

Appendix F

Technical Memo 6

Master Plan Components

TECHNICAL MEMORANDUM – MASTER PLAN COMPONENTS

September, 2008

TECHNICAL MEMORANDUM NO. 6

This technical memorandum provides a description of the facility components included in the South Tahoe Public Utility District (District) Recycled Water Facilities Master Plan. The components are individual facilities or management procedures designed to meet the District's recycled water discharge needs.

Description of Components

Components are the building blocks of the projects proposed to accomplish the Master Plan objective of recycled water use (See Sections 9 through 13 of the Master Plan for project descriptions). In addition to components that provide for the application of recycled water, other components, such as conveyance facilities or emergency storage facilities, are necessary for the operation of the recycled water system. The components that were conceived to make up the projects of the Master Plan are described in the following sections. Table 1.1 (Page 2) identifies the project components and lists the project number to which each component ties. Components 9, 15 and 21 were investigated but ultimately not utilized in any of the projects because they did not sufficiently address the Purpose and Need Statements of the Master Plan (See Section 7 of the Master Plan). Additionally, there are six components (component numbers 25-28, 33 and 34) that may possibly be implemented in the future. The implementation of these components, and thus implementation of the projects to which they tie, is contingent upon various factors affecting District operations and changed conditions in the future. These components are considered to be concepts at this time.

Master Plan Component Descriptions

Descriptions for each of the proposed Master Plan components are described below. Please note Component numbers 25-28, 33 and 34 are listed under Future Master Plan Project Component Descriptions.

1. Provide Recycled Water to New Non-Irrigated, Permitted Land

Currently, over 1,800 acres are permitted by the Lahontan Regional Water Quality Control Board to receive recycled water. Of the permitted acres, roughly 75 percent use recycled water for irrigation purposes. Recycled water is not currently applied to the remaining land partially due to the lack of infrastructure to convey water to some areas or the permitted acreage is non-pasture/agricultural land. Portions of the additional permitted lands on the Fredericksburg system, between the Fredericksburg Ditch and Fredericksburg Road in Wade Valley and along the east side of the West Fork of the Carson River have the potential to receive recycled water but additional infrastructure needs to be constructed. All of the recycled water currently produced and most of the recycled water anticipated to be produced by the year 2028 would be applied if all currently permitted acreage were irrigated with recycled water.

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Table 1.1 – Master Plan Component List

Component Number	Component Description	Ties to Project Number
1	Provide Recycled Water to New Non-Irrigated, Permitted Land	8, 9
2	Make Recycled Water Available to Irrigators in Nevada	13
3	Capacity and Conveyance Improvements in the Diamond Ditch System	5, 6
4	Provide Pressurized Recycled Water to Fredericksburg System	6, 8
5	Provide Pressurized Recycled Water through Wade Valley	10
6	Provide Pressurized Recycled Water to the Ranchettes	6, 9
7	Non-Flood Irrigation Application System	7, 8, 9
8	Improve Recycled Water Quality	26
9	Groundwater Recharge Using Infiltration Basins*	Not used in Master Plan
10	Construct Zero-Discharge Basins	Possible Variation of Project No. 1
11	Construct Emergency Storage Facility with Supply Pipeline and Pump Back to Harvey Place Reservoir	1, 2, 3
12	Grow Biomass Crops for Pulp Production Using Recycled Water	Possible Variation of Project No. 1
13	Wetland Sod and Seed Production	Possible Variation of Project No. 1
14	Piping Recycled Water Systems to Minimize Setbacks and Human Contact	7, 8, 9, 10
15	Mitigation Wetland Creation Using Freshwater*	Not used in Master Plan
16	Subsurface Recycled Water Irrigation in Public Contact or Buffer Areas	7
17	Increase Snowshoe Thompson No. 1 Conveyance Capacity	14
18	Optimize Application Rate on Existing Irrigated Lands	11
19	Pursue Permitting of More Land in Alpine County	12
20	Improve Operation of the Diamond Ditch System to Meet District and User Needs	13
21	Develop Tailwater Control System*	Not used in Master Plan
22	Parallel Recycled Water Pipeline Along Existing Diamond Ditch	6, 10
23	Route Mud Lake Winter Flows through Indian Creek Reservoir	14, 15, 16, 19
24	Transfer Additional Water Rights to Storage in Indian Creek Reservoir	14, 15, 16, 20
25	Develop Recycled Water Wholesale Program	21
26	Biosolids Composting	22
27	Become a Water Rights Buyer/Broker to Maintain the Value of Recycled Water	23
28	Power Generation	24
29	Irrigate the District Pasture Land	4
30	Irrigate the Jungle with Recycled Water	4
31	Divert Stormwater Flow away from Harvey Place Reservoir and to Indian Creek Reservoir	17
32	Indian Creek Reservoir Spillway Channel	18
33	Extend the C-Line to the State Line	25
34	Injection Well Program	26

*Components 9, 15 and 21 were not utilized in the September, 2008 Recycled Water Facilities Master Technical Memorandum 6
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Plan, Administrative Draft.

2. Make Recycled Water Available to Irrigators in Nevada

Nevada irrigators downstream of Alpine County currently do not have access to sufficient volumes of water to divert to irrigation in an average or below average precipitation year. Because of a lack of reliable freshwater sources, Nevada irrigators perceive recycled water as a desired commodity. Currently the District's recycled water is not permitted for land application in Nevada. This component would pursue the permitting of land in Nevada by the Nevada Division of Environmental Protection to receive recycled water from Harvey Place Reservoir.

3. Capacity and Conveyance Improvements in the Diamond Ditch System

Improvements to the Diamond Ditch System proposed in this component would result in increasing the capacity of the system to transport higher volumes of recycled water and in stabilizing segments of the system that are subject to erosion and/or flooding. The increase in system capacity would allow the District to manage the anticipated increases in the volume of recycled water resulting from future growth in the Tahoe Basin. The stability improvements would permit the District to provide uninterrupted flows of recycled water.

Lining or piping the unlined reaches upstream and downstream of Bar Screen Number 3 in Wade Valley would result in increased system capacity and would alleviate erosion and stability concerns. Replacing Bar Screen Number 3 would also result in increased system capacity and operational flexibility.

4. Provide Pressurized Recycled Water to the Fredericksburg System

A portion of the permitted land on the Fredericksburg system, between the Fredericksburg Ditch and Fredericksburg Road, cannot currently receive recycled water because the infrastructure necessary for delivery of the water has not been constructed. The construction of an inverted siphon from Wade Valley to the Fredericksburg system would allow the District to deliver pressurized recycled water to these permitted lands. Additionally, installation of the pipeline would provide the District the opportunity to deliver water to additional acreage that is currently not permitted in this area. The pipeline would transport water across the West Fork of the Carson River at the Paynesville Bridge, allowing land above the existing Fredericksburg system to be irrigated with recycled water.

5. Provide Pressurized Recycled Water Through Wade Valley

Land above the Upper Fredericksburg Ditch is currently permitted for irrigation with recycled water but is irrigated with fresh water because no recycled water conveyance system is available. Implementation of this component would provide recycled water to these lands and potentially to lands currently not under cultivation by the installation of a pipeline from Harvey Place Reservoir to Wade Valley upstream of the Fredericksburg system. The pipeline would cross Indian Creek near Harvey Place Reservoir dam and extend north to the Paynesville Bridge, located at the north end of Wade Valley. By providing recycled water under pressure through the pipeline, irrigators could apply the water using sprinkler systems rather than flood irrigation methods. Sprinkler irrigation is more efficient and is more effective at controlling the volume of water that is applied. Existing sprinkler irrigation systems in Wade Valley could be pressurized directly from the recycled water pipeline, eliminating the need to install additional pumps.

6. Provide Pressurized Recycled Water to the Ranchettes

A recycled water pipeline would be constructed from Harvey Place Reservoir to the area between the Lower Fredericksburg and Dressler On-Farm systems. The recycled water would be sold to

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landowners for the irrigation of smaller ranches. The expected acreage to be cultivated is 150 acres with an annual irrigation budget of approximately 500 AF. Because the areas to be irrigated are considerably smaller than the parcels currently under irrigation, sprinkler systems would be required.

7. Non-Flood Irrigation Application System

This component encourages irrigators to use either sprinkler irrigation or other application methods in lieu of flood irrigation when using recycled water. Both sprinkler and sub-surface irrigation are more efficient than flood irrigation and much greater control is available to the irrigator to determine the amount of water applied. This would help the district monitor the application rate of recycled water and this would maximize the beneficial use of the recycled water and greatly reduce the likelihood of tailwater flowing off the intended reuse area.

8. Improve Recycled Water Quality

Under this component, the District would implement a program to improve the quality of the recycled water that flows from the South Tahoe Wastewater Treatment Plant. Water quality improvements would be accomplished by upgrading the existing plant so that it is capable of producing tertiary-treated effluent.

9. Groundwater Recharge Using Infiltration Basins

Implementation of this component entails construction of one or more rapid infiltration basins (RIB) for the disposal of some or all of the recycled water from Harvey Place Reservoir. Recycled water that is routed to the RIB(s) would percolate through underlying soil and recharge the groundwater in Diamond Valley. The RIB(s) would also augment the storage capacity of Harvey Place Reservoir, which is anticipated to be exceeded as recycled water volumes increase in the future.

10. Construct Zero-Discharge Basins

Under this component, the District would construct a zero-discharge artificial wetland for the dispersal of recycled water in Alpine County. The recycled water would be dispersed in the wetland by evaporation, transpiration, and percolation. The size of the wetland would be based on the volume of recycled water requiring dispersal. The wetland would consist of several lined ponds and a downstream unlined pond. The vegetation in the lined ponds would assimilate (or uptake and metabolize) nitrogen, phosphorous and water while the liner would prevent percolation of the recycled water into groundwater. The downstream, unlined pond would allow the percolation of recycled water that is now relatively free of nutrients to underlying groundwater. The vegetation and soil in the lined ponds would require periodic replacement as salt concentrations in the soil exceed plant tolerance.

11. Construct Storage Facility With Pumping Back to Harvey Place Reservoir

Under this component, the District would construct an artificial impoundment wetland to contain excess and emergency flows from Harvey Place Reservoir. The wetland would be constructed so that the impounded recycled water could be pumped back to Harvey Place Reservoir when desired and returned to the irrigation distribution system. A new pump station and associated pipeline would be required adjacent to the wetland area in order to pump the water back to Harvey Place Reservoir.

Recycled and freshwater water would be dedicated to maintain the wetland during non-emergency periods. A levee would surround the wetland to allow for its deliberate flooding. The volume of recycled water that could be impounded in the wetland during an emergency event would depend on the impoundment area and the height of the levee. A 10-acre wetland with a 5-

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foot levee could contain over 16 million gallons, or slightly less than 4 days of discharge from the treatment plant at current flows.

The wetlands would consist of several lined ponds. Some dispersal of recycled water would occur in the impoundment wetland because vegetation in the lined ponds would assimilate (or uptake and metabolize) nitrogen, phosphorous and water. The liner would prevent percolation of the recycled water into groundwater.

12. Growing Biomass Crops for Pulp Production using Recycled Water

Under this component, recycled water would be used for growing biomass crops (e.g. poplar, willow) to be used for pulp wood production. The crops could be harvested every 4 to 6 years depending on species and growth characteristics. The District could potentially produce 20 tons of biomass per acre every 4 to 6 years. Biomass production would use about 4 to 4.5 acre-feet of recycled water per acre of land. Biomass production on 250 acres of District-owned land could dispose of approximately 1,000 acre-ft of recycled water per year.

13. Wetland sod and seed production

By implementing this component, the District would generate revenue from the production and sale of wetland sod and seed. Recycled water would be used to grow wetland species sod for transplantation to mitigation sites in the area. Seeds would also be harvested from mature wetland and sold for wetland habitat projects. Sod harvesting would potentially occur every three to four years and seed harvesting would occur every other year.

14. Pipe Recycled Water Systems to Minimize Setbacks and Human Contact

This component would convert all open channel flow in Upper and Lower Fredericksburg and Diamond Ditch systems to a buried pipe distribution system. A closed pipe network reduces the possibility of human contact with recycled water and reduces mandated setback requirements from water supply wells. Piping the delivery ditch would give the District better control of the volume of water distributed to each application area and reduce losses in the distribution system. Supplying recycled water under pressure would support ranches using sprinkler irrigation.

15. Mitigation wetland creation using freshwater

Mitigation wetlands are wetlands habitats that are constructed in response to development impacts on natural wetland systems in the area. The concept of mitigation banking is the creation of mitigation wetlands prior to the taking of natural wetlands, and then selling credits to entities required to mitigate the wetland impacts from their projects. Mitigation wetlands generally have stipulations requiring support in perpetuity. This component would create a mitigation wetland bank, supported with recycled and/or freshwater, for sale of mitigation credits to private or public organizations in need of wetland mitigation

16. Subsurface Recycled Water Irrigation in Public Contact and Buffer Areas

Title 22 of the California Code of Regulations restricts irrigation on, or directly adjacent to, public areas. No spray irrigation of any recycled water, as treated by the District's facilities, may take place within 100 feet of a residence or a place where public exposure could occur. Because of this restriction, the District pasture is not currently irrigated because of its close proximity to Alpine County's school complex. This component proposes to irrigate the property using subsurface irrigation methods. A shallow underground network of perforated pipe would be installed on the property for the distribution of recycled water.

17. Increase Snowshoe Thompson No. 1 Conveyance Capacity

Increasing the capacity of the Snowshoe Thompson No. 1 ditch would allow the District to convey its full entitlement of water diverted from the West Fork of the Carson River. Increasing the conveyance capacity of the ditch can be accomplished by replacing the open channel with a pipeline or by making improvements to the existing open channel system. Increased conveyance capacity would result in an increase in the volume of water that is routed to Indian Creek Reservoir. Increasing the volume of freshwater that flows to Indian Creek Reservoir would accelerate the improvement in water quality in the reservoir. The replacement of the open channel with a pipeline could also result in improved water quality in the reservoir by reducing the current sediment loading that occurs from ditch erosion and runoff entering the ditch.

18. Optimize Application Rate on Existing Irrigated Lands

The application rate for recycled water used for irrigation on existing permitted lands is based on the hydraulic loading rate and nutrient needs of the various combinations of soil and crop types in the area. Optimization of the application rate is required to protect groundwater and surface water resources in the region from possible contamination by nitrogen or other nutrients present in the recycled water and to avoid generating tailwater. This optimization ensures there are no losses other than those intended (that is, evapotranspiration and some percolation). The application rate is controlled by soil permeability and the nutrient requirements of the irrigated crops.

To develop a recycled water allocation system that would both maximize the volume of applied recycled water and minimize the threat to groundwater and surface water, the soil and crop types in the irrigated areas would need to be assessed and mapped. These data would be used to develop recycled water application rates that meet crop nutrient needs and protect groundwater and surface water resources. However, the volume of recycled water that is currently applied exceeds the hydraulic loading rate of available permitted lands resulting in runoff and tailwater discharges. Therefore, implementation of this component would likely result in a reduction in the volume of recycled water that is applied.

19. Pursue the Permitting of More Land in Alpine County

The ability to use recycled water as a source of irrigation water is an asset to any production system. Currently, 1,883 acres are permitted to receive recycled water in Alpine County. Of the 1,833 permitted acres, roughly 75 percent (1,411 acres) use recycled water for irrigation. This amount of acreage is not adequate to receive the 5,200 acre feet per year of recycled water that is currently generated, much less the 6,400 acre feet per year estimated to be generated by the year 2020. Additionally, development in areas currently receiving recycled water would likely result in the loss of permitted acreage. Therefore, additional lands would need to be permitted for the application of recycled water if other alternative recycled water uses are not implemented.

20. Improve Operation of the Diamond Ditch System to Meet District and User Needs

The Diamond Ditch Association currently owns the Diamond Ditch system. The District performs the operation and maintenance of the system. The costs associated with system operation and maintenance are not reimbursed by the Association to the District. Additionally, the irrigators have the right to call for water, limiting the control the District can exercise over the delivery schedule. This affects the District's ability to control system operations, provide recycled water to others, and manage the level of Harvey Place Reservoir. Under this component, the District would determine whether ownership of portions of the ditch and appurtenances or modifications of existing easements best supports the District's interests.

21. Develop Tailwater Control System

By implementing this component, the District would assist irrigators with tailwater control. The development of tailwater detention ponds would reduce the likelihood of tailwater flowing off permitted lands thereby ensuring the permitted irrigators and the District remain in compliance with applicable tailwater regulations. The tailwater would either percolate and evaporate from detention ponds or be pumped back to the irrigation ditches for re-application.

22. Parallel Recycled Water Pipeline Along Existing Diamond Ditch

By implementing this component, the District would install a recycled water pipeline generally along the current route of the Diamond Ditch. By piping the recycled water, the District would have greater control over the quantity of water delivered to any site. The recycled water would be delivered to users under pressure allowing the irrigators to use sprinkler irrigation, which is more efficient than flood irrigation. Diamond Ditch would then potentially be used as a fresh water delivery system.

23. Route Mud Lake Winter Flows through Indian Creek Reservoir

Mud Lake Reservoir is located in Douglas County, Nevada between the West and East Forks of the Carson River. The reservoir is supplied by Alpine Decree water right entitlements that are diverted from the West Fork of the Carson River in Alpine County. Winter flows to Mud Lake are conveyed from the West Fork, through the Millich Ditch to Indian Creek below Harvey Place Reservoir. The water flows into Nevada in the Indian Creek drainage to a diversion structure where it is routed to Mud Lake.

This component proposes to negotiate an agreement with owners of the Alpine Decree water rights stored in Mud Lake to route this water through Indian Creek Reservoir. Implementation of this component would result in conveying Mud Lake winter flows from the West Fork of the Carson through Snowshoe Thompson No.1 Ditch and the Upper Dressler Ditch to Indian Creek Reservoir. Increased flows of water through Indian Creek Reservoir would increase dissolved oxygen concentrations in the reservoir and would transport phosphorus from the reservoir. The Mud Lake water right entitlements could not be stored in Indian Creek Reservoir; therefore, an equal flow from the Indian Creek Reservoir outlet structure would be released into Indian Creek below Harvey Place Reservoir.

24. Transfer Additional Water Rights to Storage in Indian Creek Reservoir

Under this component, additional water rights would be transferred to storage in Indian Creek Reservoir by the District or by other water right owners. Increased flows of fresh water through Indian Creek Reservoir would increase dissolved oxygen concentrations in the reservoir and transport phosphorus from the reservoir to result in improved water quality and fish habitat.

29. Irrigate the District Pasture Land

This component would irrigate the District Pasture using recycled water. Recycled water would be supplied either from a branch off the existing C-Line or from a new pipeline leading from the existing C-Line to the Diamond Valley Ranch. Minor grading would occur to the District Pasture to prevent recycled water from entering the Upper and Lower Harvey Channels. The primary use of the Upper Harvey Channel and the Lower Harvey Channel is to direct Indian Creek flows (exceeding the conveyance capacity of the Upper Dressler Ditch) around the Harvey Place Reservoir. The Upper and Lower Harvey Channels carry freshwater only and enter Indian Creek below the dam of the Harvey Place Reservoir.

The configuration of the irrigation and associated minor grading would need to include a means

of continuing the ability to spill very high flow rates (induced by flood or snowmelt) out of the Harvey Channel. Alternatively, the Upper Harvey Channel could be enlarged to contain the peak flow rate induced by a 100-year storm event with berms to prevent recycled water from entering the channel. A variation on this project component would be to irrigate the District Pasture with freshwater if the Diamond Valley Ranch is irrigated with recycled water. In this case the water rights from the District Pasture would be used to resume irrigating the District Pasture and a portion of the water rights of Diamond Valley Ranch would be used for storage in Indian Creek Reservoir. The basis of this variation is that the original water rights for irrigating the District Pasture were transferred to storage in Indian Creek Reservoir. Since the District Pasture is no longer irrigated, it may be desirable to resume irrigating to restore the land as a pasture.

30. Irrigate the “Jungle” with Recycled Water

The District obtained land known as the “Jungle” with its purchase of the Diamond Valley Ranch. The jungle is located northwest of the Snowshoe Thompson No. 2 Ditch and north of the Millich Ditch. At its nearest point the jungle is approximately 1,100 feet from the West Fork of the Carson River. The jungle is not currently irrigated and is characterized as sloping and bottom valley land. There are approximately 150 acres that could be irrigated with recycled water once infrastructure is constructed to convey water to this area. The need for additional lands may arise from loss of lands currently irrigated with recycled water due to subdivision or some other cause, or by increased annual volume of recycled water resulting from growth in the District’s service territory. Spray irrigation methods would be utilized as the irrigation method. Water would be supplied under pressure from a pipeline branching off the existing C-Line or from the proposed pressurized line that would pump water back to Harvey Place Reservoir (Component 11).

31. Divert Stormwater Flow Away from Harvey Place Reservoir to Indian Creek Reservoir

This project component constructs a ditch near the southeast corner of the Harvey Place Reservoir to intercept stormwater and drainage flows that currently flow into the Harvey Place Reservoir and divert them to Indian Creek Reservoir. The purpose would be to reduce stormwater flow into the Harvey Place Reservoir thereby increasing the available recycled water storage volume of the Harvey Place Reservoir. Another benefit of this project component would be to increase the amount of freshwater entering Indian Creek Reservoir. A method of sediment control may be necessary to reduce sediment loading in Indian Creek Reservoir. This component would be implemented only if recycled water volume increases and additional storage volume for recycled water in Harvey Place Reservoir is needed, or if additional freshwater is needed in Indian Creek Reservoir to improve water quality and meet minimum water surface elevation obligations. The disadvantages of this project component include capital cost expenditure and additional operation and maintenance responsibilities.

32. Indian Creek Reservoir Spillway Channel

The Indian Creek Reservoir spillway originally discharged recycled water to Indian Creek in the event the reservoir filled beyond capacity. This was permissible when the District utilized tertiary treatment at its wastewater treatment plant in South Lake Tahoe. With the construction of Harvey Place Reservoir (to serve as the District’s recycled water storage reservoir) Indian Creek Reservoir was converted to a fresh water reservoir. The construction of Harvey Place Reservoir resulted in an Indian Creek Reservoir spillway configuration which discharges to Harvey Place Reservoir. This component would construct a spillway channel for Indian Creek Reservoir that conveys reservoir spillage around Harvey Place Reservoir to Indian Creek. The component has an added benefit of intercepting stormwater flow entering the east side of Harvey Place Reservoir, thereby increasing storage capacity in this reservoir for recycled water. This component would reduce the potential of emergency spills from Harvey Place Reservoir.

The implementation of this component is contingent upon the District’s desire to reduce their liability of unauthorized releases of recycled water from Harvey Place Reservoir due to very large flood events. Considerations for this component involve the likelihood of a spill from Harvey Place Reservoir. The 1997 flood event created operational problems for the District that required approval from the Lahontan Regional Water Quality Control Board (Lahontan) to apply recycled water from Harvey Place Reservoir outside of the normal irrigation season. Component implementation is a question of the likelihood of very large flood events.

Future Master Plan Project Component Descriptions

The following components are potential projects that may be implemented as a result of future actions and decisions. These projects are not a part of the Proposed Master Plan.

25. Develop Recycled Water Wholesale Program

Implementation of a recycled water wholesale program would provide revenue to the District and offset the District’s costs associated with recycled water infrastructure improvements and system operation and maintenance. The recycled water would be sold by the District and to each rancher, or the District would wholesale the water to parties who in turn would distribute the water to each individual rancher.

26. Biosolids Composting

The district may convert some District-owned or leased lands in Alpine County to a biosolids composting facility. Solid waste from the district wastewater treatment plant along with recycled water and wood chips (or other source of carbon) can be applied to land to compost the District’s solid waste. This would allow the District to dispose of their solid waste, which is presently shipped and disposed of by another party. The use of land in Alpine County for biosolids composting raises several environmental concerns. Biosolids composting may contaminate the groundwater and odor control would likely be a problem.

27. Become a Water Rights Buyer/Broker to Maintain Value of Recycled Water

If the District assumed the role of a water rights buyer/broker on the West Fork of the Carson River, it would have the ability to acquire surface water right entitlements for support of Indian Creek Reservoir. Additionally, the District could potentially influence development in Alpine County by removing or maintaining land in production, which may slow development and the loss of agricultural land to urbanization. In addition to acquiring water rights from existing water righted land in Alpine County, the District’s control of a significant amount of surface water rights could result in an increase in the value of recycled water because fewer freshwater right entitlements would remain attached to the land.

28. Power Generation

Three sites in the Alpine County area suitable for hydroelectric energy recovery are discussed here: the spillways from Harvey Place Reservoir and Indian Creek Reservoir dams, and the proposed Diamond Ditch Pipeline (Component 22).

The spillways from Harvey Place Reservoir and Indian Creek Reservoir dams are suitable for low-head impact turbines for recovery of the gravitational energy in the water. The turbines would produce single-phase electrical power. The Harvey Place Reservoir option has the ability

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to recover energy from the water and then sell the water to an end user, thus this is not mutually exclusive with the bulk sales of water baseline.

The ability to recover energy from the Diamond Ditch option prior to selling the water would depend on the point of transfer of the water from the ditch to the end user. Because Indian Creek Reservoir water is controlled by the water master, the District would not have control over the water after it leaves the reservoir.

Energy recovery from C-Line flows could be achieved by placing a single power generation facility at the bottom of the C-Line or multiple smaller facilities along the steep vertical portion of the pipeline, with pressure in individual segments not to exceed 150 psi. Either option requires replacement of the C-Line with stronger pipe. A previous study shows that the amount of time required for the power generation facility or facilities to recover the cost of the C-Line replacement would exceed the lifespan of the pipeline; therefore, this option is considered to be economically infeasible.

33. Extend the C-Line to the Nevada State Line

This component involves extending the existing C-Line from Woodfords to the Nevada State Line potentially aligned along Old CA-88 and portions of the existing Highway 88. This project component would provide additional lands for irrigation with recycled water if needed. The need for additional lands may arise from loss of lands currently irrigated with recycled water due to subdivision or some other cause, or by increased annual recycled water volume resulting from growth in the District's service territory. The C-Line extension would be constructed if the District could not secure permission from the Diamond Ditch owners to use the Diamond Ditch to convey recycled water to Nevada irrigators or if the Diamond Ditch conveyance capacity is insufficient. Disadvantages of this component include the capital expenditure required, but the capital cost could be offset by investment from the Nevada users to pay for pipeline construction.

34. Injection Well Program

In water resource management, an injection well is a well used to inject water into the groundwater aquifer as opposed to extracting water from the aquifer. Injection wells provide artificial recharge of the groundwater aquifer. Treated surface water and recycled water are typically used as the source waters for injection wells. The injected water must not biologically, chemically or physically degrade the existing water quality of the aquifer. The injection location and depth determine the functionality and usefulness of the injection well from a hydro-geologic perspective.

This future master plan component would implement an injection well program for the District's recycled water. Implementation depends on various factors including insufficient sites for land application of the recycled water, the quality of the recycled water discharged from the District's treatment facility, and cost/benefit considerations. The Diamond Valley Ranch is a candidate for injection well sites. A pipeline extending from the existing C-Line would be needed to convey water to injection well site(s). Improvement of the quality of the recycled water is necessary to implement an injection well program. The program would have to be permitted by Lahontan. Groundwater transmission studies would be necessary to evaluate, design and estimate the effectiveness of an injection well program.