



STAFF REPORT

Report To: Board of Supervisors

Meeting Date: 02/04/16

Staff Contact: Darren Schulz, Public Works

Agenda Title: Reclaimed Water Update and Discussion

Staff Summary: A presentation from Manhard Consulting and discussion on the reclaimed water storage and utilization considerations

Agenda Action: Other/Presentation

Time Requested: 15 Minutes

Proposed Motion

Presentation and discussion only

Board's Strategic Goal

Sustainable Infrastructure

Previous Action

N/A

Background/Issues & Analysis

N/A

Applicable Statute, Code, Policy, Rule or Regulation

N/A

Financial Information

Is there a fiscal impact? Yes No

If yes, account name/number:

Is it currently budgeted? Yes No

Explanation of Fiscal Impact: N/A

Alternatives

Board Action Taken:

Motion: _____

1) _____

2) _____

Aye/Nay

(Vote Recorded By)

CARSON CITY
RECLAIMED WATER
STORAGE AND UTILIZATION CONSIDERATIONS

Prepared for:

Carson City Public Works

Carson City, Nevada

Prepared by:



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January, 2016



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CARSON CITY
RECLAIMED WATER
STORAGE AND UTILIZATION CONSIDERATIONS

INTRODUCTION

Carson City, Nevada's Water Resource Recovery Facility (WRRF) has experienced a reduction in average daily flow from 5.5 mgd in the year 2000 to a current average of 4.2 mgd. The reduction appears to have leveled off at the 4.1 to 4.2 mgd range in the last four year period. The design for an upgrade to the WRRF is nearing completion and construction will start soon. Master Planning for the sewage collection system and the reclaimed water system are now a priority.

The WRRF produces reclaimed water and stores it in Brunswick Canyon reservoir during the winter months. The reclaimed water is then delivered and utilized for irrigation to a number of sites during the spring, summer, and fall. Based on the current flows and re-use, there is a minor shortage of reclaimed water that is currently being supplemented with potable water. It has been recognized that Brunswick Canyon reservoir was constructed without a lining that would prevent seepage. There is recognition that losses do occur and previous re-use master plans have identified lining the reservoir as one of the options for future utilization of the reclaimed resource. The discussion of this consideration as well as other components is appropriate based on recognition that master planning is important for the appropriate utilization of the reclaimed resource in the future.

With the economic projections indicating a growth both in job base and in population, the growth of the flows to the WRRF and, therefore, the increase in reclaimed water is anticipated. It will be important in the reclaimed master planning process to incorporate options for utilization of the resource and determine associated costs and potential revenue sources.

Manhard Consulting has been tasked with reviewing all pertinent information provided by Carson City and its' consultants related to reclaimed water and provide an overview of considerations associated with the reclaimed resource. Bringing the discussion of various considerations forward will give direction to the update of Carson City's reclaimed master plan.

BACKGROUND

During 2003, Carson City's WRRF was treating over 5 mgd in wastewater and storing it for re-use in Brunswick Canyon reservoir. There was recognition that there was seepage in the reservoir and the potential requirement of lining by NDEP prompted the development of a series of Re-Use plans to explore the options for storage and utilization of the reclaimed water. It was recognized that Carson City was producing approximately 5,800 acre feet of reclaimed water and sending approximately 3800 acre feet of reclaimed to re-use sites. This indicated that there was



approximately 2000 acre feet of loss in the reservoir system. Alternatives that anticipated lining the reservoir resulted in the need to look at additional options for re-use as the reclaimed water production would be in excess of what the re-use sites could utilize.

A series of reports developed in 2004, 2005, and 2006 looked at numerous alternatives to storing and delivering the reclaimed water. Based on the WRRF flows at that time, it was anticipated that continued growth in the flows would result in flows of 9.3 mgd by 2025. This resulted in numerous alternatives and related costs for reclaimed disposal. Since that time, flows have decreased to approximately 4.1 to 4.2 mgd resulting in a small shortage of reclaimed based on the usages at the various re-use site.

The re-use sites include the Prison Farm, Empire Ranch Golf Course, Eagle Valley Golf Course, Silver Oak Golf Course, and miscellaneous city parks and dust control fill stations. Table 1 shows the reclaimed usage from 2010 to 2015. This table also shows the average for that time period and the maximum usage that might be anticipated based on the various sites maximum usage for that time period. Note that the usage for parks and dust control has gradually been removed from the reclaimed system in recognition of the reduced flows and would only be reconnected as increased reclaimed flows occur in the future.

Table 1- RECLAIMED USAGE 2010-2015 (ACRE FEET)

	2010	2011	2012	2013	2014	2015	AVE	MAX
Prison Farm	1397	1510	968	1083*	1102 #	761 #	1137	1510
Empire Ranch	536	531	680	765	937	831	713	937
Eagle Valley	792	778	920	828	778	800	816	920
Silver Oak	428	420	486	465	425	450	446	486
Parks, Dust	205	182	197	162	14	2	127	205
TOTALS	3358	3421	3251	3303	3256	2844	3239	3421

*Prison Farm meter

#Actual irrigation at the Prison Farm was 1426 in 2014 and 997 in 2015 due to potable water augmentation.

The approximate losses in the Brunswick Canyon reservoir system from 2010 to 2015 can then be calculated by subtracting the reclaimed re-use flows from the WRRF flow and adjusting for the annual change in storage volume as well as adjusting for approximate evaporation losses.

Table 2 shows the approximate reservoir losses for the 2010-2015 time period.



Table 2- APPROXIMATE LOSS ESTIMATES 2010-2015

	2010	2011	2012	2013	2014	2015	
Annual Plant Flow (Ac Ft)	5041	5153	4704	4593	4524	4756	
Annual Recl Usage (Ac Ft)	3358	3421	3251	3303	3256	2844	Ave
Gross Recl Water loss	1683	1732	1453	1290	1268	1912	1556

$$\text{Plant Flow} - \text{Recl Usage} = \text{Gross Loss}$$

Reservoir Annual Change (Ac Ft)	-224	224	0	274	-151	-255	
Approximate Evaporation (Ac Ft)	-250	-250	-250	-250	-250	-250	Ave
Adjusted Recl Water Loss	1209	1706	1203	1314	867	1407	1284

$$\text{Gross Loss [+/- Annual Change]} - \text{Evaporation} = \text{Adjusted Loss}$$

Reservoir Annual change:

- This is a calculation of how much additional reclaimed water is added or removed from Brunswick Canyon annually. It is calculated by the difference in volume between January 1 and December 31. A negative number represents that there was more volume in the reservoir at the end of the year.

Approximate Evaporation:

- Estimate of how much reclaimed water is lost to evaporation.

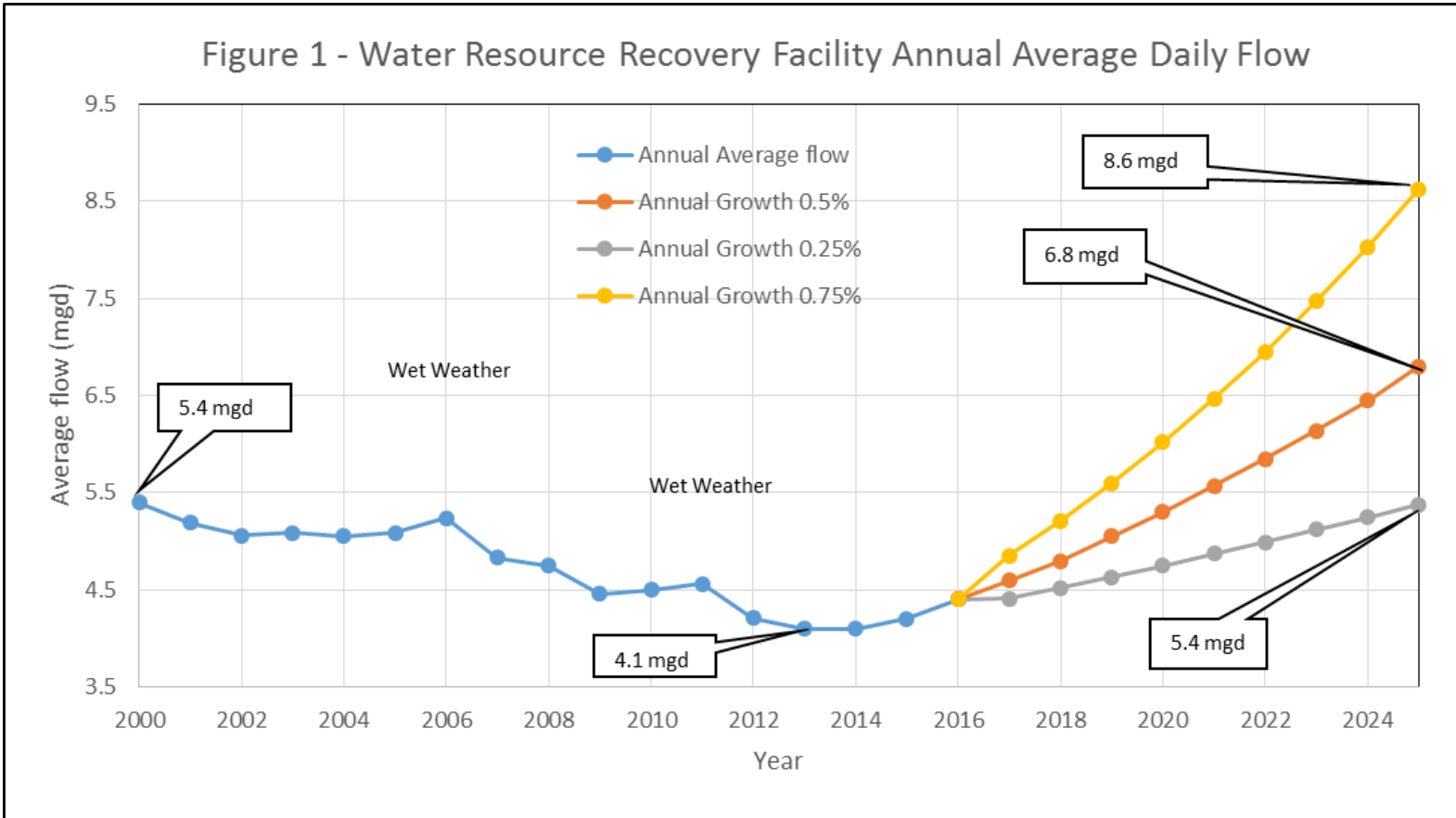
In 2004, the estimated loss was reported at an average of 2000 acre feet per year. Looking at the past 6 years, this loss has decreased to an average slightly under 1600 acre feet per year (gross reclaimed water loss). This lower number can likely be explained by the decrease in flow coming into the treatment plant. Less flow coming into the treatment plant means less storage in Brunswick Canyon reservoir. The lower storage levels in Brunswick Canyon, the lower the reclaimed water loss.

Now, to fine tune how much reclaimed water could possibly be available for future capture, we adjusted for other factors such as evaporation and changes in the reservoir level. Looking at the past 6 years, the adjusted gross is slightly under 1300 acre feet per year.

To try to anticipate what kind of flows might be realized at the WRRF, Figure 1 shows the flows from 2000 to 2015 and what the flows might look like with a 0.25%, 0.5%, and 0.75% growth. As shown, the anticipated flow at the plant could range from 5.4 to 8.6 mgd in 2025 versus the 9.3 mgd number that was projected in the 2006 Re-use Master Plan. This further reinforces the need to update the 2006 plan as the actual flows have been significantly different than anticipated at that time.



Figure 1





Included in the 2006 Re-Use Master Plan was an alternative to leave Brunswick Canyon reservoir unlined and capture the discharge flows of springs to the Carson River that result from the reservoir seepage. This is an important alternative to explore because in 2006 Carson City received approval from NDEP to permit the spring seepage at the Carson River. Questions regarding this alternative will need to be expanded and addressed in an updated re-use master plan.

In May of 2014, Manhard Consulting presented a Reclaimed Water Analysis to Carson City to look at the shortage in reclaimed water relative to the needs of the re-use sites and tried to project the anticipated water augmentation requirements. The actual water augmentation has been in the range of 200 to 300 acre feet in 2014 and 2015 and the WRRF flows have hovered at 4.1 to 4.2 mgd. This augmentation is at the lower end of the range estimated at that time and has been handled through a transfer of funds from the sewer fund to the water fund of under \$100,000 per year.

Recognizing the possibility of growth occurring due to the change in the economic situation in Carson City and the surrounding area, it will be important to bring the planning for the reclaimed uses to the forefront. Value of the reclaimed resource particularly in light of the drought may play a role in the decision making needed in a reclaimed master plan. In addition, the State's Drought Forum has identified the need for NDEP to explore the ability to provide indirect potable recharge of reclaimed water through groundwater injection. A committee has been working on the possible regulations including treatment levels that might be required to provide this as a possible alternative. The timing of this alternative coming to fruition is likely in the 3 to 5 year range but would be in the planning horizon of a re-use master plan update.

Lining Brunswick Canyon reservoir would bring an immediate result in eliminating the need to augment with potable water but will also bring the need to re-use approximately 1300 acre feet of reclaimed water. These flows will also increase with growth. Clearly, additional options for re-use need to be explored and master planned.

INFRASTRUCTURE OPTIONS AND COSTS

Carson City's 2006 Re-use Master Plan provided numerous options to re-use reclaimed water. Most of the options included lining Brunswick Canyon reservoir but each option anticipated building an additional storage reservoir at the Carson City rifle range site to allow Brunswick Canyon to be lined after draining. Carson City had the same consultant look at an option in June of this year of building an earth "coffer dam" in the reservoir, thereby allowing the lining to occur in two sections while still utilizing the reservoir for storage. The reduced flows and configuration of the bottom of the reservoir will allow that construction. This takes the cost of building an additional reservoir at the rifle range out of the equation that was previously presented in 2006.

By utilizing this construction process, the conceptual level cost to line Brunswick Canyon reservoir is approximately \$7 to \$8 million dollars based on a previous estimate and review by Manhard Consulting. Under the current reclaimed flow scenario the recovery of the 1300 acre feet would



be at a price of \$5,400 to \$6,200 per acre foot with the value improving by utilizing the higher capture rates anticipated with growth.

Previous estimates also included not lining the reservoir but instead providing a capture system for the springs near the Carson River that have developed due to the seepage from Brunswick Canyon reservoir. The spring capture alternative was estimated at \$6.7 million dollars but it is estimated that a flow of only about 500 acre feet would be realized resulting in a cost of recovery of approximately \$13,400 per acre foot.

It is also recognized that an additional storage facility will ultimately be needed for the long term buildout of the system and, therefore, the scenario of building the additional facility at the rifle range and lining Brunswick Canyon after draining was another storage alternative to consider. This alternative was estimated at \$12 million dollars in previous studies.

The biggest consideration that will need to be addressed is the utilization of the additional reclaimed water that will occur with lining Brunswick Canyon and with additional flows due to growth in the future. The previous plans recognize that the amount of land that is available for irrigation re-use is limited in Carson City and, therefore, another form of utilization is required.

Previous plans focused on the use of rapid infiltration basins (RIB's). These basins would allow the reclaimed water to be spread in a basin and allowed to percolate into the ground. To accomplish this, locations with soil conditions that have good permeability need to be identified. The cost of distributing the reclaimed water through pumping and pipelines needs to be considered in the overall reclaimed cost equation. Costs identified in the 2006 system for RIB's ranged from \$4 to \$13 million depending on location. The re-use master plan update should review potential sites and appropriate sizing to refine these costs.

Recent developments in the industrial market in Northern Nevada have been utilizing reclaimed for not only irrigation of landscaping but for items such as cooling systems. With current and potential development of industrial areas within Carson City, one alternative for re-use would include providing reclaimed to these areas. Figure 2 identifies some possible industrial areas that might be served within Carson City as well as a pipeline to the Lyon County border that might provide reclaimed to the Mound House industrial areas within Lyon County. Lineal footages were derived for each area and at a conceptual cost of \$100 to \$125 per foot, the 79,000 lineal feet of lines could be run throughout the area for \$7.9 to \$9.9 million dollars. There will also be pumping costs for the Mound House extension.

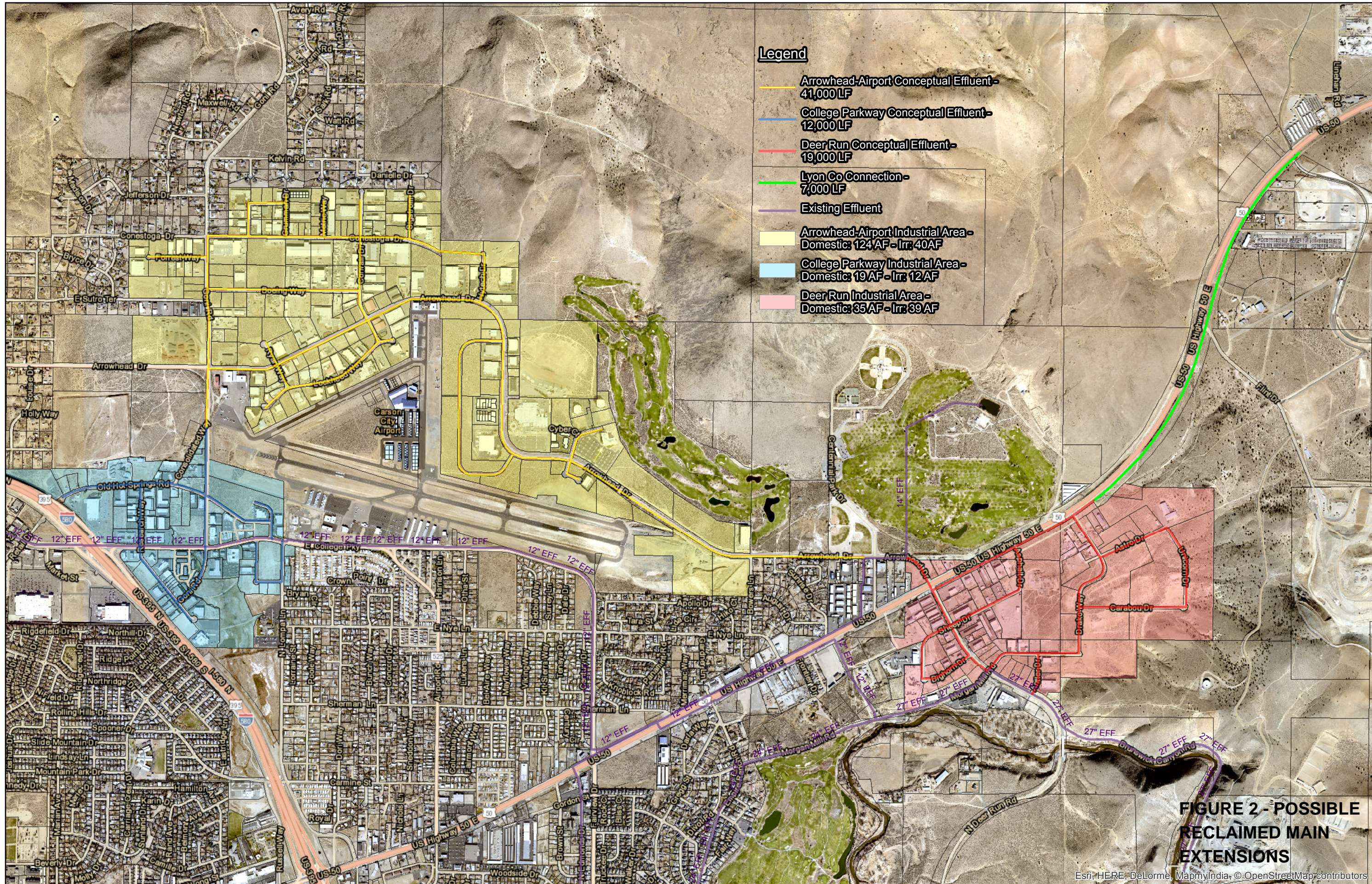
Current water use was looked at for the Carson City industrial areas identified in Figure 2. The domestic use is approximately 178 acre feet and the irrigation use was approximately 91 acre feet in 2014. Estimating that 25% of the domestic use might be able to be converted to reclaimed, coupled with the irrigation use, the current use would only amount to approximately 136 acre feet. This wouldn't warrant the construction of lines within all of the areas identified. However, there might be vacant lands that would attract a reclaimed user that would warrant the extensions. Also, there may be existing users that may be within a distance of the current effluent lines where extension might be feasible. Extension to Mound House again would be based on the potential flow utilization versus the cost of the extension. Regardless, industrial alternatives should be considered with the re-use master plan update.



The potential for future groundwater injection appears to be another alternative to analyze if the potential state regulations are tracked and timing is within the horizon of the master plan update. Determining locations for possible injection and the associated costs of piping and wells to deliver will require another alternative analysis but the additional treatment costs that will come with injection will also have to be analyzed. California, Arizona, and Texas all have successful indirect injection systems and regulations. Nevada will likely be modeled after the existing regulations from these states. Again, timing will have to be tracked to determine how this alternative might be utilized in the overall Carson City reclaimed picture.

The Carson City Water Facility Plan has also included a conceptual proposal of constructing a surface water induction well near the Carson River in the area or immediately downstream of the Brunswick Springs. As shown in Figure 3, the induction well alternative would provide a surface water recapture of the Brunswick Canyon reservoir losses and would pump water back to the potable system near Deer Run Road. Questions regarding water rights, water treatment, and system design need to be answered in the Master Planning process. The exploration of this concept to recover the reclaimed losses is an important alternative to explore as the related costs would likely provide the cheapest solution and potentially the best opportunity for immediate re-use.

The update of the Carson re-use master plan will be able to look at these additional re-use options, but most important, are the related costs for the overall picture of the reclaimed system. As indicated, not only storage, but implementing other forms of re-use will be the key in determining the most efficient reclaimed solution.



Legend

- Arrowhead-Airport Conceptual Effluent- 41,000 LF
- College Parkway Conceptual Effluent- 12,000 LF
- Deer Run Conceptual Effluent- 19,000 LF
- Lyon Co Connection- 7,000 LF
- Existing Effluent
- Arrowhead-Airport Industrial Area - Domestic: 124 AF - Irr: 40AF
- College Parkway Industrial Area - Domestic: 19 AF - Irr: 12AF
- Deer Run Industrial Area - Domestic: 35 AF - Irr: 39 AF

N
1" = 1,500'

FIGURE 2 - POSSIBLE RECLAIMED MAIN EXTENSIONS

Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors

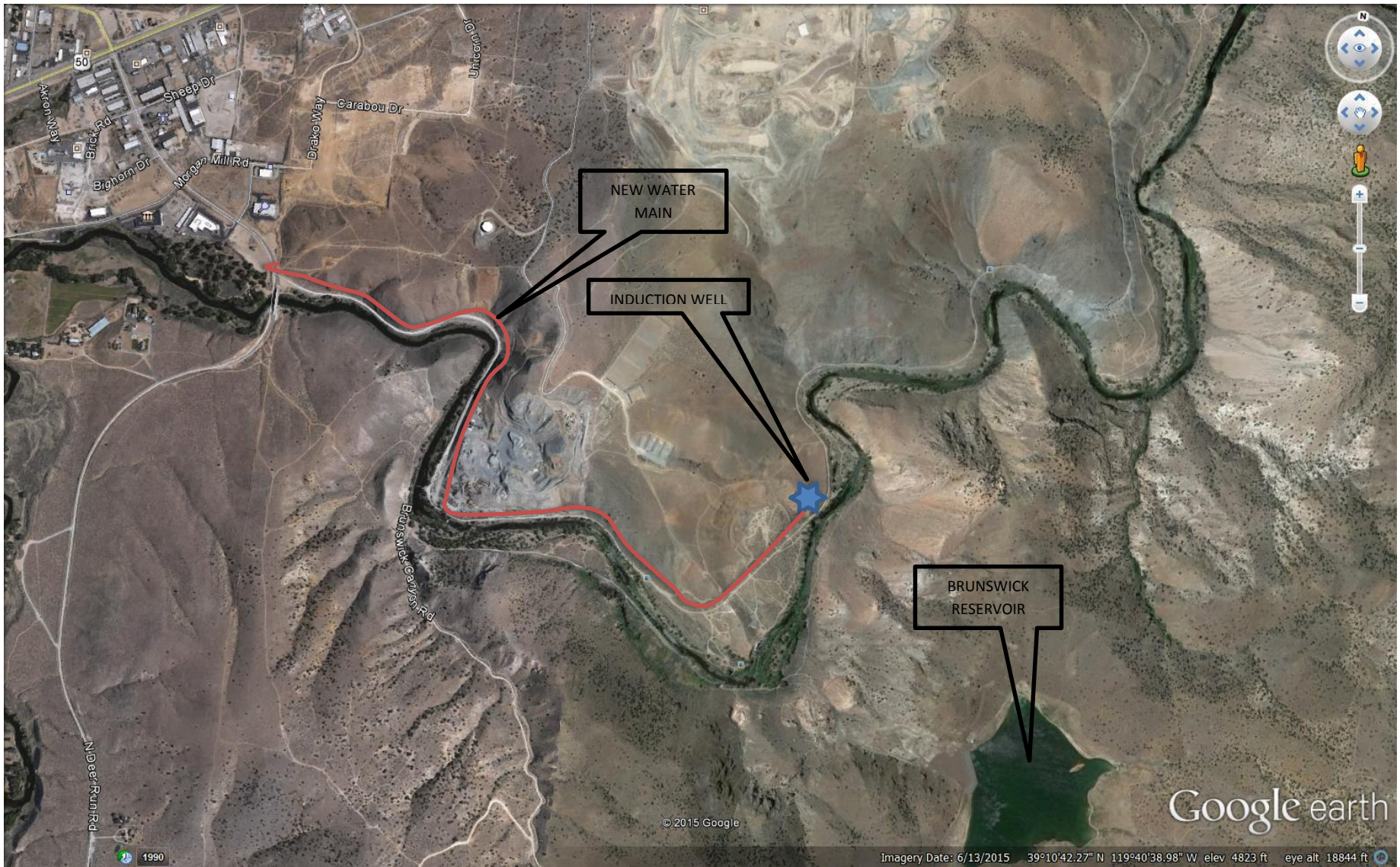


FIGURE 3 – INDUCTION WELL, SURFACE WATER RECAPTURE



REVENUE CONSIDERATIONS

As the overall reclaimed system solutions are developed and costs identified, the consideration of where the revenues are generated to pay for the system will become part of the solution. Under the current scenario, the reclaimed system is part of the overall sewer system and, as such, the costs are paid through sewer rates. As shown by the high level costs outline above, the cost of the storage and re-use of reclaimed water will be significant in the future and the analysis of the relationship to sewer rates will be important.

Another approach to the reclaimed system is that it is a resource and could be paid for through a reclaimed rate. Washoe County currently charges a water rights fee of \$3,500 per acre foot plus a privilege fee of \$2,500 per acre foot in one zone and \$4,135 per acre foot in a second zone. In addition, a monthly rate of \$1.16 per 1000 gallons is charged in one zone and \$1.74 per 1000 gallons in the second zone.

Sparks has a connection fee of \$10,000 per acre foot in one zone and \$12,000 per acre foot in a second zone. Their monthly charge is \$0.96 per 1000 gallons.

These rates are only provided to show other options as to how other entities are generating revenue for their reclaimed systems. The key is that there is enough demand for the resource to warrant enough users to pay for the system. In many cases where this format is used, there is still a shortfall that is picked up in the sewer rates.

Another option would be to provide the reclaimed resource on a case by case basis. For example, in the case of Arrowhead area, it is clear that providing reclaimed to the whole area based on the existing water demands is not feasible. However, extensions to specific existing users or parcels where a new demand that would warrant extension might exist. Calculating the infrastructure costs for the individual users based on demands could then be provided for in an individual contract. Clearly the higher demand users would likely be the candidates for this approach. The extension to Mound House may also fall under this category based on demands that might justify the extensions.

In the case of users paying for reclaimed water, it is important to assure there is adequate consumption to fund the alternatives. It is clear that assuring there are enough sites and alternatives to adequately re-use the reclaimed water is key in whatever solutions are developed in the master planning process.

The conceptual induction well solution identified in the Carson City Water Facility Plan would provide re-capture and supply to the potable water system by providing a re-use solution as well as supply to the potable system, cost sharing of this alternative could be accomplished between the water and sewer funds.



SUMMARY

As Carson City moves forward with the update of the Re-use Master Plan, reclaimed water storage and utilization are important considerations. Historically, alternatives that include lining of Brunswick Canyon reservoir and building a second reservoir at the Carson City rifle range site have been considered for storage and the need for RIB's have been recognized as the capacities of the current re-use sites are exceeded.

Previous analyses indicated costs of \$12 million dollars to build a new reservoir at the rifle range and to drain and line Brunswick Canyon reservoir. Reduction in flows and, therefore, storage volumes in Brunswick Canyon reservoir allow for a "coffer dam" approach to lining the reservoir which would allow the lining to occur while leaving the reservoir in service. This alternative is estimated at \$7 to \$8 million dollars.

Lining of Brunswick Canyon reservoir will eliminate seepage of approximately 1300 acre feet of reclaimed water based on the current flow conditions resulting in recapture value of \$5,400 to \$6,200 per acre foot. During previous periods of higher flow and storage conditions, the seepage losses were in the neighborhood of 1750 acre feet, thereby providing additional feasibility to the lining alternative and bringing recapture costs to \$4,000 to \$4,600 per acre foot.

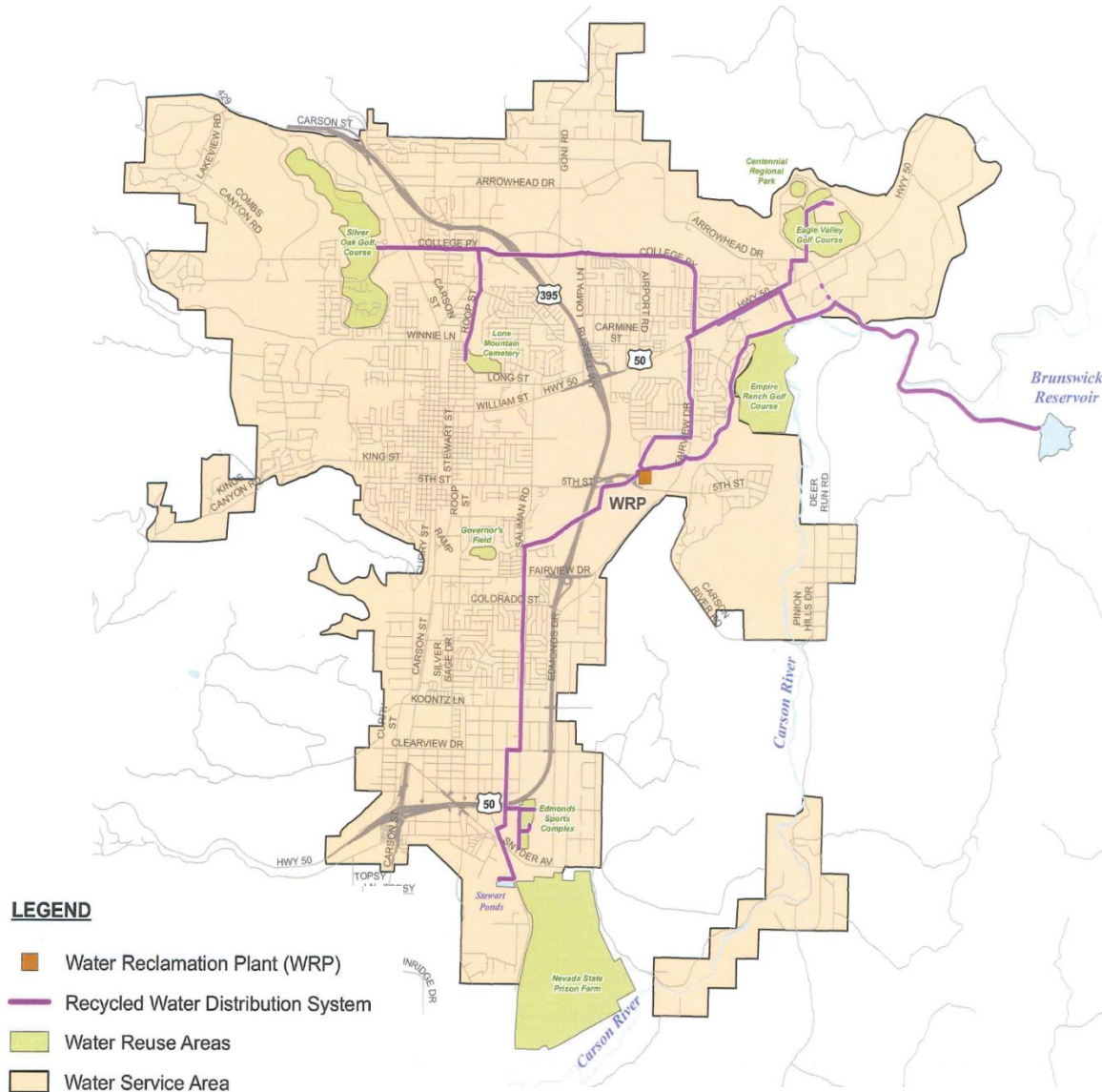
With the lining of Brunswick Canyon reservoir, the additional 1300 to 1400 acre feet of reclaimed will have to be utilized. Even if the current re-use sites were encouraged to utilize their maximum historical use, there is still a surplus that needs to be utilized. Previous alternatives included the use of RIB's at a cost of \$4 to \$13 million depending on volume and locations. Additional alternatives to consider might include industrial re-use and indirect re-injection depending on the timing of the development of state regulations allowing re-injection. Costs associated with additional wastewater treatment will have to be included in some of the options.

The Carson Water Facility Plan has included a surface water induction well solution that may provide a favorable re-use alternative assuming answers to questions regarding water rights, water treatment, and design considerations can be developed. In this scenario, the Brunswick Canyon reservoir would not be lined and the recapture of the current losses would occur via a Carson River induction well and piping back to the Carson potable system.

Costs for reclaimed water are currently provided for in Carson City's sewer rates. Other alternatives include the possibility of charging for reclaimed water as a separate segment of the sewer system. Example rates have been included from Sparks and Washoe County. Another option would be to charge a potential user based on a case by case analysis and associated agreement. Regardless of the options, the alternatives for funding are considerations in determining solutions to the reclaimed storage and re-use moving forward.

This analysis provides a high level overview of the considerations for reclaimed water moving forward. It is clear that decisions regarding the storage and utilization of reclaimed water need to be made with a clear picture of the overall costs associated with alternatives and the related funding. Updating of the 2006 Re-use Master Plan will be key in providing a picture of the new costs and options based on the current and projected flows of the Carson City Wastewater system.

Carson City Reclaimed Water Storage and Utilization Considerations



Source: Carson City Public Works

Background

- Water Resource Recovery Facility flows have reduced from an average of 5.5 MGD in 2000 to a current average of 4.2 MGD.
- Reclaimed water is stored in an un-lined Brunswick Canyon reservoir that has seepage losses.
- There has been a shortage of water to serve reclaimed sites in the last three years.
- Past Reclaimed Master Plans identified infrastructure alternatives including lining of Brunswick Canyon Reservoir.
- Current and Projected flow considerations need to be considered in updating the Reclaimed Master Plans.

Table 1 – Reclaimed Usage 2010-2015 (Acre Feet)

	2010	2011	2012	2013	2014	2015	AVE	MAX
Prison Farm	1397	1510	968	1083*	1102#	761#	1137	1510
Empire Ranch	536	531	680	765	937	831	713	937
Eagle Valley	792	778	920	828	778	800	816	920
Silver Oak	428	420	486	465	425	450	446	486
Parks, Dust	205	182	197	162	14	2	127	205
TOTALS	3358	3421	3251	3303	3256	2844	3239	3421

NOTES:

* - Prison Farm meter

- Actual irrigation at the Prison Farm was 1426 in 2014 and 997 in 2015 due to potable water augmentation.

Table 2 – Approximate Loss Estimates 2010 -2015

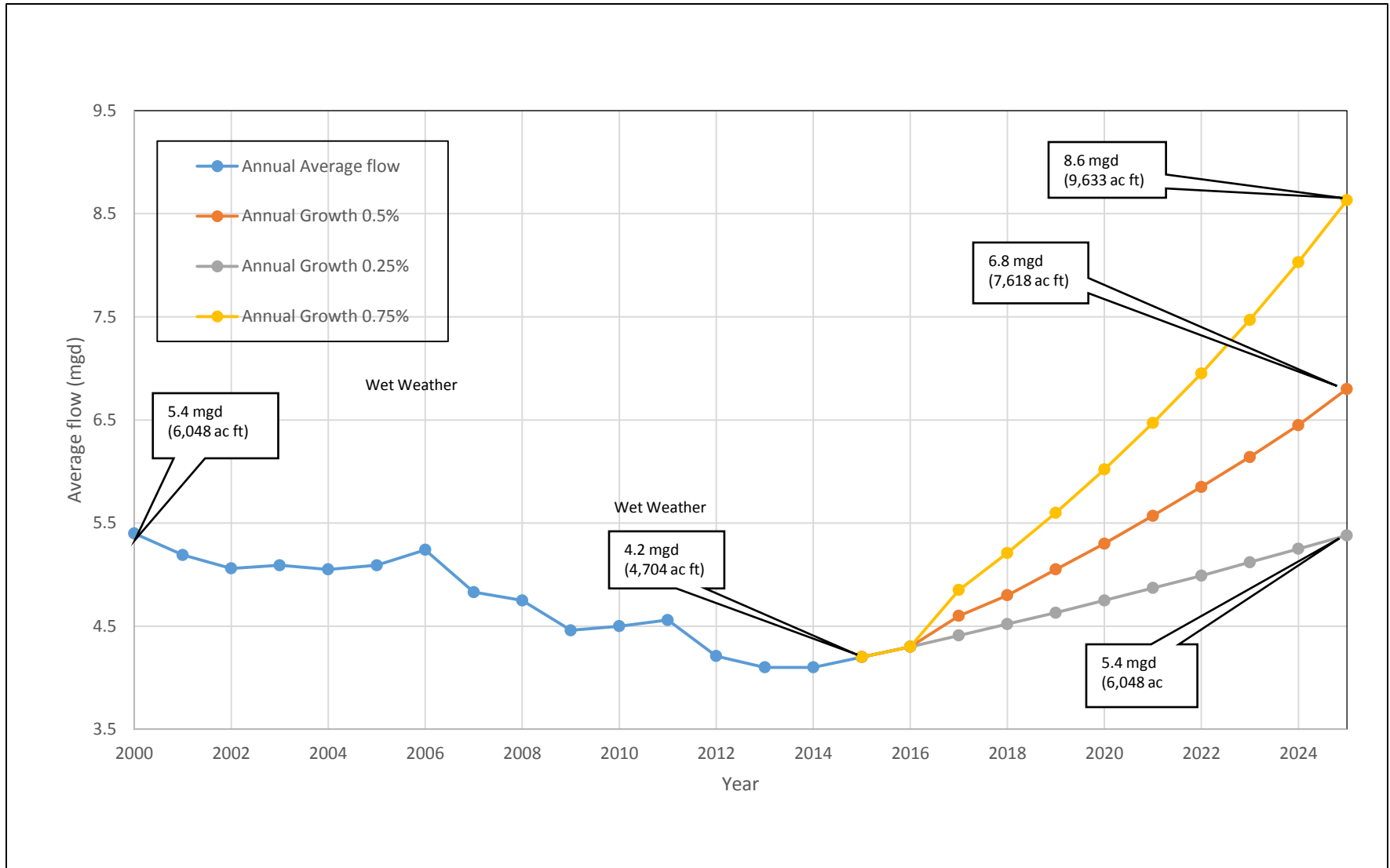
	2010	2011	2012	2013	2014	2015	
Annual Plant Flow (Ac Ft)	5041	5153	4704	4593	4524	4756	
Annual Recl Usage (Ac Ft)	3358	3421	3251	3303	3256	2844	AVE
Gross Recl Water Loss (Ac Ft)	1683	1732	1453	1290	1268	1912	1556

Plant Flow – Recl Usage = Gross Loss

Reservoir Annual Change (Ac Ft)	-224	224	0	274	-151	-255	
Approximate Evaporation (Ac Ft)	-250	-250	-250	-250	-250	-250	AVE
Adjusted Recl Water Loss (Ac Ft)	1209	1706	1203	1314	867	1407	1284

Gross Loss [+/- Annual Change] – Evaporation = Adjusted Loss

Figure 1 – Water Resource Recovery Facility Annual Average Daily Flow



Infrastructure Options and Costs

- Lining of Brunswick Canyon Reservoir costs \$7 - \$8 million.
- Lining results in a recovery of the current estimate of seepage of 1,300 acre feet.
- Previous studies identify reclaimed water going to Rapid Infiltration Basins (RIB's) at a cost of \$4 to \$13 million.
- Additional options for reclaimed utilization include delivery for additional irrigation uses, possible industrial uses, and possible indirect potable recharge.
- Induction well would provide surface water recapture of reservoir seepage and pump the water back into the system at Deer Run Road.

Figure 2 – Possible Reclaimed Extensions

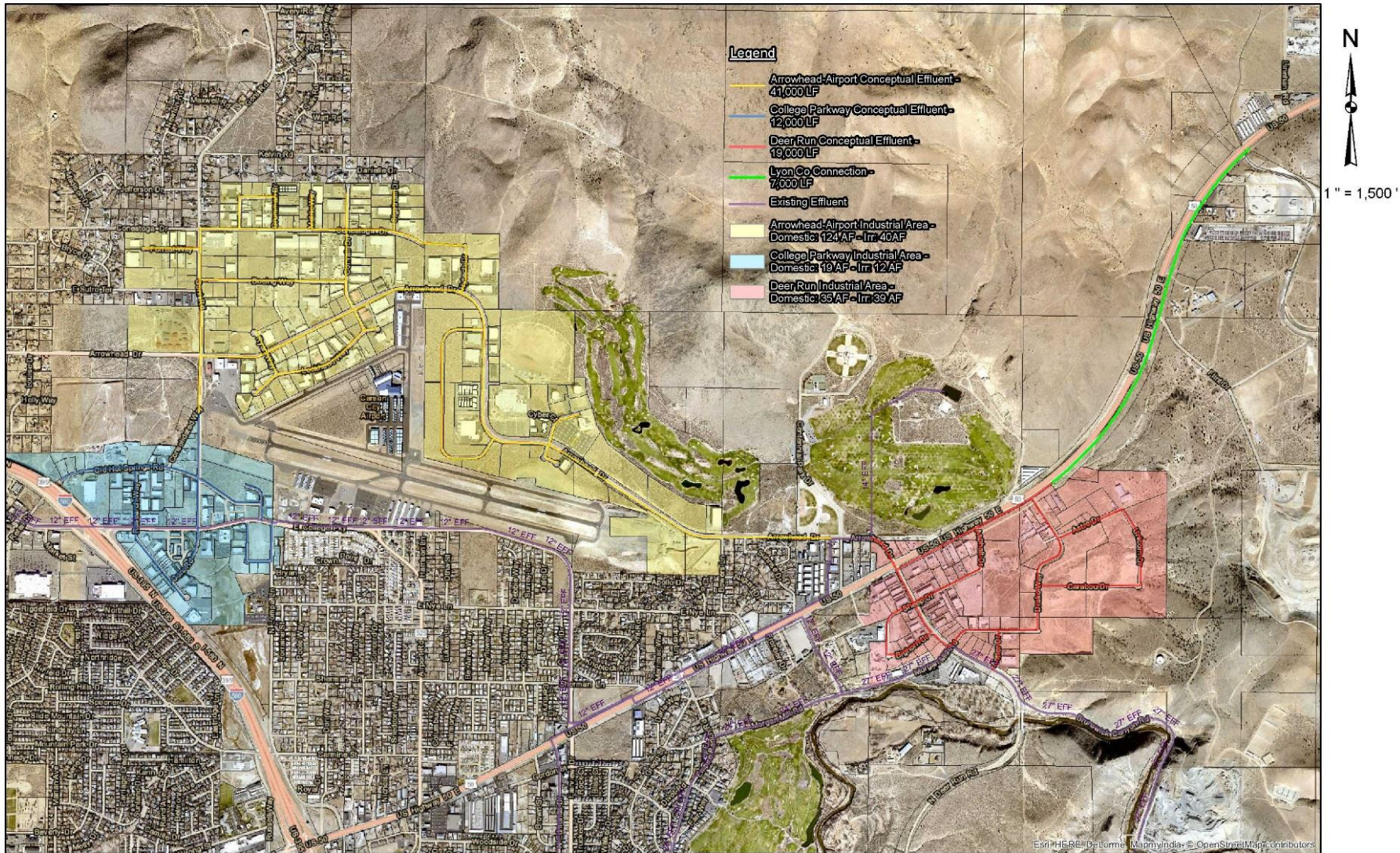
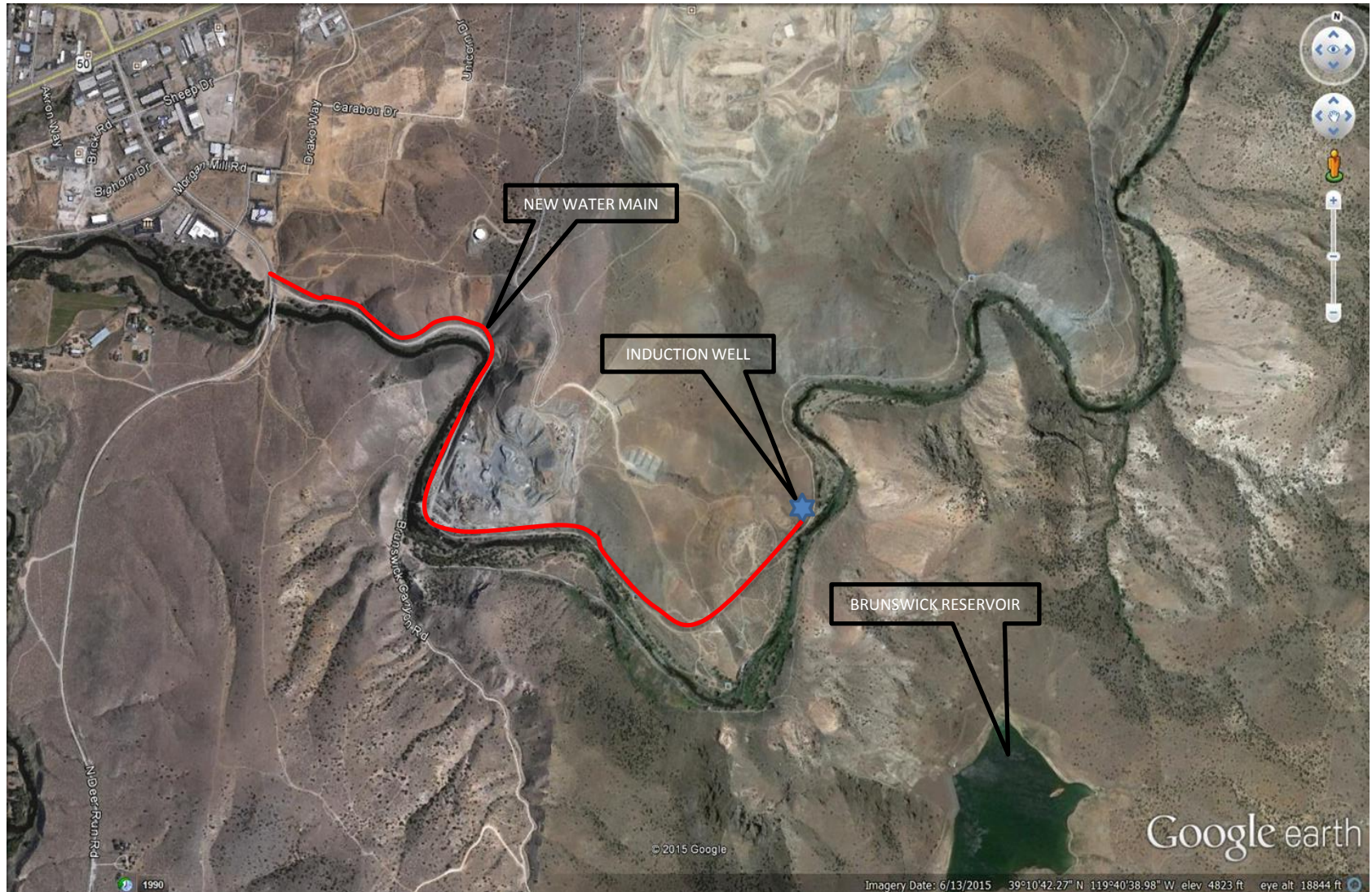


Figure 3 – Induction Well, Surface Water Recapture



Summary

- Need to update the Reclaimed Master Plan.
- Consider lining Brunswick Canyon Reservoir at a cost of \$7 to \$8 million resulting in a current. estimated recovery of 1,300 acre feet and likely additional recapture as WRRF flows increase.
- Costs to deliver additional reclaimed to RIB's range from \$4 to \$13 million based on previous studies.
- Consider reclaimed utilization uses to include additional irrigation, possible industrial uses, and possible indirect potable re-injection as regulations allow.
- Induction well for surface water recapture.
- Provide full picture of options and costs based on the current and projected flows.
- Review possible revenue considerations for development of the reclaimed uses.

Questions ?