in figure B42 and listed in table B31. Photographs of the current flume and bench mark, and a selected reference mark established for this gage on June 3, 2004, are shown in figure B43.

Quarterly measurements of water temperature and specific conductance made at this gage from April 1997 to March 2005 were provided from Converse Consultants. These data are plotted on figure B44 and listed in table B32.

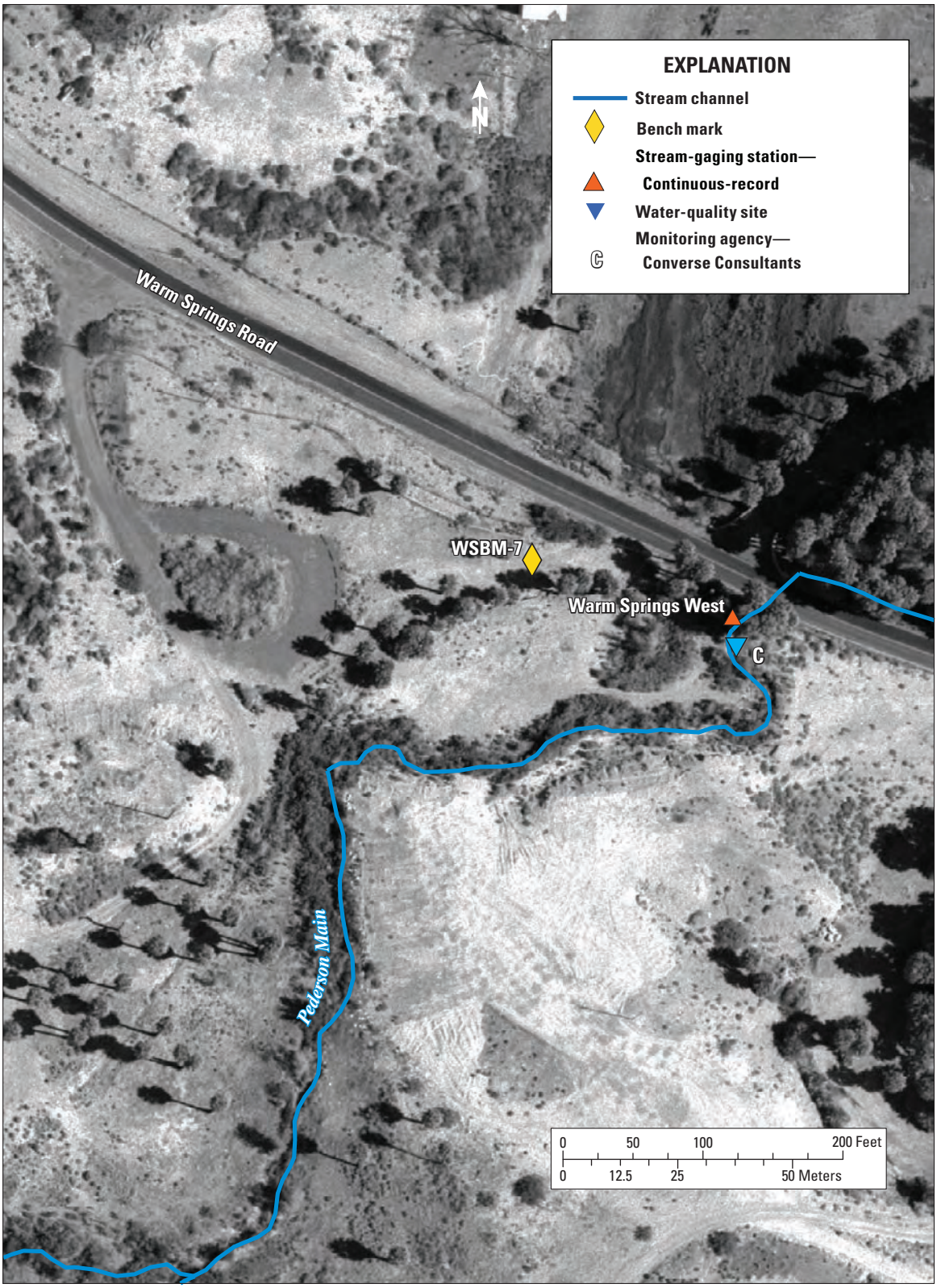


Figure B41. Location of continuous-record stream-gaging station 09415920 Warm Springs West and bench mark WSBM-7 in the Warm Springs area near Moapa, Nevada.

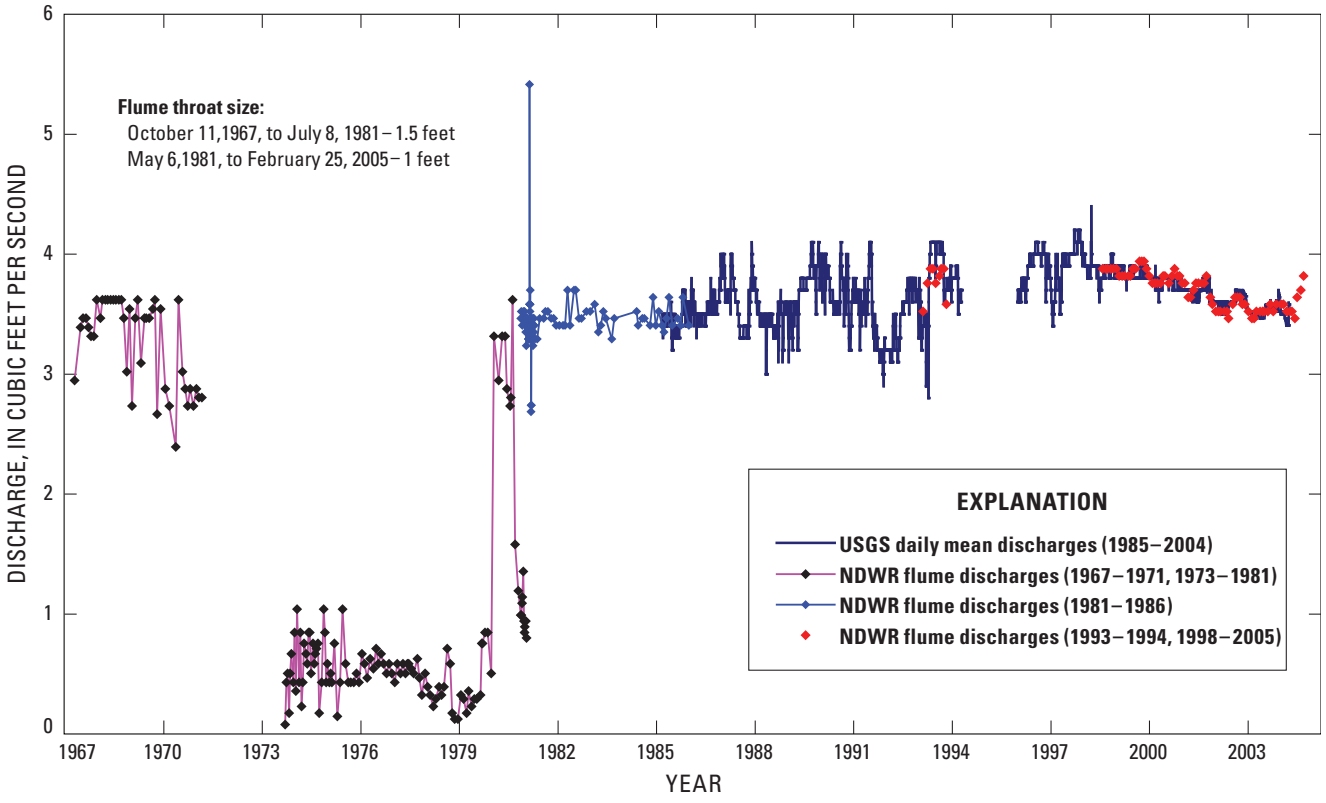


Figure B42. Instantaneous and daily mean discharges for continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada, 1967–2005. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov. NDWR, Nevada Division of Water Resources.

Table B28. Water levels and computed instantaneous discharges for Pederson Flume near Moapa, Nevada, 1967–81.

[Data from Nevada Division of Water Resources.]

Table B28 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B29. Water levels and computed instantaneous discharges for U.S. Fish and Wildlife Service flume near Moapa, Nevada, 1981–86.

[Data from Nevada Division of Water Resources.]

Table B29 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B30. Water levels and computed instantaneous discharges for U.S. Fish and Wildlife Service flume near Moapa, Nevada, 1993–2005.

[Water levels provided by Nevada Division of Water Resources.]

Table B30 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B31. Daily mean discharges for continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada, water years 1985–2004.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B31 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

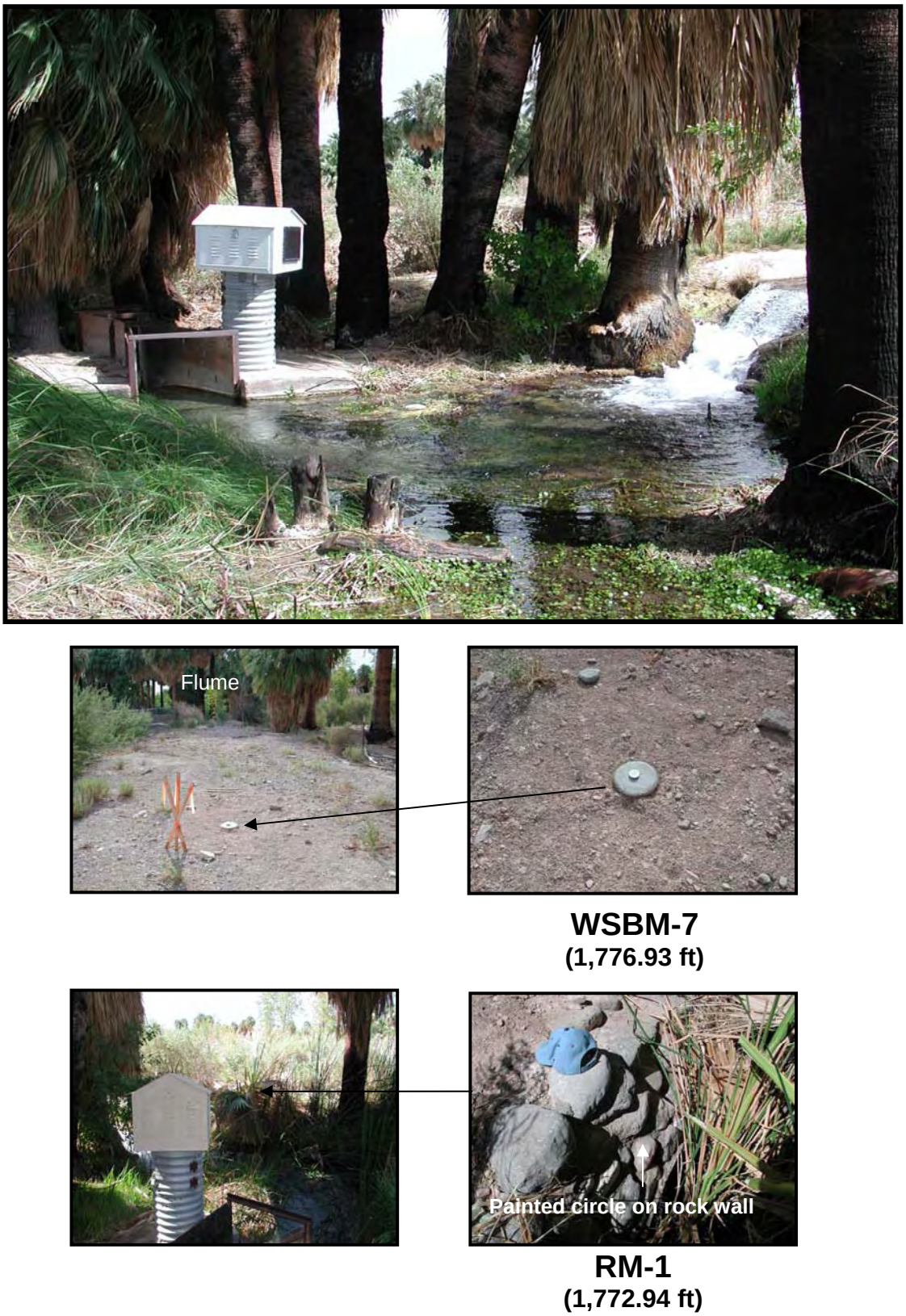


Figure B43. Location of bench mark WSBM-7 and reference mark RM-1 for continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada. The top picture shows the stream-gaging station photographed in 2001. Elevation of bench and reference marks in feet above NAVD 88.

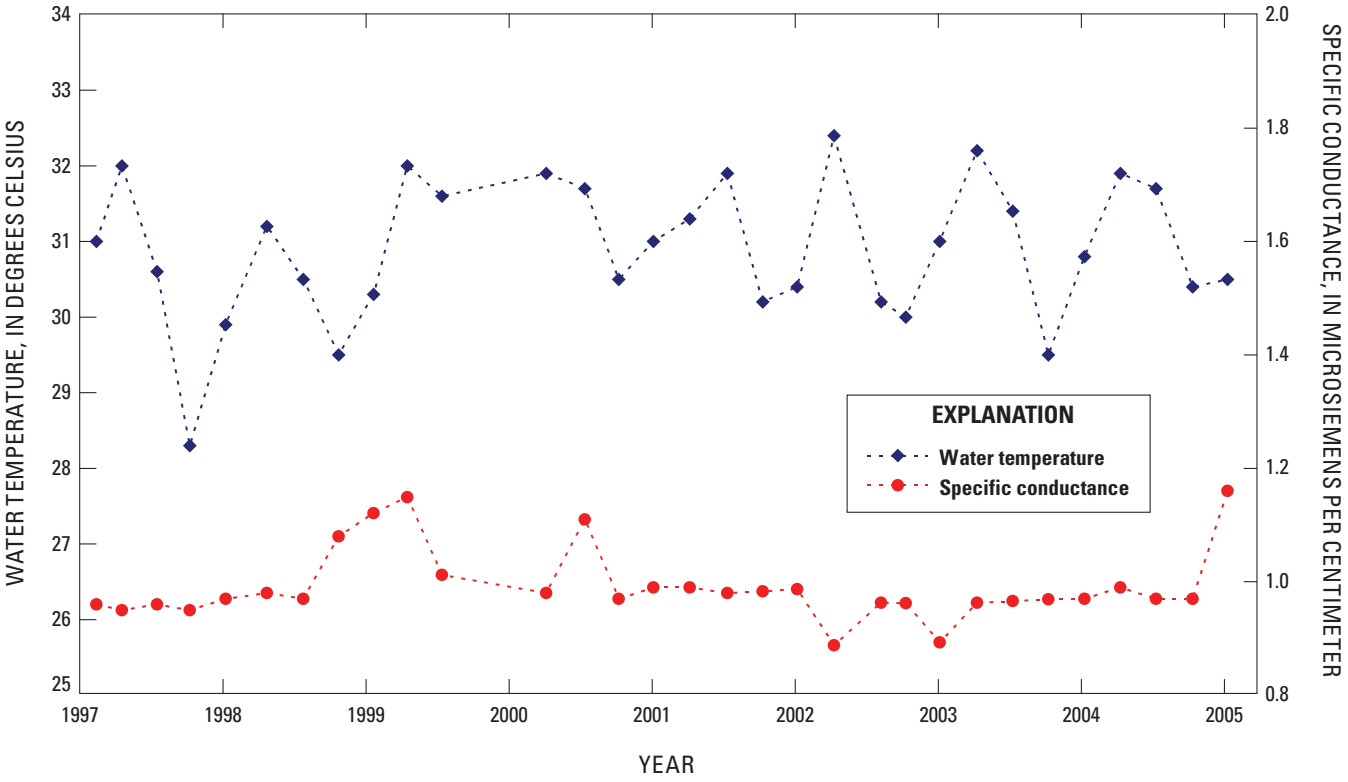


Figure B44. Water temperature and specific conductance measurements for continuous-record stream-gaging station 09415920 Warm. Springs West near Moapa, Nevada, 1997–2005. Data provided by Converse Consultants.

Table B32. Water-temperature and specific-conductance measurements by Converse Consultants at continuous-record stream-gaging station 09415920 Warm Springs West near Moapa, Nevada, 1997–2005.

Table B32 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Muddy Springs

The following site is included within this section:

09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada (1967–2005)

09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada

A 1-foot (ft) Parshall flume was installed on Muddy (Big) Springs on August 25, 1967, by the Nevada Division of Water Resources (NDWR). The flume was located approximately 0.1 mi downstream from the former Francis Taylor mansion (fig. B45) located on the L.D.S. Recreation Area. Although there are several springs in the area, most flow emanates from a large spring-fed pond on the northwest side of the mansion. Discharge from the spring-fed pond is directed around both sides of the mansion and converges just north of the large swimming pool. From there, flow generally drains to the south and joins with Muddy River about 0.5 mi downstream. Springflow is frequently diverted to fill the large swimming pool.

Data provided by NDWR show that water levels in the 1-ft flume were measured monthly from August 1967 to August 1971. Measurements were not available between September 1971 and February 1974 at which time a larger (3-ft) Parshall flume was installed. Monthly measurements resumed and continued until November 1987, although during July and August 1981, daily readings were recorded. Between December 1987 to July 1993 only six measurements were made. On July 16, 1993, a new 3-ft Parshall flume was installed and monthly measurements resumed. Because only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 1-ft and 3-ft Parshall flumes (Leupold and Stevens, 1987). Discharges for October 1967 to February 2005 are shown in figure B46. A complete listing of the water-level measurements and computed discharges is included in table B33.

A continuous-stage recorder was installed on the flume by the U.S. Geological Survey on August 22, 1985, and maintained until September 30, 1994. The gage was reactivated in June 1996 and is routinely maintained as part of the current monitoring network. Daily mean discharges computed for the period of record are also plotted on figure B46 and listed in table B34. Photographs of the current flume, bench mark, and selected reference marks established for this gage on June 3, 2004, are shown in figure B47.

Water samples were collected at this site on May 18, 2004, by Desert Research Institute (DRI) and analyzed for major ions, water temperature, and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B35.

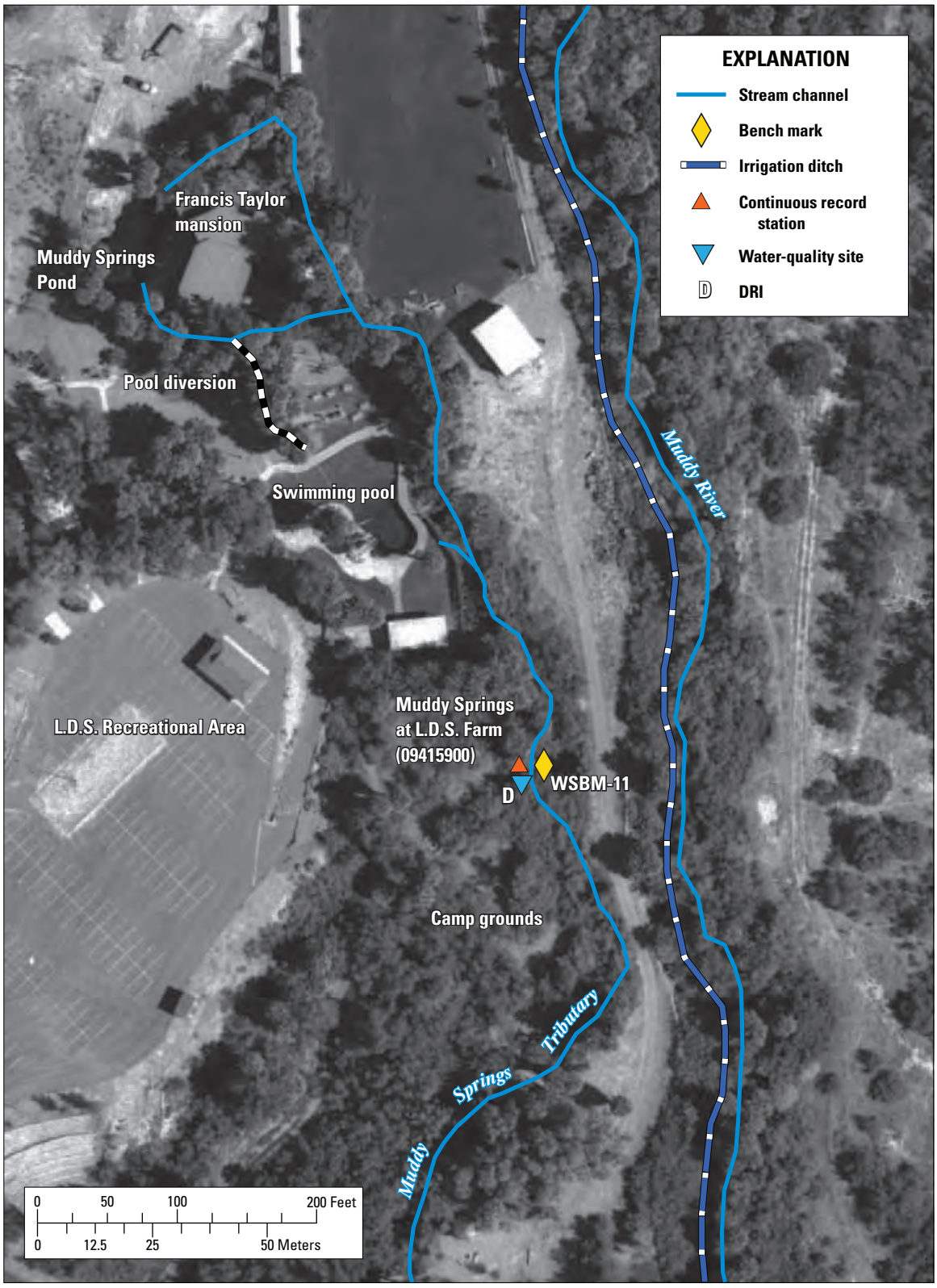


Figure B45. Location of Muddy Springs at Latter Day Saints (L.D.S.) Farm continuous-record stream-gaging station, L.D.S. Recreational Area, Desert Research Institute monitoring site, and bench mark WSBM-11 in the Warm Springs area near Moapa, Nevada.

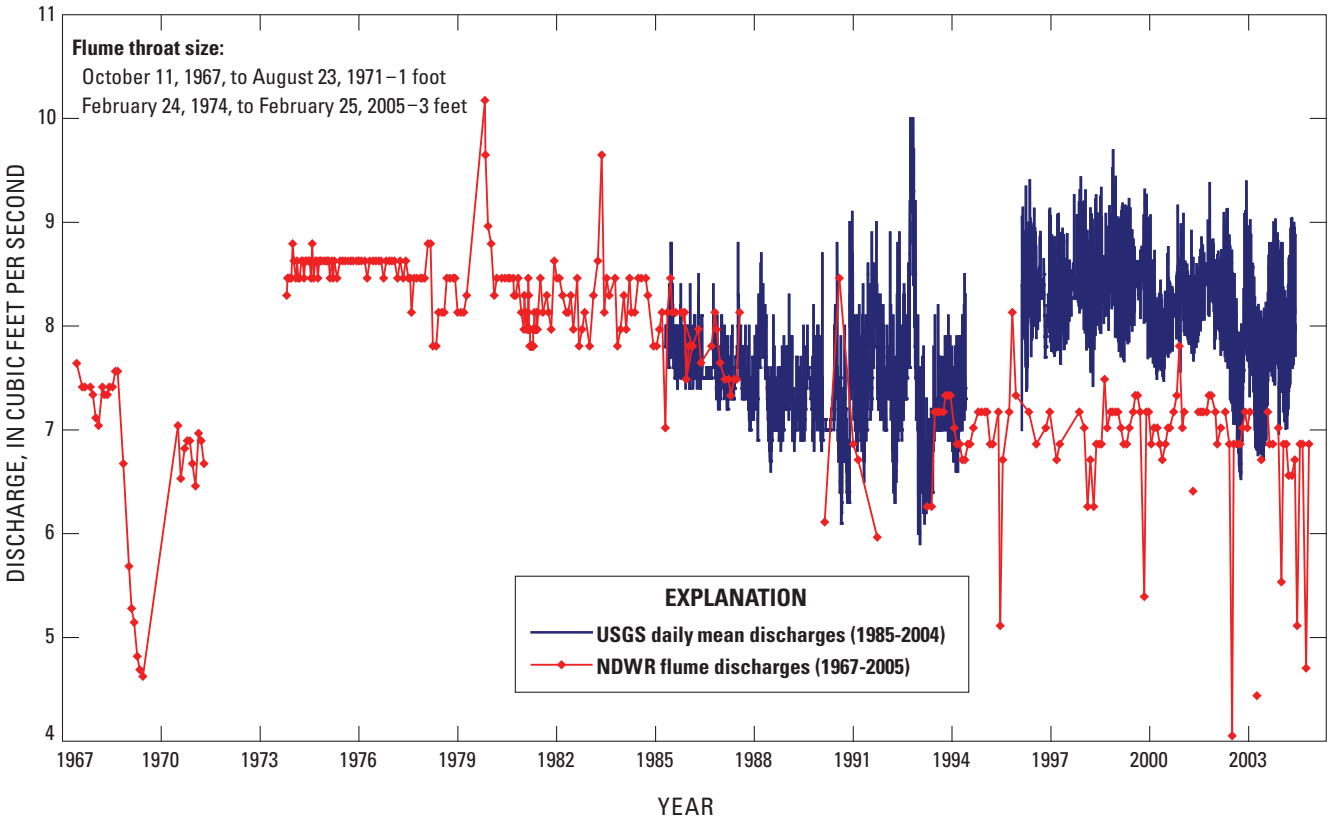


Figure B46. Instantaneous and daily mean discharge for continuous-record stream-gaging station 09415900 Muddy Springs at Latter Day Saints (L.D.S.) Farm near Moapa, Nevada, 1967–2005. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov. NWDR, Nevada Division of Water Resources.

Table B33. Water levels and computed instantaneous discharges for continuous-record stream-gaging 097415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada, 1967–2005.

Table B33 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B34. Daily mean discharges for continuous-record stream-gaging station 09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada, water years 1985–2004.

Table B34 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B47. Location of bench mark WSBM-11 and reference marks RM-3 and RM-5 at stream-gaging station 09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada. Photographed June 3, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Table B35. Water-quality data collected by Desert Research Institute for continuous-record stream-gaging at station 09415900 Muddy Springs at L.D.S. Farm near Moapa, Nevada, May 18, 2004.

Table B35 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Apcar (Pipeline Jones) Springs

The following sites are included within this section:

Garden Ditch Flume (1978–92)
North Tributary Water-Quality Site (1997–2005)
South Tributary Water-Quality Site (1997–2005)
Apcar Pumphouse Water-Quality Site (1997–2004)

Apcar (Pipeline Jones) Springs near Moapa, Nevada

Apcar Springs is about 0.1 mi west of Warm Springs Road in the south-central part of the Warm Springs area (fig. 2). Currently, two channels, the North Tributary and South Tributary, discharge water from the Apcar Spring area. The North Tributary drains to the northeast through a culvert under Warm Springs Road (fig. B48). Downstream of Warm Springs Road, flow continues in a dirt channel to the north for about 0.1 mi and then turns to the northeast. About 0.2 mi farther, the channel turns to the southeast and continues until it is just south of the confluence of Muddy Springs tributary and Muddy River (fig. 2). Most of the ditch between Warm Springs Road and the confluence is thickly overgrown. Near the confluence, flow from the ditch is directed into an old concrete irrigation trough that distributes water to the southeast fields, ultimately terminating into Refuge Stream about 0.4 mi downstream (fig. 2). The South Tributary generally drains to the east, eventually becoming Apcar Stream, which terminates into Refuge Stream about 0.55 mi downstream from the Warm Springs Road crossing (fig. 2). In 1960, a pump house (fig. B48) was constructed at the springs by the then Moapa Valley Water Company to supply water for residential and commercial areas within the southern towns of Moapa Valley.

A 9-inch (in.) Parshall flume was installed on Garden Ditch on January 4, 1978, by the Nevada Division of Water Resources (NDWR). This flume is reported to have been located on the North Tributary just upstream of the culvert at Warm Springs Road (fig. B48) (Testolin and others, 1993). The flume is no longer there; however, remnant pieces of concrete litter the area. Data provided by NDWR show that water-level measurements for the 9-in flume generally were made monthly from January 1978 until June 1981 and daily from July through September 1981. Monthly measurements resumed in October 1981 and ended in November 1987. No measurements were made from December 1987 until June 1990. From June 1990 to June 1992, only six measurements were made. No measurements are available after June 26, 1992. Because only water-level measurements were provided by NDWR, discharge rates were computed using a standard equation for the 9-in Parshall flume (Leupold and Stevens, 1987). Computed discharges from January 1978 to June 1992 are shown in figure B49. Water-level measurements and computed discharges are given in table B36.

In April 1997, Converse Consultants, on contract with Nevada Power Company, began quarterly field measurements of water temperature and specific conductance on the North and South Tributaries (fig. B48). Measurements for the North and South Tributary sites through March 2005 were provided by Converse Consultants and are plotted in figures B50 and B51 and listed in tables B37 and B38, respectively.

In December 1997, the Moapa Valley Water District (MVWD) began collecting water samples from a spigot at the Apcar Springs old pump house (fig. B48). Water samples generally are collected annually by MVWD and analyzed by Southwest Analytical, Inc., for major ions, trace metals, and selected chemical parameters (pH, specific conductance, total dissolved solids, and alkalinity). Although a new pump house was constructed during the summer of 2004 (fig. B48), all water-quality data provided by MVWD were from the original pump house (Susan Rose, Moapa Valley Water District, oral commun., 2005). The results of the analyses of the samples collected from December 1997 to August 2004 are given in table B39.

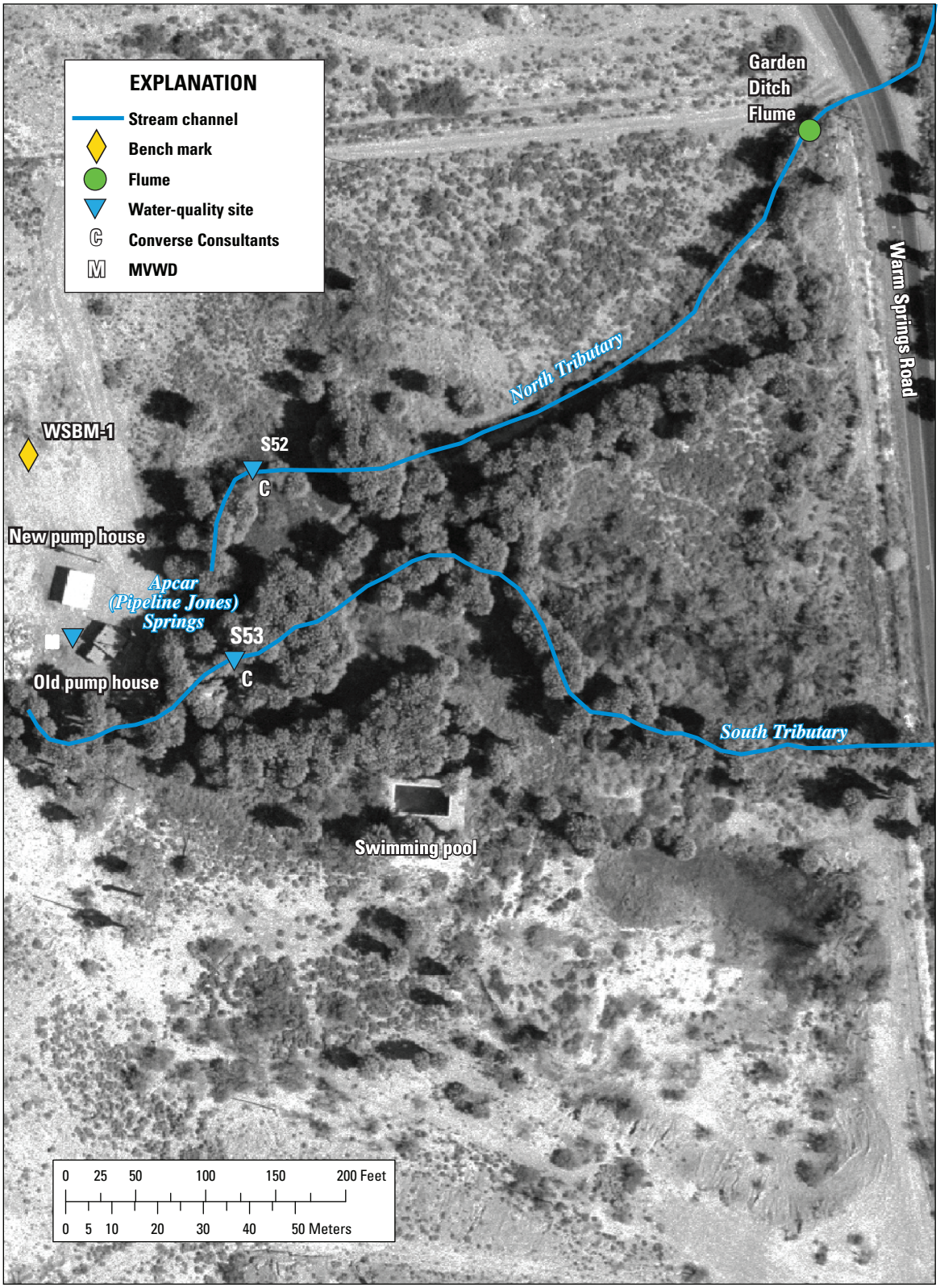


Figure B48. Location of Apcar (Pipeline Jones) Springs, pump houses, monitoring sites, and bench mark WSBM-1 in the Warm Springs area near Moapa, Nevada.

Garden Ditch Flume at Apcar (Pipeline Jones) Springs near Moapa, Nevada

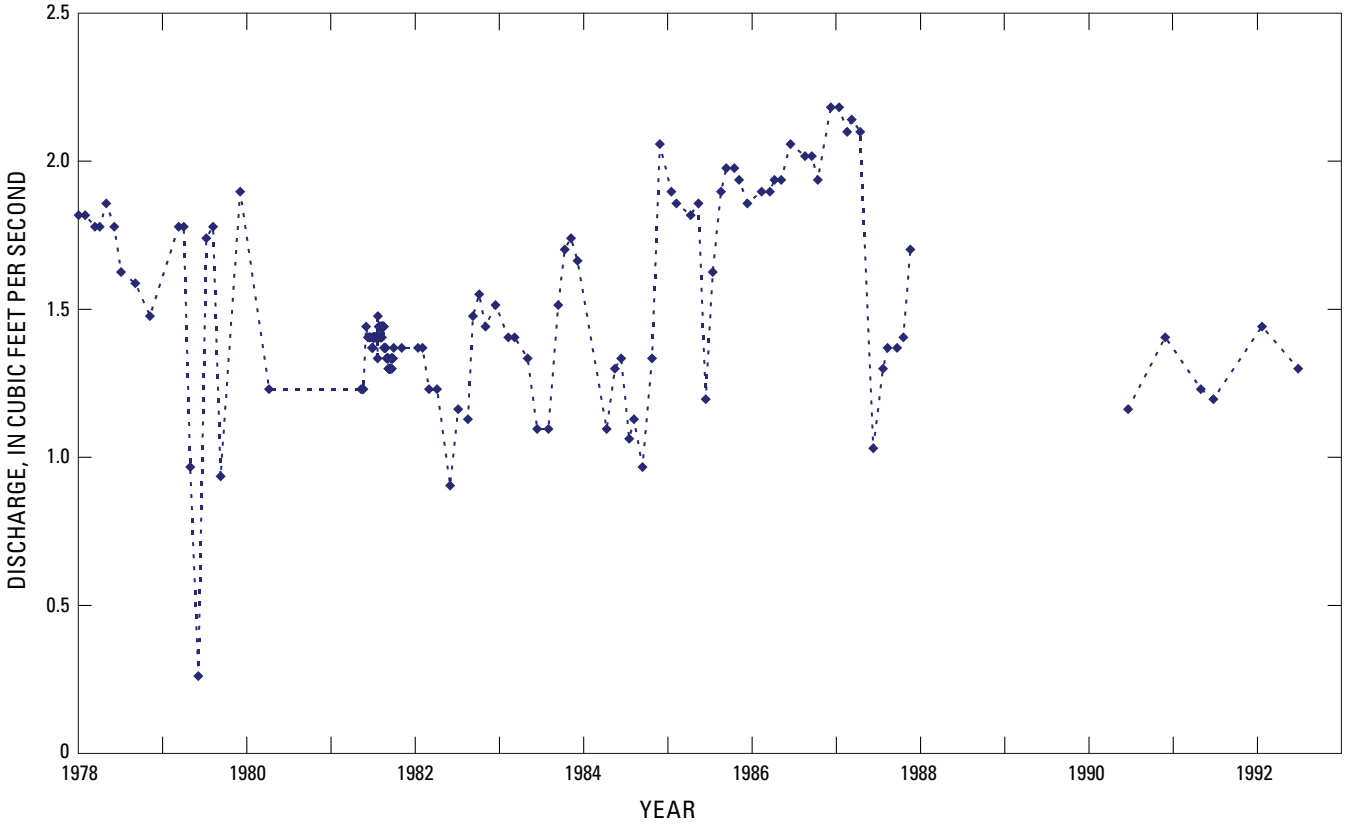


Figure B49. Instantaneous discharges computed from water-level measurements provided by Nevada Division of Water Resources for Garden Ditch Flume on North Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1978–92. Data provided by Nevada Division of Water Resources.

Table B36. Instantaneous discharges computed from water-level measurements for Garden Ditch Flume on North Tributary at Apcar (Pipelne Jones) Springs near Moapa, nevada, 1978–92.

[Data provided by Nevada Division of Water Resources.]

Table B36 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Water-Quality Sites at Apcar (Pipeline Jones) Springs near Moapa, Nevada

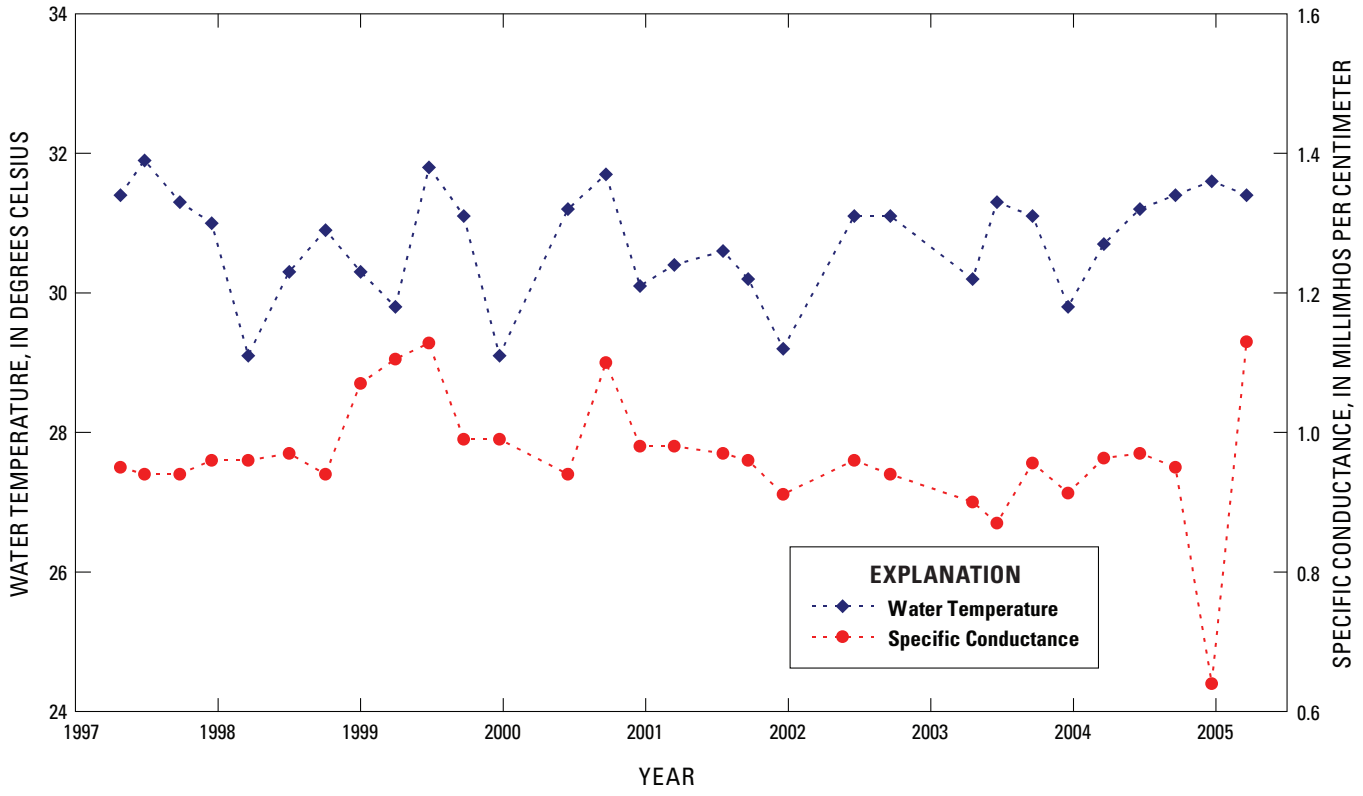


Figure B50. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S52 on North Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–32005.

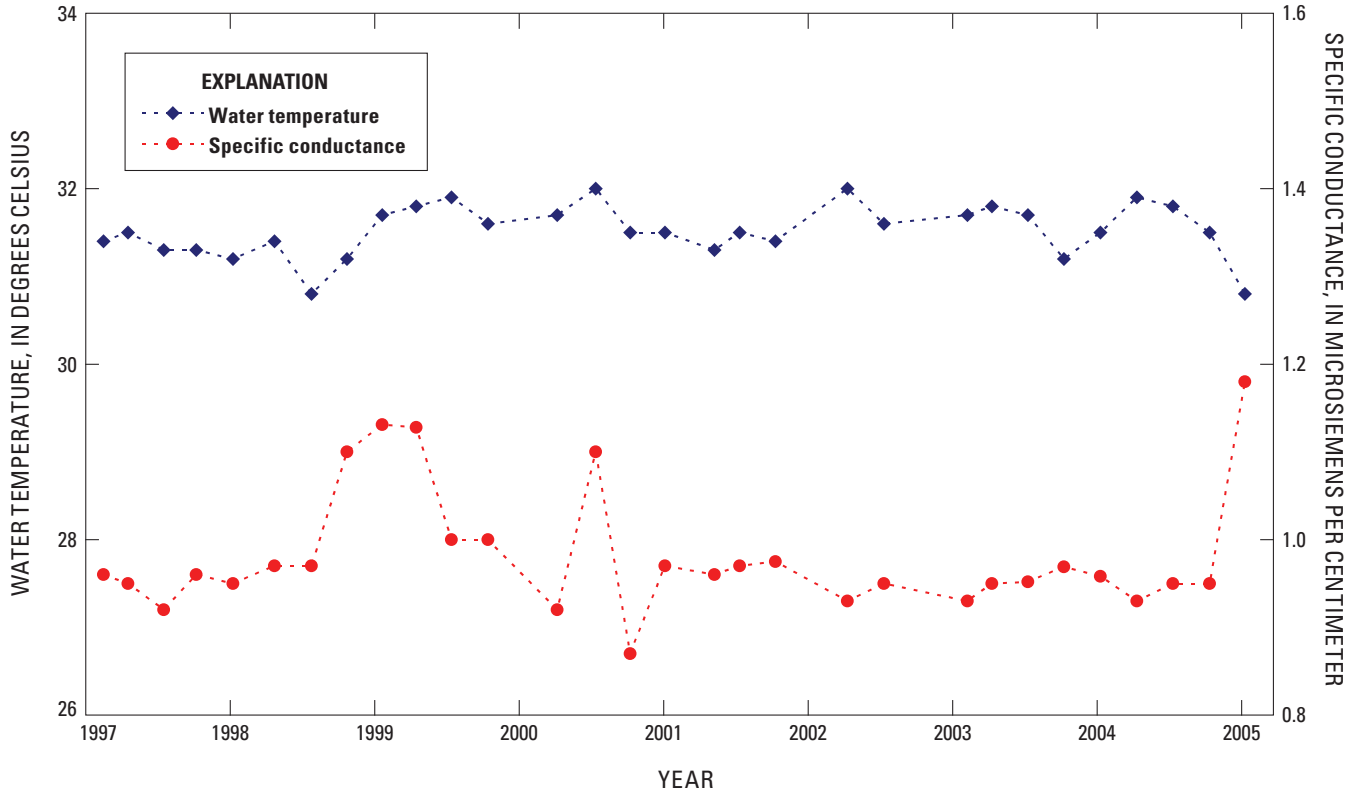


Figure B51. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S53 on South Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–2005..

Table B37. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S52 on North Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–2005.

Table B37 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B38. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S53 on South Tributary at Apcar (Pipeline Jones) Springs near Moapa, Nevada, 1997–2005.

Table B38 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B39. Water-quality data for pump house at Apcar (Pipeline Jones) Springs, near Moapa, Nevada, 1997–2004.

Table B39 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Baldwin Springs

The following sites are included within this section:

Baldwin Cuts Flume (1967–85)
09415875 Baldwin Springs Flume near Moapa, Nevada (1967–2005)
Baldwin Springs Flume Water-Quality Site (1997–2005)
Baldwin Springs Pump House Water-Quality Sites (1997–2004)

Baldwin Springs near Moapa, Nevada

Baldwin Springs is about 0.2 mi north of Warm Springs Road and about 0.5 mi west of the L.D.S. Recreation Area (fig. 2). Discharge from the springs generally trends to the northeast, and contributes most of the flow of the South Fork Muddy River (fig. B52). In 1974, a pump house was constructed in the spring area by the Moapa Valley Water District (MVWD) to supply additional water to southern areas of the valley. Water not diverted at the springs is discharged directly into the channel about 20 ft north of the pump house (fig. B52).

A 9-inch (in.) Parshall flume, called Baldwin Cuts Flume, was installed at Baldwin Springs on October 11, 1967, by the Nevada Division of Water Resources (NDWR). The exact location of the flume is unknown, but it is believed to have been installed just downstream from the pump house. Data provided by NDWR show that water-level measurements for the 9-in. flume generally were made monthly October 1967 to August 1971, February 1974 to June 1981, and October 1981 to August 1985. During July, August, and September 1981, daily measurements were recorded. Because only water-level measurements were provided by NDWR, discharge rates were computed using a standard equation for the 9-in. Parshall flume (Leupold and Stevens, 1987). Computed discharges for October 1967 to August 1985 are shown in figure B53. A complete listing of the water-level measurements and computed discharges is given in table B40.

About the same time that the Baldwin Cuts flume was installed, a 1-foot (ft) Parshall flume, the Baldwin Springs Flume, was installed by NDWR on the South Fork Muddy River about 0.25 mi downstream from the pump house and about 75 ft north of Kimball Road (fig. B54). Data provided by NDWR show that monthly readings generally were made from October 1967 to August 1971. Similar to Baldwin Cuts flume, no measurements were made from September 1971 to January 1974. On February 22, 1974, a larger 2-ft Parshall flume was installed and monthly measurements were made until July 1984. On July 15, 1993, a new 2-ft Parshall flume was installed and monthly measurements were made through February 2005. Because only water-level measurements were provided by NDWR, discharge rates for this site were computed using standard equations for the 1-ft and 2-ft Parshall flumes (Leupold and Stevens, 1987). Computed discharges from October 1967 to February 2005 are given in figure B53, which also includes the measurements computed for the Baldwin Cuts Flume. A complete listing of the water-level measurements and computed discharges is given in table B41.

In April 1997, Converse Consultants, on contract with Nevada Power Company, began making quarterly field measurements of water temperature and specific conductance at the Baldwin Springs Flume. Measurements were compiled through March 2005 and are plotted in figure B55 and listed in table B42.

On June 2, 2004, the U.S. Geological Survey established bench mark WSBM-12 (table 2) and several reference marks (table 3) at Baldwin Springs Flume to determine water-surface elevations. Photographs of the flume, bench mark, and selected reference marks are included in figure B56.

In December 1997, the Moapa Valley Water District (MVWD) began collecting water samples from a spigot at the Baldwin Springs pump house (fig. B52). Water samples generally were collected annually by MVWD and analyzed by Southwest Analytical, Inc. for major ions, trace metals, and selected chemical and physical parameters (pH, specific conductance, total dissolved solids, and alkalinity). The results of the analyses of samples collected from December 1997 to August 2004 were provided by the MVWD are given in table B43.

On January 12 and May 18, 2004, water samples were collected at the pump house by Desert Research Institute and analyzed for major ions, selected chemical and physical parameters (pH, specific conductance, and dissolved solids), and stable hydrogen and oxygen isotopes. The results of the analyses are shown in table B44.

Baldwin Cuts Flume near Moapa, Nevada

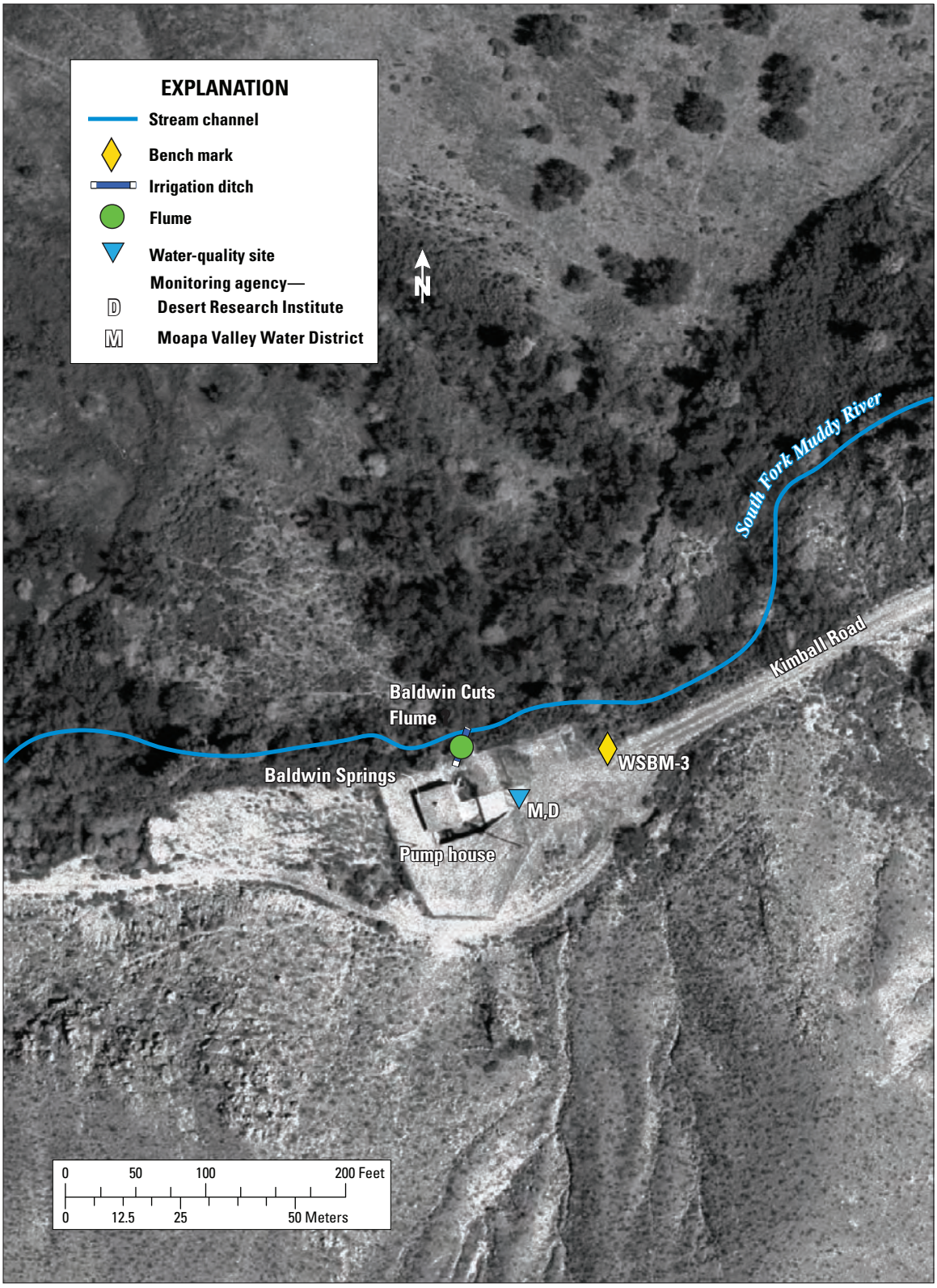


Figure B52. Location of Baldwin Springs, pump house, monitoring sites, and bench mark WSBM-3 in the Warm Springs area near Moapa, Nevada.

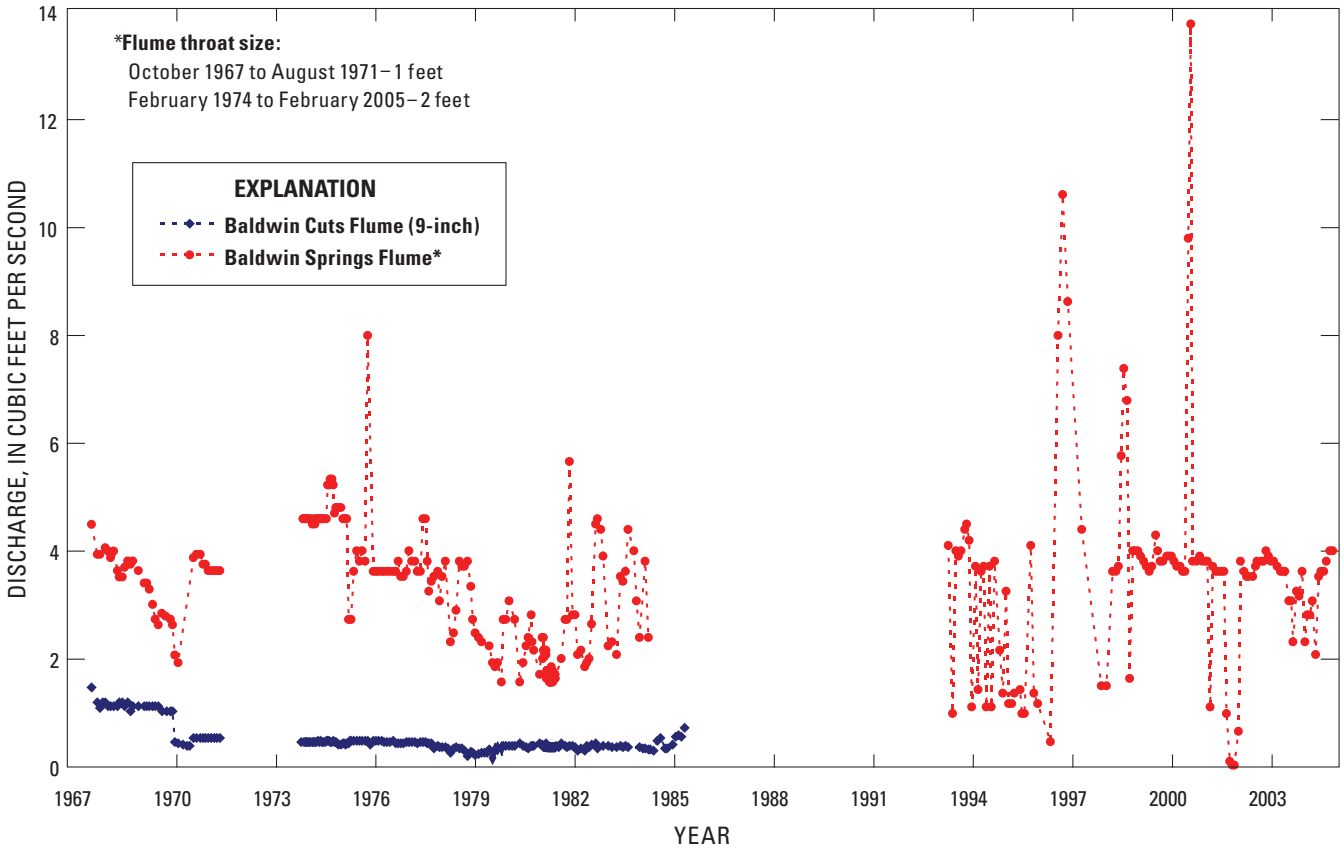


Figure B53. Instantaneous discharges computed from water-level measurements provided by Nevada Division of Water Resources for Baldwin Cuts and Baldwin Springs Flumes near Moapa, Nevada, 1967–2005.

Table B40. Instantaneous discharges computed from water-level measurements for Baldwin Cuts Flume near Moapa, Nevada, 1967–85.

Table B40 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

09415875 Baldwin Springs Flume near Moapa, Nevada

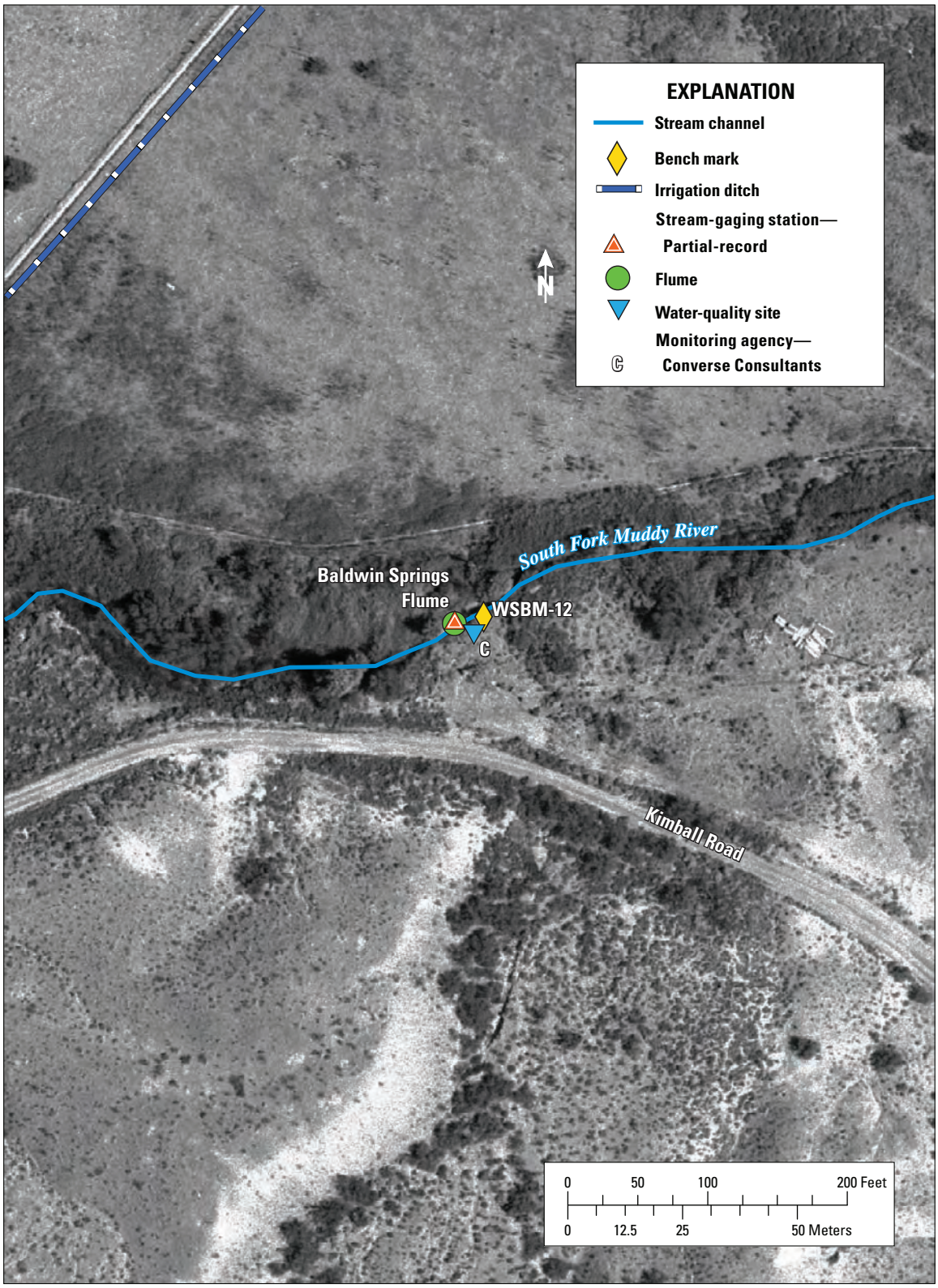


Figure B54. Location of Baldwin Springs Flume and bench mark WSBM-12 in the Warm Springs area near Moapa, Nevada.

Table B41. Water levels and computed instantaneous discharges for partial-record stream-gaging station 09415875 Baldwin Springs Flume near Moapa, Nevada, 1967–2005.

Table B41 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

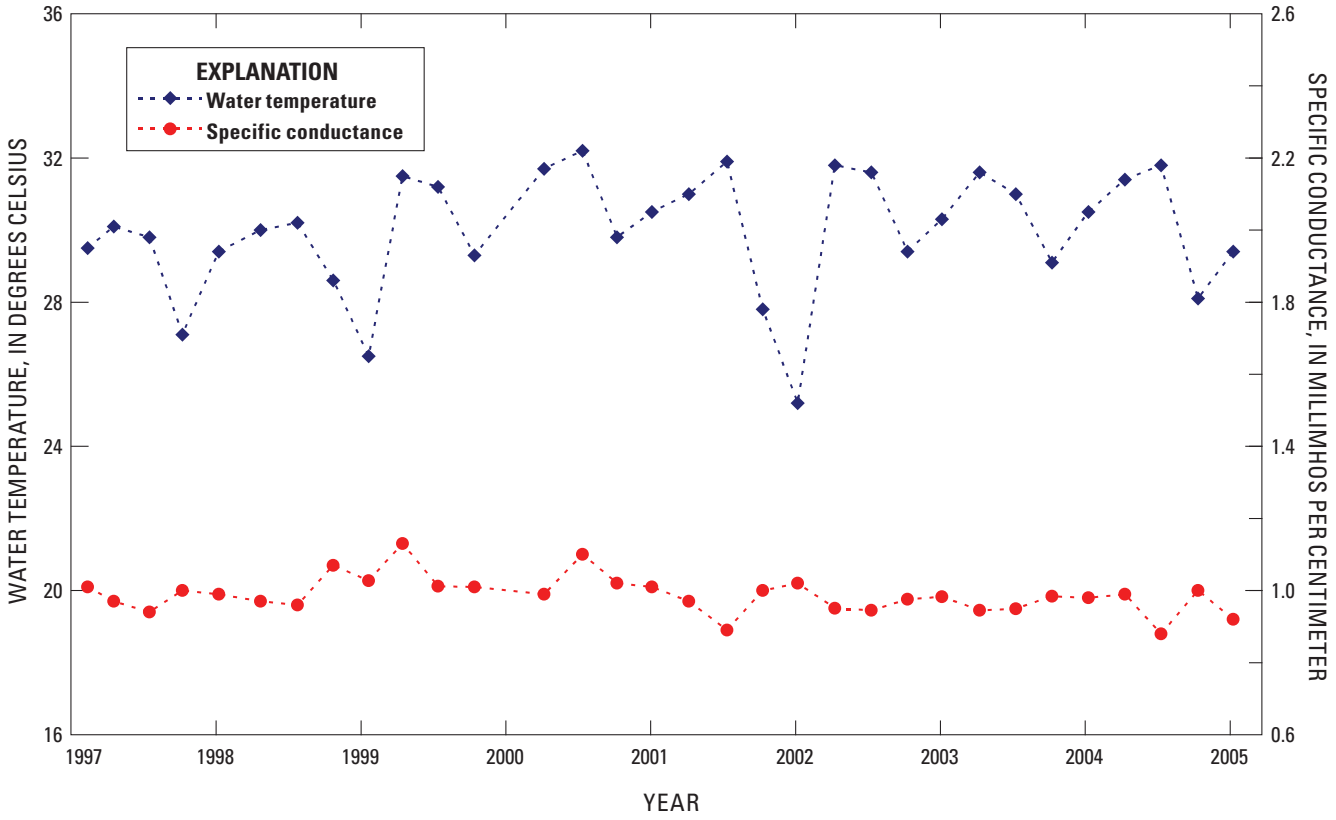


Figure B55. Water-temperature and specific-conductance measurements provided by Converse Consultants for Baldwin Springs Flume near Moapa, Nevada, 1997–2005.

Table B42. Water-temperature and specific-conductance measurements provided by Converse Consultants for Baldwin Springs Flume near Moapa, Nevada, 1997–2005.

Table B42 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

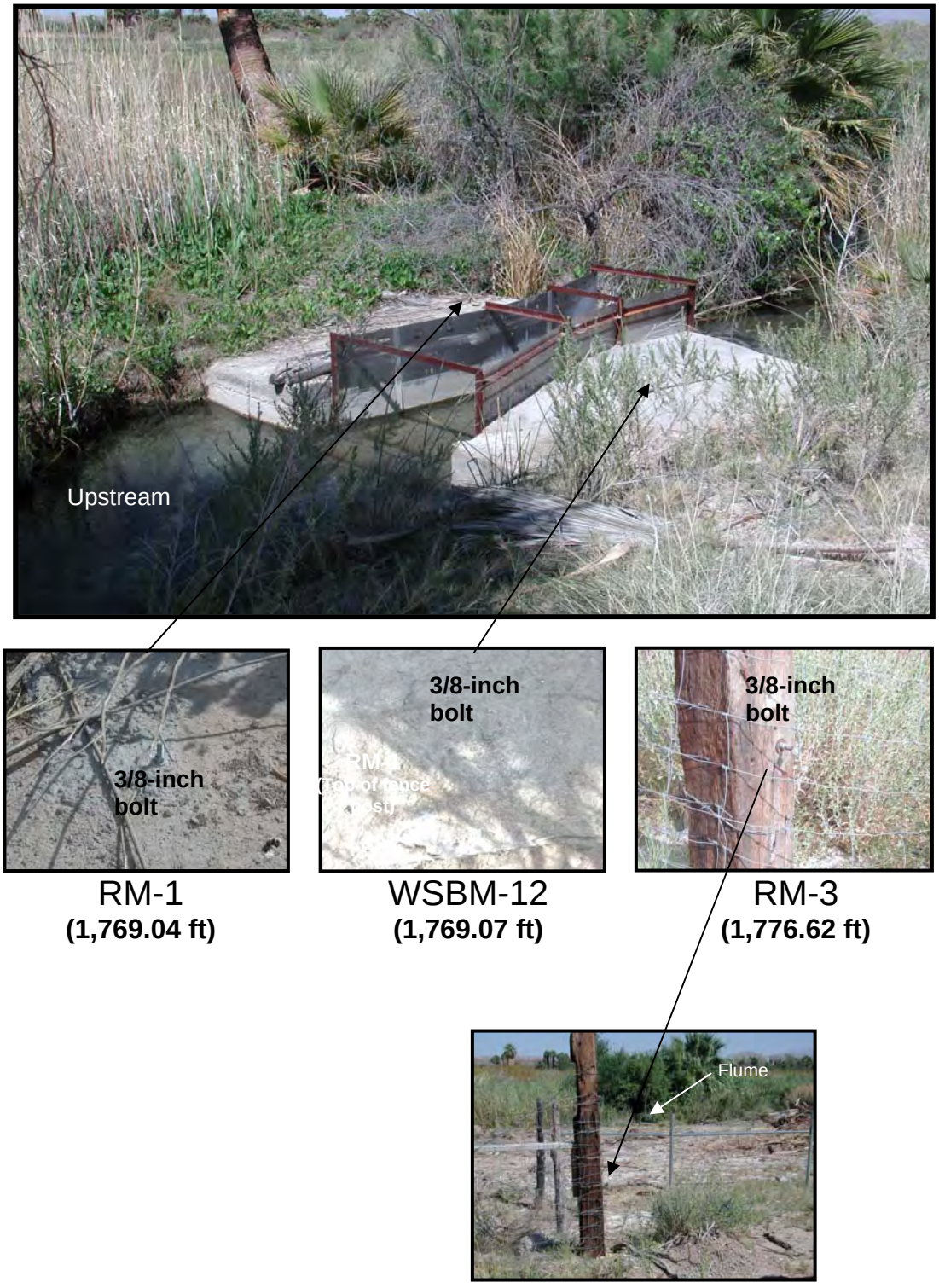


Figure B56. Location of bench mark WSBM-12 and reference marks RM-1 and RM-3 for Baldwin Springs Flume in the Warm Springs area near Moapa, Nevada. Photographed June 2, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Water-Quality Sites at Baldwin Spring Pump House near Moapa, Nevada

Table B43. Water-quality data provided by the Moapa Valley Water District for pump house at Baldwin Springs near Moapa, Nevada, 1997–2004.

Table B43 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B44. Water-quality data provided by the Desert Research Institute for pump house at Baldwin Springs near Moapa, Nevada, January 12 and May 18, 2004.

Table B44 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Cardy Lamb Springs

The following sites are included within this section:

Baldwin House Spring #1 (South) Flume (1967–80)
Baldwin House Spring #2 (North) Flume (1967–80)
364327114430801 Muddy River Springs 10 (1986–2004)
Water-Quality Site (S-15) at Cardy Lamb Pond (1997–2005)

Cardy Lamb Springs near Moapa, Nevada

Cardy Lamb Springs is about 0.1 mi east of Warm Springs Road and about 0.8 mi west-northwest of the L.D.S. Recreation Area (fig. 2). Discharge from this area generally trends to the southeast, but past agricultural and recreational developments in the area have modified or filled any pre-existing natural drainage channels. An intricate network of concrete irrigation ditches installed during the 1950s and 1960s distributed most of the flow from the springs onto agricultural fields to the east (fig. 2). Sometime during 1980, a swimming pond and a bathhouse were constructed in the area in an attempt to develop a recreational facility (fig. B57). The pond was constructed over one of the spring discharge areas and a drainage pipe was installed at the northeast wall to allow the pond to drain into the irrigation drainage network (fig. B57). Although the recreational area never materialized, the pond is still used today by the current owners to irrigate fields to the east for livestock grazing.

On October 11, 1967, two 6-inch Parshall flumes (Baldwin House Spring #1- South and Baldwin House Spring #2-North) were installed by the Nevada Division of Water Resources (NDWR) as part of a program to monitor spring discharges within the Warm Springs area. The exact location of the two flumes is unknown, but they are believed to have been located between the pond and the irrigation ditch to the east (fig. B57). Data provided by NDWR show that water-level measurements for flumes #1 and #2 generally were made monthly from October 1967 to May 1980 and October 1967 to April 1980, respectively, except during September 1971 to January 1974. Since the last measurement at both sites coincides with the installation date of the pond, the flumes are believed to have been removed at that time. Because only water-level measurements were provided by NDWR, discharge rates were computed using a standard equation for the 6-inch Parshall flumes (Leupold and Stevens, 1987). Plots of the computed discharges for both flumes from October 1967 to May 1980 are shown in figure B58. Complete listings of the water-level measurements and computed discharges for Spring #1 and Spring #2 are given in tables B45 and B46, respectively.

The partial-record station at Muddy River Springs 10 (M-10) was established by the U.S. Geological Survey (USGS) on January 28, 1986 and is located about 250 ft east of the swimming pond (fig. B57). The measurement site is inside an old concrete irrigation ditch about 2 ft downstream from a small concrete culvert. Most of the flow at Muddy River Springs 10 originates from flow within the swimming pond that discharges through the drainage pipe. Water exiting the drainage pipe flows into a small pond approximately 10 ft upstream of the concrete culvert and merges with flows from small springs to the southwest. Periodic discharge measurements have been made by the USGS since January 1986. Discharge measurements for the period of record are plotted in figure B59 and listed in table B47. Photographs of the bench mark, reference points, and selected reference marks established for the Muddy River Springs 10 monitoring site on June 3, 2004, are shown in figure B60.

In April 1997, Converse Consultants, on contract with Nevada Power Company, began quarterly field measurements of water temperature and specific conductance at site S15 (fig. B57) at the south end of the swimming pond. Measurements were compiled through March 2005 and are plotted in figure B61 and listed in table B48.

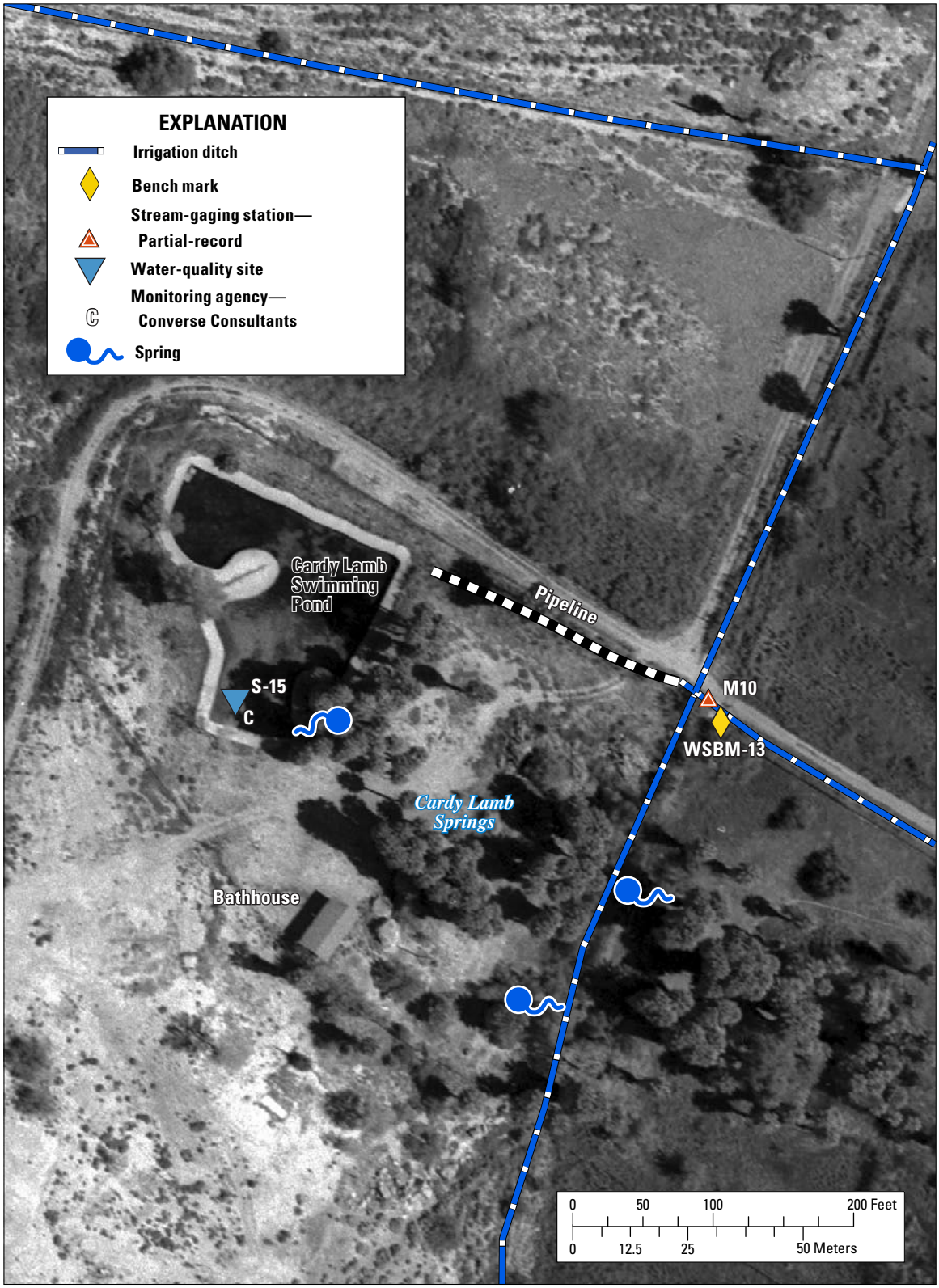

Figure B57. Location of Cardy Lamb Springs swimming pond, bench mark WSBM-13, and monitoring sites in the Warm Springs area near Moapa, Nevada.

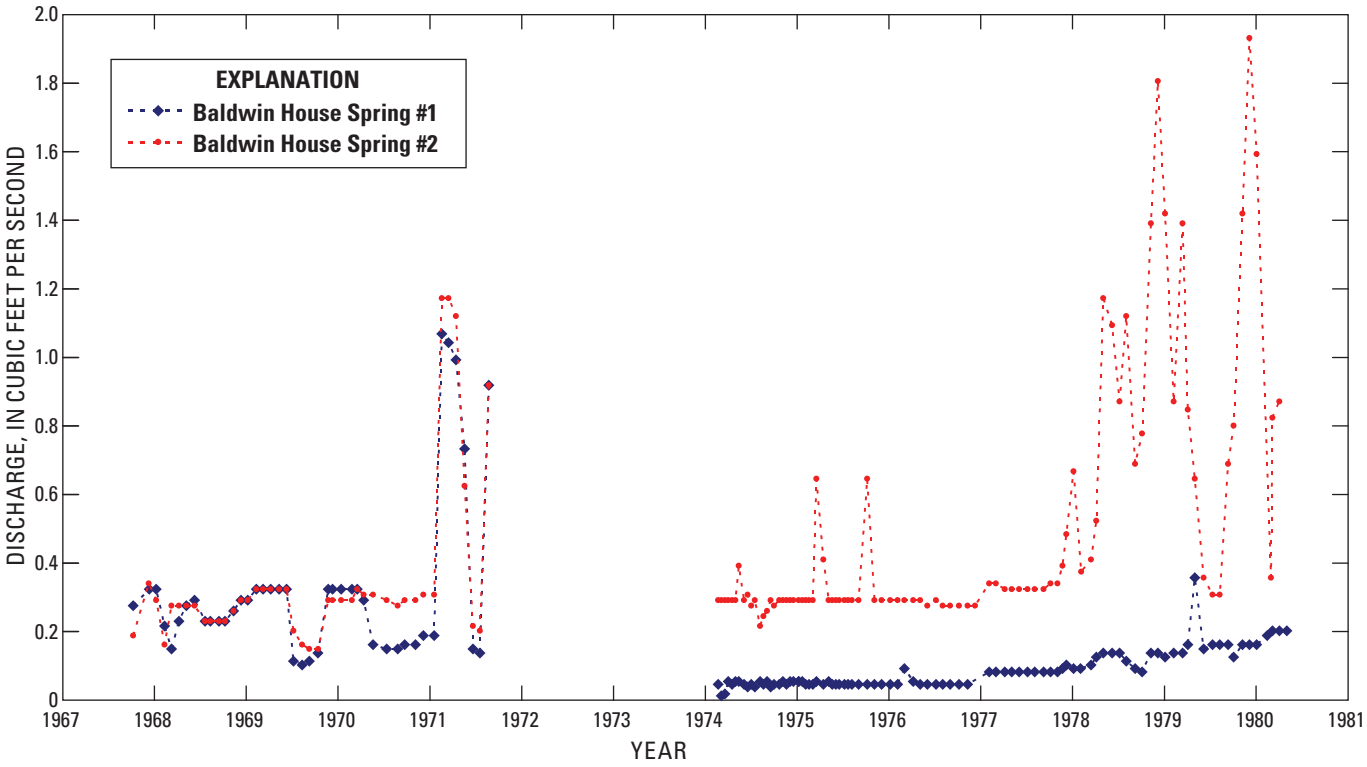

Figure B58. Instantaneous discharges for Baldwin House Springs #1 and #2 flumes at Cardy Lamb Springs near Moapa, Nevada, 1967–80. Data provided by Nevada Division of Water Resources.

Baldwin House Spring #1 (South) Flume near Moapa, Nevada

Table B45. Water levels and computed instantaneous discharges for Baldwin House Spring #1 (South) Flume at Cardy Lamb Springs near Moapa, Nevada, 1967–80.

Table B45 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Baldwin House Spring #2 (North) Flume near Moapa, Nevada

Table B46. Water levels and computed instantaneous discharges for Baldwin House Spring #2 (Nouth) Flume at Cardy Lamb Springs near Moapa, Nevada, 1967–80.

Table B46 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

364327114430801 Muddy River Springs 10 (M-10) near Moapa, Nevada

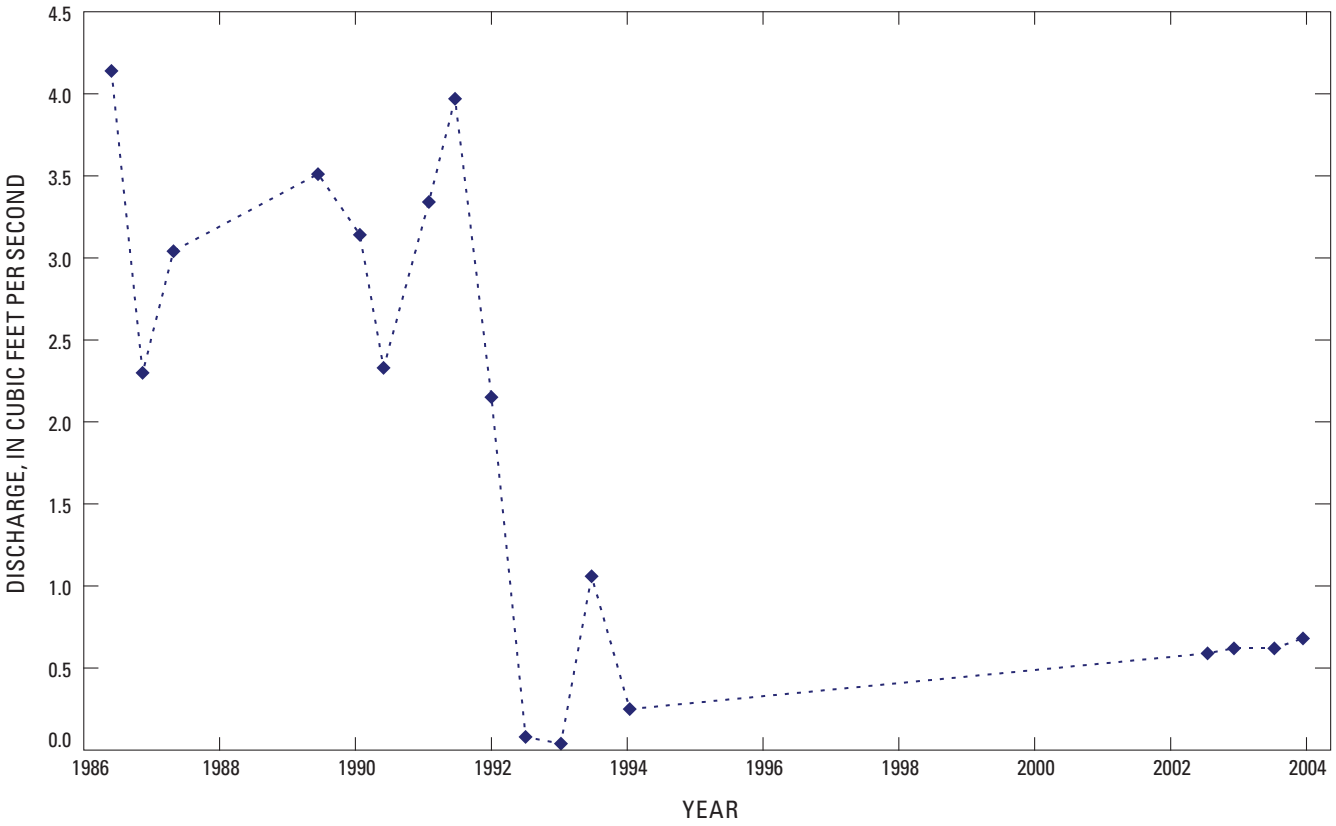

Figure B59. Periodic discharge measurements for partial-record stream-gaging station 364327114430801 Muddy River Springs 10 (M-10) at Cardy Lamb Springs near Moapa, Nevada, 1986–2004.

Table B47. Periodic discharge measurements for partial-record stream-gaging station 364327114430801 Muddy River Springs 10 (M-10) at Cardy Lamb Springs near Moapa, Nevada, 1986–2004.

Table B47 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

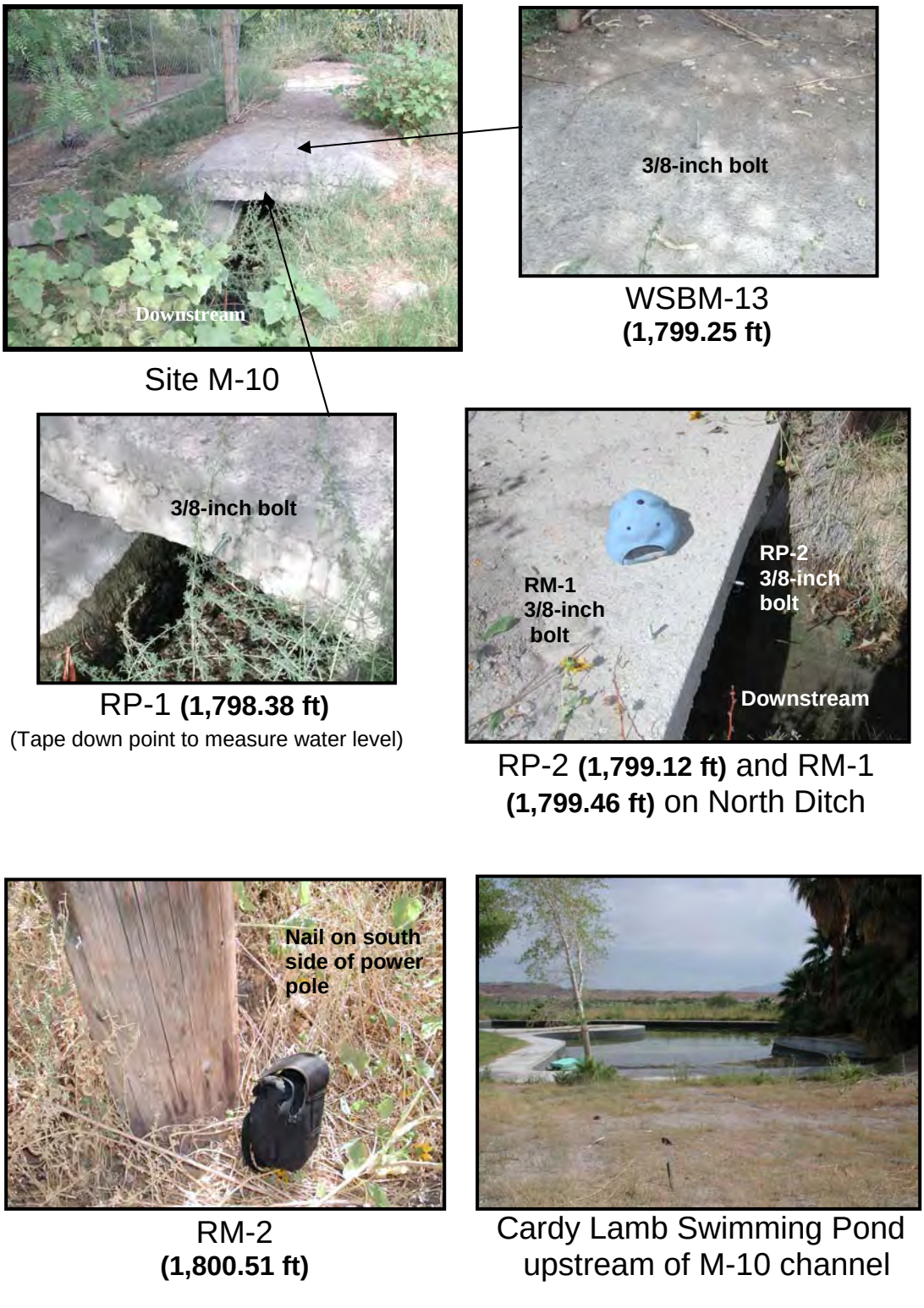

Figure B60. Location of bench mark WSBM-13, reference points RP-1 and RP-2, and reference marks RM-1 and RM-2 for partial-record station Muddy River Springs 10 (M-10) in the Warm Springs area near Moapa, Nevada. Photographed June 3, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Water-Quality Site at Cardy Lamb Pond near Moapa, Nevada

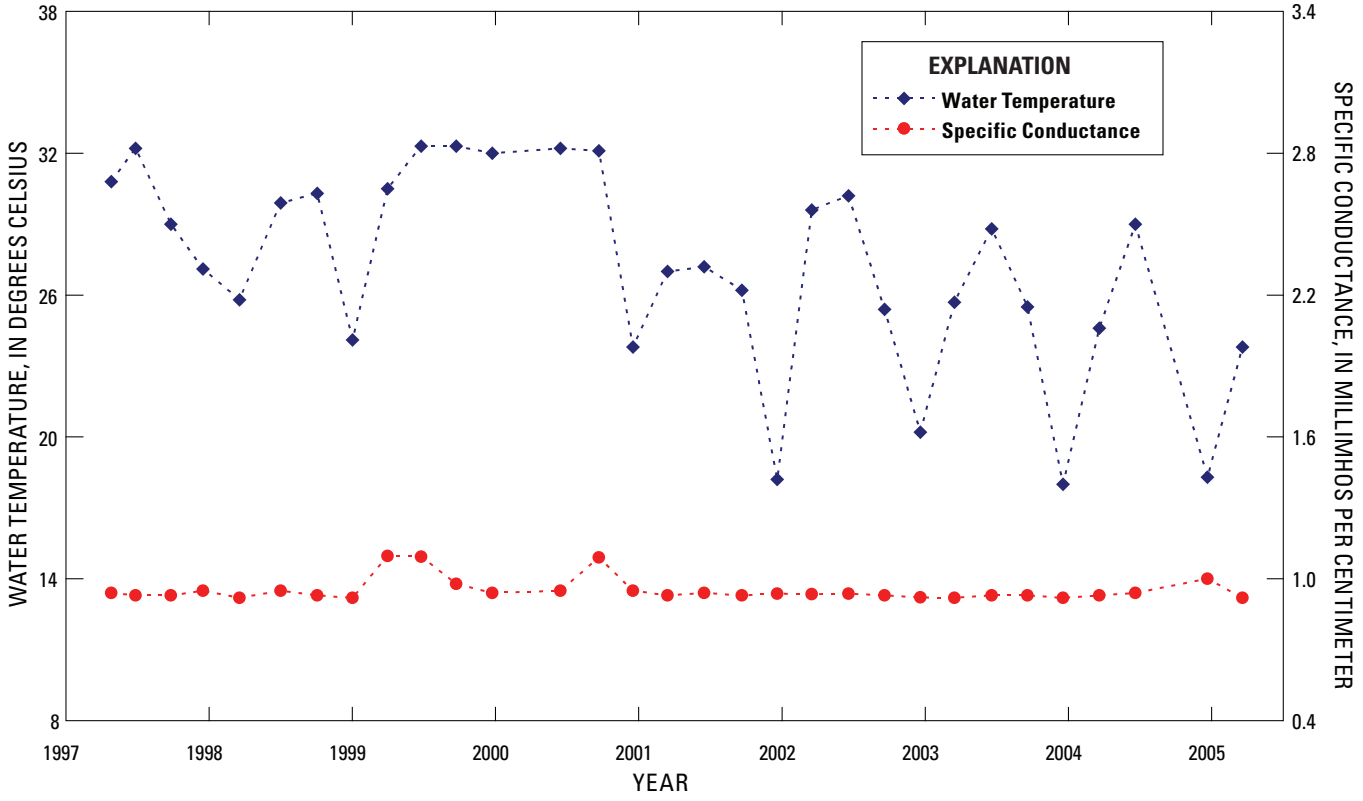

Figure B61. Water-temperature and specific-conductance measurements for site S15 at Cardy Lamb Springs near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

Table B48. Water-temperature and specific-conductance measurements provided by Converse Consultants for site S15 at Cardy Lamb Springs near Moapa, Nevada, 1997–2005.

Table B48 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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Miscellaneous Sites

The following sites are included within this section:

09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada (1967–2005)
09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada (1967–2005)
Unnamed Springs at L.D.S. East well near Moapa, Nevada (2004)
Miscellaneous Water-Quality Sites (1997–2005)

09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada

A 9-inch (in.) Parshall flume was installed on Apcar Stream on August 22, 1967, by the Nevada Division of Water Resources (NDWR). This flume is believed to have been located at or near the current flume site, which is about 670 ft north of Warm Springs Road (fig. B62) and about 0.6 mi downstream of Apcar Springs (fig. 2). Although flow at the flume originates from Apcar Springs, additional water enters the stream channel from other springs and seeps downstream of the Warm Springs Road crossing. Below the flume, flow generally drains to the east and is tributary to Refuge Stream about 0.4 mi downstream.

Data provided by NDWR show that water-level measurements for the 9-in flume were made monthly from August 1967 until May 1969. Monthly measurements resumed on February 22, 1974, when a new, 2-ft Parshall flume was installed. Measurements ended on February 7, 1985, and didn't resume until July 1993 when a new 3-ft Parshall flume was installed. Because only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 9-in., 2-ft, and 3-ft Parshall flumes (Leupold and Stevens, 1987). A plot of the computed discharges from October 1967 to February 2005 is shown in figure B63. A complete listing of the water-level measurements and computed discharges is given in table B49.

Two discharge measurements were made at this site on February 7, 2001, as part of a multi-agency synoptic seepage run in the Warm Springs area. The discharges for the two measurements were averaged and the resulting value was plotted on figure B63. Discharge values and related information for the two measurements made during the seepage run are included in Appendix E.

On July 20, 2004, the U.S. Geological Survey installed a staff plate on the flume and established one bench mark and two reference marks at the site as part of this study. Photographs of the flume, bench mark, and reference marks are shown in figure B64. During the installation of the staff plate, backwater conditions were observed at the flume caused by a large palm tree that had fallen across the channel about 40 ft downstream. Until the blockage is removed, computed discharges from water-level measurements will show erroneous higher rates of flow.

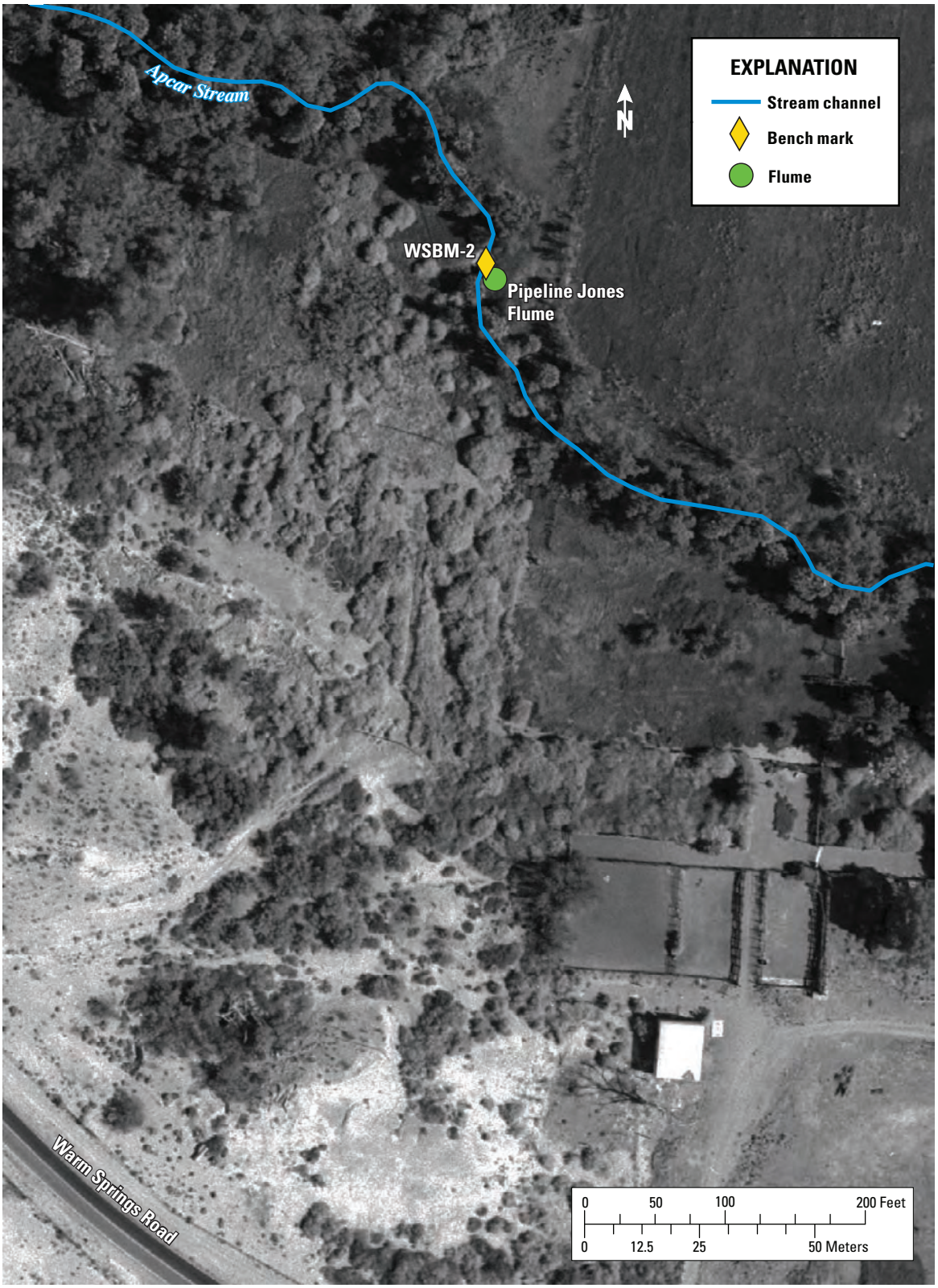

Figure B62. Location of Pipeline Jones Flume and bench Mark WSBM-2 in the Warm Springs area near Moapa, Nevada.

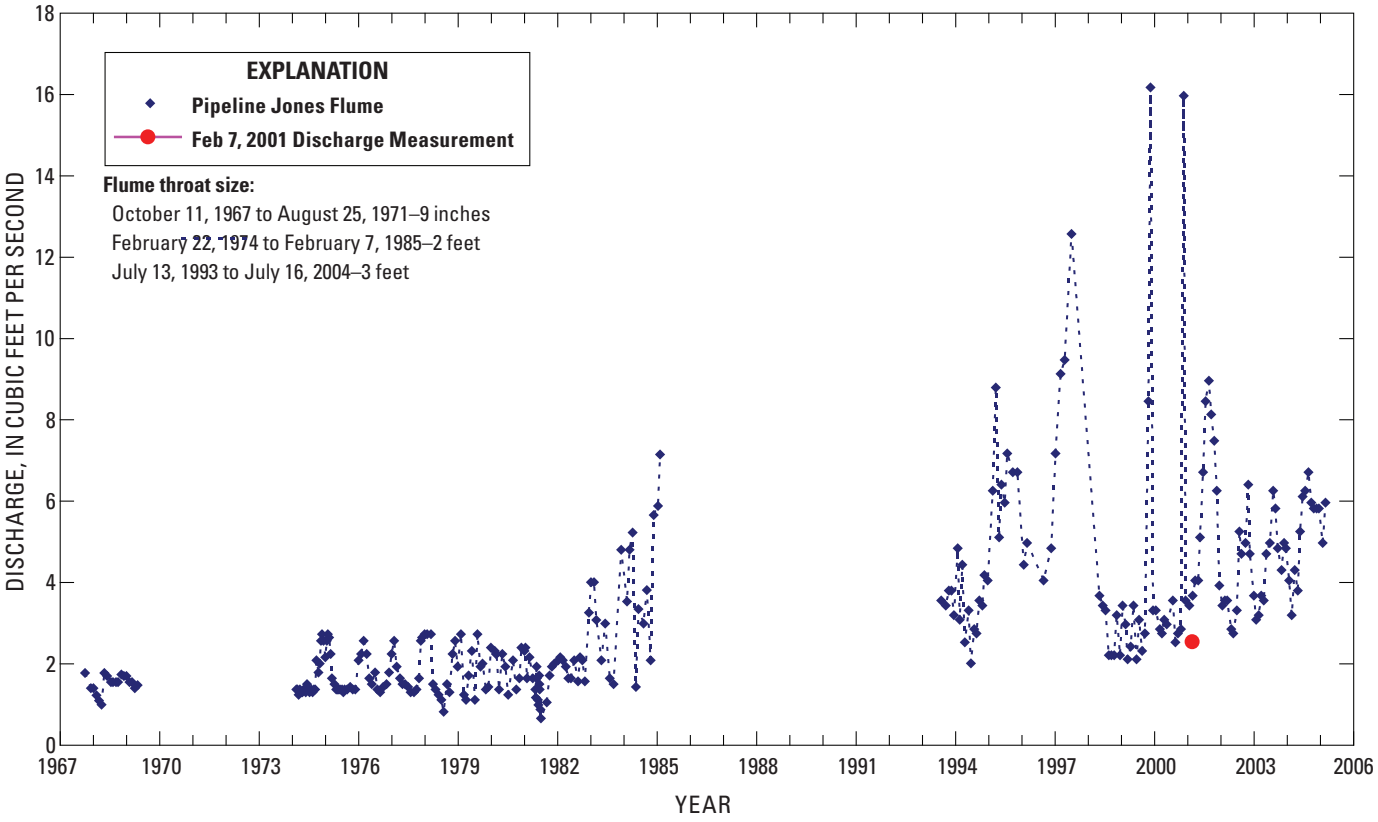

Figure B63. Instantaneous discharges compiled for 1967–2005, and discharge measurement made on February 7, 2001, for partial-record stream-gaging station 09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada.

Table B49. Water levels and computed instantaneous discharges for partial-record stream-gaging station 09415940 Apcar Stream at Pipeline Jones Flume near Moapa, Nevada, 1967–2005.

[Data from Nevada Division of Water Resources.]

Table B49 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

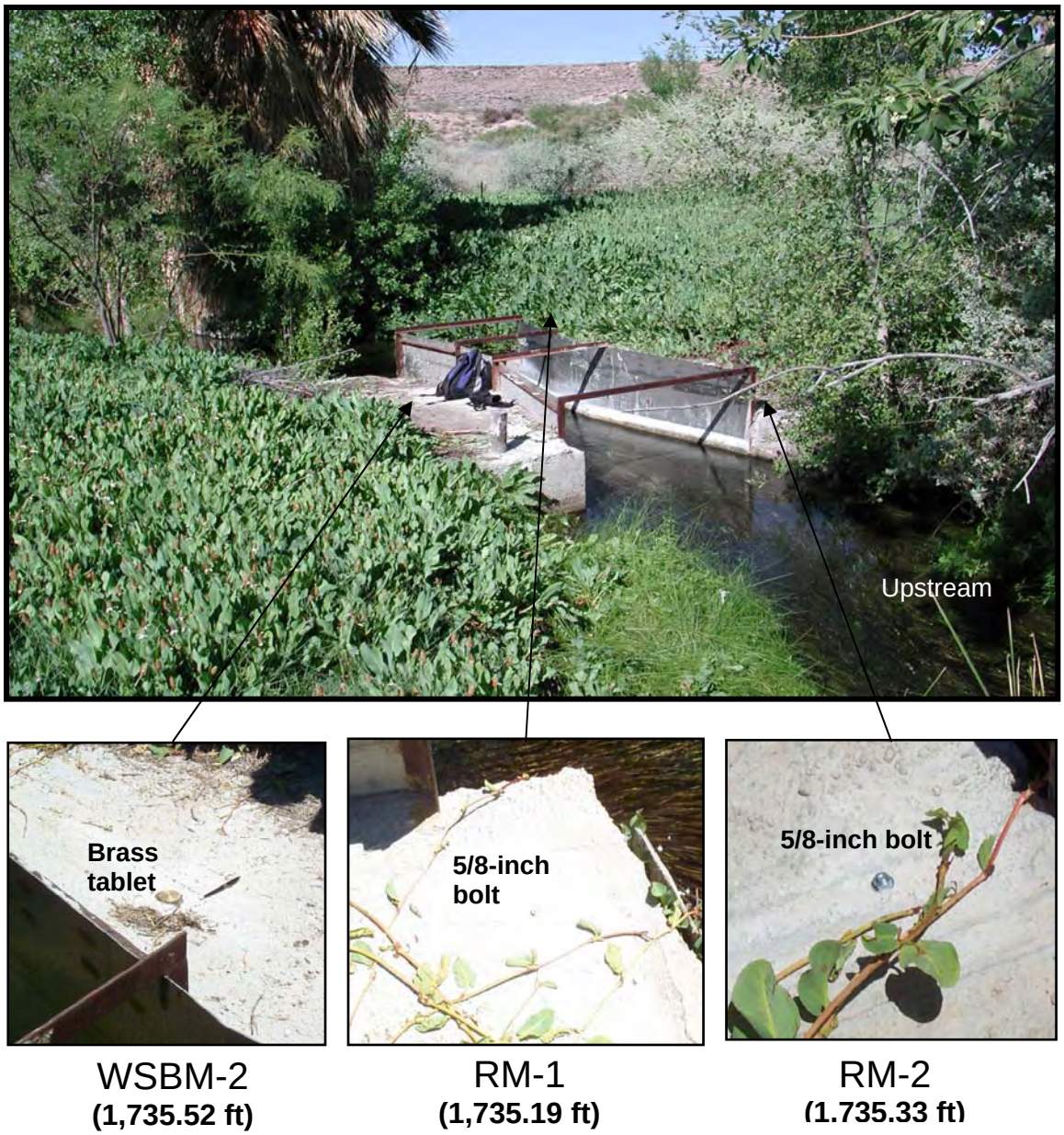

Figure B64. Location of bench mark WSBM-2 and reference marks RM-1 and RM-2 at partial-record stream–gaging station 09415940 Apcar Stream at Pipeline Jones Fume near Moapa, Nevada. Photographed July 20, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada

A 1-foot (ft) Parshall flume was installed on Refuge Stream on October 11, 1967, by the Nevada Division of Water Resources (NDWR). The flume was located approximately 0.8 mi southeast of the L.D.S. Recreational Area and about 250 ft north of Warm Springs Road (fig. B65). Flow at this flume is the combined discharges from the Plummer and Pederson Spring groups. Below the flume, flow generally drains to the northeast and is tributary to the Muddy River about 0.3 mi downstream. Flow from Apcar Stream enters Refuge Stream from the west about 800 ft downstream from the flume.

Data provided by NDWR show that water-level measurements for the 1-ft Parshall flume generally were made monthly from October 1967 until August 1971. Monthly measurements resumed on February 24, 1974, when a new, 3-ft Parshall flume was installed. Measurements ended on November 19, 1987, and didn't resume until July 1993 when a new 3-ft Parshall flume was installed. The site is still visited monthly by NDWR. Because only water-level measurements were provided by NDWR, discharge rates were computed using standard equations for the 1-ft and 3-ft Parshall flumes (Leupold and Stevens, 1987). A plot of the computed discharges from October 1967 to February 2005 is shown in figure B66. A complete listing of the water-level measurements and computed discharges are given in table B50.

A continuous-stage recorder was installed at the flume by the U.S. Geological Survey on October 1, 2001, and maintained through September 30, 2004. From the time that the gage was installed, submerged flow conditions have been in effect owing to the growth of a large palm tree and other plants in the channel downstream from the flume. Discharge measurements are routinely made at the site and used to define the stage-discharge relation for the flume. Daily mean discharges computed for the period of record have been included for comparison on the plot in figure B66 and listed in table B51. Photographs of the current flume, bench mark, and a selected reference mark established for this gage on June 3, 2004, are shown in figure B67.

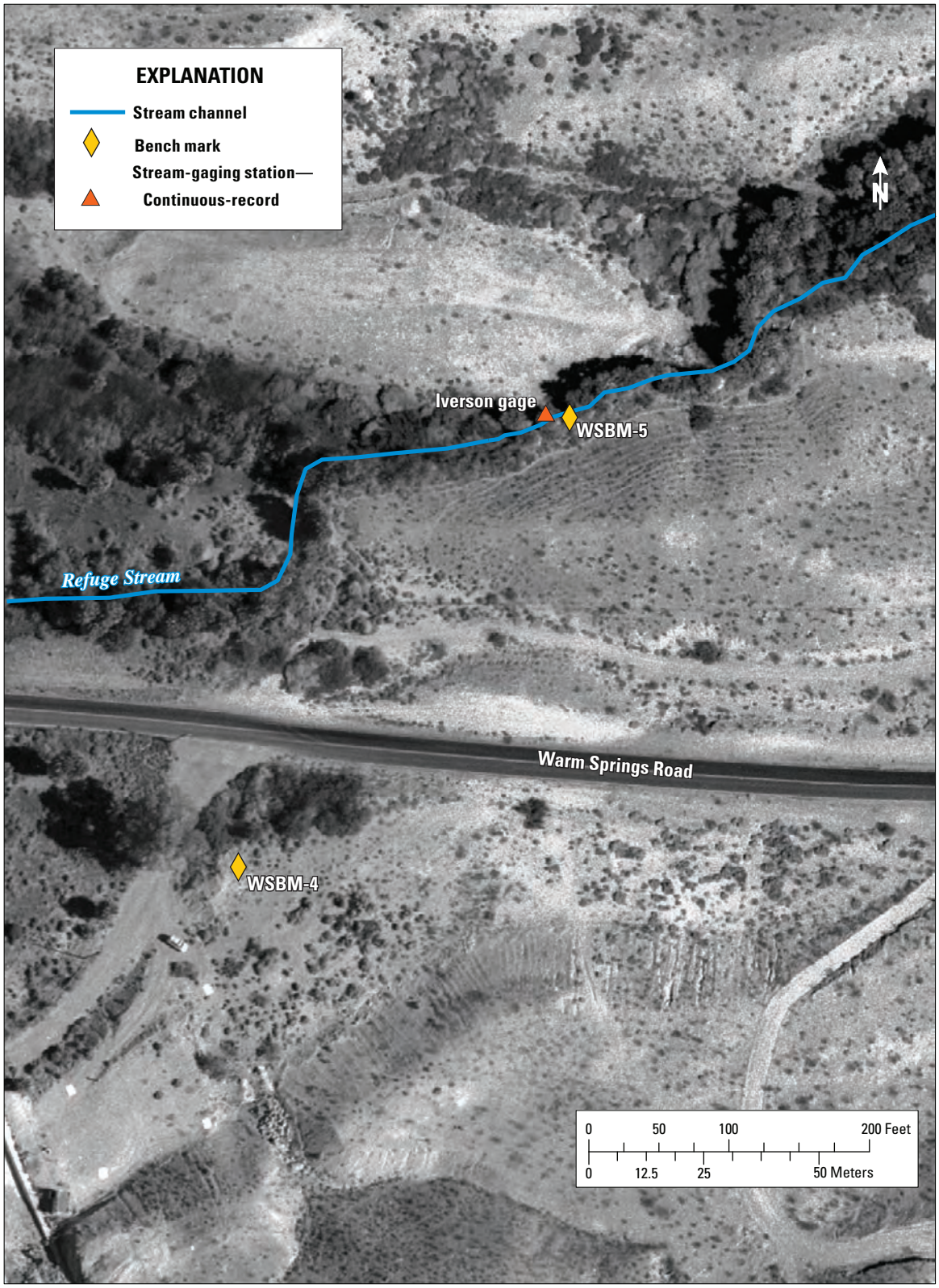

Figure B65. Location of continuous-record stream-gaging station 09415927 and bench marks, WSBM-4 and WSBM-5, Warm Springs Confluence at Iverson Flume near Moapa, Nevada.

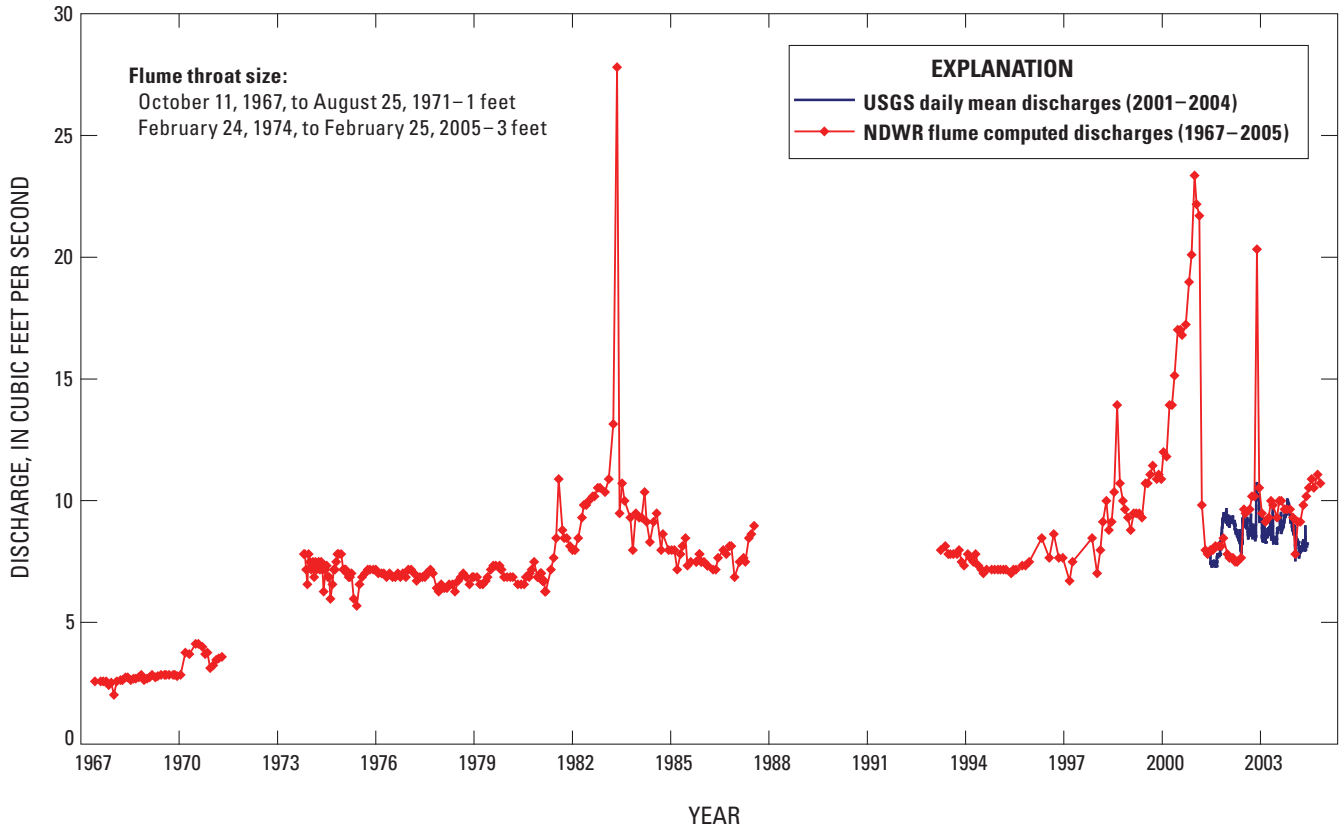

Figure B66. Instantaneous and daily mean discharges for continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada, 1967–2005. Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov. Water level measurements used to compute discharges were provided by Nevada Division of Water Resources (NDWR).

Table B50. Water levels and computed instantaneous discharges for continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada, 1967–2005.

[Water-level measurements provided by Nevada Division of Water Resources.]

Table B50 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B51. Daily mean discharges for continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada, water years 2002–04.

[Data from U.S. Geological Survey (USGS) National Water Information System (NWIS) data base, accessed 2005 at http://waterdata.usgs.gov]

Table B51 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Figure B67. Location of bench mark WSBM-5 and reference mark RM-3 at continuous-record stream-gaging station 09415927 Warm Springs Confluence at Iverson Flume near Moapa, Nevada. Photographed June 3, 2004 by D. Beck. Elevation of bench and reference marks in feet above NAVD 88.

Unnamed Springs at L.D.S. East Well near Moapa, Nevada

An unnamed group of springs is located just to the south and east of L.D.S. Well East adjacent to State Highway 168 in the north-central part of the Warm Springs area (figs. 2 and B68). Discharge from the springs may have been perennial in the past; however, discharge is currently intermittent, occurring mainly during the winter when pumpage from the well and evapotranspiration rates are at their lowest. Flow from the area generally is to the southeast, but a network of irrigation ditches distributes flow to the east and south. During field reconnaissance of the Warm Springs area in February 2004, discharge from the springs was observed flowing into the Muddy River at two locations. The first site was about 100 ft upstream of the confluence with Refuge Stream. The second site was about 0.3 mi downstream from the confluence with Refuge Stream.

On August 17, 2004, surface-water elevations at all U.S. Geological Survey monitoring sites within the Warm Springs area were measured. At this time, the unnamed springs were not discharging; therefore, the elevation of a small spring pool about 100 ft to the east of L.D.S. Well East was measured using optical theodolite surveying techniques (Kennedy, 1988). Elevation for the water-surface measurement was determined using a bench mark (WSBM-10) established at the well by the Las Vegas Valley Water District (table 2). The surface-water elevation of the pond on August 17, 2004, is given in table 4. Photographs showing the location of the bench mark and measurement site are included in figure B69.

In April 1997, Converse Consultants, on contract with Nevada Power Company, initiated quarterly field measurements of water temperature and specific conductance at the unnamed spring area (fig, B68). Measurements were compiled through March 2005 and are plotted in figure B70 and listed in table B52.

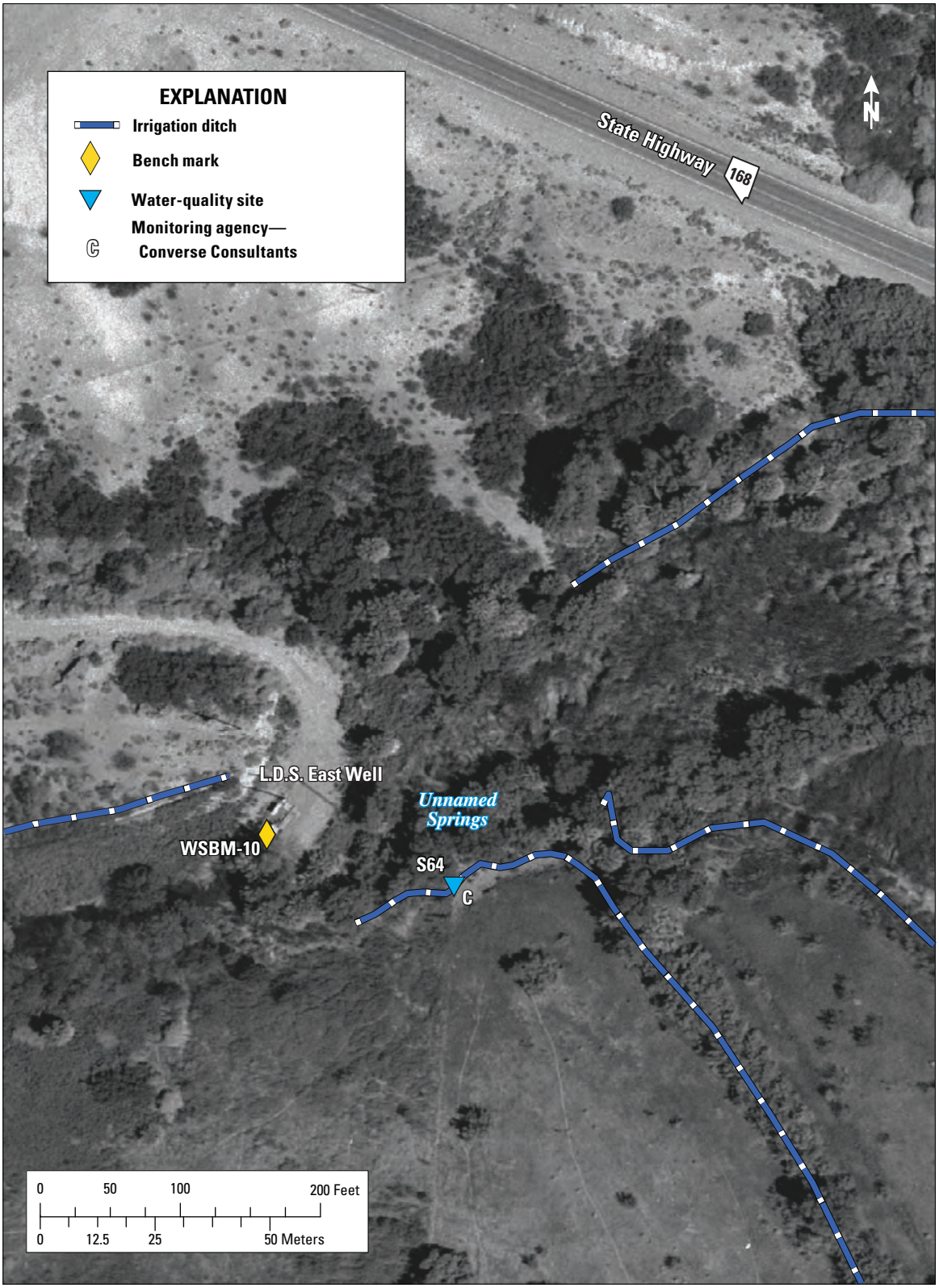

Figure B68. Location of unnamed springs near L.D.S. East well and bench mark WSBM-10 in the Warm Springs area near Moapa, Nevada.

Figure B69. Location of bench mark WSBM-10 at L.D.S. East well and spring-fed pool surveyed on August 17, 2004, at unnamed springs near Moapa, Nevada. Elevation of bench mark in feet above NAVD 88.

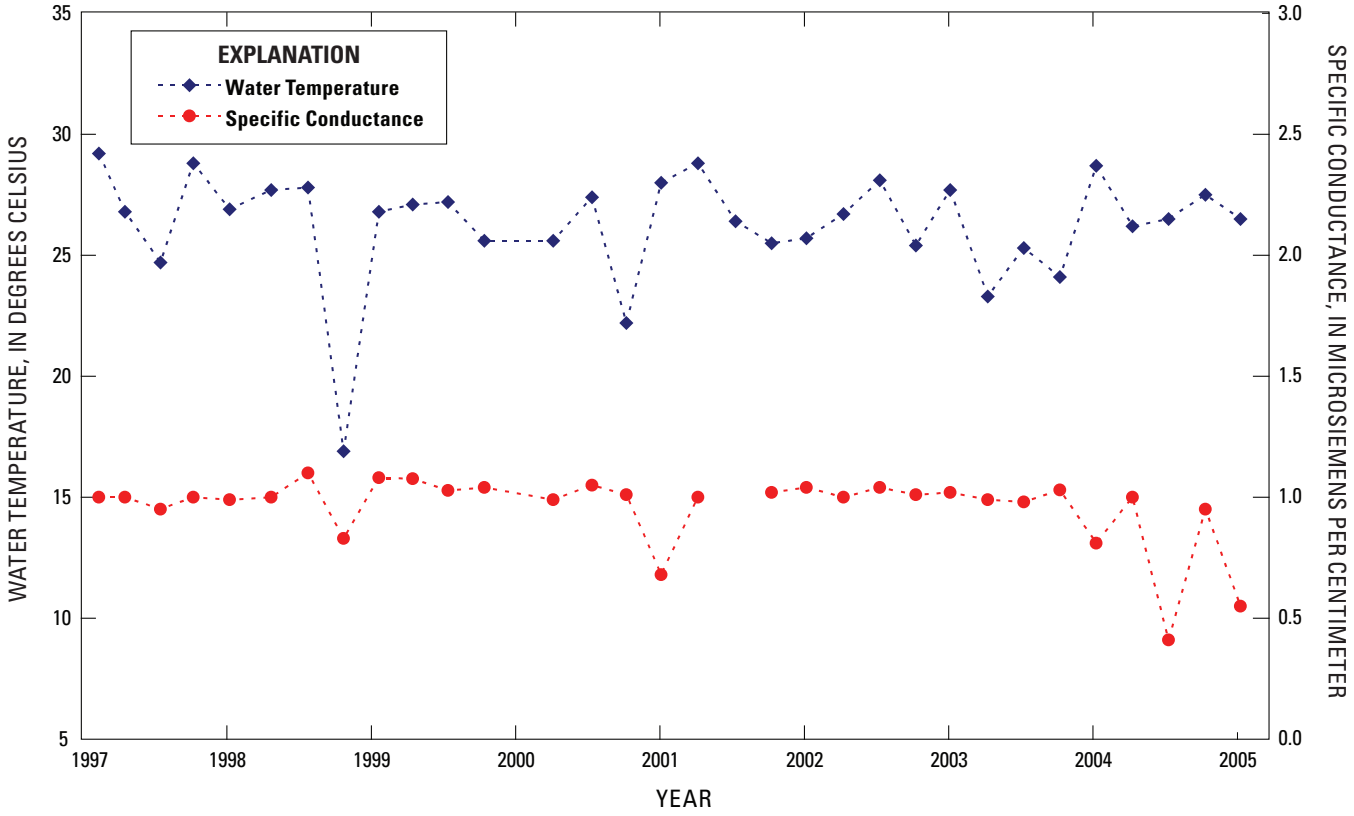

Figure B70. Water-temperature and specific-conductance measurements for spring pond at unnamed springs at L.D.S. East well near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

Table B52. Water-temperature and specific-conductance measurements by Converse Consultants for spring pond at unnamed springs at L.D.S. East well near Moapa, Nevada, 1997–2005.

Table B52 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Miscellaneous Water-Quality Sites in the Warm Springs area near Moapa, Nevada

In April 1997, Converse Consultants, on contract with Nevada Power Company, began quarterly field measurements of water temperature and specific conductance at selected springs within the Warm Springs area. Most of the measurement sites are located at springs that are included as part of the major spring groups, such as Plummer, Pederson, Apcar, Muddy, and Cardy Lamb, and are discussed elsewhere in this report. Other measurement sites that are not part of the major spring groups include S6, S7a, and S65. The locations of these sites are shown in figure B71.

Water temperature and specific conductance data for the period of record for sites S6, S7a, and S65 are plotted in figures B72, B73, and B74 and listed in tables B53, B54, and B55, respectively.

Figure B71. Location of Converse Consultants water-quality sites S6, S7a, and S65 in the Warm Springs area near Moapa, Nevada.

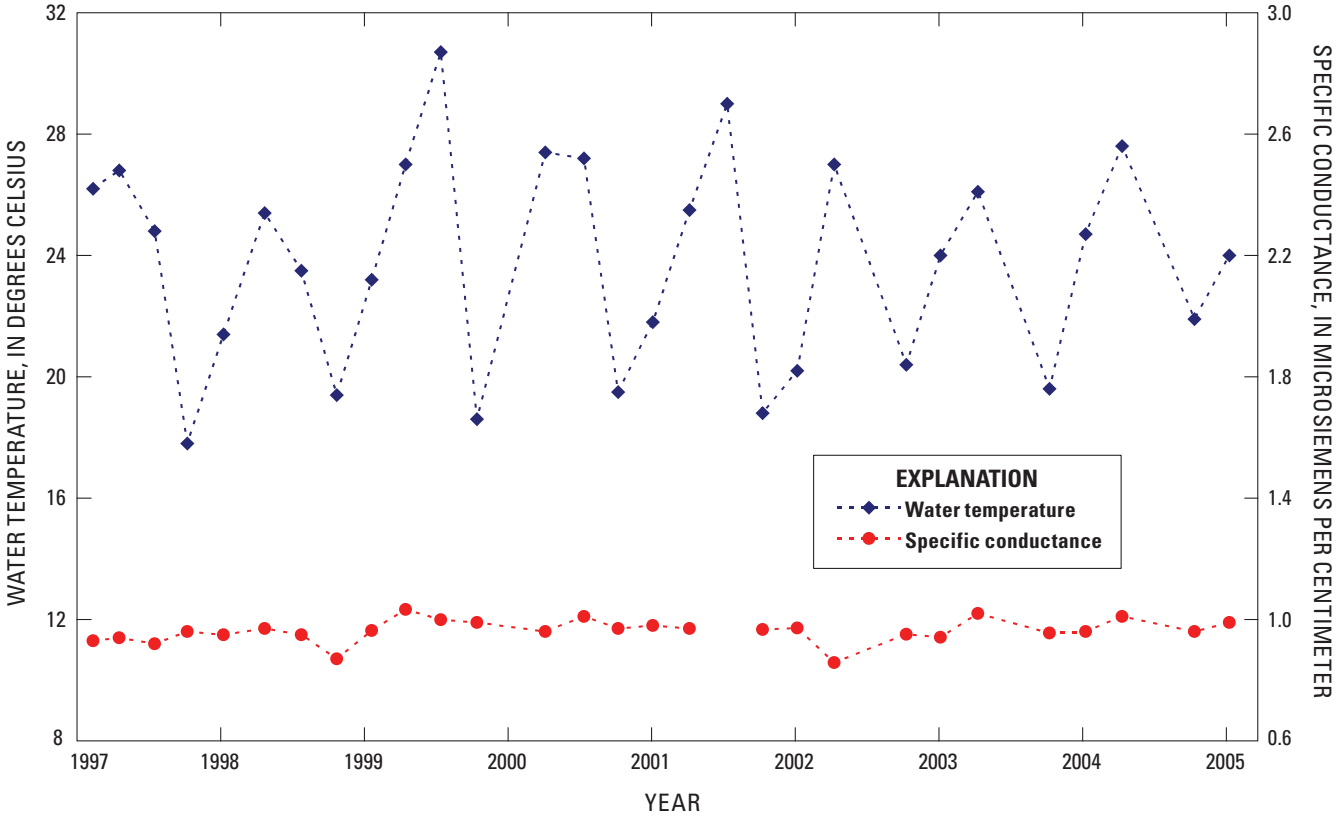

Figure B72. Water-temperature and specific-conductance measurements for site S6 in the Warm Springs area near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

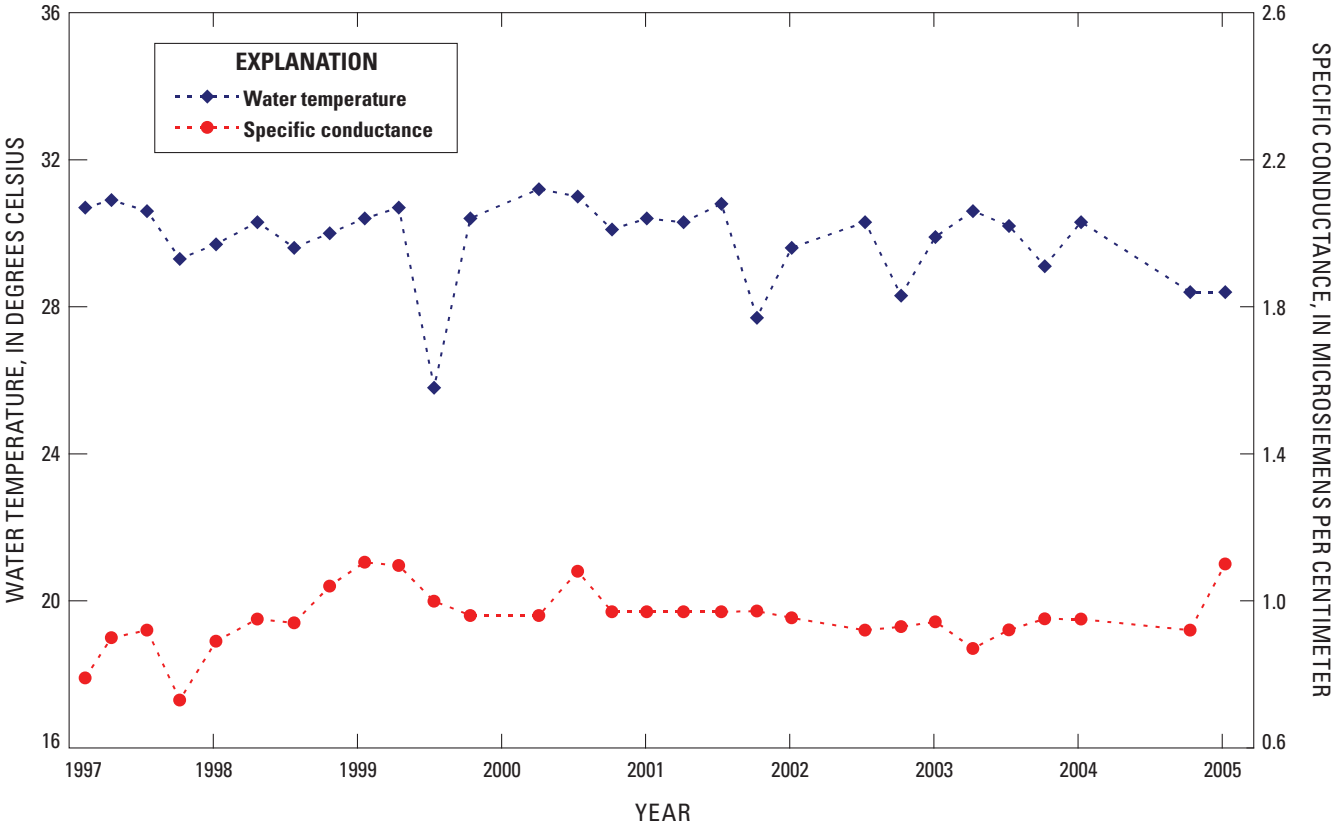

Figure B73. Water-temperature and specific-conductance measurements for site S7a in the Warm Springs area near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

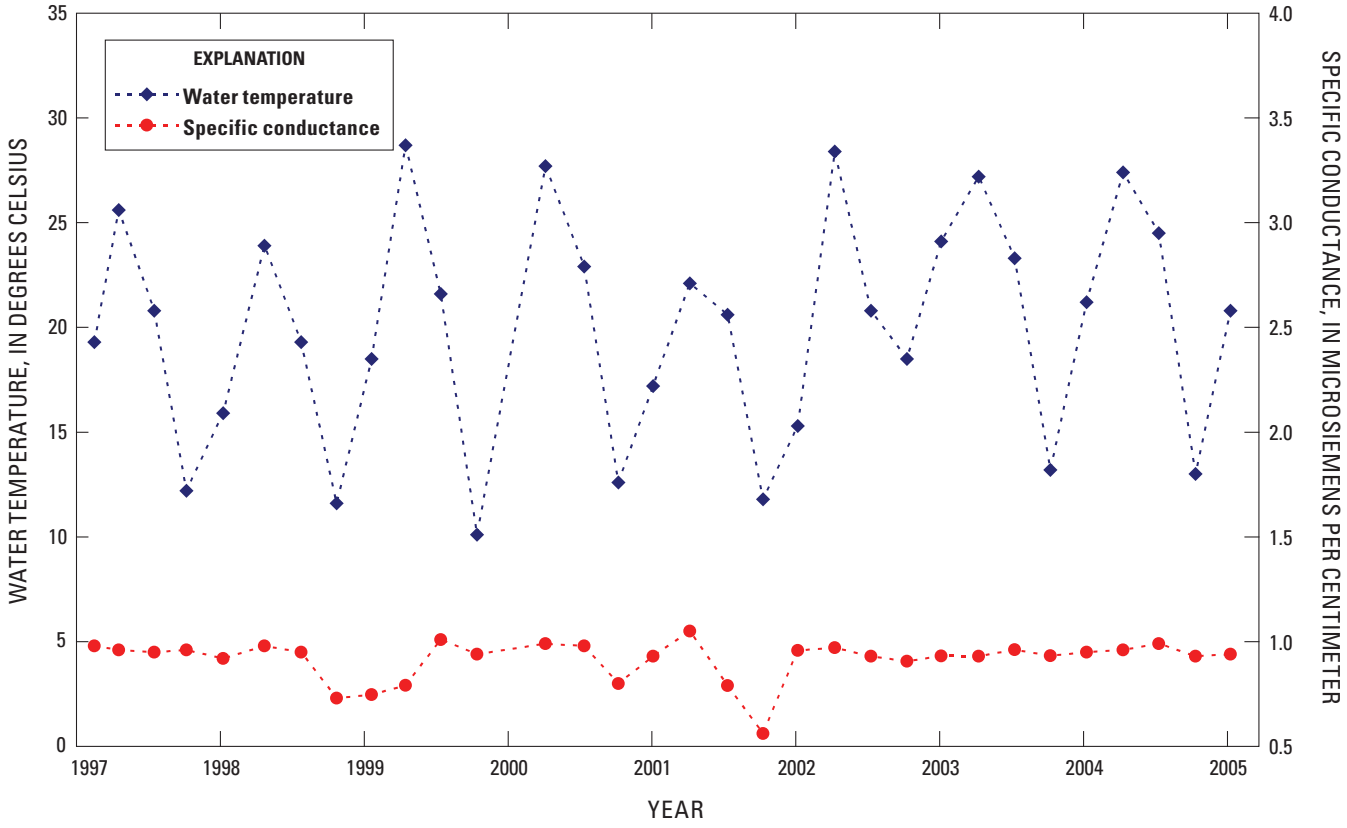

Figure B74. Water-temperature and specific-conductance measurements for site S65 in the Warm Springs area near Moapa, Nevada, 1997–2005. Measurements provided by Converse Consultants.

Table B53. Water-temperature and specific-conductance measurements by Converse Consultants at site S6 in the Warm Springs area near Moapa, Nevada, 1997–2005.

Table B53 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B54. Water-temperature and specific-conductance measurements by Converse Consultants at site S7a in the Warm Springs area near Moapa, Nevada, 1997–2005.

Table B54 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

Table B55. Water-temperature and specific-conductance measurements by Converse Consultants at site S65 in the Warm Springs area near Moapa, Nevada, 1997–2005.

Table B55 data are available in an Excel data base for download at URL: http://pubs.water.usgs.gov/ofr2006-1311.

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