

DEQ #04-06-07

Engineering Report

**PART 1: EXISTING SUBDIVISIONS
AND THE PROPOSED
LAKEFRONT SUBDIVISION**

**PART 2: THE EAST SHORE FUTURE
DEVELOPMENT MASTER PLAN**

BEAR LAKE, IDAHO

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IDAHO DEPARTMENT OF
ENVIRONMENTAL QUALITY

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the water and sewer service. At the time of the formation of the ESWC, BLS deeded assets (water well, water reservoir, sewage lagoons, and associated infrastructure) to the East Shore Water Company for water shares and an exclusive right to expand the water and sewer system, as necessary, for future development (see Deeds, Appendix C).

Currently a board of directors, which includes the following individuals, directs the company: Jack P. Balling (P.E. President), James Nebeker (Vice President), Dale Capps (Sec./Treas.), Steven Spencer (Electrical Engineer), Terry Smith (Meters and Inspection), DonRey Secrist (Meters and Inspection), Jim Child (Water Meters, valves, and mains), and Scott Balling (P.E. Idaho). The board meets twice a year or as needed to meet the needs of the company. Each water connection is given one vote as shareholder and the connection is the verification of the stock certificate as long as the water is used and the fees are paid.

The ESWC has issued a "will serve" letter to the developer of the proposed Lake Front Subdivision. After the agreed upon items within the letter are completed the ESWC will provide water and sewer services to the proposed subdivision (see ESWC Will Serve Letter, Appendix C).

3.0 Water System: Existing and Proposed Lakefront Infrastructure

The existing water system serves 53 water connections in the East Shore Subdivision, Bear Lake Sands 2 Subdivision, and the Bear Lake Villas Subdivision. There are only 38 shareholders in the ESWC, due to the fact that some of the lot owners have more than one connection. In 1993 a detailed as-built drawing was created of the water and sewer system (see East Shore Water Company Water and Sewer System, Appendix B). The system is self-contained and operates with the following infrastructure:

- Well
 - A 16" Well equipped with a 20 h.p. Grunfos Pump with a 230 Volt, 3-phase Hitachi Motor (see East Shore Subdivision Culinary Water Pump House Details, Appendix B).
 - Wellhead Elevation 5848 feet (mean sea level (msl))
 - Submersible pump
 - 180 gpm
 - Pump elevation is 125 ft below ground elevation
- A 6-ftx10-ft concrete pump house, equipped with a 3" check valve, 3" Badger Meter, 3" surge valve into an 8" discharge line (see East Shore Subdivision Culinary Water Pump House Details, Appendix B).
- 96,000-gallon Water Reservoir (40' x 24' x 15') (see Water Reservoir As-Built, Appendix B)
 - Reinforced Concrete

- Elevation 6,120 feet
- Piping, Valves and Fire Hydrants
 - 1600 lf of 10-inch PVC pipe (reservoir supply line)
 - 3300 lf of 8-inch PVC pipe (supply line)
 - 1150 lf of 6-inch PVC pipe (supply line)
 - 700 lf of 3-inch PVC pipe (supply line)
 - 1400 lf of 2-inch PVC pipe (supply line)
 - 54 – ¾" water laterals and meters
 - 5 – 6-inch Centurion Fire Hydrants Mueller A 423
 - 3 – 10-inch gate valves with boxes
 - 2 – 8-inch gate valves with boxes
 - 3 – 6-inch gate valves with boxes
 - 3 – 3-inch gate valves with boxes

3.0.1 Existing Water Usage

Table 1 below shows the water usage from 2005.

Table 1: Water Usage (2005)

Subdivision	Connections	Total Water Usage (Annual-Gallons)
East Shore Subdivision	30	2,510,000
Bear Lake Sands # 2	17	3,786,280
Bear Lake Villas	6	116,410
TOTAL	53	6,412,690

The above water usage values for 2005 reflect the indoor and irrigation water consumption. From the meter readings it is estimated that 90% of the water consumption is from May 1st to November 1st. During the six winter months the irrigation lines are drained and the most homes are winterized. The last five-year average annual water usage for the company is 6,625,000 gallons, which includes the indoor and irrigation consumption. The 2005 annual water usage is within three percent of the five-year annual average water usage. The five-year annual water usage value will be used to calculate the gallons per day per connection. Since 90% of the water usage takes place during a six month period the average water usage per connection is as follows:

$$\begin{aligned}
 &90\% * 6,625,000 \text{ gallons / year} = 5,962,500 \text{ gallons / year} \\
 &\frac{5,962,500 \text{ gallons / year}}{6 \text{ months} * 30 \text{ days}} = 33,125 \text{ gallons / day} \\
 &\frac{33,125 \text{ gallons / day}}{53 \text{ connections}} = 625 \text{ gallons / connection / day}
 \end{aligned}$$

Therefore the *average daily* consumption of water per connection is 625 gallons, which value includes the **indoor and outdoor** consumptive uses.

3.0.2 *Existing Source Capacity*

The existing source for the system is an underground well with a capacity of 162 gallons per minute (gpm), based upon a pump test completed by Lance Anderson, a licensed Engineer in the State of Idaho (see Pump Test, Appendix C). The pump test was performed by monitoring the flow meter in the pump house for a specified amount of time. The 162 gpm-pump test is within the design range specified by the pump curve provided by Mountain States Pumps for the Grunfos pump. With a flow rate of 162 gpm the total dynamic head is 320 feet with efficiency of 73% (see Grunfos Pump Curve, Appendix C). Westlake Drilling completed the well in 1980 (see Well Drillers Report, Appendix C) and the well pump tested at 400 gpm. It is the opinion of Cache-Landmark that the existing well has a capacity of 400 gpm, even though the flow test with the existing pump yielded only 162 gpm. This topic will be discussed in detail in section 3.0.5 of this report.

As-built drawing of the pump house is shown on the *Pump House Details* sheet (see Appendix B). The specifications for the construction of the pump house can be seen in Appendix D. The well lot is owned by the ESWC (see Deeds, Appendix C) and is 0.2031 acres. The well lot provides direct access to the well and pump house from the County Road (see Boundary Survey, Appendix C). The permit to appropriate water was received by James Nebeker of BLS on the 23rd of July, 1990 (see Permit to Appropriate Water, Appendix C) and the proof of beneficial use was approved on the 14th of April, 1997 (see Water Right No. 11-7372, Appendix C).

By Idaho State law a water system with more than 25 connections is required to have a second water source. As part of the Lakefront Subdivision BLS plans to install a new well, located east of the existing county road (see C-2.1, Appendix B).

3.0.3 *Lakefront Subdivision New Water Source*

The proposed well site has been approved by Department of Environmental Quality Idaho (DEQ Idaho) and will be constructed as part of the Lakefront construction (see C-2.1, Appendix B). Based upon the report *Source Water Assessment Delineation Report: East Shore Subdivision, Bear Lake County, Idaho, Well No. 2* prepared by Scott H. Clark, a Professional Geologist, the proposed well site has the following aquifer characteristics as shown in Table 2.

Table 2. Aquifer Characteristics (Scott H. Clark, 2006)

Characteristic	Value
Transmissivity (T)	1800 ft ² /d
Hydraulic Conductivity (K)	18 ft/d
Gradient of groundwater flow (i)	0.040
Direction of groundwater flow	N 90° W
Discharge (Q = gpd)	400 gpm or 576,000 gpd
Porosity (n)	0.20
Aquifer thickness (b)	100 ft

The estimated discharge from the well is 400 gpm. The new well will be connected to an existing 8-inch water main at the north side of the East Shore Subdivision (see C-2.1, Appendix B).

After completion of the well site BLS will deed the well and associated equipment, land, and any other considerations to the ESWC. Based upon the agreements of the ESWC, BLS has the exclusive right to expand the water system for future development. The new well will provide the second water source, which is required per Idaho State law and also will provide additional capacity to the ESWC water system.

3.0.4 Water System Capacity Analysis

The State of Idaho requires that with any pump out of service, the remaining pump or pumps shall be capable of providing the peak hour demand of the system or maximum day demand plus equalization storage (Idaho Administrative Code 58.01.08.541.02). The proposed new well is designed to have a capacity of 400 gpm, the existing well has a capacity of 162 gpm. The water system capacity will be calculated with the new well out of service, while meeting the **peak hourly demand** of the system.

The peak hourly demand of the system will be calculated from the average measured water demand of the current East Shore Water System. Based upon the recommendation from DEQ in the letter dated August 24, 2007, comment seven, the preferred method of determining the peak day demand rate is by actual measurements of the system. Based upon Cache-Landmark's experience designing and analyzing water systems the ratio of the peak hourly demand to the average daily demand is approximately a value three. Due to the fact that the East Shore Water

System is small, recreational resort, Cache-Landmark recommends a ratio of peak hourly demand to average daily demand of three and half.

The measured average daily water value from section 3.0.1 is 625 gallons per day per unit, which includes *indoor* and *outdoor* consumption. Based upon the ratio of three and half, described above, the peak hourly water demand per unit is described below:

$$\frac{\text{PeakHourlyDemand}}{\text{Connection}} = \frac{625 \text{ gallons / day / connection} * 3.5}{24 \text{ hours}} = 91.15 \text{ gallons / hour}$$

The peak hourly demand for the ESWC is 91.15 gallons per hour based upon actual measured flow data. Table 3 shows the peak hourly demand for the existing subdivisions and the proposed 11-lot Lakefront subdivision.

Table 3. Lakefront and Existing Development Peak Hourly Demand
Lakefront and Existing Development Connections Peak Hourly Demand

	# Units	Units	Volume Required		Volume
Indoor & Outdoor					
<i>Residential Indoor and Outdoor Proposed ¹</i>					
Lake Front	11	lots	91.15	gph	1002.65
<i>Subtotal (gpd)</i>					1002.65 gallons/hour
<i>Residential Indoor and Outdoor Existing ¹</i>					
East Shore Subdivision	63	connections	91.15	gph	5742.45
Bear Lake Sand 2	20	connections	91.15	gph	1823.00
Villas	6	connections	91.15	gph	546.90
<i>Subtotal (gpd)</i>					8112.35 gallons/hour
<i>Total Indoor and Outdoor</i>					9115.00
Total Peak Hour Water Demand (gpd)					9115.00 gallons/hour
Total Peak Hour Water Demand (gpm)					151.92 gallons/minute

¹ The peak day demand is equal to 3.5*average day demand, which is based upon an actual measured, value of 625 gpd.

Table 3 illustrates that a peak hourly demand per connection of 91.15 gallons/hour yields a total of 9,115 gallons/hour, which equals a value of 151.92 gallons per minute. As was stated above, Idaho Administrative Code 58.01.08.541.02 requires with any pump out of service the remaining pump shall be capable of meeting the peak hourly demand. Section 3.0.2 of this report references a pump test of the existing well. The pump test yielded 162-gpm capacity of the current pump (with a capacity that could be 400 gpm). With the proposed new well out of service (proposed 400 gpm) the existing well shall be capable of meeting the peak hourly demand rate of 151.92 gpm (see Table 3). The existing well is capable of meeting the peak hourly demand rate with an excess capacity of 10.09 gpm, with the potential of having 248.09 gpm excess capacity if the existing well does indeed have the capacity to yield 400 gpm.

It is the recommendation of Cache-Landmark Engineering that the existing water system with the addition of the new water well has sufficient capacity to service the existing three subdivisions and the proposed 11-lot Lakefront Subdivision to meet Idaho State standards.

3.0.5 Fire Flow Analysis

According to Idaho Administrative Code 58.01.08 subsection 501-17, which pertains to redundant fire flow capacity, states that a public water system shall provide the maximum day demand plus fire flow instead of the peak hour demand plus fire flow. Pumping systems supporting fire flow capacity must be designed so that fire flow may be provided with the largest pump out of service. The system will be analyzed in this section while meeting the maximum day demand plus fire flow.

According to Appendix B, Section B105 of the 2006 International Fire Code the fire flow requirement for one and two family dwellings having a fire-flow calculation area that does not exceed 3,600 square feet shall be 1,000 gallons per minute. Bear Lake County, the local fire authority, has a fire flow requirement of 500 gpm for two hours. But the fire flow requirement from the IRC of 1,000 gpm for two hours will be used for this project (see Fire Marshall Approval Letter, Appendix C).

Based upon Cache-Landmark's experience with design and analysis of water works systems the ratio of maximum day demand and average day demand is two. A ratio of two will be used for this project. Table 4 shows the maximum day demand values for the existing subdivisions (East Shore, Villas, and Bear Lake Sands 2) plus the proposed 11-lot Lakefront Subdivision.

Table 4. Lakefront and Existing Development Max Day Demand

Lakefront and Existing Development Connections Max Day Water Demand

	# Units	Units	Volume Required	Volume
Indoor & Outdoor				
<i>Residential Indoor and Outdoor Proposed¹</i>				
Lake Front	11	lots	1,250 gpd	13,750
<i>Subtotal (gpd)</i>				13,750 gpd
<i>Residential Indoor and Outdoor Existing¹</i>				
East Shore Subdivision	63	connections	1,250 gpd	78,750
Bear Lake Sand 2	20	connections	1,250 gpd	25,000
Villas	6	connections	1,250 gpd	7,500
<i>Subtotal (gpd)</i>				111,250 gpd
		<i>Total Indoor and Outdoor</i>		125,000
Total Max Day Demand (gpd)				125,000 gpd
Total Max Day Demand (gpm)				87 gpm

¹ The maximum day demand is equal to 2*average day demand, which is based upon an actual measured, value of 625 gpd.

Table 4 shows a value of 125,000 gpd or 87 gpm for the maximum day demand value. Based upon Idaho Administrative Code 58.01.08.501.17 the water system shall provide the maximum day demand plus fire flow, with the largest pump out of service. Thus the required fire flow capacity is 1,000 gpm for a two-hour period (fire flow) and 87 gpm (maximum day demand) for a total of 1,087 gpm.

The existing storage capacity of the water system is a 96,000-gallon reservoir (see East Shore Water Company Water and Sewer System, Appendix B). DEQ commented that the storage within the piping system is considered dead storage. Section 58.01.08.12.a of the Idaho Administrative Code details that dead storage "is either not available for use in the system or can provide substandard flows and pressures." It is the opinion of Cache-Landmark Engineering that the storage in the 10-inch supply line from the water well to the reservoir would not be considered dead storage, because it is available to the system and would provide adequate flows and pressure. The length of the 10-inch supply line is 1,702 feet (see East Shore Culinary Water Pumping System Plan and Profile, Appendix B). The supply line has 6,940-gallons of available storage, for a total of 102,940-gallons of storage combined with the reservoir.

The required storage capacity to meet the 1,000 gpm for two-hour fire flow capacity is 120,000 gallons. The existing storage shall account for 102,940 gallons leaving 17,060-gallons or 142.18 gpm to be handled by the existing well, plus the 87 gpm maximum day requirement for a total of 229.18 gpm. The existing well has a capacity of 162 gpm based upon the pump test (see Section 3.02), which is 67.18 gpm short of the needed flow capacity to meet fire flow requirements plus maximum day demand. It is the opinion of Cache-Landmark that the current East Shore Water System does not have sufficient storage capacity and flow from the existing pumps to meet the State of Idaho requirements. Cache-Landmark recommends that a flow test be performed on the existing well. When the existing well was originally flow tested in 1980 (see Well Drillers Log, Appendix C) it had a capacity of 400 gpm, which could be verified by a flow test. Idaho DEQ recommended using a higher flow rate than the flow test value of 162 gpm, with proper justification. If the flow test verifies that the well is capable of producing 300-400 gpm, then it is the recommendation of Cache-Landmark to upgrade the existing pump with a new pump capable of pumping 300-400 gpm. The new well would need to be capable of pumping at least 229.18 gpm, but Cache-Landmark recommends that the new well be able to pump 300 gpm.

If the flow test shows that the well is not capable of producing more than the required 229.18 gpm, then the East Shore Water Company shall be required to add storage volume to the existing reservoir. Currently the

storage capacity of the reservoir and 10-inch supply line is 102,940 gallons. If storage is added Cache-Landmark recommends that an additional 20,000 gallons be added to the system. The 20,000 gallons would provide the system with a total storage volume of 122,940 gallons, which would provide sufficient storage for the fire flow requirement of 1,000 gpm for two hours or 120,000 gallons. The existing pump would then have the capacity to meet the maximum day demand of 87 gpm.

Because the existing pump is supplying a portion of the fire flow requirement, section 58.01.08.501.07 of the Idaho Administrative Code requires that new community water systems have sufficient dedicated on-site standby power, with automatic switch-over capability, and/ or storage so that water may be treated and supplied to pressurize the entire distribution system during power outages. Therefore the new well will be equipped with standby power. A electrical line will be run from the standby power source to the existing water pump station to supply power in the case of emergency. The area is not accessible to gas, so it is recommended that propane be used to fuel the standby generators.

3.0.6 Existing Subdivisions plus Lakefront Water System Distribution Analysis

A water model was created to analyze two scenarios for East Shore, Bear Lake Villas, and Bear Lake Sands 2 and the proposed Lakefront subdivisions, the two scenarios are as follows: maximum day demand plus fire flow and peak hourly demand. The purpose of the analysis is to ensure the pressure ranges are acceptable and to determine if pressure reducing valves or pressure boosting pumps are needed. Haestad WaterCAD v6.0 was used to create the water model. A .dxf file was exported from the AutoCAD drawing to WaterCAD to best simulate the layout of the water system. The peak hourly and maximum day demands were calculated (see Tables 3 and 4) and inserted into the model. The water model created outputs that allowed for analysis of pipe velocity, pressures and head loss. These outputs allowed for a dynamic design of the water system to maximize the capacity of the proposed pipelines, while maintaining the guidelines of best engineering practice.

The water model incorporates the existing water system along with the proposed Lakefront Subdivision. This section will focus on the pressure ranges within the East Shore, the Bear Lake Sands 2, the Bear Lake Villas, and the Lakefront subdivisions.

The Idaho Department of Environmental Quality requested that Cache-Landmark model the max day demand plus fire flow and the peak hourly

demand (see Max Day Demand including Fire Flow and Peak Hourly Demand for Pressure Zone 1, Appendix E). Based upon the water model it was determined that the pressure ranges at maximum day demand with fire flow within the existing system (including the Lakefront) are from 42.87 to 67.93 psi (see Scenario: Max Day Demand including Fire Flow, Pressure Zone 1, Appendix E). The peak hourly demand model showed that the pressure ranges in the existing system (including the Lakefront) are from 42.22 to 88.29 psi (see Scenario: Peak Hourly Demand, Pressure Zone 1, Appendix E). The State of Idaho Rules for Public Drinking Water Systems requires that a system shall maintain a minimum static pressure of 40 psi and a maximum static pressure of 100 psi. The pressure ranges within the system at max day demand plus fire flow and peak hourly demand are within the State of Idaho guidelines for acceptable pressures. Therefore pressure reducing valves or booster pumps will not be needed within pressure zone 1, which includes the existing subdivisions and the addition of the Lakefront Subdivision.

The fire flow analysis was completed with the largest pump out of service to verify that 1,000 gpm is available at all nodes representing fire hydrants and that a minimum pressure of 20 psi is available everywhere in the system. The fire flow report in Appendix E shows that all nodes in the system have at least 20 psi and that the nodes representing fire hydrants indeed can supply 1,000 gpm.

The pressure ranges and the water model of the future development area will be explored in a future section of this ER.

4.0 Sewer System: Existing and Proposed Lakefront Infrastructure

The sewer system is operated and owned by the East Shore Water Company (ESWC) and only serves the homes in the East Shore Subdivision. There are 27 total existing sewer connections in East Shore with 36 vacant lots. The Bear Lake Sands 2 and the Bear Lake Villas subdivisions have individual septic tanks. The Company's existing sewer infrastructure consists of gravity distribution lines, two sewer lift stations, and sewer lagoon system (four cells). The lagoons were constructed in the early 1970's (originally with three cells). See Sheet C-2.1, ESWC Water and Sewer System, and the Sewer Lagoon As-Built in Appendix B for the existing sewer system as-built information. The specifications for the construction of the sewer and associated upgrades can be found in Appendix D. The certified operator of the sewer system is Mr. Boyd VanDarlin.

Of the four sewer lagoon cells only one cell is being used to treat the wastewater effluent. The active treatment area in the cell is approximately 110,180 cubic feet or 824,201 gallons (see Sewer Lagoons As-Built, Appendix B).