Capture Zone Analysis For Domestic Water Wells 04/21/2016

Within A Quarter Mile Of The Arroyo Grande

Proposed Aquifer Exemption Boundary (PAEB)

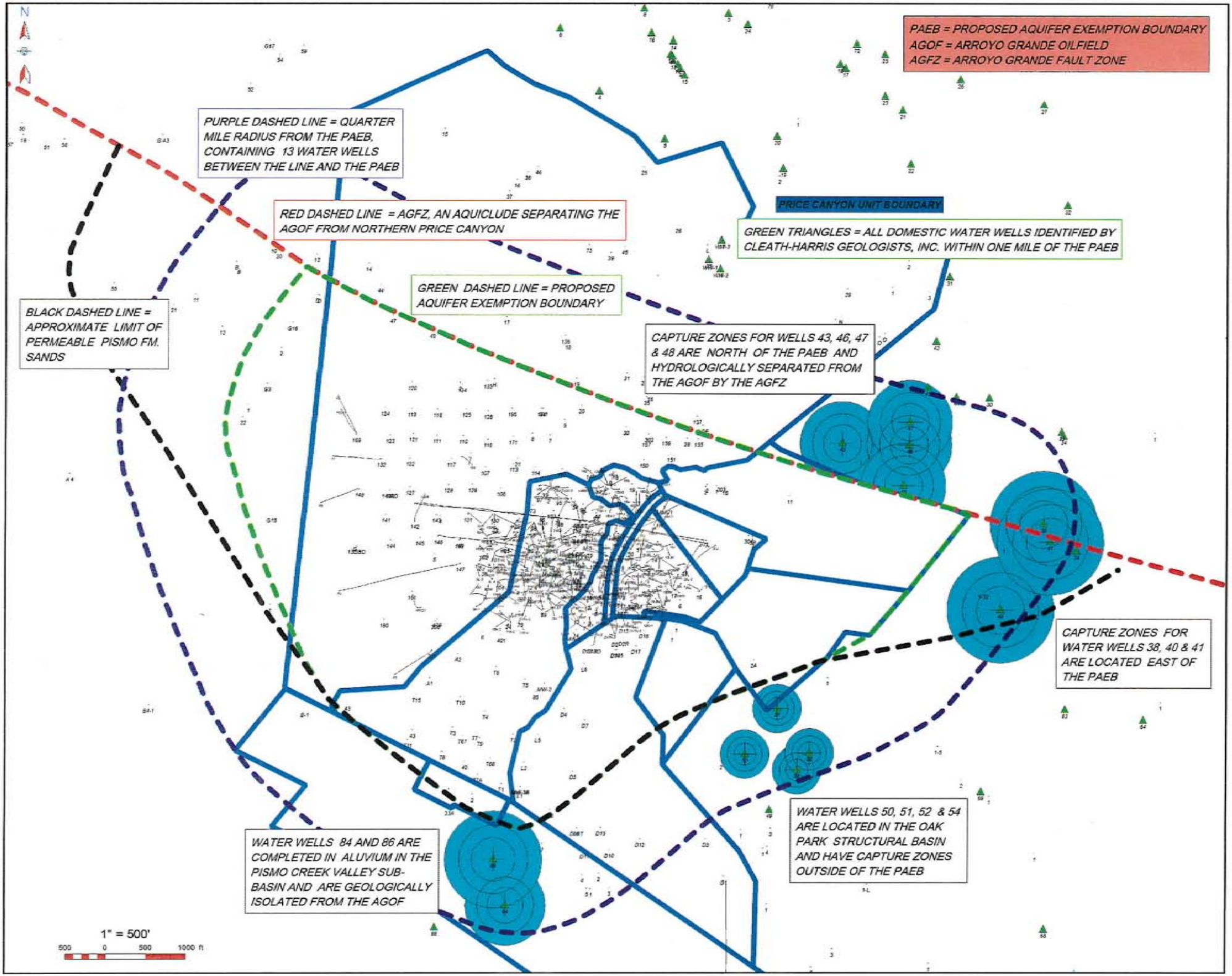
FM O&G was informed recently by DOGGR District 3 that the EPA would be requesting capture zone analysis of domestic water wells within a quarter mile of the PAEB for the Arroyo Grande Oil Field (AGOF). In response to this request, FM O&G rehired Cleath-Harris Geologists Inc. (CHG), that had conducted a survey of water wells within a 1-mile radius of the PAEB as part of the original aquifer exemption proposal, to field check the location of all water wells within a quarter mile of the PAEB and calculate each well's capture zone. CHG completed their field check reconfirming from their original 1-mile radius review that there are 13 domestic water wells within a quarter mile of the PAEB.

Following the field check, CHG calculated the capture zones for each of the 13 water wells using the 1999 California DWSAPP capture zone equation as shown in figure 1. A spreadsheet of their results is shown in figure 2. The capture zones for the 10 GPM, 2, 5 and 10 year cases for the 13 water wells are displayed in figure 3 (blue concentric circles representing the 2, 5 and 10 year cases). The 13 water well capture zones relationship to the PAEB are summarized as follows:

- Water Wells 38, 39 and 41: these water wells are located east of the PAEB and their capture zone areas do not cross the PAEB
- Water Wells 43, 46, 47 and 48: these water wells are located north of the PAEB and north of the main trace of the Arroyo Grande Fault Zone (AGFZ). Wells 46 and 47 have capture zones that do not abut the PAEB while wells 43 and 48 do. Because the AGFZ is an aquiclude, the capture zones for these two wells are limited to the north side of the main trace of the fault. The multiple lines of evidence for the AGOF being an aquiclude are given in the original aquifer exemption document.
- Water Wells 50, 51. 52 and 54: these water wells are southeast of the PAEB and their capture zones do not cross the PAEB. In addition, they are located on the north flank of the Oak Park structural basin which is an entirely separate hydrologic basin from the AGOF.
- Water Wells 84 and 85: these South Ranch water wells are completed in a thin alluvium (QAL) layer within Pismo Creek which overlies the Miguelito Member of the Pismo Formation consisting of siltstone and claystone. Hence, these wells are hydrologically isolated from the proposed aquifer exemption area. In addition, two of the four Phase IV monitoring wells, MW 3A and MW 3B completed in 2006, are located about 1000' north of these water wells along Pismo Creek in between the AGOF and the South Ranch property and have shown no change in the last ten years of oilfield operations.

A separate survey of water wells was done for the Center For Biological Diversity by Matt Hagemann, a certified hydrogeologist and a California professional geologist and co-founder of SWAPE. CHG noted in their field check that some water wells identified by Hagemann are not water wells. For example, Hagemann identified five frost protection windmills on the South Ranch property as water wells. Figure 4 shows one of these windmills which is clearly not a water well.

Parameters Used in Calculated Fixed Radius of Influence, Known Wells within 1320 feet of Proposed Exemption Boundary, Price Canyon													
Well Name	Log	Well Used as Proxy	Screen Height	Effective Porosity	2 GPM for 2 Years	2 GPM for 5 Years	2 GPM for 10 Years	5 GPM for 2 Years	5 GPM for 5 Years	5 GPM for 10 Years	10 GPM for 2 Years	10 GPM for 5 Years	10 GPM for 10 Years
38	YES	SAME	25	0.2	134	212	299	212	334	473	299	473	669
40	NO	38	25	0.2	134	212	299	212	334	473	299	473	669
41	NO	38	25	0.2	134	212	299	212	334	473	299	473	669
43	NO	46	40	0.2	106	167	236	167	264	374	236	374	529
46	YES	SAME	40	0.2	106	167	236	167	264	374	236	374	529
47	NO	46	40	0.2	106	167	236	167	264	374	236	374	529
48	NO	46	40	0.2	106	167	236	167	264	374	236	374	529
50	NO	52	120	0.2	61	97	137	97	153	216	137	216	305
51	NO	52	120	0.2	61	97	137	97	153	216	137	216	305
54	NO	52	120	0.2	61	97	137	97	153	216	137	216	305
86	YES	SAME	30	0.2	122	193	273	193	305	432	273	432	611
88	NO	84	44	0.2	101	159	225	159	252	356	225	356	504
52	YES	SAME	120	0.2	61	97	137	97	153	216	137	216	305


PAEB = PROPOSED AQUIFER EXEMPTION BOUNDARY
AGOF = ARROYO GRANDE OILFIELD
AGFZ = ARROYO GRANDE FAULT ZONE
PURPLE DASHED LINE = QUARTER MILE RADIUS FROM THE PAEB, CONTAINING 13 WATER WELLS BETWEEN THE LINE AND THE PAEB
RED DASHED LINE = AGFZ, AN AQUICLUDE SEPARATING THE AGOF FROM NORTHERN PRICE CANYON
PRICE CANYON UNIT BOUNDARY
GREEN TRIANGLES = ALL DOMESTIC WATER WELLS IDENTIFIED BY CLEATH-HARRIS GEOLOGISTS, INC. WITHIN ONE MILE OF THE PAEB
GREEN DASHED LINE = PROPOSED AQUIFER EXEMPTION BOUNDARY
BLACK DASHED LINE = APPROXIMATE LIMIT OF PERMEABLE PISMO FM. SANDS
CAPTURE ZONES FOR WELLS 43, 46, 47 & 48 ARE NORTH OF THE PAEB AND HYDROLOGICALLY SEPARATED FROM THE AGOF BY THE AGFZ
CAPTURE ZONES FOR WATER WELLS 38, 40 & 41 ARE LOCATED EAST OF THE PAEB
WATER WELLS 50, 51, 52 & 54 ARE LOCATED IN THE OAK PARK STRUCTURAL BASIN AND HAVE CAPTURE ZONES OUTSIDE OF THE PAEB
WATER WELLS 84 AND 86 ARE COMPLETED IN ALUVIUM IN THE PISMO CREEK VALLEY SUB-BASIN AND ARE GEOLOGICALLY ISOLATED FROM THE AGOF
1" = 500'
500 0 500 1000 ft

April 21, 2016

DRAFT

Ken Gester
Freeport-McMoRan Oil & Gas
Ken_Gester@fmi.com

SUBJECT: Protection Zone Analysis, Freeport-McMoRan Price Canyon Property

Dear Mr. Gester:

As requested, Cleath-Harris Geologists (CHG) has completed the protection zone analysis using the California Drinking Water Source Assessment and Protection (DWSAP) Program protocol for wells within ¼ mile of the proposed exemption boundary of the Price Canyon Property. The results of this analysis follow.

Conduct of Work

CHG has evaluated previously identified wells and those inferred by Hagemann to determine the radii for zones of protection using the formula provided in the 1999 DWSAP. These radii have been mapped to see where they cross into the proposed aquifer exemption boundary for the Freeport-McMoRan Price Canyon Property. A categorical summary of the inferred Hagemann wells, maps showing the calculated and minimum zones of protection for wells within ¼ mile of the proposed exemption boundary, and tables summarizing parameters used in calculating radii for zones of protection are included in this memorandum.

Methodology

A groundwater protection zone is defined as 'a delineated area within the source area of a drinking water well." They further state, "zones differentiate areas of varying significance in terms of threat to the water source from contamination (DWSAP 1999). " The method for determining fixed radius for the zone of protection is outlined in the 1999 DWSAP Section 6-2, Table 6-2, and Figures 6-4, 6-5, 6-6. For this method the formula:

$$r = \sqrt{\frac{Qt}{\pi \eta H}}$$

is used to calculate the fixed radius of a well where r is the fixed radius of protection in feet, t is the time in years (2, 5, and 10 years used), π is approximately 3.1416, η is the effective porosity, q is the pumping rate in ft^3/year, and H is the height of the screened interval in feet.

The DWSAP method is for evaluating the zone of protection for public water supply wells. As such, this method gives a minimum radius to be used if the calculated radius is less. For porous

media, a 2-year continuous pumping duration minimum radius is 600 feet, a 5-year continuous pumping duration the minimum radius is 1500 feet and a 10-year continuous pumping duration the minimum radius is 2250 feet. For fractured media, a 2-year continuous pumping duration minimum radius is 900 feet, a 5-year continuous pumping duration minimum radius is 1000 feet and a 10-year continuous pumping duration minimum radius is 1500 feet. Exceptions to the use of the minimum protection zone radii within the DWSAP are allowed when analytical or hydrogeologic data exists to justify a protection zone modification. Additionally if a numerical modeling method is implemented the protection zone dimensions can be modified.

Application of Methodology

For purposes of this study CHG was tasked with reviewing wells within ¼ mile (1320 feet) of the proposed exemption boundary. This included a review of wells inferred by Hagemann. Review of DWSAP methodology provided a potential minimum radius of protection of 2250 feet, which was larger than the original area of interest. In response to this, the area of interest was increased to evaluate all wells whose zone of protection could be impinged upon by the proposed aquifer exemption boundary.

Previous work by CHG identified known and potential well sites within one mile of the proposed exemption boundary (CHG, May 2015). The first step in this evaluation was to reduce this data set to those wells within the new area of interest (Figure 1). Next, wells suggested by Hagemann's aerial reconnaissance were located and those within 2250 feet of the proposed boundary were considered (Figure 2). Each of the Hagemann inferred wells was evaluated to determine if the existence of the well could be validated (known well), invalided (not a well), or if it remained unconfirmed. Validation efforts were limited to publically available information and visual verification from aerial photos and public streets. The results of this evaluation are included in Table 1A and 1B and a plot of verified and unverified wells is included in Figure 3.

Once located, wells were examined to determine if well completion reports were available. If well completion reports were not available, the nearest well with a report was used as a proxy for the height of the screened interval for the well. For purposes of this evaluation an effective porosity of 0.2 was used. This is the porosity recommended for analysis in the DWSAP protocol. This is within the range of porosity for fractured Monterey Formation and is more conservative than effective porosity of 0.25 for the Pismo Formation that was identified at nearby Cold Canyon Landfill Expansion (Fugro 2008). Continuous flow rates of 2 gpm (3.2 AFY), 5 gpm (8 AFY) and 10 gpm (16 AFY) were used in the calculations. Analysis was performed for both known wells and for the Hagemann inferred wells which were either validated, or which could not be excluded. A summary of parameters for these wells is included in Tables 2 and 3. Maps showing the calculated zones of protection for known wells are included in Figures 4-6 and maps indicating the zones of protection for Hagemann's proposed wells are shown in Figures 7-9. All calculated zoness of protection were smaller than the DWSAP minimums outlined in the protocol. As such minimum zones of protection were calculated and mapped for all known and inferred wells. A summary of wells that have zones of

protection that are impinged upon by the proposed exemption boundary can be found in Table 4 and maps showing the impingement are in Figures 10 and 11.

Discussion

Of the inferred well locations identified by Hagemann in his response to previous work by CHG, thirty-five wells were within 2250 feet of the proposed exemption boundary and had potential to be impinged upon under DWSAP minimum zones of protection. Of these, five inferred wells were determined to be frost protection windmills with associated propane tanks during field examination. These were removed from the list. Fifteen inferred wells were found to correspond to known wells, and five inferred wells were located on parcels that had been previously determined to have an unlocated well (Cleath-Harris, May 2015). The remaining ten inferred wells are associated with parcels which have at least one other located well on them. Visual examination of the property from public right of way was unable to determine the existence of additional wells.

Image showing a frost protection windmill and associated fuel tank at the site of H-97. Similar windmills mark the sites of H-98, H-99, H100, and H101. These were determined not to be wells (See Table 1B, Figures 2 and 3.)

Two significant assumptions were made in conducting the protection zone analysis. The first is the assumption of a flow rate, and the second is to assume that the screened height/zone of wells without logs were similar to those of the nearest logged wells. Assumed continuous flow rates used in evaluating wells ranged from two gallons per minute or 3 acre feet per year (AFY), which would be larger than the typical rural residential domestic use of 1.5 AFY, to ten gallons per minute 16 AFY which would represent a a light-duty agricultural well. Examination of geologic maps and locations of known wells suggests that the nearest-neighbor assumption is tenable. For wells clustered around Tolosa Place (see Figure 1, Wells 42, 43, 44, 45, 46, 47, 48), well production would likely be limited to shallow Pismo Formation or deeper fractured Monterey Formation. Known logs show wells perforated in the Monterey Formation and Pismo Formation and the assumption is made that adjacent wells penetrate and produce from at least some of the Monterey Formation. To the northeast, wells (38, 41, 40, 39) produce from a thicker interval of Pismo Formation. Wells without available logs are assumed to produce only from this thickness of the Pismo Formation, although it is possible they penetrate the underlying Monterey Formation. In the east, known wells produce from the Edna Member of the Pismo Formation, that is underlain by the Miguelito Member of the Pismo Formation. Given the deeper unproductive zone and the thicknesses of the Edna Member in this area it is likely nearby wells without logs also produce from the Edna Member.

Results for the calculated fixed radii of protection for both known and proposed wells are summarized in Tables 2 and 3. At flow rates of 2 and 5 gpm, Well 48 had a fixed radius of protection that was crossed by the proposed aquifer exemption boundary and at 5 gpm proposed Well H77 had a radius of protection that was crossed by the proposed exemption zone. At 10 gpm, three known wells (43, 48 and 86) and one proposed well (H77) were impinged upon by the boundary. While H77 cannot be verified, the impingement by the proposed exemption boundary on its zone protection warrant inclusion for analysis until its presence can be ruled out. In all cases the calculated zone of protection was much smaller than the DWSAP minimum. When the larger minimum areas are examined, 6 of the known and 10 of the inferred wells were impinged on by the proposed boundary after two years of continuous pumping. At 5 years of continuous pumping, 10 of the known and 16 of the inferred wells were impinged upon by the proposed exemption boundary and, at 10 years of continuous pumping, 20 of the known and 19 of the inferred wells were impinged upon by the proposed exemption boundary (Table 4, Figures 10 and 11).

Calculated radii for DWSAP Method protection zones could be more accurately defined by collecting actual production data and well completion reports from well owners. Additionally, data for current water levels, and water quality, and pumping tests on wells located within the area of interested should be collected if possible to further constrain the hydrogeology and protection zones of wells within the area of interest. Owner data, and testing would be particularly valuable in further constraining the three wells whose

calculated protection zones impinge on the proposed exemption boundary (Wells 48, 86, and H77).

Conclusions

The DWSAP Program protection zone methodology was applied to wells within ¼ mile of the proposed aquifer exemption boundary. A groundwater protection zone is defined as by the DWSAP method as 'a delineated area within the source area of a drinking water well." DWSAP protocols further state, "zones differentiate areas of varying significance in terms of threat to the water source from contamination (DWSAP 1999)." Calculated radii of protection for wells operating between 2 gpm and 10 gpm (continuous) resulted in three wells with protection zones that were impinged on by the proposed aquifer exemption area (Wells 48, 86, and H77). Using the minimum radius of protection from the DWSAP method found that 6 of the known and 10 of the inferred wells were impinged on by the proposed boundary after two years of continuous pumping. Using the minimum radius method with 5 years of continuous pumping, 10 of the known and 16 of the inferred wells were impinged upon and, with the minium radius method, after 10 years of continuous pumping, 20 of the known and 19 of the inferred wells were impinged upon by the proposed exemption boundary. According to the DWSAP Program guidelines, exceptions to the use of the minimum protection radii are allowed when analytical or hydrogeologic data exists to justify a protection zone modification. Additionally, a numerical flow model may also be used to modify the minimum protection zone radii.

If you have any questions regarding the recommendations or conclusions of this report, please feel free to contact us.

Sincerely,
CLEATH-HARRIS GEOLOGISTS, INC.

Timothy S. Cleath, PG CHG CEG
President

Neil D. Currie
Staff Geologist

References

Cleath-Harris Geologist, Water Well Completion Report Memo to Freeport-McMoRan, May 2015.

Division of Drinking Water and Environmental Management

California Department of Health Services, Drinking Water Souce Assessment and Protection (DWSAP) Program, January 2009 http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/dwsapguidance/DWSAP_document.pdf

Fugro West, Inc. Joint Technical Document for Cold Canyon Landfill Appendix G: Water Resources Assement, 2008

Fugro West, Inc. Joint Technical Document for Cold Canyon Landfill Appendix G: Technical Memorandum, 2008

Table 1A: Summary of Inferred Hagemann Wells				
Hagemann Well	STATUS	CHG Well ID #	Parcel	Comment
H60	VERIFIED	42	044-221-010	Same as Well 42
H61	VERIFIED	43	044-211-013	Same as Well 43
H62	UNVERIFIED	NONE	044-211-015	Possible Well, Three other wells verified/located on this parcel by CHG, Not visible from public access
H63	UNVERIFIED	NONE	044-211-015	Possible Well, Three other wells verified/located on this parcel by CHG, Not visible from public access
H64	VERIFIED	46	044-211-015	Same as Well 46
H65	UNVERIFIED	NONE	044-211-015	Possible Well, Three other wells verified/located on this parcel by CHG, Not visible from public access
H66	VERIFIED	47	044-211-015	Same as Well 47
H67	VERIFIED	45	044-211-014	Same as Well 45
H68	UNVERIFIED	NONE	044-211-014	Possible Well, Two other wells located on this parcel by CHG, Not visible from public access
H69	VERIFIED	44	044-211-014	Same as Well 44
H71	VERIFIED	35	044-191-004	Same as Well 35
H77	UNVERIFIED	NONE	044-211-003	Possible Well , One other well located on this parcel by CHG, Not visible from public access
H78	VERIFIED	38	044-211-003	Same as Well 38
H79	VERIFIED	41	044-211-009	Same as Well 41
H80	VERIFIED	39	044-211-008	Same as Well 30
H81	VERIFIED	40	044-211-009	Same as Well 40
H82	VERIFIED	63	044-301-016	Same as Well 63
H84	UNVERIFIED	NONE	044-241-055	Possible Well , One other well located on this parcel by CHG, Not visible from public access
H85	UNVERIFIED	NONE	044-301-043	Possible Well , One other well located on this parcel by CHG, Not visible from public access
H86	VERIFIED	86	044-301-043	Same as Well 86
H87	UNVERIFIED	NONE	044-301-043	Possible Well, not Visible from Public Access, one well verified near residence by CHG
H88	VERIFIED	68	044-301-038	Same as Well 68
H89	UNVERIFIED	NONE	044-301-023	Listed as Developed Parcel, Well Location not Established Figure 2 Parcel Map (CHG Report May 2015), Not visible from parcel map, visible power drop

Table 1B: Summary of Inferred Hagemann Wells				
Hagemann Well	STATUS	CHG Well ID #	Parcel	Comment
H90	UNVERIFIED	NONE	044-241-056	Listed as Developed Parcel, Well Location not Established Figure 2 Parcel Map (CHG Report May 2015), Not visible from parcel map, visible power drop
H91	UNVERIFIED	NONE	044-241-056	Listed as Developed Parcel, Well Location not Established Figure 2 Parcel Map (CHG Report May 2015), Not visible from parcel map, visible power drop
H92	UNVERIFIED	NONE	044-241-038	Possible Well, One other well located on this parcel by CHG, Not visible from public access
H93	VERIFIED	50	044-241-038	Located CHG Well 50
H94	UNVERIFIED	NONE	044-241-038	Possible Well, One other well located on this parcel by CHG, Not visible from public access
H95	UNVERIFIED	NONE	044-241-027	Listed as Developed Parcel, Well Location not Established Figure 2 Parcel Map (CHG Report May 2015), Not visible from parcel map, visible power drop
H96	UNVERIFIED	NONE	044-241-027	Listed as Developed Parcel, Well Location not Established Figure 2 Parcel Map (CHG Report May 2015), Not visible from parcel map, visible power drop
H97	NOT A WELL	NONE	079-281-027	Not A Well, Agricultural Windmill and Propane Tank for Frost Protection
H98	NOT A WELL	NONE	079-281-027	Not A Well, Agricultural Windmill and Propane Tank for Frost Protection
H99	NOT A WELL	NONE	079-281-027	Not A Well, Agricultural Windmill and Propane Tank for Frost Protection
H100	NOT A WELL	NONE	079-281-027	Not A Well, Agricultural Windmill and Propane Tank for Frost Protection
H101	NOT A WELL	NONE	079-281-027	Not A Well, Agricultural Windmill and Propane Tank for Frost Protection

Table 2: Calculated Radius of Protection for Known Wells within 1320' of Proposed Exemption Boundary, Freeport-McMoran Price Canyon Property														
Parameters						*Radii in feet*								
CHG Well ID #	Log	CHG Well # Used as Proxy	Type	Screen Height (ft)	Effective Porosity	2 gpm for 2 Years	2 gpm for 5 Years	2 gpm for 10 Years	5 gpm for 2 Years	5 gpm for 5 Years	5 gpm for 10 Years	10 gpm for 2 Years	10 gpm for 5 Years	10 gpm for 10 Years
38	YES	Same	Porous	25	0.2	134	212	299	212	334	473	299	473	669
40	NO	38	Porous	25	0.2	134	212	299	212	334	473	299	473	669
41	NO	38	Porous	25	0.2	134	212	299	212	334	473	299	473	669
43	NO	46	Fractured	40	0.2	106	167	236	167	264	374	236	374	529
46	YES	Same	Fractured	40	0.2	106	167	236	167	264	374	236	374	529
47	NO	46	Fractured	40	0.2	106	167	236	167	264	374	236	374	529
48	NO	46	Fractured	40	0.2	106	167	236	167	264	374	236	374	529
50	NO	52	Porous	120	0.2	61	97	137	97	153	216	137	216	305
51	NO	52	Porous	120	0.2	61	97	137	97	153	216	137	216	305
54	NO	52	Porous	120	0.2	61	97	137	97	153	216	137	216	305
86	YES	Same	Porous	30	0.2	122	193	273	193	305	432	273	432	611
88	NO	84	Porous	44	0.2	101	159	225	159	252	356	225	356	504
52	YES	Same	Porous	120	0.2	61	97	137	97	153	216	137	216	305

Table 3: Calculated Radius of Protection for Hagemann Inferred Wells within 1320' of Proposed Exemption Boundary, Freeport-McMoran												
Parameters				Radii in feet								
Well ID for Hagemann/ CHG ID #	Well Used as Proxy	Effective Porosity	Screen Height	2 gpm for 2 Years	2 gpm for 5 Years	2 gpm for 10 Years	5 gpm for 2 Years	5 gpm for 5 Years	5 gpm for 10 Years	10 gpm for 2 Years	10 gpm for 5 Years	10 gpm for 10 Years
H61/43	46	0.2	40	106	167	236	167	264	374	236	374	529
H62	46	0.2	40	106	167	236	167	264	374	236	374	529
H63	46	0.2	40	106	167	236	167	264	374	236	374	529
H64	46	0.2	40	106	167	236	167	264	374	236	374	529
H65	46	0.2	40	106	167	236	167	264	374	236	374	529
H66/47	46	0.2	40	106	167	236	167	264	374	236	374	529
H78/38	38	0.2	25	134	212	299	212	334	473	299	473	669
H79/41	38	0.2	25	134	212	299	212	334	473	299	473	669
H81//40	38	0.2	25	134	212	299	212	334	473	299	473	669
H92	52	0.2	120	61	97	137	97	153	216	137	216	305
H93/50	52	0.2	120	61	97	137	97	153	216	137	216	305
H94	49	0.2	100	67	106	150	106	167	236	150	236	334
H95	49	0.2	100	67	106	150	106	167	236	150	236	334
H96	49	0.2	100	67	106	150	106	167	236	150	236	334

Table 4: DWSAP protection zones that intersect the proposed groundwater exemption boundary					
Known Wells			*Hagemann Inferred Wells*		
Wells that intesect at 2 years	Wells that intesect at 5 years	Wells that intesect at 10 years	Wells that intesect at 2 years	Wells that intesect at 5 years	Wells that intesect at 10 years
43	30	30	H61	H61	H60
48	38	33	H62	H62	H61
51	42	34	H63	H63	H62
86	43	38	H64	H64	H63
46	46	39	H65	H65	H64
47	50	40	H66	H66	H65
	51	41	H77	H67	H66
	52	42	H94	H68	H67
	84	43	H95	H69	H68
	86	44	H96	H77	H69
		45		H78	H77
		46		H92	H78
		47		H93	H79
		48		H94	H81
		50		H95	H92
		51		H96	H93
		52			H94
		54			H95
		84			H96
		86			

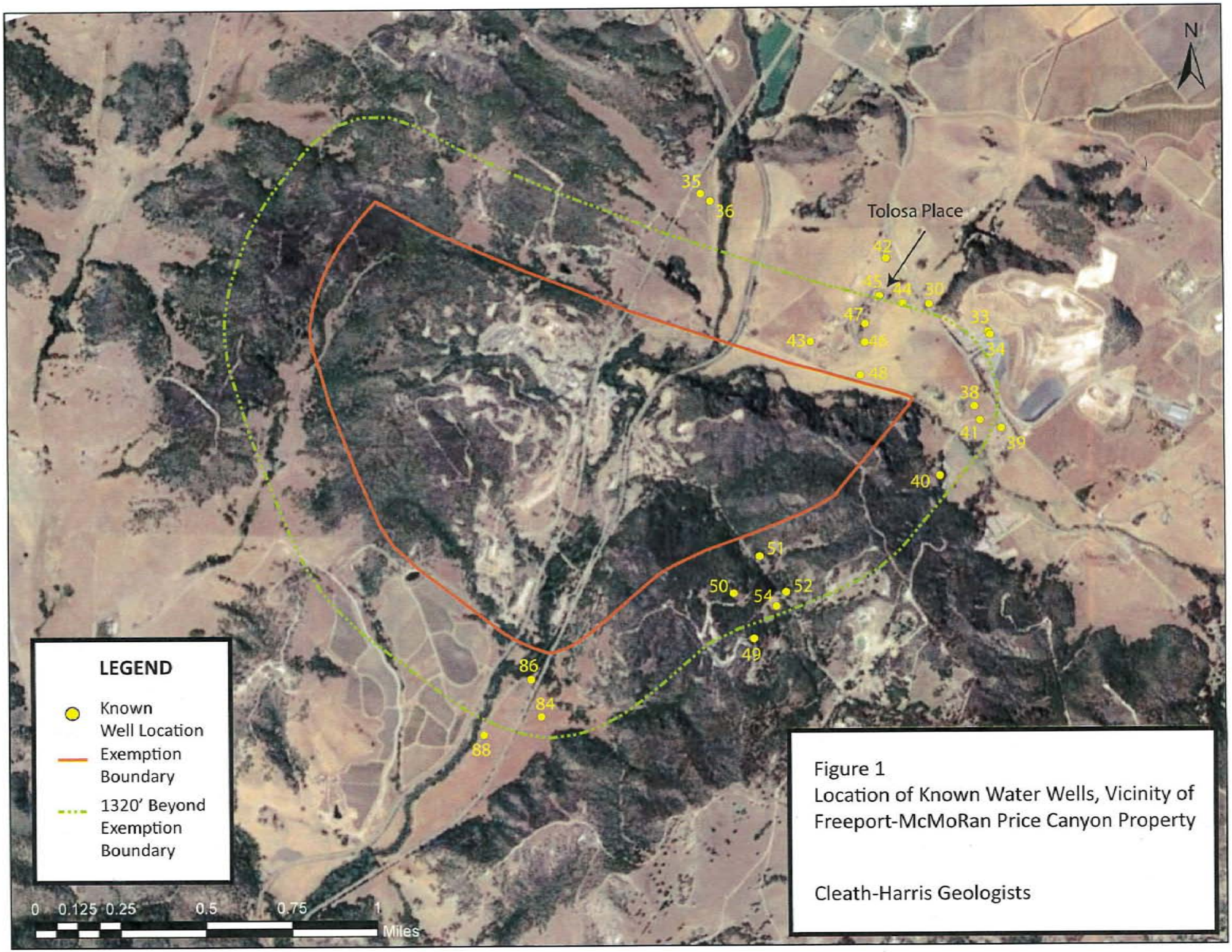


Figure 1
Location of Known Water Wells, Vicinity of Freeport-McMoRan Price Canyon Property

Cleath-Harris Geologists

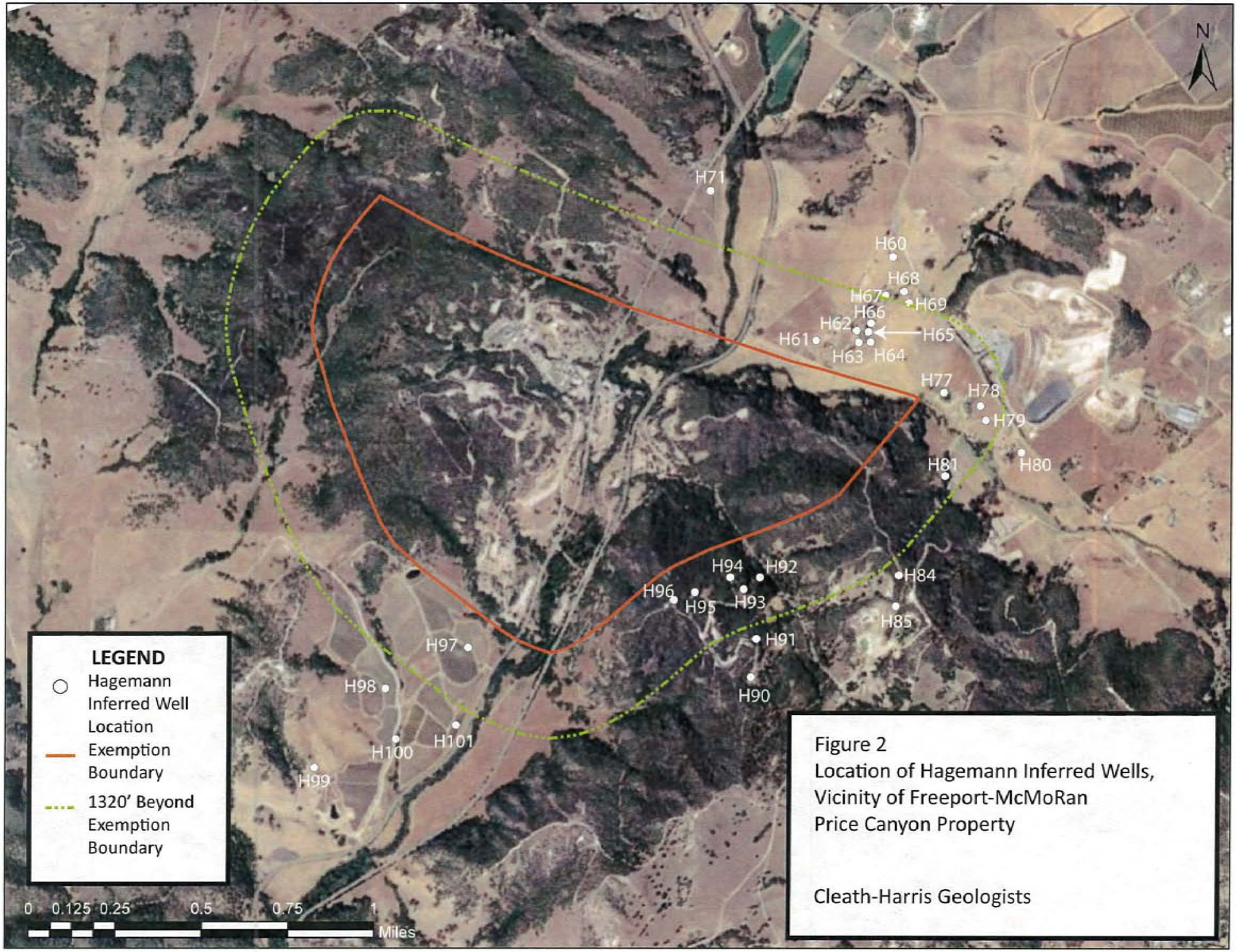


Figure 2
Location of Hagemann Inferred Wells,
Vicinity of Freeport-McMoRan
Price Canyon Property

Cleath-Harris Geologists

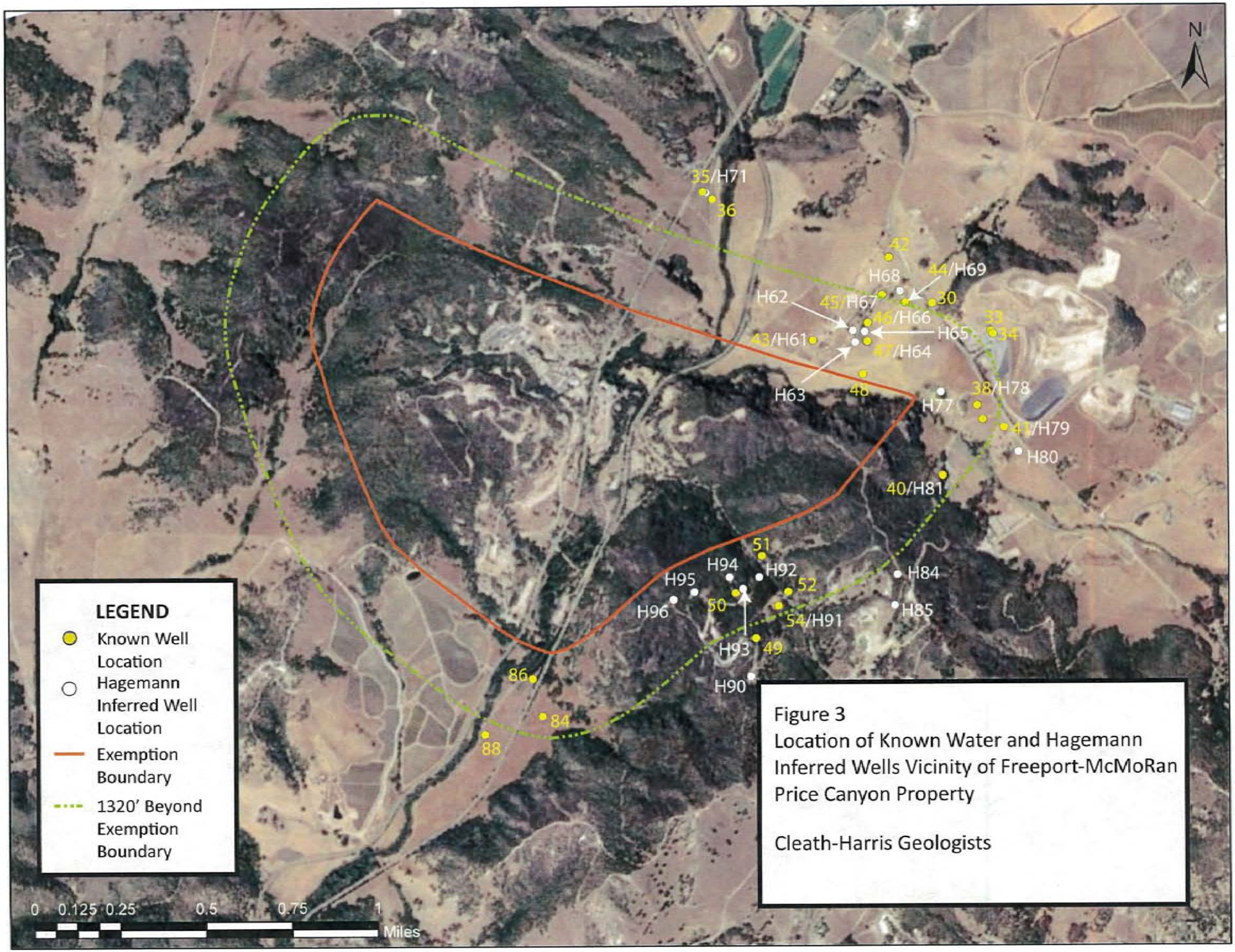


Figure 3
Location of Known Water and Hagemann Inferred Wells Vicinity of Freeport-McMoRan Price Canyon Property

Cleath-Harris Geologists

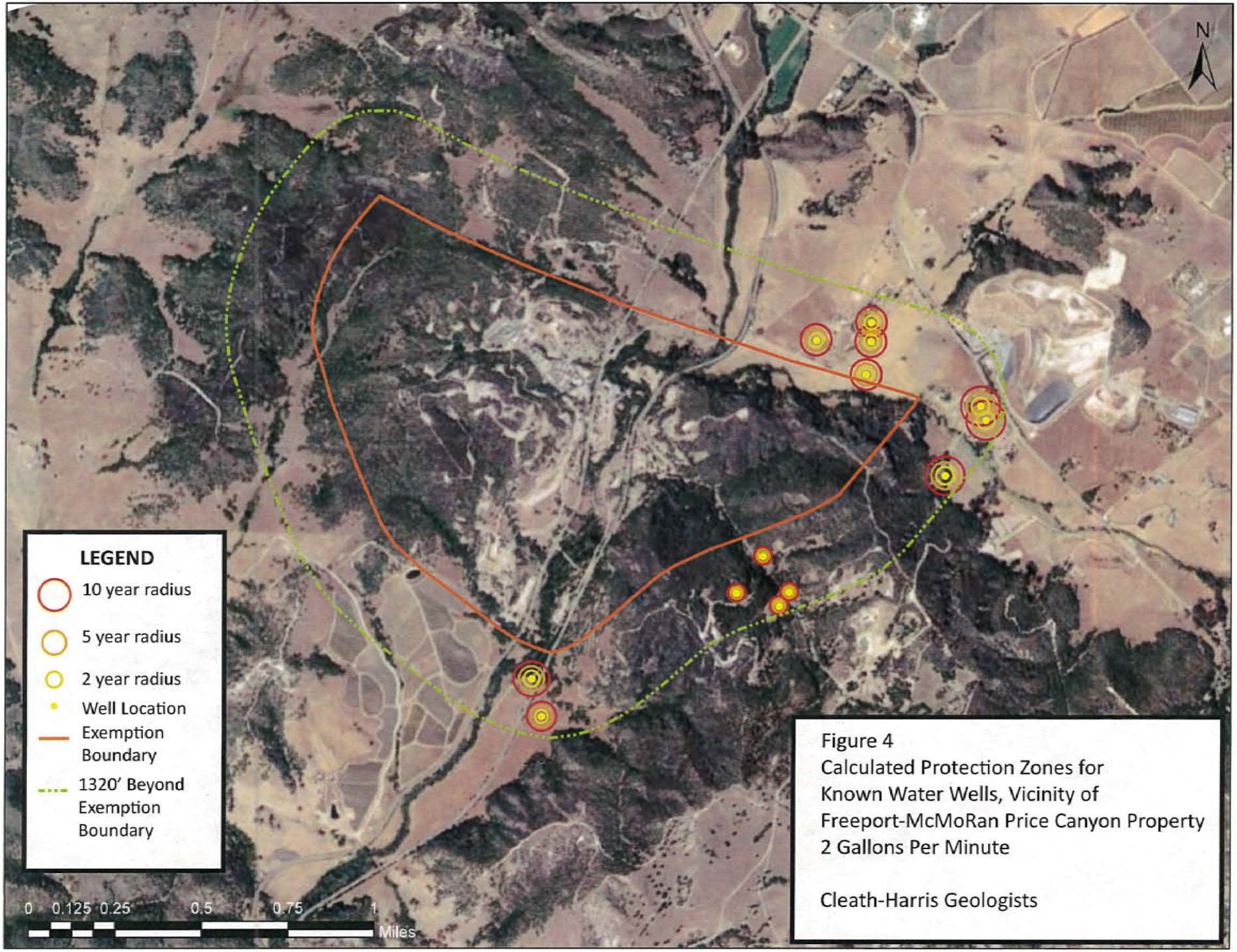


Figure 4
Calculated Protection Zones for
Known Water Wells, Vicinity of
Freeport-McMoRan Price Canyon Property
2 Gallons Per Minute

Cleath-Harris Geologists

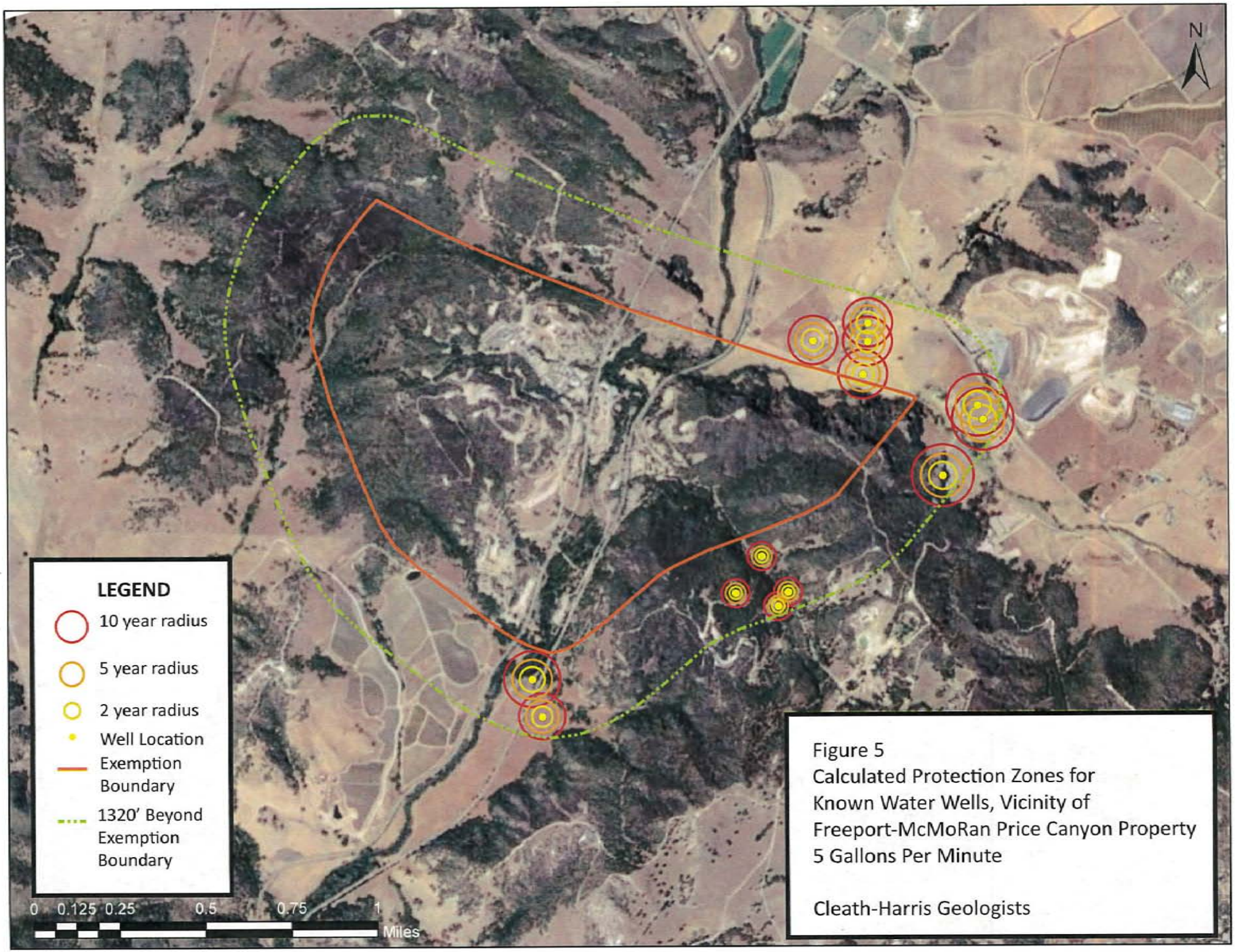


Figure 5
Calculated Protection Zones for
Known Water Wells, Vicinity of
Freeport-McMoRan Price Canyon Property
5 Gallons Per Minute

Cleath-Harris Geologists

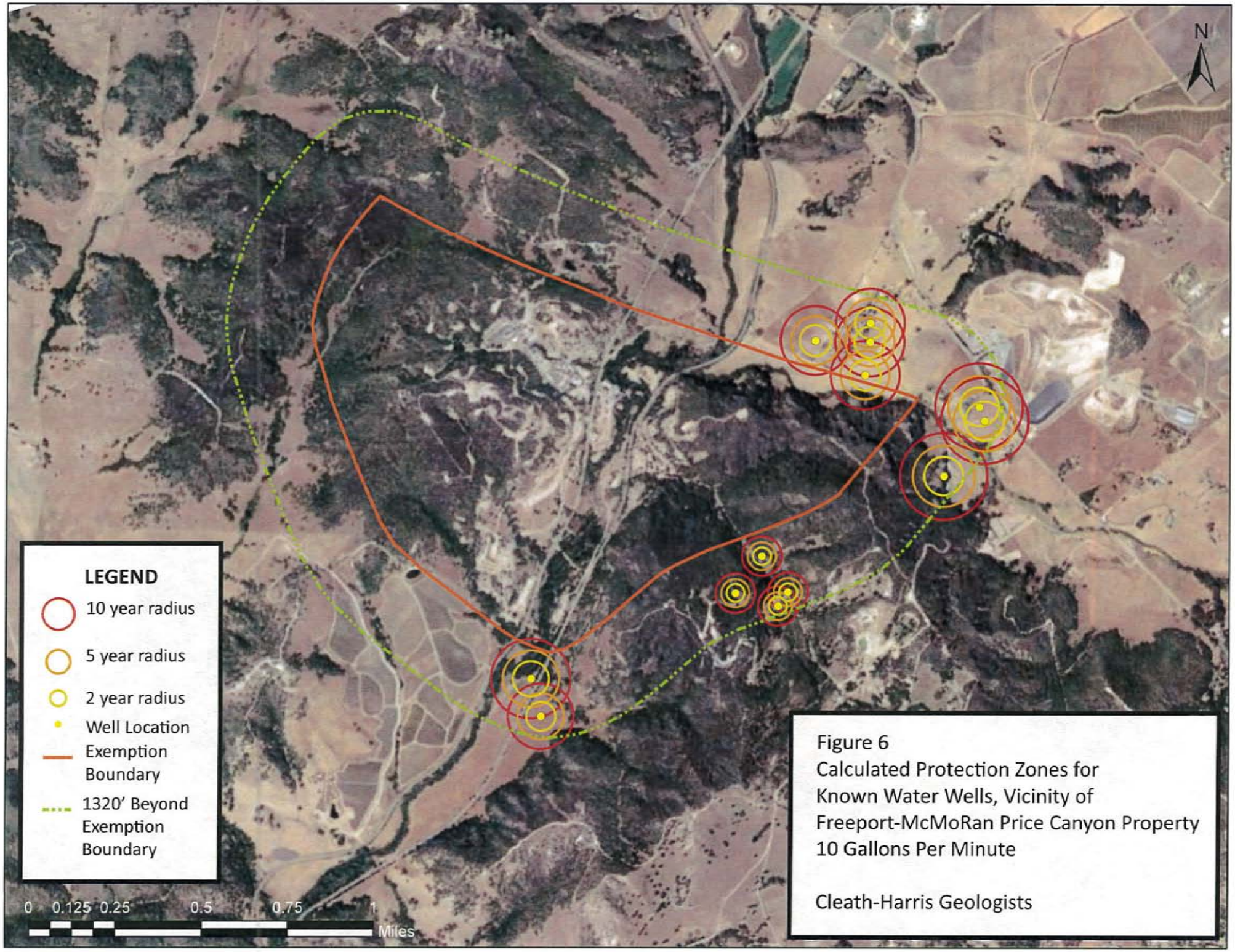


Figure 6
Calculated Protection Zones for
Known Water Wells, Vicinity of
Freeport-McMoRan Price Canyon Property
10 Gallons Per Minute

Cleath-Harris Geologists

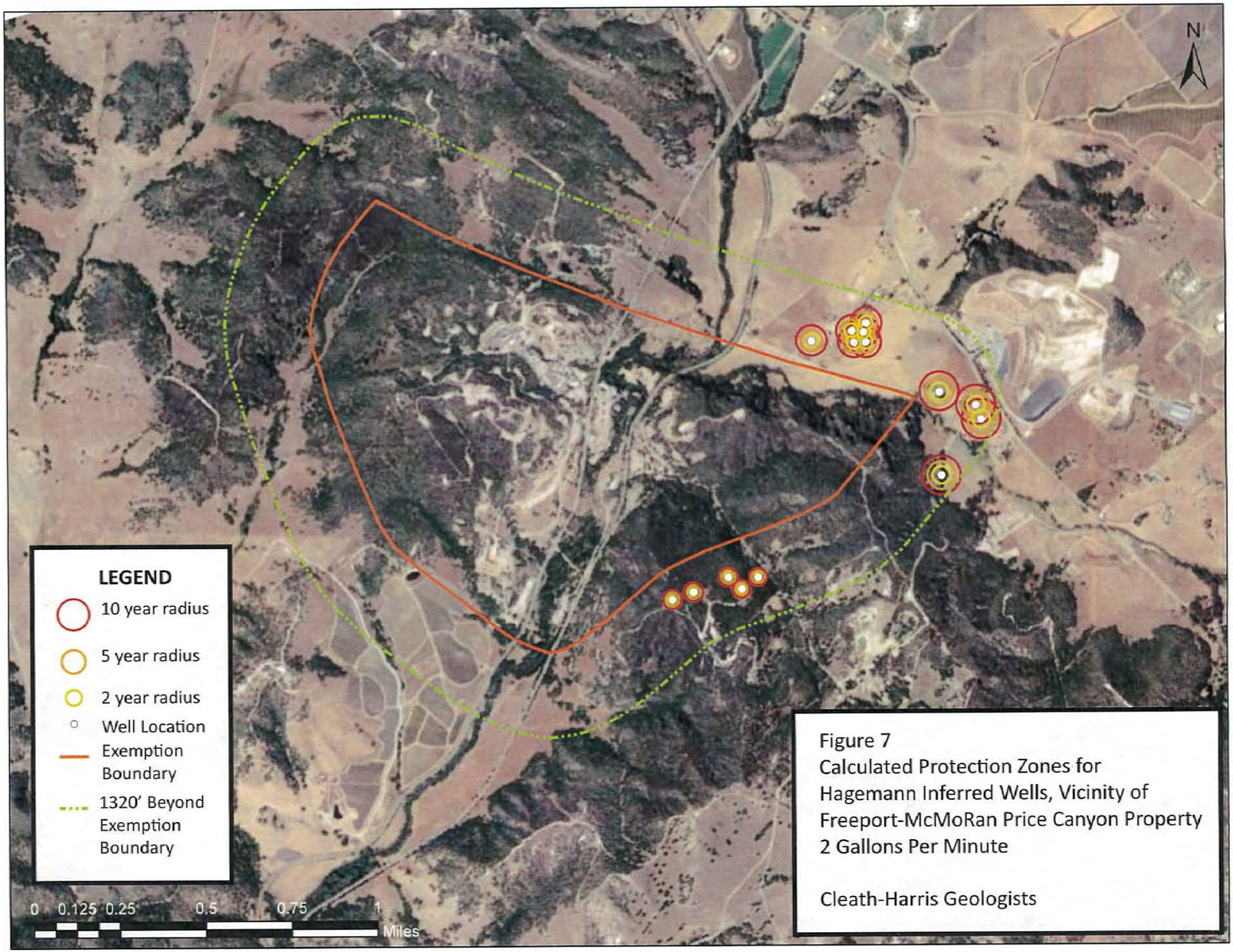


Figure 7
Calculated Protection Zones for Hagemann Inferred Wells, Vicinity of Freeport-McMoRan Price Canyon Property
2 Gallons Per Minute

Cleath-Harris Geologists

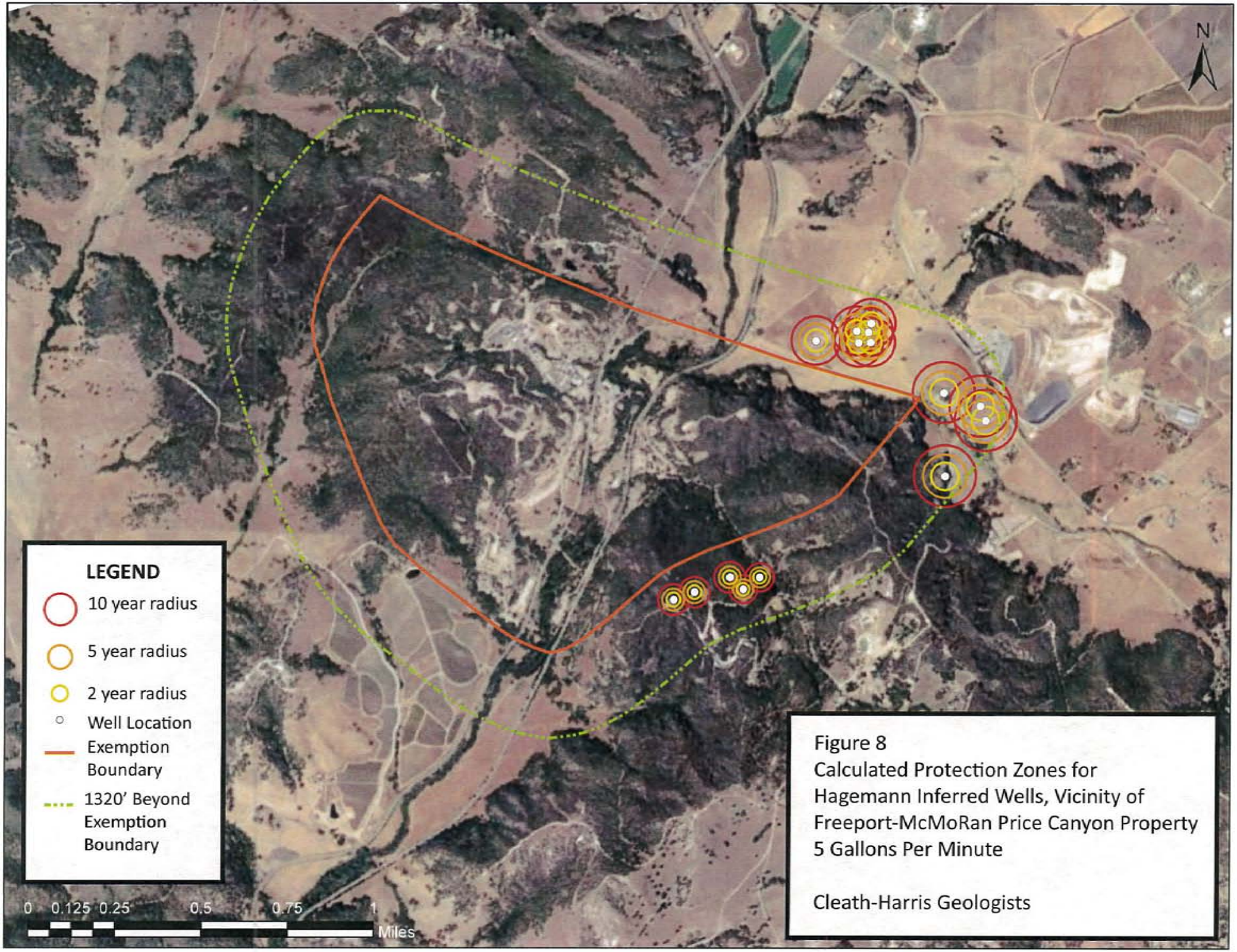


Figure 8
Calculated Protection Zones for Hagemann Inferred Wells, Vicinity of Freeport-McMoRan Price Canyon Property
5 Gallons Per Minute

Cleath-Harris Geologists

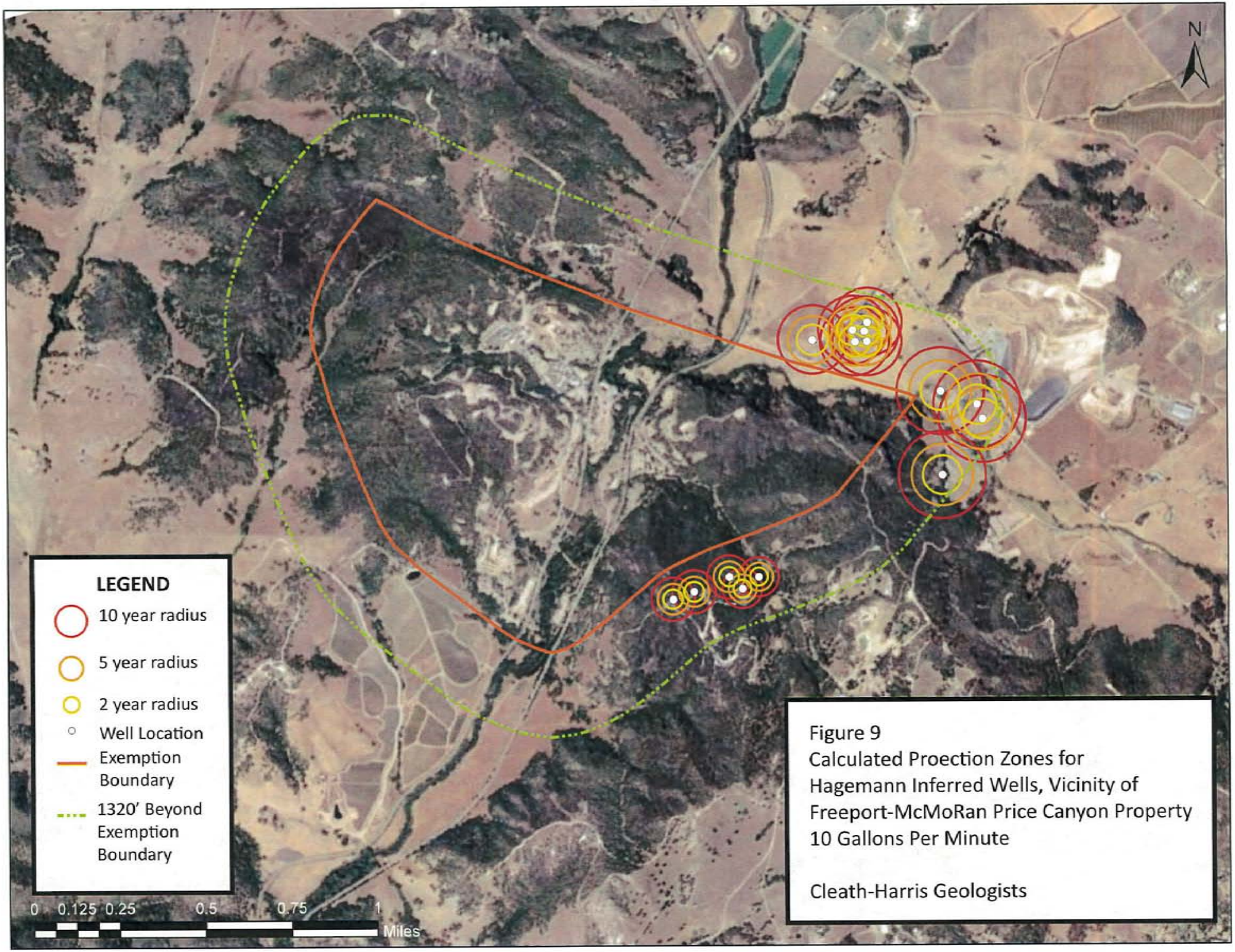


Figure 9
Calculated Proection Zones for
Hagemann Inferred Wells, Vicinity of
Freeport-McMoRan Price Canyon Property
10 Gallons Per Minute

Cleath-Harris Geologists

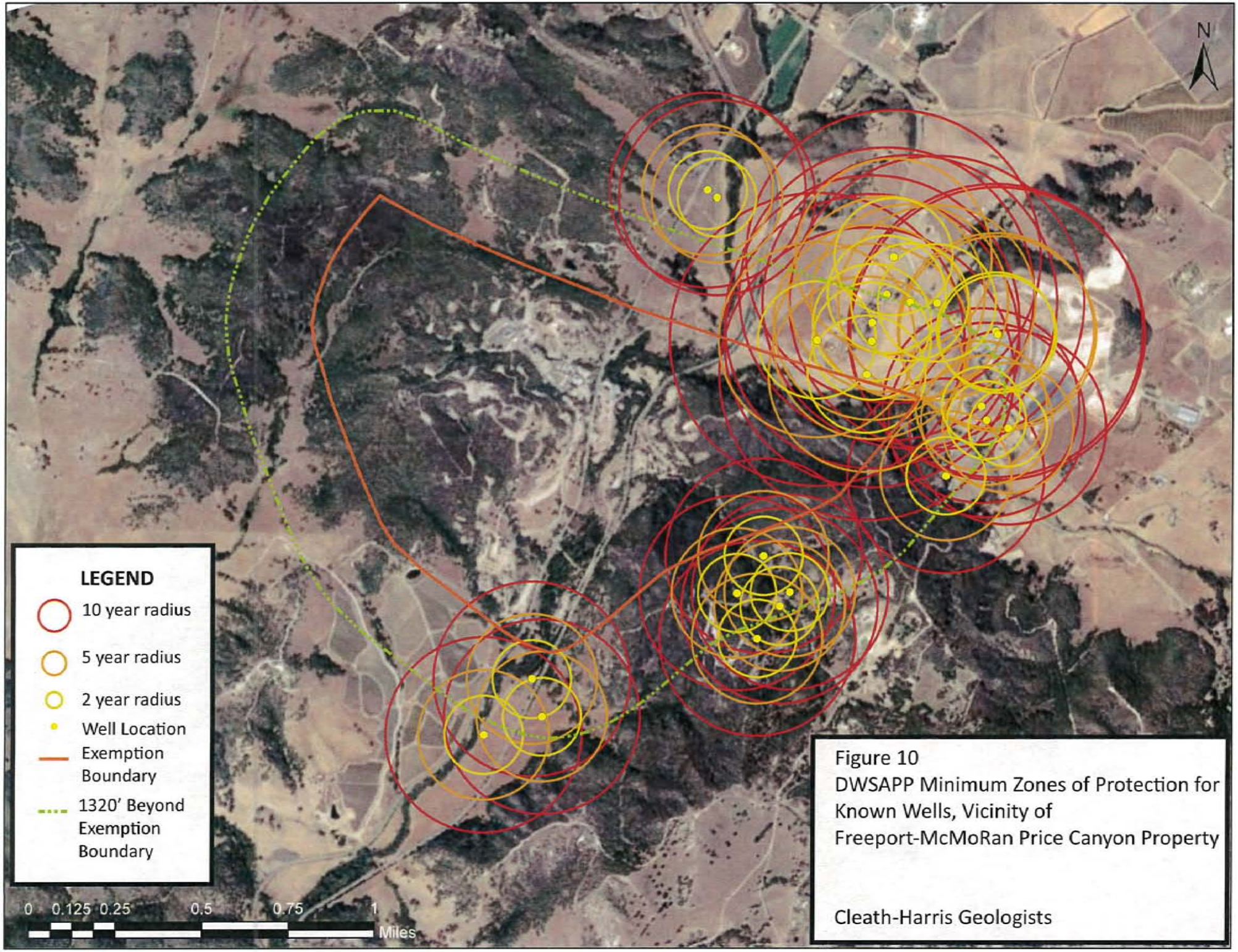


Figure 10
DWSAPP Minimum Zones of Protection for Known Wells, Vicinity of Freeport-McMoRan Price Canyon Property

Cleath-Harris Geologists

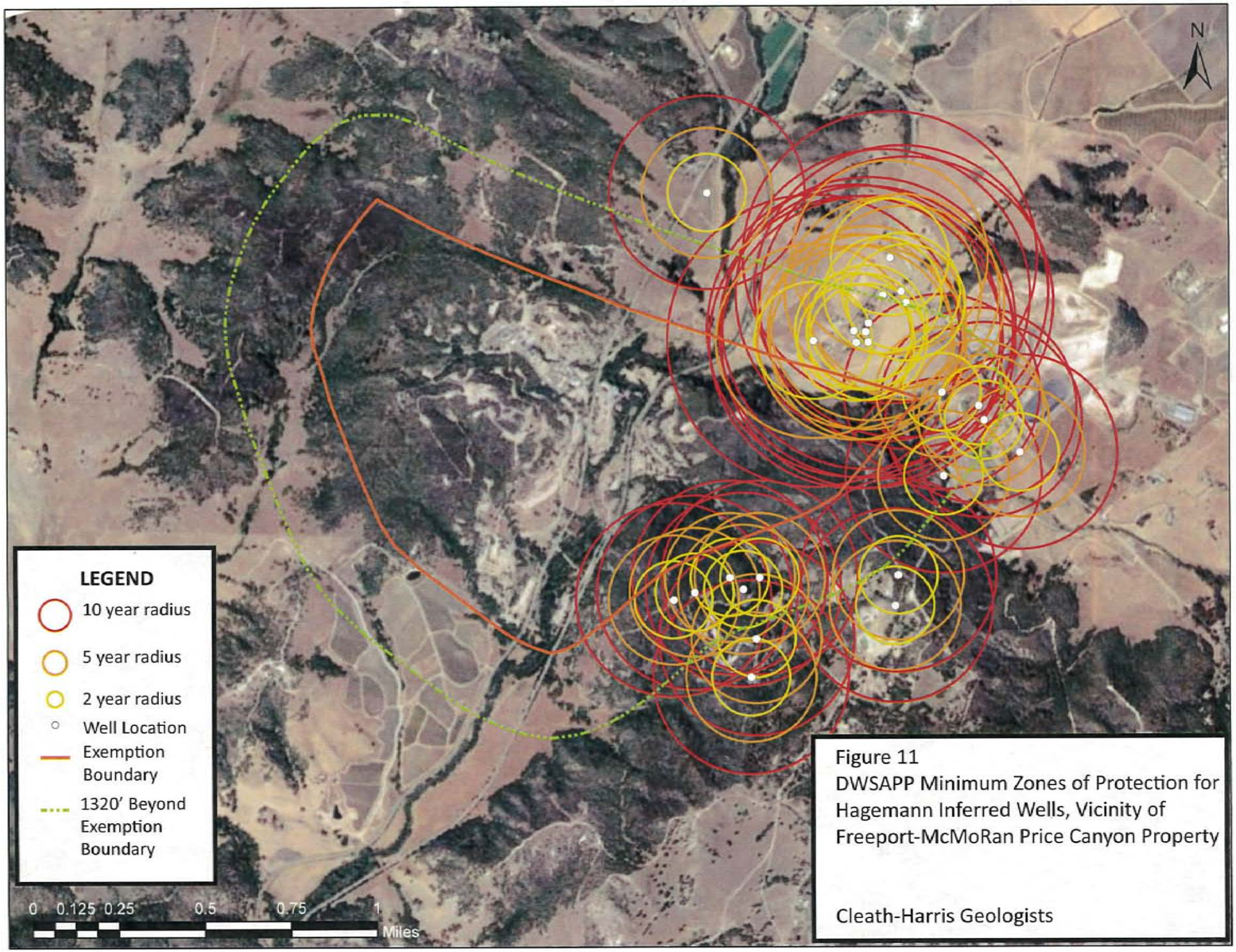


Figure 11
DWSAPP Minimum Zones of Protection for Hagemann Inferred Wells, Vicinity of Freeport-McMoRan Price Canyon Property

Cleath-Harris Geologists