MEMORANDUM

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DATE:	April 30, 2015
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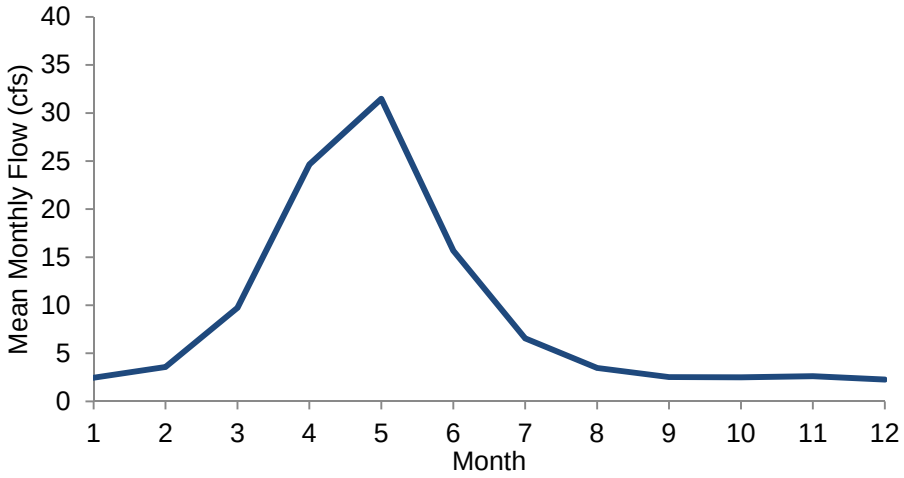
SUBJECT:	Emigration Canyon Water Resources
PROJECT NO.:	040.12.100

EXECUTIVE SUMMARY

Limited water supply in Emigration Canyon is well documented and well accepted. Professional scientists, Emigration Improvement District (EID), Salt Lake County, and canyon residents have acknowledged and are planning for a 700-home limit. After reviewing available data, Hansen, Allen & Luce (HAL) has concluded that the 700-home limit is valid. Though the limit has not yet been reached, adequate streamflows have not been maintained in 8 of the last 14 years. HAL recommends that canyon development be limited as planned in order to protect the canyon's water resources from overuse.

EMIGRATION CREEK STREAMFLOW AND CANYON DEVELOPMENT

Flow records from 1964 to 2014 describe typical flow characteristics in Emigration Creek (Salt Lake County 2015; USGS 2015). See Figure 1. Flows between September and January range from 0 to 5 cfs (cubic feet per second). Discharge increases beginning in February and peaks in April or May. The minimum flows typically occur between September and December.



Discharge in Emigration Creek and other canyon surface waters is closely related to groundwater conditions. This interaction has been indicated by "the similar quality of the water, the variation of artesian pressure in wells that corresponds to changes in streamflow, and the temperature changes in the stream in response to groundwater contribution" (Barnett 1966, 98–99). Groundwater development and other factors will continue to affect streamflow in Emigration Creek, and it is for this reason that a 700-home limit has been adopted.

Emigration Canyon is approaching its 700-home limit. In 2013, EID noted the following: "Since there are already roughly 550 homes in the canyon and 100 more lots approved for which water has been provided for, there remain about 50 future water services" (EID 2013). These estimates are consistent with population data. Over a 12-year period from 1998 to 2010, Emigration Canyon's population grew from 1,238 to 1,567 (Salt Lake County 1999, 16; U.S. Census Bureau 2012, 13). With an average 2.9 persons per household as in 1998, the 2010 population equated to 540 homes. Extending the same growth rate to 2015, HAL estimates 578 homes in the canyon.

Bill Bowen, a District trustee, "explained that the 700-home limit is predicated on maintaining a minimal flow in the stream during 80% of the years during peak use in August" (EID 2000). Based on flow records from 1964 to 2000 (the time the limit was established), HAL has determined this value to be 1.6 cfs. EID's *Water Management and Conservation Plan* explains:

> A continuing EID goal is to manage existing water resources in the canyon in such a way as to keep water flow in the creek the large majority of the time. While it is understood that in some drought years the stream may go dry, as it has historically, in most years it should be possible to maintain a flow. Recognizing that existing and future water depletions will impact the flows of Emigration Creek, EID adopted a creek protection policy to maintain our streamflow in all but the worst drought years. (EID 2013)

Even without reaching the 700-home limit, impacts to Emigration Creek have already occurred. In 2000, Bill Bowen observed that "this year they could not maintain streamflows, and if the 700-home limit is broken, he believed the stream environment would be under severe pressure in the future" (EID 2000). Average August flows in Emigration Creek since that time have been below 1.6 cfs in 8 of 14 years. While lower discharge may be attributed to various human and environmental factors, the data show that Emigration Creek is already struggling to maintain the specified minimum flow which HAL has calculated to be 1.6 cfs.

GEOLOGIC SETTING

Emigration Canyon is a syncline whose axis trends along the stream and slightly plunges to the east (Barnett 1966, 15; Bryant 1990). See Figure 2. Viewed in a roughly north–south cross-section as in Figure 3, the canyon consists of many U-shaped geologic units. Units at the bottom and center of the canyon are younger; ascending either face of the canyon, the units are progressively older. Groundwater flow is toward the center of the syncline, and most streams flow perpendicular to the bedrock strike. Several known faults exist in the canyon, though none appear to be of hydrologic significance (Barnett 1966, 15–17).

AQUIFER POTENTIAL

To better assess groundwater resources Emigration Canyon, HAL has ranked each geologic unit as having high, medium, or low aquifer potential. Each unit shown on Figure 2 is discussed in order from geologically youngest to oldest.

Freeze Creek Well #2

Brigham Fork Well

Freeze Creek Well #1

CROSS SECTION

EMIGRATION CANYON SYNCLINE

SYNCLINE

PARLEYS

GEOLOGIC UNITS
Kk - Kelvin Formation (Upper Mbr)
Kkp - Kelvin Fm (Parleys Mbr)
Jp - Preuss Sandstone
Jt - Twin Creek Limestone
JTRn - Nugget Sandstone
TRau - Ankareh Fm (Upper Mbr)
TRag - Ankareh Fm (Gartra Mbr)
TRam - Ankareh Fm (Mahogany Mbr)
TRt - Thaynes Limestone
TRw - Woodside Fm

Legend
- EID Wells
- Streams
- Watersheds

0 1,500 3,000 6,000 Feet

HANSEN ALLEN & LUCE INC ENGINEERS

EMIGRATION CANYON, UTAH

GEOLOGY AND HYDROGEOLOGY

FIGURE 2

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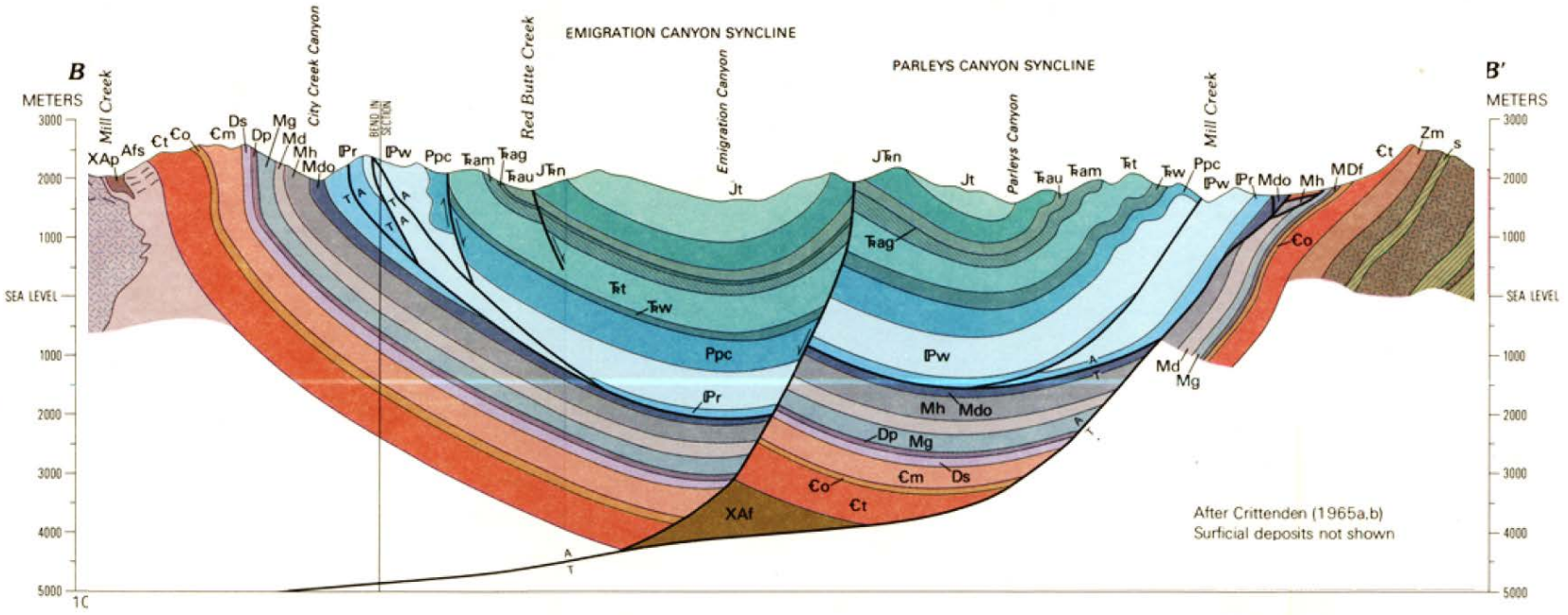

Figure 3: Cross-Section of Emigration Canyon Syncline (Bryant 1990)

Kelvin Formation (Kk, Kkp)—Medium Aquifer Potential

The Kelvin Formation is a limestone, sandstone, and siltstone unit 1,300–1,600 feet thick whose aquifer potential is depends on the member (Bryant 1990; Barnett 1966, 24). The lower member "is too fine grained to be a good aquifer. Siltstones and sandstones of the upper member are also fine grained, and most of the water movement in them must be confined to the secondary openings" (Barnett 1966, 24).

Preuss Sandstone (Jp)—Low Aquifer Potential

The Preuss Sandstone is about 1,000 feet thick and is a poor aquifer (Barnett 1966, 20; Bryant 1990; Granger 1953, 4). "The sandstones are not clean enough or coarse grained enough to be satisfactory as an aquifer. The shales and mudstones are too fine grained to allow free movement of water through them. The water movement in the formation is mainly limited to fractures, joints, and openings along the bedding planes." (Barnett 1966, 20).

Twin Creek Limestone (Jt)—High Aquifer Potential

The Twin Creek Limestone is about 2,800–3,000 feet thick (Barnett 1966, 20; Bryant 1990; Granger 1953, 4). Aquifer potential is high, though it depends on the bed. "Wells that encounter the massive, strongly jointed limestone are able to develop water because the limestone acts as an aquifer. Wells are unable to develop water from the incompetent [shale] beds because they act as partial aquicludes" (Barnett 1966, 20).

All three existing EID wells have been completed in the Twin Creek Limestone. Their surface locations fall within the formation and their depths are within the 2,800-foot formation depth described. Though the formation is part of a syncline, the wells are near the inside edge and therefore overlie the formation's greater depth. A technical memorandum confirms that Freeze Creek Wells No. 1 and No. 2 were completed in the Twin Creek Limestone and that the then-proposed Brigham Fork Well should be also be completed there (BIWC 2001, 2–4). Wells completed in the Twin Creek Limestone elsewhere in the state have also been productive (Hurlow 2012, 53).

Nugget Sandstone (JTRn)—High Aquifer Potential

The fine-grained Nugget Sandstone is 830–1,300 feet thick (Bryant 1990; Granger 1953, 4). The formation has high potential for groundwater development and is used for public supply elsewhere in the state (Hurlow 2002).

Ankareh Formation (TRau, TRag, Tram)—Low Aquifer Potential

The Ankareh formation is 1,300–1,800 feet thick and consists of three members (Bryant 1990; Granger 1953, 4). It "is an aquitard that separates Nugget Sandstone aquifer from Thaynes Formation" and therefore is a poor aquifer (Wallace et al. 2012, 114).

Thaynes Limestone (TRt)—High Aquifer Potential

The Thanyes Limestone, which is exposed higher in the canyon, is about 2,000 feet thick and consists of a thick series of limestone beds interbedded with shale and sandstone (Bryant 1990; Granger 1953, 4). "Some members are aquifers and others are aquitards, with the lower

Thaynes limestone member and upper tongue of the Dinwoody Formation being the best aquifers" (Wallace et al. 2012, 114). A few private wells in the Pinecrest area have been developed in the Thaynes Limestone. Wells completed in this formation elsewhere in the state have been productive (Hurlow 2012, 53).

Woodside Formation (TRw)—Low Aquifer Potential

The Woodside Formation is a low-permeability unit of fine-grained sandstone, siltstone, and mudstone and therefore a poor aquifer (Bryant 1990; Hurlow 2002, 23).

Park City Formation—Medium Aquifer Potential

The Park City Formation consists of interlayered cherty limestone and sandstone and is 600–2,000 feet thick (Hurlow 2002, 6; Bryant 1990). Its hydrogeologic properties are not well documented, but its thickness and media suggest a somewhat productive aquifer.

EMIGRATION IMPROVEMENT DISTRICT WATER SOURCES

EID supplies water to about 275 homes in Emigration Canyon (EID 2014). The rest are served by private, individual wells.

EID currently operates three wells for its water supply (EID 2013). Freeze Creek Well No. 1 is 500 feet deep and can reliably supply 80 gallons per minute (gpm). Freeze Creek Well No. 2 is 800 feet deep and can reliably supply 200 gpm. The Brigham Fork Well, completed in about 2003, is 1,200 feet deep and can reliably supply 150 gpm. A fourth well, presumably the so-called Nugget Well, is proposed (BIWC 2001).

With change applications, EID's water rights total 740 acre-feet (EID 2013).

DOCUMENTATION OF LIMITED WATER SUPPLY

Limited water supply in the Wasatch canyons in general and Emigration Canyon in particular has been a concern at least since the 1980s. A professional investigation by Don Barnett and Adolph Yonkee in 2000 concluded that Emigration Canyon's water resources can support 700 homes without threatening flows in Emigration Creek. The figure is based on 525 acre-feet of sustainable water supply and a use of 0.75 acre-feet per dwelling unit. Though the original report is not available, its findings are mentioned elsewhere and are supported by other documentation discussed below.

EID provides water services to about half of canyon residents. EID has acknowledged the canyon's limited water resources in its *Water Management and Conservation Plan*: "After substantial professional investigation, it was determined that the Canyon hydrology could not support more than approximately 700 homes without meaningful impacts to the flows in Emigration Creek" (EID 2013).

EID and the canyon community have repeatedly acknowledged a 700-home limit. "Don Barnett, hydrologist, and Adolph Yonkee, geologist, feel that the canyon has enough water resources to support up to 700 homes and still retain water in the creek. All District trustees are committed to meeting the objective of staying within the 700 canyon water user numbers" (EID 2002, 7–8). The topic drew considerable attention during a September 2000 trustee meeting:

> Mr. [Bill] Bowen explained that the District's best scientific information is that water resources will support only 700 homes. . . . Given that there is a finite resource sufficient to supply 700 homes using 0.75 acre feet of water per year while sustaining the resource, the Board has developed water management policies within that context. (EID 2000c)

Similar commentary is found in other meeting minutes (EID 2000a, 2000b).

The 1999 *Emigration Canyon General Plan* describes a similar limit: "Hydrologists have studied volumes of surface water and estimates of underground water sources in the canyon and have come to the conclusion that if a moderate amount of water is allowed to flow in Emigration Creek in the dry seasons of the year, there is sufficient water flow within the canyon to provide for approximately 725 dwelling units" (Salt Lake County 1999, 6). The difference of 725 homes versus 700 homes is trivial and may be attributed to a slightly different water consumption.

Many objectives of the *Emigration Canyon General Plan* involve protecting the canyon's water resources from overuse. "Everyone should be conscious of the limited supply and participate in assuring prevention of overburdening the Canyon's natural ability to recharge its water supply. Any decline in the service level or quality of the public water supply that would result from new growth should not be allowed" (Salt Lake County 1999, 24). Some of the plan's objectives are to "ensure that the public water supply remains at its current service level and is not adversely affected by new development," to "protect the community's groundwater supply from significant depletion or hazardous contamination," and to "balance the availability of water and its use to ensure that water resources are not depleted" (Salt Lake County 1999, 24, 31, 32). It also urges that "to protect the water supply, new development should not deplete existing groundwater supply beyond the ability of the local area to recharge itself" (Salt Lake County 1999, 88).

The 1989 *Wasatch Canyons Master Plan* also acknowledged a limited water supply:

> Available water within the canyons is a constraining factor in development. . . . There are about 1,100 single family dwelling units in the Canyons with over 850 of them in Emigration and Big Cottonwood Canyons. There are nearly 2,000 unoccupied, previously recorded residential lots, 1,200 in Emigration Canyon, 680 in Big Cottonwood, and the remainder in Parleys and Little Cottonwood. All of these lots of record may not qualify for a building permit because of an inadequate water supply or for other reasons. (Salt Lake County 1989, 41)

CONCLUSIONS

After reviewing and analyzing available information, HAL has reached the following conclusions.

- Limited water supply in Emigration Canyon is well established and well accepted. The Emigration Improvement District, Salt Lake County, and canyon residents have acknowledged and planned for a 700-home limit.
- In the absence of evidence to the contrary, Barnett and Yonkee's professional investigations and resultant 700-home limit appear to be valid.
- Though the 700-home limit has not yet been reached, impacts to Emigration Creek have already been observed as adequate flows have not been maintained in 8 of the last 14 years. Whether due to human or environmental factors, the lower flows indicate that the creek is struggling to maintain the specified minimum flow at the current housing density.
- Canyon development should be limited as planned in order to protect the canyon's water resources from overuse.
- Additional development will negatively impact streamflows in Emigration Canyon.

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