EBTAG Matrix of Activities - Draft of September 2005

Española Basin Technical Advisory Group
http://esp.cr.usgs.gov/ebtag/

As a follow-up to discussions from all four Española basin workshops, EBTAG is working on a list of critical activities/data needs for better understanding the hydrogeologic framework in the Española basin. With this list, we hope to identify common priorities for needed work in order to successfully meet the diversity of problems to be addressed in the basin. To help manage the large number of items, we are organizing the list within general topics under five themes.

We have been working on populating this list with information regarding the organizations currently involved in addressing these topics, what information is available or about to be available, and how to get hold of the information. This populated list, called the "EBTAG matrix of activities", was first presented for comment at the 4th annual workshop, March, 2005. After further updates, we now have a draft version (as of September, 2005) available for download at http://esp.cr.usgs.gov/ebtag/EBTAG_matrix.pdf. This is a living document that will continually need updating. You can help by providing input! Please visit http://esp.cr.usgs.gov/ebtag/ if you have something to add/change.

THEME ONE: BASIC WATER DATA

I. Surface Water Data

1. Data collection campaign to establish an existing stream-gage measurement uncertainty and sources of uncertainty.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS-uncertainty analysis	Rio Grande--Otowi & White Rock	Jack Veenhuis	• Veenhuis, 2004.	-	Demonstrates that measurement uncertainty often exceeds calculated flow differences.
USGS/City of SF	Santa Fe River	Jack Veenhuis	-	-	Evaluate existing stream gaging network.
OSE/USGS	Seepage run from Española to Otawi	Jack Veenhuis	-	-	-

2. Establish more stream gages as are logistically possible following assessment of priorities for new data (e.g., data gaps, areas where diversions and pumping may affect

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS -- analysis of streamflow and seepage	Española Basin	Jack Veenhuis	-	Santa Fe River Drainage	Analysis of streamflow gages to identify data gaps.
City of SF	La Bajada	Claudia Borchert	-	-	Measure stream loss, measure water available to acequias.
City of SF/Watershed West	Santa Fe River	Claudia Borchert	Watershed West, 2004, Stream Gaging on the Santa Fe River: Water Years 2000-2003.	Stream gage on the Arroyo Masqueras ?	Quantify volume of storm flows, stream loss.

3. Conduct streamflow measurements on appropriate streams, and on irrigation inversions/return flows. These data are needed to quantify surface-water flows, gains, and

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF/Watershed West/DBSA	Santa Fe River	Claudia Borchert	DBSA, 2002, Santa Fe River Stream-Aquifer Interaction Study.	-	Quantify stream loss.
USGS -- seepage investigation	Rio Grande -- Otowi & White Rock	Jack Veenhuis	• Veenhuis, 2003.	-	To calculate seepage based on multiple measurements at each site during low flow.

4. Measure discharge and water chemistry at significant springs.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS -- Spring discharge and spring-water chemistry.	State wide, including Española Basin	Rene Garcia	Data retrievals available at http://waterdata.usgs.gov/nm/nwis.	-	Long-term data collection.
USGS -- Spring inventory.	State wide, including Española Basin	-	• White and Kues, 1992.	-	Long-term data collection.
NMED/DOE Oversight Bureau - LANL	Pajarito Plateau; White Rock Canyon	John Volkerding; John Kieling	Data and reports located in NMED Santa Fe Office, 2905 Rodeo Park Drive East, Building 1	-	-
LANL - environmental surveillance.	Pajarito Plateau, White Rock Canyon	David Rogers Pat Longmire	2003 Environmental Surveillance Report http://www.airquality.lanl.gov/pdf/ESR/LA-14162-ENV.pdf.	-	Regulatory and water-supply needs.

5. Collect water chemistry - water quality data for surface water.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF/Watershed West/DBSA	Santa Fe River	Claudia Borchert	DBSA, 2002.Santa Fe River Stream-Aquifer Interaction Study.	-	Determine stream/aquifer interaction.
USGS -- surface-water chemistry	State wide, including Española Basin	Rene Garcia	Data retrievals available at http://waterdata.usgs.gov/nm/nwis.	-	Long-term data collection.
LANL - environmental surveillance.	Pajarito Plateau	David Rogers	2003 Environmental Surveillance Report http://www.airquality.lanl.gov/pdf/ESR/LA-14162-ENV.pdf.	-	Regulatory and water-supply needs.
NMED/DOE Oversight Bureau - LANL	State wide, including Española Basin	Marcy Leavitt	Data and reports located in NMED Runnels Bldg., 1190 St Francis Drive, Santa Fe	-	-
NMBGMR	Santa Fe Embayment	Peggy Johnson	-	-	About 60 samples.

II. Ground-Water Data

6. Collect new water level measurements in existing wells.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS / City of SF	Santa Fe municipal wells: SF1, SF2, SF3, SF4, SF5	-	-	-	-
USGS/OSE -- Water-level monitoring network.	State wide, including Española Basin	Rene Garcia	Data retrievals available at http://waterdata.usgs.gov/nm/nwis.	-	Long-term data collection.
City of SF	City wells, Buckman Wells, dedicated MW	Claudia Borchert	• Shomaker, 2004.	-	Production well maintenance, groundwater modeling, source water management.
NMED/City of SF	North of City, Old Landfills	Claudia Borchert	2004, URS, Baseline Groundwater Monitoring Report Paseo de Vista Landfill, Santa Fe, NM.	-	-
NMED/PSTB - GW monitoring at LUST sites.	Española Basin	Susan von Gonton	Data and reports located in PSTB's Santa Fe Office, 2044 Galisteo St.	-	-
NMED/GWQB - Superfund Oversight Section.	Española - Railroad Ave. site	Dana Bahar	Data and reports located in NMED Runnels Bldg., 1190 St Francis Drive, Santa Fe	-	-
NMED/GWQB - Remediation Oversight Section.	Santa Fe - PNM/Santa Fe Well site	Bart Faris	Data and reports located in NMED Runnels Bldg., 1190 St Francis Drive, Santa Fe	-	-
NMED/SWB	Landfills - state wide including Española Basin	Ed Hansen	Data and reports located in NMED Runnels Bldg., 1190 St Francis Drive, Santa Fe	-	-
NMBGMR, OSE, SFCo (participating)/water level and well GPS measurements.	Santa Fe Basin	Peggy Johnson, NMBGMR; Doug Rappuhn, NMOSE	Access database with well inventory and water levels	-	-
LANL - water level monitoring program.	Pajarito Plateau	Armand Groffman	• Koch, et. al., 2004, Manual and Transducer groundwater levels from Test Wells at LANL, 1992-2003. . • Koch and Rogers, 2003, Water Supply at Los Alamos 1998-2001.	-	Regulatory and water-supply needs.

7. Determine the locations and production rates of existing municipal, county, and private wells.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF	City wells, Buckman Wells, dedicated MW	Claudia Borchert	Monthly OSE production reports, City's production database.	-	Water rights compliance.
LA County	-	Tim Glascoe	• Koch, et. al., 2004, Manual and Transducer groundwater levels from Test Wells at LANL, 1992-2003. . • Koch and Rogers, 2003, Water Supply at Los Alamos 1998-2001.	-	Regulatory and water-supply needs.
NMED/DWB	State wide, including Española Basin	Fernando Martinez	Public wells statewide	-	-

8. Establish an expanded ground-water observation-well network, including piezometers sited to support knowledge of the hydrological system, for repeated measurement. Priority wells should be located in vicinity of faults or pumping centers. Water chemistry data should also be collected from these wells.

	Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
	City of SF	Dedicating old production wells	C. Borchert	-	-	Source water management.
	OSE/USGS Plan of Study	Española Basin	D. McAda (USGS), J. Frost (OSE)	not published, 2001		scope OSE and others funded investigations
	City of SF	Water quality testing in production wells.	R. Gallegos	-	-	Safe Drinking Water compliance.
	USGS/OSE -- Construction and monitoring of Piezometers.	Española Basin (Santa Fe County)	Jack Frost	Site info and water-level data available at http://waterdata.usgs.gov/nm/nwis; see site IDs that differ only by last two digits.	-	Measurement of 3-dimensional hydraulic-head distribution.
	LANL - water level monitoring program.	Pajarito Plateau	Armand Groffman	-	-	Regulatory and water-supply needs.
	OSE/NBMGMR	Santa Fe Embayment	NMOSE, Jack Frost	Established observation-well network; first round measurements March 2005.	Need to implement the network.	-

9. Site new monitoring wells and evaluate adequacy of existing monitoring network to evaluate water quality and support contaminant transport modeling.

	Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
OSE/N	OSE/NMBGMR -- water quality data compilation	OSE/NMBGMR -- water quality data compilation	OSE/NMBGMR -- water quality data compilation	Access database with well inventory and water chemistry		Characterize general chemistry of Southern Espanola Basin; evaluate data gaps
	OSE/USGS Plan of Study	Española Basin	D. McAda (USGS), J. Frost (OSE)	not published, 2001		scope OSE and others funded investigations
	LANL - Groundwater Protection Program.	Pajarito Plateau	Armand Groffman	-	-	Regulatory and water-supply needs.

III. Recharge Data

10. Precipitation and evapotranspiration data, where still needed, across the region, particularly in higher-elevation drainage basins.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF	Ppct gage in SF River Upper Watershed	Claudia Borchert	-	-	Adaptive management of forest thinning project.
City of SF	Ppct gage at McClure	Claudia Borchert	-	-	Surface water management.
USFS	Nichols Dam-RO Portable #3	Chuck Maxwell	http://www.met.utah.edu/droman/states/NM_state_frame.html	-	-
NRCS	SNOTEL site	-	http://www.wcc.nrcs.usda.gov/snow/	-	-
LANL-USGS-City of Santa Fe - noble gas study.	Basin wide	Andrew Manning	-	-	Regulatory and water-supply needs.

11. Collection of infiltration data; particularly within bedrock, at mountain front, and within surficial alluvium.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/LANL - Noble gas study (infiltration information from basin GW tracer signature).	Española Basin	Andrew Manning	-	-	To evaluate mountain block and mountain front recharge and their geologic controls, help calibrate basin-wide GW regional flow models.
USGS/OSE -- Study of mountain-front recharge to Tesuque aquifer system.	Sangre de Cristo Mountains near Santa Fe	Scott Anderholm	• Anderholm, 1994.	-	-
USGS -- Study of mountain-front recharge to Tesuque aquifer system.	Sangre de Cristo Mountains near Santa Fe	-	• Wasiolek, 1995.	-	-

IV. Data Representation

12. Establish a centralized, multi-user computer database of basic surface-water and ground-water information (including water chemistry) of the EBTAG region. Update hydrologic and water quality database for the region on a yearly basis for the purpose of identifying relevant trends in water supply and possible declines in surface and groundwater quality.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
SFCo/Database and public access of permit application geohydrology reports.	Santa Fe County	Stephen Wust	Geohydrology reports are in public files, Santa Fe County Utilities Department.	-	-
USGS -- NWIS	Nation - wide, including Española Basin.	Robert Gold	New Mexico data available at http://waterdata.usgs.gov/nm/nwis.	-	Long-term data collection.
LANL- WRTAO	Española Basin	Charlie Nylander	-	-	-
OSE/NMBGMR	Santa Fe Embayment.	Peggy Johnson	Searchable database on CD-ROM - available from Peggy.	-	-

13. Construct updated hydraulic-head and water-level-decline maps.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF	Sources of supply.	Claudia Borchert	Quarterly graphs.	-	Maintain quarterly graphs of water level behavoir in monitored wells.
LANL -site-wide characterization and modeling.	Pajarito Plateau (detailed), basin-scale (less detailed).	David Rogers Elizabeth Keating	Annual Status Reports.	-	-
OSE-NMBGMR, others	Española Basin	P. Johnson (NMBGMR), J. Frost (NMOSE)			

14. Build a suite of up-to-date GIS data layers for interpretive work and data display.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - many projects.	Pajarito Plateau (detailed), basin-scale (less detailed).	Rick Kelley Brad McKown	-	-	-

THEME TWO: WATER QUALITY AND WATER CHEMISTRY.

I. Data Needs and Tools to Complete Objectives Below.

1. Compile existing and historical water quality data. Determine gaps in existing Jemez y Sangre 2000 database for pre-2000 data (including NMED GWB, NMED SWB, NMED STB, City of Española, County). Update data base with 2000-present data (including LANL, EPA-STORET, NMED DWB, City). Explore availability of data from BIA and Pueblos.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Uranium geochemistry project and background chemistry project.	Basin-scale	Elizabeth Keating Pat Longmire	-	-	-
LANL, SFCo/water fairs	Pojoaque/Tesuque/Nambe	Stephen Wust	-	-	-
SFCo/Water source study	Santa Fe Basin	Stephen Wust	-	-	-
City of SF	Ground water production wells	R. Gallegos	Annual Consumer Confidence Report; City SF database.	-	Determine sources of natural and anthropogenic constituents.
NMED: water quality issues from UST sites, dry cleaners, landfills, WWTPs etc. may be identified with NMED files. LUST sites that have contaminated groundwater with petroleum hydrocarbons could be mapped with GIS coordinates.	State wide, including Española Basin	Susan von Gonten	Data and reports are located at NMED offices in Santa Fe	-	-
DOE - RACER project: Risk Assessment Corp./ LANL.	LANL and some surrounding areas	Justin Mohler	http://www.racteam.com/LANLRisk/RACERDatabase.htm	-	-

2. Compile bibliography of existing and historical water quality reports and other sources of water quality data.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR	Santa Fe embayment	Peggy Johnson	-	-	-

3. Conduct a comprehensive geochemical assessment of produced and natural waters to include major soluble ions, isotopes, effective tracers, natural and anthropogenic threats to water quality, and ground-water age determination.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS -- Geochemical assessment (proposed but unfunded).	Española Basin	Laura Bexfield	-	-	-
LANL - Uranium geochemistry project and background chemistry project.	Basin-scale	-	-	Age dates (both old and young waters).	-
OSE and NMBGMR	Santa Fe Basin	Jack Frost, Peggy Johnson	Access database with well inventory and water chemistry available upon request	-	Compile existing data and determine datagaps for characterization of basin general chemistry and stable isotopes

4. Collect new geochemical data including isotopic and water-age analyses.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS (Denver) /City SF	SF River Watershed	Claudia Borchert	-	-	Quantify recharge, characterize flow paths and water-rock interaction, and determine age of ground water in the basin.
USGS/LANL - Noble gas study	Española Basin	Andrew Manning	-	-	To evaluate mountain block and mountain front recharge and their geologic controls, help calibrate basin-wide GW regional flow models.
OSE/USGS Plan of Study	Española Basin	D. McAda (USGS), J. Frost (OSE)	not published, 2001		scope OSE and others funded investigations
OSE/NMBGMR -- water quality data collection	Santa Fe Basin	Jack Frost, Peggy Johnson	Access database with well inventory and water chemistry available upon request	-	~50 water samples analyzed for major/minor ions, trace elements, stable isotopes along E-W transects and variable depths

5. Analyze water quality and aquifer mineralogy.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Uranium geochemistry project .	Pojoaque Valley (primarily)	Elizabeth Keating Pat Longmire	-	Uranium mineralogy data from many locations in Santa Fe Group.	-
City of SF	Buckman, City of SF	Claudia Borchert	-	-	Safe Drinking Water compliance; water resource management.
City of SF/ USGS/ EE&T	Rio Grande surface water at Buckman	Claudia Borchert	USGS NM annual report; City of SF treatability studies.	-	Treatability of surface water.

II. Water Quality Objectives

6. Predict changes in groundwater chemistry, particularly along Rio Grande, that may occur with continued and/or increased pumping and provide probabilistic analysis of future water quality.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Uranium geochemistry project	Española Basin	Elizabeth Keating			

7. Examine the controls on deep upflow at the Rio Grande, and the role of deep upflow on water quality.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Uranium geochemistry project	Española Basin	Elizabeth Keating	-	-	-

8. Determine probabilistic flowpaths and travel times for contaminants at LANL, and use the results to evaluate adequacy of existing monitoring network and to potentially site new monitoring wells.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Environmental Restoration and Groundwater Protection Program.	Pajarito Plateau	Kay Birdsell Elizabeth Keating Velimir Vesselinov	-	-	-

9. Quantify recharge, characterize flow paths and water-rock interaction, and determine age of ground water in the basin.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/OSE -- Study of mountain-front recharge to Tesuque aquifer system.	Sangre de Cristo Mountains near Santa Fe	Scott Anderholm	• Anderholm,1994.	-	-
USGS/LANL - Noble gas study	Española Basin	Andrew Manning	-	-	To evaluate mountain block and mountain front recharge and their geologic controls, help calibrate basin-wide GW regional flow models.
LANL - Groundwater Protection, Uranium geochemistry.	Basin-scale	Elizabeth Keating	-	-	-
OSE/NMBGMR -- water quality characterization	Santa Fe Basin	Jack Frost, Peggy Johnson	Access database with well inventory and water chemistry	-	Characterize flow paths, recharge areas, and aquifer compartmentalization

10. Determine possible influence of faults on ground-water flow, including the chemistry of fault rocks.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR/OSE	Santa Fe River	Peggy Johnson	-	-	Evaluated location of faults in relation to geologic mapping and changes in water level.

11. Determine sources of natural and anthropogenic constituents.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF	Nitrate in Torreon; SF well	-	-	-	-
LANL - Groundwater Protection.	Pajarito Plateau and Pojoaque Valley	David Rogers Pat Longmire	-	-	-
LANL SFCo/Water Fairs.	Pojoaque/Tesuque/Nambe	Stephen Wust	-	-	-

12. Calibrate coupled flow/transport model to historical trends in ground-water chemistry using existing and new geochemical data.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Groundwater Protection.	Española Basin	Elizabeth Keating	-	-	-

THEME THREE: THREE DIMENSIONAL HYDROGEOLOGICAL ARCHITECTURE.

I. Data Acquisition and Characterization of Hydrostratigraphy and Aquifer Heterogeneity.

1. Develop a hydrostratigraphic framework of the Santa Fe Group through mapping and surface and subsurface stratigraphic analyses. This framework will include the spatially variable thickness of the Santa Fe Group aquifer, extent, continuity, and interconnectedness of high conductivity facies.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Groundwater Protection Program	Pajarito Plateau	Greg Cole	-	-	Regulatory and water-supply needs.
USGS - Geologic quad mapping	Española Basin	Mark Hudson	-	-	Geologic information understanding hydrogeologic framework and to address goals of USGS National Cooperative Mapping Program.
USGS - Geologic map compilation 1:100K	Los Alamos 1:100K	David Sawyer	-	-	Geologic information understanding hydrogeologic framework and to address goals of USGS National Cooperative Mapping Program.
USGS/OSE - geophysical studies	Española Basin	Tien Grauch	• Grauch and Bankey, 2003. • Phillips and Grauch, 2004.	Deep borehole information	Focus on thickness of SFG, basin geometry, thickness of volcanics for ultimate inclusion in a 3D geologic model of the basin.
USGS - Geologic compilation/synthesis	La Bajada and Cerros del Rio	Scott Minor, David Sawyer	• Minor, in press	-	Part of geologic and geophysical synthesis
NMBGMR/OSE - geologic/hydrogeologic studies	Española Basin	Dan Koning	Read and others, 2005; geologic quad maps at http://geoinfo.nmt.edu/statemap/home.html	permission to access wells	Understand 3-D hydrogeologic architecture

2. Quantify hydrogeological contrasts and connections between saturated Ancha, Tesuque, Espinaso, and Galisteo Formations in the Santa Fe embayment.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
OSE, NMBGMR	Santa Fe Embayment	Peggy Johnson	-	-	Ancha and Ancha/Tesuque contact.
City SF	Greater SF area via gw model	Claudia Borchert	-	-	GW resource management.
OSE/USGS Plan of Study	Española Basin	D. McAda (USGS), J. Frost (OSE)	not published, 2001		scope OSE and others funded investigations

3. Determine hydrologic significance of volcanic rocks including distribution of volcanic aquifers and nature of fracture flow in these aquifers.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Groundwater Protection Program	Pajarito Plateau	Elizabeth Keating	-	-	Regulatory and water-supply needs.
USGS - Cerros del Rio studies	Cerros del Rio	Mark Hudson	-	-	Information on lateral distribution of volcanic packages within field.
City SF	Greater SF area via GW model	Claudia Borchert	-	-	GW resource management.

4. Determine relationship between geologic and hydrologic properties by acquisition of porosity/permeability data for all hydrostratigraphic units.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR/OSE - geologic/hydrogeologic studies	Santa Fe and Buckman	Peggy Johnson	-	-	Permeametry tests & looking .
UNM-E&PS	Near La Puebla	Gary Smith	• Gaud, 2002.	-	-

5. Acquire paired corehole and well data for hydrologic tests and geophysical logs to determine correlation of rock types to geophysical responses and hydrological properties.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Groundwater Protection Program	Pajarito Plateau	Steven McLin	-	-	Regulatory and water-supply needs.

6. Develop paleogeographic reconstructions to aid understanding of present-day distribution of rock types and structures.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
UNM-E&PS	North-central NM	Gary Smith	• Smith, 2004.	-	Regional synthesis of geologic history and development of Rio Grande rift.

II. Data Acquisition and Characterization of The Influence of Structure on Ground-water Flow.

7. Use geologic mapping and seismic-reflection data to define dip domains within the basin; Evaluate anisotropy of dipping beds.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR-STATEMAP program	Española basin	Mike Timmons	http://geoinfo.nmt.edu/statemap/home.html	-	Geologic mapping of 7-and-1/2 minute quads.
USGS - Geologic quad mapping	Española basin	Mark Hudson	-	-	Geologic information understanding hydrogeologic framework and to address goals of USGS National Cooperative Mapping Program.
LANL - Site-wide characterization data	Pajarito Plateau	David Broxton	-	-	Regulatory and water-supply needs.

8. Locate faults based on new mapping and geophysical data.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR-STATEMAP program	Española Basin	Mike Timmons	http://geoinfo.nmt.edu/statemap/home.html		Locate faults as part of geologic mapping.
USGS - Geologic quad mapping	Española Basin	Mark Hudson	-	-	Mapped faults to be used in regional fault characterization.
USGS - Regional fault characterization	Española Basin	Mark Hudson/Scott Minor		-	Detailed examination of faults.
USGS/OSE - geophysical studies	Southern Española Basin	Tien Grauch	• Grauch and Bankey, 2003; • U.S.G.S. et. al., 1999.	-	Mapping of faults from aeromagnetic data.

9. Conduct field studies to characterize faults in different rock types, characterize hydrological characteristics of damage zones, determine extent of cementation, etc.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS - Regional fault characterization	Española Basin	Mark Hudson/Scott Minor/Jonathan Caine	• Minor and Hudson, in press (N. Albuquerque basin)	-	Information intended for ultimate inclusion in a 3D geologic model of the basin & for understanding hydrogeologic properties of faults.
LANL - Seismic hazards	-	Claudia Lewis	-	-	Regulatory and water-supply needs.

10. Locate potential faults that influence ground-water flow utilizing existing water-level and pump-test data. These studies would include faults within the basin and near or within the mountain block to the east.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR/OSE-geologic/hydrogeologic studies	Santa Fe Embayment	Peggy Johnson	-	-	As part of jointly scoped hydrogeologic studies.

11. Design aquifer test with observation wells near a well-characterized fault. Dedicate piezometer nest near one or more faults to monitor basin-scale and well field-scale affects of faults on temporally varying head distribution.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
-	-	-	-	-	-

12. Evaluate fault hydraulic properties via water chemistry differences.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
-	-	-	-	-	-

III. Geophysics and Remote-Sensing Data Acquisition and Analysis.

13. Acquire additional airborne time-domain electromagnetic surveys to tie existing surveys together and obtain complete coverage of basin: Integrate with ground TEM data.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS - geophysical studies	Cerros del Rio area	Brian Rodriguez	• Rodriguez et al., in press. • Deszcz- Pan, et. al., 2000.	Need to acquire more.	Airborne is on our wish list. We have airborne TEM over Cochiti Pueblo area and are tying it to ground-based MT data collected in larger area, including Cerros del Rio.
LANL	Pajarito Plateau	Scott Baldridge Greg Cole	-	Need to acquire more.	-

14. Reinterpret magnetotelluric data to extract shallow hydrogeologic data and to map water table beneath volcanic rocks (e.g., Cerros del Rio).

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Environmental Restoration	Pajarito Plateau; Cerros del Rio	Scott Baldridge	-	-	Regulatory and water-supply needs.
USGS - geophysical studies	Cerros del Rio area	Brian Rodriguez	• Rodriguez et al., in press. • Williams and Rodriquez, 2003. • Williams and Rodriquez, 2001.	-	We are tying ground magnetotelluric data to airborne TEM data to determine water table where possible W. of Cerros del Rio.

15. Acquire denser network of ground-based gravity data.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
SAGE	Española Basin, especially Eldorado area and La Bajada.	Scott Baldridge	• Biehler, 1999. • Biehler et al., 1991. • Ferguson et al., 1999.	-	Gravity data collection part of ongoing SAGE activities; determine basin shape and fault structure.

16. Use time-lapse micro-gravity measurements to determine effect of drought on water levels, changes in aquifer storage, inflow/outflows.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL	-	Allen Cogbill	-	-	-

17.Reinterpret existing and acquire new high-resolution seismic data, especially on the east side of the basin.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
SAGE	-	Scott Baldridge	-	-	Student training.

18. Investigate and monitor potential aquifer compaction and land-surface subsidence in response to groundwater pumping (geodetic network and InSAR).

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL/Scripps-collecting GPS, gravity measurements.	-	Allen Cogbill Davis Thomsen	-	-	-

19. Develop mechanisms to run recommended suite of borehole geophysics logs in priority holes.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
-	-	-	-	-	-

20. Reopen Yates La Mesa #2 well and update geophysical evaluation and interpretation of the Tesuque aquifer and deeper horizons.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
OSE (proposed)	Yates La Mesa #2 well	Jack Frost	-	Funding required.	-evaluate deep Santa Fe Group and build monitoring well.

IV. Integrated Analyses.

21. Develop procedures to better integrate geological and hydrological data to evaluate geological controls on the ground-water flow system. Include examination of relationships of drawdown to aquifer properties and faults.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	GW resource management.

22. Integrate ground-water chemistry (including ground-water age) data with geological and hydrological data to model flow paths, recharge, and affects of hydrostratigraphic heterogeneity and faults on ground-water flow.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	GW resource management.

23. Integrate new geologic and geophysical investigations regarding the presence of faults, dipping strata, and changes of porosity and permeability in the basin formations; analyze existing pump test results to assess importance of dipping beds, horizontal anisotropy, and model parameters.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	GW resource management.

24. Use information and conceptualizations of anisotropy and heterogeneity to conduct probabilistic analyses of changes in hydraulic gradients and water levels that will occur due to continued and/or increased ground water withdrawal.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS WRD and BIA	Pojoaque valley		Hearne, 1985		models dipping beds; Aamodt lawsuit
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	GW resource management.

25. Integrate geological, geochemical, geophysical, and hydrological data to model water budget and quantify groundwater-surface water exchange and mountain front recharge.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	GW resource management.

THEME 4: WATER BALANCE AND STREAM/AQUIFER INTERACTION.

I. Data Needs.

1. Precipitation and evapotranspiration data across the region.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
BIA (Ppct station in Tesuque Basin).	Tesuque basin	Bill White	-	-	-
City of SF	Ppct gage in SF River Upper Watershed.	Claudia Borchert	-	-	Adaptive management of forest thinning project.
City of SF	Ppct gage at McClure.	Claudia Borchert	-	-	Surface water management.
USFS	Nichols Dam-RO portable #3	Chuck Maxwell	http://www.wcc.nrcs.usda.gov/snotel/new_mexico/new_mexico.htm;	-	-
NRCS-SNOTEL	Tesuque and Santa Fe watersheds.	-	http://www.wcc.nrcs.usda.gov/snotel.pl?sitenum=922&state=nm	-	-

2. Measure water levels in alluvium associated with streams and in adjacent regional aquifer system.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/OSE -- Water-level monitoring network.	State wide, including Española Basin	Rene Garcia (USGS), Doug Rappuhn (NMOSE)	Data retrievals available at http://waterdata.usgs.gov/nm/nwis	-	Long-term data collection.

3. Fill in gaps of streamflow measurements, including irrigation diversions and returns, based on analysis of existing data and the current measurement network. Conduct a single season of streamflow measurements on streams in the Santa Fe River, Rio Pojoaque, and Rio Santa Cruz drainage basins to quantify a snapshot in time of surface-water flows, gains, and losses.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/OSE -- analysis of streamflow and seepage.	Española Basin	Jack Veenhuis	-	Santa Fe River Drainage.	Identify data gaps.

4. Measure discharge and conduct chemical analyses of water from significant springs.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
-	-	-	-	-	-

5. Collect water-chemistry data to help identify recharge zones and flow paths between surface and ground water.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/SF City - Noble gas study.	Santa Fe River	Andy Manning	-	-	To evaluate if stream loss from SF river is a significant GW recharge component.
USGS -- Geochemical assessment (proposed:unfunded).	Española Basin	Laura Bexfield	-	-	-

6. Maintain up-to-date data base of ground-water pumping.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City of SF	City production wells	Claudia Borchert	Internal database	Need way to provide access to public.	-
LANL - WRTAO	Española Basin	Charlie Nylander	-	-	-

7. Update hydrologic and water-quality databases on a yearly basis for the purpose of identifying relevant trends in water supply and possible declines in surface- and ground-water quality.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - WRTAO	Española Basin	Charlie Nylander	-	-	-

II. Analyzing Geological Controls on Ground-Water/Surface-Water Interaction.

8. Update interpretation of the geologic framework and its influence on ground-water flow. Integrate new geologic and geophysical investigations regarding the presence of faults, dipping strata, and changes of porosity and permeability in the basin-fill strata.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF	Greater SF area via GW model	Claudia Borchert	-	-	GW resource management.
OSE/USGS Plan of Study	Española Basin	Mc Ada, Frost	not published, 2001		scope OSE and others funded investigations

9. Integrate surface-water models with ground-water models.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
SFCo/Water source study.	Santa Fe Basin	Stephen Wust	-	-	-

10. Estimate propagation of pumping effects from ground-water pumping centers particularly where it may influence other wells and surface-water flow. Estimate effects of pumping on surface-water flow.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - regional modeling.	Española Basin	Elizabeth Keating	Manscript in review	-	GW resource management.
OSE models and water rights studies	statewide	Tom Morrison	many memos and reports		water rights administration
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	-
SFCo/Water source study.	Santa Fe Rver Basin	Stephen Wust	-	-	-
USGS/SF City - Noble gas study.	Santa Fe River	Andrew Manning	-	-	-

11. Use new data and models to determine the impact of anisotropy caused by dipping beds, facies (conductivity) changes, and structural discontinuities in the Santa Fe Group to determine stream loss/gain, water levels in shallow aquifers, and ground-water flow paths.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF	Greater SF area via GW flow model.	Claudia Borchert	-	-	GW resource management.
OSE and partners	Española Basin				basis for improved administration

III. Water-Balance Analyses.

12. Utilize comprehensive ground-water and surface-water models of the Española Basin to better understand ground-water flows between sub-basins, the interconnection of ground water and surface water, and an overall water budget for the basin.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - regional modeling.	Española Basin	Elizabeth Keating	• Keating et. al., 2003.	-	-
OSE and USGS-WRD models and studies	Española Basin and statewide	Tom Morrison	McAda-Wasiolek model and variations, local studies		stream aquifer impacts
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	-

13. Analyze water-chemistry data to identify recharge zones and regional ground-water-flow paths.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS -- Geochemical assessment (proposed;unfunded).	Española Basin	Laura Bexfield	-	-	To evaluate mountain block and mountain front recharge and their geologic controls, help calibrate basin-wide GW regional flow models.
LANL - regional modeling	Española Basin	Elizabeth Keating	-	-	-
USGS/LANL - Noble gas study.	Española Basin	Andrew Manning	-	-	-

14. Conduct studies to better quantify (a) water budget components stemming from ground-water/surface-water exchange; (b) surface-water inflow to sub-basins; (c) irrigated acreages and the surface-water diversions associated with them; and (d) mountain-front recharge.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/SF City - Noble gas study.	Santa Fe River	Andrew Manning	-	-	To evaluate if stream loss from SF river is a significant GW recharge component.

15. Use population-growth estimates to refine the estimation of future ground-water diversions by pumping in sub-basins.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF	Santa Fe	Rick Carpenter	-	-	-
SFCo/Water source study.	Santa Fe River	Stephen Wust	-	-	-

THEME 5: DATA INTEGRATION AND MODEL HYPOTHESIS TESTING.

I. Data Integration.

1. Maintain and update a suite of up-to-date geographic information system (GIS) data layers for interpretive work and data display. Make available for data exchange for different purposes.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
OSE	Española Basin	Jack Frost	http://www.ose.state.nm.us/water-info/gis-data/EBTAG.html	-	-
USGS - geologic studies/3D modeling.	Española Basin	Ted Brandt	-	-	GIS in support of geologic mapping and 3D modeling.
NMBGMR-STATEMAP program	Española basin	Mike Timmons	http://geoinfo.nmt.edu/statemap/home.html	-	Geologic maps of 7-and-1/2 minute quads Espanola Basin 50K compilation.

2. Identify and/or develop software tools that allow multiple conceptual models of hydrostratigraphy to be easily integrated into ground-water flow and transport models.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
SFCo/Water source study.	Santa Fe River Basin	Stephen Wust	-	-	-

3. Assess existing flow models and conduct model revisions taking into account new data and improved modeling capabilities, including GIS. Experiment with new calibration and parameter estimation techniques to reduce model uncertainties in predicting impact.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
City SF	Greater SF area via GW flow model.	Claudia Borchert	-	-	GW resource management.
SFCo/Water source study.	Santa Fe River Basin	Stephen Wust	-	-	-
LANL - ongoing regional modeling.	Española Basin	Elizabeth Keating	-	-	-

4. Collect, compile, and evaluate porosity and permeability (transmissivity and storage properties) of hydrogeologic units, including evaluation of compatibility of data collected with different methods and at different spatial scales.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
NMBGMR/OSE	Santa Fe and Buckman	Peggy Johnson	-	-	Correlations between mappable hydrostratigraphic units and hydraulic conductivity
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	GW resource management.
LANL - Groundwater Protection.	Focus on Pajarito Plateau	Elizabeth Keating	• Nylander, C., et al., 2002, Groundwater Protection Program Annual Status Report.	-	-
NMED/DOE Oversight Bureau - LANL.	-	John Volkerding	Data and reports located in NMED Santa Fe Office, 2905 Rodeo Park Drive East, Building 1	-	-

5. Develop end-user interfaces for ground-water models developed by LANL, USGS, OSE or other public agencies.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Groundwater Protection.	Española Basin	-	-	-	-
NMED/DOE Oversight Bureau - LANL.	Española Basin	John Volkerding	Data and reports located in NMED Santa Fe Office, 2905 Rodeo Park Drive East, Building 1	-	-

6. Integrate surface-water and ground-water models.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
SFCo/Water source study.	Santa Fe River Basin	Stephen Wust	-	-	-

II. Model Analysis and Hypothesis Testing

7. Use sensitivity analysis to determine what type of data, collected where and by what methods are most significant to the outcomes of hydrogeological modeling. Using this process, identify critical areas where additional surface and subsurface data are needed.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
LANL - Groundwater Protection.	Pajarito Plateau	Elizabeth Keating	-	-	GW resource management.
OSE Hydrology Bureau	Española Basin pumping centers	Tom Morrison	many internal memos and reports		ongoing, enhanced impact assessment
City SF/County SF	Greater SF area via gw model	Claudia Borchert/ Stephen Wust	-	-	-
USGS -- Quantitative assessment of data needs using model uncertainty (proposed;unfunded).	Española Basin	Doug McAda	-	-	-

8. Develop Española basin specific hypotheses, testable by existing models and their variants. Evaluate them in terms of 3D geohydrology. Analyze the uncertainty using probabilistic as well as deterministic models.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
-	-	-	-	-	-

9. Examine the effects of geologic heterogeneities on ground-water flow and ground-water surface-water interactions. Analyses using geologic information and stream gain/loss information to quantify the effect of dipping and alternating beds of differing permeability in contact with stream alluvium. Evaluate what geological parameters most strongly affect the ground water flow system, and learn how to model them using predictive numerical flow models.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
USGS/BIA/OSE -- Hearne model (incorporates dipping beds).	Pojoaque River Basin	-	• Hearne, 1985. BIA Consultant/OSE versions for Aamodt lawsuit.	-	-

10. Determine where and which fault properties impact ground-water flow and chemistry. Analyze and interpret model results and hypotheses test results to define and refine most important parameters of fault related fluid flow in the aquifer system. Depending on ground water flow directions, differences in geochemistry and age of water on either side of faults may be used to help identify barriers to flow. Conversely differences in geochemistry may indicate the presence of barrier not previously identified.

Agency / Activity	Study Location	Contact	Data / Publications / Reports	Needs	Rationale
-	-	-	-	-	-

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Abbreviations

BIA	Bureau of Indian Affairs
City SF	City of Santa Fe
DBSA	Daniel B. Stevens & Associates
EE&T	Environmental Engineering and Technology, Inc.
E&PS	Earth and Planetary Sciences
DWB	Drinking Water Bureau (NMED)
DOE	Department of Energy
GPS	Global Positioning System
GW	Groundwater
GWQB	Ground Water Quality Bureau (NMED)
IGPP	Institute of Geophysics and Planetary Physics
InSAR	Interferometric Synthetic Aperture Radar
LANL	Los Alamos National Laboratory
LUST	Leaking Underground Storage Tank
MW	Monitor well
MT	Magnetotelluric
NMBGMR	New Mexico Bureau Geology & Mineral Resources
NM	New Mexico
NMED	New Mexico Environment Department
NRCS	Natural Resource Conservation Service
NWIS	National Water Information System
OSE	Office of State Engineer
Ppct	Precipitation
PSTB	Petroleum Storage Tank Bureau (NMED)
RACER	Risk Assessment-Communication-Evaluation-Reduction
SAGE	Summer of Applied Geophysical Experience
SF	Santa Fe
SFCO	Santa Fe County
SWB	Solid Waste Bureau (NMED)
SWQB	Surface Water Quality Bureau (NMED)
TEM	Airborne time domain electromagnetic
UNM	University of New Mexico
USFS	United States Forest Service
USGS	United States Geological Survey
UST	Underground Storage Tank
WRTAO	Water Research Technical Assistance Office

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