

MEMORANDUM

DATE: September 12, 2014 **PROJECT:** 605.141

TO: Vicky Peacey and Kami Ballard
RESOLUTION COPPER MINING LLC

FROM: Todd Keay
MONTGOMERY & ASSOCIATES

SUBJECT: SUMMARY OF HYDRAULIC CONDUCTIVITY ESTIMATES FROM
TESTING OF HYDROLOGIC CHARACTERIZATION WELLS, 2004-
2012

In accordance with a request from Vicky Peacey, Resolution Copper Mining LLC, we have prepared a table summarizing hydraulic conductivity estimates from testing of wells and boreholes during hydrologic characterization activities conducted by Montgomery & Associates (M&A) during the period 2004 through 2012. To date, results of hydraulic testing and analysis have been provided in individual reports or technical memoranda for wells or groups of wells completed over the course of the 8 year period from 2004 to 2012. To assist in disseminating hydraulic conductivity (K) data developed by M&A to other parties, this memorandum has been prepared as an interim summary of available data.

Table 1 provides a comprehensive listing of wells for which test data are available for estimating values for hydraulic conductivity. **Table 1** includes information on location and collar elevation of wells for which test data are available, type of hydraulic test conducted, test interval, hydrogeologic unit(s) tested, and estimated K values from these tests. In addition, pertinent references that provide detailed discussion of testing methods, results, and analysis are noted. A comprehensive reference list for pertinent M&A reports is provided below.

Reference List

- Montgomery & Associates, 2005, **Results of preliminary hydrogeologic characterization for Apache Leap Tuff aquifer system in Devils Canyon and Upper Queen Creek watersheds, Pinal and Gila Counties, Arizona:** *DRAFT* report prepared for Resolution Copper Company, June 3, 2005 (revised May 2006).
- _____, 2008, **Hydrogeologic characterization well HRES-4: Results of long-term aquifer test, Resolution Copper Mining LLC, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining, LLC, Superior, Arizona, May 23, 2008, 8 p.
- _____, 2010, **Results and analysis of long-term pumping test at well HRES-07, Resolution Copper Mining LLC, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining, LLC, Superior, Arizona, April 21, 2010, 5 p.
- _____, 2011a, **Results of drilling, construction, equipping, and testing at hydrologic test well DHRES-06, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, May 13, 2011, 17 p.
- _____, 2011b, **Results of drilling, construction, equipping, and testing at hydrologic test wells HRES-10 and HRES-11, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, May 13, 2011, 21 p.
- _____, 2011c, **Results of drilling, construction, and testing at hydrologic test wells DHRES-03, DHRES-04, DHRES-05, and DHRES-05B, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, June 17, 2011, 22 p.
- _____, 2011d, **Results of drilling, construction, and testing at hydrologic test well DHRES-09, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, December 8, 2011, 15 p.
- _____, 2011e, **Results of drilling, construction, and testing at hydrologic test wells DHRES-11 and HRES-12, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, December 8, 2011, 22 p.
- _____, 2011f, **Results of drilling, construction, and testing at hydrologic test wells DHRES-12 and DHRES-13, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, December 22, 2011, 18 p.

- _____, 2012a, **Results of drilling, construction, and testing at hydrologic test well HRES-13, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, January 5, 2012, 13 p.
- _____, 2012b, **Results of drilling, construction, and testing at hydrologic test wells HRES-09 and DHRES-07, Resolution Copper Mining, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining LLC, January 25, 2012, 22 p.
- _____, 2012c, **Results and analysis of 23-day aquifer test at well HRES-09, Resolution Copper Mining LLC, Pinal County, Arizona:** Technical memorandum prepared for Resolution Copper Mining, LLC, Superior, Arizona, January 26, 2012, 9 p.
- _____, 2012d, **Summary of hydrogeologic investigations conducted during the period 2006 through 2010, Resolution Copper Mining, Pinal County, Arizona:** Report prepared for Resolution Copper Mining LLC, July 6, 2012, 42 p.

**TABLE 1. SUMMARY OF HYDRAULIC CONDUCTIVITY ESTIMATES FOR WELLS AND BOREHOLES
HYDROGEOLOGIC CHARACTERIZATION INVESTIGATIONS, 2004 - 2012
RESOLUTION COPPER MINING LLC, SUPERIOR, ARIZONA**

WELL	TYPE OF HYDRAULIC TEST	LOCATION COORDINATES (State Plane 1983 - Arizona Central Zone)		TEST INTERVAL				HYDROGEOLOGIC UNIT ^c	ESTIMATED HYDRAULIC CONDUCTIVITY (cm/s) ^e	MONTGOMERY & ASSOCIATES SOURCE
		NORTHING (feet)	EASTING (feet)	COLLAR ELEVATION (feet amsl) ^a	TOP (feet bls) ^b	BOTTOM (feet bls) ^b	THICKNESS (feet)			
APACHE LEAP TUFF AQUIFER										
HRES-01	4-hour open borehole airlift test	839000	959223	4169	879	1598	719	Tal	3.E-05	M&A, 2005
HRES-01	Zone A: 12-hour constant rate pumping test			4169	1033	1111	78	Tal	3.E-06	M&A, 2005
HRES-01	Zone B: 12-hour constant rate pumping test			4169	1345	1420	75	Tal	3.E-05	M&A, 2005
HRES-01	Zone C: 12-hour constant rate pumping test			4169	1527	1600	73	Tal	1.E-05	M&A, 2005
HRES-02	Zone A: 12-hour constant rate pumping test	836245	961757	3979	646	692	46	Tal	1.E-03	M&A, 2005
HRES-02	Zone B: 12-hour constant rate pumping test			3979	1017	1053	36	Tal	3.E-05	M&A, 2005
HRES-02	Zone C: 12-hour constant rate pumping test			3979	1256	1313	57	Tal	2.E-05	M&A, 2005
HRES-03	2-hour open borehole airlift test	841033	967960	4076	397	1500	1103	Tal	7.E-06	M&A, 2005
HRES-03	Falling-head slug test			4076	1456	1500	44	Tal	2.E-07	M&A, 2012d
HRES-04	25-day constant rate pumping test	835383	964532	4075	569	782	213	Tal	1.E-04	M&A, 2008
HRES-05	Zone A: 12-hour constant rate pumping test	830986	965230	3992	374	435	61	Tal	6.E-03	M&A, 2005
HRES-06	12-hour constant rate pumping test	852682	977112	4432	392	800	408	Tal	7.E-05	M&A, 2012d
HRES-07	60-day constant rate pumping test	829960	969606	4016	382	749	367	Tal	9.E-04	M&A, 2010
HRES-07	Falling-head slug test			4016	812	1019	207	Tal	2.E-05	M&A, 2012d
HRES-09	23-day constant rate pumping test	831903	965770	3923	271	1078	807	Tal	1.E-04	M&A, 2012c
HRES-10	10-hour constant rate pumping test	829225	990434	2935	158	398	240	Tal	9.E-04	M&A, 2011b
HRES-11	48-hour constant rate pumping test	821967	980584	3466	598	1078	442	Tal	1.E-04	M&A, 2011b
HRES-12	7.5-hour constant rate pumping test	847210	963794	4169	1767	1967	200	Tal	1.E-06	M&A, 2011e
HRES-13	12-hour constant rate pumping test	829165	962268	4199	470	860	390	Tal	4.E-04	M&A, 2012a
Oak Flat	3-hour constant rate pumping test	841129	967934	4077	401	432	31	Tal	2.E-05	M&A, 2012d
A-06	8.5-hour constant rate pumping test	834172	971258	4168	523	1475	952	Tal	2.E-04	M&A, 2012d
MJ-11	5-hour constant rate pumping test	829456	973629	3918	298	785	487	Tal	1.E-04	M&A, 2012d
DEEP GROUNDWATER SYSTEM										
DHRES-04	12-hour constant rate pumping test	837627	947291	3022	1770	2319	549	QTg	1.E-05	M&A, 2011c
DHRES-05	Falling-head slug test	836291	943640	2778	1628	2915	1287	QTg	6.E-09	M&A, 2011c
DHRES-06	24 hour constant rate pumping test	826029	965588	4046	1262	2891	1629	Pnaco, Me, Dm, Cb, pCdiab	4.E-05	M&A, 2011a
DHRES-07	Bail-down Test	831891	965873	3923	4026	4429	404	pCdiab, Cb, Dm	6.E-06	M&A, 2012b
DHRES-09	24-hour constant rate pumping test	841697	947571	3116	430 1611 1971	910 1671 2071	640	pCdiab, pCds	4.E-06	M&A, 2011d
DHRES-11	31-hour constant rate pumping test	847171	963820	4168	4910	6679	1769	Dm, Cb, pCmls, pCdiab, pCdsu, pCdsl	1.E-07	M&A, 2011e
DHRES-13	24-hour constant rate pumping test	832219	954075	3443	1768 2457	2296 3530	1601	pCy	1.E-06	M&A, 2011f

^a Feet above mean sea level

^b Feet below land surface

^c Hydrogeologic Units:

Tal = Apache Leap Tuff

Tw = Whitetail Conglomerate

QTg = Gila Conglomerate

Pnaco = Naco Formation

Me = Escabrosa Formation

Dm = Martin Formation

Cb = Bolsa Quartzite

pCdiab = Precambrian Diabase

pCds = Precambrian Dripping Springs Quartzite (dsu = upper; dsl = lower)

pCmls = Precambrian Mescal Limestone

pCy = undifferentiated Younger Precambrian rocks

^d square meters per day (cubic meters per day per meter width of aquifer at 1:1 hydraulic gradient)

^e meters per day (cubic meters per day per meter of aquifer at 1:1 hydraulic gradient)