

# Shangri-La Shores, Inc. Seawater Mitigation Plan

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## MITIGATION PLAN – SEAWATER INTRUSION

### A. OVERVIEW

The Island County Health Department has identified the western area of Sections 8 and 17, Township 31 North, Range 2 East, W. M. (east of Race Road) as being in a “high risk” area for seawater intrusion. This is verified by water quality monitoring results from August 12, 2010 showing chloride and conductivity levels of 120 mg/L and 859 µmhos/cm, respectively.

The following is a summary of Island County Seawater Intrusion Policy “Risk Categories”, June 6, 2005:

Risk Category	Water Level Elevation (feet)	Chloride Concentration (mg/L)
Low	Greater than 8.4	Any level
Medium	Less than or equal to 8.4	Less than 100
High	Less than or equal to 8.4	Between 100 and 250
Very High	Less than or equal to 8.4	Greater than 250

Water level elevation refers to Mean Sea Level (MSL) datum.

The flowing mitigation plan was prepared to provide guidance in the management of the water system to minimize the risk of seawater intrusion.

### B. SUMMARY OF SYSTEM INFORMATION

The following system information is relevant to the seawater mitigation plan.

#### Source:

The system is supplied from one well located on Lot 1 in Block 1 in the plat of Shangri-La Shores, Inc. Division 1 in the Southwest Quarter of Section 8, Township 31 North, Range 2 East, W.M. The 6-inch diameter well was drilled in 1963 to a depth 155 feet and equipped with a 5-foot long screen located at a depth of 150 to 155 feet. The well has a Washington State Department of Ecology identification number AGA984. The well log shows that the well was developed in water gravel starting at a depth of 150 feet. The well log indicates an aquitard consisting of hardpan from a depth of 139 to 150 feet.

The well is located approximately 720 feet from Saratoga Passage.

The source has a Washington State Department of Ecology water right certificate, Number 6500, for 50 gpm instantaneous withdrawal and for 45 acre-feet annual withdrawal.

The current well production rate is 43 gpm.

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A future well site was secured with the easement purchased in 1992 for the new water storage reservoir ("Reservoir Easement"). The 100 foot by 217 foot easement is located west of Race Road on Parcel R23118-436-0240. The site is approximately 1,900 feet from Saratoga Passage. With the Reservoir Easement, a restrictive covenant was not obtained for the future well's 100-foot sanitary control radius, but the Reservoir Easement prohibits the owner of the Parcel from making any use of the Parcel that may impair, disrupt, or impede the use of the easement by Shangri-La Shores, Inc.

The following is a summary of the monthly well production in summer months:

### Summer Water Use

Month	Day	Year	Water Use (gallons)	Water Use/Conn. (gpd)	Water Use/Full Time Conn. (gpd)
June	28	2007	142,960	51.9	186.9
July	5	2007	34,770	92.0	331.1
August	7	2007	131,220	73.6	265.1
Sept.	10	2007	151,140	82.3	296.4
June	17	2008	147,880	65.2	234.7
July	8	2008	107,560	94.9	341.5
August	5	2008	179,290	118.6	426.9
Sept.	2	2008	125,410	82.9	298.6
June	25	2009	172,453	93.9	338.1
July	1	2009	43,798	135.2	486.6
August	20	2009	334,482	123.9	446.0
Sept.	17	2009	137,410	90.9	327.2

### Storage and Pumping:

Storage is provided in one concrete reservoir with a nominal total volume of 79,000 gallons. Well control is by level probes (electrodes).

Water is supplied to the entire system by gravity.

### Water Quality and Treatment:

The following is a summary of the major water quality parameters (May 6, 2010):

Parameter	Units	MCL	Results
Arsenic	mg/L	0.010	0.005
Iron	mg/L	0.30	0.10
Manganese	mg/L	0.05	0.0
Hardness	mg/L	-	300
Chloride	mg/L	250	119
Conductivity	µmhos/cm	700	<b>817</b>

No treatment is currently provided. The source water is not chlorinated.

## **Distribution System**

The entire distribution system was replaced in 1995. The new water mains are 4 and 6-inch C900 PVC.

## **C. HYDROGEOLOGIC EVALUATION**

The well is completed in the sea level aquifer. Water is pumped from a fresh water lens floating on the underlying seawater. The thickness of the lens decreases from the center of the island towards the coastline. The interface between the fresh and seawater is not a sharply defined boundary. The level of chloride and conductivity, indicators of the presence of seawater, increases with depth.

The elevation of the fresh/seawater interface is lowered during periods of high precipitation; and raised during periods of low precipitation. The highest interface, and thus highest chloride concentration at the well, would be expected in the summer and early fall. The fresh water lens is recharged entirely from rainfall.

The tides may have a relatively high influence on the water level in wells in the sea level aquifer. Tidal influences have a direct relationship with chloride levels; high tides raise the fresh/seawater interface. No measurements have been made of the tidal influence in the source of supply.

In the existing well the increase in chlorides is likely due to upwelling (also referred to as upconing). Upwelling is the raising of the fresh/seawater interface to a point where a production well begins to induce a greater concentration of seawater. Upwelling does not have a permanent detrimental effect; chlorides levels are reduced with decreased pumping, increased precipitation, etc.

The upwelling effect on the fresh/seawater interface is decreased by reducing the pumping rate of the well. For each foot of drawdown during pumping, interface between the fresh and seawater rises in the shape of an inverted cone about 20 feet. When using widely spaced multiple wells, the pumping rate from each well can be reduced, and thus, the upwelling reduced.

## **MITIGATION PLAN**

The goal of the mitigation plan is to maintain withdrawal of groundwater with less than 100 mg/L of chloride.

The mitigation plan consists of the following components:

- 1) Weekly monitoring of chloride level during the summer and early fall.
- 2) Change of well pumping rate to minimize chloride level (upwelling).
- 3) Promotion of water conservation to allow for reduced pumping rate.
- 4) Along with reduced well pumping rate use standby storage (reservoir) for multi-day recovery.
- 5) Replace or supplement the existing well with new well at reservoir site (up gradient).
- 6) Construct an additional reservoir for multi-day storage.

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In the event that Island County or Washington State Department of Health sets a limit on the number of new customers until the chloride level is reduced (for example, 6 added connections), or if the chloride level reaches 175 mg/L the Water Service Policies will be amended to impose a requirement that a new customer start construction within one-year. The recommended wording for this provision is provided in Attachment A.

### **Well Monitoring**

The monitoring plan consists of the following:

1. A water sample for the system operator's field analysis of chloride should be collected each week from the well. The sample should be collected after the well has been in operation for at least 4 (four) hours to establish the stable pumping level (drawdown).
2. Well meter and hour meter readings should be recorded at the time of collection of the sample for the measurement of chloride level.
3. Each three months, for quality control, a water sample (split of the sample used for field measurement) should be collected from the well for laboratory analysis of chloride and conductivity.
4. Static and pumping water level depths in each well should be measured monthly. For an accurate assessment of the static water level elevation (above mean sea level), the top of casing elevation should be obtained from a licensed surveyor using a direct observation GPS measurement (to 0.1 foot).

Weekly field chloride measurement is done using a HACH test kit or equivalent. The results from the HACH kit are normally higher than those obtained from samples collected for laboratory analysis. They may be in error by 20 mg/L (reading increment).

The frequency of measuring chloride level should be increased to daily when the chloride level remains above 120 mg/L for three consecutive readings or a single reading is greater than 150 mg/L. The frequency of readings may be reduced to weekly once the chloride level falls below 120 mg/L for three consecutive readings.

### **Well Operation**

When the chloride level increases to the level described above, the system operator shall throttle the well discharge valve to reduce the flow rate. The flow rate should be adjusted to the average daily rate divided by 1,440 minutes (number of minutes in the day). The system operator should then monitor chloride levels and water production daily. Water production should be adequate to recover the reservoir level within a 24-hour period. If the chloride level cannot be maintained at 120 mg/L or below, the system operator shall implement the first stage of the water conservation plan.

To minimize the cost of employing the system operator, the daily monitoring of well production and adjustment of well production is limited to the time of year when chloride levels exceed 120 mg/L. This is normally in the summer and fall period.

### **Water Conservation Plan**

The water conservation plan for seawater mitigation shall consist of the following:

- a) In the Consumer Confidence Report provide a reminder that water conservation is necessary to prevent seawater intrusion.
- b) When the chloride level exceeds 100 mg/L, mail a notice to customers (or provide e-mail notification where available) reminding them to conserve water.
- c) When the chloride level increases to the level described above, and well operation fails to be effective in reducing the chloride level, implement water use restrictions in the following order of severity that:
  - Bans outside water use for washing vehicles, boats, power washing, and filling of pools, hot tubs and Jacuzzis.
  - Bans lawn watering.

Water meters are installed on all of the customer's properties to record water usage. To encourage water conservation, the Shangri-La Shores, Inc. Board has established guidelines that encourage water conservation, and those going beyond the established guidelines will be assessed additional fees.

### **Use of Standby Storage**

The recommended amount of standby storage is the volume equal to one maximum day demand. Standby (or emergency) storage is provided to operate the system during the period need to repair a well pump. Where multiple wells supply the reservoir, it is assumed that the highest producing well is removed. A credit may be applied against the recommended standby storage equal to the daily production from the remaining wells. Where fire flow storage is needed (15,000 gallons for the Shangri-La Shores, Inc. system), Island County permits the fire storage to be "nested" not added to the standby storage. The greater of the two storage components must be provided.

The provision of standby storage is a recommendation (not a requirement) of the Washington Department of Health *Design Guidelines*. The amount of standby storage may be reduced below the recommended level in the *Design Guidelines* if "community expectations are amenable to a lesser standby storage capacity".

A maximum day demand seldom occurs on consecutive days. A two or three day running average may be significantly less than the maximum day demand. If needed, the well pumping rate can be adjusted (lowered) to match the two or three day average rather than to recover (fill) the reservoir following the maximum day demand.

### **Replace or Supplement the High Chloride Well**

A new well constructed at the reservoir site would tap the aquifer up gradient from the

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existing well. The static and pumping water levels should be higher, thus reducing the risk on seawater intrusion by upwelling. Also, the use of both the new and old well would allow the required production to be split between the two wells. The pumping rate of the old well would be restricted to ensure the chloride level would remain below 100 mg/L. The balance of production would be obtained from the new well. For the use of both the old and new well it is assumed that the wells are not in alignment with the groundwater flow pattern in such that withdrawal from the new well would interfere with old well.

The advantage of a new well to supplement the existing well is a reduction can be made in the amount of standby storage. Also, two wells provide redundancy for a well casing failure or other well maintenance problem that requires significant time to correct.

RCW 90.44.100(3) allows for the drilling of a second or subsequent well to withdrawal water under an existing water right permit or certificate. The major stipulations for approval of the second well are:

- The well is an additional or replacement well that will tap the same body of public ground water as the original well; and
- The combined withdrawal does not exceed the quantity authorized by the water right.

Generally, the second well must be within the water right description of the place of withdrawal, or otherwise within 1,000 feet distance from the existing well and within the same quarter section of land.

Without qualifying under this regulatory provision, an application must be submitted to and approved by the Washington State Department of Ecology for a change in the water right permit or certificate place of withdrawal. The time to receive approval of the change in place of withdrawal depends on the work load and staffing at the Washington State Department of Ecology. Historically, it has taken years to receive approval unless the Washington Department of Health certifies that the new well is needed for public health reasons. Mitigation of seawater intrusion, unless the chloride level exceeds the regulatory maximum contaminant level (MCL) of 250 mg/L, does not constitute a public health hazard.

The Reservoir Easement where the future well is proposed is approximately 1,400 feet in distance from the existing well and within a different quarter section.

The Reservoir Easement where the future well is proposed is 100 feet wide by 217 feet deep. The requisite sanitary control radius for a well supplying a public water system is 100 feet. The Reservoir Easement does not contain provisions for a restrictive covenant from the property owner that granted the easement (Parcel R23118-393-5090), nor with the adjacent property owner (Parcel R23118-436-0240) where a portion of a 100-foot sanitary control radius would extend. The restrictive covenant contained in the Reservoir Easement granted by the property owner and recorded with the Island County Auditor prohibits the owner of the Parcel R23118-393-5090 from making any use of the Parcel that may impair, disrupt, or impede the use of the easement by Shangri-La Shores, Inc. and this restrictive covenant may be utilized to prevent the construction of facilities or use of that Parcel in a manner that would pose a risk of contamination of the well, such as installation of a septic system, construction of a pig pen, etc.

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Without first obtaining a restrictive covenant from each impacted property, approval from the Washington State Department of Health is needed for construction of a well with less than a 100-foot sanitary control radius. Approval has been granted for a smaller sanitary control radius where the new well is a replacement well or a needed additional point of withdrawal.

To obtain approval for a well with a sanitary control radius of less than 100-feet the well construction method must be submitted to and approved by the Washington State Department of Health. The measures used to mitigate a smaller than standard sanitary control radius includes, but are not limited to:

- Provide a bentonite surface seal around the well casing in a greater depth than the standard minimum seal depth of 18-feet. Preferably the bentonite seal would be extended into the underlying clay aquitard.
- Sloping of the ground surface to carry runoff water away from the well site.
- Installing a French drain along the property line of the easement to intercept the surface and shallow groundwater flow and carry it downhill from the well site.

### **Additional Storage**

Additional storage would allow for a greater number of days for recovery of storage following peak demand periods, and thus, a lower withdrawal rate of water from the sea level aquifer. For the reason of cost, this is the last task considered in the mitigation plan. The Reservoir Easement is large enough to accommodate two reservoirs.

**Attachment A**  
**Recommended Service Policy Addition**

- Except in the case of an Application submitted in connection with any existing physical connection in place prior to the adoption of these Water Service Policies or with a change of ownership of a parcel of land, the Purveyor shall accept a signed *Application for Water Service* only on the condition that Customer will be required to commence construction of a dwelling unit on the parcel of land described in the *Application for Water Service* within one (1) year of the date (“Acceptance Date”) that the Purveyor conditionally agrees to provide Water Service to the parcel of land owned by the Customer and delivers to the Customer a copy of the acceptance of the Application for Water Service signed by the Purveyor. If the Customer thereafter fails to commence construction of a dwelling unit on the applicable parcel of land owned by the Customer described in the *Application for Water Service* within the prescribed period, the *Application for Water Service* will be voided and the Purveyor will refund to the Customer the amount of the Connection Fee and other applicable fees paid by Customer to Purveyor on the date the *Application for Water Service* was submitted to the Purveyor, but without interest; provided that no refund will be made to the Customer for any water rate fees and charges or for any actual costs incurred by the Purveyor for any materials and labor of installation of any water meter or service pipe, if applicable, for the benefit of the Customer. For good cause and upon written request submitted by the Customer to Purveyor prior to the end of the prescribed period, an extension may be granted for a period up to six (6) months. An *Application for Water Service* shall not be accepted by Purveyor for the purpose of a Customer pre-servicing a parcel of land prior to its sale by a Customer. The Customer shall demonstrate intent to construct a dwelling on the parcel of land described in the Application by attaching a full set of building plans for the dwelling along with a copy of the application for a County building permit for the dwelling or other such evidence of intent deemed satisfactory to the Purveyor at its sole discretion.