USGS
science for a changing world

A Data Viewer for Stream-Sediment and Surface-Water Chemistry, Geology, and Geography of the Humboldt River Basin, Northern Nevada

Bulletin 2210-F

U.S. Department of the Interior
U.S. Geological Survey

A Data Viewer for Stream-Sediment and Surface-Water Chemistry, Geology, and Geography of the Humboldt River Basin, Northern Nevada

By Douglas B. Yager and Helen W. Folger

Chapter F of
Geoenvironmental Investigations of the Humboldt River Basin, Northern Nevada
Edited by Lisa L. Stillings

Bulletin 2210-F

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
Gale A. Norton, Secretary

U.S. Geological Survey
P. Patrick Leahy, Acting Director

U.S. Geological Survey, Reston, Virginia: 2005
Version 1.0

This publication is available online at URL:
http://pubs.usgs.gov/bul/b2210-f/

For information on other USGS products and ordering information:
World Wide Web: http://www.usgs.gov/pubprod/
Telephone: 1-888-ASK-USGS

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:
World Wide Web: http://www.usgs.gov/
Telephone: 1-888-ASK-USGS

Suggested citation:
Yager, D.B., and Folger, H.W., 2005, A data viewer for stream-sediment and surface-water chemistry, geolgoy, and geography of the Humboldt River basin, northern Nevada, chap. F *of* Stillings, L.L., ed., Geoenvironmental investigations of the Humboldt River basin, northern Nevada: U.S. Geological Survey Bulletin 2210-F, 9 p., available at URL <http://pubs.usgs.gov/bul/b2210-f/>.

Preface

Northern Nevada is one of the world's foremost regions of gold production. The Humboldt River Basin (HRB) covers 43,500 km^2 in northern Nevada (Crompton, 1995), and it is home to approximately 18 active gold and silver mines (Driesner and Coyner, 2001) among at least 55 significant metallic mineral deposits (Long and others, 1998). Many of the gold mines are along the Carlin trend in the east-central portion of the HRB, and together they have produced 50 million ounces of gold from 1962 (when the Carlin mine first opened) through April 2002 (Nevada Mining Association, 2002). Mining is not new to the region, however. Beginning in 1849, mining has taken place in numerous districts that cover 39 percent of the land area in the HRB (Tingley, 1998). In addition to gold and silver, As, Ba, Cu, Fe, Hg, Li, Mn, Mo, Pb, S, Sb, V, W, Zn, and industrial commodities such as barite, limestone, fluorite, sand and gravel, gypsum, gemstones, pumice, zeolites, and building stone, have been extracted from the HRB (McFaul and others, 2000).

Due to the large amount of historical and recent mining in the HRB, the Bureau of Land Management (BLM) in Nevada asked the U.S. Geological Survey (USGS) Mineral Resources Program to conduct a series of mineral-deposit-related environmental studies in the HRB. BLM required data and geoenvironmental interpretations regarding (1) the chemical composition of water, soil, sediment, and mine waste in the HRB, (2) the natural background chemistry of these materials, and (3) how mining activities may have altered their chemistry. The paper that follows describes one of the studies conducted by the USGS Minerals Program to answer these and similar questions.

All papers within this series of investigations can be found as lettered chapters of USGS Bulletin 2210, *Geoenvironmental Investigations of the Humboldt River Basin, Northern Nevada*. Each chapter is available separately online.

References Cited

Crompton, E.J., 1995, Potential hydrologic effects of mining in the Humboldt River Basin, northern Nevada: U.S. Geological Survey Water Resources Investigations Report 94-4233, 2 sheets.

Driesner, D., and Coyner, A., 2001, Major mines of Nevada 2000: Mineral industries in Nevada's economy: Nevada Bureau of Mines and Geology Special Publication P-12, 28 p.

Long, K.R., DeYoung, J.H., Jr., and Ludington, S.D., 1998, Significant deposits of gold, silver, copper, lead, and zinc in the United States: U.S. Geological Survey Open-File Report 98-206A, 33 p. [USGS Open-File Report 98-206B contains one 3.5-inch diskette].

McFaul, E.J., Mason G.T., Jr., Ferguson, W.B., and Lipin, B.R., 2000, U.S. Geological Survey mineral databases—MRDS and MAS/MILS: U.S. Geological Survey Digital Data Series DDS-52, two CD-ROMs.

Nevada Mining Association, 2002, Industry to celebrate 50 millionth ounce of gold: Nevada Mining Association News Release, April 11, 2002.

Tingley, J.V., 1998, Mining districts of Nevada (2nd ed.): Nevada Bureau of Mines and Geology Report 47d, one CD-ROM.

Contents

Preface iii
Introduction 1
GIS Terminology 1
Themes and Databases Included as Part of the Data Viewer 1
    Geologic and Mining-Related Themes 1
        Geology of Northern Nevada 1
        Significant Mineral Deposits in Nevada 1
        Mineral Favorability Tracts 2
        Mill, Smelter, and Fluvial Tailings Locations 3
    Geochemical Themes 3
        Data Sets for Sediment and Soil Chemistry 3
        Surface-Water-Chemistry Theme and Database 4
    Geographic Themes 4
Use of ArcExplorer to View Humboldt River Basin Data Sets 4
    ArcExplorer Software 4
    ArcExplorer Functionality 4
        Open ArcExplorer Project File 4
        Add Theme 5
        Query Tool 5
        Identify 6
        Map Tips 6
Use of MapSheetsExpress to View Humboldt Basin Data Sets 6
    MapSheetsExpress Software 6
    MapSheetsExpress Functionality 6
        Swiper 6
        Transparency 6
        Pop-Up Label 7
        Legend 7
        Layer and Map Views 7
    Example of Using MapSheetsExpress to View Humboldt River Basin Data Sets 7
Acknowledgments 7
References 8
Appendix A—System Requirements 9

Figure

1. Organization of data 5

Tables

1. Names and descriptions of vector data sets included with the Humboldt River basin data viewer 2
2. Raster digital terrain coverage, NURE geochemical contour maps, and mineral favorability tracts for the Humboldt River basin and vicinity 3
3. Compilation of surface-water chemistry for the Humboldt River basin, northern Nevada, for samples collected from June 28, 1989, through August 1, 2000
   [Excel file table_3.xls downloadable from DATA\WATER_DATA\Spreadsheet directory]

Note Regarding Downloading Files

A user may install the entire contents of this report on their personal computer including the text, GIS data viewing software, GIS vector and image data, readme file, and metadata by downloading the "viewer.zip" file from the "B2210-F Downloads" link on the front page of this Web site. Note that, once the entire contents of the B2210_F.zip file are extracted, the directory structure should not change, as some files are dependent on established directory paths in order to function properly.

Additional information on the mineral and environmental assessments done by the U.S. Geological Survey may be found at the following URLs.

http://pubs.usgs.gov/mf/2003/mf-2407/#MF2407M
http://pubs.usgs.gov/bul/b2210-a/
http://pubs.usgs.gov/bul/b2210-c/
http://pubs.usgs.gov/bul/b2210-d/
http://pubs.usgs.gov/bul/b2210-e/
http://pubs.usgs.gov/of/2004/1245/plu-FAQ.htm

A Data Viewer for Stream-Sediment and Surface-Water Chemistry, Geology, and Geography of the Humboldt River Basin, Northern Nevada

By Douglas B. Yager[1] and Helen W. Folger[2]

Introduction

Data viewers that employ geographic-information-system (GIS) software are useful for displaying and analyzing geographic relationships between diverse data sets. This product utilizes two GIS software packages (ArcExplorer by Environmental Systems Research Inc., and MapSheetsExpress by Leica Geosystems Inc.) for the analysis of data compiled for the Humboldt River basin, northern Nevada. The primary goal of the data viewer is to provide interactive GIS capabilities for visualization and querying of geologic and geochemical data. This method of display enables data collected over large geographic areas to be viewed in the context of land ownership and management.

GIS Terminology

Users of this product should be familiar with some of the commonly used GIS terms that relate to the data sets that are presented here. The ArcExplorer terms "theme" and "coverage," and the MapSheetsExpress term "layer" are defined as digital versions of maps that relate to a geographic element or feature of interest. A few examples of themes, coverages, and layers include the map of roads, county boundaries, or geochemical-element grids. A layer is essentially all digital maps that are included in each raster and vector data subdirectory.

Vector and raster data sets are the two fundamental data types that are used to represent various geographic feature types. Vector data consists of discrete points, lines, and (or) polygons that have associated attribute information describing each feature. Raster data consists of grid cells that have a consistent *x* and *y* dimension, unique geographic location, and an associated cell value. Raster data are commonly used to represent continuous surface data, such as geochemically gridded data or terrain elevation data.

[1] U.S. Geological Survey, Denver, Colo.

[2] U.S. Geolgical Survey, Reston, Va.

Themes and Databases Included as Part of the Data Viewer

Geologic and Mining-Related Themes

Geology of Northern Nevada

A digital geologic map and fault theme (Stewart and Carlson, 1978; Raines and others, 1996) are found in the *nvgeo.shp* and *faults.shp* coverages, respectively (table 1). The geologic coverage may be used to explore the relationships between bedrock geology, geologic structures, and other coverages included in the data viewer.

Significant Mineral Deposits in Nevada

Two mineral-deposit themes are included (table 1): (1) a combined MAS (minerals availability system) and MILS (minerals industry location system) past-producing-mines coverage (*pprod.shp*) derived from McFaul (2000), and (2) mineral-deposit-district coverage (*tracts.shp*), as identified by the Nevada Bureau of Mines and Geology (Tingley, 1992). Note that these and all other vector files are located in the directory DATA\VECTOR.

The past-producing-mines coverage (McFaul, 2000) is provided as an estimate of the density of past-producing mining activity in the Humboldt River basin region. The past producing mines coverage was culled from the MAS/MILS database[3], which was created by the former U.S. Bureau of Mines and is now maintained by the U.S. Geological Survey (USGS) (McFaul, 2000).

These types of data are useful to determine an estimate for the number of past-producing mines in a management unit such as a BLM tract or hydrologic unit area. Land-manage-

[3] Although the MAS/MILS data were derived from a past-producing-mines database, mine sites that were once inactive properties may now or in the future be actively mined.

Table 1. Names and descriptions of vector data sets included with the Humboldt River basin data viewer.

[Coverage attributes for all data are described in the metadata.txt file in the METADATA folder]

Vector data category	Coverage name	Data description	Applicable scale	Data source
Base data	nvcntys	County boundaries	1:100,000	BLM
	nvcties	Major city locations	1:1,000,000	BLM
	nvrds	Major roads/highways		BLM
	nvstbnd	State boundary	1:500,000	BLM
	nvtopo	Topographic contours		Raines and others (1996)
	ownlcc	Land ownership	1:100,000	BLM
Geology	nvgeo	Bedrock geology	1:500,000	Raines and others (1996)
	faults	Structural features	1:500,000	Raines and others (1996)
NURE	hrbsc, hrbco, hrbag, hrbba, hrbtl, logfec, logni, logcu, logzn, logas, logse, logsb, logba, logau, logpb, logce	Geochemical analyses for Sc, Co, and Ag for the Humboldt River basin data set and Fe, Ni, Cu, Zn, As, Se, Sb, Ba, Au, Tl, Pb, Ce in soils and sediments for the combined Humboldt River basin and Winnemucca-Surprise data sets	1:500,000	Folger (2000)
	wssc, wsco, wsag, wsba, wstl	Geochemical analyses for Sc, Co, and Ag in soils and sediments for Winnemucca-Surprise data set	1:500,000	Folger (2000) King and others (1962)
Significant deposits	pprod	Past producing mines	N.A.	McFaul and others (2000)
	tracts	Tingley mineral deposit districts	1:1,000,000	Tingley (1992)
	tails	Mill, mine, and fluvial tailings	N.A.	Nash (2003)
Water data	pstrm	Perennial streams	1:100,000	BLM
	water1	Perennial streams	1:1,000,000	BLM
	hbh2o	Water quality geochemical analyses from USGS, NWIS and EPA STORET database	N.A.	USGS National Water Quality System (NWIS), Environmental Protection Agency storage and retrieval repository (STORET), and USGS Humboldt River basin assessment project data sets
	wsbnd	Humboldt River basin watershed boundary	1:2,000,000	U.S. Geological Survey hydrologic units in the conterminous United States
	hucs	Preliminary 10-digit hydrologic-unit-code boundaries	1:24,000	D. Pickel, U.S. Department of Agriculture, Natural Resources Conservation Service, Nev.—GIS Coordinator

ment agencies may use this information in establishing land-use-decision priorities for specific management units.

A mineral-deposit-district coverage of northern Nevada was culled from work accomplished by the Nevada Bureau of Mines and Geology (Tingley, 1992). Mineral-deposit-district coverage attributes consist of deposit commodity, name, and type (metallic versus non-metallic).

Mineral Favorability Tracts

Also included in the data viewer are maps (geo-rectified raster images with separate explanations, table 2; DATA/RASTER/TRACTS downloadable directory) that show possible locations of undiscovered deposits of gold, silver, platinum, and palladium. The explanations for each tract map

are located in the DATA/RASTER/ TRACTS /explanations directory and are stored as JPEG images (plu_expl.jpg, sed_expl.jpg, and vol_expl.jpg). The explanations are opened with any image viewer that supports the JPEG format.

These maps were developed as part of the USGS assessment of metallic mineral resources, Humboldt River basin, northern Nevada (Wallace and others, 2004). The assessment focused on mineral deposits and geologic environments that were known to contain these elements—they are economically important commodities in the Humboldt River basin at present and may be important commodities in the near future.

The mineral resource assessment used a combination of expert (knowledge-based) and geographic-information-system data-analysis methods to potentially identify three types of mineral deposits: (1) multielement deposits related to plutonic rocks, (2) gold-silver deposits in sedimentary rocks, and (3) gold-silver deposits that formed in near-surface, epithermal environments. U.S. Geological Survey geologists used their knowledge and expertise to compile and develop geological, geophysical, geochemical, and mineral-deposit data that was pertinent to the assessment. The data were then analyzed and modeled in a geographic information system (GIS) using weights-of-evidence and weighted logistic regression techniques to produce maps showing areas of varying degrees of favorability for the occurrence of the three types of undiscovered deposits (*plu.jpg*, *vol.jpg*, and *sed.jpg*). The areas with the highest likelihood of containing undiscovered deposits were classified as "prospective," (colored red) and those with the next highest likelihood were classified as "favorable" (colored yellow). "Permissive" (colored purple) areas are the broadest and most general category, and all undiscovered deposits are likely to occur in these areas. The dark-gray areas represent tracts that have an overburden thickness of greater than 1 km and are thus "nonpermissive." White areas are nonpermissive because they do not meet any minimum criteria for hosting a deposit type.

Mill, Smelter, and Fluvial Tailings Locations

The coverage *tails* (table 1) includes point locations for mine-related sites such as smelters, mills, and fluvial tailings. Data were compiled during the U.S. Geological Survey Humboldt River watershed environmental assessment (Nash, 2003).

Geochemical Themes

Data Sets for Sediment and Soil Chemistry

Geochemical analyses of stream-sediment and soil samples collected by the NURE (National Uranium Resource Evaluation) program and the U.S. Geological Survey are integrated both as point coverages of log-transformed data (vector data sets, table 1) and as images of gridded and normalized data (raster data sets, table 2). The data sets contain updated and new chemical analyses of the original NURE samples and analysis of additional stream sediments collected by the USGS (King and others, 1996; Folger, 2000). These new analyses were completed during the period 1995 to 2000 specifically to provide a regional and analytically consistent geochemical data set for the mineral and environmental assessment on public lands. The sample coverage for the Humboldt River basin is generally spatially uniform with a sample density of one sample site per 17 km^2 . Sample density is greatest along range fronts and sparsest along mountain ridges and valley bottoms.

These NURE data sets are useful for evaluating relationships between water and sediment chemistry, as well as identifying areas that may warrant further mineral exploration (Folger, 2000, Yager and Folger; 2003).

Table 2. Raster digital terrain coverage, NURE geochemical contour maps, and mineral favorability tracts for the Humboldt River basin and vicinity.

[Data-set attributes for all data are described in the metadata.txt file in the METADATA folder]

Raster data category	Data set name	Data description	Applicable scale	Data source
Elevation	nev_dem	Digital elevation model	30-m resolution	USGS
Geochemistry	Sc, Fe, Co, Ni, Cu, Zn, As, Se, Ag, Sb, Ba, Au, Tl, Pb, Ce	Geochemical contour maps for Sc, Fe, Co, Ni, Cu, Zn, As, Se, Ag, Sb, Ba, Au, Tl, Pb, Ce	1:500,000	(Folger and others, 2000)
Mineral tracts	plu sed vol	Mineral favorability tracts hosted in plutonic (plu), sedimentary (sed), and volcanic (vol) rocks	1:500,000	(Wallace and others, 2004)

Add Theme

The add theme button icon is accessed from the toolbar and permits multiple georeferenced data sets to be loaded into the view window. Geographic data formats that a user can load with the add theme button include shapefiles, coverages, images, CAD drawings, VPF layers, and ArcSDE layers. Follow these instructions to add a theme:

1. Press the "Add Theme" button (a new pop-up window is displayed).
2. Navigate to the VECTOR or RASTER folder.
3. Double-click the coverage or image of interest or single-click the desired coverage and press the "Add Theme" button in the new pop-up window.
4. Click the white box adjacent to the added theme name (a check appears in the box and the theme is drawn in the display area). In order to use other tools on a theme, or to query the data in a coverage, single-click the legend theme name to activate the coverage (clicking the white legend box only to display the data does not make the coverage active). If the theme is active, then a box outline will appear in raised relief. Double-clicking a layer name in the ArcExplorer window legend and selecting such classification options such as "Unique Values" permits modification of feature symbology.

Query Tool

The query function button icon is accessed from the toolbar and permits a geographic query of a vector data set. This tool is useful for identifying such coverage attributes as land ownership, chemical concentrations in surface water and

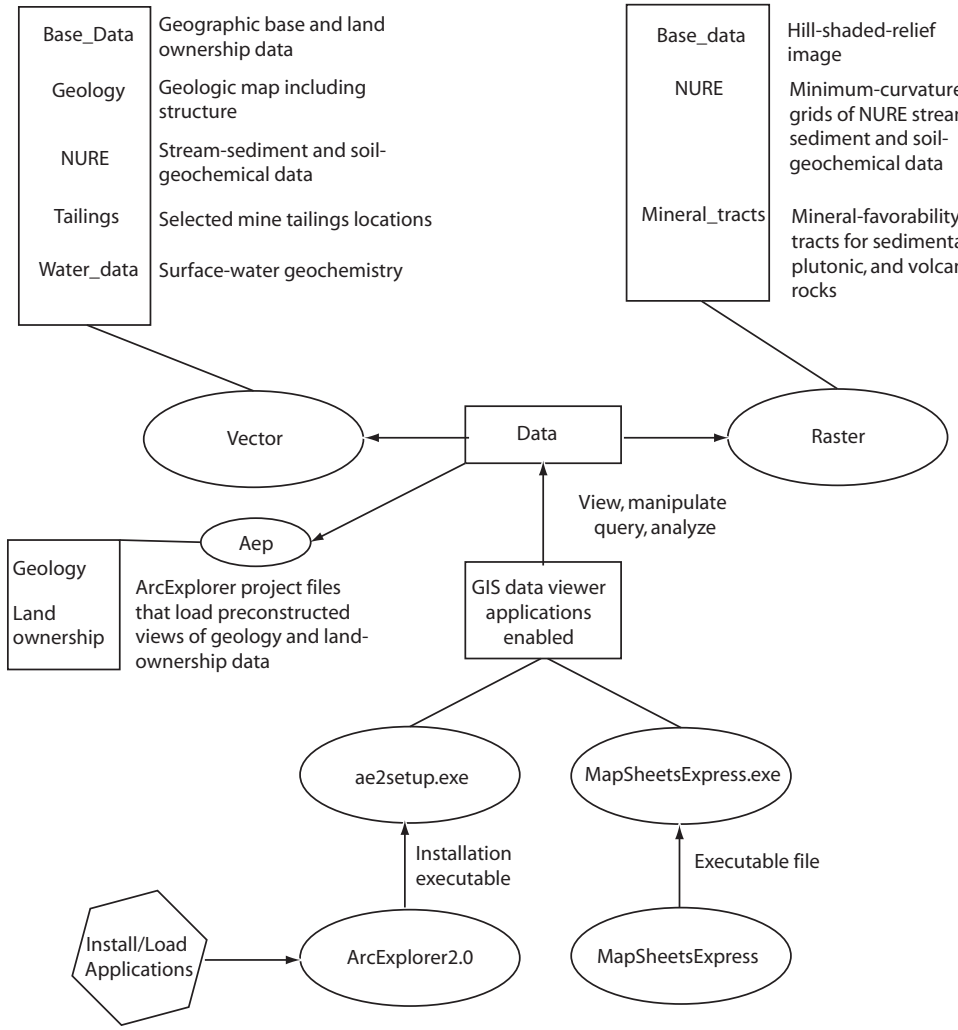
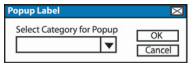


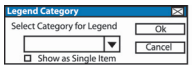
Figure 1. Organization of data.

Pop-Up Label

The "Pop-up Label" function is accessed from the pull-down menu "Layer" option on the main toolbar. When the "Pop-Up Labels" option is toggled on and the cursor is initially placed over a feature in a coverage, the "Pop-Up Label" window 

will open, prompting the user to select an attribute field that will be displayed when the cursor is placed over the next feature. This function is particularly useful for examining the chemistry of water, soil or sediment samples at a specific location. The value of grid cells may also be displayed; however, the grid-cell data for the contoured sediment-chemistry maps are not provided with these data sets (table 2) but are included in Folger and others (2000). The maps referenced in table 2 use color-coded legends to indicate ranges of chemical concentration.

Legend

The legend function is accessed from the "View" pull-down menu option on the main toolbar. When the "Legend" option is toggled on, the "Legend Category" window 

opens, prompting the user to select a legend category from the attribute-field list. The legend is displayed on the right side of the view window immediately after selecting a category. When a coverage feature is selected by double-clicking in the active coverage, the row of the legend corresponding to the feature is highlighted. Geochemical contour maps and a hill-shaded terrain map available for display in MapSheetsExpress are listed in table 2. All vector data (table 1) may also be displayed combined with other raster data sets.

Layer and Map Views

MapSheetsExpress permits switching between the standard "Layer View" window and a page-size map-composition view referred to as "Map View." Map View allows the additional functionality of adding geographic images or drawings to a view window. MapSheetsExpress does not support printing of Map View compositions, although it is possible to print page-size map compositions with the use of other software. The user is referred to the program help for functionality of this and other parts of the MapSheetsExpress application.

Example of Using MapSheetsExpress to View Humboldt River Basin Data Sets

Geospatial comparisons may be made between the data sets for water chemistry, sediment and soil chemistry, and geology that were compiled for this product. The following step-by-step example indicates how a user may visually compare geochemical contour maps for arsenic and selenium in sediments, the coverage for geologic faults in northern Nevada, and the Humboldt River basin water-chemistry database using MapSheetsExpress.

1. Launch MapSheetsExpress by double-clicking the MapSheetsExpress executable file in the downloadable MapSheetsExpress folder. Alternatively, the entire MapSheetsExpress folder should be copied to a users computer hard drive to run the application locally. A readme.txt file is also accessible in this folder that discusses such issues as known incompatibilities, system requirements, and product notes and tips.
2. Open the following files in the same MapSheetsExpress view window.

   as.tif
   se.tif
   faults.shp
   hbh2o.shp

3. Click the "Swipe" function and select *as.tif* from the "Swipe layers to left of" drop-down list.
4. Use the Swipe function slider to remove the overlying raster and vector databases to reveal the underlying arsenic geochemical contour map.
5. Click the "Transparency" function and select the selenium map as the "Layer" in the drop-down list and use the "Transparency" slider to render the *se.tif* map transparent.
6. Click the *hbh2o* tab at the bottom of the view window to make the *hbh2o* coverage the active layer.
7. Select "Layer" from the main toolbar followed by "Pop-Up Label." Select the attribute of the water database of interest, i.e., pH.
8. Place the cursor over a point to determine pH at a specific site.
9. Select "View" from the main toolbar followed by "Legend" and select the "Category" of interest from the drop-down list.

Acknowledgments

We wish to thank Marguerite McKee, Bureau of Land Management, Reno, Nev., and Tracy Sole, U.S. Geological Survey, Denver, Colo., for their reviews of this report. We thank editor Richard Scott for his critique of an earlier version of this chapter. Dave Pickel, Natural Resources Conservation Service, Reno, Nev., provided a hydrologic unit coverage for the project area. Special thanks are in order for Marguerite McKee who facilitated integration of coverages that were created and maintained by the Bureau of Land Management office in Reno, Nev.

References

Baedecker, P.A., Grossman, J.N., and Buttleman, K.P., 1998, National geochemical database, PLUTO geochemical database for the United States: U.S. Geological Survey Digital Data Series, DDS-47, 1 CD-ROM.

Cox, D.P., and Singer, D.A., 1986, Mineral deposit models: U.S. Geological Survey Bulletin 1693, 379 p.

du Bray, E.A., ed., 1995, Preliminary compilation of descriptive geoenvironmental mineral deposit models: U.S. Geological Survey Open-File Report 95-831, 268 p.

Folger, H.W., 2000, Analytical results and sample locations of reanalyzed NURE stream-sediment and soil samples for the Humboldt River basin mineral-environmental assessment, northern Nevada: U.S. Geological Survey Open-File Report 00-421, 1 CD-ROM.

Gray, J.E., Adams, M.G., Crock, J.G., and Theodorakos, P.M., 1999, Geochemical data for environmental studies of mercury mines in Nevada: U.S. Geological Survey Open-File Report 99-576, 47 p.

Grimes, D.J., McHugh, J.B., and Meir, A.L., 1995, Chemical analyses of major, minor, and trace elements including gold and arsenic species, As(III), and As(V), in water samples collected along the Getchall trend, Humboldt County, Nevada: U.S. Geological Survey Open-File Report 95-636, 26 p.

Grimes, D.J., McHugh, J.B., and Meir, A.L., 1994, Chemical analyses of major, minor, and trace elements including gold and arsenic species, As(III), and As(V), in water samples from Kelly Creek Valley, Humboldt County, Nevada: U.S. Geological Survey Open-File Report 1994-135, 14 p.

King, H.D., Fey, D.L., Mootooka, J.M., Knight, R.J., Roushey, B.H., and McGuire, D.J., 1996, Analytical data and sample locality map of stream-sediment and soil samples from the Winnemucca-Surprise Resource Assessment Area, northwest Nevada and northeast California: U.S. Geological Survey Open-File Report 96-062-A [paper] and 96-062-B [diskette], 341 p.

McFaul, E.J., Mason, G.T., Jr., Ferguson, W.B., and Lipin, B.R., 2000, U.S. Geological Survey mineral databases; MRDS and MAS/MILS: U.S. Geological Survey Digital Data Series, DDS-52, 2 CD-ROMs.

Miller, W.R., 2000, Geochemical baselines of stream and spring waters and rankings of the potential release of total dissolved solids and resistance to introduced acidity from watersheds underlain by four rock compositional types from the Humboldt River basin, Nevada: U.S. Geological Survey Open-File Report 00-161, 50 p.

Nash, J.T., 2000, Hydrogeochemical data for historic mining areas, Humboldt watershed and adjacent areas, northern Nevada: U.S. Geological Survey Open-File Report 00-459, 49 p., available online at URL <http://pubs.usgs.gov/of/2000/ofr-00-0459/>.

Nash, J.T., 2003, Historic mills and mill tailings as potential sources of contamination in and near the Humboldt River basin, northern Nevada: U.S. Geological Survey Bulletin 2210-D, 36 p., available online at URL <http://pubs.usgs.gov/bul/b2210-d/>.

Raines, G.L., Sawatzky, D.L., Connors, K.A., 1996, Great Basin geoscience data base: U.S. Geological Survey Digital Data Series DDS-41, 2 CD-ROMs.

Stewart J.H., and Carlson, J.E., 1978, Geologic map of Nevada: U.S. Geological Survey and Nevada Bureau of Mines and Geology, scale, 1:500,000.

Tingley, J.V., 1992, Mining districts of Nevada: Nevada Bureau of Mines and Geology, Mackay School of Mines, Nevada Bureau of Mines and Geology Map 43, scale 1:1,000,000.

Wallace, A.R., Ludington, S., Mihalasky, M.J., Peters, S.G., Theodore, T.G., Ponce, D.A., and Berger, B.R., 2004, Assessment of metallic mineral resources in the Humboldt River basin, northern Nevada, *with a section on* platinum-group-element (PGE) potential of the Humboldt mafic complex by M.L. Zientek, G.B. Sidder, and R.A. Zierenberg: U.S. Geological Survey Bulletin 2218, 1 CD-ROM.

Yager, D.B., and Folger, H.W., 2003, NURE geochemical maps for the Humboldt River watershed and surrounding areas, northern Nevada: U.S. Geological Survey Miscellaneous Field Studies Map MF-2407-A–M.

Appendix A—System Requirements

Your system must meet the following requirements for ArcExplorer and MapSheetsExpress to install and function properly on your PC:

- Windows 95 and 98, Windows NT version 4.0, Windows 2000
- IBM/PC or compatible system with 486-class processor or better
- 16 MB RAM
- 40 MB hard-disk space for a typical installation (10 MB for minimum installation)
- Video card capable of 256-color (8-bit) display or better

The following items are recommended for best performance:

- Pentium-class processor or better.
- 32 MB RAM.
- 2 MB accelerated video card, capable of high-color (16-bit) display at 1024×768 resolution.

Published in the Central Region, Denver, Colorado
Manuscript approved for publication October 13, 2005
Editing, page layout, photocomposition—Richard W. Scott, Jr.
Graphics by the authors