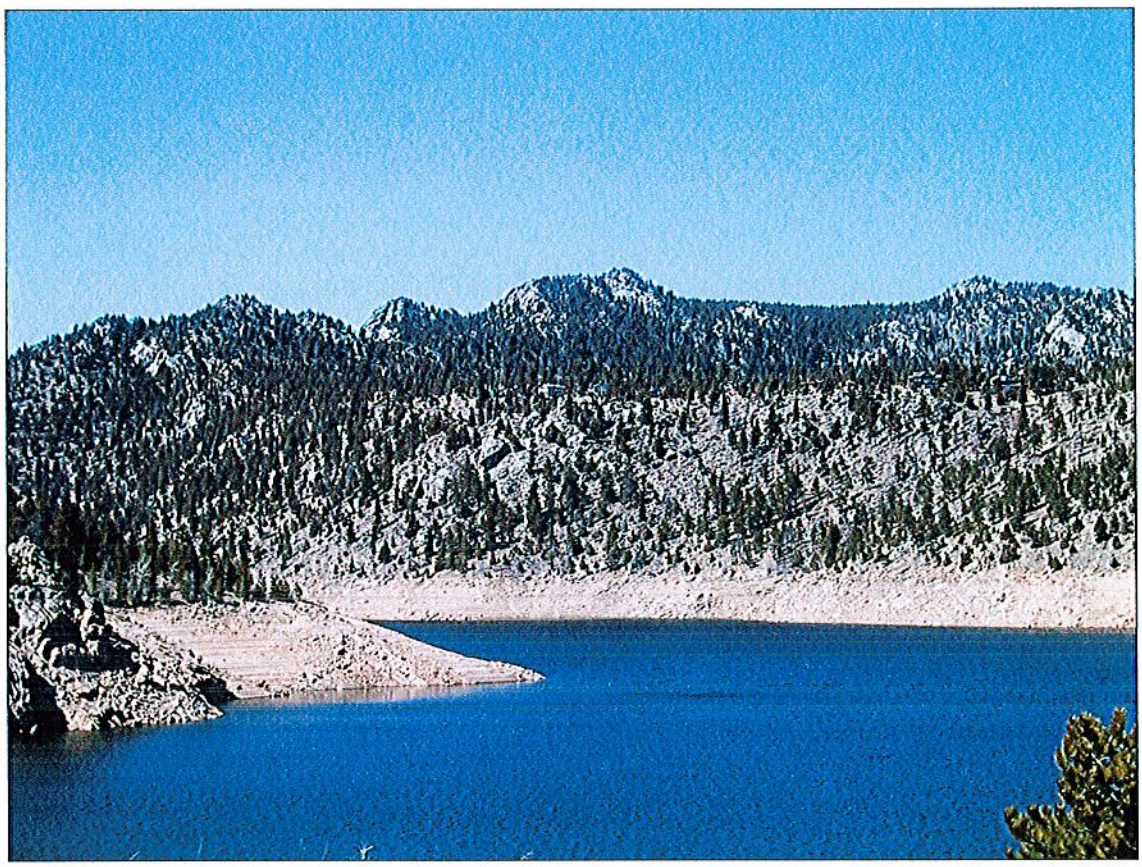
Attachment 3

GROSS RESERVOIR

TREE REMOVAL PLAN FOR POOL ENLARGEMENT



February, 2008

Prepared by Land Stewardship Associates, LLC

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INTRODUCTION

Denver Water Department owns and operates Gross Reservoir as part of its water supply system along the Front Range of Colorado. This reservoir is located southwest of Boulder, Colorado, in the upper reaches of the South Boulder Creek.

Current plans call for increasing the size of the dam at the Gross Reservoir, thereby raising the pool at the spillway elevation from 7,282' (USGS quad maps show the current spillway pool at 7,287') to 7,400'. **To minimize problems in the future with floating debris, etc., all trees and their associated debris, e.g. tops, slash, etc., on about 430 acres along 12.5 miles of shoreline will need to be removed between the current pool elevation of 7,282' and 7,410', which is ten feet above the new pool elevation.**

Because of the topography, e.g. very steep slopes, rock outcrops, etc., several, more complex tree removal (logging) systems will need to be used and some temporary roads will need to be constructed to remove the trees. Bruce Short, of Short Forestry, LLC, assisted Land Stewardship Associates, LLC in identifying and analyzing appropriate logging systems and access options. Also, because of air quality concerns, disposal of the "residue" resulting from tree removal, both merchantable forest products and slash, becomes complex and costly.

This "Tree Removal Plan" uses data and information from the recently completed "Gross Reservoir Forest Management Plan (May 22, 2005)" to characterize the condition of the vegetation along the shoreline. It also identifies recommended tree removal systems and alternative residue removal approaches and their associated costs.

There are a few recreation developments that will need to be removed or relocated if the reservoir is expanded: a boathouse, a few picnic sites, and a boat dock. New shoreline access roads may also be planned.

DESCRIPTION OF AREA

Vegetation, Topography and Surface Soil Conditions

Vegetation along the shoreline is primarily forest cover containing ponderosa pine, Douglas fir, and in spots, Rocky Mountain juniper, with inclusions of grass/shrub savannah. Most of the trees are 20 to 50 feet tall and vary in diameter at breast high (dbh) 4 to 14 inches. The density of the forest ranges from approximately 150 to 1800 trees/acre. See the "Gross Reservoir Forest Management Plan (May 22, 2005)" for a detailed description of the vegetation types.

Thirty five (35) unique "stands" representing eleven (11) vegetation types (taken from the Gross Reservoir Forest Management Plan) were identified along the shoreline. **Maps A and B** in the **Appendix** identify the specific location of the stands. **Table 2** lists the stands and briefly identifies the vegetation, stems and merchantable volume for each stand. In addition, the table cross-references the vegetation types contained in the "Gross Reservoir Forest

Management Plan (May 22, 2005)" in a column labeled "Match" for a more detailed description of the vegetation**.**

Following are several photos displaying vegetation, topography and tree removal method or other uses.

Stand 3 – Hand Fall, Grapple Skidder

Stand 22 – Feller/buncher

Stand 24 - Cable

Stand 2 – Hand Fall, Grapple Skidder

Stand 20A – Main Helipad, ACDs

Stand 7 - Helicopter

Topography. Shoreline slopes range from 20% to well over 60%. **Map A** in the **Appendix** is a USGS contour map of the area. Because 40% slope is a usual guide to help determine whether ground-based logging systems are appropriate, **Map A** identifies slopes that are over 40 percent. **Table 2** lists the average slope of each stand, whether less than 40%, over 40% or a mix of under and over 40%. A **Gross Reservoir Map**, as listed in the **Appendices** and located in the report pocked, is a topographic map of the lake bottom. The **Gross Reservoir Map** is the only contour map of the lake bottom that the authors of this report found available. Because the cartographic controls are not known, the map is included for general reference purposes only.

Surface Soil Conditions. The shoreline soils are primarily comprised of a very porous decomposed granite. There is a very high density of small to large rock outcrops on all the slopes around the reservoir. These outcrops can have a substantial impact in selecting the appropriate type of tree removal system.

Access

Points to the lakeshore are the access road from Flagstaff Road east and north of the dam, Gross Dam Road to the south of the dam through Crescent to Highway 72, and from the west across Winiger Ridge using Forest Road 359 and the 68 Road. Portions of Forest Road 359 will need to be improved in order to haul the necessary equipment for logging, residue removal, etc.

Air Quality Considerations

Approximately fifty thousand tons of forest biomass are expected to be produced during the pool expansion clearing of Gross Reservoir. Most if not all of the material currently has little, if any, commercial value. Without a market the clearing residue becomes waste. Traditionally most of the slash would have been piled and burned in place. Any easily accessible firewood would have

been sold or given away. Today, burning large quantities of forest residue, in close proximity to residential areas, is problematic in the extreme.

Colorado Department of Health, Air Quality Division and the Bolder County Department of Health are responsible for stewardship of the air shed in the Gross Reservoir area. Two factors complicate the use of open burning on the large scale required for this project. Homes with year long residents are within a half mile to a mile of the most likely burn pile locations. Night time, down canyon air drainage, will concentrate smoke along Boulder Creek and well into the Boulder Area. This project will adversely impact air quality in the region for numerous days and nights.

None of the air quality regulations can be manipulated to allow the open burning of 50,000 tons of slash anticipated from the clearing. There is a full discussion of options for dealing with project residue in the Slash Disposal section of this report.

TREE REMOVAL SYSTEMS AND COSTS

Limited road access to the lakeshore, steep slopes and large rock outcrops complicate tree removal in most areas along the lake shoreline. Ground-based systems (hand-felling with rubber-tired grapple skidding and tracked feller/buncher) and cable yarding are used where existing roads are in place or where temporary road construction is possible along the shoreline. Helicopter yarding is employed where road access is not available or possible. Hydro-axing is recommended in the upper reaches of Forsythe Canyon (Stands 1 and 3) for tree removal due to steep slopes and heavy rock.

Table 2 identifies the recommended tree removal method and estimated costs for each stand. Production and costs were modeled using **'LOGCOST 8.0'** software developed by the USDA Forest Service Pacific Northwest Region. Total costs do not include improvements to Forest Road 395 across Winiger Ridge for hauling of equipment.

The use of specific equipment manufacturers names does not represent an endorsement by Land Stewardship Associates, LLC. Instead they are included only as representative equipment with certain production and operational capabilities and were used for modeling these capabilities in **'LOGCOST 8.0'**.

It should also be noted that the recommended tree removal methods for some of the units may leave pockets and stringers of trees due to steep pitches in slope and the presence of rock barriers. Throughout the removal area it may be necessary to use combinations of special spot removal techniques. This could include hand felling and the use of grapple skidders where feller/buncher is the prescribed method. In other units it may mean hand falling and short cable skidding where a grapple skidder was prescribed. For removal of trees on small rock bluffs prescribed for cable or some other technique, the use of helicopter may be necessary.

Piece size is the primary cost factor for all the logging systems used in the project. Many of the trees are small diameter and short in height. The project entails removal of as much of every tree

as possible to reduce floating debris once the reservoir reaches its new pool elevation. Accomplishing this objective means that smaller diameter trees and tops are skidded and removed from the harvest areas, further reducing average piece size. Most material is expected to be skidded whole-tree, i.e., with tops and limbs attached.

Ground-based Systems

The analysis was modeled in **'LOGCOST 8.0'** using a Cat 545B grapple skidder and hand felling with a medium-sized loader for conventional tractor operations; and a Timbco 425 EXL tilt tracked feller/buncher and JD 648 grapple skidder with medium loader for feller/buncher operations. Rubber-tired skidders were used for modeling due to their production rates, the amount of rock present in the project area and the general availability of that type of machine. Tracked skidders may be used in place of rubber-tired skidders if desired.

Example Grapple Skidder and Feller/Buncher

Cable System

The analysis uses a Linkbelt crane double drum yarder with an Eaglet Super carriage, a D6 landing cat and a medium loader.

Example High Lead Cable System

Helicopter System

The analysis was based on a light helicopter, e.g. Bell 210, with a payload of about 4800 pounds. Several of the harvest units (Stands 11A, 12, 13, 14A and 16A) use pre-bunching of the cut trees on centralized landings to increase helicopter efficiency and reduce costs. The helicopter landings are designated on **Map B** in the **Appendix** as H11, H13 and H16. The delivery point for all helicopter-yarded material is the main helipad located on the end of Winiger Ridge, accessed by Forest Road 359.

Example Bell 210 Helicopter

Example Hydro-ax

Hydro-ax

A Hydro-ax is recommended for tree removal in Stands 1 and 26 due to poor access, very low stocking levels, small trees, steep slopes and heavy rock. This machine can be worked around much of the rock and will reduce the trees and brush to small chunks which will readily decay.

Landings

Approximate landing locations for all yarding systems are shown on **Map B** in the **Appendix**. Helicopter landings are shown for Stands 11A, 12, 13, 14A and 16A. Helicopter landings H11 and H16 are located below the maximum existing pool elevation in order to utilize flatter terrain (see **Appendix** Gross Reservoir Contour map in report pocket). The remainder of the helicopter-yarded units are yarded directly from the stump to the main helipad.

Approximate landing locations for all other systems are shown on **Map B** in the **Appendix**. . Average yarding distance is generally less than 400 feet for ground-based and cable systems. Landings for Stands 2, 3, 3A, 8, 9, 10, 10A, 11, 16, and 17 are located below the existing maximum pool elevation to take advantage of flatter terrain features at the base of the tractor and feller/buncher units (see **Appendix** Gross Reservoir Contour map in report pocket). Pool elevations will need to be approximately 60 feet below maximum pool during logging operations to utilize these locations.

Temporary Roads

Temporary roads are needed to log Stands 2, 3, 3A, 8, 10, 10A, 11, 14, 15, 17, 24 and 24A and are shown on **Map B** in the **Appendix**, some of which are below existing maximum pool elevation as indicated on **Table 2.** Costs for the temporary roads are estimated at $1.00 per foot and are included in the logging system costs.

Costs

The costs between individual stands vary depending on slope, size of unit, number of stems per acre, move in/move out costs and the amount of temporary roads. Using the results of the **'LOGCOST 8.0'** analysis, the range and average costs per acre for each system are given in **Table 1**.

Table 1: Average Costs for Tree Removal Systems

System	Range in Costs ($/Acre)	Average Costs ($/Acre)
Cable	$4,400 - $4,700	$4,600
Feller/Buncher	$ 900 - $3,400	$1,500
Grapple Skidder	$1,000 - $6,200	$2,900
Hydro-ax	---	$750
Hellicopter	$2,000 - $13,500	$9,000

Access

From the west, across Winiger Ridge using Forest Road 359 and the 68 Road, a main helipad can be located in the open area designated as Unit 20A and adjacent open areas just north of Unit 20A. Unit 20A, and the area just north, are large enough and have favorable topography for safe helicopter operations and servicing plus enough area to locate decks of merchantable logs for resale. Chippers or Air Curtain Destructors can also be located in the Unit 20A area. As previously noted, the roads on Winiger Ridge (west side of the reservoir) will need some upgrading to bring them up to a standard needed for efficient access by helicopter refuel vehicles, timber utilization and transport of ACDs. The costs of improving the Winiger Ridge road are not included in this plan.

RECOMMENDED TREE REMOVAL METHODS

The following **Table 2** displays the tree removal/logging methods recommended for each of the stands identified on **Appendix I – Maps A and B**, and a number of other characteristics of the stands, including the costs of removal for each stand. Again, the costs include temporary road construction but not improvements to the Winiger Ridge road.

Table 2: Recommended Tree Removal Methods for Stands

Stand ID	Slope (%)	Acres*	Dominant Vegetation**	Stems (#/AC)	Merch Vol (CCF)***	Tree Removal Method	Costs ($)	Match**** (Tract #)	Comments
1	Mix	6	J, PP, DF, Shrub	248	0	Hydro-ax	3,750	109	Not loggable
2	Mix	20	DF, PP	717	246	Hand fall, grapple skidder	68,550	103A	Lndngs/Temp Rds below 7282'
26	>40	5	J, PP, DF, Shrub	248	0	Hydro-ax	3,000	109	Not loggable
25	>40	3	J, PP, DF, Shrub	717	0	none	0	103A	Cliff, hand fell a few trees
3	>40	13	PP,DF,J	307	66	Hand fall, grapple skidder	21,250	65B	Lndngs/Temp Rds below 7282'
3A	Mix	20	PP,DF,J	307	105	Hand fall, grapple skidder	28,800	65B	
4	<40	6	DF, PP, J	125	31	Hand fall, grapple skidder	6,000	54A	
24	>40	27	DF, PP	1,170	76	Cable	120,900	58B	
24A	<40	8	DF, PP	1,170	18	Hand fall, grapple skidder	15,550	58B	
5	Mix	14	DF, PP	257	170	Hand fall, grapple skidder	37,350	47A	
22	<40	15	PP	307	75	Feller/buncher	19,750	65B	
18	<40	15	Shrub, Grass				0	Savanna	No treatment
23	<40	1	PP, DF	1,350	6	Hand fall, grapple skidder	4,300	65A	
21	<40	6	PP, DF	717	70	Feller/buncher	16,800	103A	
20	<40	8	PP	307	41	Feller/buncher	10,900	65B	
19	<40	4	PP	140	53	Feller/buncher	3,750	49A	
16	<40	28	PP, DF	717	352	Hand fall, grapple skidder	102,950	103A	Lndngs/Temp Rds below 7282'
16A	Mix	15	PP, DF	717	194	Helicopter	114,600	103A	
14	<40	5	PP, DF	1,350	25	Hand fall, grapple skidder	16,100	65A	
14A	>40	10	PP, DF	1,350	45	Helicopter	77,400	65A	Lndngs/Temp Rds below 7282'
15	>40	6	PP	307	30	Hand fall, grapple skidder	7,600	65B	
6	>40	20	PP, DF	386	126	Helicopter	85,800	108	
6A	>40	6	PP, DF	386	55	Cable	30,900	108	
13	Mix	35	PP, DF, J, Shrub	717	427	Helicopter	442,600	103A	
7	>40	4	DF, PP, J	125	21	Hand fall, grapple skidder	8,000	54A	
11	Mix	15	PP, DF	282	360	Hand fall, grapple skidder	72,450	60A	Lndngs/Temp Rds below 7282'
11A	>40	7	PP, DF	282	180	Helicopter	74,350	60A	Lndngs/Temp Rds below 7282'
12	>40	17	DF, PP	248	91	Helicopter	102,200	109	
8	<40	10	PP	307	47	Feller/buncher	12,550	65B	Lndngs/Temp Rds below 7282'
10	<40	6	PP	282	159	Hand fall, grapple skidder	32,500	60A	Lndngs/Temp Rds below 7282'
10A	Mix	31	DF, PP	248	161	Hand fall, grapple skidder	43,000	109	Lndngs/Temp Rds below 7282'

Table 2: Recommended Tree Removal Methods for Stands (continued)

Stand ID	Slope (%)	Acres*	Dominant Vegetation**	Stems (#/AC)	Merch Vol (CCF)***	Tree Removal Method	Costs ($)	Match**** (Tract #)	Comments
9	<40	8	PP	218	84	Feller/buncher	8,550	107A	Lndngs/Temp Rds below 7282'
17	<40	12	PP	282	279	Hand fall, grapple skidder	68,400	60A	Lndngs/Temp Rds below 7282'
17A	>40	9	PP	282	231	Helicopter	121,500	60A	Lndngs/Temp Rds below 7282'
20A	<40	15	Grass, Rock, Shrub				0	Savanna	Helipad, ACDs, Log decks
Totals		**430**			**3,824**		**$1,782,100**		

* Includes removing trees to 7,410', or 10 feet above the new pool level of 7,400'.
** PP=ponderosa pine, DF=Douglas fir, J=Rocky Mountain juniper.
*** Merchantable Volume in Hundred Cubic Feet, assuming trees with 8" dbh and 20' height
**** Tracts from "Gross Reservoir Forest Management Plan Update", May 22, 2005.

Note: LSA considered the possibility of using a barge(s) in removing trees and moving residue. The use of barges could reduce the costs of temporary road construction, and a cable logging system could possibly be modified to pile trees and residue on a barge. However, it was concluded that the need for docking (loading/unloading) facilities, the need to maintain a full pool level, likely additional handling of the residues (loading and unloading) and the haul costs of barges to the reservoir would likely not make their use cost effective. If, however, barges will be needed during reconstruction of the dam, it may be prudent to evaluate their use at that time.

RESIDUE (PRODUCTS AND SLASH) DISPOSAL

About fifty thousand tons of forest residues will be produced during the clearing phase of pool expansion for Gross Reservoir. Some of the residue can be turned into products (sawtimber, firewood, etc.) with the remaining material being slash (unmerchantable material).

Table 3: Residue Volumes for Stands (Tons)

STANDS	ACRES	TONS/ACRE	TOTAL TONS
Stand 5	14	70.92	992.88
Stand 19	4	115.21	460.84
Stands 4 & 7	11	57.56	633.16
Stand 24 & 24A	35	206.63	7,232.05
Stands 10,10A,11,11A,17&17A	80	132.57	10,605.60
Stands 14 , 14A & 23	16	148.90	2,382.40
Stands 3,3A,8,15,20 & 22	72	106.24	7,649.28
Stands 2,13,16, 16A 21 & 25	107	159.59	17,076.13
Stand 9	8	93.94	751.52
Stand 6 & 6A	26	117.70	3,060.2
Stands 1,12 & 26	28	98.39	2,754.92
Totals	**401**		**53,598.98**

A traditional pile and burn approach to disposing of this material is no longer viable due to air quality concerns and regulations. To make the job less onerous, all opportunities to utilize some of the material need to be explored—see the discussion below in the **Potential Savings from Product Utilization** section of this report. Residue treatment options, with or without, utilization include: 1) burning in an air curtain destructor (ACD); 2) grinding whole trees and hauling to a landfill; 3) loading untreated residue into trucks and hauling to a landfill.

Each approach has its pros and cons. The following comparison of residue disposal methods is based on 2008 dollars and should be considered an approximation of the overall costs of each alternative. Perhaps the most important aspect of the analysis is the relative merits and costs of each approach.

Description of Residue Disposal Methods

Air Curtain Destructors are widely used in land clearing projects throughout the world. An ACD is a simple machine that is, in fact, a large mobile incinerator. Combustible material is loaded into the large bin and a fan blows a high pressure curtain of air across the top of the bin. The curtain recirculates combustible gases and smoke until only heat and a minimum of pollutants escape from the bin. ACDs have a 96 to 98 % reduction rate, so 2,000 pounds of slash turns into 40 to 80 pounds of ash. The ash is usually hauled to landfill.

Example Air Curtain Destructor

Operating an ACD is relatively simple. Brochures from Air Burners LLC describe the process. Slash is accumulated in large decks and a track hoe or loader with a thumb on the bucket is used to load the slash into the ACD. Each ACD will consume from 2 to 12 tons per hour depending upon the size of the unit. If one assumes a 12 ton/hour thru-put rate it will take 4,167 hours to burn all the slash anticipated from the clearing. A bank of several ACDs working simultaneously will speed the disposal process and efficiently utilize the track hoe or loader. Five ACDs working at peak efficiency can be expected to consume the slash in 833 hours. Equipment and personnel never run at peak efficiency 100% of the time. With 20% down time for maintenance and administrative gyrations the real burn time is closer to 1,000 hours for five ACDs working together. 1,000 to 2,000 tons of ash will be produced by the ACD operation and will need to be hauled to a landfill in a covered dump truck.

Grinding Whole Trees and Hauling to Landfill is another option for slash disposal. Large grinders are used to convert entire trees into rough chips. These chips can be used as fuel for steam generation, compost or simply dumped in a landfill. Currently there aren't any utilization opportunities in the steam generation or composting arena that will handle the amount of slash anticipated from this project. That leaves the landfill as the most likely contemporary solution.

Grinder operations are straight forward. Slash is decked in large piles and fed through the grinder with a track hoe or loader. The grinder blows chips into a pile or a truck and the chips are hauled to a landfill. If chips are not hauled off in a timely way, the chip pile can get large and take up a lot of space. Don Sanford from Spur Associates says they can grind 22.5 tons of dry logs in about twenty minutes. At this pace it will take 2,222 hours to grind the slash anticipated in this project. Realistically it will probably take 2,666 hours to grind the material when maintenance and administrative time is added. Obviously several grinders working at the same time will grind the material faster. Large chip vans, capable of holding

100 cubic yards of chips, will carry approximately 23 tons per load which equates to 2,174 truck loads. Grinding will produce 217,400 cubic yards of waste.

Loading and Hauling Whole Trees to a Landfill is the most primitive solution and perhaps the most expensive when haul costs and tipping fees are considered. Operationally it is the least complex approach. Trees are decked in several different locations. A track hoe with a grapple is used to load trucks. The loads are taken to a landfill. Stuffing entire trees in a truck is like trying to load cats in a bag. The loads will not be nearly as dense as chips, so many more truck loads will be required. The number of cubic yards resulting from this approach is 434,800.

Three landfills exist in the area: Denver Regional, Foothills and Front Range will accept the ash, chips or slash. Their tipping-fees range from $9.00 to $15.51 per cubic yard. Foothills Landfill is located at 8900 Hwy 93 near Golden and is closest to the project and also has the lowest tipping fee.

Table 4 summarizes the costs of disposing of residues using the above residue disposal methods.

Table 4: Residue Disposal Alternatives

ITEM	AIR CURTAIN DESTUCTOR	GRIND & LANDFILL DISPOSAL	WHOLE TREE HAUL & LANDFILL DISPOSAL
Tons of Residue	50,000	50,000	50,000
Cubic Yards to Landfill	3,613	217,400	434,800
Tipping Fees @ $9.00/yd	**$32,517**	**$1,956,600**	**$3,913,200**
Hours of operation	5,000	2,666	0
Operational costs/ton	$225	$525	0
Pre-haul costs	**$1,125,000**	**$1,399,650**	**0**
Load & haul to landfill $200/round trip	**$20,000**	**$434,800**	**$869,600**
Total Costs	**$1,177,517**	**$3,791,050**	**$4,782,800**
Cost/ton ($s)	**23.55**	**75.82**	**95.66**

Potential Savings by Product Utilization

If all of the residue generated from the shoreline clearing is disposed of by burning, it will take over four months with four Air Curtain Destructors (ACD) operating 12 hours a day, seven days a week with no breakdowns. Crews with equipment would need to be present at all times to feed the ACDs as they consume their loads. It includes over fifty thousand tons of forest residues (slash) a lot of which is tree stems over 6 inches in diameter and up to 50 feet long.

Removing merchantable material, such as logs and/or firewood, will reduce the volume of material to be treated. According to **'LOGCOST 8.0'**, generally 50% of a tree's above ground biomass is distributed in the crown (limbs, needles, and stem <4" diameter). As noted in **Table 2**, about 3,824 CCF (or about 1,800 MBF) of merchantable volume is included in the residue.

Removing and selling this material can reduce the residue volume by 25,000 tons, or 50 %, and can generate a substantial savings in residue disposal costs.

Table 5: Potential Savings by Removing Merchantable Products and/or Firewood from Residue

APPROACH TO RESIDUE DISPOSAL	AIR CURTAN DESTRUCTOR	GRIND & LANDFILL DISPOSAL	WHOLE TREE HAUL & LANDFILL DISPOSAL
Dispose of 100% of the material removed from pool zone	$1,177,517	$3,791,050	$4,782,800
Remove merchantable sized/firewood material from residue disposal system	$588,758	1,895,525	2,391,400
Savings in Disposal from Utilization *	**$588,758**	**$1,895,525**	**$2,391,400**

* Does not include potential income from selling the merchantable material.

Market Situation for Merchantable Component of the Residue

Wood product prices vacillate according to market conditions. For example, the current market price for pine in this area in February 2008 is $5 to $10/ton. However, the prices are going down due to slowdowns in the housing market and because there is a surplus of pine. The surplus of pine on the market is caused by the mountain pine beetle epidemic in the Colorado and Wyoming lodgepole pine. Growing quantities of pine are being "dumped" on the market through service contracts and stewardship contracts where the logger is being paid to remove the dead or dying trees.

Aside from market conditions, most of the trees within the Gross Reservoir removal area are not highly desirable by the wood industry because of their relative short height and number of limbs (knots). Also, conventional logging truck access to most of the wood, even when decked, will be restrictive and expensive. However, there is a potential for conversion to a variety of small wood products. With the use of service contract(s) (subsidizing the logging or hauling cost depending on market conditions), disposal cost can be reduced if most of the logs (over 6 inches in diameter) were to be removed and utilized by the local wood product industry. Around the reservoir, Stands 4, 8, 9, 10, 16, 19, 20, 21, 22, and 23 are all on slopes that can be logged with conventional methods. With the use of service contracts, local loggers could clear cut and remove the timber on over 100 acres (the above listed Stands) and machine pile the slash for disposal later. One hundred acres is one fourth the total acreage and accounts for possibly 7,500 to 12,500 tons or 15 to 25 % of the total tonnage. **At current market prices of $5 to $10/ton, this could potentially generate $37,500 to $125,000 in income that could be applied to offset the project costs.** As previously discussed, the tonnage to be disposed could be reduced by 25,000 tons or 50% of the total if all the heavier pieces of wood throughout the removal area could be hauled away and utilized for firewood or some other wood product. Marketing the merchantable wood or paying a small fee to have it hauled to a local mill rather than burning it could generate substantial savings in disposal cost. Possibly the future tree removal contractor could consider salvaging the heavier (logs) when developing a proposal to remove all trees within 7410'.

Currently the most likely outlet for the small sized material coming from this project may be firewood sales or giveaway. There are approximately 3,800 cords of ponderosa pine and Douglas fir firewood within the area to be cleared. There will be a cost associated with disposing of the firewood. The least-cost approach will be to allow someone to salvage all the firewood for free. This approach will involve administering the salvage operation. The highest cost method to remove firewood from the slash is to buck and split all the wood and allow people to haul it off. The method selected depends on how much control Denver Water feels they need over the pace and quality of the firewood operation.

SUMMARY OF METHODS AND COSTS

Table 6 displays the costs for tree removal, options for residue removal and savings resulting from product utilization**.** The costs do not include improvement of the Winiger Ridge road (Forest Road #359). **In general, total costs range from $2.27 million for tree removal combined with product utilization and use of Air Curtain Destructors to as much as $6.51 million for tree removal and whole tree haul to a landfill without product utilization.**

Table 6: Summary of Costs for Tree and Residue Removal and Utilization Reduction ($)

Tree Removal Costs*	Residue Removal Costs **			Tree & Residue Removal Costs	Utilization Savings Reduction***	Total Costs****
	Air Curtain Destructors	Grind & Landfill	Whole Tree To Landfill			
$ 1,782,100	$ 1,177,517			$ 2,959,617	$ 688,758	**$ 2,270,859**
$ 1,782,100		$ 3,791,050		$ 5,573,150	$ 1,995,525	**$ 3,577,625**
$ 1,782,100			$ 4,728,800	$ 6,510,900	$ 2,491,400	**$ 4,019,500**

* From Table 2.
** From Table 4—includes load and haul costs to landfill.
*** In addition to savings from Table 5, utilization reduction includes $100,000 from product sales assuming 10,000 tons at a market value of $10/ton.
**** Does not include costs associated with improvement of the Winiger Ridge road (#359)

Map A - Slope, Pool Line & Stands - Gross Reservoir Area

Slope derived from USGS 10 meter digital elevation models

105°24'0"W 105°23'30"W 105°23'0"W 105°22'30"W 105°22'0"W 105°21'30"W 105°21'0"W 105°20'30"W

39°57'30"N 39°57'0"N 39°56'30"N 39°56'0"N

Pool Line =7,400' ele.

Stands labeled with Stand-ID

Slope

0 - 40 %

> 40 %

2/22/2008

0 0.25 0.5 1 Miles

1 inch equals 1,000 feet

Land Stewardship Associates LLC
PO Box 1964
Canon City, CO 81215
Ph: 1-866-721-0704 (toll free)
www.landstewards.net

Map B - 2005 NAIP aerial with Stands, Landings, Roads and Helispots - Gross Reservoir Area

105°24'0"W 105°23'30"W 105°23'0"W 105°22'30"W 105°22'0"W 105°21'30"W 105°21'0"W 105°20'30"W

39°57'30"N 39°57'0"N 39°56'30"N 39°56'0"N

Landings and Helipads
- Landing
- Helispots
- Main Helipad

Roads
- Existing
- Temporary

- Pool Line =7,400' ele.
- Stands labeled with Stand-ID

2/22/2008

0 0.25 0.5 1 Miles

1 inch equals 1,000 feet

Land Stewardship Associates LLC
PO Box 1904
Canon City, CO 81215
Ph: 1-866-721-0704 (toll free)
www.landstewards.net

APPENDIX II: REFERENCES

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APPENDIX III: LIST OF POTENTIAL OPERATORS/MILLS

Mill Creek Enterprises

125 W. Swallow Road Fort Collins, CO 80525 970-207-9428	**e-mail**	andreMCE@Juno.com
	website	

PRODUCTS: High-quality mulch derived from Colorado slash.

Morgan Timber Products

5722 W. County Rd. 54E Bellvue, CO 80512-7101 970-484-4065	**e-mail**	mtpksm@hotmail.com
	website	

PRODUCTS: Western Rail fencing (2,3 &4 rail) both massive and standard size. Field posts, rails, barnpoles, houselogs, handrail, security fence, privacy fence, timbres, specialty wood products, firewood, peelings, chips, mulch.

Rocks & Pines Forest Products

e-mail	rocksandpines@juno.com
website	

PRODUCTS: Treated and untreated fence posts, corral poles, barn poles, log railings and buck fence. Pole gates and hardware. Western rail/tenon-jointed 2, 3 and 4 fencing. Burled character logs, furniture materials, mulch and livestock bedding from shavings. Firewood in cords or bundled.

Renewable Fiber

8395 U.S. Hwy. 85 P.O. Box 205 Fort Lupton, CO 80621 303-857-0763	**e-mail**	cspaulding@renewablefiber.com
	website	www.renewablefiber.com

PRODUCTS: Compost and soil products; mulch and bark products; rock products; edging and supplies, animal bedding; landscape timbers; truckload quantities of firewood; and bioenergy fuel.

United Wood Products Inc.

7860 Diagonal Hwy. Longmont, CO 80503-8760 303-652-2872	**e-mail**	uwp@unitedwoodproductsinc.com
	website	unitedwoodproductsinc.com

PRODUCTS: Rough-sawn pine, aspen, slabwood, custom sawing and machining, specialty fencing, tongue & groove aspen & pine. Log-rail systems (unpeeled, machine-peeled and hand-peeled) made to fit. Logs with bark, machine peeled or hand-peeled, custom ripping, grooving and cutting of logs. Unpeeled, machine-peeled or hand-peeled posts, poles or rails. Western rail or tenon-joint fence, buck fence, log gates and hardware, firewood, mulch, animal bedding and wood chips.

Armstrong Helicopters, LLC		
1251 Haystack Dr. Castle Rock, CO 80104 877-777-9188	**e-mail**	
	website	
PRODUCTS: Flies UH1-F/H – a military version of Bell 210		

Precision Helicopters		
HCR 85, Box 139X Bonners Ferry, ID 83805 208-267-2169	**e-mail**	
	website	
PRODUCTS: Flies UH1-H AND Kaman HH43 B/F		

Swanson Group Aviation		
2794 Foothill Blvd Grants Pass, OR 97526 541-494-7600	**e-mail**	
	website	
PRODUCTS: Flies Kaman K-Max – payload to 6,000 lbs but costs similar to Bell 210		

Intermontain Resources, LLC		
11925 6530 Road Montrose, CO 81401 970-249-0812	**e-mail**	
	website	
PRODUCTS: Uses all species but aspen. Has conventional, feller/buncher and cable		

Rue Logging, Inc.		
PO Box 155 South Fork, CO 81154 719-873-5862	**e-mail**	
	website	
PRODUCTS: Conventional and feller/buncher logging, also has Hydroax		

APPENDIX IV: RESIDUE VOLUME CALCULATIONS

Stand 5 (14 acres) (Match 47A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Doug fir	4	30	114	190	21660	
Doug fir	7	40	38	488	18544	
Doug fir	8	45	28	718	20104	
Ponderosa	8	35	28	718	20104	
Doug fir	10	48	18	958	17244	
Doug fir	12	50	31	1425	44175	
Total			**257**		**141831**	**992.88**

Stand 19 (4 acres) (Match 49A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	11	30	30	1176	35280	
Ponderosa	12	32	51	1514	77214	
Ponderosa	13	22	22	1790	39380	
Ponderosa	14	31	37	2123	78551	
Total			**140**		**230425**	**460.84**

Stands 4 & 7 (10 acres) (Match 54A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	8	22	28	718	20104	
Doug fir	8	20	28	718	20104	
Doug fir	9	31	45	839	37755	
Rocky Mtn Juniper	10	26	18	958	17244	
Doug fir	17	35	6	3320	19920	
Total			**125**		**115127**	**575.60**

Stand 24 (31 acres) (Match 58B)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	4	17	458	190	87020	
Doug fir	4	15	229	190	43510	
Ponderosa	6	20	102	399	40698	
Ponderosa	7	20	299	546	163254	
Doug fir	8	21	57	718	40926	
Ponderosa	12	24	25	1514	37850	
Total			**1170**		**413258**	**6,405.53**

Stands 10, 11 & 17 (44 acres) (Match 60A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	8	35	57	718	40926	
Ponderosa	9	38	136	839	114104	
Ponderosa	10	40	37	958	35446	
Ponderosa	11	40	30	1176	35280	
Ponderosa	13	44	22	1790	39380	
Total			**282**		**265136**	**5833.08**

Stands 14 & 23 (14 acres) (Match 65A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Doug-fir	3	18	1,018	123	125214	
Doug-fir	4	18	229	190	43510	
Doug-fir	7	32	38	546	20748	
Ponderosa	8	17	28	718	20104	
Ponderosa	12	20	12	1514	18168	
Doug fir	13	25	11	1790	19690	
Doug fir	14	27	10	2123	21230	
Ponderosa	22	55	4	7286	29144	
Total			**1,350**		**297808**	**2084.60**

Stands 3,3A,8,15,20 & 22 (68 acres) (Match 65B)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	5	16	147	286	42042	
Ponderosa	6	17	102	399	40698	
Ponderosa	10	15	37	958	35446	
Ponderosa	17	30	13	3320	43160	
Ponderosa	21	35	8	6392	51136	
Total			**307**		**212482**	**7224.32**

Stands 2,13,16,21 & 25 (99 acres) (Match 103A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	4	14	229	190	43510	
Ponderosa	5	16	147	286	42042	
Ponderosa	6	28	102	399	40698	
Ponderosa	7	25	75	546	40950	
Ponderosa	8	30	57	718	40926	
Ponderosa	9	35	45	839	37755	
Doug fir	10	40	37	958	35446	
Doug fir	12	44	25	1514	37850	
Total			**717**		**319177**	**15799.41**

Stand 9 (7 acres) (Match 107A)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	7	30	75	546	40950	
Ponderosa	9	32	45	839	37755	
Ponderosa	10	34	37	958	37446	
Ponderosa	11	35	61	1176	71736	
Total			**218**		**187887**	**657.58**

Stand 6 (25 acres) (Match 108)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	6	12	102	399	40698	
Doug fir	6	16	102	399	40698	
Doug fir	7	16	75	546	40950	
Ponderosa	9	23	45	839	37755	
Ponderosa	10	32	37	958	37446	
Doug fir	12	25	25	1514	37850	
Total			**386**		**235397**	**2942.50**

Stands 1, 10A, 12 & 26 (54 acres) (Match 109)

SPECIES	DBH (INCHES)	HEIGHT (FEET)	TREES/ ACRE	WEIGHT/ TREE	#/ ACRE	TOTAL TONS
Ponderosa	6	12	102	399	40698	
Ponderosa	8	19	57	718	40926	
Doug fir	9	22	45	839	39105	
Doug fir	11	24	30	1176	35280	
Ponderosa	16	28	14	2912	40768	
Total			**248**		**196777**	**5313.06**