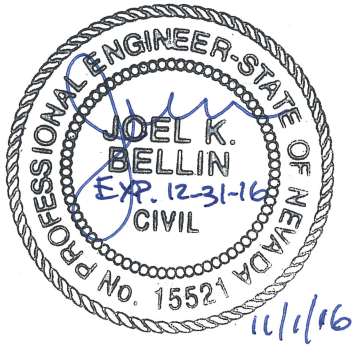
# Uppaway Estates Water System Evaluation

Preliminary Engineering Report

*Douglas County, Nevada*

November 1, 2016



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# 1 Executive Summary

The objective of the Uppaway Estates (Uppaway) Preliminary Engineering Report (PER) is to:

- Identify water system deficiencies
- Develop and compare project alternatives to address those deficiencies
- Identify and evaluate environmental impacts of the project alternatives
- Prioritize recommended alternatives
- Provide preliminary costs for the recommended project alternatives

## 1.1 Need for Project

The system was evaluated based on the following criteria:

- Nevada Administrative Code (NAC) 445A
- Douglas County design standards
- Overall condition of facilities based on previous County reports and field visits

The results of the assessment are summarized in the following general areas.

### 1.1.1 Supply Wells & SCADA

The following deficiencies were noted for Well No.1 and No.2:

1. Decreased well capacity (approximately 65% for Well No.1) and increased well drawdown.

2. Sanding in Well No.2.

3. Undersized 6-inch diameter well casing requires a supplemental booster pump for Well No.2, due to the limitation of a 4-inch pump.

4. Well No.2 has a PVC casing which is prone to breakage and limits rehabilitation options.

5. Existing Well, Tank, and Booster RTUs are nearing obsolescence and will require replacement.

### 1.1.2 Distribution and Storage

The following deficiencies were noted for the water distribution and storage components:

1. Excessive line leaks due to old piping with poor installation.

2. Insufficient fire flows and system pressures.
3. Services are not metered, water use is very high.
4. Inadequate storage volume to meet fire flow requirements.

## 1.2 Project Alternatives

The following table summarizes the identified water system deficiencies and project alternatives:

**Table 1-1 Summary of Deficiencies and Alternatives**

| No. | Deficiency | Relevant Codes | Alternative 1 | Alternative 2 |
|---|---|---|---|---|
| 1 | Insufficient Fire Flow | Fire Authority/ NFC County 4.1.3 | Upsize Pipes | N/A |
| 2 | Minimum Distribution Pressure – FF + Max Day Demand (MDD) | NAC 445A.6672 County 4.1.1 | Upsize Pipes | N/A |
| 3 | Maximum Velocity (Fire Flow + ADD) | County 4.1.4 | Upsize Pipes | N/A |
| 4 | Minimum Main Line Size (All) | County 4.5 | Upsize Pipes | N/A |
| 6 | Excessive Line Leaks | NAC 445A.6727 | Replace Pipes | N/A |
| 6 | Inadequate Storage Volume | NAC 445A.6674 | Supplemental Storage Tank | Robert Lee Residence Fire Sprinkler System |
| 7 | Water Conservation/ Meter Irrigation | NRS 540.131/ County 4.5.6 | Meter Services | N/A |
| 8 | Wells & SCADA | 445A.6672 | New Wells | Rehab Well |

## 1.3 Alternatives Analysis

The alternatives (where applicable) were evaluated based on the following weighted criteria, and ranked accordingly.

- Implementation (20%) – Is the alternative feasible to implement? Is the alternative constructible?
- Reliability (25%) – Will the alternative provide reliable results?

- Operability/Maintenance (40%) – Does the alternative require large quantities of time in terms of operator attention? Does the alternative require specialized maintenance requirements that cannot be performed in-house, or does it require frequent calibration, cleaning, tuning, etc. Does it require an ongoing contract for maintenance?
- Environmental Consideration (15%): Will the alternative be difficult to permit? Can TRPA thresholds be met? Are there short-term or long-term effects on the environment?

## 1.4 Prioritization of Improvements and Cost Summary

The recommended alternatives were prioritized based on the following criteria:

- Priority 1 – These deficiencies represent public health and safety risks. Consequence of failure is includes potential loss of life and property.
- Priority 2 – Represent deficiencies which may result in temporary disruption of water service or compliance, but generally minimal public health and safety impacts.
- Priority 3 – Represent deficiencies which may result in less efficient operations, but are not likely to cause loss or disruption of service or compliance.
- Priority 4 – Represent projects which may result in further gains in efficiency from priority 3, but are not directly needed for operations. Projects in this category represent “wants” more than “needs”, and do not address code violations.

The following table summarizes the overall project priorities and costs.

## Table 1-2 Project Priority and Cost Summary

| Deficiency No. | Description | Priority | Recommended Alternative | Capital Cost (x$1,000) |
|---|---|---|---|---|
| 1-5 | Fire Flow, Pressure, Velocity, Line Leaks | 1 | Upsize/ Replace Pipes | $ 3,232 |
| 6 | Storage Volume | 2 | 2 – Install Fire Sprinklers at 1860 Highway 50 residence | $ 93 |
| 7 | Water Conservation | 3 | Install Water Meters | $ 568 |
| 8 | Supply Wells & SCADA | 2 | 1 – Replace existing wells & SCADA RTUs | $ 842 |
| | | | **Total** | **$ 4,735** |

# 2 Project Planning

## 2.1 Location

Uppaway Estates (Uppaway) is a small private gated community of homes that are located on a 44 acre lakefront property located at the southern end of the Glenbrook Bay portion of Lake Tahoe, 0.75 miles south of the community of Glenbrook, Nevada, as shown in Figure 3-1. It is bounded on the east by U.S. Highway 50, on the north by a property line at (N 88°45'14" W), on the west by Lake Tahoe, and on the south by a property line (N 89°15'30" W).

The Uppaway Service area also includes the 25 acre Robert Lee property adjacent to the southern border. This parcel has the equivalent of 3 additional residential customers.

**Figure 2-1 Typical Uppaway Street**

## 2.2 Environmental Resources Present

### 2.2.1 Geology and Land Capability

Under the Bailey Land Scoring System, soil types are classified into categories 1 through 7, with subcategories 1a, 1b (stream environment zone), and 1c being the most environmentally sensitive and 7 being the least sensitive. Development is prohibited on capability 1 through 3 lands, with allowable base coverage limited to 1% for capability 1 and 2 lands and up to 5% on capability 3 lands.

Allowable coverage increases to 20% and 25% for capability 4 and 5 land, respectively, and up to 30% for capability 6 and 7 land.

The majority of the Uppaway Water Service Area (WSA) consists of "other environmentally sensitive areas," which are lands within capability 1a, 1c, 2 and 3. These lands are located in the northwest portion of the WSA, with small areas also located in the northeast corner at Kelly Ct., South Point Place, and Glenbrook Rd. The remainder of the WSA, from the southwest corner to the northeast corner and including the southern and eastern portions of the WSA, includes non-sensitive land capability classes (4-7).

According to the NRCS Web Soil Survey (accessed 8/18/15), the soil units in the Uppaway WSA include:

### Table 2-1 NRCS Soils

NRCS Soils in the Uppaway WSA

| Soil Type[1] | Parent Material[2] | Surface Runoff Class[3] | Slowest Permeability[4] | Shrink-Swell Potential[5] | Corrosivity[6] | Drainage Class[7] | Available Water Capacity[8] | Hydrologic Soil Group[9] |
|---|---|---|---|---|---|---|---|---|
| **Cagwin-Rock outcrop complex, 15-30% slopes, extremely stony (7412)** | Colluvium over grus derived from granodiorite | Medium | Rapid | Low | Moderate/ Low | Somewhat excessively drained | Very Low (2.1 in.) | B |
| **Cagwin-Rock outcrop complex, 30-50% slopes, extremely stony (7413)** | Colluvium over grus derived from granodiorite | Medium | Rapid | Low | Moderate/ Low | Somewhat excessively drained | Very Low (2.1 in.) | B |
| **Cassenai gravelly loamy coarse sand, 5-15% slopes, very stony (7421)** | Colluvium derived from granodiorite | Low | Rapid | Low | Moderate/ Low | Somewhat excessively drained | Low (4.5 in.) | A |
| **Cassenai gravelly loamy coarse sand, 15-30% slopes, very stony (7422)** | Colluvium derived from granodiorite | Medium | Rapid | Low | Moderate/ Low | Somewhat excessively drained | Low (4.5 in.) | A |
| **Cassenai gravelly loamy coarse sand, 30-50% slopes, very stony (7423)** | Colluvium derived from granodiorite | Medium | Rapid | Low | Moderate/ Low | Somewhat excessively drained | Low (4.5 in.) | A |

Source: NRCS 2015 Soil Survey Maps

Table Notes:

1. See Figure 2-2for locations
2. Parent material. The unconsolidated and chemically weathered mineral and organic material in which the solum of a soil is formed as a result of pedogenic processes.
3. Runoff. The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called ground-water runoff or seepage flow from ground water.

4. Permeability. The quality of the soil that enables water or air to move downward through the profile. The rate at which a saturated soil transmits water is accepted as a measure of this quality.
5. Shrink/Swell Potential provides criteria for determination of expansive soil properties.
6. Ratings are for Concrete/Steel. The ratings provided are the most conservative and based on the highest % representative aggregate. Site-specific soil resistivity analysis will be necessary prior to site development.
7. Drainage class (natural). Refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized—excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."
8. Available water capacity (AWC) (available moisture capacity). The volume of water that should be available to plants if the soil, inclusive of fragments, were at field capacity. It is commonly estimated as the difference between the amount of water at field capacity and the amount at wilting point with adjustments for salinity, fragments, and rooting depth. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as: Very low 0 to 2.5; Low 2.5 to 5.0; Moderate 5.0 to 7.5; High 7.5 to 10.0; Very high more than 10.0.
9. Hydrologic soil groups. Refers to soils grouped according to their runoff potential. The soil properties that influence this potential are those that affect the minimum rate of water infiltration on a bare soil during periods after prolonged wetting when the soil is not frozen. These properties are depth to a seasonal high water table, the infiltration rate and permeability after prolonged wetting, and depth to a very slowly permeable layer. The slope and the kind of plant cover are not considered but are separate factors in predicting runoff. Hydrologic Soils Group Definitions: A =low runoff potential (0.30 to 0.45 in/hr); B=moderate runoff potential (0.15 to 0.30 in/hr); C=moderately high runoff potential (0.05 to 0.5 in/hr); D=high runoff potential (less than 0.05 in/hr)

Geologic hazards in the area include earthquakes, seiche, tsunami, and erosion. The primary north-south fault zone that separates the eastern edge of the Sierra Nevada from the parallel fault block mountains of Nevada and Utah is located about six miles east of the Lake Tahoe Basin. Significant fault movement along the Sierra Nevada frontal fault could occur in the future with resultant ground failure and severe ground shaking within the Lake Tahoe Basin. Fault lines, including the Incline Village Fault, Stateline Fault, East Tahoe Fault, and West Tahoe Fault, traverse the lake and numerous earthquakes have occurred in the Lake Tahoe Basin within the past 100years. Due to an earthquake in 1966, a seiche occurred on the lake measuring 0.4 feet. Both seiche and tsunami events could occur if triggered by an earthquake event in or near the lake. The Lake Tahoe Basin is classified as Zone III for earthquake intensity, which is the highest intensity zone and one in which structural damage may occur. Runoff from roadways and urban development, as well as ground disturbance, can result in erosion. Due to the slopes within the area, erosion caused by runoff and storm events can occur. While EIP programs are implemented to address surface runoff in the area and control erosion and siltation, some erosion can continue to occur.

A unique rock formation, Shakespeare Point, is located within the WSA; however water system improvements and repairs would not affect its continued presence or current state.

### 2.2.2 Air Quality

The only Nevada Division of Environmental Protection air monitoring station in the basin is located in Stateline and monitors only carbon monoxide (CO) emissions. According to the TRPA 2011 Threshold Evaluation, improvements in CO emission reductions result in attainment of threshold standards for 1-hour and 8-hour CO emissions. The region is also in attainment with ozone ($O_3$),

nitrogen oxides ($NO_x$), and particulate matter ($PM_{10}$ and $PM_{2.5}$). Improvements to the water system may result in a temporary increase in emissions during the active construction period as a result of vehicle and equipment fuel combustion and ground disturbance, but would not affect long-term emissions levels. Likewise odors from construction equipment idling would be temporary and limited to the area of active construction activity.

## Figure 2-2. Uppaway Soils Map

### 2.2.3 Water Quality and FEMA Flood Zones

The Uppaway WSA primarily includes land within the FEMA Zone X 500-year flood zone; however, portions of the area include the edge of Lake Tahoe and the lake shore, which area within FEMA Zone A of the 100-year flood zone. Base flood elevations have not been determined by FEMA within Zone A. There are no major creeks within the Uppaway WSA.

According to the Draft Tahoe Douglas Area Plan (2014), the Douglas County portion of the basin contributes three percent of the Basin-wide fine sediment particle load. Various water quality and erosion control projects have been completed in the area through the County, NDOT and the TRPA EIP. TMDL reductions are planned through various erosion control and drainage improvement projects in the area, some of which have been completed and some of which are planned for future EIP projects. The Tahoe Douglas Area Plan and 2012 Douglas County Master Plan indicate a number of private parcels in the area have Best Management Practice (BMP) certification. In all of the Tahoe-area of Douglas County in 2012, including areas outside the Water System Areas, there were 946 BMP-certified single-family residential units (36%), 751 BMP-certified multi-family residential units (43%) and 71 BMP-certified commercial units (51%) (Douglas County Master Plan, 2012).

### 2.2.4 Biological Resources

The WSAs are located within the U.S. Forest Service Carson Range Ecological Subsection. Predominant vegetation types within the Carson Range include Jeffrey pine (*Pinus jeffreyii*) and white fir (*Aibes concolor*). Sedge meadow communities and willow thickets can occur in wet areas, with lodgepole pine (*Pinus contorta*) occurring around the margins of wet areas. The Carson Range also includes shrubs such as big sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), greenleaf manzanita (*Arctostaphylos patula*), rabbitbrush (*Ericameria nauseosa*), and tobacco brush (*Ceanothus velutinus*). In the Uppaway WSA, the predominant vegetation communities include Jeffery pine, montane chaparral, and urban.

### 2.2.5 Vegetation

According to the TRPA 2011 Threshold Evaluation, the dominant vegetation associations in the Uppaway WSA are yellow pine and some areas of shrub. Yellow pine forest typically includes Jeffrey pine, white fir, incense cedar (*Calocedrus decurrens*), and sugar pine (*Pinus lambertiana*), and is the most common vegetation association in the basin. Shrub association includes greenleaf and pinemat manzanita (*Arctostaphylos nevadensis*), tobacco brush, Sierra chinquapin (*Chrysolepis sempervirens*), huckleberry oak (*Quercus vacciniifolia*), and mountain whitethorn (*Ceanothus cordulatus*). The WSA does not provide suitable habitat to support populations of Galena Creek rockcress

(*Arabis rigidissima* var. *demota*), Cup Lake draba (*Draba asterophora* var. *macrocarpa)*, Long-petaled lewisia (*Lewisia longipetala*), Tahoe Draba (*Draba asterophora* var. *asterophora)*, or Tahoe yellow cress (*Rorippa subumbellata*), although Tahoe yellow cress is identified along the lake's sandy beaches in the Skyland and Zephyr WSAs.

### 2.2.6 Wildlife

Species in Douglas County listed by the Nevada Natural Heritage Program (heritage.nv.gov, Accessed 7/16/2015) include the following:

**Table 2-2 NNHP Species List**

| Common Name | Species | G Rank | S Rank | Status (NNHP/Federal/NV Protection/USFS/NNPS) |
|---|---|---|---|---|
| **Amphibian** | | | | |
| northern leopard frog | Lithobates pipiens | G5 | S2S3 | Watch List/C/PA |
| Sierra Nevada yellow-legged frog | Rana sierrae | G1G2 | SH | At-Risk List/USFS S |
| **Bird** | | | | |
| Tricolored Blackbird | Agelaius tricolor | G2G3 | S1B | At-Risk List |
| Golden Eagle | Aquila chrysaetos | G5 | S4 | Watch List |
| Short-eared Owl | Asio flammeus | G5 | S4 | Watch List |
| Ferruginous Hawk | Buteo regalis | G4 | S2 | At-Risk List |
| Western Snowy Plover | Charadrius nivosus nivosus | G3T3 | S3B | Watch List |
| Olive-sided Flycatcher | Contopus cooperi | G4 | S2B | Watch List |
| Prairie Falcon | Falco mexicanus | G5 | S4 | Watch List |
| Peregrine Falcon | Falco peregrinus | G4 | S2 | At-Risk List/USFS S |
| Pinyon Jay | Gymnorhinus cyanocephalus | G5 | S3S4 | Watch List |
| Loggerhead Shrike | Lanius ludovicianus | G4 | S4 | Watch List |
| Lewis's Woodpecker | Melanerpes lewis | G4 | S3 | Watch List |
| Mountain Quail | Oreortyx pictus | G5 | S3 | Watch List/GB/USFS S |
| Sage Thrasher | Oreoscoptes montanus | G5 | S5B | Watch List |
| American White Pelican | Pelecanus erythrorhynchos | G4 | S2B | Watch List |
| Flammulated Owl | Psiloscops flammeolus | G4 | S4B | Watch List/USFS S |
| Brewer's Sparrow | Spizella breweri | G5 | S4B | Watch List |
| **Fish** | | | | |
| mountain whitefish | Prosopium williamsoni | G5 | S3 | Watch List/GF |
| **Mammal** | | | | |
| mountain beaver | Aplodontia rufa | G5 | S1 | At-Risk List |
| big brown bat | Eptesicus fuscus | G5 | S4 | Watch List |
| spotted bat | Euderma maculatum | G4 | S2 | At-Risk List/TM/USFS S |
| northern flying squirrel | Glaucomys sabrinus | G5 | S3 | Watch List |
| silver-haired bat | Lasionycteris noctivagans | G5 | S3B | Watch List |
| hoary bat | Lasiurus cinereus | G5 | S3N | Watch List |
| sagebrush vole | Lemmiscus curtatus | G5 | S3 | Watch List |
| Sierra Nevada snowshoe hare | Lepus americanus tahoensis | G5T3T4Q | S3 | Watch List/GM |
| American marten | Martes americana | G5 | S2S3 | At-Risk List/FM |
| California myotis | Myotis californicus | G5 | S4 | Watch List |
| western small-footed myotis | Myotis ciliolabrum | G5 | S3 | Watch List |

| Common Name | Species | G Rank | S Rank | Status (NNHP/Federal/NV Protection/USFS/NNPS) |
|---|---|---|---|---|
| long-eared myotis | Myotis evotis | G5 | S4 | Watch List |
| little brown myotis | Myotis lucifugus | G5 | S3 | Watch List |
| fringed myotis | Myotis thysanodes | G4 | S2 | At-Risk List/PM |
| long-legged myotis | Myotis volans | G5 | S4 | Watch List |
| Yuma myotis | Myotis yumanensis | G5 | S3S4 | Watch List |
| Allen's chipmunk | Neotamias senex | G5 | S2S3 | Watch List |
| American pika | Ochotona princeps | G5 | S2 | At-Risk List/PM |
| American water shrew | Sorex palustris | G5 | S2 | At-Risk List |
| Trowbridge's shrew | Sorex trowbridgii | G5 | S2 | Watch List |
| Mexican free-tailed bat | Tadarida brasiliensis | G5 | S3S4B | Watch List/PM |
| Douglas's squirrel | Tamiasciurus douglasii | G5 | S5 | Watch List/PM |
| mountain pocket gopher | Thomomys monticola | G5 | S3 | Watch List |
| western jumping mouse | Zapus princeps | G5 | S2 | At-Risk List |
| **Reptile** | | | | |
| northern rubber boa | Charina bottae | G5 | S3S4 | Watch List |
| Sierra alligator lizard | Elgaria coerulea palmeri | G5T4 | S2S3 | At-Risk List/PR |
| Sierra gartersnake | Thamnophis couchii | G4 | S3 | Watch List |
| **Invertebrate** | | | | |
| endemic Tahoe annelid | Varichaeta nevadana | GNR | SNR | Watch List |
| Tahoe cave obligate amphipod | Stygobromus lacicolus | G1 | SNR | Watch List |
| Tahoe cave obligate amphipod | Stygobromus tahoensis | G1 | SNR | Watch List |
| Tahoe benthic stonefly | Capnia lacustra | G1 | S1 | At-Risk List |
| Carson Valley wood nymph | Cercyonis pegala carsonensis | G5T1T2 | S2 | At-Risk List |
| Mono checkerspot | Euphydryas editha monoensis | G5T2T3 | S1 | At-Risk List |
| northern Sierra endemic ant | Formica microphthalma | G2? | S1 | At-Risk List |
| Carson Valley sandhill skipper | Polites sabuleti genoa | G5T3T4 | S1 | At-Risk List |
| Carson wandering skipper | Pseudocopaeodes eunus obscurus | G3G4T1 | S1 | At-Risk List/LE |
| Apache silverspot butterfly | Speyeria nokomis apacheana | G3T2 | S2 | At-Risk List |
| Carson Valley silverspot | Speyeria nokomis carsonensis | G3T1 | S1 | At-Risk List |
| Nevada water mite | Thermacarus nevadensis | GH | SH | Watch List |
| western Lahontan pyrg | Pyrgulopsis longiglans | G2G3 | S2S3 | At-Risk List |
| Wongs pyrg | Pyrgulopsis wongi | G2G3 | S1 | At-Risk List |
| **Plant** | | | | |
| Shevock bristlemoss | Orthotrichum shevockii | G2 | S1 | Watch List/USFS S/NNPS M |
| Washoe tall rockcress | Arabis rectissima var. simulans | G4G5T1Q | S1 | At-Risk List/USFS 4/NNPS T |
| Margaret's Rushy milkvetch | Astragalus convallarius var. margaretiae | G5T2 | S2 | At-Risk List/NNPS D |
| Lavin eggvetch | Astragalus oophorus var. lavinii | G4T2 | S2 | At-Risk List/USFS S/NNPS W |
| Nevada suncup | Camissonia nevadensis | G3 | S3 | Watch List/NNPS D |
| Steamboat | Diplacus ovatus | G1G2Q | S1S2 | At-Risk List/NNPS T |

| Common Name | Species | G Rank | S Rank | Status (NNHP/Federal/NV Protection/USFS/NNPS) |
|---|---|---|---|---|
| monkeyflower | | | | |
| Tahoe draba | Draba asterophora var. asterophora | G2T2 | S1S2 | At-Risk List/USFS S/NNPS T |
| Slide Mountain buckwheat | Eriogonum ovalifolium var. eximium | G5T3 | S2 | At-Risk List/NNPS W |
| sand cholla | Grusonia pulchella | G4 | S2S3 | At-Risk List/CY/NNPS D |
| Webber ivesia | Ivesia webberi | G2 | S2 | At-Risk List/LT/CE/USFS S/NNPS T |
| soft lupine | Lupinus malacophyllus | G3? | S3? | Watch List/NNPS D |
| Wassuk beardtongue | Penstemon rubicundus | G2G3 | S3 | At-Risk List/USFS S/NNPS D |
| tuni | Perideridia lemmonii | G4? | S3? | Watch List |
| Williams combleaf | Polyctenium williamsiae | G2Q | S2 | At-Risk List/CE/USFS S/NNPS T |
| Tahoe yellowcress | Rorippa subumbellata | G1 | S1 | At-Risk List/C/LTBMU S/NNPS T |
| Tiehm peppercress | Stroganowia tiehmii | G2 | S2 | At-Risk List/NNPS W |
| Leichtlin mariposa lily | Calochortus leichtlinii | G4 | S3 | Watch List |

**G -** Refers to the **global** population of a species.
**T -** Refers to the subspecific or variety **taxonomic** level (used in conjunction with G-rank); uses numeric ranks 1-5 in the same way that G and S ranks are applied.
**S -** Refers to the **subnational** (state) population of a species, subspecies, or variety.
**X - Presumed Extinct** or extirpated (S-rank) – Not located despite intensive searches and virtually no likelihood of rediscovery.
**H - Possibly Extinct** – Known from only historical occurrences but still some hope of rediscovery.
**1 - Critically Imperiled** – At very high risk of extirpation in the jurisdiction due to very restricted range, very few populations or occurrences, very steep declines, severe threats, or other factors.
**2 - Imperiled** – At high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.
**3 - Vulnerable** – At moderate risk of extirpation in the jurisdiction due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
**4 - Apparently Secure** – At fairly low risk of extirpation in the jurisdiction due to an extensive range and/or many populations or occurrences, but with possible cause for some concern as a result of local recent declines, threats, or other factors.
**5 - Secure** – At very low or no risk of extirpation in the jurisdiction due to a very extensive range, abundant populations or occurrences, with little to no concern from declines or threats.
**S#S# - Range Rank** – A numeric range rank (e.g., S2S3 or S1S3) is used to indicate uncertainty about the exact status of a taxon. Ranges cannot skip more than two ranks (e.g., SU is used rather than S1S4). A range rank could also be applied at the global scale as well (e.g., G2G3).
**NR -** Taxon **Not Ranked** – rank not yet assessed.
**NA -** Conservation status rank is **Not Applicable** because element is not a suitable target for conservation activities (often used for non-native species or hybrids).
**U - Unrankable** – Currently unrankable due to lack of information or due to substantially conflicting information about status or trends.
**Q - Questionable taxonomy –** taxonomic distinctiveness of the entity at the current level is questionable or currently being reviewed; resolution of this uncertainty may result in change from a species to a subspecies, variety or hybrid, or the inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority conservation status.
**B -** Breeding – Conservation status refers to the breeding population of the element in the nation or state/province.
**N - Non-breeding** – Conservation status refers to the non-breeding population of the element in the nation or state/province (e.g., wintering bird populations).
**M - Migrant** – Migrant species occurring regularly on migration at particular staging areas or concentration spots where the species might warrant conservation attention. Conservation status refers to the aggregating transient population of the species in the nation or state/province.
**C –** USFWS Candidate for listing as Threatened or Endangered
**LT –** USFWS Listed Threatened
**LE –** USFWS Listed Endangered
**CE –** Critically Endangered Plant (State of NV Protection and Designation)
**CY –** Protected as a cactus, yucca, or Christmas tree (State of NV Protection and Designation)

**GF –** Game Fish (State of NV Protection and Designation)
**PA –** Protected Amphibian (State of NV Protection and Designation)
**PR –** Protected Reptile (State of NV Protection and Designation)
**GM –** Game Mammal (State of NV Protection and Designation)
**FM –** Fur-bearing Mammal (State of NV Protection and Designation)
**PM –** Protected Mammal (State of NV Protection and Designation)
**TM –** Threatened Mammal (State of NV Protection and Designation)
**USFS S –** Region 4 (Humboldt-Toiyabe National Forest) Sensitive
**LTBMU –** USFS LTBMU listed species
**NNPS M –** Marginal/disjunct, rare and/or possibly distinct, and potentially vulnerable in the NV portion of its range, but more widespread and secure outside NV.
**NNPS T –** Threatened, believed to meet the ESA definition of Threatened but not formally listed.
**NNPS D –** Delisted, dropped from consideration, no longer of concern.
**NNPS W –** Watch list species, potentially vulnerable to becoming Threatened or Endangered.

Species listed by the US Fish and Wildlife Service for the project area include:

### Table 2-3 USFWS Species List

| Type | Species | Federal Status |
|---|---|---|
| Fishes | Cui-ui (*Chasmistes cujus*) | Endangered |
| Fishes | Lahontan cutthroat trout (Oncorhynchus clarkii henshawi) | Threatened |

While northern goshawk (*Accipiter gentilis*) are not known to occur in the area, the area adjacent to the WSA contains suitable habitat for this species. Additionally, willow flycatcher (*Empidonax traillii*) habitat may be present in the wet meadow area. Osprey (*Pandion haliaetus*) nests, which are protected under the Migratory Bird Treaty Act, have been recorded south of the Uppaway WSA in the Cave Rock WSA (Shay Zanetti, Personal Communication 28 Sept. 2015). The Uppaway WSA includes wintering bald eagle (*Haliaeetus leucocephalus*) protection areas although there are no known nesting sites within the WSA (TRPA 2011 Threshold Evaluation). Fragmented areas appropriate for mule deer summer fawning and foraging habitat occur in the area. Each WSA includes some area subject to TRPA's disturbance (free) zone for listed species and species groups.

According to the LTBMU Forest Plan, there are no Protected Activity Centers (California Spotted Owl (*Strix occidentalis*) and Northern goshawk) or Home Range Core Areas (Spotted Owl), Whitebark pine (*Pinus albicaulis*) species refuge area, or species refuge area for Sierra Nevada yellow-legged frog (*Rana sierrae*) or Lahontan cutthroat trout within the WSA. However, there are species refuge areas for Tahoe yellow cress within the ZWUD and Skyland WSA, along the shores of Zephyr Cove.

Pre-construction surveys for nesting bird species will be required in order to conform with the Migratory Bird Treaty Act of 1918. As noted above, no known Protected Activity Centers for either northern goshawk or California spotted owl are known to occur in the area, however creation of a new roadway, pipeline or tank site would likely require protocol surveys to be performed.

### 2.2.7 Noise

Since the Uppaway WSAs are residential areas, the primary noise source is U.S. Highway 50, although some noise may be generated by the Douglas County Water pumping facility. The maximum community noise equivalent level for PAS 059 is 50 CNEL, with a maximum of 65 CNEL for the US 50 corridor.

The TRPA 2011 Threshold Evaluation Report indicates that noise levels along U.S. Highway 50 are at or somewhat better than targets. Noise studies indicate that roadway noise levels are below 65 CNEL, ranging between 58 and 65 A-weighted decibels (dBA), for an average of 61 dBA.

### 2.2.8 Land Use

The Uppaway WSA is located within the Tahoe Douglas Area Plan. According to the Area Plan and the Regional Plan Land Use map, land uses in the Uppaway WSA are residential. In the Uppaway WSA, Douglas County zoning is Residential (PAS 059).

The Uppaway WSA is located within Plan Area Statement 059 Shakespeare Point, which has a land use classification of residential and management strategy of mitigation with no special designations. According to the Plan Area Statement, “The area should continue as residential area, maintaining the existing character of the neighborhood.” The area includes residential estates, private recreation areas, a post office and fire station, with private access to the shoreline. The area is 50% built out. Planning considerations and policies for the area are focused on containing and treating runoff from US 50. Potable water service facilities are considered a special use.

### 2.2.9 Transportation

The primary roadway through the area is U.S. Highway 50, which is a 4 lane rural undivided highway through the WSAs. Nevada Department of Transportation and the 2012 Regional Plan EIR indicate traffic volumes on U.S. 50 range from 15,100 ADT west of Meyers to 12,000 ADT east of SR 28. SR 28 intersects U.S. 50 just northeast of the Uppaway WSA near Glenbrook. Summer 2010 traffic counts indicate between 27,000 to 33,000 ADT on U.S. 50 between South Stateline and Zephyr Cove, while counts dropped to 14,900 on U.S. 50 at Glenbrook near SR 28. SR 28 experienced an ADT of 7,200, indicating a majority of the trips on U.S. 50 in this area continued on out of the basin and into the Carson Valley.

Transit service is available within the WSAs along U.S. 50 through the Tahoe Transportation District BlueGo/Valley and Lake Express Service that operates one route (Stateline to Carson City) along this stretch of U.S. 50; however there are no transit stops within the Uppaway WSA. The nearest stops are located in Zephyr Cove near Whittell High School (Skyland WSA), Zephyr Cove Stables,

and Zephyr Cove Resort (Zephyr WSA). Although no bike path is located in the area, a bikeway is planned to include this portion of U.S. 50, and encircle the lake.

Water utility system improvements and repair would have no long-term effect on traffic and circulation, although some temporary construction delays on U.S. 50 and neighborhood streets may occur during the active construction period.

### 2.2.10 Hazards

Since the area is primarily residential, there are no hazardous materials sites in the WSA. The nearest active Leaking Underground Storage Tank (LUST) sites are the Round Hill Shell located at 199 U.S. 50 in Zephyr Cove and Zephyr Cove Resort at 760 U.S. 50 in Zephyr Cove, both of which have confirmed release of gasoline (Nevada Division of Environmental Protection, 7/15/15).

The entire WSA areas are within the Wildland Urban Interface (WUI) as shown in the LTBMU Forest Plan Map (Map 4, Forest Plan, 2015).

U.S. 50 is the primary evacuation route through this area, as well as the Cave Rock and Skyland WSAs, and Zephyr Water Utility District.

### 2.2.11 Public Utilities and Services

Utility and service providers within the Uppaway WSA include Douglas County, Douglas County School District, Douglas County Sewer Improvement District, Douglas County Sheriff's Office, Tahoe Douglas Fire Protection District, South Tahoe Refuse, NV Energy, Southwest Gas, and Frontier Communications (Douglas County Master Plan, 2012).

Douglas County provides water service within the Uppaway, Cave Rock, and Skyland WSAs as well as the Zephyr Water Utility District. These areas were consolidated under the County. The County is currently evaluating the existing system, planning for repairs and improvements, and assessing future needs. With little growth anticipated, efforts focus on system improvements and repairs.

Tahoe Douglas Sewer District provides collection of wastewater and conveys it to Douglas County Sewer Improvement District No. 1 for treatment and export from the Lake Tahoe Basin. Treated effluent is pumped to the Carson Valley for irrigation use.

South Tahoe Refuse provides solid waste service under a franchise agreement with Douglas County. Refuse and recyclables are transported to a material recovery facility and transfer station in South Lake Tahoe, California, and then transported to the Lockwood Landfill in Storey County.

The Douglas County Sheriff's Office has a substation at Kingsbury Grade and U.S. 50 south of the WSAs, with County law enforcement support services centered in the South Shore area.

The Tahoe Douglas Fire Protection District provides fire protection, emergency response, and rescue services. The nearest fire stations are the Glenbrook Station #25 south of the Uppaway WSA, and the Zephyr Cove Station #24 in the Skyland WSA.

The Douglas County School District operates Zephyr Cove Elementary (K-6) and George Whittell High School (7-12), located in the Skyland WSA. Due to declining enrollment, Kingsbury Middle School was closed in 2008 and may be redeveloped into commercial and residential uses. Library services are provided by the County at the Library in Zephyr Cove, located south of the WSAs in the Skyland WSA.

Recreation in the area includes U.S. Forest Service land and trails for hiking, biking, and other recreation activities, while other recreation resources in the vicinity of the WSAs includes the Glenbrook golf course, the Zephyr Cove marina, Spooner Lake, and the Tahoe Rim Trail. Area schools also provide recreational facilities; however few developed recreation facilities are located within or near the WSAs. The LTBMU Forest Plan identifies the Uppaway WSA as completely within the Rural Natural Recreation Spectrum.

Nevada Energy and Southwest Gas provide electricity and natural gas services to the area, and Frontier Communications provides communication services.

### 2.2.12 Scenic Resources

The Uppaway WSA include Scenic Roadway Unit 29 Scenic Shoreline Unit 26 (Wagstaff and Brady 1983). Scenic Roadway Unit 29 – Cave Rock stretches from north of Lincoln Park up to the Glenbrook area north of the Uppaway WSA. Within the Uppaway WSA views include Glenbrook Bay, the lake and waterfront development, Logan Shoals, and Shakespeare Point's sheer rock walls. The scenic quality is defined as high in this area with a rating of 3. The TRPA 2011 Threshold Report indicates the threshold composite rating has increased from 23 in 1982 to 23.5 in 2011, with improvement in roadway distractions. Improved roadway safety features and residential features affected the increase in rating. Overall, the ratings include: man-made features – 3; roadway distractions – 4.5; road structure – 3; lake views – 5; landscape views – 5; and variety – 3.

The Uppaway WSA includes portions of Scenic Shoreline Unit 26 – Cave Rock. Shoreline views include Shakespeare Point's craggy rock feature and the steep rocky shore and housing intermixed with pine forest and scrub. While the overall scenic quality is defined as moderate with a rating of 2, the views within the WSAs have a high scenic quality and rating of 3. According to the 2011 TRPA Threshold Report, the composite rating has slightly decreased from 10 in 1982 to 9.5 due to the development of highly visible large new homes with high reflectivity and poor screening, as well as piers and boatlifts. Although some structural improvements have been made, they were not sufficiently widespread

to improve the rating and the area is at risk as it is not in threshold attainment. Ratings include: composite – 9.5; man-made features – 2.5; background views – 4; and variety – 3.

According to the Forest Plan Scenic Stability rating, the Uppaway WSA is rated as a high stability area.

U.S. 50 is a National Scenic Byway within each of the Douglas County Water System areas.

### 2.2.13 Cultural Resources

Less than 25% of the Uppaway WSA has been subjected to cultural resources survey and inventory. Four inventories have been completed within the Uppaway WSA. Three were linear surveys completed for the Nevada Department of Transportation (NDOT); and one was completed by a private entity (nvcris.shpo.nv.gov, accessed on 10/20/15).

**Table 2-4 Cultural Resources Inventory**

| SHPO Report Number | Lead Agency | Title | Author | Report Year |
|---|---|---|---|---|
| DBI_NV_2007_198 | NDOT | Cultural Resources Inventory Report Lower US 50 Erosion Control -- Storm Water Management Master Plan Douglas County, Nevada | Reno, Ronald and Charles D. Zeier | 2000 |
| 5949 | NDOT | Archaeological Inventory Report State Route 207, Kingsbury Grade Erosion Control / Archaeological Inventory Lower US 50 Erosion Control - Storm Water Management Master Plan Douglas County, Nevada | Zeier, Charles D. | 2006 |
| 4522 | NDOT | Archaeological Inventory Report US 50 North of Cave Rock Erosion Control--Storm Water Management Master Plan, Douglas County, Nevada | Reno, Ronald and Charles D. Zeier | 2009 |
| 3-171 | Private | Uppaway-Boucher Young Estates Water Supply System Heritage Resource Inventory Glenbrook Nevada | Lindstrom, Susan G | 1997 |

There are two historical properties listed on the NRHP in Glenbrook, Douglas County, Nevada. The Lake Shore House in Glenbrook, north of the Uppaway WSA, and the Tahoe Shipwreck in Lake Tahoe (National Register of Historic Places Research Database, nps.gov/nR/research/index, accessed on 10/20/15). There are two recorded historical resources within and adjacent to the Uppaway WSA. They consist of two roads and a mule trail segment. Historical resources further from the project area include a large historical timber-harvest landscape, and numerous resources associated with historical agricultural practices.

| Trinomial | Age | Description | Site Record NRHP Evaluation |
|---|---|---|---|
| DO799 | Historic | Road | Ineligible |
| DO1190 | Historic | Road and mule trail segment | Ineligible |

**Table 2-5 Historical Resources Inventory**

No prehistoric archaeological resources have been recorded in the Uppaway WSA (nvcris.shpo.nv.gov, accessed on 10/20/15 and 10/21/15). Prehistoric sites would most likely be ethnographically associated with the Washoe Tribe of Nevada and California. The closest recorded archaeological sites to the Uppaway WSA are located along the lakeshore. The prehistoric sites are primarily food preparation areas surrounding bedrock mortar (grinding hole) stations.

The Uppaway WSA has a medium to low cultural resources sensitivity. Within the Uppaway WSA resources would most likely be associated with historical timber harvesting and forestry practices. Large complex prehistoric or historic resources requiring costly mitigation measures are not anticipated within the Uppaway WSA. This assessment is based solely on a records search conducted electronically with the Nevada Cultural Resources Information System (nvcris.shpo.nv.gov, accessed on 10/20/15 and 10/21/15). There is always the possibility that previously unrecorded cultural resources are present near and around the Uppaway WSA.

## 2.3 Population Trends

According to the 2011 Douglas County Master Plan, population trends in the Lake Tahoe region of Douglas County indicate the full-time permanent population declined between 2000 and 2010 as a result of an increase in second and vacation home ownership. The number of active vacation home rentals in the area is expected to continue to increase. The population in the Tahoe area decreased between 2000 and 2010 the Zephyr Cove/Roundhill CDP experiencing a population decrease of 373 persons or -20% for a total population of 1,324. Similar trends occurred in other portions of the Lake Tahoe area such as Kingsbury and Stateline, while the portions of Douglas County outside of the Lake Tahoe Basin experienced population growth. TRPA socioeconomic data for 2010 indicates that percentage of primary residences in Douglas County versus secondary residences is 51/49 (TRPA 2011 Threshold Evaluation – Appendix A). Overall, the population increased by 14% between 2000 and 2010 in Douglas County, with a 2010 population of 46,997 persons.

Nevada County Population Projections 2014-2033 prepared by the Nevada State Demographer's Office (October 1, 2014), project the population of Douglas County will be approximately 49,620 persons in 2032, as compared to 48,478 persons in 2013. Overall, population trends indicate a population decrease in Douglas County through 2018, with an average annual increase of 0.3% through 2033. The 2014-2013 Projections also indicate most job growth will occur in the fields of construction (1.2%), accommodation and food services (1.8%), and professional, scientific, and technical services (0.8%), among others.

Redevelopment employment along US 50 is unlikely to result in population growth despite employment gains as workforce housing has not increased. In addition, wages corresponding to the employment growth areas in the Lake Tahoe Basin do not afford employees residence within the Lake Tahoe area. Those employed by new jobs will continue to commute to the area from more affordable areas in Douglas County. Therefore, population growth trends will continue to decrease or remain stagnant in the Lake Tahoe Basin area.

There are 10 vacant lots in Uppaway that have high enough land capability score to be built on. Of these 10, there are 2 with active water system connection permits.

## 2.4 Community Engagement

The community will be engaged via open-house type meetings where small groups will have the opportunity to view easel-type presentations and ask questions of the design engineers or County representatives. These open-house meetings will present the concerns and system deficiencies, as well as alternatives and associated costs or rate increases.

# 3 Existing Facilities

## 3.1 Location Map

The Uppaway Water System currently serves 31 residents, with a build out potential of approximately 42 residents. There is one dedicated fire service as well. The Water Service Area (WSA) is depicted in Figure 3-1. The boundaries for the Uppaway WSA include Lake Tahoe to the west, U.S. 50 to the east, the end of Lakefront Drive and South Point Place to the north and Lakefront Drive to the south, excluding the approximately 310,000 square foot area (310' x 1,000') at the western end of Yan Road. The WSA is located in Douglas County, Nevada within the Glenbrook, NV United States Geological Survey (USGS) 7.5-minute quadrangle Township 14 North, Range 18 East, Section 15.


**Figure 3-1 Location Map**

Source: Google Earth

## 3.2 History

Although the property has been occupied since the 1930's, modern infrastructure and improvements were constructed beginning in the late 1970's. The original potable system involved a T-shaped intake located on the lake bottom approximately 600' from shore. This intake was connected via a 6" pipe to a pump house located just onshore. 60 gpm booster pumps lifted water to a 150,000 gallon tank at the top of the hill.

In the late 1990's drinking water standards necessitated that the lake intake be abandoned, or surface water treatment would be required. In 1997, Uppaway Well No. 1 (south well) and Uppaway Well No. 2 (north well) were drilled approximately 150' inland from the pier shown in the lower right portion of Figure 3-1. Additionally, water rights were transferred from other Douglas County systems to provide for the existing 6.5 million gallon deficit in demand.

The Uppaway Wells No. 1 and 2 Pumping Test Analysis (Kleinfelder, August 10, 1999) recommended that the pumps be set at 250 feet below grade and operate at 140 gallons per minute. Uppaway Well No. 1 was established to be the production well and Uppaway Well No. 2 was established to be the backup well. Accordingly, during the 2015 site visit, Well No.1 was observed to be in the "auto" (run) position, while Well No. 2 was observed to be in the "off" position.

In 2000 the Uppaway Water System Improvement Project consisted of construction of a Well Building, civil improvements including paved access road, Well No.2 casing rehabilitation, pump to waste piping and infiltration gallery, sodium hypochlorite disinfection, and other well improvements.

In 2009, the original 150,000 gallon tank was replaced with a 375,000 gallon tank located on the same site.

In 2014, a hydro-pneumatic booster station was constructed on South Point Place to provide sufficient water pressure to 1 existing residence, and 3 additional future residences. The water system currently serves about 30 customers.

## 3.3 Supply Wells & Building

The domestic water source for Uppaway consists of groundwater Wells No.1 and No.2. Historically, Well No.1 is the primary well, and Well No.2 serves as a backup. Based on pump tests conducted by Kleinfelder and Gilmore Engineering from 1999 to 2000, the wells act as infiltration wells that are recharged by Lake Tahoe. The tests also demonstrate that the wells are hydraulically connected, as the drawdown in the monitoring well (Well No. 2) closely follows the drawdown in the pumped well (Well No. 1).

Both wells have 6-inch diameter casings with submersible pumps and pitless adapters. A filter pack with 4-inch inside diameter, was installed in Well No.2 in 2000 to mitigate sanding from holes in the PVC casing.

The Well Building houses the pump switchgear and controls, well discharge piping, diesel standby generator, booster pump for Well No.2, and hypochlorite tank and metering pump. The booster pump for Well No.2 is required due to the filter pack, which limits the pump size to 4-inch. A 4-inch pump was not available that could meet the head requirements, hence the booster pump was added.

The following table summarizes the well design data.

## Table 3-1 Well Summary

| Item | Well No.1 | Well No.2 |
|---|---|---|
| Depth | 255 feet [a] | 250 feet [a] |
| Motor | Franklin (30 horsepower) [a] | Franklin (7.5 horsepower) [a] |
| Pump Model | Grundfos (submersible) 150S300-15 [a] | Grundfos (submersible) 75S75-12 [a c] |
| Casing Diameter/ Material | 6-inch Stainless Steel [e] | 6-inch PVC. 4-inch I.D. in location of filter pack [e] |
| Applied Pressure During Test | 150 psi [b] | 150 psi [b] |
| Drawdown During Test | 220 feet [b] | 165 feet [b] |
| Rate During Test | 140 gpm [b] | 62 gpm [b] |
| TDH During Test (combined pump and booster) | 575 feet TDH [b] | 512 feet TDH [b] |
| Outlet Size | 3" [c] | 2" [c] |
| Specific Capacity | 0.64 gpm/ft drawdown [d] | 0.68 gpm/ft drawdown [d] |
| Well Screen Area | 53 to 216 Feet & 233 to 250 Feet | 101 to 256 Feet 31.0% [c] |
| Screen Size | 0.020 - In | 0.020 - In |
| Design Operating Point | 150 gpm at 580 feet TDH [c] | 75 gpm at 260 feet TDH [c] |
| Sanitary Seal | Cement - 50 Feet | Cement - 50 Feet |
| Booster Pump | N/A | Baldor (7.5 horsepower) [a] |

Source:

[a] - Water Right – Well #1 Certificate # 16865 – Well #2 Certificate # 17352

[b] - KASL Engineers December 22, 2000 Phase Two Uppaway Water System Improvement Project Start Up Tests

[c] - Manufacturer Provided Pump Curve and Component Information

[d] - Uppaway Wells No.1 and 2 Pumping Test Analysis, Kleinfelder 1999

[e] Gilmore Uppaway Water System Improvement Project Design Drawings, 2000

### 3.3.1 Water Rights

The water rights for Well No.1 fall under 10 State of Nevada Permits. The following table summarizes the water rights for Wells No.1 and No.2.

**Table 3-2 Water Rights Summary**

| Water Right | Comments | Permit No. |
|---|---|---|
| **Well No.1** | | 66242, 66243, 66244, 66245, 66246, 66247, 66248, 66249, 66250 |
| 46.96 AFA | Total Annual | |
| 15.30 MGal | Total Annual | |
| 130 gpm | Rate of diversion | |
| **Well No.2** | | 66298 |
| 25.12 AFA | Total Annual | |
| 8.18 MGal | Total Annual | |
| 73 gpm | Rate of diversion | |
| **Combined** | | |
| 72.08 AFA | Total Annual | |
| 23.48 Mgal | Total Annual | |

Notes:
AFA – Acre Feet Annually

The average annual water use since 1997 is 13.8 million gallons. Water use has been trending downward in recent years (likely due to conservation efforts) and it appears that the water rights are sufficient to meet existing demands. The peak water usage to date was 18.3 million gallons in 2012.

### 3.3.2 Condition

The Well Building and equipment is relatively new and generally in good condition. Some paint is beginning to fail on the water piping.

Recommendations for the Uppaway SCADA system are described in the County's June 2015 SCADA Master Plan, and include upgrades to the Tank, Booster, and Wells RTUs.

### 3.3.3 Regulatory Compliance

The water from Wells No.1 and No.2 is considered groundwater by the State, even though pump tests conducted by Gilmore Engineering show the wells are recharged by Lake Tahoe. The County conducted a micro-particulate analysis which demonstrated from a water quality standpoint that the water is

groundwater. The water is filtered enough through the soil that it is considered groundwater. As such, it is not subject to Surface Water Treatment Rule regulations, which would require filtration or additional disinfection. However, from a water rights perspective, the County is able to use their surface water rights.

Of the water quality constituents measured for state compliance, no compliance issues have been identified. Both wells have the state required 50-foot cement sanitary seals.

### 3.3.4 Operational Issues

In July of 2015 the County noticed reduced production and high drawdown from Well No.1. Production was approximately 50 gpm at 218-feet of drawdown, compared to 120 gpm at 176-feet of drawdown from 1999 Kleinfelder well pumping tests. Well No.1 is programmed to shutdown at a max drawdown of 220-feet. The main well was shut down and the backup well (No.2) was tested. It produced 55 gpm with comparable drawdown to Well No.1. The reduced well output resulted in the well running close to 24 hours per day. Both wells cannot be run at the same time due to their proximity and connectivity.

The backup Well No.2 is not normally run because it produces sand. Some of the increased draw down may be related to low lake levels (below the natural rim) due to the extended drought. The County had to consider implementing watering restrictions that summer, and there were only 10 homes occupied full time.

## 3.4 Distribution System

The distribution system consists primarily of 6-inch and 8-inch diameter steel piping with cement mortar lining and asphaltic coating. The system is primarily pressured by gravity from the storage tank.

**Table 3-3. Piping Data**

| Item | Value |
|---|---|
| Material | 12 Gage Steel |
| Lining | Cement Mortar |
| Coating (and Wrapping) | Asphalt |
| Installed | 1976 (date of design drawings) |
| 6” diameter | 2,300 +/- feet + 600’ long intake into Lake Tahoe (subsequently abandoned) |
| 8” diameter | 3,000 +/- feet |

Source: 1976 Improvement Plans for Uppaway (W.F. Pillsbury Inc. Engineers).

Note: this table does not include any piping for the tap and service to the Boucher-Young Estate.

### 3.4.1 Condition

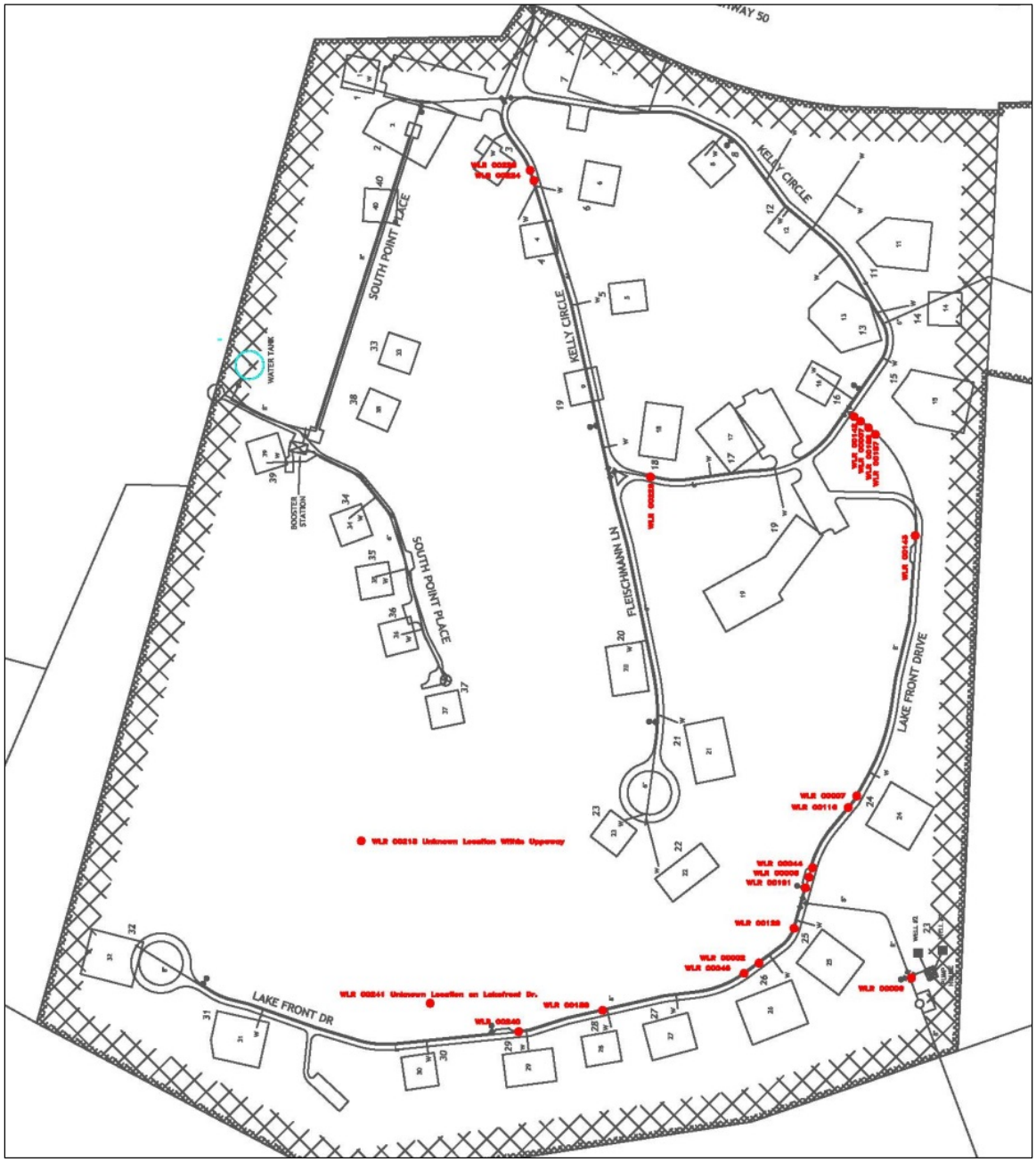
To date, the Douglas County Public Works Department reports that 22 leaks have been repaired (see Figure 3-2). These leaks have occurred primarily on the 8” pipes, but also on 6” pipes as well. There is a high likelihood that a few additional leaks and repairs have occurred, which either weren’t documented or were lumped in with repair orders to near-by water system(s) but weren’t specifically designated to the Uppaway System. The following photos show leak repairs from September 2015. The leak pictured is right next to an older repair band. Also note the electrical line right on top of the water line.

**Photo 3-1 Leak Next to Existing Repair Band**

**Photo 3-2 Cracked Pipe Near Electrical Line**

**Photo 3-3 Repair Band**

**Figure 3-2 Uppaway Water Line Leak Repairs 2001-2012**




Source: Douglas County Public Works Utility Division. Red dots indicate leak repairs.

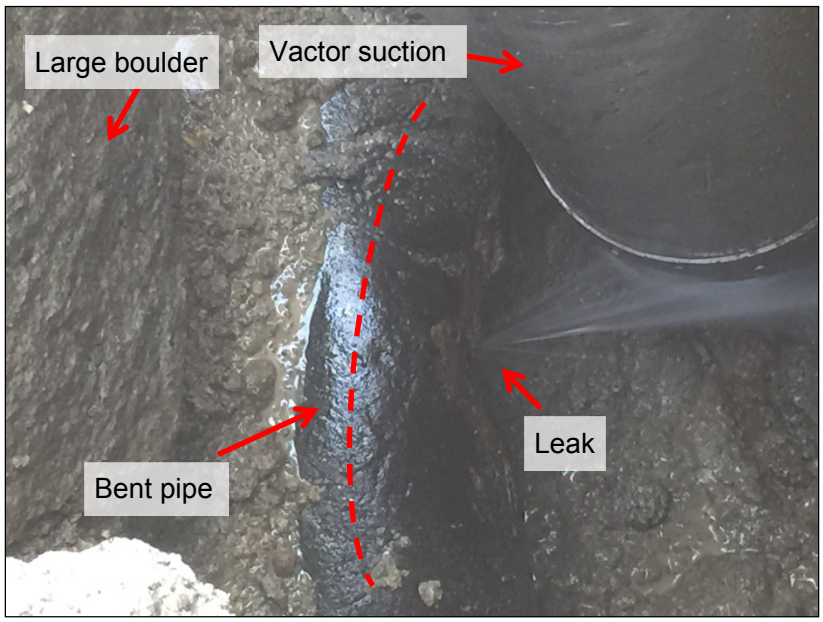
Observing the map of leaks, a correlation does not seem to exist between leak locations and high pressures (note: the terrain generally falls from the upper portion of the figure down to Lake Tahoe at the bottom of the picture). When the tank is full a maximum static pressure of 130 psi exists at the lowest home (located at the lower left of the figure). Although this pressure is above the 100 psi limit set forth in NAC 445A.6711 it is presumably within the tolerances used for specifying pipes in a pressure system, and no leaks have been reported around this location.

However, leaks in other similar-age systems seem to be much more related to construction practices as opposed to system pressures. An observation of photographs from repairs to the Cave Rock system indicates that the following construction practices were utilized along the East shore of Lake Tahoe in the 1970's:

1. Native materials, including large rocks, were used as bedding and backfill directly on the pipes.
2. Pipes were sometimes bent during installation, in lieu of installing elbows.

Both of these practices will compromise pipe integrity and lead to leaks.

**Figure 3-3. Cave Rock System Repair Photograph**




Source: Douglas County Public Works Utility Division

The following figures summarize the leak history and associated costs.

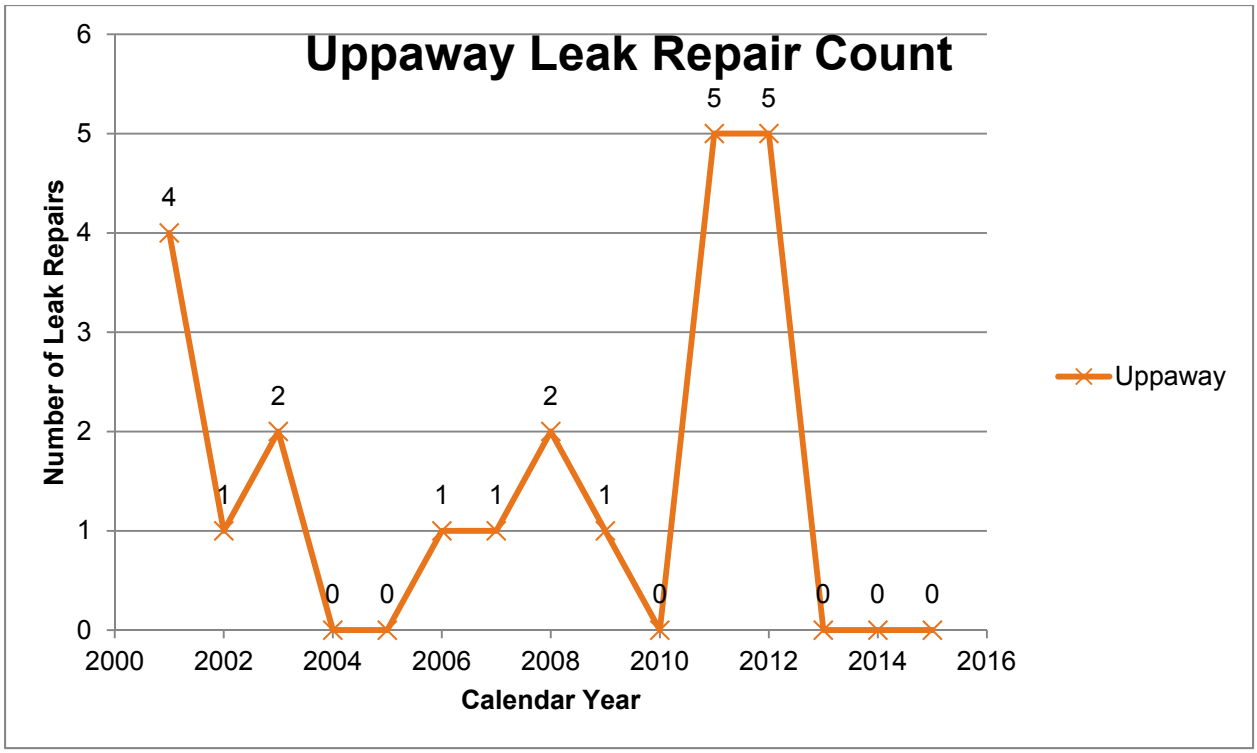



**Figure 3-4 Leak Repair History**

**Table 3-4 Leak Repair Costs**

| Fiscal Year | Leak Repair Cost (1) |
|---|---|
| 2009-10 | $23,453 |
| 2010-11 | $59,025 |
| 2011-12 | $98,036 |
| 2012-13 | $63,344 |
| 2013-14 | $32,731 |
| **Annual Avg.** | **$ 55,318** |

Source: Douglas County Records
(1) Leak Repair Costs include Cave Rock and Uppaway, as they share funding. Costs are for contractor only, and do not include County oversight costs.

### 3.4.2 Regulatory Compliance

The distribution system must meet State and Federal regulations, as documented in the Nevada Administrative Code (NAC) section 445A. In addition to the criteria in NAC 445A, Douglas County has its own Design Criteria, some of

which are stricter than the NAC. Lastly, fire flow requirements are ultimately governed by the local fire authority, the Tahoe Douglas Fire District.

The following table summarizes the general water distribution requirements for both Douglas County and the State of Nevada. In the few instances where County code criteria were stricter than NAC (as shown in italicized red font), the stricter code governs.

**Table 3-5 Code Comparison Criteria**

| | NAC 445A | County |
|---|---|---|
| **System Residual Pressure** | | |
| Fire Flow & Max Day | 20 psi | 20 psi |
| Max Day | 40 psi | 40 psi |
| Peak Hour | 30 psi | 30 psi |
| Max Static | 100 psi | 100 psi |
| **Pipe Velocity** | | |
| All Conditions (except Fire Flow) | 8 fps | 8 fps |
| Fire Flow & Ave Day Demand | None | *10 fps* |
| Minimum Pipe Size | 6-inch | *8-inch* |
| Pipe Material | As per Orange Book/AWWA | *Ductile Iron or C900 PVC* |

Source: NAC and Douglas County Design Criteria

### 3.4.3 Fire Flow Requirements

The County met with Tahoe Douglas Fire District (TDFD) on February 25, 2015 to discuss fire flow requirements for Zephyr Water Utility District, which is a part of Douglas County. The County requirement for fire flow is 1,500 gpm minimum. Historically, this fire flow requirement has been applied “across the board” with respect to residential fire flow requirements for water system modeling and analysis for water systems in Douglas County. However, at this meeting, TDFD as represented by Eric Guevin, Fire Marshall, stated that fire flow requirements were governed by the International Fire Code (IFC). In the IFC, fire flow is determined based on building size and construction, as summarized in Figure 3-5 (IFC Table B105.1).

**TABLE B105.1**
**MINIMUM REQUIRED FIRE-FLOW AND FLOW DURATION FOR BUILDINGS**

| FIRE-FLOW CALCULATION AREA (square feet) | | | | | FIRE-FLOW (gallons per minute)[b] | FLOW DURATION (hours) |
|---|---|---|---|---|---|---|
| Type IA and IB[a] | Type IIA and IIIA[a] | Type IV and V-A[a] | Type IIB and IIIB[a] | Type V-B[a] | | |
| 0-22,700 | 0-12,700 | 0-8,200 | 0-5,900 | 0-3,600 | 1,500 | 2 |
| 22,701-30,200 | 12,701-17,000 | 8,201-10,900 | 5,901-7,900 | 3,601-4,800 | 1,750 | |
| 30,201-38,700 | 17,001-21,800 | 10,901-12,900 | 7,901-9,800 | 4,801-6,200 | 2,000 | |
| 38,701-48,300 | 21,801-24,200 | 12,901-17,400 | 9,801-12,600 | 6,201-7,700 | 2,250 | |
| 48,301-59,000 | 24,201-33,200 | 17,401-21,300 | 12,601-15,400 | 7,701-9,400 | 2,500 | |
| 59,001-70,900 | 33,201-39,700 | 21,301-25,500 | 15,401-18,400 | 9,401-11,300 | 2,750 | |
| 70,901-83,700 | 39,701-47,100 | 25,501-30,100 | 18,401-21,800 | 11,301-13,400 | 3,000 | 3 |
| 83,701-97,700 | 47,101-54,900 | 30,101-35,200 | 21,801-25,900 | 13,401-15,600 | 3,250 | |
| 97,701-112,700 | 54,901-63,400 | 35,201-40,600 | 25,901-29,300 | 15,601-18,000 | 3,500 | |
| 112,701-128,700 | 63,401-72,400 | 40,601-46,400 | 29,301-33,500 | 18,001-20,600 | 3,750 | |
| 128,701-145,900 | 72,401-82,100 | 46,401-52,500 | 33,501-37,900 | 20,601-23,300 | 4,000 | 4 |
| 145,901-164,200 | 82,101-92,400 | 52,501-59,100 | 37,901-42,700 | 23,301-26,300 | 4,250 | |
| 164,201-183,400 | 92,401-103,100 | 59,101-66,000 | 42,701-47,700 | 26,301-29,300 | 4,500 | |
| 183,401-203,700 | 103,101-114,600 | 66,001-73,300 | 47,701-53,000 | 29,301-32,600 | 4,750 | |
| 203,701-225,200 | 114,601-126,700 | 73,301-81,100 | 53,001-58,600 | 32,601-36,000 | 5,000 | |
| 225,201-247,700 | 126,701-139,400 | 81,101-89,200 | 58,601-65,400 | 36,001-39,600 | 5,250 | |
| 247,701-271,200 | 139,401-152,600 | 89,201-97,700 | 65,401-70,600 | 39,601-43,400 | 5,500 | |
| 271,201-295,900 | 152,601-166,500 | 97,701-106,500 | 70,601-77,000 | 43,401-47,400 | 5,750 | |
| 295,901-Greater | 166,501-Greater | 106,501-115,800 | 77,001-83,700 | 47,401-51,500 | 6,000 | |
| — | — | 115,801-125,500 | 83,701-90,600 | 51,501-55,700 | 6,250 | |
| — | — | 125,501-135,500 | 90,601-97,900 | 55,701-60,200 | 6,500 | |
| — | — | 135,501-145,800 | 97,901-106,800 | 60,201-64,800 | 6,750 | |
| — | — | 145,801-156,700 | 106,801-113,200 | 64,801-69,600 | 7,000 | |
| — | — | 156,701-167,900 | 113,201-121,300 | 69,601-74,600 | 7,250 | |
| — | — | 167,901-179,400 | 121,301-129,600 | 74,601-79,800 | 7,500 | |
| — | — | 179,401-191,400 | 129,601-138,300 | 79,801-85,100 | 7,750 | |
| — | — | 191,401-Greater | 138,301-Greater | 85,101-Greater | 8,000 | |

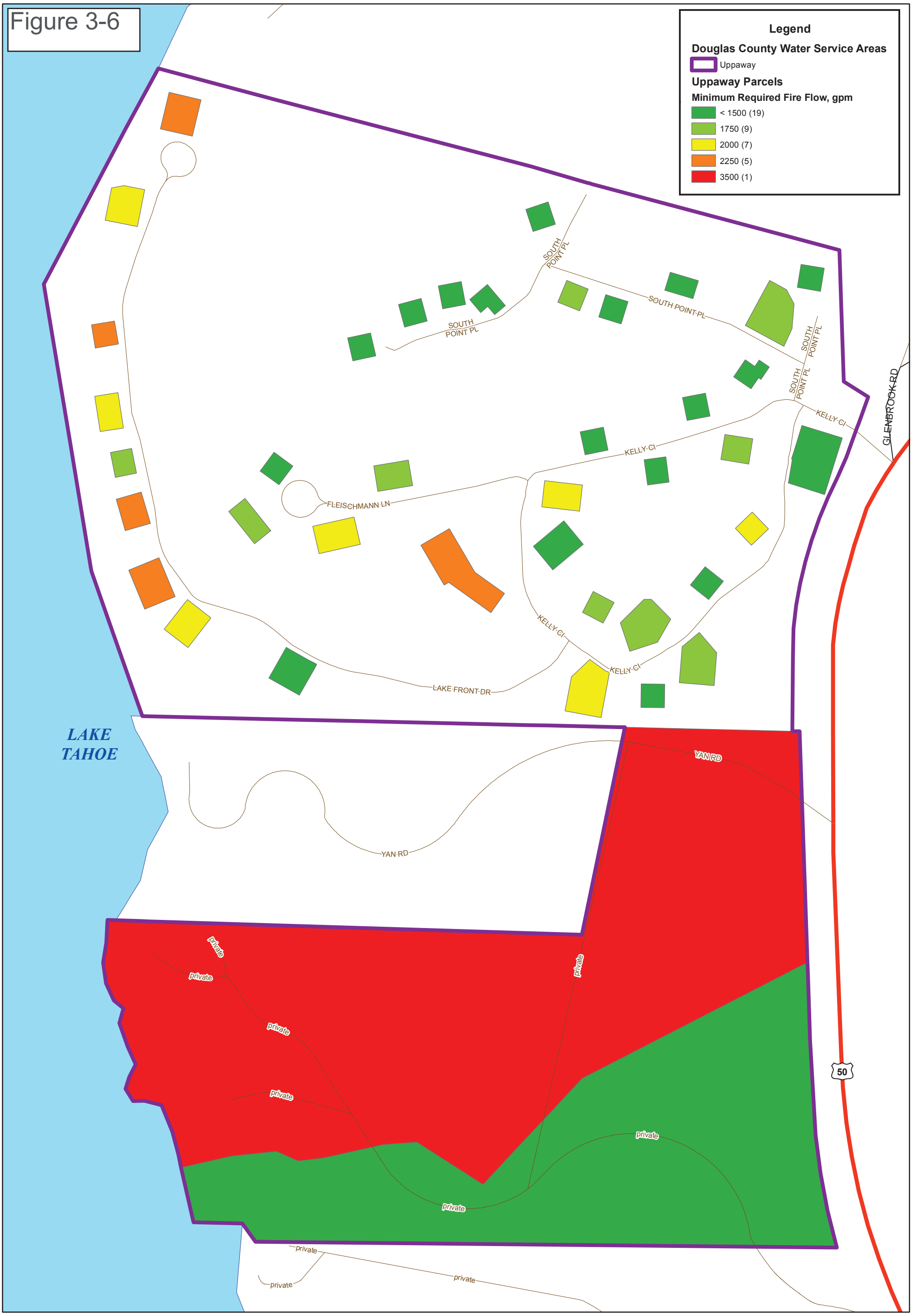
For SI: 1 square foot = 0.0929 m2, 1 gallon per minute = 3.785 L/m, 1 pound per square inch = 6.895 kPa.
a. Types of construction are based on the *International Building Code*.
b. Measured at 20 psi residual pressure.

**Figure 3-5. IFC Table B105.1**

The County used building information obtained from County GIS records to determine the fire flow criteria for each parcel in the water system. This information is shown on the following figure. The required parcel fire flows were allocated to nearby hydrants, as indicated by the colored circles shown in Figure 3-6. These flows were used as the basis for water system modeling to verify the system meets pressure and flows under the various demand scenarios.

# Uppaway Water System - - Minimum Required Fire Flows, gpm

Figure 3-6




Print Date: 4/9/2015 - - File Name: FireFlow_Uppaway_Z597_11x17P

### 3.4.4 Services & Water Meters

Currently none of the water services are metered, although 37 South Point Place has a meter pit. Non-metered services are charged a flat rate, which does not promote water conservation. The County's Water Conservation Plan, required under NRS 540.131, is located online at: http://www.douglascountynv.gov/DocumentCenter/Home/View/1137.

Metering of all water services is not required under the current plan, however, the County is talking to other water purveyors in the Carson Valley about adopting a common plan.

Additionally, common landscape areas are being irrigated through several of the domestic services. It is believed that a significant amount of water is being used for landscape irrigation. The County would like to put meters on the irrigation services, and they need to be properly protected from backflow. The following table summarizes the existing service connections. The 1 and 2-inch services are for the Robert Lee parcel south of Uppaway, address 1860 Highway 50.

**Table 3-6 Water Service Summary**

| Service Size (in) | Type | No. of Connections |
|---|---|---|
| 0.75 | Residential | 29 |
| 1.00 | Parcel, 1860 Highway 50 | 1 |
| 2.00 | Parcel, 1860 Highway 50 | 1 |
| 0.75 | Fire Protection | 1 |
| | **Total** | **32** |

Source: Douglas County Records

## 3.5 Water System Modeling

Douglas County provided a hydraulic model of the Uppaway water distribution to HDR for modeling fire flows and system pressures. The model was analyzed and updated based on County water distribution system evaluation criteria. The modeling software package Bentley® WaterGEMS® V8i was used for this analysis.

### Model Infrastructure

The County model contains the entire Uppaway water system including the production wells, storage tank, and distribution system.

### 3.5.1 Water System Demands

In designing and analyzing water systems, a careful consideration of customer demand for water is crucial. It is standard engineering practice to evaluate three demand periods: Average Daily Demand (ADD). Maximum Daily Demand (MDD), and Peak Hour Demand (PHD). Table 3-7 provides a summary of the estimated ADD, MDD, and PHD rates used in the various model scenarios.

**Table 3-7 Model Demands**

| Demand Scenario | Average Day Demand (gpm) | Maximum Day Demand (gpm) | Peak Hour Demand (gpm) |
|---|---|---|---|
| Total | 25 | 50 | 62.5 |
| Peaking Factor | 1.0 | 2.0 | 2.5 |

Since growth in the service area is currently negative and there is very limited room for expansion of the system, current demands are considered adequate for representing future conditions.

### 3.5.2 Evaluation Criteria

Evaluation criteria for analyzing the model are based on the Nevada Administrative Code Section 445A, and Douglas County Design Standards, and are summarized in Table 3-5.

### 3.5.3 Pressure and Velocity

These criteria include minimum/ maximum pressures and velocities for the following flow conditions:

- Maximum Day Demand (MDD)
- Peak Hour Demand (PHD)
- MDD plus Fire Flow (MDD + FF)
- Average Day Demand (ADD)

**Table 3-8 Evaluation Criteria**

| Criteria | Value | Units |
|---|---|---|
| MDD Min Pressure | 40 | psi |
| PHD Min Pressure | 30 | psi |
| MDD + FF (Min) | 20 | psi |

| Criteria | Value | Units |
|---|---|---|
| ADD Max Pressure | 100 | psi |
| ADD Max Velocity | 8 | ft/s |
| ADD + FF Max Velocity | 10 | ft/s |

### Fire Flow

Fire flow requirements were determined based on parcel data provided by the County, as summarized in Section 3.4.3. The resulting map and list of fire flow requirements per hydrant and model node are shown in Figure 3-6. There is an existing pumper truck connection located on South Point Place. For fire flow analysis, it was assumed that a fire pumper truck would be connected and discharge based on the pumper truck pump curve.

## 3.5.4 Existing System Analysis

The existing system was analyzed based on the evaluation criteria. Model simulations were run for ADD, ADD+FF, MDD, MDD+FF, and PHD. Tank levels were adjusted based on the type of analysis being run. For high pressure sensitive simulations, for example, ADD maximum pressure analysis, the level of the tanks were set to approximately 75 percent full.

All pressure reducing valves (PRVs) were allowed to open for fire flow simulations based on the assumption PRVs in the real world system are set to fully open in the event of a major pressure gradient is experienced in the direction of flow.

**Table 3-9. Tank Data during Model Scenarios**

| Item | Value | Units |
|---|---|---|
| Base Elevation | 6,529.5 | Ft |
| High Water Elevation | 6,560.0 | Ft |
| Diameter | 45.0 | Ft |
| Volume | 362,840 | Gal |
| Percent Full | 75 | % |
| Initial Level | 22.8 | Ft |
| Maximum Level | 30.5 | Ft |
| Minimum Level | 0 | Ft |

### Results

Modeling results are summarized in Figure 3-7.

*Average Day Demand*

Three (3) model nodes were above 100 psi.

*Max Day Demand & Fire Flow*

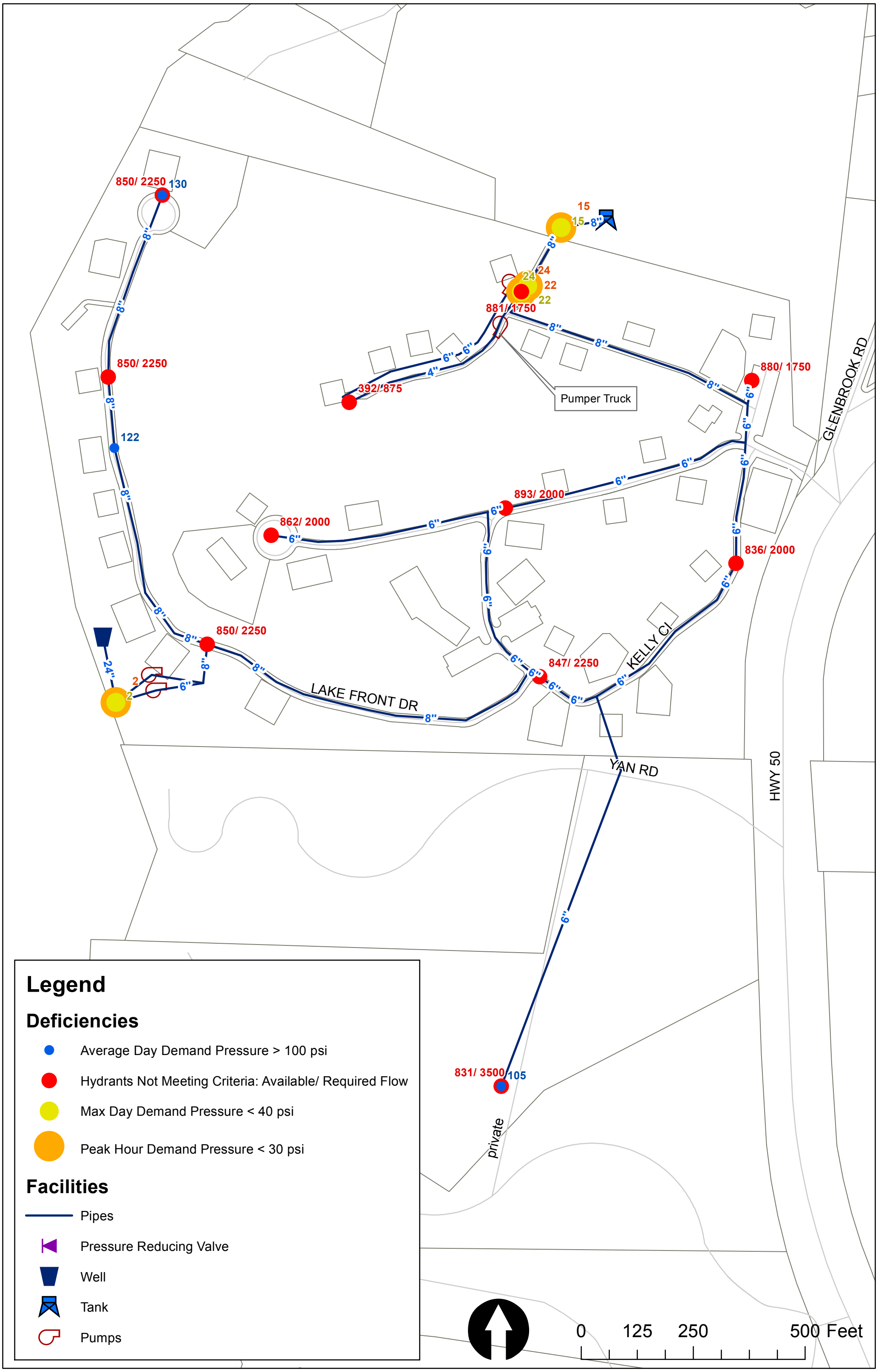
Eleven (11) fire flow deficiencies were located throughout the system.

*Max Day Demand*

One (1) model node has less than 40 psi pressure. Since this node is located near the tank, the system is considered to meet the max day demand pressure requirements.

*Peak Hour Demand*

One (1) model node has less than 30 psi pressure. Since this node is located near the tank, the system is considered to meet the peak hour demand pressure requirements.


850/ 2250
130
850/ 2250
122
881/ 1750
15
15
24
24
22
22
392/ 875
Pumper Truck
880/ 1750
893/ 2000
862/ 2000
836/ 2000
850/ 2250
847/ 2250
2
2
LAKE FRONT DR
KELLY CI
YAN RD
HWY 50
GLENBROOK RD
831/ 3500
105
private
8"
6"
4"
24"
Legend
Deficiencies
Average Day Demand Pressure > 100 psi
Hydrants Not Meeting Criteria: Available/ Required Flow
Max Day Demand Pressure < 40 psi
Peak Hour Demand Pressure < 30 psi
Facilities
Pipes
Pressure Reducing Valve
Well
Tank
Pumps
0
125
250
500 Feet

## 3.6 Hydro-Pneumatic Tank

A hydro-pneumatic (HP) tank and booster pump was installed in 2014 to boost pressure to the homes on South Point Place since these homes are close in elevation to the Uppaway Tank and would not otherwise meet NAC pressure requirements. The tank and pumps are located inside a new CMU building. The following table summarizes HP tank design criteria.

**Table 3-10. Hydro-Pneumatic Tank Data**

| Item | Value |
|---|---|
| Tanks | |
| Quantity | 2 |
| Size | N.A. |
| Operating Pressure (one pump) | 88 psi |
| Booster Pumps | |
| Quantity | 2 |
| Design Flow (each) | 15 gpm |
| Design Flow (firm) | 30 gpm |
| TDH | N.A. |
| HP (each) | 1.5 |
| Piping | |
| Size | 2-in |
| Material | Galvanized Steel |

Source: Douglas County Photos. N.A. – Not available.

### 3.6.1 Condition

The HP booster station was built in 2014 and is in good condition.

**Photo 3-4 Hydro-Pneumatic Tanks**


**Photo 3-5 Booster Pumps & Piping**

### 3.6.2 Regulatory Compliance

There are no known compliance issues with the HP booster station.

### 3.6.3 Operational Issues

Initially, the booster PRVs were set at 65 psi, which was too low, and they would discharge on a regular basis. Since the site visit, new PRVs were installed set at 125 psi, and new pump start and stop set points were programmed. The booster currently serves just one home, but there are 3 vacant parcels on which homes can be built. Assuming 5 gpm per equivalent dwelling unit (EDU), the booster station needs to provide a peak flow of 20 gpm. This is possible with both pumps running. The velocity in the station piping at this flow is 2 ft/s.

## 3.7 Storage Tank

The original Uppaway storage tank was replaced in 2011 with a new welded steel tank. It is located off South Point Place. The following table summarizes the design criteria for the new tank.

**Table 3-11. Water Storage Tank Data**

| Item | Value |
|---|---|
| Year Built | 2011 |
| Material | A36 Steel |
| Diameter | 45-feet |
| Max WS Height | 30.5-feet |
| Usable Volume | 362,840 gal |
| Inlet/Outlet Pipe Diameter | 12-inch |

Source: 2011 Uppaway Water Storage Tank Upgrade Project (HDR)

### 3.7.1 Condition

The tank was inspected in 2014 and overall the coatings are in very good to excellent condition. Spot repairs were made in several areas with NSF approved epoxy to lengthen the life of the coatings. Refer to the complete tank inspection report in Appendix D.

**Photo 3-6 Uppaway Tank**

## 3.7.2 Regulatory Compliance

### Tank Volume

Storage volume is covered under the following sections of the NAC 445A:

- 6674 – Storage Capacity
- 66745 – Operating Storage
- 6675 – Emergency Reserve

Douglas County shares the NAC 445A requirements for total storage volume, which for *new* systems is comprised of:

- Total Storage = Operating Storage + Emergency Reserve + Fire Demand.

Where:

- Operating Storage = Max day demand based on historical data, minus the system capacity to treat and pump water. Max day demand occurs in July and is approximately 574 gpm (1993 to 2014 data).
- Emergency Reserve = 75% of Operating Storage
- Fire Storage = 2,500 to 3,000 gpm for 2 hours

However, for *existing* systems, NAC 445A.6674 says *"An existing public water system maintains a storage capacity that, as determined by an engineer on the*

*basis of historical data, accepted engineering judgment and a network hydraulic analysis, is sufficient to ensure that the total capacity of the public water system will meet current and anticipated demands for water while maintaining the pressures indicated in NAC 445A.6711."*

Accepted practice for sizing storage tanks is to provide the greater of either;

- Equalization Storage (EQ) + Fire Flow Storage

  Or

- 2 x EQ

Equalization storage refers to the volume needed to meet peak hour demands while production facilities are operating at design capacity. This is typically calculated as the difference between peak hour demand and max day demand for a period of 6 hours.

Fire flow storage is the required fire flow and duration, based on the Fire District requirements. In this case 3,500 gpm for 2 hours governs. Table 3-12 shows the calculated storage volume required. The bold numbers are the governing storage requirement.

**Table 3-12. Storage Requirements by Zone**

| Zone | AAD1 | MDD2 (gpm) | PHD3 (gpm) | EQ4 (gal) | Fire Vol5 (gal) | 2EQ6 (gal) | EQ + Fire7 (gal) |
|---|---|---|---|---|---|---|---|
| Uppaway | 28 | 53 | 67 | 5,242 | 420,000 | 10,483 | **430,483** |

1 – Based on May to Sept pumpage data, 1992 to 2014
2 – Assumed 1.88 Peaking Factor
3 – Assumed 2.4 Peaking Factor
4 – Difference between PHD and MDD for 6 hours
5 – Per Fire District, 3,500 gpm for 2 hours
6 – 2 x EQ
7 – EQ + Fire Vol

Table 3-13 shows the surplus or deficit in storage for the system. As a whole, the system has a deficit of 67,642 gallons in storage capacity. This storage deficit is directly attributable to the large fire flow requirement for the residence on 1860 Highway 50. If the fire flow is reduced to the next highest required, 2,250 gpm, a surplus of storage exists.

**Table 3-13 Surplus/ Deficit Storage Requirement by Zone**

| Zone | Existing Storage (gal) | Required Storage1 (gal) | Surplus/ (Deficit) (gal) |
|---|---|---|---|
| Uppaway | 362,841 | 430,483 | (67,642) |

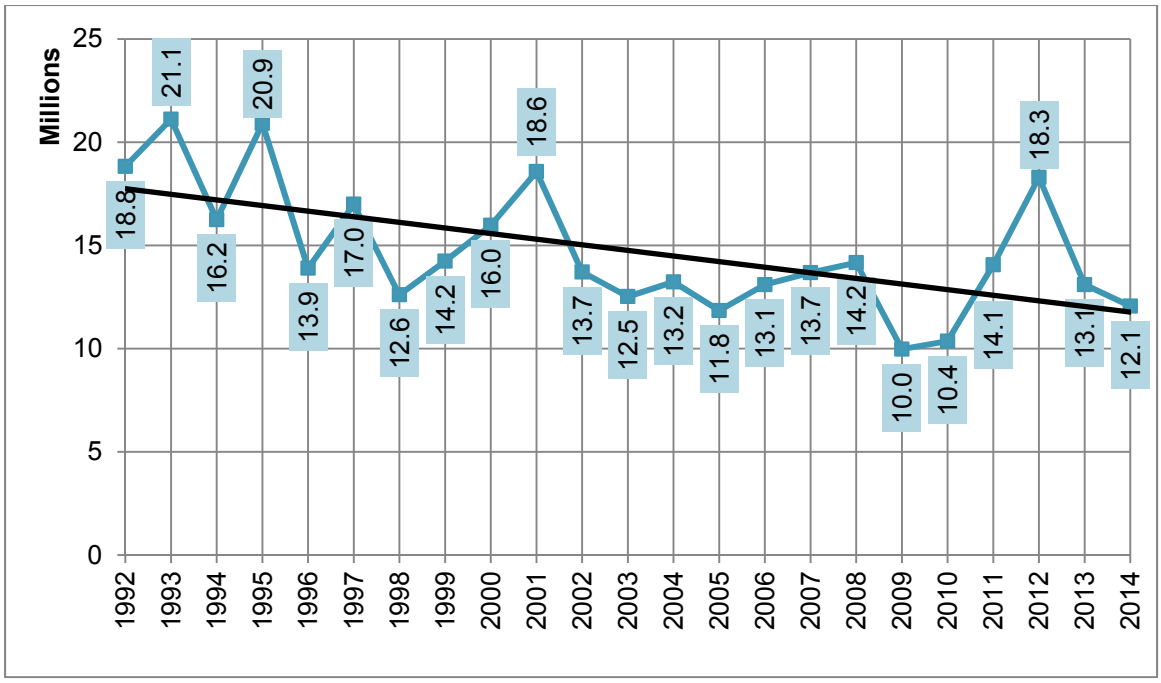
Notes: 1 – Per Table 3-12

## 3.8 Water Use Trends

A review of pumping records for the past 23 years shows a marked reduction in water consumption, from 21.1 million gallons in 1993, to 12.1 million gallons in 2014. This amounts to a reduction of 43% as shown in Figure 3-8. This reduction is in part due to a program of water conservation begun by Douglas County in 1996. This program hinges around public outreach via water conservation reminders sent in the mail as well as intermittent door to door visits.

Even with the reduction in consumption, the 2014 volume was consumed by 29 homes, equating to an average of 417,000 gallons of water per residence, and 1,100 gallons per home per day. By way of comparison, the United States EPA estimates that the average American family uses approximately 300 gallons of water per day per home (US EPA). Over 3 times more water was used per year per residence in Uppaway last year than the nation-wide average, and 2014 was the lowest volume year of the past 23 years. It is believed that much of the water being used is for landscape irrigation of both private and common areas.

**Figure 3-8. Uppaway Annual Water Use**




Source: Douglas County Public Works Utility Division

## 3.9 Sanitary Surveys

Nevada Division of Environmental Protection (NDEP) last conducted a sanitary survey of the water system on June 26, 2013. A subsequent letter from NDEP dated July 2, 2013 identified one deficiency. The following table summarizes the deficiencies noted by NDEP and the County's response.

**Table 3-14 Summary of Sanitary Survey**

| No. | Facility | Description | Response |
|---|---|---|---|
| 1 | Well No.1 (West) | Well discharge pipes and appurtenances not properly screened or air gapped. NAC 445A.66925 | Corrections were made to screen and gap the drain lines. |

The NDEP sanitary survey and response is included in Appendix D.

## 3.10 Financial Status of Existing Facilities

The Uppaway community has only one municipal electrical meter for their water system. This meter (located on Lake Front Drive) serves Well No. 1 as well as Well No. 2 and the booster pump, although they are not operated often.

### 3.10.1 Audit information

A Comprehensive Annual Financial Report (CAFR) is completed annually for the County which outlines the financial activities over the past fiscal year. The details of the utilities financial review are included as part of the CAFR as a major enterprise fund. The CAFR provides a summary of the Uppaway's financial position. The full CAFR is available on the County's website. For the analysis completed for the plan, the Fiscal Year (FY) 2013/14 CAFR was reviewed which was the most recent year available at the beginning of the study. Shown below in Table 3-15 is a summary of the FY 2013/14 CAFR review for the County's Uppaway water system.

**Table 3-15 FY 13/14 CAFR Summary (July 1, 2013 – June 30, 2014)**

| | Budget | Actual | Variance |
|---|---|---|---|
| | **Uppaway[1]** | **Uppaway[1]** | **Uppaway[1]** |
| Operating Revenues | $771,000 | $773,759 | $ 2,759 |
| Operating Expenses | $735,551 | $650,826 | $84,725 |

| | Budget | Actual | Variance |
|---|---|---|---|
| Operating Bal/(Def) | **$35,449** | **$122,933** | **$87,484** |
| Plus: Non-Op Rev/(Exp) | ($76,508) | ($53,516) | $22,992 |
| Plus: Contributed Capital | $0 | $27,508 | $110,476 |
| Plus: Transfers In | $1,750 | $1,750 | $0 |
| Change in Net Position | **($39,309)** | **$98,675** | **$137,984** |

*[1] – Figures include Cave Rock and Uppaway system costs as financials are combined*

### 3.10.2 Income

The primary source of income for the Uppaway system is through user rates. The budgeted water user fees are based on the current rate schedules for the water system and the number of metered and unmetered customers. In addition to user rates, additional sources of income include late charges, loan proceeds and rent/lease income along with interest on current investments. Shown below in Table 3-16 is a summary of Uppaway's current budgeted FY 2014/15 O&M expenses. It is important to note that the Uppaway system is budgeted with the Cave Rock system and the costs are shown as combined below.

**Table 3-16 Summary of Annual Income (FY 14/15 Budget)**

| Account # | Account Description | Uppaway[1] |
|---|---|---|
| 344.850 | Water User Fees | $713,400 |
| | **Charges for Service Totals** | **$713,400** |
| 360.810 | Late Charges | $1,000 |
| 360.750 | Loan Proceeds | $135,726 |
| 361.200 | Interest on Investment | $800 |
| 362.100 | Rent/Lease Income | $31,680 |
| | **Other Financing Sources Totals** | **$169,206** |
| | **Totals Revenues** | **$882,606** |

*[1] – Budget includes Cave Rock system costs as system financials are combined*

### 3.10.3 Rate Schedule

HDR reviewed the current water rate schedule for the Uppaway water system. Currently, residential customers have a flat monthly charge. There are 31 residential customers and consumption is unknown as customers are unmetered. There are no commercial or irrigation customers at this time for the Uppaway system. A summary of the current water rates (as of July 1, 2015) for the Uppaway water system is shown in Table 3-17.

**Table 3-17 Summary of the Current Uppaway Monthly Water Rates**

| Meter Size | Residential – Flat | Commercial - Metered | Irrigation – Metered |
|---|---|---|---|
| 5/8 inch | $195.37 | $89.12 | $51.39 |
| 3/4 inch | $195.37 | $89.12 | $51.39 |
| 1 inch | $488.42 | $222.80 | $128.51 |
| 1-1/2 inch | $976.83 | $445.59 | $256.99 |
| 2 inch | $1,562.93 | $712.96 | $411.18 |
| 3 inch | N/A | $1,425.91 | $822.37 |
| 4 inch | N/A | $2,227.98 | $1,284.96 |
| **Volumetric Charge** | | | |
| $ per 1,000 gallons Used | | $6.56 | $6.56 |
| **# of Customers** | **31** | **0** | **0** |
| **Consumption (1,000 gallons)** | **n/a** | **0** | **0** |

## 3.10.4 Metering Customers

A key component of rate setting is the ability to provide the customer with a price signal that reflects the impacts (costs) placed on the system by their consumption. This is typically accomplished through the use of metered rates. However, not all utilities have meters on all customers, and as a result charge a flat rate that reflects the average customer use based on metered customers. Given the recent drought in the western United States, which has highlighted water resource management, a renewed interest in metering customers has been emphasized. Although the transition to metered water service and rates can be costly and demanding, it can be a process that ends with the utility and the customer understanding the cost impacts placed on the system during peak use periods and the infrastructure necessary to provide service. Given the increased visibility of metered rates, the County has been considering a transition to metered rates and has started to evaluate the alternatives.

### Capital Cost and Rate Adjustments

The first item to consider would be the initial capital investment as it is the first step in implementation and there is a substantial financial burden at onset. Many

utilities will be challenged by the cost of the metering program but this can be mitigated by strategic planning. It is most likely to be a phasing in approach where meters are replaced over a period of years, not necessarily in a single year. The final meter implementation plan typically reflects the available funding for the capital investment in meters. With the advent of meters comes the necessity of a residential metered rate, similar to commercial and irrigation. The structure would be designed to meet the County's rate design goals and objectives (i.e. conservation, revenue stability, etc.).

Also, there would need to be rate adjustments to provide the additional funding to finance the meter purchases and installation. Reserve funds can also play a pivotal role in storing up funds and then dispersing them as the program requires them. The reserves are then typically restored over time to maintain prudent minimum reserve levels.

### Conservation

Currently, the amount of water used is not apparent to customers as there is no volumetric component. This can lead to a greater use of water, and some may argue, wasteful use. The County does notify customers annually to conserve water.

### Reduction in Use

Another key aspect to include in the analysis is the anticipated reduction in per capita water usage as customer's transition to metered rates and reduces consumption. This can impact rate revenue but it can also provide for additional available capacity for the District's system which may defer future capital needs for water supply and push them out a number of years which results in cost savings for the utility in the short term. It can also save money in the area of source of supply. The reduced use can result in the delay of source of supply projects or the avoidance of purchasing water from other purveyors, depending on the water supply portfolio of the Utility.

### System Leaks

Another aspect of metering customers is the ability to detect leaks in the system. As meters are placed in service the County will be able to compare total production to total metered sales and begin to gain an understanding of the unaccounted for water on the system and develop a plan to minimize the water loss. These losses may occur on the distribution system or on the customer owned facilities.

### Funding

Finally, the metering of water customers is becoming a "mandatory" requirement as many grant and low interest loan applications are requesting the utility to note

if customers are billed on a metered rate. The ability to obtain future low interest loans or grants may be enhanced by metering customers. It should be noted that there are additional funding sources that may be utilized in order to minimize rate impacts from the cost of metering customers. The lowest cost funding available are grant and low interest loan programs. However, these programs are becoming more difficult to obtain given availability of funds, the 'competition' for them with other utilities, as well as the County's eligibility to meet the requirements. Each program has different eligibility requirements and projects that can be funded from the program. It should also be noted that the full project cost will most likely not be funded through grants or low interest loans and other sources of funding will be necessary. These can be other low interest loan programs, existing reserves, rate funded, or additional long-term debt. Other utilities in the Tahoe Basin have recently been successful in receiving grant and low interest loan funding to assist in funding the installation of meters over the next several years.

### 3.10.5 Annual O&M Cost

The goal of all utilities is to operate the system in a way that provides service to it's customers into perpetuity. A large component of this is the annual operations and maintenance (O&M) expense required to maintain and operate the water system. As with all costs, the O&M costs will typically increase with time due to inflationary measures. Costs can also increase due to additions like new full-time employees, programs, or other. Because the annual O&M costs are anticipated to increase with time, it is important to model this trend as best as possible and then plan accordingly by adjusting rates to have the capacity to adequately fund the utility's budgeted O&M. Shown below in Table 3-18 is a summary of Cave Rock and Uppaway's budgeted FY 2014/15 O&M expenses.

**Table 3-18 Summary of Cave Rock and Uppaway Annual O&M Costs**

| | Salaries & Wages | Employee Benefits | Services & Supplies | Total O&M Expenses |
|---|---|---|---|---|
| O&M Expenses | $121,534 | $48,478 | $333,286 | $503,298 |

### 3.10.6 Energy Costs

When reviewing Uppaway's historical energy costs, it was noted that they had a slight decrease for Uppaway in kWh in calendar year (CY) 2013 and the 11 months of CY 2014 are showing the same downward trend from CY 2012 levels For FY 2015/16, energy costs are budgeted at $46,350 for Uppaway (includes Cave Rock's portion). Shown in Table 3-19 is a summary of the energy costs.

**Table 3-19 Annual Energy Costs [1]**

| Year | Uppaway | Cave Rock [3] | Total |
|---|---|---|---|
| CY 2012 | $ 7,264 | $ 32,143 | $ 39,408 |
| CY 2013 | $ 5,945 | $ 31,380 | $ 37,325 |
| CY 2014[2] | $ 5,816 | $ 31,374 | $ 37,190 |

[1] Dated from the NV Energy billing Jan 2012 – Nov 2014

[2] 2014 uses the 11 months as provided by the County and the average for December from the previous 2 years

[3] Water Treatment Plant power split 50/50 between Cave Rock and Skyland

In additional to the summary shown above, the monthly power usage is shown below to further aide in analyzing power costs. Figure 3-9 is a summary of the monthly power use for CY 2012 – CY 2014 for the Cave Rock and Uppaway water systems. Costs increase in portion to higher demands and pumping in the spring and summer months.

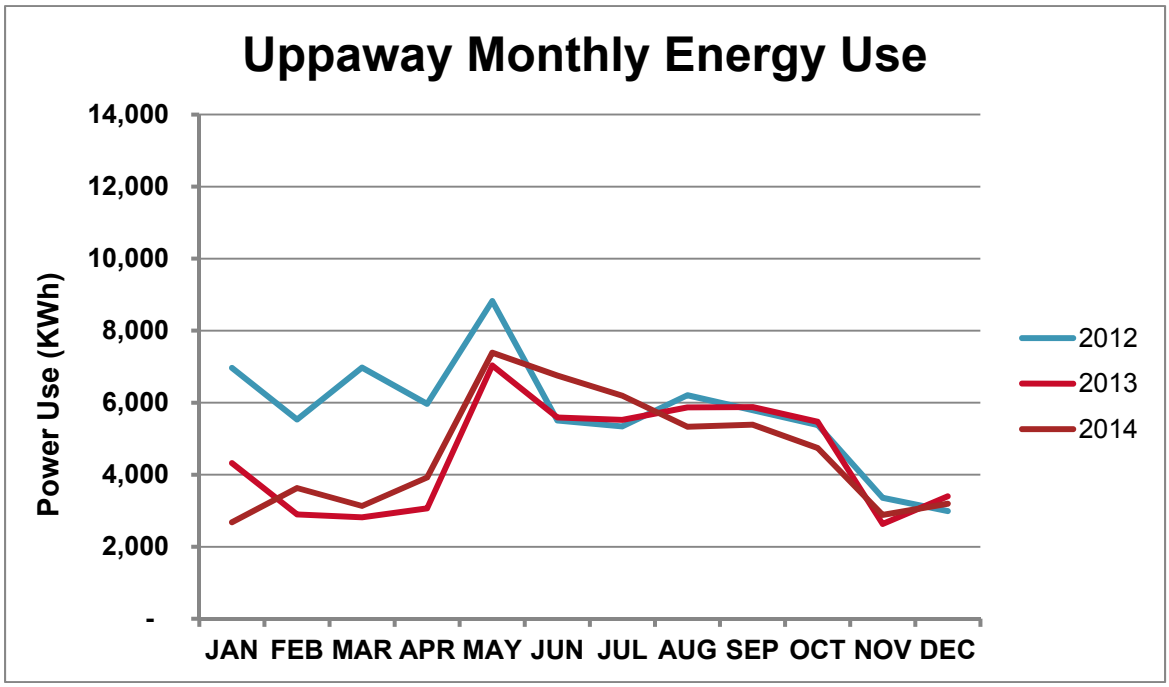



**Figure 3-9 Monthly Energy Usage**

## 3.10.7 Capital Improvements Program

The Uppaway water system's CIP for FY 2015/16 through FY 2020/21 is summarized in Table 3-20 below; again, the Cave Rock water system costs are included as the County combines the financials for these two systems.

**Table 3-20 Uppaway/ Cave Rock Capital Improvement Budget ($1,000s)**

| | FY 14/15 | FY 15/16 | FY 16/17 | FY 17/18 | FY 18/19 | FY 19/20 |
|---|---|---|---|---|---|---|
| Treatment Plant – Redundancy[1] | $0 | $0 | $39 | $527 | $0 | $0 |
| Water System Improv. Phase 2B | $0 | $0 | $128 | $1,187 | $1,083 | $0 |
| Water Distribution System Improv. | $0 | $0 | $0 | $264 | $1,354 | $3,501 |
| Replace Hidden Woods Tank | $0 | 0 | $0 | $0 | $0 | $1,669 |
| **Total Capital Projects** | **$0** | **$0** | **$167** | **$1,978** | **$2,437** | **$5,170** |

*[1] – Project contains only Uppaway/Cave Rock's proportion (50%)*

## 3.10.8 Debt Repayments

Currently, Uppaway has three debt obligations: 2005 revenue bond, 2009 State Revolving Fund (SRF) loan, and 2012 revenue bond. The 2005 revenue bond is retired in FY 2015/16 which results in a reduction of annual debt service of approximately $16,000 for Uppaway. Table 3-21, shows a summary of the current debt service for the current budget year and a 5-year projected period for the Uppaway water system.

**Table 3-21 Uppaway/ Cave Rock Debt Obligations ($1,000s)**

| | FY 14/15 | FY 15/16 | FY 16/17 | FY 17/18 | FY 18/19 | FY 19/20 |
|---|---|---|---|---|---|---|
| 2005A Water Refunding Bond | $15 | $16 | $0 | $0 | $0 | $0 |
| 2009 SRF Loan | $151 | $155 | $155 | $154 | $154 | $154 |
| 2012A Water Refunding Bond | $106 | $147 | $148 | $149 | $149 | $149 |
| **Total Capital Projects** | **$273** | **$318** | **$302** | **$303** | **$303** | **$303** |

Table 3-20 shows that the 2009 SRF Loan and the 2012A Bond continue throughout the review period. This means shows that a significant portion of the current debt for Uppaway will need to be serviced and care should be taken to maintain strong Debt Service Coverage (DSC) ratios. As shown in Table 3-21, it can be seen that the 2005A Water Refunding Bond is retired in FY 2016. This would allow the County the ability to fund future capital improvements through means that the County can add addition new long-term borrowing up to the level that of the annual debt service payment of the 2005A bond, or does not exceed

approximately $16,000, and there would be no net impact to current rate levels. However, if additional long-term borrowing is necessary to fund the project(s) in the future and the annual debt service exceeds that amount, the balance would most likely need to be funded through increases in user rates. The County should proactively manage the retirement of the existing long-term debt with regards to timing large capital projects to maximize available funding sources and leverage capital funding prudently.

### 3.10.9 Reserve Funds

An important component of a utility financial health is maintaining prudent reserve ending balances. There are many different types of reserve funds and numerous objectives that can be accomplished with them. Currently, the Uppaway water system has three financial reserves: operating, capital, and emergency. The County also has a set of existing financial policies to guide the maintenance of the reserve funds for the operating reserve, the capital reserve, and the emergency reserve.

For the operating fund, the County currently has a minimum level at 60 days of O&M expenses with a goal of 90 days. This figure is targeted in order to provide funding for the utilities operations, should there be a shortfall due to perhaps a wetter summer than normal or decreased rate revenues. The target for Uppaway for FY 2015 is $124,000 which is currently being met and exceeded by the ending fund balance. As mentioned previously, this figure includes the Cave Rock system.

Next is the County's capital reserves, which holds loan and bond proceeds as well as other capital-related revenues such as connection fee revenue. Currently, the County's policy for the capital reserve ending balance is 2.0% of the total (original) cost of utility fixed assets. Again this is to provide funding should an anomaly occur for the utility but with regards to capital infrastructure. For instance, if a major water main bursts and a sudden need for a large amount of cash for repairs is required. This allows the utility greater resiliency during those times and to limit the loss of service for the customers as a result of cash flow issues.

The final reserve is for emergencies. This reserve, as the name implies is to cover unexpected emergencies and is similar in nature to the objective of the capital fund but is more intended for small scale equipment failures rather than system-wide. The minimum emergency reserve balance is $50,000 with a goal of $75,000. The County is currently meeting the minimum balance for the Uppaway water system.

Table 3-22, below, is the beginning reserve fund balances from the current FY 2014/15 budget (beginning reserve balance July 1, 2014) for Uppaway.

### Table 3-22 Uppaway/ Cave Rock Beginning Reserve Fund Balances ($1,000s)

| Reserve Funds | Uppaway[1] |
|---|---|
| Operating Reserves | $393 |
| Capital Reserves | $573 |
| Emergency Reserves | $50 |

*[1] – Uppaway reserve funds are combined with Cave Rock on the County's financial system*

# 4 Need for Project

The evaluation of the existing system in Section 3 identified various needs or deficiencies for the water system. These needs are categorized under the following general categories. Note that some needs could be classified under more than one category.

## Health, Sanitation, and Security

The needs in this section include compliance with relevant regulations and codes such as NAC 445A and County Design Criteria, health and sanitation, and security issues that may have been brought to light by state regulatory agencies, such as sanitary surveys. This item also includes impacts to water resources brought on by drought and climate change, such as lower levels in Lake Tahoe and potential water quality changes.

## Aging Infrastructure

Aging infrastructure eventually results in system failures if it is not rehabilitated or replaced. The age of the existing distribution infrastructure is approximately 40 years. At this age, and given the materials and methods used in the past for construction, failures become imminent. A review of field repairs reveals that leaks primarily occur where fittings were field welded and at bends in the pipe or as a result of improper bedding or installation that causes interior and exterior damage to the line.

In addition to aging, much of the infrastructure is undersized to meet current fire flow requirements.

## Reasonable Growth

This item includes reasonable growth capacity that is necessary to meet needs during the planning period. The population in Douglas County in Lake Tahoe actually decreased from 2000 to 2010, as documented in the County's 2011 Master Plan, due to increases in the number of second/vacation home ownership. This trend is expected to continue in the future.

With little to no growth in the area, and slow growth projected in the future, the need for the improvements is primarily a result of aging infrastructure and health, sanitation, and code compliance as discussed above. Increases in distribution pipe size and storage facilities are to meet fire flow and storage volume code requirements, not in general, in relation to population growth projections.

## 4.2 Distribution and Storage System

Based on the results of the condition assessment, operational issues, code compliance, and water model results described in Section 3.5, the distribution system has the following deficiencies which need to be addressed.

**Table 4-1 Summary of Distribution and Storage System Deficiencies**

| No. | Deficiency | Relevant Codes | Requirement/ Goal | Existing Condition(1) |
|---|---|---|---|---|
| 1 | Fire Flow | Fire Authority/ NFC County 4.1.3 | Up to 2,250 gpm | <2,250 gpm |
| 2 | Minimum Distribution Pressure – FF + Max Day Demand (MDD) | NAC 445A.6672 County 4.1.1 | 20 psi | <20 psi |
| 3 | Maximum Velocity (Fire Flow + ADD) | County 4.1.4 | 10 fps | >10 fps |
| 4 | Minimum Main Line Size (All) | County 4.5 | 8 inch | 4 inch |
| 5 | Line Leaks | NAC 445A.6727 | Minimize repair costs | 22 leaks since 2001 |
| 6 | Storage Volume | NAC 445A.6674 | 430,500 gal | 362,840 gal |
| 7 | Water Conservation/ Meter Irrigation | NRS 540.131/ County 4.5.6 | 100% Metered | 0% Metered |

(1) Refer to modeling results in Section 3.5.

## 4.3 Wells No.1 and No.2

Wells No.1 and No.2 are barely keeping up with peak summer demands, in part, due to declining lake levels. Well No.2 produces sand upon initial startup and at lower water levels. At higher water levels, there is little or no sanding problem[1]. Historically, it has not been used on a regular basis.

### 4.3.1 SCADA

SCADA improvements were identified for Uppaway in the 2015 County SCADA Master Plan. The upgrades are summarized in the following table taken from the

[1] Ron Roman 1-28-2016 email.

report. Priority 1 indicates the RTU replacement should be planned as soon as possible. Priority 2 indicates non-ethernet capable RTUs that should be replaced to simplify and better utilize a telemetry upgrade. Priority 3 indicates non-obsolete RTUs that should be replaced when they fail or approach obsolescence.

**Table 4-2 SCADA Recommendation Summary [1]**

| Location | RTU | Replacement Priority |
|---|---|---|
| Uppaway Tank | SCADAPack 350 | 3 |
| Uppaway Booster | Tesco RTU | 3 |
| Well 1 and 2 | SCADAPack | 2 |

(1) SCADA Master Plan, June 2015, CH2MHILL

**Table 4-3 Summary of Well Deficiencies**

| No. | Deficiency | Relevant Codes | Requirement/ Goal | Existing Condition(1) |
|---|---|---|---|---|
| 8.1 | Declining capacity, barely meeting peak demands | 445A.6672 | 100 gpm | 50 gpm |
| 8.2 | Sanding (No.2) | National Drinking Water Standards | Meet Secondary Standards | Sand at low water levels |
| 8.3 | SCADA | NA | Per County Master Plan | |

(1) Douglas County summer 2015 data

# 5 Project Alternatives

Table 5-1 and the following sections summarize the project alternatives for the deficiencies described in Sections 3 and 4. Only the relevant sub-sections are included in the alternatives sections. For example, “Land Requirements” is not discussed under Line Leak alternatives.

**Table 5-1 Needs and Alternatives Matrix**

| No. | Deficiency | Relevant Codes | Alternative 1 | Alternative 2 |
|---|---|---|---|---|
| 1 | Fire Flow | Fire Authority/ NFC County 4.1.3 | Upsize Pipes | N/A |
| 2 | Minimum Distribution Pressure – FF + Max Day Demand (MDD) | NAC 445A.6672 County 4.1.1 | Upsize Pipes | N/A |
| 3 | Maximum Velocity (Fire Flow + ADD) | County 4.1.4 | Upsize Pipes | N/A |
| 4 | Minimum Main Line Size (All) | County 4.5 | Upsize Pipes | N/A |
| 5 | Line Leaks | NAC 445A.6727 | Replace Pipes | N/A |
| 6 | Storage Volume | NAC 445A.6674 | Supplemental Storage Tank | Robert Lee Residence Fire Sprinkler System |
| 7 | Water Conservation/ Meter Irrigation | NRS 540.131/ County 4.5.6 | Meter Services | N/A |
| 8 | Wells & SCADA | 445A.6672 | New Wells | Rehab Well |

## 5.1 Deficiencies 1 – 5: Fire Flow/ Pressure, Velocity, Line Size, and Line Leaks

### 5.1.1 Alternative 1 – Upsize and Replace Pipes

This alternative includes replacement of nearly the entire distribution system, approximately 6,700 lineal feet of new pipe. This includes line upsizing to meet pressure and velocity criteria for fire flow.

Of that total, 2,300 lineal feet of new pipe are required for replacement of lines in leak prone areas. Table 5-2 summarizes the line upsizing and replacements required for this alternative.

**Table 5-2. Pipeline Improvements Summary**

| Diameter | Quantity Criteria (ft) | | Total |
|---|---|---|---|
| | Leak Repair | Velocity & Pressure | |
| 8-inch Pipeline | 900 | 744 | 1,644 |
| 10-inch Pipeline | 1,400 | 1,783 | 3,183 |
| 12-inch Pipeline | 0 | 1,910 | 1,910 |
| **Total** | **2,300** | **4,437** | **6,737** |

The following Figure 5-1 summarizes the line upgrades required to meet code criteria.

# Figure 5-1 Deficiency 1-5 Improvements

PNEUMATIC TANK

Pumper Truck

KELLY CI

LAKE FRONT DR

YAN RD

HWY 50

GLENBROOK RD

private

private

0 125 250 500 Feet

## Legend

### Pipes

- Upsized
- Existing
- Pressure Reducing Valve
- Well
- Tank
- Pumps

### 5.1.2 Environmental Impacts

Development of upsized pipeline and the replacement of existing pipeline will not adversely affect population rates or housing resources, operation noise, circulation systems, public services, utilities, minerals, agriculture or forestry, or recreation, or create significant hazards. The new and replacement pipelines would be located beneath existing pavement, where feasible, or in line with existing pipeline. In areas where the pipe is upsized, additional easement may be required. Mitigable impacts may occur in relation to construction noise, air emissions, and traffic, geology and land coverage, hydrology and water quality, aesthetics, biological resources, and cultural resources.

Operation of the pipelines would not create noise levels that exceed threshold limits. Construction noise is expected to occur; however BMPs such as heavy equipment muffling, limiting construction hours to TRPA's construction noise exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant. BMPs may include, but are not limited to equipment muffling, use of temporary sound barriers, alternate backup warning systems, and pre-construction building inspection and monitoring during construction, among other methods.

Some temporary air emissions may occur during construction as a result of construction activity, however standard BMPs for the Tahoe Basin would be employed to limit construction emissions. No long-term operational or traffic-related emissions would occur. BMPs include those listed in the TRPA Code of Ordinances (33.3.3 and Chapter 65), such as limits on diesel engine vehicle idling, covering exposed soils and stored materials with a chemical dust suppressant or water, removing track out, and limiting construction vehicle speeds, among others. Operation of the pipelines would not result in an increase in daily vehicle trip ends, congestion, or other traffic related changes that would increase air emissions. Construction VMT is temporary in nature and therefore expected to be below threshold limits.

Pipeline upgrades along local roadways may result in temporary traffic events, but construction within the neighborhood roadways would meet County traffic control requirements including signage, implementation of safety devices and other controls as determined necessary.

Construction and replacement of the pipelines will result in ground disturbance, which can adversely affect erosion and water quality. On average, the new replacement pipelines would be installed at depths ranging from 42 to 48 inches below the ground surface. Implementation of BMPs, including those listed in TRPA's Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Best Management Practices (TRPA, May 2014) and the TRPA Code of Ordinances Section 60.4 would reduce water quality impacts and erosion to a less than significant level. These BMPs include, but are not limited

to, infiltration devices, slope stabilization, revegetation of disturbed areas, and runoff controls. The Project will incorporate standard practices to comply with TRPA regulations to avoid, reduce, minimize and mitigate water quality impacts, including implementation of: an Erosion Control Plan, onsite monitoring, a Storm Water Pollution Prevention Plan (SWPPP), a dewatering plan, tree protection measures, a revegetation plan, and operations BMPs and monitoring. The Bureau of Water Pollution Control within the Nevada Department of Environmental Planning is responsible for regulating discharges into the waters of the State and will require a site-specific SWPPP to prevent debris, soil, silt, oil, or other earthen or construction materials from entering into surface waters. The SWPPP will describe, locate, and implement the BMPs specific to each area in which construction and operation occurs, will designate areas for construction staging and access, and will include a spill response and groundwater management plan. As required by the TRPA, construction shall also occur in the dry season to minimize siltation.

The new and replacement pipelines would be located below ground, primarily beneath existing area roadway pavement, and would not result in additional land coverage. Typical disturbance for the pipelines would average 42 to 48 inches in depth and approximately 2.5 feet in width along the length of the alignment. The upsized pipeline in the area around Yan Road between Kelly Circle and Shakespeare Point would result in additional ground disturbance and would not be located underneath existing or proposed roadway pavement. This area is within Land Capability Class 4 and it is unlikely that the disturbance will exceed land coverage limits since the pipeline will be backfilled with native material at the surface. If excess land coverage occurs, mitigation would include 1) coverage reduction onsite; 2) offsite coverage reduction; 3) payment of excess coverage mitigation fee; 4) findings for excess land coverage; or 5) a combination of these options. As stated in TRPA Code of Ordinances Section 30.4.2.D, “The maximum land coverage for linear public facilities and public health and safety facilities is limited to the minimum amount needed to achieve its public purpose.” Section 30.4.2.F states, “The maximum land coverage for other public service facilities located outside of an approved community plan is 50 percent of the project area.” According to Section 30.5.1.C, “Land coverage and disturbance for public service facilities may be permitted in Land Capability Districts 1a, 1c, 2, and 3 if TRPA finds that: The project is necessary for public health, safety…There is no reasonable alternative…The impacts are fully mitigated….” Since a little more than half of the Uppaway WSA area is located within land capability 1a and 2, locating the pipelines within a higher land capability is not always feasible, particularly given the location of the existing infrastructure. Repair of linear public facilities and minor utility projects (replacement, repair, interconnection of existing utilities) is not subject to excess land coverage mitigation (TRPA Code of Ordinances Section 30.6.2.E and F).

New pipelines would be located below existing pavement, where existing pipeline would be replaced or upsized, and would not result in a noticeable change to scenic quality.

There are no known wildlife resources in the area; however pre-construction surveys for nesting bird species will be required in order to conform with the Migratory Bird Treaty Act of 1918. No known Protected Activity Centers for either northern goshawk or California spotted owl are known to occur in the area. Once final design occurs, the plan detail will be able to indicate potential tree or vegetation removal. Implementation of vegetation protection BMPs during construction will ensure no significant impacts occur (TRPA Code of Ordinances Chapter 33.6) and the project will be required to comply with resource protection actions required by the resource agencies.

There are no known cultural resources within the area where replacement pipeline is proposed. If previously undiscovered human remains or archaeological resources are discovered during construction, construction activity shall temporarily cease in the vicinity of the discovery until the TRPA Cultural Resources staff (or their qualified consultant) evaluates the resource for NRHP eligibility, Native American (Washoe) values, and compliance with TRPA Code, and consults with the Nevada SHPO, TRPA, and the Washoe Tribe, as appropriate (TRPA Code of Ordinances, 33.3.7, 67.3, and 67.4).

### 5.1.3 Cost Opinion

The cost opinion provided is a level 4, or feasibility level cost opinion. The level or accuracy for feasibility level estimates typically ranges between +40% and -20%, with a recommended contingency of 20% to 30%. Costs include 25% for administrative costs such as engineering, legal, and construction management. Detailed cost break downs are included in Appendix A.

**Table 5-3. Cost Opinion for Deficiency 1-5: Pipelines**

| Item | Quantity | Cost (x$1,000) |
|---|---|---|
| Division 1 | LS | $265 |
| Pipelines (various) | LS | $1,733 |
| Road Slurry Seal | LS | $71 |
| Contingency (25%) | LS | $517 |
| Administrative (25%) | LS | $647 |
| **Total Capital** | | **$3,232** |

Notes: Cost does not include associated easements.

## 5.2 Deficiency 6 – Storage Volume

### 5.2.1 Alternative 1 – Supplemental Storage Tank

The storage analysis in Section 3.7.2 showed that the tank has a 68,000 gallon storage deficiency. Since the Uppaway tank was just replaced in 2011 and is just 5 years old, it does not make sense to replace the tank, but rather add storage with a supplemental tank. A 70,000 gallon tank is proposed on the top of South Point Place, APN 1-418-15-511, which is owned by Uppaway Estates, Inc., as shown in Figure 5-2. The tank would have the same hydraulic grade line as the existing tank, and be constructed to AWWA D-100 standards, with a concrete ring foundation, and NSF-61 certified epoxy coating.

The tank will require a new paved access road off South Point Place, with the associated earthwork and grading.

Figures

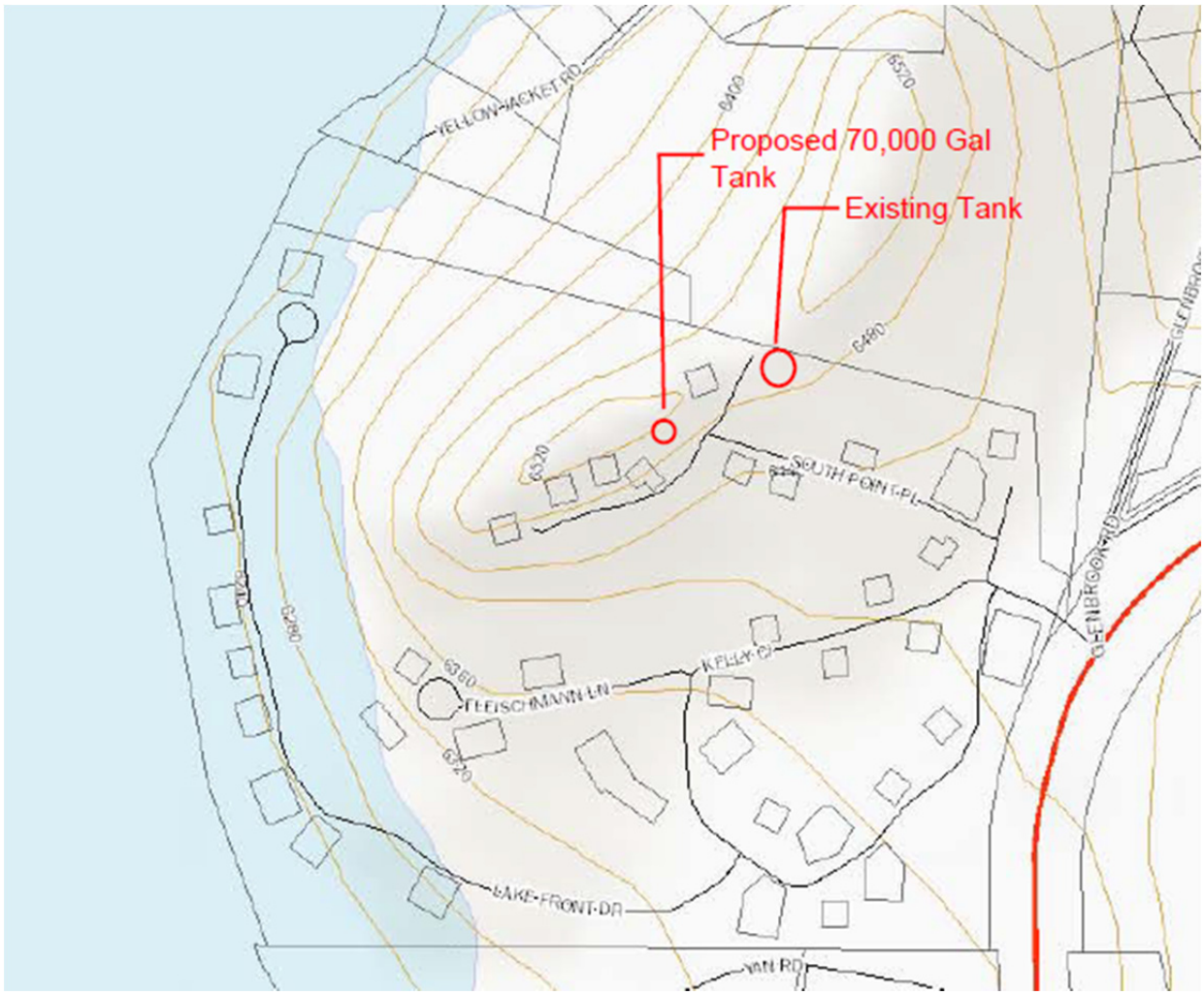



**Figure 5-2 Supplemental Tank Site**


**Figure 5-3 Aerial Photo - Supplemental Tank Site**

### Environmental Impacts

Development of a supplemental water storage tank and access road will not adversely affect population rates or housing resources, circulation systems, public services, utilities, minerals, agriculture or forestry, or recreation, or create significant hazards. Mitigable impacts may occur in relation to operation noise, construction air emissions, traffic, geology and land coverage, hydrology and water quality, aesthetics, biological resources, and cultural resources.

Operation of an additional tank would not create new noise levels that would exceed threshold limits. Construction noise is expected to occur; however BMPs such as heavy equipment muffling, limiting construction hours to TRPA's construction noise exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant. As stated above, construction would be limited to TRPA's construction noise exemption hours and BMPs would be implemented to reduce construction noise disturbance. BMPs may include, but are not limited to equipment muffling, use of temporary sound barriers, alternate backup warning systems, and pre-construction building inspection and monitoring during construction, among other methods. Construction may require directional drilling or rock removal, which may create noise and vibration disturbance to nearby residents. As stated above, construction would be limited to TRPA's construction noise exemption hours and BMPs would be implemented to reduce construction noise disturbance. BMPs may include, but are not limited to equipment muffling, use of temporary sound barriers, alternate backup warning systems, and pre-

construction building inspection and monitoring during construction, among other methods.

Some temporary air emissions may occur during construction as a result of construction activity, however standard BMPs for the Tahoe Basin would be employed to limit construction emissions. No long-term operational or traffic-related emissions would occur. BMPs include those listed in the TRPA Code of Ordinances (33.3.3 and Chapter 65), such as limits on diesel engine vehicle idling, covering exposed soils and stored materials with a chemical dust suppressant or water, removing track out, and limiting construction vehicle speeds, among others. As discussed above, the access to and operation of the supplemental storage tank would not result in an increase in daily vehicle trip ends, congestion, or other traffic related changes that would increase air emissions. Construction VMT is expected to be below threshold limits.

Although an access road will be constructed from South Point Place to the supplemental water storage tank to allow operation and maintenance access, this would not be a public through road and would not generate traffic or serve as neighborhood access.

Construction of the storage tank and access road would result in ground disturbance on steep slopes, which can affect erosion and water quality. It is estimated that approximately 2,700 square feet of ground disturbance on steep slopes would be required to construct the tank and access road. This footprint may be reduced if site limitations are extensive. Implementation of BMPs, including those listed in TRPA's Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Best Management Practices (TRPA, May 2014) and the TRPA Code of Ordinances Section 60.4 would reduce water quality impacts and erosion to a less than significant level. These BMPs include, but are not limited to, infiltration devices, slope stabilization, revegetation of disturbed areas, and runoff controls. Permanent BMPs would be included to address runoff from the new storage tank and access road coverage. The Project will incorporate standard practices to comply with TRPA regulations to avoid, reduce, minimize and mitigate water quality impacts, including implementation of: an Erosion Control Plan, onsite monitoring, a Storm Water Pollution Prevention Plan (SWPPP), a dewatering plan, tree protection measures, a revegetation plan, and operations BMPs and monitoring. The Bureau of Water Pollution Control within the Nevada Department of Environmental Planning is responsible for regulating discharges into the waters of the State and will require a site-specific SWPPP to prevent debris, soil, silt, oil, or other earthen or construction materials from affecting water quality. The SWPPP will describe, locate, and implement the BMPs specific to each area in which construction and operation occurs, will designate areas for construction staging and access, and will include a spill response and groundwater management plan. Construction shall also occur in the dry season to minimize siltation.

The supplemental storage tank and access road would result in new land coverage. Coverage from the storage tank would vary based on final design, but is anticipated to be approximately 1,260 sq. ft for a 30-foot diameter storage tank and 10-foot ring road. The access road to the tank is estimated to be 12 feet wide by 120 feet long. Additional coverage from the access road is estimated to be approximately 1,440 sq. ft. Total coverage would be approximately 2,700 square feet. Design of the storage tank and access road will take into account spatial and land capability limitations to avoid exceeding coverage limits on the affected parcels, but the location of the proposed facilities is within environmentally sensitive land capability area 1A. If excess land coverage occurs, mitigation would include 1) coverage reduction onsite; 2) offsite coverage reduction; 3) payment of excess coverage mitigation fee; 4) findings for excess land coverage; or 5) a combination of these options. As stated in TRPA Code of Ordinances Section 30.4.2.D, "The maximum land coverage for linear public facilities and public health and safety facilities is limited to the minimum amount needed to achieve its public purpose." Section 30.4.2.F states, "The maximum land coverage for other public service facilities located outside of an approved community plan is 50 percent of the project area." According to Section 30.5.1.C, "Land coverage and disturbance for public service facilities may be permitted in Land Capability Districts 1a, 1c, 2, and 3 if TRPA finds that: The project is necessary for public health, safety…There is no reasonable alternative…The impacts are fully mitigated…." Since this would supplement storage capacity for a nearby tank on South Point Place, and the majority of the area is located within land capability 1a, locating the tank within a higher land capability is not feasible, particularly given the location of the existing infrastructure. Repair of linear public facilities and minor utility projects (replacement, repair, interconnection of existing utilities) is not subject to excess land coverage mitigation (TRPA Code of Ordinances Section 30.6.2.E and F).

Uppaway Estates has a blanket Public Utility Easement on the entire common area per Document 394. As such, the storage tank and associated access road on Uppaway Estates property would not require an easement.

The storage tank and access road would be located on APN 1-418-15-511, which is owned by Uppaway Estates, Inc. (40.03 acres). The County will need to work with the Uppaway HOA to provide an acceptable location and screening for any future tank.

Since the storage tank would be an above-ground structure, it would be visible within the area and may affect views from the surrounding residences. The estimated height of the tank would be 14 feet; however, site limitations may require a reduced footprint, which would increase the height to maintain required tank volume. The new tank would not be visible from U.S. 50 due to intervening vegetation, such as tall and dense conifers near the edge of the roadway and existing development, but may have limited visibility from views farther away

located in Lake Tahoe. The tank would be located in a rocky area of steep slopes, which increases visibility from the surrounding area. Due to topography and proximity to the roadway, it is unlikely that visible linear scarring will be prevalent as a result of tree removal for the access road. Once design is complete, a more detailed plan would need to be prepared to ensure compliance with TRPA height limitations and design standards (TRPA Code of Ordinances Chapters 37 and 36). To ensure no adverse impacts occur, the project may require mitigation in accordance with the height and design standards such as, lowering the height of the tank, installing landscape screening, use of color blending, and other methods to reduce visibility and maintain the existing visual character of the residential area. No public roadway signage is associated with the structure.

There are no known wildlife resources in the area; however pre-construction surveys for nesting bird species will be required in order to conform to the Migratory Bird Treaty Act of 1918. No known Protected Activity Centers for either northern goshawk or California spotted owl are known to occur in the area. Once final design occurs, the plan detail will be able to indicate potential tree or vegetation removal. Implementation of vegetation protection BMPs during construction will ensure no significant impacts occur (TRPA Code of Ordinances Chapter 33.6) and the project will be required to comply with resource protection actions required by the resource agencies.

There are no known cultural resources within the area of the water storage tank or affected neighborhood roadways. If previously undiscovered human remains or archaeological resources are discovered during construction, construction activity shall temporarily cease in the vicinity of the discovery until the TRPA Cultural Resources staff (or their qualified consultant) evaluates the resource for NRHP eligibility, Native American (Washoe) values, and compliance with TRPA Code, and consults with the Nevada SHPO, TRPA, and the Washoe Tribe, as appropriate (TRPA Code of Ordinances, 33.3.7, 67.3, and 67.4).

### Cost Opinion

**Table 5-4 Cost Opinion for Deficiency 6, Alternative 1**

| Item | Quantity | Cost (x$1,000) |
|---|---|---|
| Division 1 | LS | $44 |
| Uppaway Tank | 70,000 Gal | $140 |
| Site Work | LS | $50 |
| Piping | LS | $49 |
| Controls/SCADA | LS | $20 |

| Item | Quantity | Cost (x$1,000) |
|---|---|---|
| Contingency (25%) | LS | $76 |
| Administrative (25%) | LS | $95 |
| **Total Capital** | | **$475** |

### 5.2.2 Alternative 2 – Fire Sprinklers for 1860 Highway 50 Residence

The larger fire flow requirement for this single residence is responsible for the increased storage volume requirement. If the Robert Lee residence is excluded, the fire flow requirement is 2,250 gpm, and the existing tank provides a surplus of storage.

If the Highway 50 residence had an approved automatic fire sprinkler system, the fire flow requirement would be decreased by 50%, and would be only 1,750 gpm. This would make the governing fire flow 2,250 gpm for the system as a whole based on the next largest residence requirement, thus eliminating the storage deficiency.

For the purpose of comparing alternatives in this report, we will assume the County pays for the fire sprinkler system, although it could be argued that the home owner should be responsible for this cost.

#### Environmental Impacts

No significant environmental impacts are associated with this alternative.

#### Cost Opinion

**Table 5-5 Cost Opinion Deficiency 6, Alternative 2**

| Item | Quantity | Unit Cost | Cost (x$1,000) |
|---|---|---|---|
| Division 1 | LS | | $7 |
| Fire Sprinklers | 17,330 SF | $3.00 | $52 |
| Contingency (25%) | LS | | $15 |
| Administrative (25%) | LS | | $19 |
| **Total Capital** | | | **$93** |

## 5.3 Deficiency 7 – Water Conservation

Uppaway residents use over 3 times the national average water consumption.

### 5.3.1 Alternative 1 – Installation of Water Meters

To comply with NRS requirements for a Water Conservation Plan, this alternative includes the installation of approximately 32 water meters throughout the distribution system.

#### Environmental Impacts

No significant environmental impacts are associated with this alternative.

#### Cost Opinion

**Table 5-6. Cost Opinion of Deficiency 7: Water Meters**

| Item | Quantity | Unit Cost | Cost (x$1,000) |
|---|---|---|---|
| Division 1 | LS | | $43 |
| Residential 1-Inch Meter Pit Assemblies | 32 | $7,500 | $240 |
| Irrigation 2-Inch Meter Pit Assemblies | 8 | $10,000 | $80 |
| Contingency (25%) | LS | | $91 |
| Administrative (25%) | LS | | $114 |
| **Total Capital** | | | **$568** |

## 5.4 Deficiency 8: Wells & SCADA

Wells No.1 and No.2 have experienced declining production, increased drawdown, and are undersized for the pumping requirements. Well No.2 also produces sand at low water levels.

The tank, wells, and booster have been identified for SCADA upgrades.

### 5.4.1 Alternative 1 – Drill New Wells

This alternative includes drilling 10-inch diameter wells to replace the existing 6-inch wells, based on 1.5-inch minimum clearance for a 6-inch pump. The incremental cost increase of a 10-inch casing over an 8-inch casing is minimal,

and it provides ample clearance for the pump to insure water flow over the motor for cooling.

A hydro-geotechnical investigation should be conducted to determine the location for the pilot wells, and final production wells. For the purpose of calculating costs, it is assumed the new wells will be located within approximately 50-feet of the existing wells.

### Environmental Impacts

Drilling new replacement wells would not adversely affect population rates or housing resources, transportation and circulation systems, operation noise, public services, utilities, recreation, minerals, agriculture or forestry, or create significant hazards. Mitigable impacts may occur in relation to construction noise and air emissions, geology, hydrology and water quality, aesthetics, biological resources, and cultural resources.

The new wells would be equipped with new submersible pumps and upsized electrical starters and breakers may be installed within the well building. Since the new wells would replace existing wells that would be taken out of operation, the operation noise levels are not expected to substantially change or increase and would not exceed threshold limits. Temporary noise would occur during construction of the wells. Well drilling would require 40 to 60 hours of drilling and installation; however, this could occur in 8-hour shifts using air rotary drilling with a small rig that does not require continuous, 24-hour operation. BMPs such as heavy equipment muffling, limiting investigative and cleaning work hours to TRPA's construction noise exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant.

Some temporary air emissions may occur during construction as a result of construction activity, however standard BMPs for the Tahoe Basin would be employed to limit construction emissions. No long-term operational or traffic-related emissions would occur. BMPs include those listed in the TRPA Code of Ordinances (33.3.3 and Chapter 65), such as limits on diesel engine vehicle idling, covering exposed soils and stored materials with a chemical dust suppressant or water, removing track out, and limiting construction vehicle speeds, among others. As discussed above, the access to and operation of the wells would not result in an increase in daily vehicle trip ends, congestion, or other traffic related changes that would increase air emissions. Construction VMT is expected to be below threshold limits.

Since new wells would be drilled within 150 feet from the lake and within 50 feet of the existing wells, and would technically connect to groundwater, drilling activities have the potential to affect groundwater quantity and quality. The existing wells are approximately 250 feet deep and the replacement wells are likely to require a similar depth. In addition, new pipeline would be needed to

connect the new wells to the distribution system. Approximately 100 linear feet of 8-inch diameter pipe would be installed. Average pipeline depth would be 42 to 48 inches below the ground surface, and surface disturbance width would be approximately 2.5 feet along the length of the pipeline. Prior to installation of a new well, hydrogeologic investigations are needed and a pilot test boring and monitoring well would need to occur to determine the hydrology and monitor water quality of the new wells. Implementation of BMPs, including those listed in TRPA's Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Best Management Practices (TRPA, May 2014) and the TRPA Code of Ordinances Sections 60.3 and 60.4 would reduce water quality impacts to a less than significant level. In addition, compliance with Nevada Division of Water Resources requirements would occur, including necessary permits, reporting, and BMPs. The Project will incorporate standard practices to comply with TRPA and State regulations to avoid, reduce, minimize and mitigate water quality impacts, including implementation of onsite monitoring during the drilling process and development and implementation of a spill control plan. The Bureau of Water Pollution Control within the Nevada Department of Environmental Planning is responsible for regulating discharges into the waters of the State and should be consulted prior to activities to ensure materials are not discharged into the lake or groundwater.

The replacement well and 100 linear feet of 8-inch diameter pipeline would result in some new land coverage, and the existing wells would need to be capped. Since the wells and pipeline must be placed near the lake and the existing well building, the location of the proposed facilities is within environmentally sensitive area comprised of land capability 2. If excess land coverage occurs, mitigation would include 1) coverage reduction onsite; 2) offsite coverage reduction; 3) payment of excess coverage mitigation fee; 4) findings for excess land coverage; or 5) a combination of these options. As stated in TRPA Code of Ordinances Section 30.4.2.D, "The maximum land coverage for linear public facilities and public health and safety facilities is limited to the minimum amount needed to achieve its public purpose." Section 30.4.2.F states, "The maximum land coverage for other public service facilities located outside of an approved community plan is 50 percent of the project area." According to Section 30.5.1.C, "Land coverage and disturbance for public service facilities may be permitted in Land Capability Districts 1a, 1c, 2, and 3 if TRPA finds that: The project is necessary for public health, safety…There is no reasonable alternative…The impacts are fully mitigated…." Since the wells are needed to address declining production, and the existing well facilities are located within land capability 2, locating the wells within a higher land capability is not feasible, particularly given the location of the existing infrastructure. Repair of linear public facilities and minor utility projects (replacement, repair, interconnection of existing utilities) is not subject to excess land coverage mitigation (TRPA Code of Ordinances Section 30.6.2.E and F).

If the replacement wells and associated pipeline cannot be located within the existing easement, additional easement area may be required. Construction and operation of the replacement wells and piping will be required to comply the terms and conditions established in the easement. Changes to existing well permits would be needed to record closure of existing wells and new permits from the State of Nevada would be needed for development and operation of the new wells.

Since the wells and pipeline will be below ground, they will not affect the visual character of the area. Construction activities will be visible that may temporarily affect views from the lake and surrounding residences. Some tree removal may be required, dependent upon the final location of the wells and pipe alignment; however, it is unlikely that visible linear scarring will be prevalent. If extensive vegetation removal is required, post construction revegetation may be required to maintain the visual character of the area and reduce the visual change caused by necessary ground disturbance.

There are no known wildlife resources in the area; however pre-construction surveys for nesting bird species will be required in order to conform to the Migratory Bird Treaty Act of 1918. No known Protected Activity Centers for either northern goshawk or California spotted owl are known to occur in the area. Once final design occurs, the plan detail will be able to indicate potential tree or vegetation removal. Implementation of vegetation protection BMPs during construction will ensure no significant impacts occur (TRPA Code of Ordinances Chapter 33.6) and the project will be required to comply with resource protection actions required by the resource agencies.

There are no known cultural resources within the area of the wells. If previously undiscovered human remains or archaeological resources are discovered during construction, construction activity shall temporarily cease in the vicinity of the discovery until the TRPA Cultural Resources staff (or their qualified consultant) evaluates the resource for NRHP eligibility, Native American (Washoe) values, and compliance with TRPA Code, and consults with the Nevada SHPO, TRPA, and the Washoe Tribe, as appropriate (TRPA Code of Ordinances, 33.3.7, 67.3, and 67.4).

### Cost Opinion

The cost opinion for this alternative includes the following items:

- Initial Pilot Test Boring and Monitoring Well
- Production Well and Pumping Test
- Yard Piping
- Electrical and Controls

**Table 5-7 Cost Opinion Deficiency 8, Alternative 1**

| Item | Quantity | Unit Cost | Cost (x$1,000) |
|---|---|---|---|
| Division 1 | LS | | $60 |
| Abandon Existing Wells | 2 Ea | $3,500 | $7 |
| 10-in Municipal Wells | 2 Ea | $190,000 | $380 |
| Yard Piping | LS | | $35 |
| Electrical & Controls | LS | | $52 |
| Contingency (25%) | LS | | $135 |
| Administrative (25%) | LS | | $169 |
| **Total Capital** | | | **$842** |

### 5.4.2 Alternative 2 – Investigate and Rehabilitate Existing Wells

A common rule of thumb is when well performance has declined by 25%, it is time to begin well rehabilitation. Based on the Well No.1 pump tests completed after drilling, the well output has declined by approximately 65%. If well rehabilitation cannot restore the original performance or close to, well replacement is required.

#### Causes

Well problems are typically related to the aquifer type, but can be summarized under the following areas:

- Incrustation
- Biofouling
- Physical Plugging of the Screen
- Corrosion

Incrustation (Scale) – Is caused by precipitation of dissolved minerals in the groundwater on the well screen. This problem is exasperated in the in the well screen area based on the velocity and turbulence. Thus a larger well casing will generally help to minimize incrustation by lowering the screen velocity.

Biofouling – Slime deposits from bacteria reacting with the dissolved minerals in the water. This is a common side effect of incrustation. The bacteria can cause clogging and corrosion as well as water quality issues.

Physical Plugging – Over time, most wells experience a loss of specific capacity based on the movement of fine particles into the gravel pack where the hinder flow into the well. A side effect of physical plugging is increased sanding. Proper well development can significantly delay this effect.

Corrosion – Corrosion of the casing can cause holes which allow fines to enter resulting in sanding and reduced production. Also the corrosion byproducts (rust) can reduce the effective pathway of the screened area. This is unlikely to be a major cause of well performance reduction considering the wells are constructed of PVC and stainless steel.

### Rehabilitation Methods

Prior to rehabilitation, a down-hole video investigation should be conducted to determine the possible causes of production decline, as previously discussed. The County is currently planning to perform such an investigation. The video will provide information needed to determine the required course of rehabilitation. It may also show breaks in the screen or casing.

Typical rehabilitation methods fall under the following categories:

- Chemical Cleaning
- Physical Brushing and Jetting
- Shockwave and Shockblasting

It is widely accepted that a combined approach of chemical cleaning and physical brushing and jetting are more effective than either technique employed alone.

Chemical Cleaning – For iron bacteria and slime, a bacteriacide such as hydroxyacetric acid is effective, although it takes longer than other acids to work. It is also safer and relatively non-corrosive. For carbonate scale, hydrochloric and sulfuric acids are used with inhibitors and modifiers to minimize corrosive effects on the screen and casing. The acids are placed into the well for and agitated for 24 to 72 hours. The well is then pumped to waste and tested prior to placing the well back in service.

Physical Cleaning – A wire brush is run down the screen to remove encrustation and open up the screen slots. Double swabbing and /or jetting is used to remove accumulated fines and debris from the screen and filter pack. The process is repeated until the well efficiency is restored, in conjunction with chemical treatments. An aquifer pumping test should be performed to evaluate well efficiency and long-term pumping rates.

Shockwave and Shockblasting – These are proprietary blended techniques that utilize the following processes simultaneously:

1. Harmonic shockwaves to gently loosen hardened mineral, bacterial, and other deposits.

2. Pulsating gas pressure jets fluid at high velocity back and forth through the screen perforations to clean the gravel pack and aquifer.

There are numerous proprietary methods that utilize various forms of explosive/implosive cleaning methods.

### Environmental Impacts

Investigation and rehabilitation of existing wells would occur within the existing wells and would not adversely affect population rates or housing resources, transportation and circulation systems, public services, utilities, minerals, agriculture or forestry, hydrology, recreation, geology and coverage, air emissions, aesthetics, biological resources or cultural resources.

Temporary noise may occur during investigation and cleaning activities. BMPs such as limiting investigative and cleaning work hours to TRPA's construction noise exemption hours (8 AM to 6:30 PM), and compliance with TRPA Code of Ordinances Section 68.9 Noise will ensure noise levels are not significant.

Since well rehabilitation has the potential to use chemical cleaning, or the use of pressurized fluid, and the wells connect to groundwater, cleaning activities have the potential to affect water quality. Implementation of BMPs and those required for well maintenance per the existing well permits, including those listed in TRPA's Water Quality Management Plan for the Lake Tahoe Region, Volume II, Handbook of Best Management Practices (TRPA, May 2014) and the TRPA Code of Ordinances Section 60.4 would reduce water quality impacts to a less than significant level. Cleaning activities will incorporate standard practices to comply with TRPA and Nevada Department of Environmental Planning regulations to avoid, reduce, minimize and mitigate water quality impacts, including continued implementation of regular onsite monitoring during the cleaning process.

### Cost Opinion

The costs provided in the table below are based on the following assumed rehabilitation method of wire brush, jetting, acid for 1 day. Actual methods used would be based on the results of the well video.

### Table 5-8 Opinion of Cost Deficiency 8, Alternative 2

| Item | Quantity | Unit Cost | Cost (x$1,000) |
|---|---|---|---|
| Division 1 | LS | | $8 |
| TV Inspection | 2 Ea | $2,500 | $5 |
| Well Rehabilitation – 1 Day | 2 Ea | $7,000 | $14 |
| Pump Testing | 2 Ea | $2,800 | $6 |
| SCADA Upgrades | LS | | $30 |
| Contingency (25%) | LS | | $16 |
| Administrative (25%) | LS | | $20 |
| **Total Capital** | | | **$99** |

# 6 Alternatives Analysis

For the purpose of evaluating the alternatives proposed for deficiencies 6 and 8, four weighted criteria will be used to develop an overall score. The criteria will be ranked on a scale of one (1) to four (4), with one being the highest (best) ranking, and four being the lowest (worst). The overall lowest score is considered the best alternative. Cost will be a stand alone criterion, which is not factored into the weighted score. The following criteria and weighting will be used to score the alternatives:

- Implementation (20%) – Is the alternative feasible to implement? Is the alternative constructible?
- Reliability (25%) – Will the alternative provide reliable results?
- Operability/Maintenance (40%) – Does the alternative require large quantities of time in terms of operator attention? Does the alternative require specialized maintenance requirements that cannot be performed in-house, or does it require frequent calibration, cleaning, tuning, etc.? Does it require an ongoing contract for maintenance?
- Environmental Consideration (15%): Will the alternative be difficult to permit? Can TRPA thresholds be met? Are there short-term or long-term effects on the environment?

## 6.1 Deficiency 6 – Storage Capacity

### 6.1.1 Rankings Summary

**Table 6-1. Summary of Alternatives**

| Alternative | Description |
|---|---|
| 1 | Build a supplemental 70,000 gallon storage tank reservoir to augment the existing tank. |
| 2 | Install automatic fire sprinklers at the 1860 Highway 50 residence to reduce the system fire flow requirement. |

**Table 6-2. Deficiency 6 Alternative Rankings**

| Criterion | Weight | Alternative Rank | | Weighted Score | |
|---|---|---|---|---|---|
| Alternative | | 1 | 2 | 1 | 2 |
| Implementation | 20% | 3 | 1 | 0.60 | 0.20 |
| Reliability | 25% | 1 | 1 | 0.25 | 0.25 |
| Operability/Maintenance | 40% | 2 | 1 | 0.80 | 0.40 |
| Environmental/Permitting | 15% | 3 | 1 | 0.45 | 0.15 |
| | | | Net Score | 2.1 | 1.0 |
| | | | Net Rank | 2 | **1** |

Notes:
1. Ranking 1 – 4.1 is highest (best), 4 is lowest (worst).
2. Lowest net score is considered best alternative.

**Table 6-3. Capital Cost Summary**

| Alternative | Capital Cost (x$1,000) |
|---|---|
| 1 – Build a supplemental 70,000 gallon storage tank reservoir to augment the existing tank | $ 475 |
| 2 – Install automatic fire sprinklers at the 1860 Highway 50 residence to reduce the system fire flow requirement | $ 93 |

## 6.1.2 Discussion of Rankings

### Implementation

Alternative 1 requires a tank to be placed in very steep and rocky terrain. Access and excavation for construction will be difficult due to the slopes and rock. The home owners in this area are likely to object to a tank next to their house.

Alternative 2 is straightforward construction in an indoor environment. However, this alternative will require the consent of the homeowner which may be problematic if cost is borne on the homeowner.

### Reliability

Each alternative provides equally reliable results.

#### Operability/ Maintenance

Alternative 1 requires periodic tank maintenance and inspection, while Alternative 2 maintenance responsibility is presumably borne on the homeowner. Thus Alternative 2 was ranked higher.

#### Environmental/ Permitting

Alternative 1 requires TRPA permitting due to creation of additional coverage and disturbance in the basin, and potential visibility from the Highway 50 scenic corridor. Alternative 2 is construction indoors and would not require a TRPA permit.

### 6.1.3 Recommended Alternative

Alternative 2 received the highest ranking, and is also the lower cost alternative. HDR recommends the County pursue this alternative. A supplemental tank would be a fallback alternative if the homeowner involved is uncooperative. Even if the County bears the full cost of installing fire sprinklers, it is much less expensive than Alternative 1. However, a legal review should be conducted regarding precedence on such matters.

## 6.2 Deficiency 8 – Supply Wells & SCADA

### 6.2.1 Rankings Summary

**Table 6-4. Summary of Alternatives**

| Alternative | Description |
|---|---|
| 1 | Abandon and replace the existing supply wells. |
| 2 | Rehabilitate the existing supply wells. |

**Table 6-5. Deficiency 8 Alternative Rankings**

| Criterion | Weight | Alternative Rank | | Weighted Score | |
|---|---|---|---|---|---|
| Alternative | | 1 | 2 | 1 | 2 |
| Implementation | 20% | 2 | 1 | 0.40 | 0.20 |
| Reliability | 25% | 1 | 3 | 0.25 | 0.75 |
| Operability/Maintenance | 40% | 1 | 2 | 0.40 | 0.80 |
| Environmental/Permitting | 15% | 2 | 1 | 0.30 | 0.15 |
| | | | Net Score | 1.4 | 1.9 |
| | | | Net Rank | **1** | 2 |

Notes:
1. Ranking 1 – 4.1 is highest (best), 4 is lowest (worst).
2. Lowest net score is considered best alternative.

**Table 6-6. Capital Cost Summary**

| Alternative | Capital Cost (x$1,000) |
|---|---|
| 1 – Abandon and replace the existing supply wells | $ 842 |
| 2 – Rehabilitate the existing supply wells | $ 99 |

### 6.2.2 Discussion of Rankings

#### Implementation

Both alternatives feasible to implement, however, since Alternative 1 requires a hydro-geological investigation to determine well locations, as well as test borings, etc. it is ranked lower for implementation.

#### Reliability

Alternative 1 is ranked higher since the outcome of rehabilitation of the existing wells is something of an unknown, at least until a video investigation of the wells is performed. Given the age and potential lack of maintenance over the years, rehabilitation may not get the wells back to original condition. Also, there is risk in trying to rehabilitate Well No.2 which has a PVC casing. It can break during jetting or brushing, which will cause sanding.

#### Operability/ Maintenance

Alternative 1 is ranked highest given that a properly designed and developed well with a stainless steel screen can last 100 years. There is no guarantee the existing wells can be successfully rehabilitated. All wells require routine maintenance to perform at their best. However, upsizing and the wells will minimize performance degradation in the long run. The existing well screen size of 0.020-inch is very small, and may be contributing to the lower pumping rate. A larger well would be more efficient.

#### Environmental/ Permitting

Alternative 2 is ranked higher since there are no permits required to rehabilitate the existing wells. Alternative 1 will require permits with the State Engineer and likely TRPA due to new piping and connections.

### 6.2.3 Recommended Alternative

Alternative 1 has the highest ranking and is the recommended alternative. Since cost is a factor, we recommend that the County video the wells to determine if rehabilitation appears feasible as a short term fix. The long term solution is likely to drill new wells.

# 7 Prioritization of Improvements and Cost Summary

## 7.1 Discussion of Priorities

Prioritization of projects is based on risk. System deficiencies with higher associated risk consequences will be given higher priority. The projects are grouped into four priority categories as follows:

- Priority 1 – These deficiencies represent public health and safety risks. Consequence of failure includes potential loss of life and property.
- Priority 2 – Represent deficiencies which may result in temporary disruption of water service or compliance, but generally minimal public health and safety impacts.
- Priority 3 – Represent deficiencies which may result in less efficient operations, but are not likely to cause loss or disruption of service or compliance.
- Priority 4 – Represent projects which may result in further gains in efficiency from priority 3, but are not directly needed for operations. Projects in this category represent “wants” more than “needs”, and do not address code violations.

### 7.1.1 Priority 1 Projects

Priority 1 projects address direct threats to public health and safety.

Fire flow represents potential threats to public health and safety. Potential results of insufficient fire flow include loss of property and life. As such, project(s) that address Deficiencies 1-6 were deemed the only Priority 1 projects.

### 7.1.2 Priority 2 Projects

Priority 2 project address deficiencies which result in system shutdown downs and minor compliance issues. These deficiencies generally do not pose threats to public health.

Line leaks result in partial system shutdowns, and risk distribution system contamination.

Storage volume deficiency may impact the ability to supply water to customers and result in water rationing. This deficiency may also impact fire suppression capabilities. Since there is no historical occurrence of this happening, it is rated as a priority 2 deficiency instead of 1.

Supply well capacity and reliability is directly related to the ability of the water system to meet peak hour demands and water quality requirements, thus it is a priority 2 project.

### 7.1.3 Priority 3 Projects

Priority 3 projects generally address deficiencies which result in less efficient system operation, but no threats to public health or safety. Water conservation is placed under this category since it could help address storage and well capacity deficiencies.

### 7.1.4 Priority 4 Projects

Priority 4 projects are not related directly to code requirements, but may provide benefits to the system reliability and efficiency. These projects are more “wants” than “needs”.

## 7.2 Project Priority Summary and Costs

**Table 7-1. Project Priority Summary and Costs**

| Deficiency No. | Description | Priority | Recommended Alternative | Capital Cost (x$1,000) |
|---|---|---|---|---|
| 1-5 | Fire Flow, Pressure, Velocity | 1-2 | Upsize and replace pipes | $3,232 |
| 6 | Storage Volume | 2 | 2 – Install Fire Sprinklers at 1860 Highway 50 residence | $93 |
| 7 | Water Conservation | 3 | Install Water Meters | $568 |
| 8 | Supply Wells & SCADA | 2 | 1 – Replace existing wells | $842 |
| | | | **Total** | **$4,735** |

# 8 References

1. Preliminary Design Report, Gilmore Engineering, April 1999
2. Well Pumping Test Analysis, Kleinfelder, October 1999
3. Pump Test Result Letter, Gilmore Engineering, August 1999
4. Well Start-Up Tests, KASL Engineers, December 2000
5. Well Rehabilitation – International School of Well Drilling

# APPENDIX A – COST OPINIONS

| | Job No. | | | Calc. No. |
|---|---|---|---|---|
| **Computation** | | | | |
| ***Project:*** | Uppaway Water System Preliminary Engineering | | ***Computed:*** | JB |
| ***Subject:*** | Fire Flow, Pressure, Velocity, and Size Criteria | | ***Date:*** | 11/1/2016 |
| ***Task:*** | Deficiency 1-5 Cost Opinion | | ***Reviewed:*** | MB |
| ***File Name:*** | *C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\Uppaway\Costs\[Uppaway _ Costs_2-26.xlsx]Def 1-5 FF & Leaks* | | | |

| DESCRIPTION | QUANTITY | UNITS | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| ***General Requirements*** | | | | |
| Mobilization | 1 | LS | 3.00% | $55,800 |
| Demobilization | 1 | LS | 1.00% | $18,300 |
| Bonds and Insurance | 1 | LS | 2.50% | $46,300 |
| Construction Facilities/Fencing | 1 | LS | 0.50% | $9,100 |
| General Conditions | 1 | LS | 2.00% | $36,800 |
| Shop Drawings and O&M Manuals | 1 | LS | 2.00% | $36,800 |
| Facilities Start-up & Testing | 1 | LS | 2.00% | $36,800 |
| Traffic Control | | LS | | $25,000 |
| **SUBTOTAL** | | | 13.0% | **$265,000** |
| | | | | |
| ***Pipelines - Upsizing*** ***(includes patch paving)*** | | | | |
| 8" DIP | 750 | LF | $193 | $144,775 |
| 8" Gate Valve | 1 | EA | $2,900 | $2,900 |
| 10" DIP | 1800 | LF | $227 | $408,777 |
| 10" Gate Valve | 3 | EA | $3,200 | $9,600 |
| 12" DIP | 1910 | LF | $261 | $498,822 |
| 12" Gate Valve | 3 | EA | $3,500 | $10,500 |
| Hydrant Connections | 12 | EA | $3,500 | $42,000 |
| **SUBTOTAL** | | | | **$1,117,374** |
| | | | | |
| ***Pipelines - Leaks*** ***(includes patch paving)*** | | | | |
| 8" DIP | 900 | LF | $193 | $173,730 |
| 8" Gate Valve | 2 | EA | $2,900 | $5,800 |
| 10" DIP | 1400 | LF | $227 | $317,938 |
| 10" Gate Valve | 2 | EA | $3,200 | $6,400 |
| Tie-Ins | 8 | EA | $6,000 | $48,000 |
| **SUBTOTAL** | | | | **$551,868** |
| ***Service Connections*** | | | | |
| 1-in Service Tap | 42 | EA | $1,500 | $63,000 |
| **SUBTOTAL** | | | | **$63,000** |
| ***Road Slurry Seal*** | | | | |
| Slurry Seal | 11,267 | SY | $6.26 | $70,491 |
| **SUBTOTAL** | | | | **$70,491** |
| | | | **SUBTOTAL** | $1,802,733 |
| | | | **(ADDITIVE FOR) DIVISION 1 (ABOVE)** | $265,000 |
| | | | **SUBTOTAL 2** | $2,067,733 |
| | | | **CONTINGENCY (25%)** | $517,000 |
| | | | **SUBTOTAL 3** | $2,585,000 |
| | | | **ADMINISTRATIVE (25%)** | $647,000 |
| | | | **TOTAL** | **$3,232,000** |

| | Job No. | | | Calc. No. |
|---|---|---|---|---|
| **Computation** | | | | |
| ***Project:*** | Uppaway Water System Preliminary Engineering | | ***Computed:*** | JB |
| ***Subject:*** | Storage Alternative 1 - Supplemental Tank | | ***Date:*** | 11/1/2016 |
| ***Task:*** | Deficiency 6 Cost Opinion | | ***Reviewed:*** | MB |
| ***File Name:*** | *C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\Uppaway\Costs\[Uppaway _ Costs_2-26.xlsx]Def 6 Storage- A* | | | |

| DESCRIPTION | QUANTITY | UNITS | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| ***General Requirements*** | | | | |
| Mobilization | 1 | LS | 3.00% | $7,771 |
| Demobilization | 1 | LS | 1.00% | $2,590 |
| Bonds and Insurance | 1 | LS | 2.50% | $6,476 |
| Construction Facilities/Fencing | 1 | LS | 0.50% | $1,295 |
| General Conditions | 1 | LS | 2.00% | $5,181 |
| Shop Drawings and O&M Manuals | 1 | LS | 2.00% | $5,181 |
| Facilities Start-up & Testing | 1 | LS | 2.00% | $5,181 |
| Traffic Control | | LS | | $10,000 |
| **SUBTOTAL** | | | 13.0% | **$44,000** |
| | | | | |
| ***Supplemental Storage Tank*** | | | | |
| Steel Tank | 70,000 | Gal | $2.00 | $140,000 |
| **SUBTOTAL** | | | | **$140,000** |
| | | | | |
| ***Site Work*** | | | | |
| Concrete Foundation | 21 | CY | $500 | $10,472 |
| Site Grading | 2450 | SY | $6 | $14,701 |
| Cut/Fill Earthwork | 414 | CY | $30 | $12,434 |
| Road Paving | 336 | SY | $36 | $12,093 |
| **SUBTOTAL** | | | | **$49,701** |
| | | | | |
| ***Piping*** | | | | |
| 12-in DIP | 120 | LF | $261 | $31,340 |
| 12-In Gate Valve | 3 | EA | $3,500 | $10,500 |
| Tie-Ins | 1 | EA | $7,500 | $7,500 |
| **SUBTOTAL** | | | | **$49,340** |
| ***Controls*** | | | | |
| Tank Level Controls/SCADA | | LS | | $20,000 |
| **SUBTOTAL** | | | | **$20,000** |
| | | | **SUBTOTAL** | $259,040 |
| | | | **(ADDITIVE FOR) DIVISION 1 (ABOVE)** | $44,000 |
| | | | **SUBTOTAL 2** | $303,040 |
| | | | **CONTINGENCY (25%)** | $76,000 |
| | | | **SUBTOTAL 3** | $379,040 |
| | | | **ADMINISTRATIVE (25%)** | $95,000 |
| | | | **TOTAL** | **$475,000** |

| | | | | |
|---|---|---|---|---|
| | *Job No.* | | | Calc. No. |

## Computation

| | | | |
|---|---|---|---|
| ***Project:*** | Uppaway Water System Preliminary Engineering | ***Computed:*** | JB |
| ***Subject:*** | Storage Alternative 2 - Fire Sprinklers | ***Date:*** | 11/1/2016 |
| ***Task:*** | Deficiency 6 Cost Opinion | ***Reviewed:*** | MB |
| ***File Name:*** | *C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\Uppaway\Costs\[Uppaway _ Costs_2-26.xlsx]Def 6 Storage- A* | | |

| DESCRIPTION | QUANTITY | UNITS | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| ***General Requirements*** | | | | |
| Mobilization | 1 | LS | 3.00% | $1,560 |
| Demobilization | 1 | LS | 1.00% | $520 |
| Bonds and Insurance | 1 | LS | 2.50% | $1,300 |
| Construction Facilities/Fencing | 1 | LS | 0.50% | $260 |
| General Conditions | 1 | LS | 2.00% | $1,040 |
| Shop Drawings and O&M Manuals | 1 | LS | 2.00% | $1,040 |
| Facilities Start-up & Testing | 1 | LS | 2.00% | $1,040 |
| | | | | |
| **SUBTOTAL** | | | 13.0% | **$7,000** |
| | | | | |
| ***Automatic Fire Sprinklers*** | | | | |
| 1860 Highway 50 Residence | 17,330 | SF | $3.00 | $51,990 |
| **SUBTOTAL** | | | | **$51,990** |

| | |
|---|---|
| **SUBTOTAL** | $51,990 |
| **(ADDITIVE FOR) DIVISION 1 (ABOVE)** | $7,000 |
| **SUBTOTAL 2** | $58,990 |
| **CONTINGENCY (25%)** | $15,000 |
| **SUBTOTAL 3** | $73,990 |
| **ADMINISTRATIVE (25%)** | $19,000 |
| **TOTAL** | **$93,000** |

| | Job No. | | | Calc. No. |
|---|---|---|---|---|

## Computation

| | | | |
|---|---|---|---|
| ***Project:*** | Uppaway Water System Preliminary Engineering | ***Computed:*** | JB |
| ***Subject:*** | Water Conservation - Water Meters | ***Date:*** | 10/31/2016 |
| ***Task:*** | Deficiency 7 Cost Opinion | ***Reviewed:*** | MB |
| ***File Name:*** | *C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\Uppaway\Costs\[Uppaway _ Costs_2-26.xlsx]Def 7-Water meters* | | |

| DESCRIPTION | QUANTITY | UNITS | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| ***General Requirements*** | | | | |
| Mobilization | 1 | LS | 3.00% | $9,900 |
| Demobilization | 1 | LS | 1.50% | $4,900 |
| Bonds and Insurance | 1 | LS | 2.50% | $8,300 |
| Construction Facilities/Fencing | 1 | LS | 1.50% | $4,900 |
| General Conditions | 1 | LS | 2.50% | $8,300 |
| Shop Drawings and O&M Manuals | 1 | LS | 2.00% | $6,600 |
| | | | | |
| **SUBTOTAL** | | | 13.0% | **$43,000** |
| | | | | |
| ***Residential Meters*** | | | | |
| Install 1-in Meter, Yolk, and Pit Assembly | 32 | EA | $7,500 | $240,000 |
| **SUBTOTAL** | | | | **$240,000** |
| ***Irrigationl Meters*** | | | | |
| Install 2" Meter, Yolk, and Pit Assembly | 8 | EA | $10,000 | $80,000 |
| **SUBTOTAL** | | | | **$80,000** |

| | |
|---|---|
| **SUBTOTAL** | $320,000 |
| **(ADDITIVE FOR) DIVISION 1 (ABOVE)** | $43,000 |
| **SUBTOTAL 2** | $363,000 |
| **CONTINGENCY (25%)** | $91,000 |
| **SUBTOTAL 3** | $454,000 |
| **ADMINISTRATIVE (25%)** | $114,000 |
| **TOTAL** | **$568,000** |

| | Job No. | | | Calc. No. |
|---|---|---|---|---|

## Computation

| | | | |
|---|---|---|---|
| ***Project:*** | Uppaway Water System Preliminary Engineering | ***Computed:*** | JB |
| ***Subject:*** | Well Replacement | ***Date:*** | 10/31/2016 |
| ***Task:*** | Deficiency 8 Cost Opinion - Alternative 1 | ***Reviewed:*** | MB |
| ***File Name:*** | *C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\Uppaway\Costs\[Uppaway _ Costs_2-26.xlsx]Def 8-Wells-Alt 1* | | |

| DESCRIPTION | QUANTITY | UNITS | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| ***General Requirements*** | | | | |
| Mobilization | 1 | LS | 3.00% | $14,700 |
| Demobilization | 1 | LS | 1.50% | $7,300 |
| Bonds and Insurance | 1 | LS | 2.50% | $12,200 |
| Construction Facilities/Fencing | 1 | LS | 1.00% | $4,800 |
| General Conditions | 1 | LS | 2.50% | $12,200 |
| Shop Drawings and O&M Manuals | 1 | LS | 2.50% | $12,200 |
| **SUBTOTAL** | | | 13.0% | **$63,400** |
| ***Well Abandonment*** | | | | |
| Remove pump, fill well with bentonite and file report | 2 | EA | $3,500 | $7,000 |
| **SUBTOTAL** | | | | **$7,000** |
| ***Municipal Wells*** | | | | |
| 10-in Steel Casing (including pilot test boring, monitoring well, and pump test) | 2 | EA | $165,000 | $330,000 |
| 6-in Submersible Pumps | 2 | EA | $25,000 | $50,000 |
| **SUBTOTAL** | | | | **$380,000** |
| ***Yard Piping*** | | | | |
| 6-in DIP | 100 | LF | $175 | $17,500 |
| 6-in Gate Valve | 4 | EA | $2,500 | $10,000 |
| Tie-In | 1 | EA | $7,500 | $7,500 |
| **SUBTOTAL** | | | | **$35,000** |
| ***Electrical & Controls*** | | | | |
| Electrical | | LS | 25% | $21,250 |
| Tank, Well, and Booster SCADA Upgrades | | LS | | $30,000 |
| **SUBTOTAL** | | | | **$51,250** |

| | |
|---|---|
| **SUBTOTAL** | $473,250 |
| **(ADDITIVE FOR) DIVISION 1 (ABOVE)** | $64,000 |
| **SUBTOTAL 2** | $537,250 |
| **CONTINGENCY (25%)** | $135,000 |
| **SUBTOTAL 3** | $673,000 |
| **ADMINISTRATIVE (25%)** | $169,000 |
| **TOTAL** | **$842,000** |

| | Job No. | | | Calc. No. |
|---|---|---|---|---|

## Computation

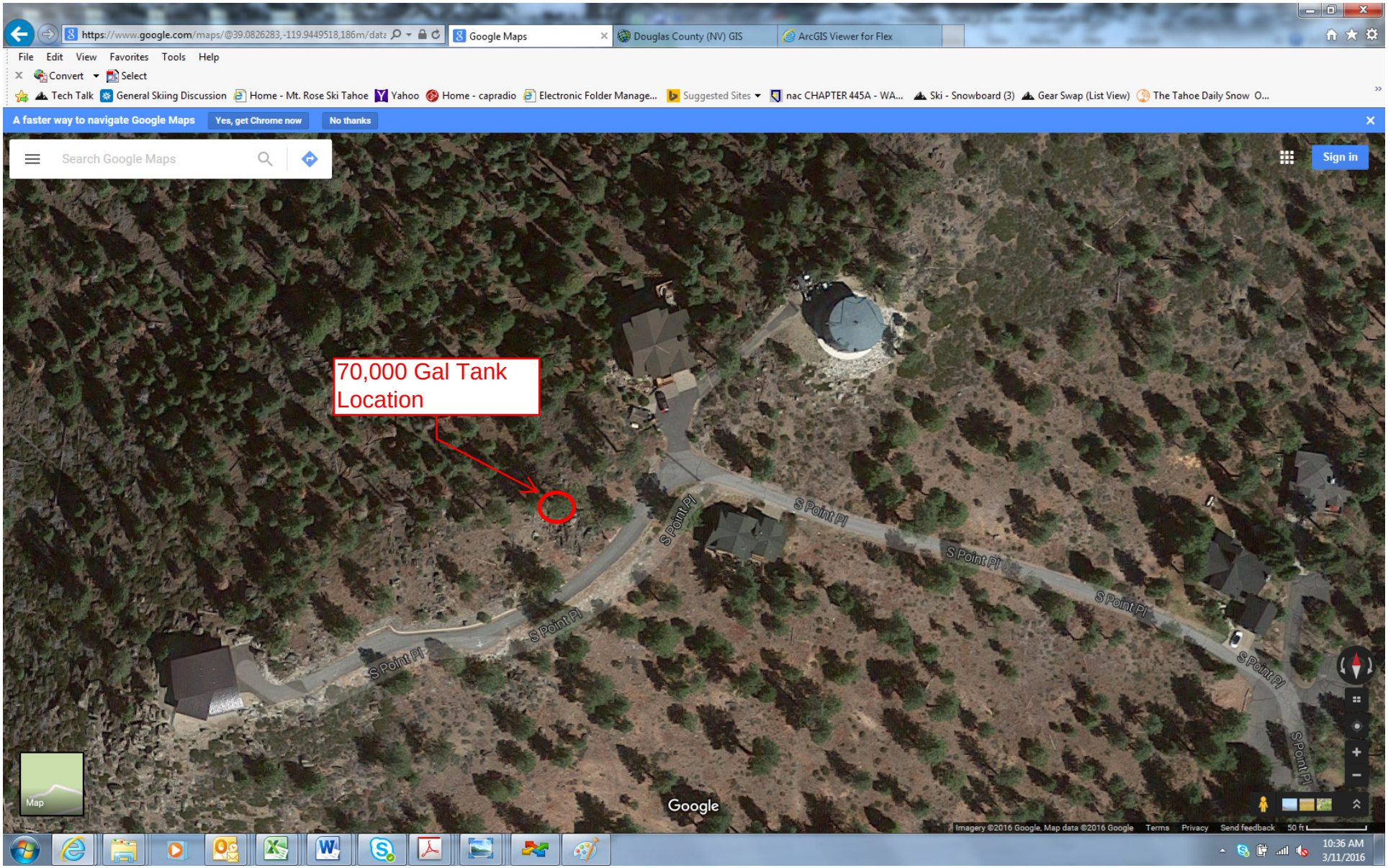
| | | | |
|---|---|---|---|
| ***Project:*** | Uppaway Water System Preliminary Engineering | ***Computed:*** | JB |
| ***Subject:*** | Well Rehabilitation | ***Date:*** | 10/31/2016 |
| ***Task:*** | Deficiency 8 Cost Opinion - Alternative 2 | ***Reviewed:*** | MB |
| ***File Name:*** | *C:\Users\jbellin\Desktop\Projects\Douglas County\Lake Water PER\PERs\Uppaway\Costs\[Uppaway _ Costs_2-26.xlsx]Def 8-Wells-Alt 2* | | |

| DESCRIPTION | QUANTITY | UNITS | UNIT COST | TOTAL COST |
|---|---|---|---|---|
| ***General Requirements*** | | | | |
| Mobilization | 1 | LS | 3.00% | $1,700 |
| Demobilization | 1 | LS | 1.50% | $900 |
| Bonds and Insurance | 1 | LS | 2.50% | $1,400 |
| Construction Facilities/Fencing | 1 | LS | 1.00% | $600 |
| General Conditions | 1 | LS | 2.50% | $1,400 |
| Shop Drawings and O&M Manuals | 1 | LS | 2.50% | $1,400 |
| **SUBTOTAL** | | | 13.0% | **$7,400** |
| | | | | |
| ***Well Rehabilitation*** | | | | |
| TV Well Inspection | 2 | EA | $2,500 | $5,000 |
| Pull and Reinstall Well Pump | 2 | EA | $2,000 | $4,000 |
| Well Rehabilitation - Wire brush, jetting, acid - 1 day | 2 | EA | $5,000 | $10,000 |
| Pump Testing - Step and Constant Rate | 16 | Hr | $350 | $5,600 |
| **SUBTOTAL** | | | | **$24,600** |
| ***SCADA Upgrades*** | | | | |
| Tank, Well, and Booster SCADA Upgrades | | LS | | $30,000 |
| **SUBTOTAL** | | | | **$30,000** |

| | |
|---|---|
| **SUBTOTAL** | $54,600 |
| **(ADDITIVE FOR) DIVISION 1 (ABOVE)** | $8,000 |
| **SUBTOTAL 2** | $62,600 |
| **CONTINGENCY (25%)** | $16,000 |
| **SUBTOTAL 3** | $79,000 |
| **ADMINISTRATIVE (25%)** | $20,000 |
| **TOTAL** | **$99,000** |

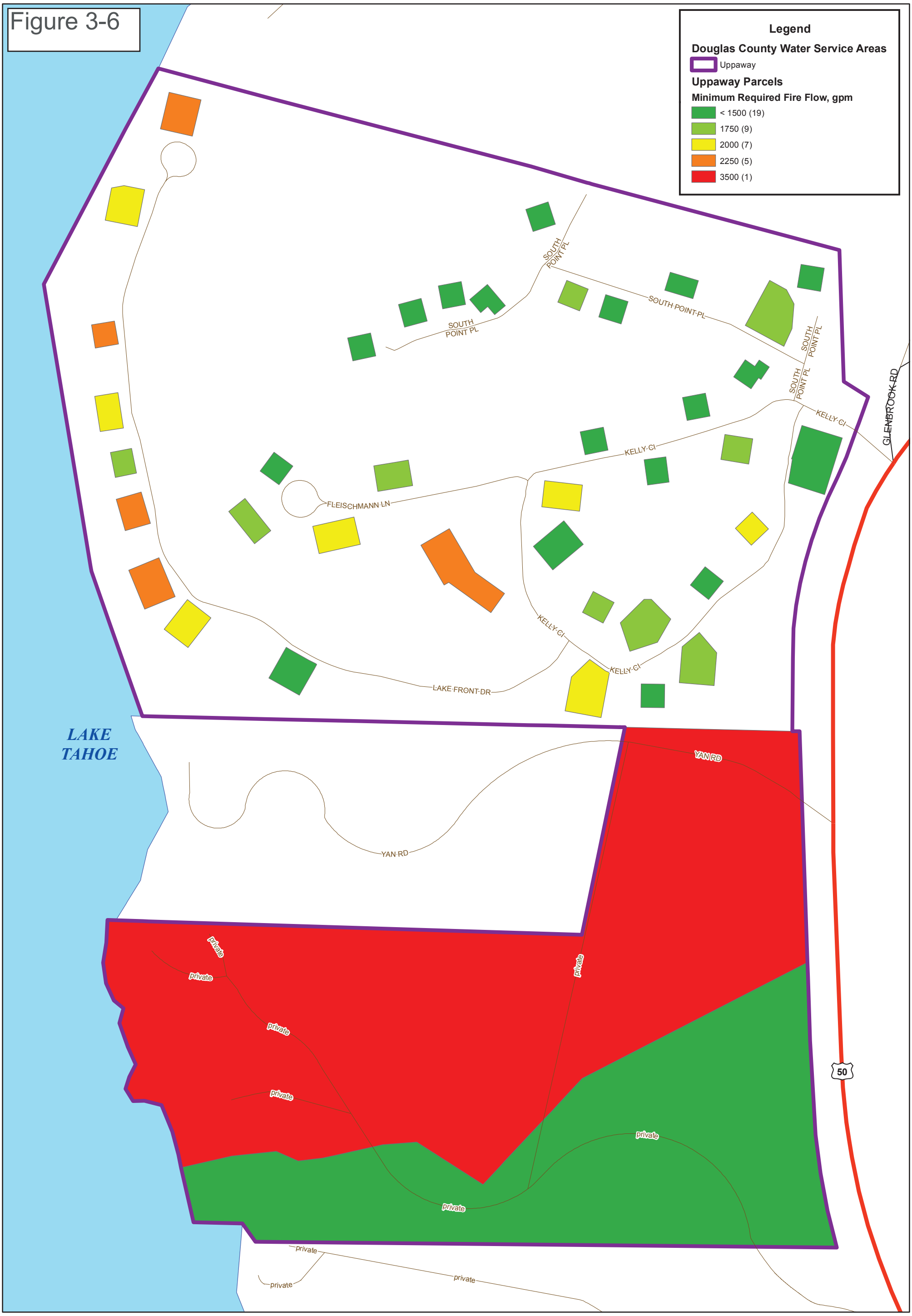
# APPENDIX B – FIGURES


Glenbrook
SOUTH POINT PLACE
HIGHWAY 50
50
LAKEFRONT DR
YAN RD
Fleischman Ln
Kelly Cir
Yan Rd
Wells No.1 & No.2
Lakefront Dr
LAKE TAHOE


https://www.google.com/maps/@39.0826283,-119.9449518,186m/data
Google Maps
Douglas County (NV) GIS
ArcGIS Viewer for Flex
File Edit View Favorites Tools Help
Convert Select
Tech Talk
General Skiing Discussion
Home - Mt. Rose Ski Tahoe
Yahoo
Home - capradio
Electronic Folder Manage...
Suggested Sites
nac CHAPTER 445A - WA...
Ski - Snowboard (3)
Gear Swap (List View)
The Tahoe Daily Snow O...
A faster way to navigate Google Maps
Yes, get Chrome now
No thanks
Search Google Maps
Sign in
70,000 Gal Tank Location
S Point Pl
Map
Google
Imagery ©2016 Google, Map data ©2016 Google
Terms
Privacy
Send feedback
50 ft
10:36 AM
3/11/2016

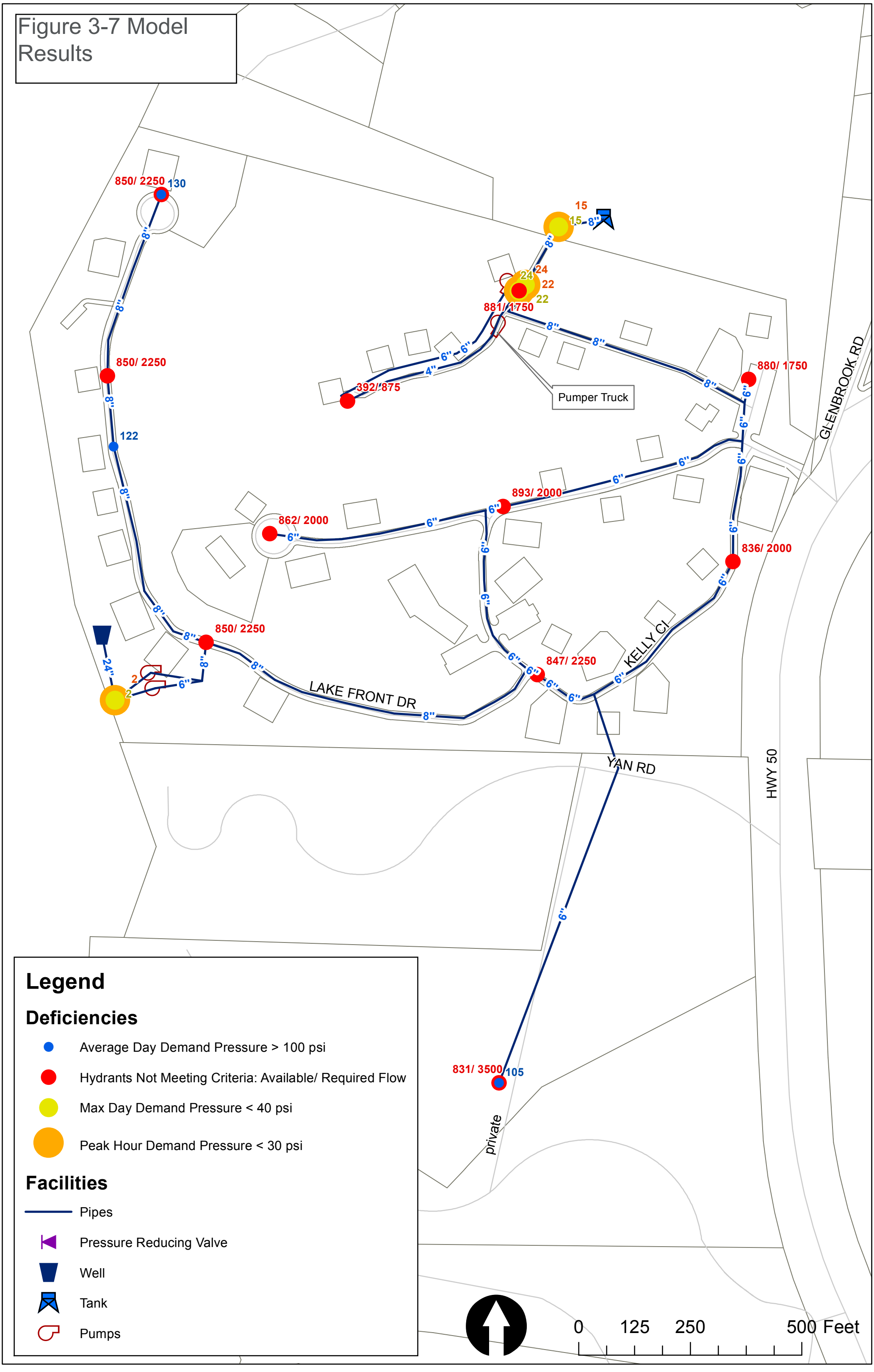
# Uppaway Water System - - Minimum Required Fire Flows, gpm

Figure 3-6




Print Date: 4/9/2015 - - File Name: FireFlow_Uppaway_Z597_11x17P

# Figure 3-7 Model Results




## Legend

### Deficiencies

- Average Day Demand Pressure > 100 psi
- Hydrants Not Meeting Criteria: Available/ Required Flow
- Max Day Demand Pressure < 40 psi
- Peak Hour Demand Pressure < 30 psi

### Facilities

- Pipes
- Pressure Reducing Valve
- Well
- Tank
- Pumps

# Figure 5-1 Deficiency 1-5 Improvements

PNEUMATIC TANK

Pumper Truck

KELLY CI

LAKE FRONT DR

YAN RD

HWY 50

GLENBROOK RD

private

private

0 125 250 500 Feet

## Legend

### Pipes

- Upsized
- Existing
- Pressure Reducing Valve
- Well
- Tank
- Pumps

# APPENDIX D – REPORTS

Blue Locker
Commercial Diving Services LLC

Douglas County

Uppaway Reservoir

06/05/2014

**ATTN: Ronnie Leeper**
**Client: Douglas County Public Works**
**ADDRESS: P.O. BOX, 218, MINDEN, NV, 89423**
**Office: 775-782-9989**
**Fax: 775-782-6266**

**Tank: Welded Steel**
**Capacity: 375,000 Gallons**
**Height: 33FT.**
**Diameter: 45ft.**
**Year Built: 2009**
**Number of Rings: 4**

**Water Quality Appearance: Good**
**Discharge Location: At Overflow Discharge Site**
**Coating Type: Epoxy**

**Water Temperature:**
**Near Surface - 67 Degrees (Fahrenheit)**
**Near Bottom - 62 Degrees (Fahrenheit)**

Approximate Measurements for all fixtures:

- Man Way - #1-36''
- Man Way - #2-36''
- Overflow - 6''
- Access Hatch - 36'' x 36''
- Central Roof Vent - 12''
- Perimeter Roof Vent - #1-10''
- Perimeter Roof Vent - #2 - 10''
- Inlet - 12''
- Outlet - 12''
- Drain - 6 ''
- Inside Sump - 36''
- Cathotic Protection Penetration - 2''

**Date: 06/05/2014**

**Uppaway Reservoir**

**On June 05th, 2014, Blue Locker Commercial Diving Services, L.L.C. Performed a Cleaning and Inspection of the Uppaway Reservoir for Douglas County Public Works. Upon completion of the inspection, spot repairs using a NSF approved epoxy were made in several areas in efforts to lengthen the life of the coating. Tank is referenced like the face of a clock. 12-3 o'clock is quadrant A or 1. Quadrant B or 2 is 3-6 o'clock etc.**

Section 1: Interior & Exterior Shell (Page, 4, 6, 11-14,18 &23)

- **Coating on Shell is in Very Good Condition**
- No Blisters, Cracking or Peeling Observed
- Previous Repairs on Shell are Good - 2 appear to have Rust showing signs of Seeping through
- Rust Streaming down Shell in top Rings at Beams

Section 2: Floor (Page, 18-20 & 24-25)

- **Coating on Floor Panels is in Very Good Condition**
- No Blisters, Rust, Peeling or Cracking Observed
- Patch of Rusty Debris on Floor Near Ladder (Possibly Slag) 12'oclock position
- Rust & Rust Staining in Crevices Under Support Pole Base
- No other flaws observed

Section 3: Ceiling (Page, 11, 22-23 & 28)

- **Coating is in Very Good Condition**
- Rust and Rust Staining at Beams
- No other flaws observed

Section 4: Support Pole (Page, 20-21)

- **Center Support Pole is Excellent Condition**
- No Flaws Observed

Section 5: Water Level Indicator (Page, 5 & 10 - 11)

- **No Mechanical W.L.I. Present**
- **Electronic W.L.I - 11:30 position**
- **Transducer suspended approximately 3'' off the floor**
- **Appears functional - Good Condition**

Section 6: Roof Vents (Page, 8 & 13)

- **2 x 10'' Perimeter Roof Vents**
- Screens are intact
- **12'' Center Roof Vent**
- Screens Intact

Section 7: Exterior Ladder (Page 11)

- **Exterior Ladder-No Climbing Device Present**
- **Exterior Ladder is in Excellent Condition**
- No Flaws Observed, On Rungs, Runners or Cage

Section 8: Access Hatch (Page, 7)

- **24'' x 24'' Access Hatch is in Excellent Condition**
- No flaws observed

Section 9: Interior Ladder (Page, 9-10)

- **Interior Ladder - No Climbing Device Present**
- **Interior Ladder is in Excellent Condition**
- No Other Flaws Observed

Section 10: Inlet (Page, 16)

- **12'' Is in Good Condition**
- Previous Epoxy Repair Made on the Interior of Pipe - Good Condition
- Light Staining on Interior Where Previous Repairs were made
- No, Blisters, Rust, Cracking or Peeling observed

Section 12: Outlet (Page, 27)

- **12'' Outlet is in Good Condition**
- Previous Epoxy Repair Made to the Interior of the Pipe-Good Condition
- No Other Flaws Observed

Section 14: Overflow (Page, 5 &27)

- **6'' Overflow Pipe on Exterior of Tank is in Good Condition**
- **Overflow Box on the Interior of the Tank is in Excellent Condition**
- No Flaws Observed
- Water Level Was to Low to view the Interior of the Overflow Box

Section 15: Drain (page, 26)

- **6'' Drain in 36'' Sump - Is in Very Good Condition**
- Previous Repairs on Interior of Pipe - Good Condition
- No other Flaws Observed

Section 16: Man Ways (Page 2, 4 16 & 25)

- 2 - 36'' Diameter Man Ways - Both appear to be in Excellent Condition
- No Flaws Observed

Section 17: Sample Tap (Page 3 & 17)

- **1'' Sample Tap appears to be in Good Condition**
- Rust Forming on the Interior of Opening
- No other Flaws Observed

# Recommendations,

**Interior Coating of this tank overall, appeared to be in excellent condition. Keep up with the regular scheduled maintenance and Spot Repair.**

**Sincerely,**
**Kelan Gondrezick**

**Blue Locker**
**Commercial Diving Services, L.L.C.**

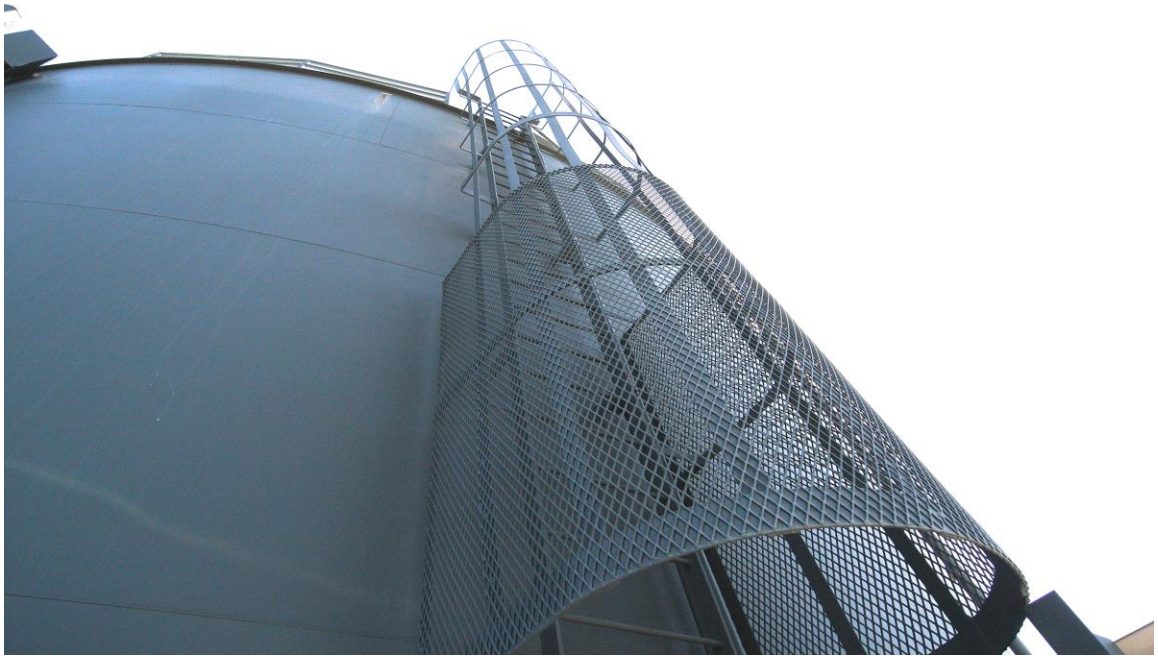

# Blue Locker Diving - Photo Documentation

## Members - AWWA & NRWA

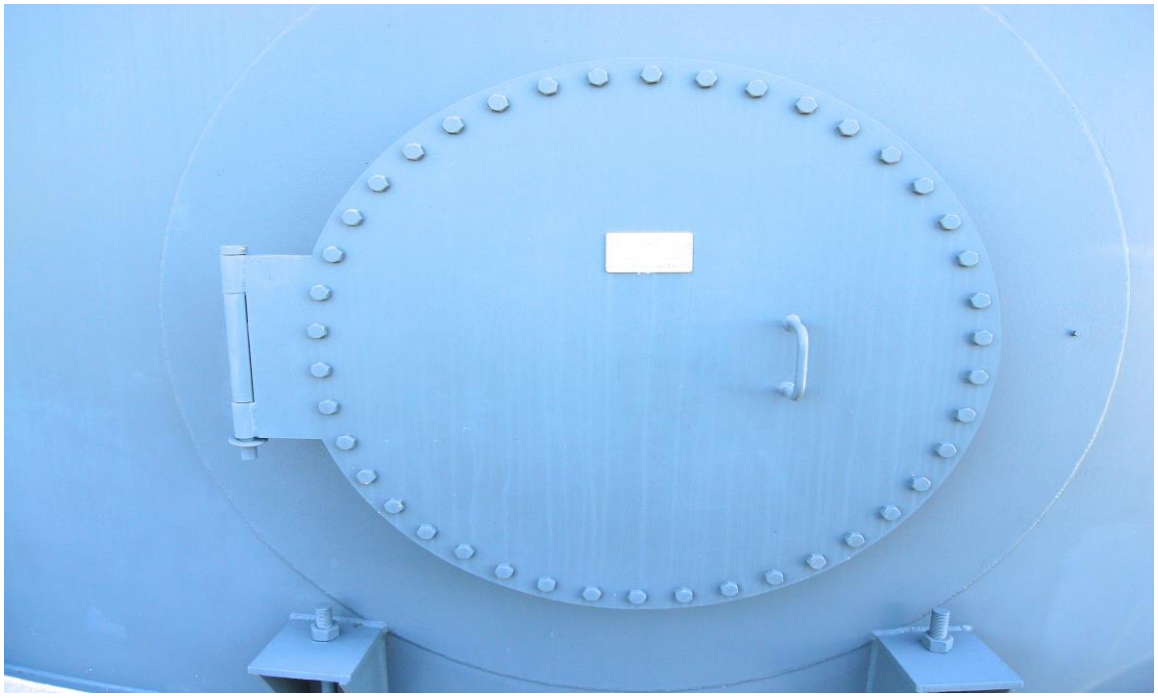
# UPPAWAY RESERVOIR - DOUGLAS COUNTY
# 06 - 05 - 2014

#1 - UPPAWAY RESERVOIR

#2 - EXTENSION LADDER

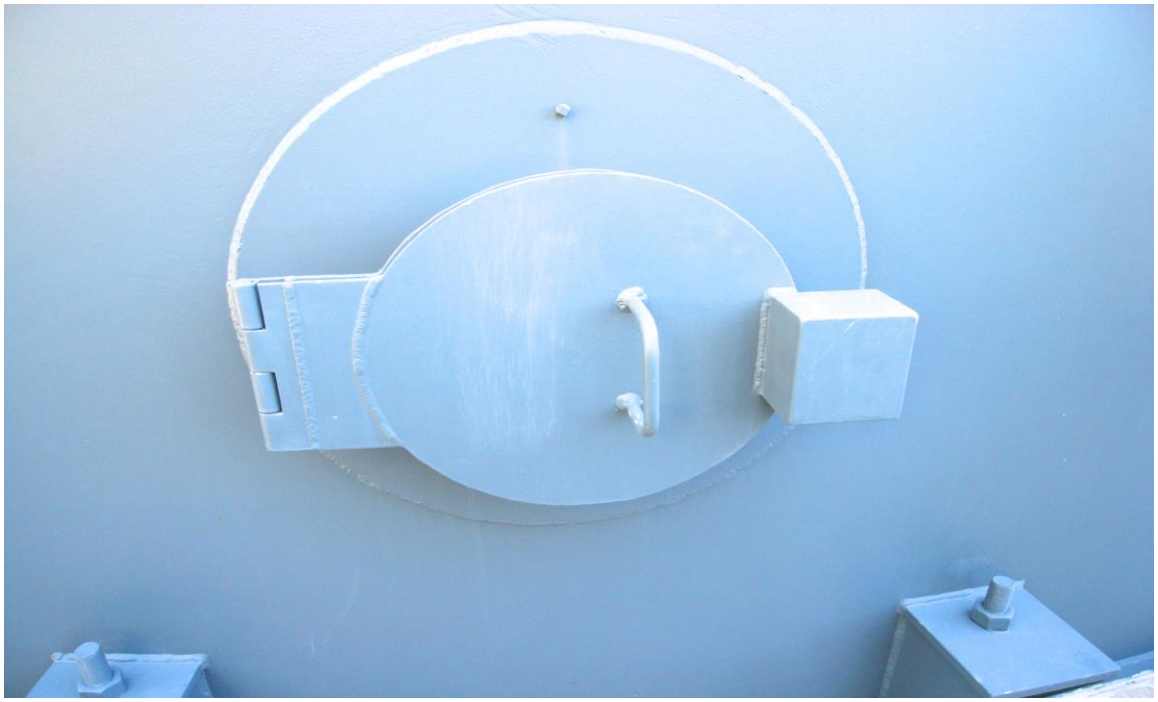


#3 - MANWAY #1



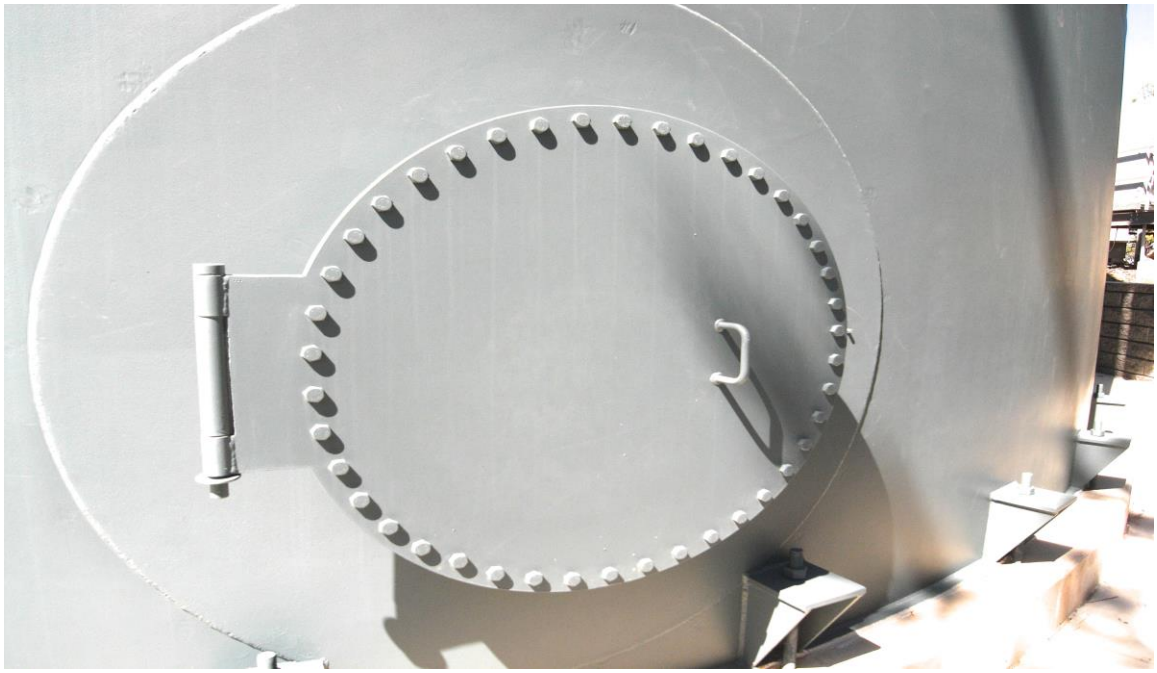
#4 - CHINE (SEISMIC REFERENCE)

#5 - SAMPLE TAP



#6 - TANK EXTERIOR (SEISMIC REFERENCE)

#7 - MANWAY #2



#8 - TANK EXTERIOR (SEISMIC REFERENCE)

#9 - OVERFLOW NEAR BOTTOM

#10 - OVERFLOW AT TOP

#11 - CATHOTIC PROTECTION - PENETRATION

#12 - ROOF EDGE - (SEISMIC REFERENCE)

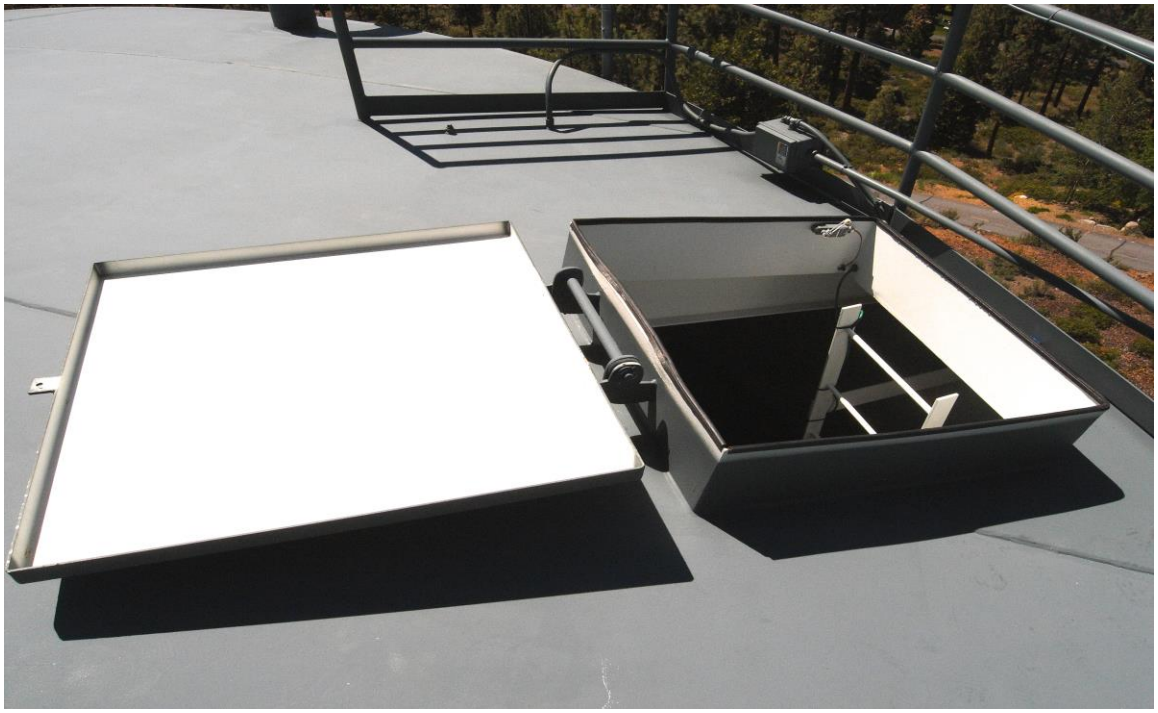
#13 - ROOF (SEISMIC REFERENCE)

#14 - 1 OF 2 - PERIMETER ROOF VENTS

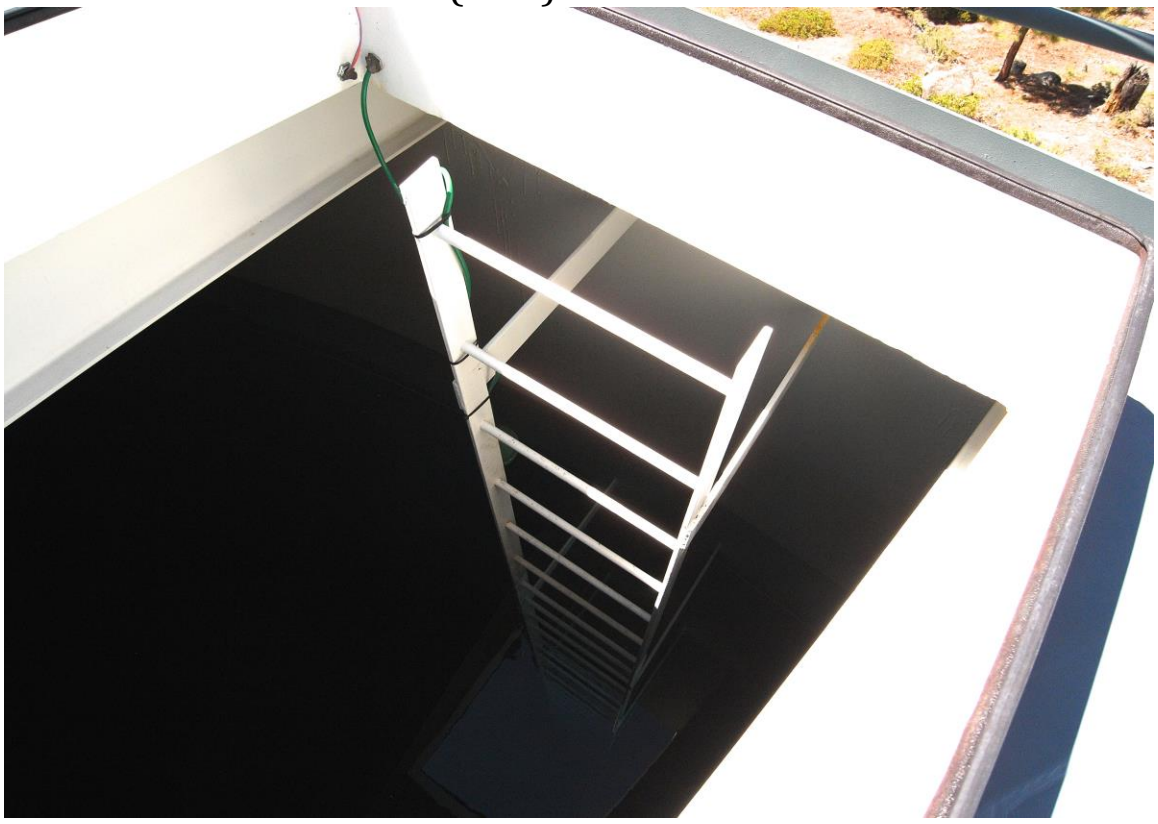
#15 - 1 OF 2 PERIMETER ROOF VENTS - SCREEN

#16 - CENTER ROOF VENT

#17 - ACCESS HATCH



18 - INTERIOR LADDER (TOP)



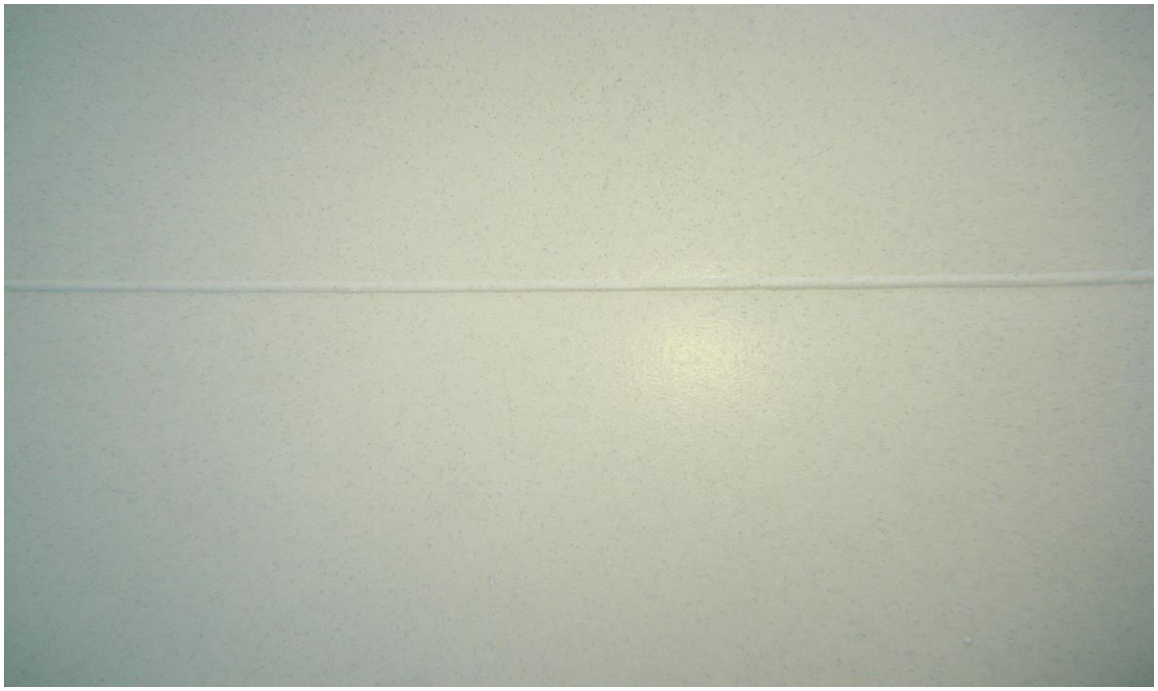
#19 - INTERIOR LADDER  (MIDDLE)

#20 - INTERIOR LADDER (BOTTOM)

#21 - SHELL AT CEILING

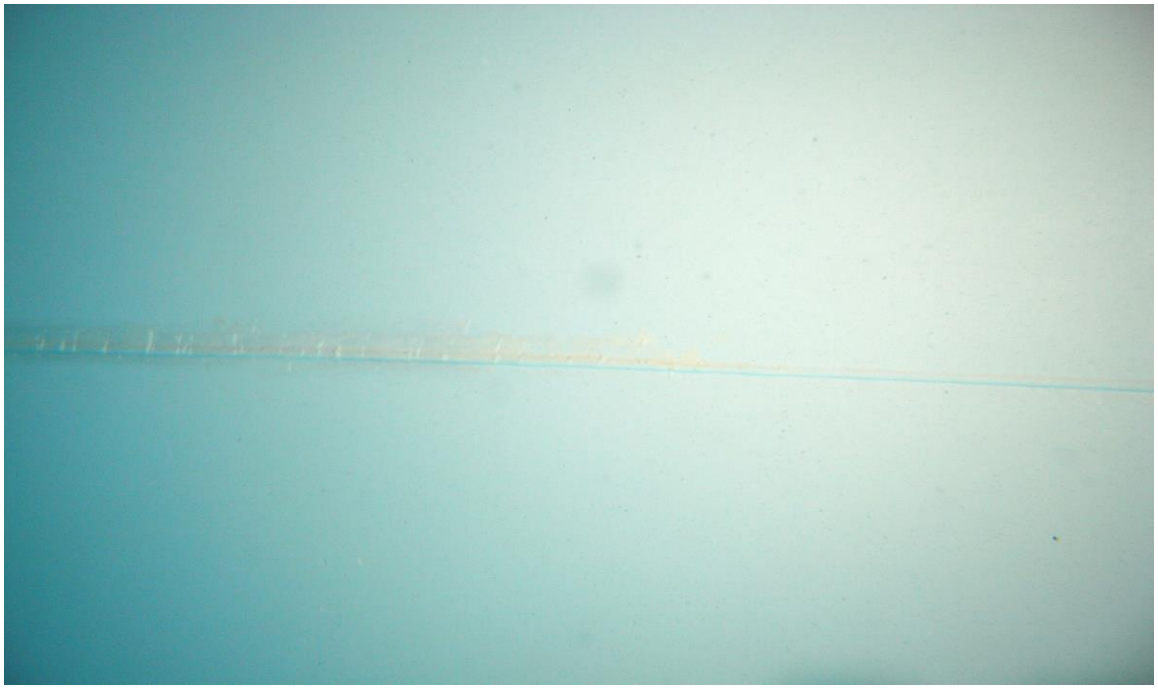
#22 - SHELL AT CEILING

#23 - SHELL SEAM RINGS - #3 & #4

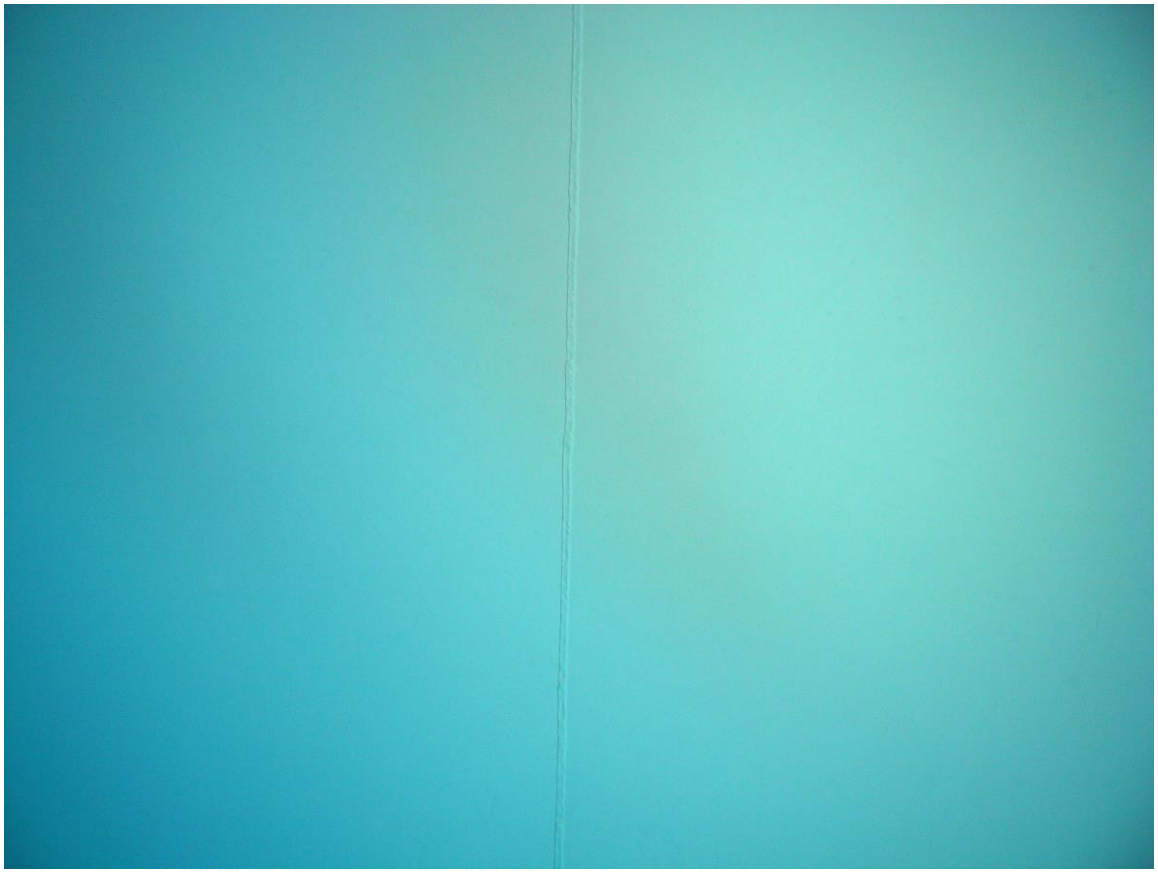


#24 - SHELL RING #3

#25 - SHELL SEAM RINGS -#2 & #3

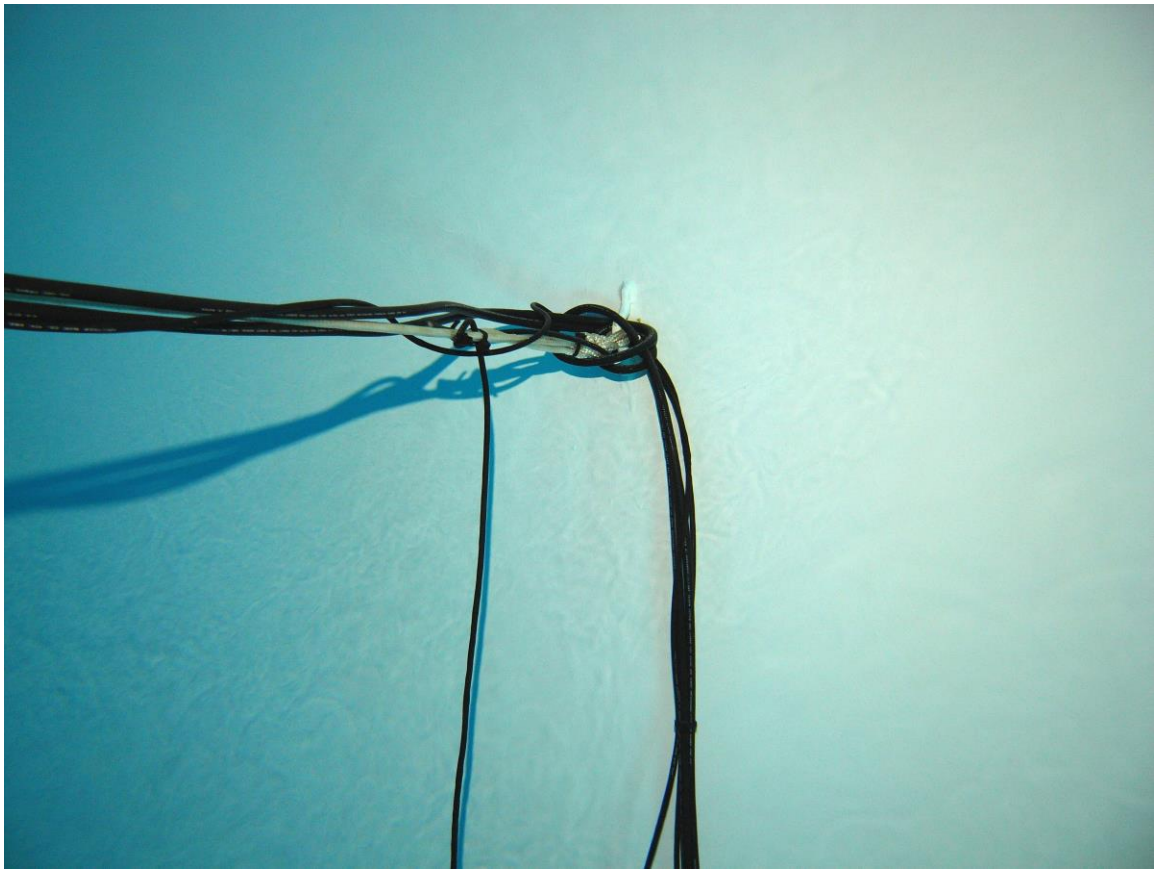


#26 - SHELL RING #2

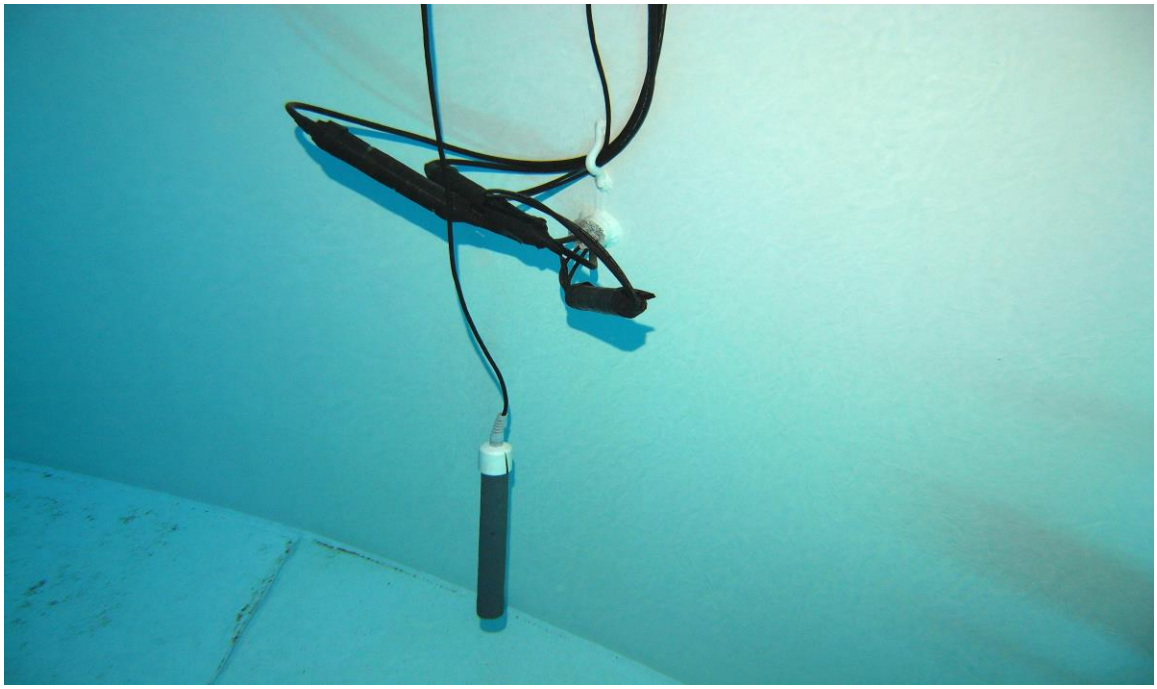


#27 - SHELL SEAM RINGS - #1 & #2

#28 - SHELL RING #1 & C.P. ANCHOR

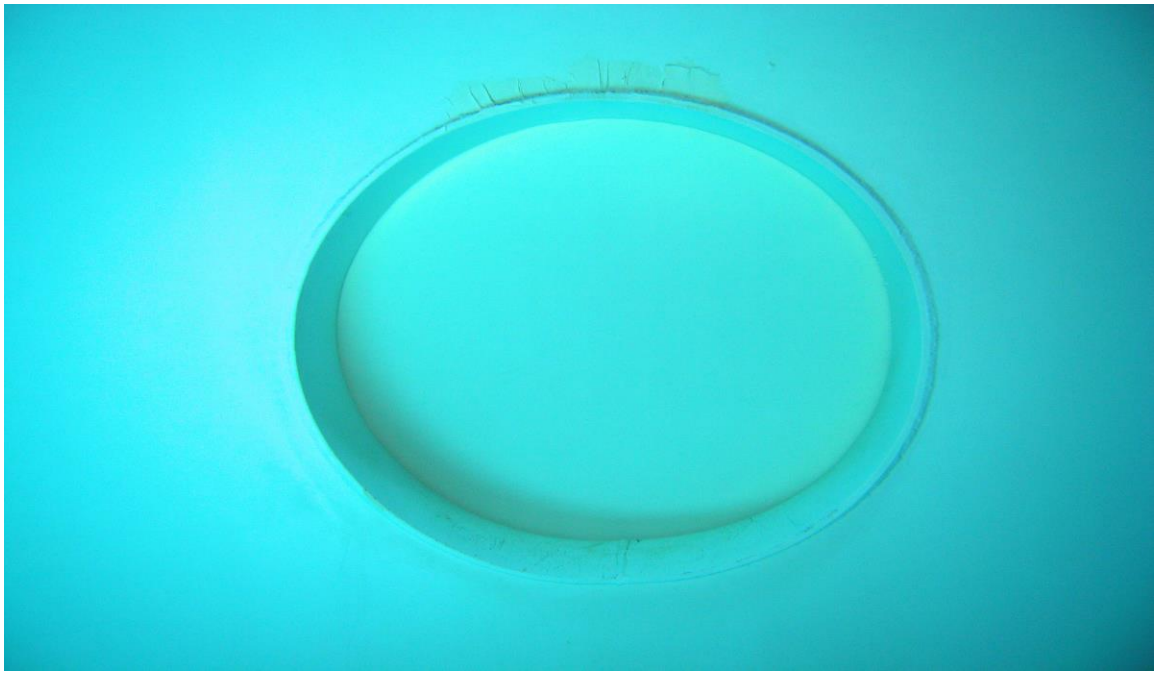


#29 - C.P. PENETRATION

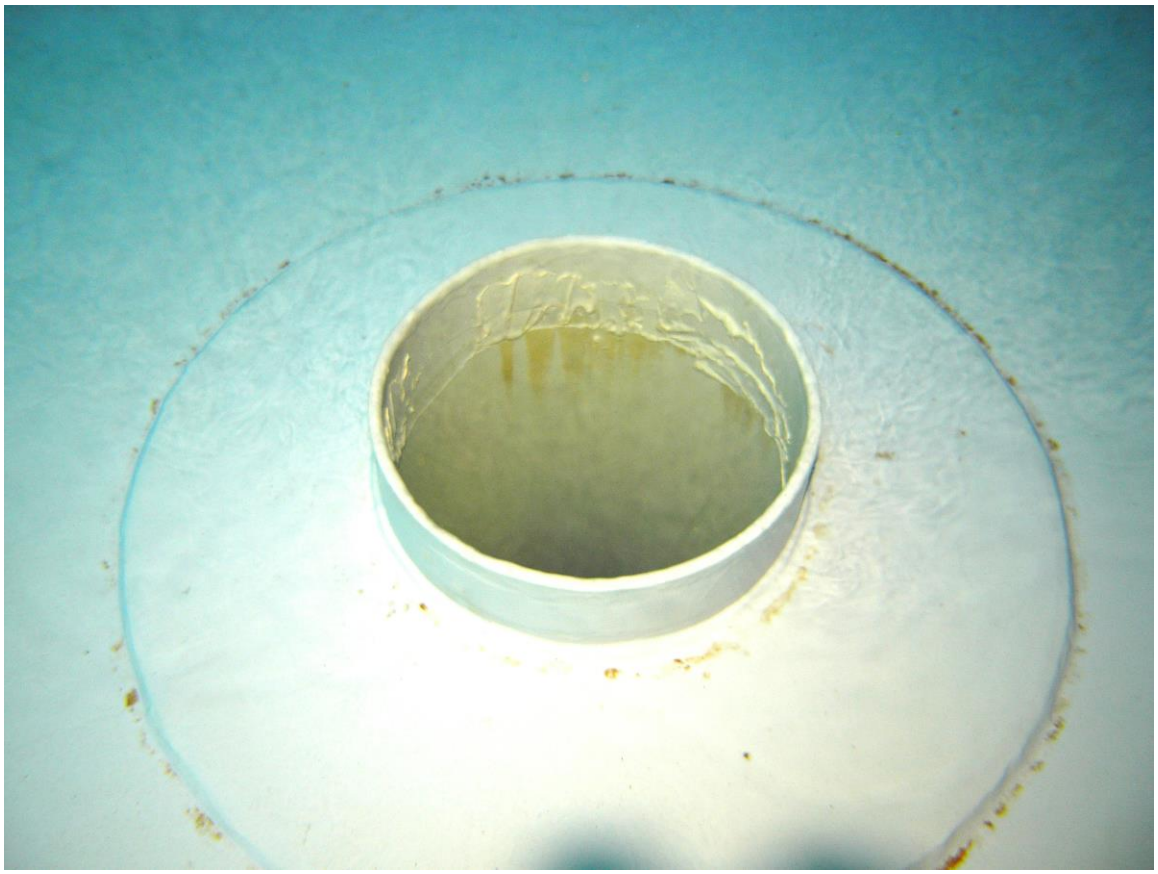


#30 - W.L.I. TRANSDUCER

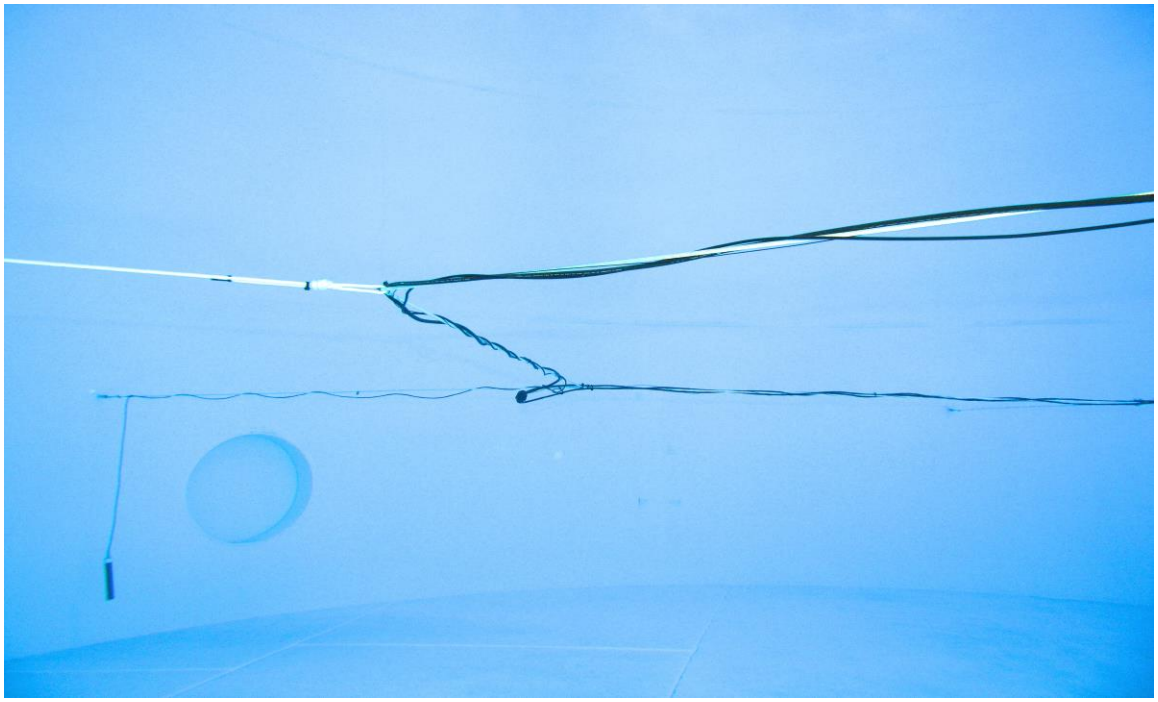
#31 - MAN WAY #1



#32 - INLET



#33 - C.P. - PLATINUM WIRES



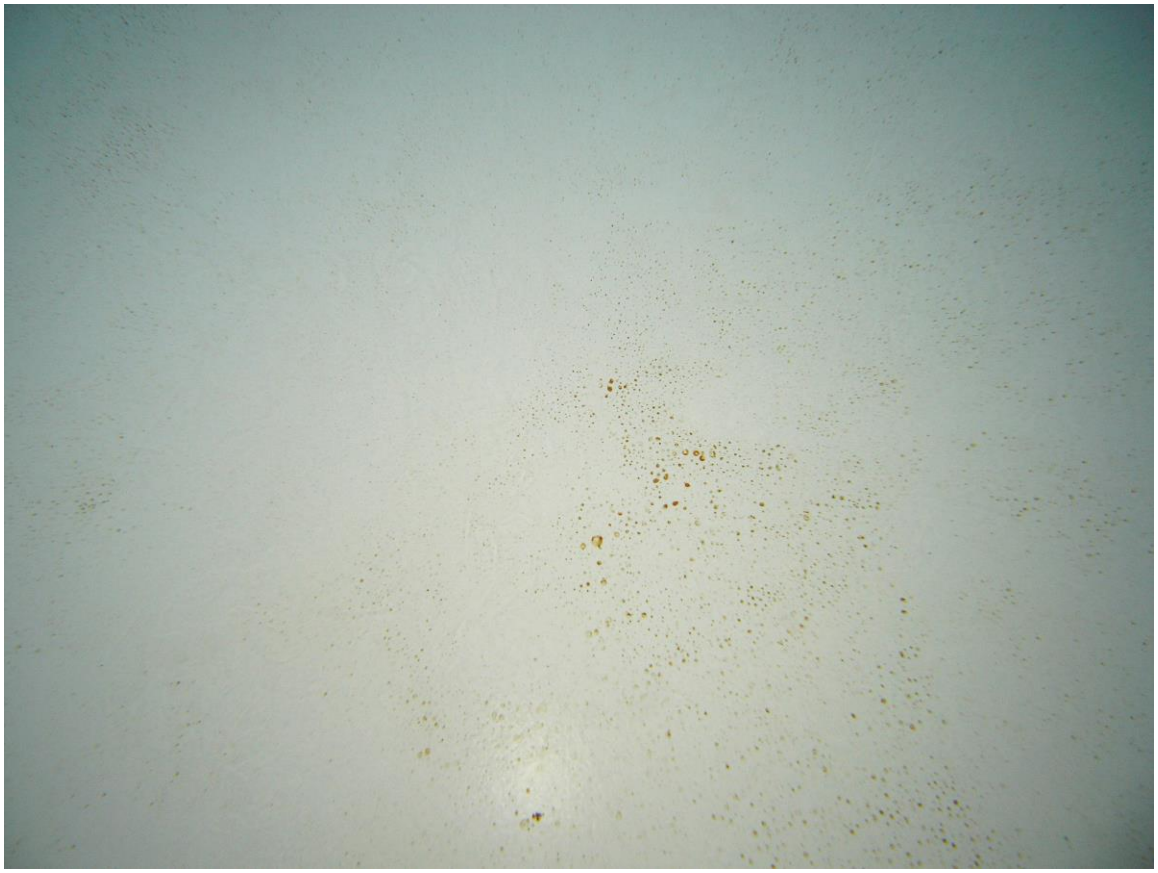
#34 - SAMPLE TAP

#35 - SHELL RING #1 - PREVIOUS REPAIR

#36 - SHELL AT FLOOR

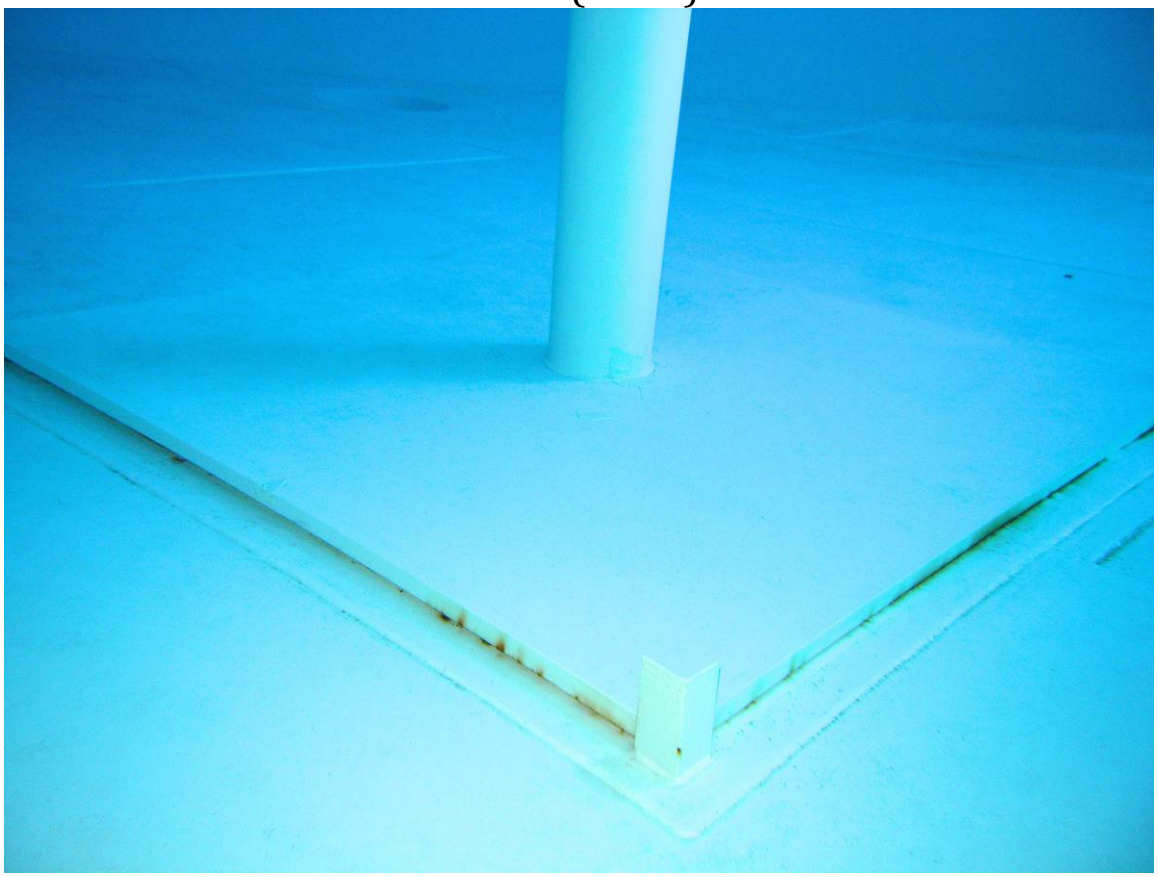
#37 - FLOOR

#38 - FLOOR

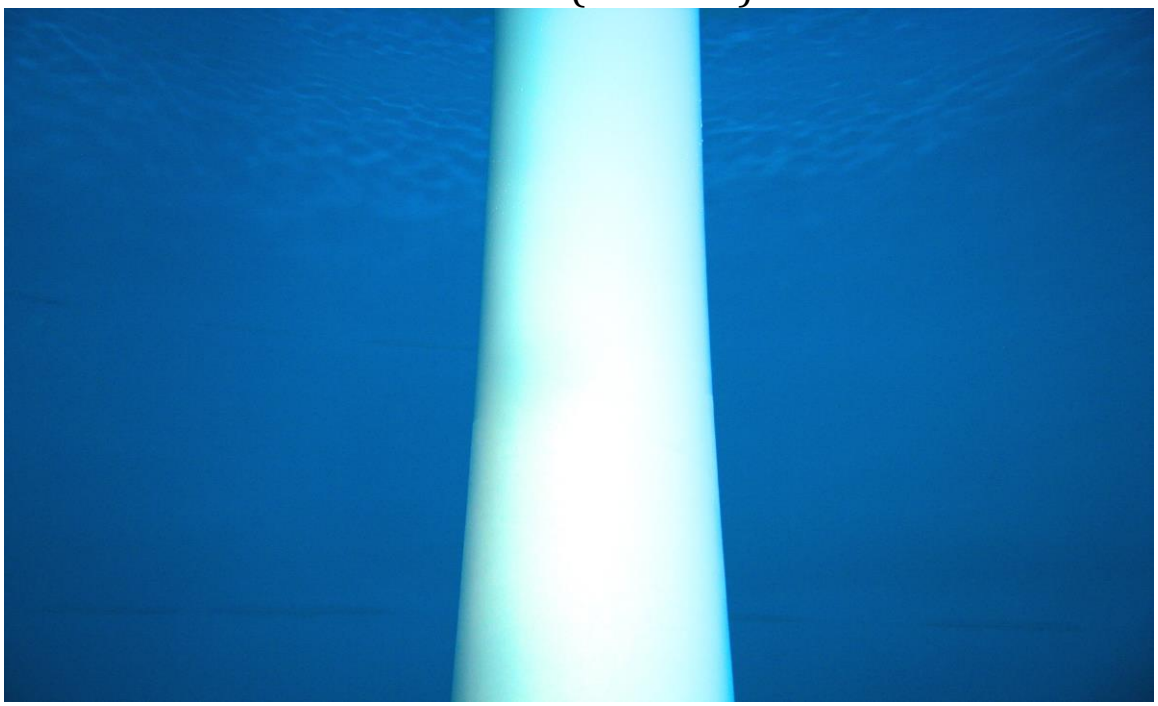


#39 - FLOOR

#40 - CENTER SUPPORT POLE (BASE)



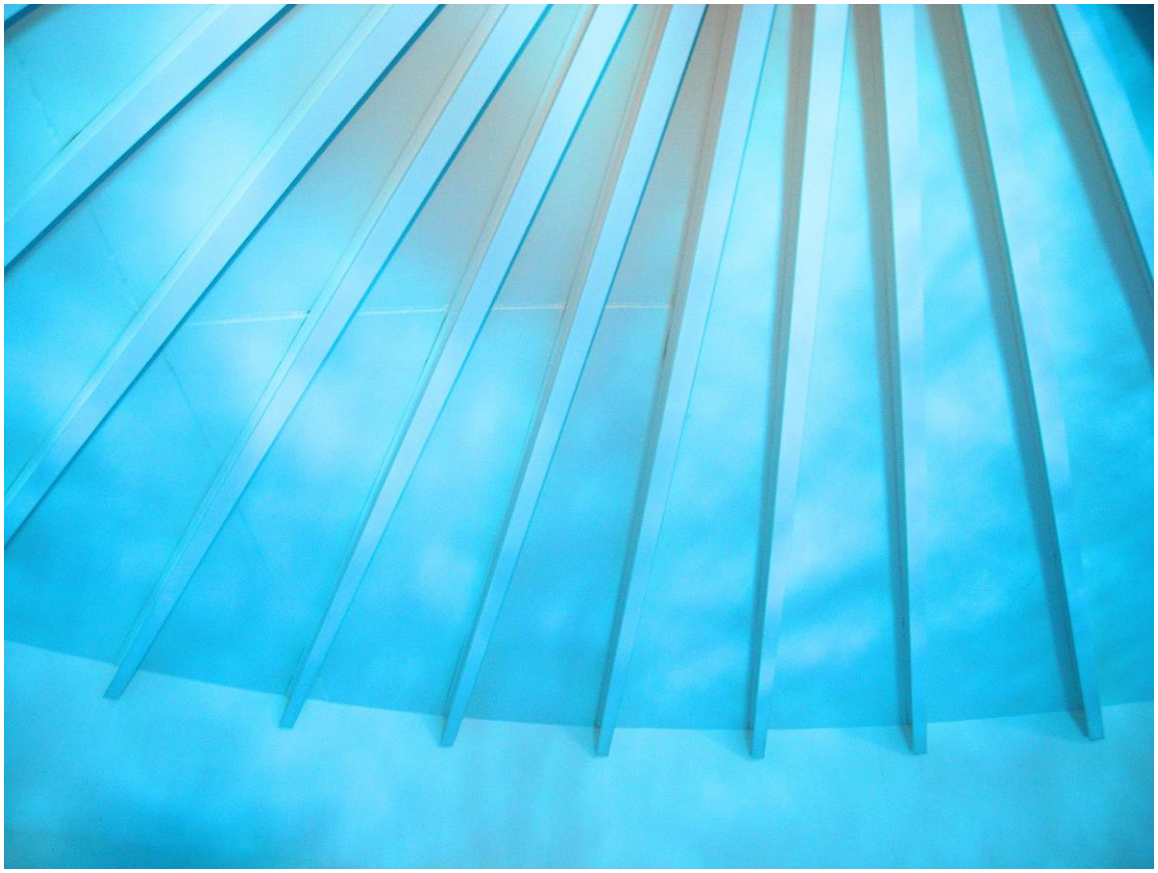
#41 - CENTER SUPPORT POLE (MIDDLE)



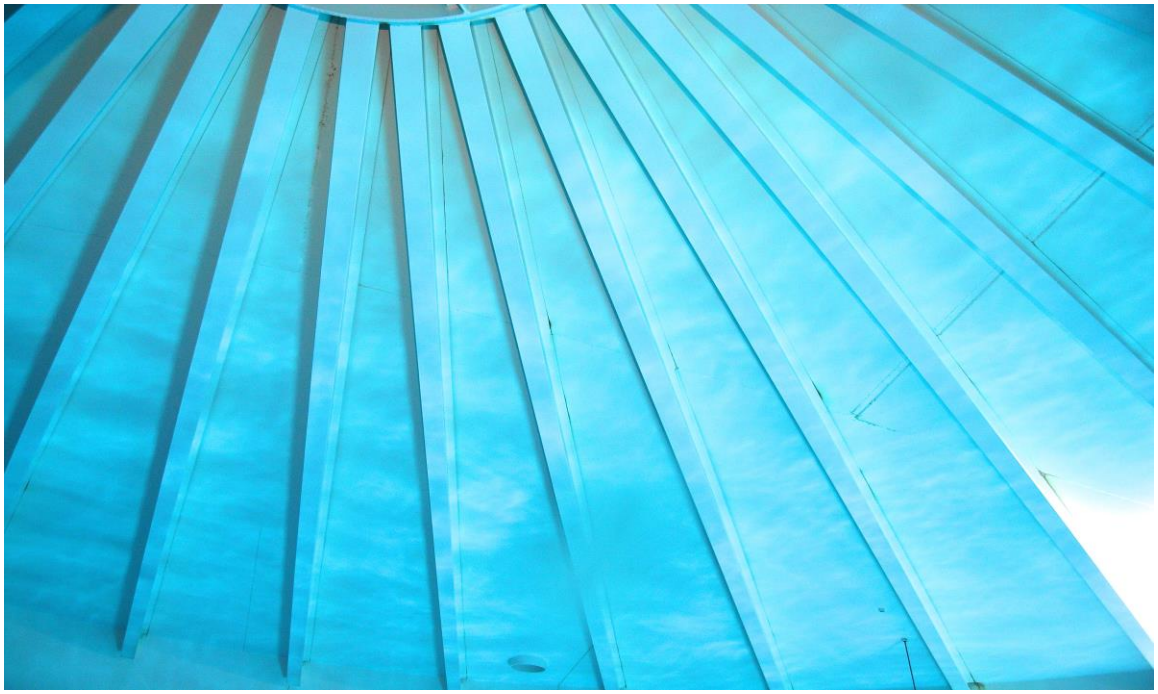
#42 - CENTER SUPPORT POLE (TOP)

#43 - CEILING

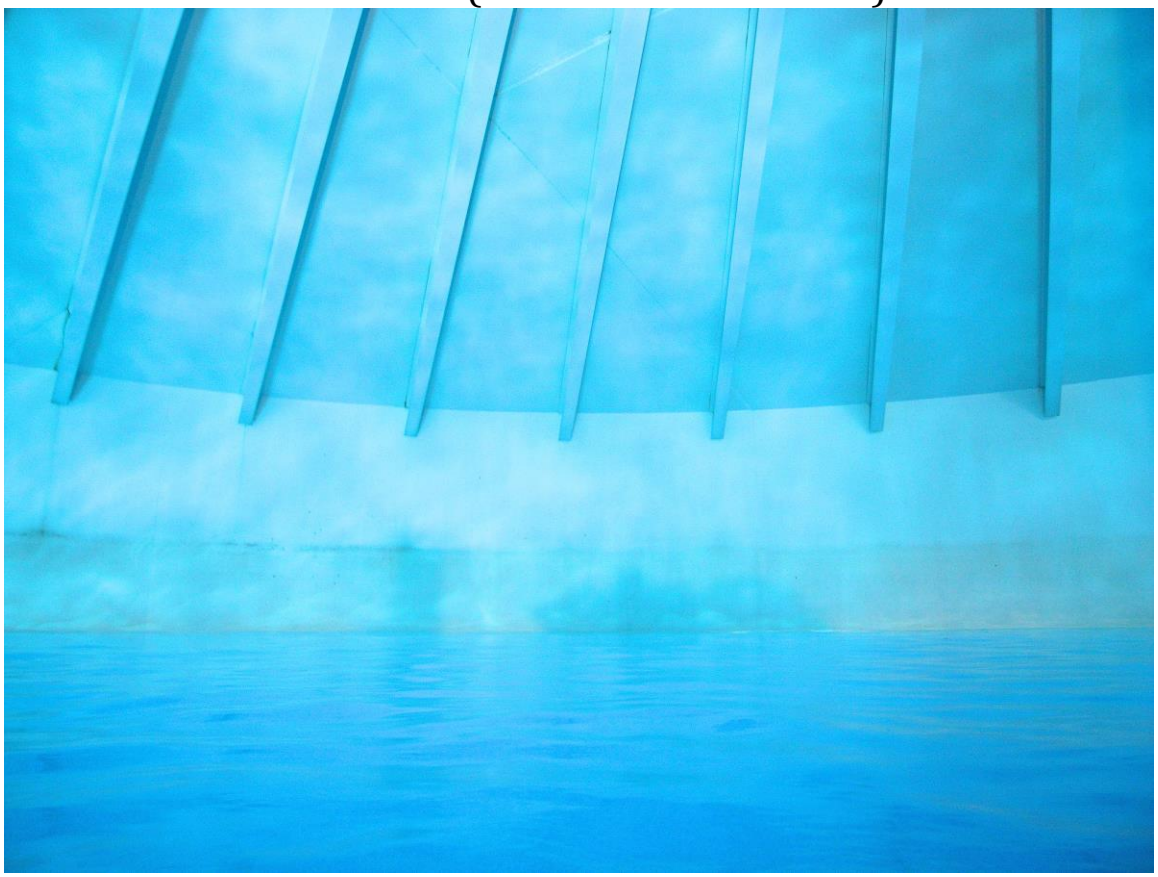
#44 - CEILING



#45 - CEILING

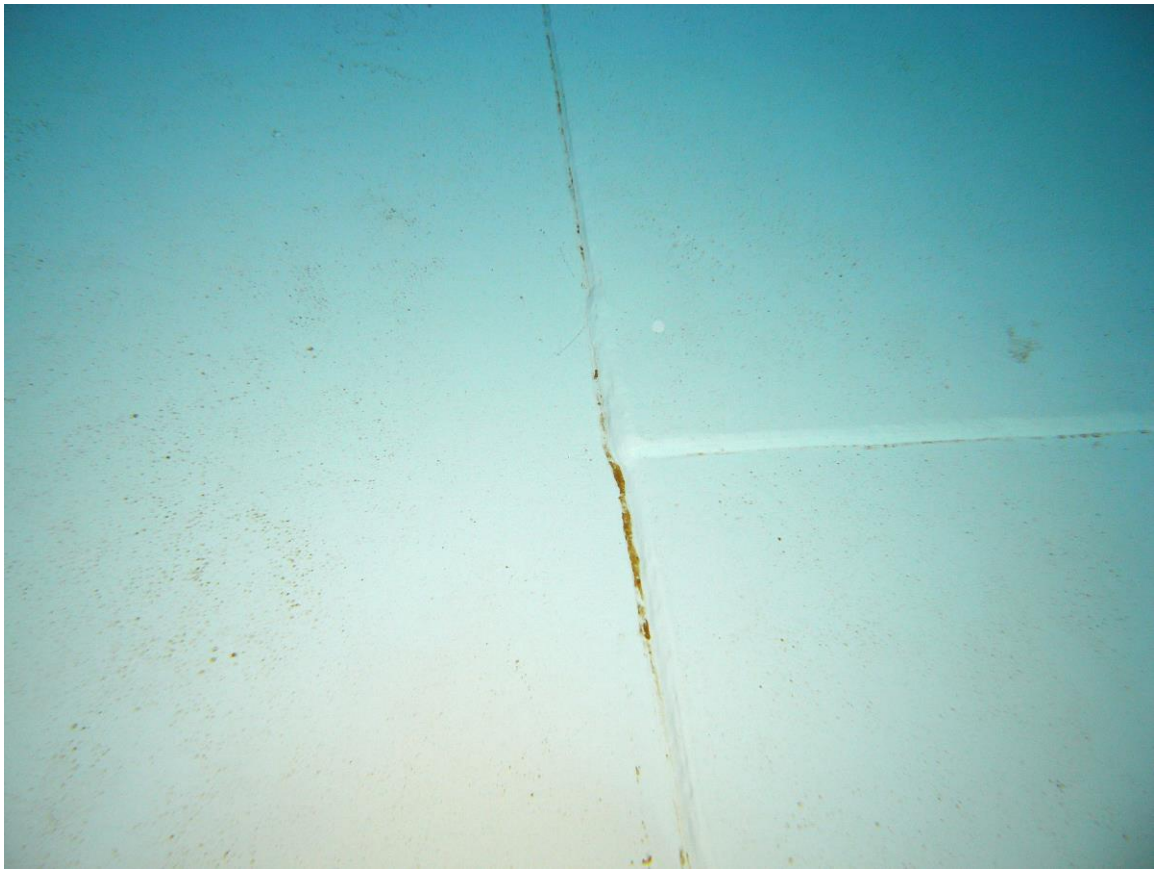


#46 - CEILING AT SHELL (SEISMIC REFERENCE)

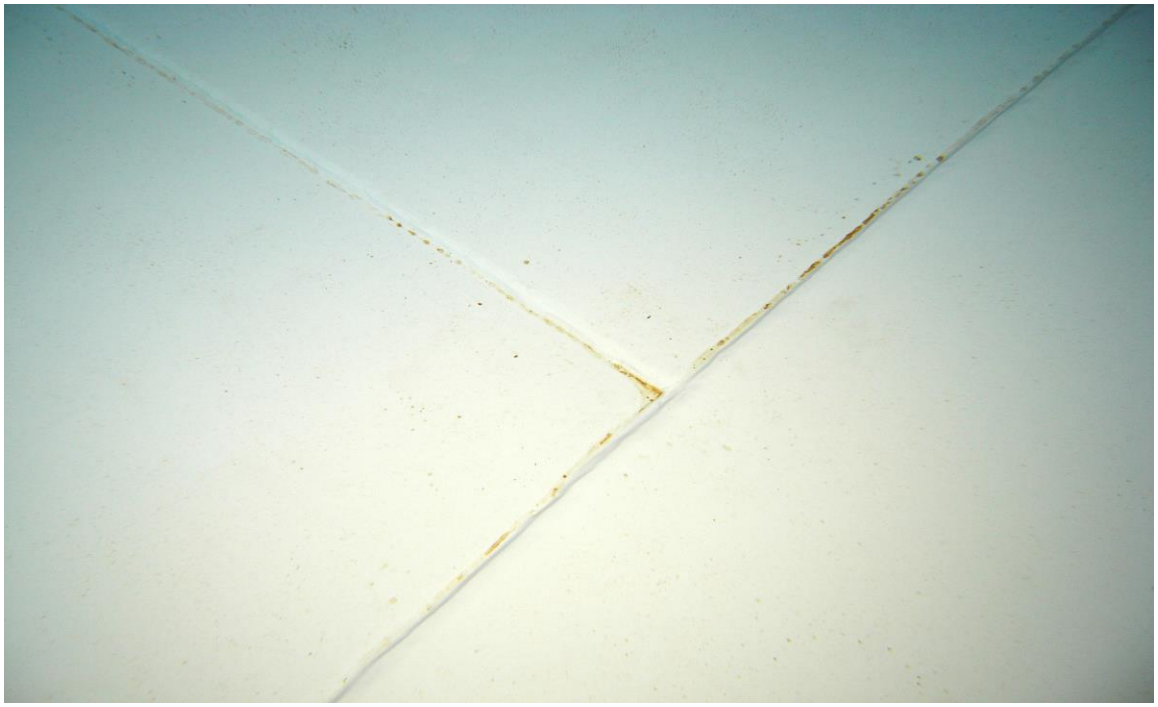


#47 - FLOOR NEAR INTERIOR LADDER  (RUST DEBRIS)

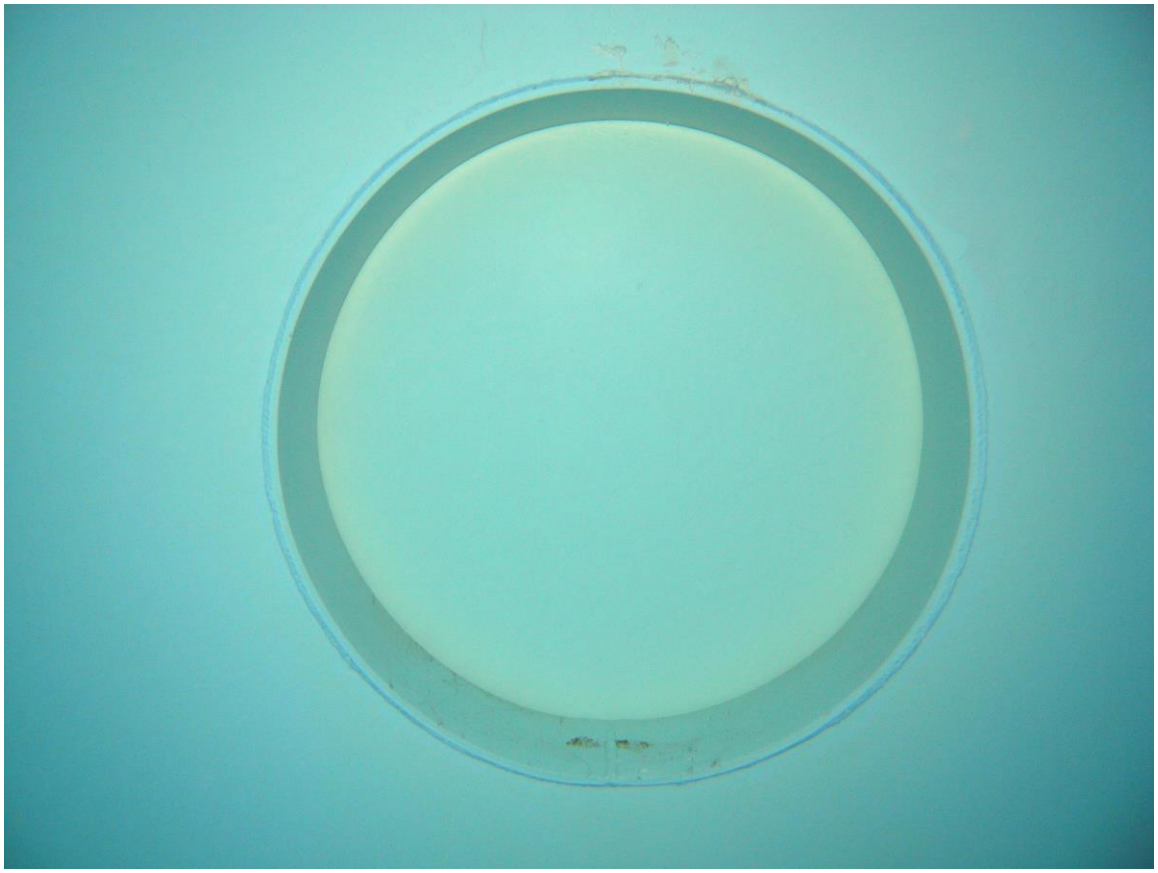
#48 - FLOOR



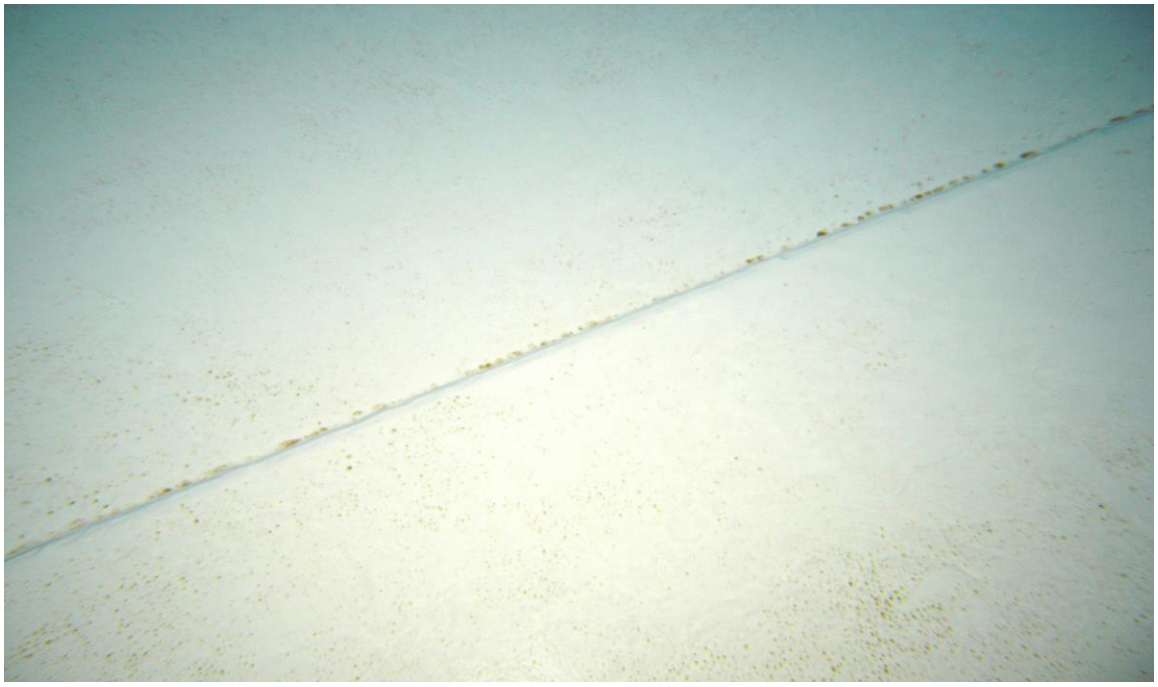
#49 - FLOOR



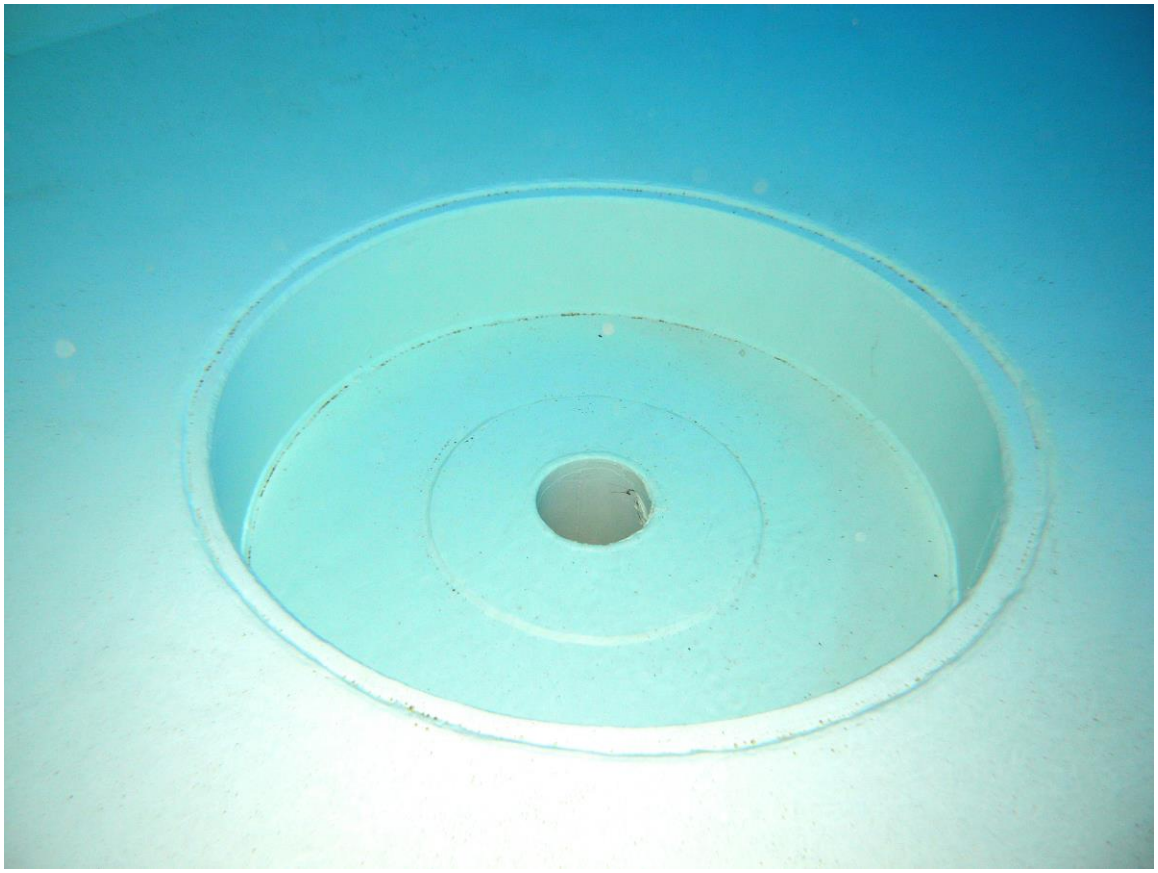
#50 -MANWAY #2



#51 - FLOOR



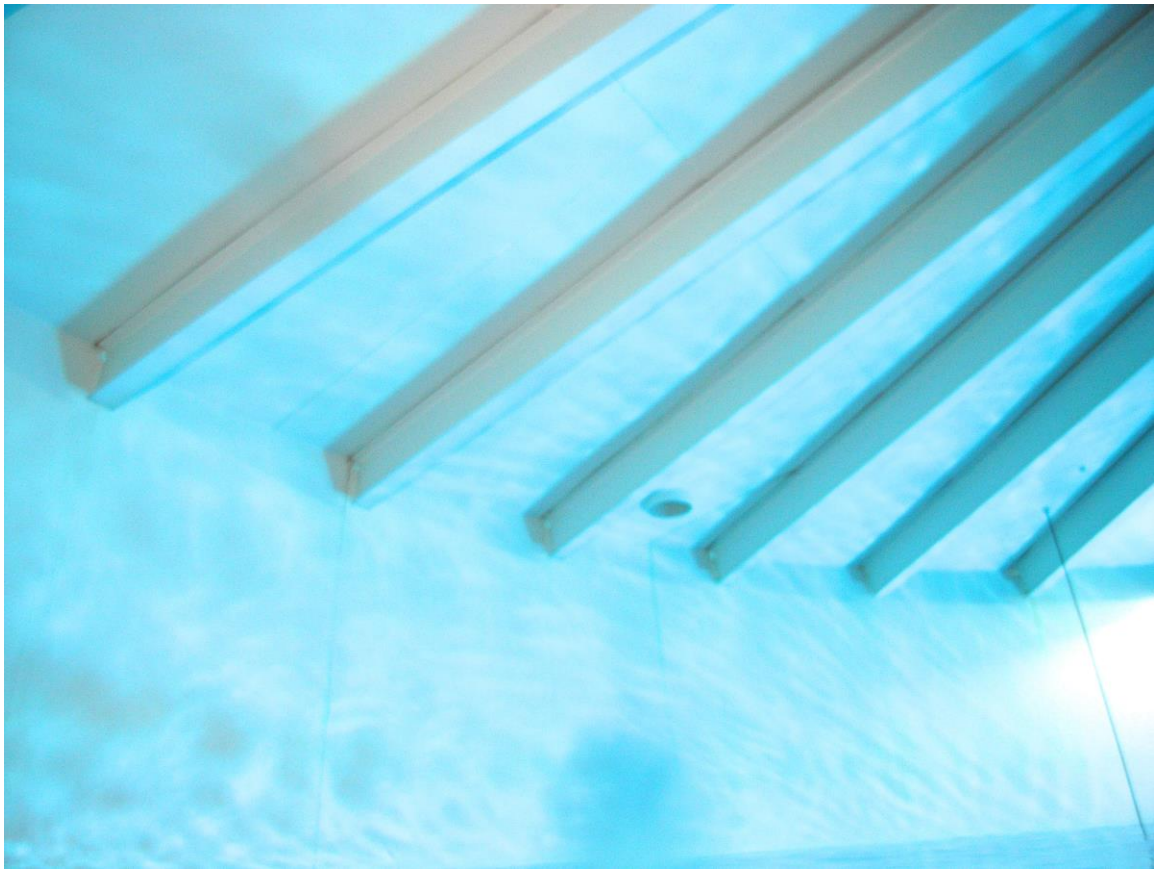
#52 - DRAIN IN SUMP



#53 - OUTLET

#54 - OVERFLOW BOX

#55 - CEILING AT SHELL - PERIMETER ROOF VENT #1



**PUBLIC WORKS**
1120 Airport Rd., Bldg. F-2, Minden, Nevada 89423

Carl Ruschmeyer, P.E.
DIRECTOR

775-783-6480
FAX: 775-782-6266
website: www.douglascountynv.gov

Water/Sewer Utility
Road Maintenance
Bldg. & Fleet Services

August 2, 2013

Ross Cooper
Environmental Scientist III
Department of Conservation and Natural Resources
Division of Environmental Protection
901 South Stewart Street, Suite 4001
Carson City, NV 89701-5249

Re: Sanitary Survey (Uppaway Water System) PWS #0817

Dear Ross,

Enclosed please find response to the Sanitary Survey dated July 2, 2013.

Other Deficiencies

**W01 – Well 1 West**

Corrections have been noted and made. Photos are included for your review.

If you have any questions or concerns, please do not hesitate to contact me at 775-783-6487 (office) or 775-790-7584 (cell).

Sincerely,

Tim DeTurk
Superintendent-Utility System

ndep
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

# STATE OF NEVADA

Department of Conservation & Natural Resources

DIVISION OF ENVIRONMENTAL PROTECTION

Brian Sandoval, Governor

Leo M. Drozdoff, P.E., Director

Colleen Cripps, Ph.D., Administrator

RECEIVED

JUL 08 2013

DOUGLAS COUNTY
PUBLIC WORKS

July 2, 2013

Mr. Carl Ruschmeyer
Douglas County Water
PO BOX 218
Minden NV 89423

**Subject: SANITARY SURVEY OF UPPAWAY WATER SYSTEM (NV0000817); DOUGLAS COUNTY**

Dear Mr. Ruschmeyer,

This letter serves to report the results of the Sanitary Survey inspection conducted by the Nevada Division of Environmental Protection, Bureau of Safe Drinking Water (BSDW), of the above referenced facility on **June 26, 2013**. The assistance of water system representatives mentioned below was very helpful and greatly appreciated.

**Parties Present**

| NAME | ORGANIZATION |
|---|---|
| Ross Cooper | Bureau Of Safe Drinking Water |
| James R Ashby | Op Cert |
| Reginald Lang III | Bureau Of Safe Drinking Water |
| Thomas C Rouch | Op Cert |

The deficiencies listed below were noted during the inspection and require corrective action. **Please provide a written response addressing these issues within 45 days of receipt of this report, August 17, 2012.** Your response must outline the course of action that has or will be taken and the date by which you propose to correct the deficiencies.

**Significant Deficiencies**

The following items are significant deficiencies which require immediate attention:

No observations were recorded in this category.

**Other Deficiencies**

The following items are deficiencies which require corrective action:

| FACILITY | CATEGORY | DESCRIPTION |
|---|---|---|
| W01 - WELL 1 WEST | Source | Well discharge pipes and other appurtenances are not properly screened, oriented, and air gapped. NAC 445A.66925 |
| **Comments**: System had screened discharge per 2010 Sanitary Survey, but the use of too fine a mesh caused both screens to blow off. Use 22 or 24 mesh/inch to screen discharge line. **See Attachment #1** | | |

**Observations/Recommendations**

The following are observations, comments, and/or recommendations and require written response where indicated. The recommendations will enable your system to better conform to the requirements of applicable design criteria or other industry standards:

No observations were recorded in this category.

**Monitoring and Reporting**

Monitoring Violations:

No monitoring violations were reported in the past year.

Maximum Contaminant Level (MCL) Violations during the past year:

No maximum contaminant level violations were reported in the past year.

Positive bacteriological sampling history for the past year:

No Positive Samples were reported in the past year.

**Reminders**

The Nevada Administrative Code (NAC) 445A.6669 requires the Division's approval prior to commencement of construction of any improvements, treatment process modifications, or the addition of new water sources.

The Nevada Administrative Code contains specific requirements for record keeping. Some records must be kept for as long as ten years. The Public Water System is responsible for maintaining its own records.

Most regulations, guidance documents, and forms are available via Internet on the Bureau's website. Please link to www.ndep.nv.gov/bsdw for further information.

Additional information and guidance is available on the EPA's Office of Ground Water and Drinking Water web site (www.epa.gov/safewater) or at the Safe Drinking Water hotline (1-800-426-4791).

If you have any questions, please contact me at 775-687-9522. Thank you for your time and cooperation.

Sincerely,

R Cooper

Ross Cooper, Env Scientist III
Bureau of Safe Drinking Water
rcooper@ndep.nv.gov

cc: Andrea Seifert, P.E., PWS Compliance Branch Supervisor
Thomas C Rouch, Douglas County Utilities

**Attachments**


**Attachment #1**
**Severity:** Minor
**Facility ID:** WELL 1 WEST
**Category:** Source
**Attachment Comments:** System had screened discharge per 2010 Sanitary Survey, but the use of too fine a mesh caused both screens to blow off. Use 22 or 24 mesh to screen discharge line.

**GILMORE**
**ENGINEERING**

101 River Ridge Court, Folsom, CA 95630
Phone 916 • 987 • 7124
Fax 916 • 988 • 8757

# PRELIMINARY DESIGN REPORT

# UPPAWAY WATER SYSTEM

## DOUGLAS COUNTY COMMUNITY DEVELOPMENT
**MINDEN, NEVADA**

**April 1999**



**Specialists in Water Treatment**

On July 25, 1997, a permit for the construction of the necessary improvements was issued by TRPA. This permit will require some minor modifications, since there are some revisions to the scope of work that was presented to TRPA. These revisions are not substantial, however.

PRESENT AND FUTURE DEMAND

Presently, there are 27 homes connected to the Uppaway water system. In addition, a large area between the homes, called the common area, is irrigated with treated water. At full buildout, 41 homes could be connected to the system. The 1997 water use records indicate that during July, the peak usage month, a total of 3,279,448 gallons was consumed. Assuming 27 houses, that is approximately 3,900 gallons/house per day, which is far higher than for comparable utilities. Generally, the maximum day demand is estimated to be twice the average day demand during the peak month. Per that guideline, the maximum day demand for 27 homes would be 7,800 gallons per day per home. At 7,800 gallons per day per home, and with 41 homes, the maximum day demand for the entire water system is about 320,000 gallons. For the current 27 homes, the maximum day demand is about 211,000 gallons. Note that since the average consumption per house is much higher than normal, the normal 2:1 guideline re the relationship between average day demand and maximum day demand may not be valid. Based on 24 hours per day operation, 222 gallons per minute of well production is required in order to produce 320,000 gallons.

WELL DATA

Two wells were drilled and improved during September and October of 1997. The pertinent data on the wells is contained in the following table, and a cross section of the wells is included in the Exhibits (copies of Plates 2 and 3 from the Kleinfelder report).

| ITEM | WELL #1 | WELL #2 |
|---|---|---|
| Borehole diameter | 12 in. | 9 to 15 in., see plate 2 |
| Casing material[1] | Mild steel and stainless steel | PVC |
| Static water level[2] | 41.2' bgs | 46' bgs |
| Wellhead elevation | 6,269' | 6,273' |
| Depth of well | 255' | 256' |
| Top of well screen elevation | 6,219' | 6,178' |
| Yield based on extended step-drawdown test | 140 gpm[3] | 80gpm[4] |
| Maximum drawdown at above yield | estimated | 120 feet |
| Water quality[5] | | |
| • Iron & manganese | 0.42/.07 max | .42/.071 max |
| • gross alpha | 19pC/L max | 25 pC/L max |
| • Radium | 0.0 | 0.4 pC/L max |
| • Uranium | 39µg/L max | 37µg/L max |
| • Radon | not tested | 3,700 pC/l max |
| MPA test | negative | negative |

ANALYSIS OF AND COMMENTS ON WELL DATA

- Well #2 Casing

  Well #2 has a PVC casing and PVC well screen. The screen is broken in two places, at about 152 feet and 212 feet bgs. These broken sections may be the reason why the well produces sand at the 80 gpm yield listed above. Kleinfelder

[1] See Kleinfelder report for additional details
[2] Measured on 11/21/97
[3] Must be verified with another step drawdown test--see text
[4] Produces sand in excess of 5 ppm at this rate of pumping
[5] Test results varied widely, see text and Kleinfelder report

estimates that the well production would have to be limited to 50 gpm in order to stay within the 5 ppm requirement for a municipal well. As a remedy to the broken screen and high sand production, a prepacked well screen has been proposed. A prepacked well screen is specially fabricated for a particular well. The prepacked screens are constructed of a well screen inside another well screen, with the annular space between them filled with special filter sand. In this case, with the 6" PVC casing, the maximum size of the outer screen is 5", to allow insertion into the 6" casing. Inside of the 5" PVC screen a 4" PVC screen is inserted. The ID of the 4" screen is 4.00", which is only 1/8" (approximately) greater than the outside diameter of a 4" submersible pump motor. Submersible pump manufacturers (Grundfos) state that the installation of a 4" pump in a 4" screen casing is standard practice, even though the space between the motor and the screen is only about 1/16". This space is not sufficient to allow for the installation of a motor shroud, which is typically recommended in order to ensure a flow of water past the motor for cooling. Grundfos, and Carson Pump stated that the installation without a shroud is acceptable. One significant point to consider is that once installed, a PVC prepacked screen could not be removed from the well, if the installed pump is operated for any significant period of time. This is due to the fact that sand coming through the existing 6" screen will lodge between it and the outer 5" screen of the prepacked screen. Subsequent lifting on the top of the prepacked screen would pull apart the screen at the joints. This would not be true of a stainless steel prepacked screen, due to the strength of the material. However, a stainless steel prepacked screen would cost several times as much as a PVC screen. A diagram of a prepacked screen and a description is included in the Exhibits.

- Well # 1 Yield

Kleinfelder's report indicates that the yield from well #1 is 140 gpm. However, this is not based on the actual or theoretical well yield. It is based on Kleinfelder's conclusion that

140 gpm is the maximum pump capacity attainable with a 6" pump installed in a 6" screen casing. However, a review of pump literature indicates that at least a 175 gpm pump can be installed.

In addition, Kleinfelder's report states that the calculated theoretical yield for well #1 is 300 gpm, based multiplying the specific capacity times the available drawdown times a factor of 0.66, which is recommended by Driscoll (1986) for this type of aquifer. However, the drawdown used for this calculation was 207 feet, which was not based on an actual measurement. This is an estimated value. Drawdown for well #2 was measured during the step drawdown pumping test with a transducer, but in well #1, the transducer was installed too high to measure the actual drawdown.

Consequently, for two reasons, another step drawdown test for well #1 is recommended. (Note that Kleinfelder also recommended another step drawdown test for this well.) First, another test will accurately determine drawdown, with a transducer located at the proper depth. It is imperative to have accurate drawdown figures, since the proper selection of a pump depends on that data. Second, with another pumping test, the ability of the well to sustain a 175 gpm yield can be established. This additional capacity could become significant in the future if all of the possible homes are constructed.

- Pumping and Well Issues

When a well pump is first started, the water level in the wells may be as high as the static water level reached after a long period of recovery. During pumping, the dynamic water level in the well will drop. For example, the data for well #1 contained in Kleinfelder's report, based on a 140 gpm flow rate, indicates that after six hours of pumping the drawdown reached about 31 feet. The maximum drawdown for this well was estimated to be 207 feet, and at that drawdown, Kleinfelder estimated the Total Dynamic Head to be 575 feet. At a drawdown of 31 feet, the TDH would be approximately 400 feet, assuming that the headlosses due to friction are the same as at the 575 foot TDH condition. (Since the flow will be higher at the lesser drawdown level, the

friction losses will be slightly greater). The different head conditions represented between the two levels of maximum drawdown and the static water level will cause a variation of flow from the pump. For example, with the Grundfos 150S300-17 pump with a 30hp motor, the pump would deliver 175 gpm at 575 ft TDH, and at 400 ft, it would deliver 220 gpm. This variation in flow is enough to cause an unacceptably large variation in the dosage of chlorine injected into the water stream.

Another consideration when starting a pump are water quality issues. Given the history of water samples taken after long periods of no pumping, it is possible that water of inferior quality may be discharged from the well upon startup. As a hedge against this possibility, a waste valve could be installed off a tee in each well discharge line, which would discharge to an infiltration gallery. This waste period should be adjustable, and conceivably could be eliminated if the water quality should be acceptable at startup.

Note that if the prepacked screen is installed in well #2, and a 4" pump is installed in it, there will be no room for a motor shroud, otherwise known as a flow inducer sleeve, over the motor. This is also true with well #1, with a 6" pump in a 6" screen. It is standard practice to install the shrouds to ensure a steady flow of water past the motor for cooling. That will not be possible with either well, and there is no available remedy. When two well and pump contractors were contacted about this issue, they said that there are a lot of pumps installed that are the same size as the well screens, so there should be no problem with cooling the motor. Given that the lead pump (well #1) will likely run for extended periods, there could be an overheating problem with this pump. Also, if well #2 is run for an extended period, overheating may result.

Three options are available to maintain a constant dosage of chlorine. One is to install a rate of flow control valve on the pump discharge, the second option is to use a variable frequency control on the motor to maintain flow at a constant setpoint, and the other is to use a signal from the flowmeter that will be required to pace the chlorine feed pumps

according to flow. With the variable frequency control option, an analog signal from a flowmeter would be input to a flow setpoint controller. The output signal from the setpoint contoller would in turn be input to the variable frequency control.

- Water Quality

Iron, manganese, and several other quality parameters exceeded allowable standards in at least one of the samples tested. However, where samples taken after extensive pumping, water quality was acceptable. It is believed that once in actual use, the quality of the water will meet current drinking water standards without treatment. In addition, the pumping tests conducted indicate that there is intrusion from Lake Tahoe into the acquifer, due to the fact that the time/drawdown curve flattens out after a period of pumping and remains flat for an extended period of time. The entry of Lake Tahoe water into the acquifer will dilute the groundwater and is expected to improve the quality of the tested parameters with increased pumping. One unknown at this time is the requirements of proposed regulations regarding radioneuclides. Future treatment is not expected, but may be required depending on the regulations that are adopted.

- Water Treatment Issues

Treatment for the removal of iron, manganese, radon, and uranium may be required in the future if:

- The water quality does not improve with normal pumping, as is expected, or
- Future regulations that may be more stringent re radioneuclides, including radon and uranium, may require treatment

<u>Iron and Manganese Removal</u>

Iron and manganese removal is a well known technology. A significant number of treatment processes that would be effective are available. Given that it is desirous to avoid repumping the water, pressure filtration is the preferred option. Numerous types of filter media could be used, including several proprietary types of media. Most processes require the oxidation of iron and manganese to precipitate the constituents to a

filterable solid, followed by filtration to remove the solids. A detailed discussion of the iron and manganese removal options would be quite lengthy, and could easily be the subject of a separate report. Suffice it to say here that the most proven, operator friendly process for iron and manganese removal with pressure filters is to use chlorine for oxidation. Since chlorine is desired for residual disinfection, and may be required in the future after adoption of the Groundwater Disinfection Rule, it makes sense to use it for oxidation of the iron and manganese rather than some other oxidizing chemical such as potassium permanganate. In addition, the Douglas County operators are familiar with handling chlorine, and other oxidizing chemicals, including potassium permanganate, are both messy to use and expensive to buy. Lastly, the new iron and manganese removal facility at China Spring Youth Camp, operated by Douglas County personnel, is the same type of treatment process, and the operators are familiar with it.

For the filter media, manganese greensand with an anthracite cap is the obvious choice. With this type of media, manganese can be effectively removed with only chorine as the oxidant. The filtration process for Uppaway will require two filters, since the required flow rate to backwash a single filter would be higher than the distribution system could deliver without causing a significant drop in pressure in the system. Two 5 foot diameter vertical pressure filters are proposed, which together would handle flows up to 250 gpm or more at a service flow rate of a little over 6 gpm per square foot of filter area, depending on the iron and manganese levels. The backwash rate for each filter would be about 240 gpm, which can be delivered by the distribution system. The backwash water would be captured in a Recycle Tank, which could be a buried fiberglass tank. A tank capacity of approximately 5000 gallons is anticipated. After a period of settling of approximately an hour, the supernatant would be pumped back to the inlet of the pressure filters at a flow rate of approximately 10% of the well flow rate. The recycle pump could be a submersible pump placed in the fiberglass tank, or a self priming pump located in the treatment building alongside the filters. Due to the desire to make the building as small as possible, the recycle pump should be located in the Recycle Tank.

Periodically, the solids that settle to the bottom of the Recycle Tank will require offsite disposal, or would have to be pumped to the sewer. Since a sewer line is not required for any other reason, the logical choice is to install an additional pump in the Recycle Tank to be used to transfer the settled solids to a vacuum or tank truck. Disposal would be required approximately twice per year. The iron/manganese solids are not hazardous, and are widely accepted at wastewater treatment plants.

Radon Removal

Typically, radon is easily removed by air stripping. Air stripping involves cascading the untreated water through air stripping columns or towers at atmospheric pressure. As the falling water passes through the air, the air becomes entrained in the water and displaces the radon gas. The objection to this process is that the water must be depressurized and repumped, which would add to the operational cost. In addition, a surge tank would be required after the air stripper in order to provide a few minutes of equalization time for balancing the pump flows. Lastly, the towers would be tall, if vertical, and would be require a taller building to house them. That would likely be objectionable to TRPA and/or the homeowner's association. Low profile towers are available, but they require more floor space than vertical towers, thereby increasing the size of the building. One option is to use a degasifying system that operates under pressure, such as the process offered by the GDT Corporation. This system is compact, low profile, and can easily be housed in the building without increasing the height above that required for housing the other equipment. Since the floor space requirement is small, not much additional building space is required. The principle of the system is that the raw water is passed through an eductor, creating a vacuum at the eductor throat. Atmospheric air is educted into the water stream, and is entrained in the water in very small bubbles. After passing through the eductor throat, the water pressure is restored to a few pounds less than at the entrance of the eductor. After leaving the eductor, the water/air/radon mixture is

introduced into a degasifying separator, where both the air and the radon are removed. The degasifying equipment would be located upstream of the pressure filters.

One unknown at this time is the issue of having radon gas vented into the atmosphere. Further study may be required in the future to address this issue. Additional data re the GDT process is included in the Exhibits.

Uranium Removal

Uranium may be removed by chemical precipitation followed by filtration, by ion exchange, or by reverse osmosis. Given that ion exchange involves the use of very expensive ion exchange media, and the use of hazardous chemicals for regeneration of the ion exchange resins, this process can easily be ruled out. Reverse osmosis is also objectionable not only to the very high capital and operational costs that would be involved, but also due to the fact that a very high amount of wastewater would be produced. RO systems generate a reject stream (wastewater) that can vary from 10% of the raw water flow to as high as 50%. Needless to say, that amount of wastewater would be objectionable for a variety of reasons.

Chemical precipitation would involve adding an additional chemical to the raw water stream to reduce the uranium to a filterable state, followed by filtration. Chemicals that may be used are ferrous chloride, ferric chloride, aluminum sulfate, and possibly the newer polymeric coagulants that contain a blend of aluminum sulfate and cationic polymers. Given that little data is available from operating plants from which to draw conclusions, it is likely that a pilot study would be required in the future to determine the optimum coagulant and the optimum filter parameters if uranium treatment is seriously considered. For purposes of this report, however, it will be assumed that aluminum sulfate would be used as the coagulant, and that vertical pressure filters would be used. Again, little data is available upon which to base an informed recommendation as to the size of the filters, but given the relatively low amount of solids that would be involved, it is believed that

filters of the same size as those proposed for iron and manganese removal would be adequate. In fact, iron, manganese, and uranium could be simultaneously removed with that type of filter.

For a discussion of the issues of backwashing the filters, and backwash water handling issues, refer to the discussion of iron and manganese removal filters.

Treatment Equipment Operational Issues

The treatment equipment would be automated, requiring operator attention for the following:

- Daily visits to check on the plant to verify proper operation, record process values.
- Refill chemical containers approximately twice weekly.

The operator certification level required is Grade 1, Treatment.

OTHER EQUIPMENT REQUIREMENTS

In addition to the well pumps, piping and valving, a standby emergency generator and an automatic transfer switch will be required to provide power during outages. To provide disinfection, a sodium hypochlorite feed pump is recommended. Electrical controls, including telemetry/SCADA equipment will complete the equipment package. A level switch installed in the existing water storage tank will start and stop the well pumps, and provide alarm signals. Water level transducers in each well will provide drawdown information, and in addition will be used to provide low level protection for the pumps. A flowmeter equipped with a transmitter to provide an analog signal proportional to flow is required, in order to provide input to the SCADA system for transmission offsite, and to pace the chlorine feeder.

A suggested list of items to be telemetered offsite include the following:

- water flow rate-analog
- tank water level-analog

- well drawdown levels-one for each well, analog
- low level in chlorine and other chemical solution tanks
- water storage tank high and low alarm water levels
- building intrusion alarms
- pump on, one for each pump
- utility power failure
- generator data--up to 15 parameters
- PLC failure
- UPS battery low
- Pump failure

Up to 35 parameters may be included in the list of items to be included. Transmission offsite to interface with the existing SCADA system at the Lake will require the transmission to the Cave Rock raw water pump station, and retransmission from there to the Cave Rock Water Treatment Plant for integration into the SCADA system there.

DESCRIPTION OF OPERATION

The water level in the existing storage tank will be used to start and stop the well pumps. Falling level will call on one pump, and if that pump cannot sustain the level in the tank, the second pump would be called on in a lead-lag arrangement. If the second pump (lag pump) were called on, both pumps would continue to run until the normal shutoff level was reached. Given that well #1 has the highest capacity, and produces less sand, it is recommended to establish it as the lead pump. A control device such as the Sierra Controls Systems 900 is suggested to provide control logic for operating the pumps and the waste valve, plus providing telemetry offsite.

NEW EXTENDED DRAWDOWN TEST FOR WELL #1

In order to accurately determine the drawdown during pumping, and to determine whether the well can sustain a pumping rate of up to 175 gpm, a second drawdown test is required. Given that the first drawdown test has already established that the well can sustain a flow

rate of 140 gpm, the second test does not need to be as extensive as the first test. An initial 8 hour step test is recommended, followed by a 24 hour constant test at up to 175 gpm. The pumping rate for the 24 hour test would be determined during the 8 hour step test. Test equipment would include a pump, a pressure transducer to measure drawdown, a flowmeter and a pitot tube to indicate flow rates; and an inline sand tester. The required TRPA permit has been issued, but would require updating with TRPA. During the drawdown test, a second MPA test will be conducted.

**FACILITIES BUILDING**

The building will require the approval of both TRPA and the Uppaway Homeowner's Association Architectural Committee. In a meeting with the Architectural Committee on January 11, the members expressed their preferences re the roof materials, the siding materials, and the type of foundation. They want a heavy composition shingle for the roof, with earthtone color, lapped cedar siding stained in an earthtone color, and either a river rock or broken granite veneer over the foundation. They want the generator exhaust directed away from the nearby residences, and they want the generator equipped with the silencing features that offer the quietest operation.

The recommended type of construction is concrete block. Over the block, furring strips can be secured, to which the lapped siding may be attached. The rock veneer may be laid up against the poured concrete foundation, starting below grade, and may continue up to a level two to three feet above the finished floor elevation. A separately itemized cost for the rock veneer is presented in the cost estimate.

The building will be designed to accomodate the future addition of a water treatment room, if required. The well discharge piping will be brought into the building, where chlorine will be injected. A flowmeter will be installed on the well water piping inside the building, and the piping will be laid out to accomodate the future addition of treatment equipment.

No sanitary facilities are planned for the Facilities Building.

## SITE IMPROVEMENTS

- The temporary dirt access road to the well site will require improvement. The base will require grading and compaction, installation of a compacted rock sub-base, and the road surface must be paved with asphalt. In addition, a rock lined ditch will be required on one side of the road to catch runoff and carry it to an infiltration trench.
- AC paving of the parking and turnaround area at the facilities building will be required, approximately 2000 square feet (in addition to the roadway area).
- Installation of a 2 foot wide decomposed granite access path from the nearest paved area to the pier stairs. A redwood border will be installed on each side of the path to prevent the granite from migrating. The Architectural Committee and TRPA wants the pathway landscaped on each side, and barriers (large boulders) strategically placed to protect the landscaping from foot or other traffic.
- Earth slopes shall be stabilized with rock. The rock to be used for slope stabilization shall be presented to TRPA for approval.
- In addition to landscaping the granite pathway, a minimum of three trees are required to screen the Facilities Building when viewed from the Lake.
- Permanent BMP's shall be provided including drip line trenches at the building, infiltration trenches at the parking/turnaround area and the end of the drainage ditch alongside the road, and for the water to be wasted upon startup of the wells.

## CONSTRUCTION RELATED ISSUES

- Temporary BMP's are required to protect existing vegetation and to prevent runoff from reaching the Lake
- A temporary staging area meeting the approval of TRPA is to be provided. A staging area site plan is required showing the location of all equipment and soil storage, temporary BMP's, a restoration plan, and a parking area for construction workers.

- An archeologist's services must be provided during construction to monitor ground disturbance activities.

**PERMITS REQUIRED**

The following permit requirements are anticipated:

- Nevada Bureau of Health Protection Services plan review
- Douglas County Construction Permit
- Douglas County Building Permit
- Tahoe Regional Planning Agency permit (already issued, requires modification)

**PROJECT COSTS**

Re capital costs, refer to the Engineer's Estimate of Quantities and Costs included as an Exhibit.

WELLS ONLY, NO TREATMENT

Operational and Maintenance Costs are not expected to increase significantly from the present costs since no significant change will occur. The pumping costs may increase slightly since the water will be pumped from a water level lower than the Lake. The operational time requirement should not increase from present levels, as the scope of equipment and operational requirements will be the same as at present.

TREATMENT

If Iron and Manganese Removal and/or Uranium Removal Treatment is required, the O&M costs will increase from present levels. Pumping costs will increase approximately 10 to 15% due to the increased pressure loss through the equipment. Chemical costs will be approximately 4 cents per 1000 gallons treated, not including sodium hypochlorite, which is already used.

## PROJECT SCHEDULE

| Milestone | Date |
|---|---|
| Complete Predesign phase and Preliminary Design Report | April 26, 1999 |
| Complete Drawdown Test, Design, advertise project for bids | June 21, 1999 |
| Receive bids and award contract for construction | August 9, 1999 |
| Complete Construction[6] | November, 1999 |
| Testing and startup | December, 1999 |

[6] Based on no water treatment equipment included in the project scope

# EXHIBITS

**ENGINEER'S ESTIMATE OF QUANTITIES AND COSTS**
**UPPAWAY WATER SYSTEM IMPROVEMENTS**
**OPTION 1---BUILDING SIZED FOR WELLS ONLY, NO TREATMENT**
**APRIL 1999**

| Item | Description | Quantities, Units | Unit Price | Cost |
|---|---|---|---|---|
| 1 | Step drawdown test | LS | - | $5,000 |
| 2 | Site preparation-excavation & engineered fill, removal and compaction of uncompacted fill material | 100CY | $50/CY | $5,000 |
| 3 | Temporary and permanent BMP's including infiltration trenches | LS | - | $10,000 |
| 4 | Infiltration gallery for waste water from well starts | LS | - | $8,000 |
| 4 | Facilities building -14'8" x 16' | 235 sq ft | $150/sf | $35,300 |
| 5 | Site grading and paving with 2"AC over 6" AB base | 2,000 sq ft | $6.50/sf | $13,000 |
| 6 | Access path to pier | LS | - | $3,000 |
| 7 | Landscaping | LS | - | $10,000 |
| 8 | Well # 1 pump (30hp), pitless adapter and accessories, installed | LS | - | $13,500 |
| 9 | Well # 2 pump (10hp), pitless adapter and accessories | LS | - | $11,000 |
| 10 | Well # 2 prepacked screen | LS | - | $10,000 |
| 11 | Piping and valves from the building to the existing main | LS | - | $5,000 |
| 12 | Piping and valves from wells to the building | LS | - | $6,000 |
| 13 | Electrical including generator and new telemetry equipment | LS | - | $75,000 |
| 14 | Subtotal-Construction Cost | | | $209,800 |
| 15 | Contractor's Overhead and Profit-25% | | | $52,500 |
| 16 | Subtotal | | | $262,300 |
| 17 | Contingencies @ 20% | | | $52,500 |
| 18 | Engineering costs[1] | | | $96,642 |
| 19 | Permits[2] | LS | - | $5,000 |
| 20 | **Total Project Cost** | | | $416,442 |

For a river rock veneer from below grade level up to 3 feet above finished floor elevation, add $30/sf = $9,000.00. For a granite cap veneer, add $50/sf = $15,000.00.

Note that Douglas County Administrative costs are not included in the above costs.

[1] Represents Gilmore Engineering contract costs only- prior engineering costs are not included
[2] Includes the Douglas County Design Review fee, the Building Permit fee, and the TRPA permit fee

**ADD FOR OPTION #2---BUILDING LARGE ENOUGH TO HOUSE WATER TREATMENT EQUIPMENT, NO EQUIPMENT INCLUDED**

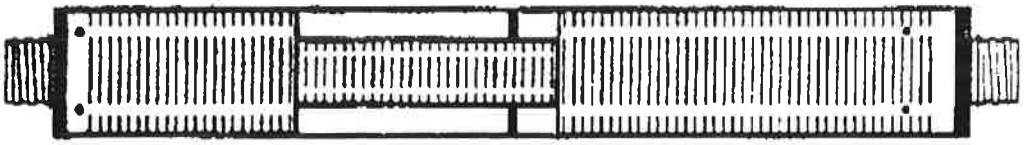
| Item | Description | Quantities, Units | Unit Price | Cost |
|---|---|---|---|---|
| 1 | Additional building area | 256 sf | $150 | $38,400 |
| 2 | Contractor's overhead and profit-25% | - | - | $9,600 |
| 3 | **Total Additional Cost** | - | - | $48,000 |

For a river rock veneer from below grade level up to 3 feet above finished floor elevation, add $30/sf = $7,200.00. For a granite cap veneer, add $50/sf = $12,000.00. These costs are in addition to the costs stated for Option 1.

**ENGINEER'S ESTIMATE OF QUANTITIES AND COSTS**
**UPPAWAY WATER SYSTEM IMPROVEMENTS**
**OPTION 3---ADDITIONAL COST FOR TREATMENT EQUIPMENT**
**APRIL 1999**

| Item | Description | Quantities, Units | Unit Price | Cost |
|---|---|---|---|---|
| 1 | Two each 5' diameter vertical pressure filters | LS | - | $55,000 |
| 2 | Air stripper | LS | - | $10,000 |
| 3 | Chemical feeders (two) and accessories | LS | - | $4,000 |
| 4 | Recycle tank, 20,000 fiberglass, buried | LS | - | $20,000 |
| 4 | Recycle pump, submersible in recycle tank | LS | - | $2,500 |
| 5 | Electrical & instrumentation | LS | - | $15,000 |
| 6 | Piping to recycle tank | LS | - | $4,000 |
| 7 | Subtotal-Construction Cost | - | - | $110,500 |
| 8 | Contractor's Overhead and Profit-25% | - | - | $27,600 |
| 9 | Subtotal | - | - | $138,100 |
| 10 | Contingencies @ 20% | - | - | $27,600 |
| 11 | **Total Additional Cost for Treatment** | - | - | $165,700 |

- ✓ U-Pack® screens offer an economical solution for installing wells where a normal sand pack is not feasible. Typical applications include horizontal and angled wells, artesian wells, rock wells, jetted wells, open excavations, silty and fine grained soils, heaving sands, industrial filtrations, and the relining of deteriorated wells.
- ✓ Monoflex U-Pack® well screens consist of an outer PVC well screen and a centralized inner PVC well screen.
- ✓ U-Pack® screens are shipped fully assembled and ready to pack. Since they are shipped empty, freight costs are reduced and ease of handling is increased. These units are filled on site with a clean filter media before, during, or after the well is drilled. A different filter media may be used for each hole depending on the well requirements.
- ✓ All materials are clean, ink free, NSF approved, and no glues or solvents are used in the manufacture or assembly of these units.
- ✓ U-Pack® screens are available from ½" to 10" diameters in a variety of lengths, slot sizes, and slot configurations. Standard threads conform to ASTM F480. Standard slot spacing is 1/8" or ¼". While .010 and .020 are the most common slot sizes (other slot sizes are available).
- ✓ Flush Thread U-Pack® screens are compatible with our PVC flush thread casings. Units can be ordered with flush thread caps or points on the bottom.



***NOTE:*** *If more than one unit is to be installed per well, order double female flush thread couplings to attach one unit to the next. Monoflex flush thread wash down valves may also be used to assist in the placement of these screens.*

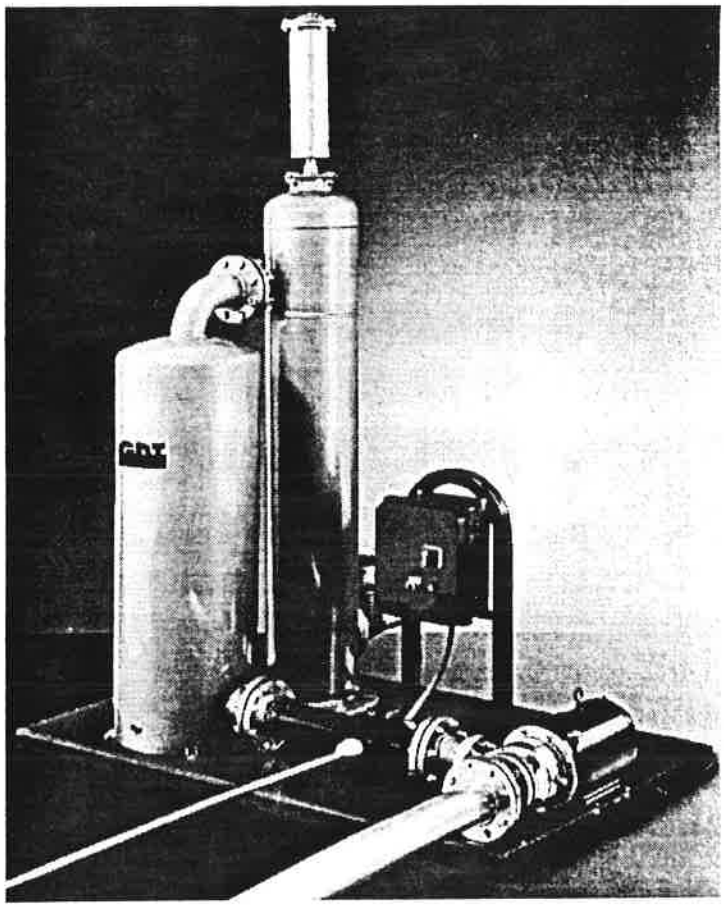
| PART NUMBER | SLOT SIZE | NOMINAL SIZE | TOTAL LENGTH | OUTER PIPE O.D. | OUTER PIPE I.D. | INNER PIPE O.D. | INNER PIPE I.D. | LBS EACH |
|---|---|---|---|---|---|---|---|---|
| FP4010X00505__*__ | * | 1" x ½" | 5' | 1.315" | 1.169" | .840" | .608" | 3 |
| FP4010X00510__*__ | * | 1" x ½" | 10' | 1.315" | 1.169" | .840" | .608" | 5 |
| FP4030X0205__*__ | * | 3" x 2" | 5' | 3.500" | 3.042" | 2.375" | 2.049" | 12 |
| FP4030X0210__*__ | * | 3" x 2" | 10' | 3.500" | 3.042" | 2.375" | 2.049" | 23 |
| FP4040X0205__*__ | * | 4" x 2" | 5' | 4.500" | 3.998" | 2.375" | 2.049" | 15 |
| FP4040X0210__*__ | * | 4" x 2" | 10' | 4.500" | 3.998" | 2.375" | 2.049" | 29 |
| FP4050X0405__*__ | * | 5" x 4" † | 5' | 5.563" | 5.107" | 4.500" | 3.998" | 24 |
| FP4050X0410__*__ | * | 5" x 4" † | 10' | 5.563" | 5.107" | 4.500" | 3.998" | 45 |
| FP4060X0405__*__ | * | 6" x 4" | 5' | 6.625" | 6.031" | 4.500" | 3.998" | 30 |
| FP4060X0410__*__ | * | 6" x 4" | 10' | 6.625" | 6.031" | 4.500" | 3.998" | 58 |

* *Specify Slot Size*

5" utilizes SDR 26 • 1" utilizes SDR 21.
† will fit inside 6 ¼" hollow stem augers.

# Efficient Solution To Water Treatment Challenges

The growing demand for quality drinking water has led to the development of a new process to efficiently treat compromised water supply sources. The GDT™ Process, an outgrowth of a strategic technical alliance between Mazzei Injector Corporation and Claude Laval Corporation, utilizes gases such as ozone, air, nitrogen or oxygen to treat problem water.

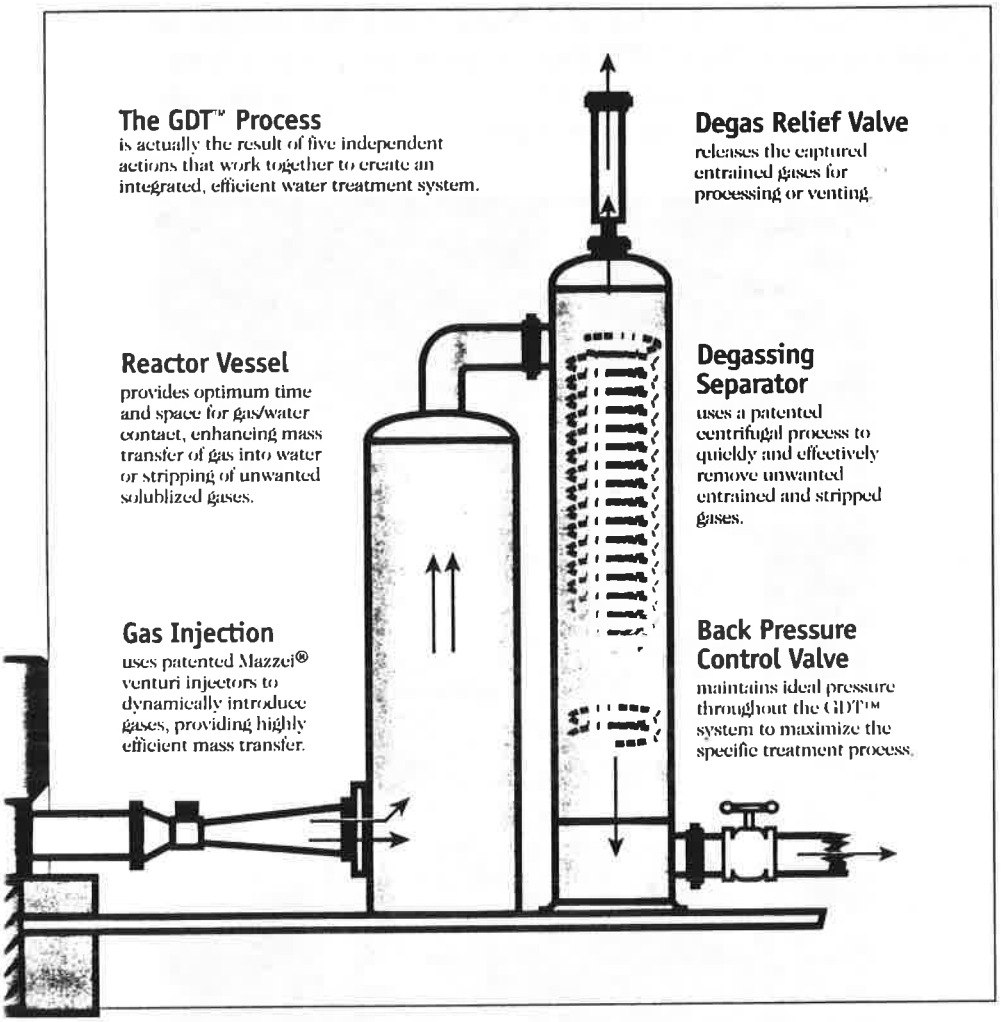



The GDT™ Process is designed to provide exceptionally high mass transfer of gas to solution. This dynamic transfer allows reaction gases such as ozone to pass into solution for disinfection of chlorine tolerant micro-organisms including cryptosporidium oocysts, giardia cysts, polio virus and E.coli bacteria. The exceptional gas/water mixing force can also drive stripping of unwanted aesthetically unpleasant or health compromising gases such as radon, hydrogen sulfide($H_2S$), methane and "acid water" causing carbon dioxide($CO_2$) from solution. The GDT™ Process has also been demonstrated to be efficient in stripping Volatile Organic Compounds (VOC) from contaminated water supplies including xylene, benzene and tetrachloroethylene (PCE).

Reaction gas is aspirated via high efficiency Mazzei® injectors in the patent pending GDT™ process. The dynamic mixing and mass transfer that occurs at the injector is enhanced in the reaction vessel specifically designed for each application. A patented degas separator and degas relief valve remove undesirable entrained or stripped gases for venting or processing. The total process takes place under pressure and is controlled by a back pressure control valve to minimize electrical operating cost.

The GDT™ Process offers municipal and industrial users the benefits of design flexibility for any flow rate, combined with low capital, installation and operating costs, in a compact, low maintenance, non-fouling, skid mounted system.

For more information on this innovative process contact:
GDT CORPORATION
20805 N. 19th Ave.
SUITE 1
PHOENIX, AZ. 85027
602-587-8858 (PHONE)
602-587-1511 (FAX)




GDT CORPORATION

**Advanced Water Processing**

20805 North 19th Avenue
Suite 1
Phoenix, Arizona 85027

*Telephone:*
602-587-8858

*Facsimile:*
602-587-1511

## Laval-Mazzei Degassing Separators

| MODEL NO. | DS-100-SS | DS-200-SS | DS-300-SS | DS-400-SS | DS-600-SS | DS-800-SS | DS-1000-SS | DS-1200-SS |
|---|---|---|---|---|---|---|---|---|
| Inlet/Outlet | 1" MNPT | 2" MNPT | 3" FLANGE | 4" FLANGE | 6" FLANGE | 8" FLANGE | 10" FLANGE | 12" FLANGE |
| Max Pressure, PSI | 80 | 80 | 80 | 80 | 80 | 80 | 80 | 80 |
| Max Pressure, kPa | 551 | 551 | 551 | 551 | 551 | 551 | 551 | 551 |
| **Flow Rates,gpm** | **10-50** | **50-150** | **100-300** | **250-400** | **400-800** | **800-1600** | **1200-2000** | **2000-3500** |
| Flow Rates, m3/hr | 2.3-11.4 | 11.4-34.2 | 22.8-68.4 | 56.8-90.8 | 90.8-181.7 | 181.7-272.5 | 272.5-454.2 | 454.2-794.8 |
| Pressure Loss, PSID | 1.0-7.0 | 1.0-7.0 | 1.0-7.0 | 1.0-7.0 | 1.0-7.0 | 1.0-7.0 | 1.0-7.0 | 1.0-7.0 |
| Weight, Pounds | 45 | 80 | 195 | 315 | 435 | 1000 | 1585 | 2400 |
| Weight, Kilograms | 20.5 | 36.4 | 88.6 | 142.3 | 197.7 | 454.5 | 720.5 | 1091 |
| Height, Inches | 32-5/16" | 42-13/16" | 60-5/16" | 78-7/8" | 97" | 144" | 168-7/8" | 212-7/8" |
| Height, cm | 82.07 | 108.7 | 153.2 | 200.3 | 246.4 | 365.7 | 428.9 | 540.7 |
| Base Diameter, Inches | 13-1/8" | 17-3/8" | 20-3/8" | 24" | 26-3/8" | 32" | 38" | 48" |
| Base Diameter, cm | 33.1 | 44.1 | 51.8 | 61 | 67 | 81.3 | 96.5 | 121.9 |

KLEINFELDER
An employee owned company

August 10, 1999
Project No. 60-1993-01

Mr. Roger G. Gilmore
Gilmore Engineering
101 River Ridge Court
Folsom, CA 95630

Subject: Uppaway Wells No. 1 and 2
Pumping Test Analysis
Test Date July 30, 1999

Dear Mr. Gilmore,

In accordance with Kleinfelder's Engineering Services Agreement No. 60-YP2208, dated July 15th, 1999, we have completed analysis of the pumping test data you provided to us. Gilmore Engineering conducted the pumping test on July 30, 1999 using a Hermit 1000 data logger. The data was extracted from the data logger by Kleinfelder's Reno office staff and e-mailed to Kleinfelder's Seattle office on August 2, 1999. A complete description of the Uppaway Wells including well construction, preliminary aquifer and well hydraulic analyses, and well operation recommendations, is presented in Kleinfelder's October 27, 1998 report entitled, "Uppaway and Boucher-Young Water System, Well Installation Report, Douglas County, Nevada". The scope of our current services is to analyze the recent pumping test data and present the results of the analysis in a short letter.

**Background and Data Analysis**

According to information you faxed to us on August 2, 1999, Uppaway Well No. 1 (Uppaway 1) was the pumping well, and Uppaway Well No. 2 (Uppaway 2) was the monitoring well. Uppaway 1 was pumped at a rate of 180 gallons per minute (gpm) for approximately 22 hours, then stepped down to 120 gpm for the remainder of the test (approximately 24.6 hours). The pumping rate was reportedly decreased because the pump was cavitating at 180 gpm.

We used Waterloo Hydrogeologic's Aquitest Software package to analyze the data. Figure 1, attached, shows a time-drawdown plot with discharge for both wells. Figure 2 shows a Pumping test analysis graph interpreted by Neuman's Method for the unconfined aquifer penetrated by




KLEINFELDER 2405 140th Avenue, NE, Suite A101, Bellevue, WA 98005 (425) 562-4200 (425) 562-4201 fax

Uppaway 1 and Uppaway 2. We used data from Uppaway 2 to calculate aquifer characteristics to eliminate turbulence induced by pumping Uppaway 1. The data files used to graph the data are presented in Appendix A.

**Conclusions**

Based on the analysis for the July 30, 1999 pumping test using Uppaway 2, Neuman's Method, and a pumping rate of 120 gpm, we calculated the following parameters:

| | |
|---|---|
| Static Water Level: | 46 feet below surface |
| (Based on October, 1998 Report) | |
| Aquifer Thickness: | 210 feet |
| (Based on October, 1998 Report) | |
| Maximum Drawdown: | 176 feet |
| Specific Capacity: | 0.68 gpm/ft drawdown |
| Aquifer hydraulics- | |
| Transmissivity: | 0.127 $ft^2$/min |
| Specific Yield: | 0.037 |
| Hydraulic Conductivity: | 6.07 x $10^{-4}$ ft/min |

Based on the data collected during the July 30, 1999 pumping test, we calculated the following parameters for Uppaway 1:

| | |
|---|---|
| Static Water Level: | 41 feet below surface |
| (Based on October, 1998 Report) | |
| Aquifer Thickness: | 214 feet |
| (Based on October, 1998 Report) | |
| Maximum Drawdown: | 233 feet |
| Specific Capacity at Q=120 gpm: | 0.51 gpm/ft drawdown |
| Specific Capacity at Q=150 average gpm: | 0.64 gpm/ft drawdown |
| Estimated Sustained Yield of Well | |
| (Based on Aquifer Transmissivity of 0.127 $ft^2$/min): | 134 gpm |

In the October 1998 report we recommended setting the pump in Uppaway Well No. 1 at 250 feet and design for 140 gallons per minute (gpm). Based on this pumping test, the sustained yield of the well is about 134 gpm. These calculated values are fairly consistent with values presented in the October, 1998 report.

Therefore, we recommend designing the well to pump in the neighborhood of 134 gpm to 140 gpm with the pump set at 250 feet. This should be well below maximum draw-down. However, as before, install a shroud around the intake of the pump to prevent overheating, air entrainment and cavitation from possible cascading water.



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| | | |
|---|---|---|
| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Time-Drawdown plot<br>with discharge | Page 1<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | |
| Discharge 148.27 U.S.gal/min | |

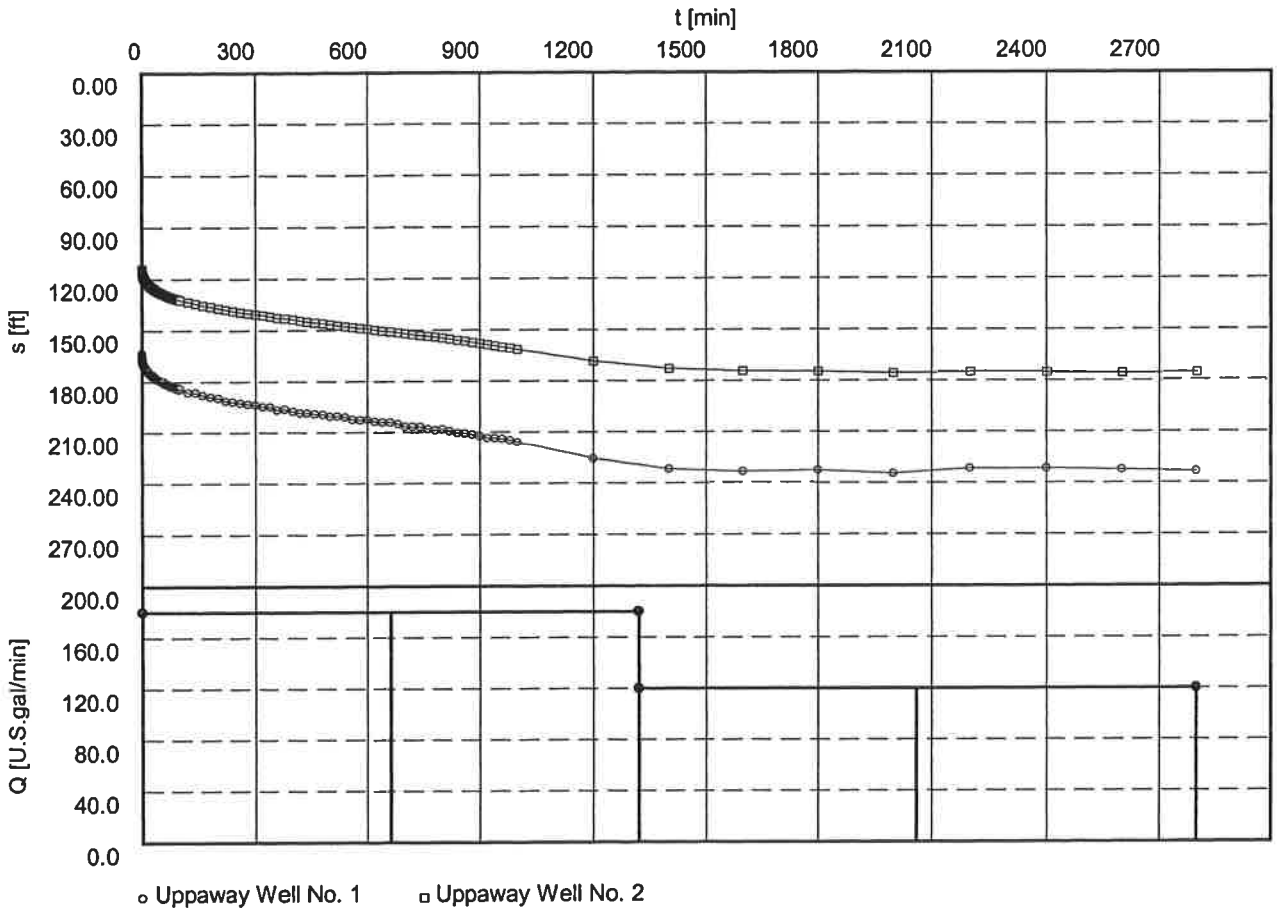
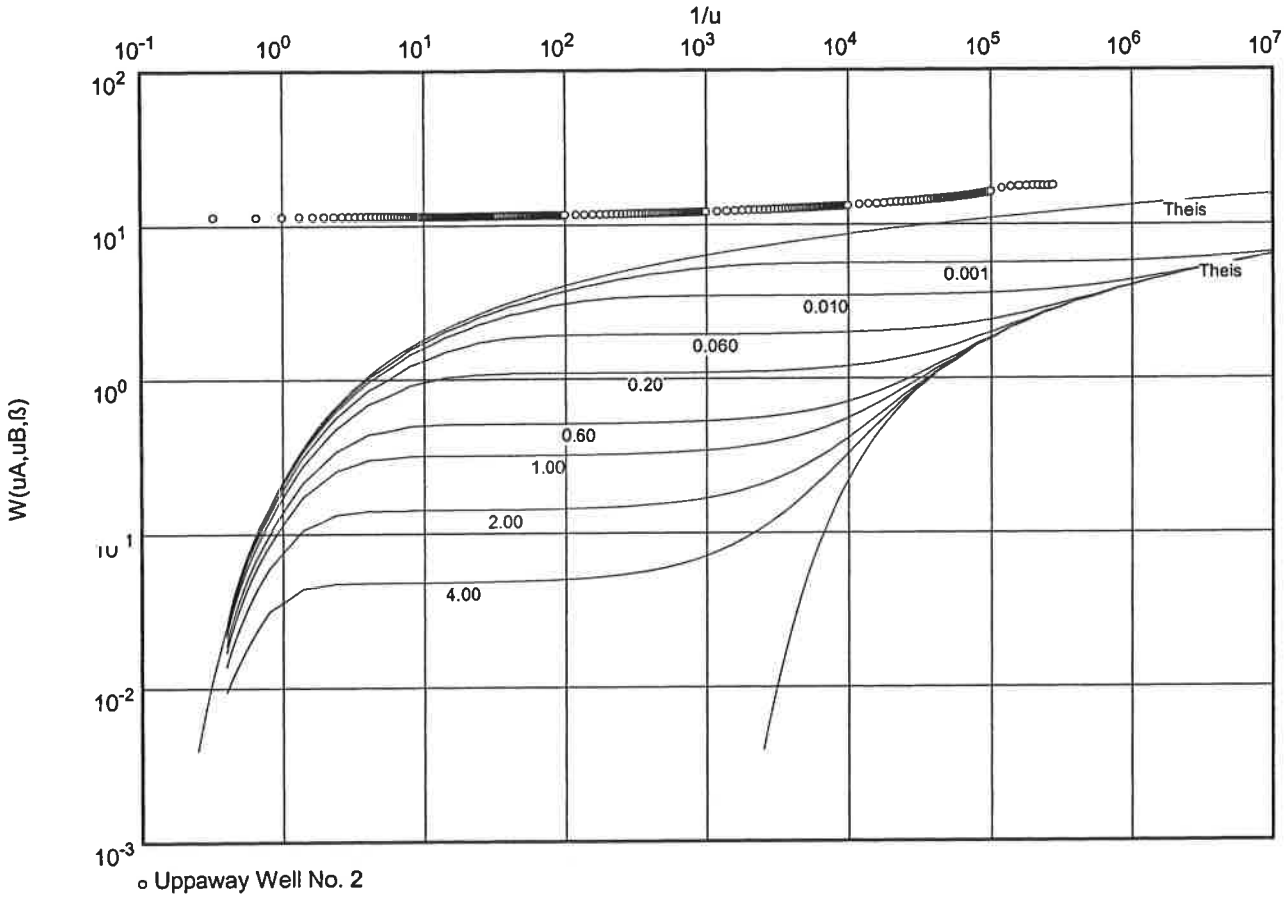



Figure #1

| | | |
|---|---|---|
| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>NEUMAN's method<br>Unconfined aquifer with<br>delayed watertable response | Page 1<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | |
| Discharge 120.00 U.S.gal/min | |




o Uppaway Well No. 2

Transmissivity [ft²/min]: $1.27 \times 10^{-1}$

Hydraulic conductivity [ft/min]: $6.07 \times 10^{-4}$

Aquifer thickness [ft]: 210.00

Storativity: $3.72 \times 10^{-6}$

Specific yield: $3.72 \times 10^{-2}$

Figure #2

| Waterloo Hydrogeologic<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Time-Drawdown plot<br>with discharge | Page 2<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 1 |
| Discharge 148.27 U.S.gal/min | |
| Static water level: 41.00 ft below datum | |

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] | |
|---|---|---|---|---|
| 1 | 0.00 | 204.48 | 163.48 | |
| 2 | 0.01 | 205.29 | 164.29 | |
| 3 | 0.02 | 205.23 | 164.23 | |
| 4 | 0.03 | 206.04 | 165.04 | |
| 5 | 0.04 | 206.79 | 165.79 | |
| 6 | 0.05 | 206.60 | 165.60 | |
| 7 | 0.06 | 207.26 | 166.26 | |
| 8 | 0.07 | 207.48 | 166.48 | |
| 9 | 0.08 | 207.57 | 166.57 | |
| 10 | 0.09 | 208.08 | 167.08 | |
| 11 | 0.10 | 207.54 | 166.54 | |
| 12 | 0.11 | 208.45 | 167.45 | |
| 13 | 0.12 | 208.29 | 167.29 | |
| 14 | 0.13 | 208.39 | 167.39 | |
| 15 | 0.14 | 208.36 | 167.36 | |
| 16 | 0.15 | 208.17 | 167.17 | |
| 17 | 0.16 | 208.45 | 167.45 | |
| 18 | 0.17 | 207.51 | 166.51 | |
| 19 | 0.18 | 208.58 | 167.58 | |
| 20 | 0.19 | 207.39 | 166.39 | |
| 21 | 0.20 | 208.23 | 167.23 | |
| 22 | 0.21 | 207.36 | 166.36 | |
| 23 | 0.22 | 207.64 | 166.64 | |
| 24 | 0.23 | 207.76 | 166.76 | |
| 25 | 0.24 | 207.29 | 166.29 | |
| 26 | 0.25 | 207.54 | 166.54 | |
| 27 | 0.26 | 207.57 | 166.57 | |
| 28 | 0.27 | 207.57 | 166.57 | |
| 29 | 0.28 | 207.54 | 166.54 | |
| 30 | 0.29 | 206.92 | 165.92 | |
| 31 | 0.30 | 207.29 | 166.29 | |
| 32 | 0.31 | 207.29 | 166.29 | |
| 33 | 0.32 | 206.95 | 165.95 | |
| 34 | 0.33 | 207.51 | 166.51 | |
| 35 | 0.35 | 207.45 | 166.45 | |
| 36 | 0.37 | 207.11 | 166.11 | |
| 37 | 0.38 | 207.39 | 166.39 | |
| 38 | 0.40 | 207.32 | 166.32 | |
| 39 | 0.42 | 207.29 | 166.29 | |
| 40 | 0.43 | 207.39 | 166.39 | |
| 41 | 0.45 | 207.64 | 166.64 | |
| 42 | 0.47 | 206.95 | 165.95 | |
| 43 | 0.48 | 206.92 | 165.92 | |
| 44 | 0.50 | 207.29 | 166.29 | |
| 45 | 0.52 | 207.61 | 166.61 | |
| 46 | 0.53 | 207.76 | 166.76 | |
| 47 | 0.55 | 207.29 | 166.29 | |
| 48 | 0.57 | 207.11 | 166.11 | |
| 49 | 0.58 | 207.76 | 166.76 | |
| 50 | 0.60 | 207.98 | 166.98 | |

| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Time-Drawdown plot<br>with discharge | Page 3<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 1 |
| Discharge 148.27 U.S.gal/min | |
| Static water level: 41.00 ft below datum | |

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] | |
|---|---|---|---|---|
| 51 | 0.62 | 207.67 | 166.67 | |
| 52 | 0.63 | 207.42 | 166.42 | |
| 53 | 0.65 | 207.54 | 166.54 | |
| 54 | 0.67 | 207.64 | 166.64 | |
| 55 | 0.68 | 208.26 | 167.26 | |
| 56 | 0.70 | 207.73 | 166.73 | |
| 57 | 0.72 | 207.54 | 166.54 | |
| 58 | 0.73 | 207.70 | 166.70 | |
| 59 | 0.75 | 207.82 | 166.82 | |
| 60 | 0.77 | 208.39 | 167.39 | |
| 61 | 0.78 | 207.64 | 166.64 | |
| 62 | 0.80 | 207.51 | 166.51 | |
| 63 | 0.82 | 207.98 | 166.98 | |
| 64 | 0.83 | 208.14 | 167.14 | |
| 65 | 0.85 | 208.42 | 167.42 | |
| 66 | 0.87 | 208.17 | 167.17 | |
| 67 | 0.88 | 208.08 | 167.08 | |
| 68 | 0.90 | 207.79 | 166.79 | |
| 69 | 0.92 | 207.98 | 166.98 | |
| 70 | 0.93 | 208.54 | 167.54 | |
| 71 | 0.95 | 208.48 | 167.48 | |
| 72 | 0.97 | 208.01 | 167.01 | |
| 73 | 0.98 | 207.70 | 166.70 | |
| 74 | 1.00 | 208.17 | 167.17 | |
| 75 | 1.20 | 209.05 | 168.05 | |
| 76 | 1.40 | 208.70 | 167.70 | |
| 77 | 1.60 | 209.36 | 168.36 | |
| 78 | 1.80 | 208.95 | 167.95 | |
| 79 | 2.00 | 210.05 | 169.05 | |
| 80 | 2.20 | 210.46 | 169.46 | |
| 81 | 2.40 | 209.64 | 168.64 | |
| 82 | 2.60 | 209.86 | 168.86 | |
| 83 | 2.80 | 210.24 | 169.24 | |
| 84 | 3.00 | 210.58 | 169.58 | |
| 85 | 3.20 | 210.33 | 169.33 | |
| 86 | 3.40 | 210.74 | 169.74 | |
| 87 | 3.60 | 210.49 | 169.49 | |
| 88 | 3.80 | 211.08 | 170.08 | |
| 89 | 4.00 | 211.08 | 170.08 | |
| 90 | 4.20 | 210.71 | 169.71 | |
| 91 | 4.40 | 211.15 | 170.15 | |
| 92 | 4.60 | 211.90 | 170.90 | |
| 93 | 4.80 | 211.93 | 170.93 | |
| 94 | 5.00 | 211.99 | 170.99 | |
| 95 | 5.20 | 211.58 | 170.58 | |
| 96 | 5.40 | 211.33 | 170.33 | |
| 97 | 5.60 | 211.86 | 170.86 | |
| 98 | 5.80 | 211.71 | 170.71 | |
| 99 | 6.00 | 212.08 | 171.08 | |
| 100 | 6.20 | 211.96 | 170.96 | |

| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Time-Drawdown plot<br>with discharge | Page 4<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 1 |
| Discharge 148.27 U.S.gal/min | |
| Static water level: 41.00 ft below datum | |

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] | |
|---|---|---|---|---|
| 101 | 6.40 | 211.90 | 170.90 | |
| 102 | 6.60 | 212.55 | 171.55 | |
| 103 | 6.80 | 212.21 | 171.21 | |
| 104 | 7.00 | 212.18 | 171.18 | |
| 105 | 7.20 | 212.52 | 171.52 | |
| 106 | 7.40 | 212.40 | 171.40 | |
| 107 | 7.60 | 213.12 | 172.12 | |
| 108 | 7.80 | 212.58 | 171.58 | |
| 109 | 8.00 | 213.30 | 172.30 | |
| 110 | 8.20 | 212.71 | 171.71 | |
| 111 | 8.40 | 213.33 | 172.33 | |
| 112 | 8.60 | 212.80 | 171.80 | |
| 113 | 8.80 | 213.30 | 172.30 | |
| 114 | 9.00 | 212.83 | 171.83 | |
| 115 | 9.20 | 212.83 | 171.83 | |
| 116 | 9.40 | 212.96 | 171.96 | |
| 117 | 9.60 | 213.71 | 172.71 | |
| 118 | 9.80 | 213.71 | 172.71 | |
| 119 | 10.00 | 213.93 | 172.93 | |
| 120 | 12.00 | 214.62 | 173.62 | |
| 121 | 14.00 | 214.78 | 173.78 | |
| 122 | 16.00 | 214.87 | 173.87 | |
| 123 | 18.00 | 216.18 | 175.18 | |
| 124 | 20.00 | 216.37 | 175.37 | |
| 125 | 22.00 | 216.94 | 175.94 | |
| 126 | 24.00 | 217.56 | 176.56 | |
| 127 | 26.00 | 217.75 | 176.75 | |
| 128 | 28.00 | 217.12 | 176.12 | |
| 129 | 30.00 | 218.06 | 177.06 | |
| 130 | 32.00 | 218.28 | 177.28 | |
| 131 | 34.00 | 219.16 | 178.16 | |
| 132 | 36.00 | 218.66 | 177.66 | |
| 133 | 38.00 | 219.66 | 178.66 | |
| 134 | 40.00 | 219.78 | 178.78 | |
| 135 | 42.00 | 220.03 | 179.03 | |
| 136 | 44.00 | 220.25 | 179.25 | |
| 137 | 46.00 | 220.32 | 179.32 | |
| 138 | 48.00 | 220.88 | 179.88 | |
| 139 | 50.00 | 220.69 | 179.69 | |
| 140 | 52.00 | 221.41 | 180.41 | |
| 141 | 54.00 | 221.19 | 180.19 | |
| 142 | 56.00 | 220.85 | 179.85 | |
| 143 | 58.00 | 222.38 | 181.38 | |
| 144 | 60.00 | 222.57 | 181.57 | |
| 145 | 62.00 | 222.41 | 181.41 | |
| 146 | 64.00 | 222.13 | 181.13 | |
| 147 | 66.00 | 222.82 | 181.82 | |
| 148 | 68.00 | 222.57 | 181.57 | |
| 149 | 70.00 | 223.10 | 182.10 | |
| 150 | 72.00 | 223.76 | 182.76 | |

**Waterloo Hydrogeologic**
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Time-Drawdown plot
with discharge



Project: Gilmore Engineering

Evaluated by: K.I. | Date: 02.08.1999

Pumping Test No. 1 | Test conducted on: 7/30/99

Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 1

Discharge 148.27 U.S.gal/min

Static water level: 41.00 ft below datum

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] | |
|---|---|---|---|---|
| 151 | 74.00 | 223.20 | 182.20 | |
| 152 | 76.00 | 223.79 | 182.79 | |
| 153 | 78.00 | 223.35 | 182.35 | |
| 154 | 80.00 | 223.45 | 182.45 | |
| 155 | 82.00 | 223.88 | 182.88 | |
| 156 | 84.00 | 224.45 | 183.45 | |
| 157 | 86.00 | 224.07 | 183.07 | |
| 158 | 88.00 | 224.51 | 183.51 | |
| 159 | 90.00 | 225.29 | 184.29 | |
| 160 | 92.00 | 224.98 | 183.98 | |
| 161 | 94.00 | 224.57 | 183.57 | |
| 162 | 96.00 | 225.07 | 184.07 | |
| 163 | 98.00 | 225.76 | 184.76 | |
| 164 | 100.00 | 224.98 | 183.98 | |
| 165 | 120.00 | 227.39 | 186.39 | |
| 166 | 140.00 | 227.39 | 186.39 | |
| 167 | 160.00 | 228.80 | 187.80 | |
| 168 | 180.00 | 230.02 | 189.02 | |
| 169 | 200.00 | 230.77 | 189.77 | |
| 170 | 220.00 | 232.43 | 191.43 | |
| 171 | 240.00 | 232.74 | 191.74 | |
| 172 | 260.00 | 233.59 | 192.59 | |
| 173 | 280.00 | 234.40 | 193.40 | |
| 174 | 300.00 | 234.78 | 193.78 | |
| 175 | 320.00 | 235.72 | 194.72 | |
| 176 | 340.00 | 235.78 | 194.78 | |
| 177 | 360.00 | 237.60 | 196.60 | |
| 178 | 380.00 | 237.25 | 196.25 | |
| 179 | 400.00 | 238.60 | 197.60 | |
| 180 | 420.00 | 239.50 | 198.50 | |
| 181 | 440.00 | 239.63 | 198.63 | |
| 182 | 460.00 | 240.10 | 199.10 | |
| 183 | 480.00 | 240.48 | 199.48 | |
| 184 | 500.00 | 241.70 | 200.70 | |
| 185 | 520.00 | 241.48 | 200.48 | |
| 186 | 540.00 | 241.95 | 200.95 | |
| 187 | 560.00 | 243.51 | 202.51 | |
| 188 | 580.00 | 243.86 | 202.86 | |
| 189 | 600.00 | 243.48 | 202.48 | |
| 190 | 620.00 | 244.70 | 203.70 | |
| 191 | 640.00 | 245.01 | 204.01 | |
| 192 | 660.00 | 245.20 | 204.20 | |
| 193 | 680.00 | 246.17 | 205.17 | |
| 194 | 700.00 | 247.55 | 206.55 | |
| 195 | 720.00 | 247.64 | 206.64 | |
| 196 | 740.00 | 247.80 | 206.80 | |
| 197 | 760.00 | 249.05 | 208.05 | |
| 198 | 780.00 | 249.90 | 208.90 | |
| 199 | 800.00 | 249.33 | 208.33 | |
| 200 | 820.00 | 250.43 | 209.43 | |

| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Time-Drawdown plot<br>with discharge | Page 8<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 2 |
| Discharge 148.27 U.S.gal/min | Distance from the pumping well 37.00 ft |
| Static water level: 46.00 ft below datum | |

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] |
|---|---|---|---|
| 1 | 0.00 | 160.05 | 114.05 |
| 2 | 0.00 | 160.05 | 114.05 |
| 3 | 0.01 | 160.05 | 114.05 |
| 4 | 0.01 | 160.06 | 114.06 |
| 5 | 0.01 | 160.06 | 114.06 |
| 6 | 0.02 | 160.08 | 114.08 |
| 7 | 0.02 | 160.08 | 114.08 |
| 8 | 0.02 | 160.09 | 114.09 |
| 9 | 0.03 | 160.11 | 114.11 |
| 10 | 0.03 | 160.11 | 114.11 |
| 11 | 0.03 | 160.13 | 114.13 |
| 12 | 0.04 | 160.14 | 114.14 |
| 13 | 0.04 | 160.14 | 114.14 |
| 14 | 0.04 | 160.16 | 114.16 |
| 15 | 0.05 | 160.17 | 114.17 |
| 16 | 0.05 | 160.17 | 114.17 |
| 17 | 0.05 | 160.19 | 114.19 |
| 18 | 0.06 | 160.19 | 114.19 |
| 19 | 0.06 | 160.21 | 114.21 |
| 20 | 0.06 | 160.21 | 114.21 |
| 21 | 0.07 | 160.22 | 114.22 |
| 22 | 0.07 | 160.24 | 114.24 |
| 23 | 0.07 | 160.24 | 114.24 |
| 24 | 0.08 | 160.25 | 114.25 |
| 25 | 0.08 | 160.25 | 114.25 |
| 26 | 0.08 | 160.27 | 114.27 |
| 27 | 0.09 | 160.28 | 114.28 |
| 28 | 0.09 | 160.28 | 114.28 |
| 29 | 0.09 | 160.30 | 114.30 |
| 30 | 0.10 | 160.32 | 114.32 |
| 31 | 0.10 | 160.32 | 114.32 |
| 32 | 0.10 | 160.33 | 114.33 |
| 33 | 0.11 | 160.35 | 114.35 |
| 34 | 0.11 | 160.36 | 114.36 |
| 35 | 0.11 | 160.36 | 114.36 |
| 36 | 0.12 | 160.38 | 114.38 |
| 37 | 0.12 | 160.39 | 114.39 |
| 38 | 0.12 | 160.39 | 114.39 |
| 39 | 0.13 | 160.41 | 114.41 |
| 40 | 0.13 | 160.43 | 114.43 |
| 41 | 0.13 | 160.44 | 114.44 |
| 42 | 0.14 | 160.44 | 114.44 |
| 43 | 0.14 | 160.46 | 114.46 |
| 44 | 0.14 | 160.47 | 114.47 |
| 45 | 0.15 | 160.47 | 114.47 |
| 46 | 0.15 | 160.49 | 114.49 |
| 47 | 0.15 | 160.50 | 114.50 |
| 48 | 0.16 | 160.50 | 114.50 |
| 49 | 0.16 | 160.52 | 114.52 |
| 50 | 0.16 | 160.54 | 114.54 |

| Waterloo Hydrogeologic<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Time-Drawdown plot<br>with discharge | Page 12<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 2 |
| Discharge 148.27 U.S.gal/min | Distance from the pumping well 37.00 ft |
| Static water level: 46.00 ft below datum | |

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] | |
|---|---|---|---|---|
| 201 | 40.00 | 173.04 | 127.04 | |
| 202 | 42.00 | 173.29 | 127.29 | |
| 203 | 44.00 | 173.53 | 127.53 | |
| 204 | 46.00 | 173.75 | 127.75 | |
| 205 | 48.00 | 173.99 | 127.99 | |
| 206 | 50.00 | 174.21 | 128.21 | |
| 207 | 52.00 | 174.43 | 128.43 | |
| 208 | 54.00 | 174.62 | 128.62 | |
| 209 | 56.00 | 174.84 | 128.84 | |
| 210 | 58.00 | 175.01 | 129.01 | |
| 211 | 60.00 | 175.21 | 129.21 | |
| 212 | 62.00 | 175.39 | 129.39 | |
| 213 | 64.00 | 175.58 | 129.58 | |
| 214 | 66.00 | 175.77 | 129.77 | |
| 215 | 68.00 | 175.93 | 129.93 | |
| 216 | 70.00 | 176.10 | 130.10 | |
| 217 | 72.00 | 176.28 | 130.28 | |
| 218 | 74.00 | 176.42 | 130.42 | |
| 219 | 76.00 | 176.58 | 130.58 | |
| 220 | 78.00 | 176.74 | 130.74 | |
| 221 | 80.00 | 176.88 | 130.88 | |
| 222 | 82.00 | 177.02 | 131.02 | |
| 223 | 84.00 | 177.15 | 131.15 | |
| 224 | 86.00 | 177.29 | 131.29 | |
| 225 | 88.00 | 177.43 | 131.43 | |
| 226 | 90.00 | 177.56 | 131.56 | |
| 227 | 92.00 | 177.68 | 131.68 | |
| 228 | 94.00 | 177.81 | 131.81 | |
| 229 | 96.00 | 177.92 | 131.92 | |
| 230 | 98.00 | 178.01 | 132.01 | |
| 231 | 100.00 | 178.17 | 132.17 | |
| 232 | 120.00 | 179.29 | 133.29 | |
| 233 | 140.00 | 180.33 | 134.33 | |
| 234 | 160.00 | 181.30 | 135.30 | |
| 235 | 180.00 | 182.21 | 136.21 | |
| 236 | 200.00 | 183.10 | 137.10 | |
| 237 | 220.00 | 183.87 | 137.87 | |
| 238 | 240.00 | 184.61 | 138.61 | |
| 239 | 260.00 | 185.34 | 139.34 | |
| 240 | 280.00 | 186.02 | 140.02 | |
| 241 | 300.00 | 186.63 | 140.63 | |
| 242 | 320.00 | 187.23 | 141.23 | |
| 243 | 340.00 | 187.81 | 141.81 | |
| 244 | 360.00 | 188.45 | 142.45 | |
| 245 | 380.00 | 189.06 | 143.06 | |
| 246 | 400.00 | 189.69 | 143.69 | |
| 247 | 420.00 | 190.31 | 144.31 | |
| 248 | 440.00 | 190.89 | 144.89 | |
| 249 | 460.00 | 191.49 | 145.49 | |
| 250 | 480.00 | 192.03 | 146.03 | |

**Waterloo Hydrogeologic**
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Time-Drawdown plot
with discharge



Project: Gilmore Engineering

Evaluated by: K.I. | Date: 02.08.1999

Pumping Test No. 1 | Test conducted on: 7/30/99

Uppaway Well No. 1 (Pumping Well) | Uppaway Well No. 2

Discharge 148.27 U.S.gal/min | Distance from the pumping well 37.00 ft

Static water level: 46.00 ft below datum

| | Pumping test duration [min] | Water level [ft] | Drawdown [ft] | |
|---|---|---|---|---|
| 251 | 500.00 | 192.63 | 146.63 | |
| 252 | 520.00 | 193.16 | 147.16 | |
| 253 | 540.00 | 193.72 | 147.72 | |
| 254 | 560.00 | 194.25 | 148.25 | |
| 255 | 580.00 | 194.79 | 148.79 | |
| 256 | 600.00 | 195.33 | 149.33 | |
| 257 | 620.00 | 195.86 | 149.86 | |
| 258 | 640.00 | 196.42 | 150.42 | |
| 259 | 660.00 | 196.95 | 150.95 | |
| 260 | 680.00 | 197.50 | 151.50 | |
| 261 | 700.00 | 198.05 | 152.05 | |
| 262 | 720.00 | 198.58 | 152.58 | |
| 263 | 740.00 | 199.10 | 153.10 | |
| 264 | 760.00 | 199.63 | 153.63 | |
| 265 | 780.00 | 200.15 | 154.15 | |
| 266 | 800.00 | 200.71 | 154.71 | |
| 267 | 820.00 | 201.32 | 155.32 | |
| 268 | 840.00 | 201.97 | 155.97 | |
| 269 | 860.00 | 202.60 | 156.60 | |
| 270 | 880.00 | 203.23 | 157.23 | |
| 271 | 900.00 | 203.89 | 157.89 | |
| 272 | 920.00 | 204.65 | 158.65 | |
| 273 | 940.00 | 205.36 | 159.36 | |
| 274 | 960.00 | 206.07 | 160.07 | |
| 275 | 980.00 | 206.78 | 160.78 | |
| 276 | 1000.00 | 207.50 | 161.50 | |
| 277 | 1200.00 | 214.44 | 168.44 | |
| 278 | 1400.00 | 218.88 | 172.88 | |
| 279 | 1600.00 | 220.31 | 174.31 | |
| 280 | 1800.00 | 220.72 | 174.72 | |
| 281 | 2000.00 | 221.60 | 175.60 | |
| 282 | 2200.00 | 221.49 | 175.49 | |
| 283 | 2400.00 | 221.30 | 175.30 | |
| 284 | 2600.00 | 221.60 | 175.60 | |
| 285 | 2800.00 | 221.84 | 175.84 | |

| Waterloo Hydrogeologic<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Recovery method after<br>THEIS & JACOB<br>Confined aquifer | Page 8<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 1 |
| Discharge 148.00 U.S.gal/min | |
| Static water level: 41.00 ft below datum | Pumping test duration: 2800.00 min |

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 2 | 0.00 | 269.24 | 228.24 | |
| 3 | 0.01 | 269.02 | 228.02 | |
| 4 | 0.01 | 269.09 | 228.09 | |
| 5 | 0.01 | 269.43 | 228.43 | |
| 6 | 0.02 | 269.90 | 228.90 | |
| 7 | 0.02 | 270.40 | 229.40 | |
| 8 | 0.02 | 270.65 | 229.65 | |
| 9 | 0.03 | 270.93 | 229.93 | |
| 10 | 0.03 | 271.15 | 230.15 | |
| 11 | 0.03 | 270.90 | 229.90 | |
| 12 | 0.04 | 270.87 | 229.87 | |
| 13 | 0.04 | 270.93 | 229.93 | |
| 14 | 0.04 | 270.53 | 229.53 | |
| 15 | 0.05 | 270.40 | 229.40 | |
| 16 | 0.05 | 270.28 | 229.28 | |
| 17 | 0.05 | 270.09 | 229.09 | |
| 18 | 0.06 | 269.81 | 228.81 | |
| 19 | 0.06 | 269.56 | 228.56 | |
| 20 | 0.06 | 269.21 | 228.21 | |
| 21 | 0.07 | 268.99 | 227.99 | |
| 22 | 0.07 | 268.87 | 227.87 | |
| 23 | 0.07 | 268.40 | 227.40 | |
| 24 | 0.08 | 268.59 | 227.59 | |
| 25 | 0.08 | 268.18 | 227.18 | |
| 26 | 0.08 | 268.02 | 227.02 | |
| 27 | 0.09 | 267.96 | 226.96 | |
| 28 | 0.09 | 267.96 | 226.96 | |
| 29 | 0.09 | 267.83 | 226.83 | |
| 30 | 0.10 | 267.52 | 226.52 | |
| 31 | 0.10 | 267.52 | 226.52 | |
| 32 | 0.10 | 267.55 | 226.55 | |
| 33 | 0.11 | 267.18 | 226.18 | |
| 34 | 0.11 | 267.40 | 226.40 | |
| 35 | 0.11 | 266.90 | 225.90 | |
| 36 | 0.12 | 267.24 | 226.24 | |
| 37 | 0.12 | 266.71 | 225.71 | |
| 38 | 0.12 | 266.87 | 225.87 | |
| 39 | 0.13 | 266.83 | 225.83 | |
| 40 | 0.13 | 266.49 | 225.49 | |
| 41 | 0.13 | 266.55 | 225.55 | |
| 42 | 0.14 | 266.40 | 225.40 | |
| 43 | 0.14 | 266.30 | 225.30 | |
| 44 | 0.14 | 266.24 | 225.24 | |
| 45 | 0.15 | 266.18 | 225.18 | |
| 46 | 0.15 | 266.02 | 225.02 | |
| 47 | 0.15 | 265.89 | 224.89 | |
| 48 | 0.16 | 265.93 | 224.93 | |
| 49 | 0.16 | 265.99 | 224.99 | |
| 50 | 0.16 | 265.93 | 224.93 | |

**Waterloo Hydrogeologic**
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Recovery method after
THEIS & JACOB
Confined aquifer



Project: Gilmore Engineering

Evaluated by: K.I. | Date: 02.08.1999

Pumping Test No. 1 | Test conducted on: 7/30/99

Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 1

Discharge 148.00 U.S.gal/min

Static water level: 41.00 ft below datum | Pumping test duration: 2800.00 min

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 201 | 40.00 | 257.85 | 216.85 | |
| 202 | 42.00 | 257.66 | 216.66 | |
| 203 | 44.00 | 257.47 | 216.47 | |
| 204 | 46.00 | 257.29 | 216.29 | |
| 205 | 48.00 | 257.10 | 216.10 | |
| 206 | 50.00 | 256.91 | 215.91 | |
| 207 | 52.00 | 256.75 | 215.75 | |
| 208 | 54.00 | 256.57 | 215.57 | |
| 209 | 56.00 | 256.41 | 215.41 | |
| 210 | 58.00 | 256.22 | 215.22 | |
| 211 | 60.00 | 256.06 | 215.06 | |
| 212 | 62.00 | 255.88 | 214.88 | |
| 213 | 64.00 | 255.72 | 214.72 | |
| 214 | 66.00 | 255.53 | 214.53 | |
| 215 | 68.00 | 255.38 | 214.38 | |
| 216 | 70.00 | 255.22 | 214.22 | |
| 217 | 72.00 | 255.03 | 214.03 | |
| 218 | 74.00 | 254.88 | 213.88 | |
| 219 | 76.00 | 254.72 | 213.72 | |
| 220 | 78.00 | 254.56 | 213.56 | |
| 221 | 80.00 | 254.41 | 213.41 | |
| 222 | 82.00 | 254.25 | 213.25 | |
| 223 | 84.00 | 254.09 | 213.09 | |
| 224 | 86.00 | 253.94 | 212.94 | |
| 225 | 88.00 | 253.75 | 212.75 | |
| 226 | 90.00 | 253.59 | 212.59 | |
| 227 | 92.00 | 253.44 | 212.44 | |
| 228 | 94.00 | 253.28 | 212.28 | |
| 229 | 96.00 | 253.15 | 212.15 | |
| 230 | 98.00 | 253.00 | 212.00 | |
| 231 | 100.00 | 252.84 | 211.84 | |
| 232 | 120.00 | 251.43 | 210.43 | |
| 233 | 140.00 | 250.05 | 209.05 | |
| 234 | 160.00 | 248.77 | 207.77 | |
| 235 | 180.00 | 247.58 | 206.58 | |
| 236 | 200.00 | 246.42 | 205.42 | |
| 237 | 220.00 | 245.33 | 204.33 | |
| 238 | 240.00 | 244.26 | 203.26 | |
| 239 | 260.00 | 243.26 | 202.26 | |
| 240 | 280.00 | 242.20 | 201.20 | |
| 241 | 300.00 | 241.23 | 200.23 | |
| 242 | 320.00 | 240.26 | 199.26 | |
| 243 | 340.00 | 239.35 | 198.35 | |
| 244 | 360.00 | 238.44 | 197.44 | |
| 245 | 380.00 | 237.60 | 196.60 | |
| 246 | 400.00 | 236.75 | 195.75 | |
| 247 | 420.00 | 235.97 | 194.97 | |
| 248 | 440.00 | 235.19 | 194.19 | |
| 249 | 460.00 | 234.43 | 193.43 | |
| 250 | 480.00 | 233.68 | 192.68 | |

| Waterloo Hydrogeologic<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Recovery method after<br>THEIS & JACOB<br>Confined aquifer | Page 13<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 1 |
| Discharge 148.00 U.S.gal/min | |
| Static water level: 41.00 ft below datum | Pumping test duration: 2800.00 min |

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 251 | 500.00 | 232.99 | 191.99 | |
| 252 | 520.00 | 232.27 | 191.27 | |
| 253 | 540.00 | 231.62 | 190.62 | |
| 254 | 560.00 | 230.96 | 189.96 | |
| 255 | 580.00 | 230.33 | 189.33 | |
| 256 | 600.00 | 229.71 | 188.71 | |
| 257 | 620.00 | 229.11 | 188.11 | |
| 258 | 640.00 | 228.55 | 187.55 | |
| 259 | 660.00 | 227.99 | 186.99 | |
| 260 | 680.00 | 227.42 | 186.42 | |
| 261 | 700.00 | 226.89 | 185.89 | |
| 262 | 720.00 | 226.39 | 185.39 | |
| 263 | 740.00 | 225.89 | 184.89 | |
| 264 | 760.00 | 225.42 | 184.42 | |
| 265 | 780.00 | 224.95 | 183.95 | |
| 266 | 800.00 | 224.48 | 183.48 | |
| 267 | 820.00 | 224.07 | 183.07 | |
| 268 | 840.00 | 223.63 | 182.63 | |
| 269 | 860.00 | 223.20 | 182.20 | |
| 270 | 880.00 | 222.76 | 181.76 | |
| 271 | 900.00 | 222.35 | 181.35 | |
| 272 | 920.00 | 221.94 | 180.94 | |
| 273 | 940.00 | 221.54 | 180.54 | |
| 274 | 960.00 | 221.13 | 180.13 | |
| 275 | 980.00 | 220.72 | 179.72 | |
| 276 | 1000.00 | 220.35 | 179.35 | |
| 277 | 1200.00 | 216.65 | 175.65 | |
| 278 | 1400.00 | 212.99 | 171.99 | |
| 279 | 1600.00 | 209.55 | 168.55 | |
| 280 | 1800.00 | 206.64 | 165.64 | |
| 281 | 2000.00 | 204.41 | 163.41 | |
| 282 | 2200.00 | 202.91 | 161.91 | |
| 283 | 2400.00 | 202.00 | 161.00 | |
| 284 | 2600.00 | 201.41 | 160.41 | |
| 285 | 2800.00 | 201.03 | 160.03 | |

| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Recovery method after<br>THEIS & JACOB<br>Confined aquifer | Page 2<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 2 |
| Discharge 148.00 U.S.gal/min | Distance from the pumping well 37.00 ft |
| Static water level: 46.00 ft below datum | Pumping test duration: 2800.00 min |

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| | | | | |
| 2 | 0.01 | 221.95 | 175.95 | |
| 3 | 0.02 | 221.95 | 175.95 | |
| 4 | 0.03 | 221.95 | 175.95 | |
| 5 | 0.04 | 221.95 | 175.95 | |
| 6 | 0.05 | 221.95 | 175.95 | |
| 7 | 0.06 | 221.95 | 175.95 | |
| 8 | 0.07 | 221.93 | 175.93 | |
| 9 | 0.08 | 221.93 | 175.93 | |
| 10 | 0.09 | 221.93 | 175.93 | |
| 11 | 0.10 | 221.93 | 175.93 | |
| 12 | 0.11 | 221.93 | 175.93 | |
| 13 | 0.12 | 221.93 | 175.93 | |
| 14 | 0.13 | 221.92 | 175.92 | |
| 15 | 0.14 | 221.92 | 175.92 | |
| 16 | 0.15 | 221.92 | 175.92 | |
| 17 | 0.16 | 221.90 | 175.90 | |
| 18 | 0.17 | 221.90 | 175.90 | |
| 19 | 0.18 | 221.90 | 175.90 | |
| 20 | 0.19 | 221.89 | 175.89 | |
| 21 | 0.20 | 221.89 | 175.89 | |
| 22 | 0.21 | 221.87 | 175.87 | |
| 23 | 0.22 | 221.87 | 175.87 | |
| 24 | 0.23 | 221.87 | 175.87 | |
| 25 | 0.24 | 221.86 | 175.86 | |
| 26 | 0.25 | 221.86 | 175.86 | |
| 27 | 0.26 | 221.84 | 175.84 | |
| 28 | 0.27 | 221.84 | 175.84 | |
| 29 | 0.28 | 221.82 | 175.82 | |
| 30 | 0.29 | 221.82 | 175.82 | |
| 31 | 0.30 | 221.81 | 175.81 | |
| 32 | 0.31 | 221.81 | 175.81 | |
| 33 | 0.32 | 221.79 | 175.79 | |
| 34 | 0.33 | 221.79 | 175.79 | |
| 35 | 0.35 | 221.76 | 175.76 | |
| 36 | 0.37 | 221.75 | 175.75 | |
| 37 | 0.38 | 221.73 | 175.73 | |
| 38 | 0.40 | 221.71 | 175.71 | |
| 39 | 0.42 | 221.70 | 175.70 | |
| 40 | 0.43 | 221.70 | 175.70 | |
| 41 | 0.45 | 221.68 | 175.68 | |
| 42 | 0.47 | 221.67 | 175.67 | |
| 43 | 0.48 | 221.65 | 175.65 | |
| 44 | 0.50 | 221.64 | 175.64 | |
| 45 | 0.52 | 221.62 | 175.62 | |
| 46 | 0.53 | 221.60 | 175.60 | |
| 47 | 0.55 | 221.59 | 175.59 | |
| 48 | 0.57 | 221.57 | 175.57 | |
| 49 | 0.58 | 221.57 | 175.57 | |
| 50 | 0.60 | 221.56 | 175.56 | |

**Waterloo Hydrogeologic**
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Recovery method after
THEIS & JACOB
Confined aquifer



Project: Gilmore Engineering

Evaluated by: K.I. | Date: 02.08.1999

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 2 |
| Discharge 148.00 U.S.gal/min | Distance from the pumping well 37.00 ft |
| Static water level: 46.00 ft below datum | Pumping test duration: 2800.00 min |

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 51 | 0.62 | 221.54 | 175.54 | |
| 52 | 0.63 | 221.52 | 175.52 | |
| 53 | 0.65 | 221.51 | 175.51 | |
| 54 | 0.67 | 221.51 | 175.51 | |
| 55 | 0.68 | 221.49 | 175.49 | |
| 56 | 0.70 | 221.49 | 175.49 | |
| 57 | 0.72 | 221.48 | 175.48 | |
| 58 | 0.73 | 221.48 | 175.48 | |
| 59 | 0.75 | 221.46 | 175.46 | |
| 60 | 0.77 | 221.46 | 175.46 | |
| 61 | 0.78 | 221.45 | 175.45 | |
| 62 | 0.80 | 221.43 | 175.43 | |
| 63 | 0.82 | 221.43 | 175.43 | |
| 64 | 0.83 | 221.41 | 175.41 | |
| 65 | 0.85 | 221.41 | 175.41 | |
| 66 | 0.87 | 221.40 | 175.40 | |
| 67 | 0.88 | 221.40 | 175.40 | |
| 68 | 0.90 | 221.38 | 175.38 | |
| 69 | 0.92 | 221.37 | 175.37 | |
| 70 | 0.93 | 221.37 | 175.37 | |
| 71 | 0.95 | 221.35 | 175.35 | |
| 72 | 0.97 | 221.35 | 175.35 | |
| 73 | 0.98 | 221.33 | 175.33 | |
| 74 | 1.00 | 221.33 | 175.33 | |
| 75 | 1.20 | 221.24 | 175.24 | |
| 76 | 1.40 | 221.18 | 175.18 | |
| 77 | 1.60 | 221.13 | 175.13 | |
| 78 | 1.80 | 221.08 | 175.08 | |
| 79 | 2.00 | 221.02 | 175.02 | |
| 80 | 2.20 | 220.97 | 174.97 | |
| 81 | 2.40 | 220.93 | 174.93 | |
| 82 | 2.60 | 220.88 | 174.88 | |
| 83 | 2.80 | 220.85 | 174.85 | |
| 84 | 3.00 | 220.80 | 174.80 | |
| 85 | 3.20 | 220.77 | 174.77 | |
| 86 | 3.40 | 220.72 | 174.72 | |
| 87 | 3.60 | 220.69 | 174.69 | |
| 88 | 3.80 | 220.66 | 174.66 | |
| 89 | 4.00 | 220.61 | 174.61 | |
| 90 | 4.20 | 220.58 | 174.58 | |
| 91 | 4.40 | 220.55 | 174.55 | |
| 92 | 4.60 | 220.50 | 174.50 | |
| 93 | 4.80 | 220.47 | 174.47 | |
| 94 | 5.00 | 220.44 | 174.44 | |
| 95 | 5.20 | 220.39 | 174.39 | |
| 96 | 5.40 | 220.36 | 174.36 | |
| 97 | 5.60 | 220.33 | 174.33 | |
| 98 | 5.80 | 220.29 | 174.29 | |
| 99 | 6.00 | 220.26 | 174.26 | |
| 100 | 6.20 | 220.23 | 174.23 | |

| Waterloo Hydrogeologic<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Recovery method after<br>THEIS & JACOB<br>Confined aquifer | Page 4<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 2 |
| Discharge 148.00 U.S.gal/min | Distance from the pumping well 37.00 ft |
| Static water level: 46.00 ft below datum | Pumping test duration: 2800.00 min |

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 101 | 6.40 | 220.20 | 174.20 | |
| 102 | 6.60 | 220.17 | 174.17 | |
| 103 | 6.80 | 220.14 | 174.14 | |
| 104 | 7.00 | 220.10 | 174.10 | |
| 105 | 7.20 | 220.07 | 174.07 | |
| 106 | 7.40 | 220.04 | 174.04 | |
| 107 | 7.60 | 220.01 | 174.01 | |
| 108 | 7.80 | 219.98 | 173.98 | |
| 109 | 8.00 | 219.95 | 173.95 | |
| 110 | 8.20 | 219.92 | 173.92 | |
| 111 | 8.40 | 219.88 | 173.88 | |
| 112 | 8.60 | 219.85 | 173.85 | |
| 113 | 8.80 | 219.84 | 173.84 | |
| 114 | 9.00 | 219.81 | 173.81 | |
| 115 | 9.20 | 219.77 | 173.77 | |
| 116 | 9.40 | 219.74 | 173.74 | |
| 117 | 9.60 | 219.71 | 173.71 | |
| 118 | 9.80 | 219.68 | 173.68 | |
| 119 | 10.00 | 219.63 | 173.63 | |
| 120 | 12.00 | 219.25 | 173.25 | |
| 121 | 14.00 | 218.94 | 172.94 | |
| 122 | 16.00 | 218.69 | 172.69 | |
| 123 | 18.00 | 218.43 | 172.43 | |
| 124 | 20.00 | 218.21 | 172.21 | |
| 125 | 22.00 | 218.01 | 172.01 | |
| 126 | 24.00 | 217.80 | 171.80 | |
| 127 | 26.00 | 217.61 | 171.61 | |
| 128 | 28.00 | 217.43 | 171.43 | |
| 129 | 30.00 | 217.24 | 171.24 | |
| 130 | 32.00 | 217.05 | 171.05 | |
| 131 | 34.00 | 216.86 | 170.86 | |
| 132 | 36.00 | 216.68 | 170.68 | |
| 133 | 38.00 | 216.49 | 170.49 | |
| 134 | 40.00 | 216.32 | 170.32 | |
| 135 | 42.00 | 216.13 | 170.13 | |
| 136 | 44.00 | 215.96 | 169.96 | |
| 137 | 46.00 | 215.78 | 169.78 | |
| 138 | 48.00 | 215.63 | 169.63 | |
| 139 | 50.00 | 215.47 | 169.47 | |
| 140 | 52.00 | 215.30 | 169.30 | |
| 141 | 54.00 | 215.15 | 169.15 | |
| 142 | 56.00 | 215.00 | 169.00 | |
| 143 | 58.00 | 214.84 | 168.84 | |
| 144 | 60.00 | 214.68 | 168.68 | |
| 145 | 62.00 | 214.54 | 168.54 | |
| 146 | 64.00 | 214.38 | 168.38 | |
| 147 | 66.00 | 214.22 | 168.22 | |
| 148 | 68.00 | 214.08 | 168.08 | |
| 149 | 70.00 | 213.92 | 167.92 | |
| 150 | 72.00 | 213.78 | 167.78 | |

| Waterloo Hydrogeologic<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Recovery method after<br>THEIS & JACOB<br>Confined aquifer | Page 5<br>Project: Gilmore Engineering<br>Evaluated by: K.I. \| Date: 02.08.1999 |
|---|---|---|

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 2 |
| Discharge 148.00 U.S.gal/min | Distance from the pumping well 37.00 ft |
| Static water level: 46.00 ft below datum | Pumping test duration: 2800.00 min |

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 151 | 74.00 | 213.62 | 167.62 | |
| 152 | 76.00 | 213.48 | 167.48 | |
| 153 | 78.00 | 213.32 | 167.32 | |
| 154 | 80.00 | 213.18 | 167.18 | |
| 155 | 82.00 | 213.02 | 167.02 | |
| 156 | 84.00 | 212.88 | 166.88 | |
| 157 | 86.00 | 212.74 | 166.74 | |
| 158 | 88.00 | 212.58 | 166.58 | |
| 159 | 90.00 | 212.44 | 166.44 | |
| 160 | 92.00 | 212.28 | 166.28 | |
| 161 | 94.00 | 212.14 | 166.14 | |
| 162 | 96.00 | 212.01 | 166.01 | |
| 163 | 98.00 | 211.87 | 165.87 | |
| 164 | 100.00 | 211.73 | 165.73 | |
| 165 | 120.00 | 210.38 | 164.38 | |
| 166 | 140.00 | 209.05 | 163.05 | |
| 167 | 160.00 | 207.84 | 161.84 | |
| 168 | 180.00 | 206.67 | 160.67 | |
| 169 | 200.00 | 205.56 | 159.56 | |
| 170 | 220.00 | 204.51 | 158.51 | |
| 171 | 240.00 | 203.47 | 157.47 | |
| 172 | 260.00 | 202.47 | 156.47 | |
| 173 | 280.00 | 201.45 | 155.45 | |
| 174 | 300.00 | 200.47 | 154.47 | |
| 175 | 320.00 | 199.54 | 153.54 | |
| 176 | 340.00 | 198.62 | 152.62 | |
| 177 | 360.00 | 197.76 | 151.76 | |
| 178 | 380.00 | 196.94 | 150.94 | |
| 179 | 400.00 | 196.13 | 150.13 | |
| 180 | 420.00 | 195.34 | 149.34 | |
| 181 | 440.00 | 194.57 | 148.57 | |
| 182 | 460.00 | 193.83 | 147.83 | |
| 183 | 480.00 | 193.10 | 147.10 | |
| 184 | 500.00 | 192.39 | 146.39 | |
| 185 | 520.00 | 191.71 | 145.71 | |
| 186 | 540.00 | 191.05 | 145.05 | |
| 187 | 560.00 | 190.42 | 144.42 | |
| 188 | 580.00 | 189.80 | 143.80 | |
| 189 | 600.00 | 189.20 | 143.20 | |
| 190 | 620.00 | 188.64 | 142.64 | |
| 191 | 640.00 | 188.05 | 142.05 | |
| 192 | 660.00 | 187.50 | 141.50 | |
| 193 | 680.00 | 186.98 | 140.98 | |
| 194 | 700.00 | 186.46 | 140.46 | |
| 195 | 720.00 | 185.95 | 139.95 | |
| 196 | 740.00 | 185.46 | 139.46 | |
| 197 | 760.00 | 184.99 | 138.99 | |
| 198 | 780.00 | 184.53 | 138.53 | |
| 199 | 800.00 | 184.09 | 138.09 | |
| 200 | 820.00 | 183.66 | 137.66 | |

**Waterloo Hydrogeologic**
180 Columbia St. W.
Waterloo,Ontario,Canada
ph.(519)746-1798

Pumping test analysis
Recovery method after
THEIS & JACOB
Confined aquifer



Project: Gilmore Engineering

Evaluated by: K.I. | Date: 02.08.1999

Pumping Test No. 1 | Test conducted on: 7/30/99

Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 2

Discharge 148.00 U.S.gal/min | Distance from the pumping well 37.00 ft

Static water level: 46.00 ft below datum | Pumping test duration: 2800.00 min

| | Time from end of pumping [min] | Water level [ft] | Residual drawdown [ft] | |
|---|---|---|---|---|
| 201 | 840.00 | 183.24 | 137.24 | |
| 202 | 860.00 | 182.81 | 136.81 | |
| 203 | 880.00 | 182.40 | 136.40 | |
| 204 | 900.00 | 181.99 | 135.99 | |
| 205 | 920.00 | 181.58 | 135.58 | |
| 206 | 940.00 | 181.19 | 135.19 | |
| 207 | 960.00 | 180.79 | 134.79 | |
| 208 | 980.00 | 180.41 | 134.41 | |
| 209 | 1000.00 | 180.02 | 134.02 | |
| 210 | 1200.00 | 176.36 | 130.36 | |
| 211 | 1400.00 | 172.68 | 126.68 | |
| 212 | 1600.00 | 169.25 | 123.25 | |
| 213 | 1800.00 | 166.41 | 120.41 | |
| 214 | 2000.00 | 164.25 | 118.25 | |
| 215 | 2200.00 | 162.81 | 116.81 | |
| 216 | 2400.00 | 161.93 | 115.93 | |
| 217 | 2600.00 | 161.34 | 115.34 | |
| 218 | 2800.00 | 160.98 | 114.98 | |

| **Waterloo Hydrogeologic**<br>180 Columbia St. W.<br>Waterloo,Ontario,Canada<br>ph.(519)746-1798 | Pumping test analysis<br>Recovery method after<br>THEIS & JACOB<br>Confined aquifer | Page 7 | |
|---|---|---|---|
| | | Project: Gilmore Engineering | |
| | | Evaluated by: K.I. | Date: 02.08.1999 |

| | |
|---|---|
| Pumping Test No. 1 | Test conducted on: 7/30/99 |
| Uppaway Well No. 2 (Observation Well) | Uppaway Well No. 2 |
| Discharge 148.00 U.S.gal/min | |
| Pumping test duration: 2800.00 min | |

| | Discharge<br>[U.S.gal/min] | Water level below datum<br>[ft] | Drawdown<br>[ft] | |
|---|---|---|---|---|
| 1 | 148.27 | 221.84 | 175.84 | |