THE USE OF GRAZING ANIMALS IN ROADSIDE VEGETATION MANAGEMENT

Washington State Department of Transportation
Maintenance Operations Division
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Washington State Department of Transportation

ABSTRACT

Targeted grazing for weed and brush control is an emerging vegetation maintenance method within the overall practice of Integrated Vegetation Management (IVM). However, the evaluation of grazing in roadside vegetation management has not been well documented. This report documents the evaluation and findings from three case studies conducted on WSDOT right of way during the 2015 growing season. Costs of grazing are compared to costs for accomplishing the same work using traditional manual, mechanical, and/or herbicide techniques. Advantages and disadvantages between grazing and traditional methods for each case are discussed in terms of traffic safety, employee safety, effectiveness in vegetation control, and environmental impacts. It was found that grazing is a viable and cost-effective option for roadside vegetation management in limited locations and settings.

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Roadside Asset Manager

EXECUTIVE SUMMARY

This report explains the findings from trials using grazing as a vegetation management tool on highway roadsides in Washington State. Trials were conducted and evaluated in three typical roadside vegetation maintenance situations:

1. Brush and weed control in fenced stormwater ponds
2. Brush control in an urban freeway setting
3. Noxious weed control in a rangeland freeway setting

In each case goats were used to graze selected areas with a goal of providing the same desired vegetation control outcome as traditional maintenance methods using tractor-mounted mowing/trimming, cutting and removal by hand, or treatment with broadcast herbicides. Costs for grazing vs. traditional methods are compared side by side in each case. Benefits/disadvantages are evaluated and discussed in terms of:

1. Traffic safety
2. Employee safety
3. Effectiveness in vegetation control
4. Environmental impacts

In all of its vegetation management activities, WSDOT practices Integrated Vegetation Management (IVM) with a goal of establishing desirable low-maintenance vegetation over time and reducing maintenance requirements wherever possible. As an IVM practice in the situations evaluated, some form of mowing/cutting or broadcast spraying is a required initial action in reclaiming overgrown sites. In the years following initial reclamation, any additional mowing or spraying is selective to target vegetation and planned in combination with other treatment methods, with a goal of encouraging desirable vegetation while reducing mowing and all other maintenance requirements over time.

Findings

It was found that grazing with goats is an effective tool for accomplishing IVM mowing when reclaiming overgrown roadside sites in some of the locations and situations tested. The most practical and cost effective case for use of grazing is for reclamation work in removing overgrown vegetation in already fenced stormwater management facilities.

For brush and weed control in reclaiming other overgrown urban freeway settings, grazing could be a viable option in some cases dependent on fencing requirements and site accessibility. In the location chosen for the case study, cost of grazing was significantly higher than traditional methods, mainly due to fencing costs. However, in some urban freeway settings where fencing and site access are less challenging grazing could be cost effective. If on-call contractors were available to provide bids for reclamation projects, WSDOT maintenance would be able to consider grazing as an option in cases where site access and the logistics of containing the animals make it cost advantageous.

For noxious weed management in rangeland settings, grazing would not likely be used on roadsides even if on-call contractors were available. In the Spokane case study costs of grazing were four times that of traditional IVM methods using herbicides. Because herbicides also control the root systems and prevent seed germination they are also more effective in achieving more complete weed removal and suppression, allowing for a more accelerated natural reclamation process.

Conclusions

Based on the findings of this study, grazing is shown to be a viable option for IVM treatments in a select set of right of way situations where reclamation of the site is the goal, primarily in Western Washington. The use of this management tool would be facilitated if WSDOT were to solicit proposals and establish on-call agreements with local grazing contractors in each of the larger metropolitan areas of Western Washington where there is currently a need for reclamation work in stormwater treatment facilities. If

this option is available for consideration when planning IVM treatments, maintenance crews will be able to utilize targeted grazing as a vegetation management treatment where it is safe, practical, effective, and where it makes economic sense compared to traditional methods. The grazing projects implemented as a result of this type of arrangement would provide further information and experience to expand the use of this IVM tool as an option to traditional mechanical mowing practices in other urban settings if it continues to prove effective.

The Use of Grazing Animals in Integrated Roadside Vegetation Management

Washington State Department of Transportation Maintenance Operations Division
December 2015

BACKGROUND

The practice of "targeted grazing" has seen an increase in recent years. Herding/grazing contractors in the US and Canada have experienced an increase in business opportunities for brush and weed control in urban parks, utility rights of ways, and for homeowner's associations. However, grazing as a vegetation management tool on highway roadsides has not been well evaluated or documented. To evaluate the cost and effectiveness of this vegetation management tool on roadsides, WSDOT conducted and documented a set of case studies in three distinct roadside settings during the 2015 growing season.

The Use of Grazing within WSDOT's Roadside Management Program

For vegetation control in certain types of roadside reclamation, grazing could be used within WSDOT's Integrated Vegetation Management (IVM) program to provide vegetation control comparable to mowing/trimming with tractor mounted equipment or with hand tools. However, with WSDOT's recently revised mowing policy the only roadside area that will be receiving annual routine mowing is a narrow strip along the pavement edge where it is unsafe and impractical for grazing due to traffic safety concerns or animal containment requirements.

The only places it may be practical to use grazing on roadsides are away from the edge of pavement in areas along wider freeway rights of way. In these areas mowing or herbicide use of any kind is intended as a means of improving the overall health of the roadside and minimizing vegetation maintenance requirements over time. This is the basis for the practice of integrated vegetation management where a series of carefully planned methods and timing are used to target and remove unwanted vegetation, while at the same time encouraging the healthy growth of soil and plant communities. Within this strategy for roadside management, grazing could be used in some cases as an option to mechanical mowing or broadcast spraying when reclaiming/restoring areas away from the road edge. However, once areas are reclaimed and established with desirable vegetation, grazing would no longer be required.

As a mowing tool, goats have some advantages over mechanical mowing: Their digestive systems reduce weed seed viability, they self-compost the controlled vegetation on-site, they can access steep and uneven slopes, and they do not produce the same concentration of greenhouse gas as tractors or hand-held power equipment. Also, in areas where herbicide use is restricted, grazing may be a viable option.

In 2014 WSDOT Southwest (SW) Region Maintenance demonstrated the feasibility and effectiveness of grazing Japanese knotweed in a fenced stormwater retention pond. A herd of 7 to 15 goats was left in the stormwater management facility for two, two week intervals with only supplemental drinking water. This test case was conducted by one of the WSDOT maintenance employees in the area and

the use of the animals was donated for the test. This test case was extended, expanded and documented as part of this benefit/cost analysis.

The only other use of grazing on WSDOT rights of way to date has been in the Seattle area in locations where the City has agreed to take over maintenance. In recent years the City has contracted with grazing contractors in two locations along Interstate 5 to clear areas overgrown with blackberry vines and other weeds and brush in difficult to access areas. The City of Seattle has found grazing to be cost effective in a variety of settings and plans to continue use of this tool when reclaiming overgrown urban sites.

Other States' Experience with Grazing on Highway Roadsides

The Transportation Research Board (TRB) Roadside Maintenance Operations Committee (AHD50) has been working on information exchange and research needs with regard to this topic for the past several years. In August of 2014 a query was sent out to the committee's international contact list resulting in considerable discussion. Based on the responses and ensuing discussion, only a handful of DOT examples of grazing on roadsides were described and most were similar to WSDOT's experience. The most common concerns over a broader application of grazing as a mowing technique were:

- The perceived costs for fencing, watering, and supervising the animals are significantly higher than traditional mechanical and chemical controls
- Liability from escaped animals and traffic
- Potential distraction to drivers
- Limited availability of grazing contractors

The most recent extensive grazing example found with the state transportation agencies was in Nebraska over the past several years. The Nebraska Department of Roads (NDOR) has been utilizing goats for vegetation control in wetland mitigation bank sites. Several projects have been contracted over the past two years and the effort worked well for some species control, such as cottonwoods. However, timing for other species was less than opportune due to the goat herder's schedules. Due to the costs associated with goats and the scheduling constraints, NDOR is discontinuing the practice of using goats for vegetation control. Instead of goats, NDOR is looking into the feasibility of cattle grazing, as well as refining herbicide and mowing schedules, to manage wetland mitigation bank sites.

Employee Union Concerns

WSDOT has been in contact with the Washington Federation of State Employees and informed them of our research on the use of grazing animals. The union is concerned that grazing might be used to take the place of work traditionally done by state employees. The agency has committed to maintaining an open discussion with the union based on the findings and recommendations in this report. Because this analysis shows that grazing may be an advantageous tool for roadside vegetation management, and recommends the use of contracts to conduct the work, WSDOT will need to bring the subject up when negotiating collective bargaining agreements with the employees' union.

WSDOT GRAZING FIELD TRIALS

In the 2015 growing season, WSDOT conducted a set of three pilot projects to study the use of goats as a mowing tool for roadside reclamation efforts on state highway rights of way. These projects included documentation and evaluation of the work already begun in the previous year in SW Region stormwater ponds, along with additional trials utilizing grazing contractors for other roadside reclamation applications in Olympia and Spokane. The trials were designed to study the use of grazing as a mowing tool for three distinct vegetation management situations found within the highway right of way:

1. Brush and weed control in fenced stormwater treatment facilities
2. Brush control in an urban freeway setting
3. Noxious weed control in rangeland

In each case the documented cost and results findings are presented in comparison to the cost and results of achieving the same outcome in the same conditions using WSDOT employees and traditional chemical, mechanical, and/or manual methods. For the sites that were grazed by contractors in Olympia and Spokane, cost data was generated from actual costs of grazing recorded in the WSDOT accounting system. However, for the trials in Vancouver and for the comparative costs on traditional maintenance, estimates were developed based on experience of grazing contractors and WSDOT crew leads.

WSDOT would like to acknowledge the expertise and assistance of the two local grazing contractors who assisted in conducting the trials and providing information and input to this report. Without the help of Rent-a-Ruminant LLC, and Healing Hooves LLC this report would not be possible.

It should be pointed out that another option for accomplishing reclamation work in stormwater facilities and urban brush control situations is the use of crews from local and state correctional facilities. When WSDOT is able to use these crews, project costs can be as much as 50-60% lower than doing the same work with WSDOT employees. However, corrections crews are not always available when needed. Although the use of these crews provides another (low-cost) option for accomplishing mowing in roadside reclamation it is not included as a “traditional method” for the cost comparison in this study.

Before and after pictures show the type of vegetation removal required in stormwater management ponds and swales.

TRIAL DESCRIPTIONS AND FINDINGS

1. Stormwater Treatment Facilities

Stormwater Treatment Facility Site Descriptions

The eight sites selected for study were fully fenced treatment facilities within the greater Vancouver metropolitan area in WSDOT's Southwest Region. Total area grazed between the eight sites was 5.94 acres. Sites are situated so the animals were not highly visible and a potential distraction to drivers.

Site	Location	Size in Acres	Target Vegetation
Swale 1	SR500, MP 7.00	0.37	Himalayan blackberry
Swale 2	SR500, MP 7.38	1.00	Himalayan blackberry, cottonwood
Swale 3	SR500, MP 8.74	0.51	Himalayan blackberry
Pond 1	SR503, MP 2.09	0.67	Scotch broom, Canada thistle, Himalayan blackberry
Pond 2	SR503, MP 3.15	1.22	Knotweed
Pond 3	SR502, MP 0.54	1.10	Himalayan blackberry, cattail, bulrush
Pond 4	SR500, MP 5.35	0.33	Himalayan blackberry, scotch broom
Pond 5	SR500, MP 5.45	0.74	Cottonwood, Himalayan blackberry
Total Area		5.94	

Stormwater Treatment Facilities – Grazing

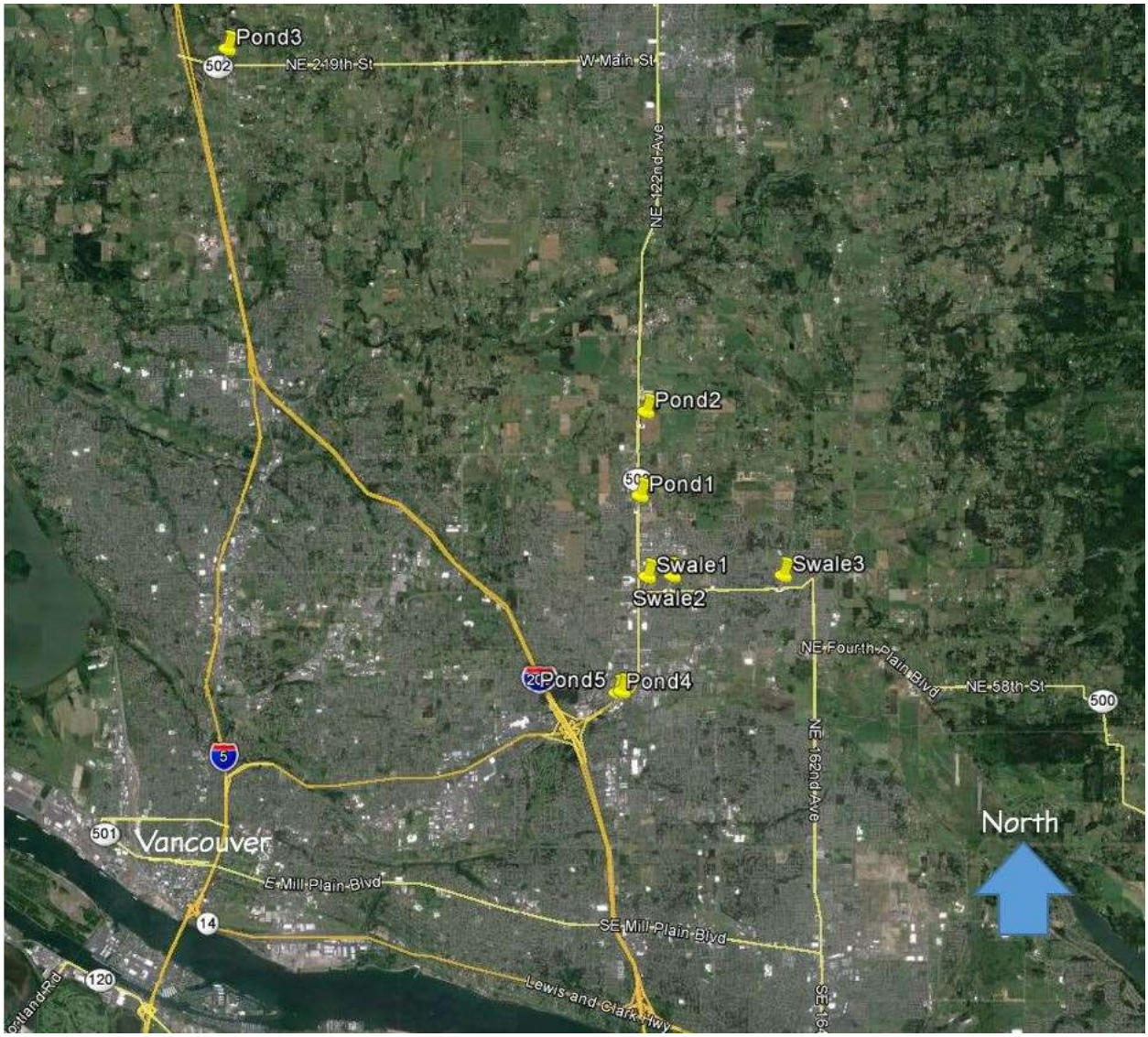
In this trial a herd of 12 goats was rotated through a series of eight fenced stormwater treatment facilities. Each site was grazed one or two times depending on the target vegetation. The animals were provided with water and left to graze unsupervised except for daily checks by WSDOT maintenance employees. In some cases neighbors helped to keep an eye on the animals.

Stormwater Treatment Facilities – Traditional Methods Comparison

Traditional methods for controlling the same target vegetation would include a mixture of cutting with power equipment and hand tools, and timed herbicide treatments. The labor, equipment, and materials required using these methods in the same sites and conditions were estimated by the Southwest Region Stormwater Maintenance Crew based on past experience.

Comparisons were also done to test for increased fecal coliform in stormwater outflow. Samples were collected during spring and fall storms and tested for content and are discussed under findings for Stormwater Treatment Facilities.

Traditional methods were estimated based on a crew of five with power hand tools and a chipper for disposing of tree trunks and larger branches. Smaller cut vegetation would be removed and disposed at a vegetation recycling facility.



Map showing the distribution of sites throughout the greater Vancouver Metropolitan Area. Total area of all sites combined is 5.94 acres.

Stormwater Treatment Facilities Findings

Of the three roadside situations tested in this study, this set was the most practical and economical application of grazing as an IVM tool. Because sites are fenced and the animals can be left unsupervised for periods of time, the cost is significantly less than in locations where 24 hour supervision and temporary fencing is required.

Cost Comparison

Both the grazing and the traditional methods cost figures for the work done in the eight sites around Vancouver are based on estimates. The grazing work for the trial was conducted by WSDOT employees with volunteered goats. So, to determine a cost comparable to what WSDOT would likely have to pay for this service, WSDOT asked Rent-a-Ruminant LLC, to provide a bid for what a local grazing contractor would charge to do the same work. Rent-a-Ruminant advised against leaving the goats unsupervised and the resulting bid includes full time supervision and the contractor would hand cut branches and seedling trees as part of the

grazing service. The resulting estimated per acre cost for grazing is based on Rent-a-Ruminant's estimate for grazing all eight sites, divided by the total area of 5.94 acres.

To determine the cost of what it would have taken to deliver the same outcome as the grazing experiment using traditional methods, WSDOT consulted internally with a group of regional stormwater maintenance lead techs. Based on past experience this group agreed to a scalable per acre estimate that was applied to size and configurations of ponds and swales grazed in the test cases to generate the estimated cost in the table below.

Stormwater Treatment Facilities Cost Comparison in Average Cost/Acre

Grazing (contractor bid price + estimated WSDOT admin.)	$5,350
Traditional Methods (estimated WSDOT Maintenance cost)	$5,650

*Estimate detail provided in **Appendix A**.*

Site Access and Traffic Safety

There is always a potential for goats on the roadside to draw unwanted attention and become a distraction to drivers or from people stopping to look and take pictures. In the WSDOT cases tested there were no notable disadvantages in site access or traffic safety. However, there were two notable disadvantages of grazing:

- Additional fence repair and reinforcement was needed to keep the goats contained at some sites.
- Potential disadvantage is loss of animals; in one of the pond sites a goat was killed when a coyote was able to get through the fence from the outside.

Employee Safety

Grazing is better for employee safety. Traditional methods can be a source of employee injury and accidents with the use of power tools and walking on uneven terrain.

Vegetation Control Efficiency and Effectiveness

With the type of vegetation and amount of growth in the stormwater facilities tested, grazing results were comparable to traditional mowing/cutting methods. However, in cases where heavy equipment can be utilized with traditional methods, the cost and effectiveness improves. In some sites the maturity of overgrown vegetation may preclude the use of goats entirely. Also, traditional methods are more efficient in being able to accomplish multiple IVM treatments in a single operation:

- If larger diameter trunks or branches require removal, grazing requires follow up or pre-cutting by the crews with hand tools.
- When using traditional mechanical cutting WSDOT is able to apply herbicides to the cut surface at the time of cutting to prevent re-sprouting.

Environmental Impacts

The primary environmental concerns considered in comparing grazing to traditional methods in any of the cases studied include air and water quality impacts. For stormwater facilities the following points are relevant:

- Air quality – The research did not include a study of comparative emissions between grazing animals and power equipment. Further research would be required to evaluate the overall carbon footprint of each method.

- Water quality – The primary concern in stormwater facilities is an increased fecal coliform bacteria in outflow. This was tested as part of the project in one pond, with comparative samples tested in spring and fall inundations. Results showed an increase in fecal coliform from 49MPN/100mL to 920MPN/100mL as a result of the goats presence on the site tested, but the highest levels detected are still well below any level of concern.

Stormwater Treatment Facilities Conclusions

Grazing is a viable and potentially cost effective solution for reclamation work in already fenced stormwater treatment facilities. If a list of local on-call grazing contractors were established in urban areas and available to do this type of work in stormwater treatment facilities, it is likely that grazing would be used in some cases.

SW Region employee's goats working in a stormwater pond in 2014.

2. Urban Roadside Brush Control

Urban Roadside Brush Control Site Description

In this location the goats were used to clear out the underbrush in an urban interchange where there has been a problem with reoccurring homeless camp sites and trash accumulation. Enhanced visibility will allow WSDOT and law enforcement to monitor the site for any future trespass from homeless activity. The campers and their garbage were removed from the site prior to grazing and lower branches were pruned from established conifer trees.

Site	Location	Size in Acres	Target Vegetation
Capitol Interchange	I-5, MP 105.30	1.0	Himalayan blackberry, English ivy, willow, aspen, all understory branches to a height of 6 ft.

The State Capitol Interchange site included approximately 1 acre of clearing and 850 feet of perimeter fence.

Condition of the site prior to clean up and reclamation; the access road comes out on Henderson Blvd.

Urban Roadside Brush Control – Grazing

In this test case a local contractor was hired to provide a herd of goats to remain on site for up to eight days. The contractor was tasked with clearing all seedling trees, trimming lower branches from willow and aspen trees, and clearing all understory plants up to a height of six to seven feet, to improve visibility from the street into the site. The contractor utilized a herd of 45 goats for six days to accomplish the desired results. WSDOT maintenance support was provided for site preparation and chain link fence installation around the sides of the site facing the freeway and city street. The contractor completed the site enclosure with temporary light weight electric fence. WSDOT maintenance also provided traffic control to move the contractor on and off the site.

Urban Roadside Brush Control – Traditional Methods Comparison

Traditional methods in this case would involve cutting material with hand tools. The IVM treatment would include not only cutting but chemically treating the cut surfaces immediately after cutting to prevent regrowth from the root system.

Urban Roadside Brush Control Findings

Grazing in this case proved less effective and more expensive than traditional methods. However, there may be other urban situations along state highways where the roadside area and vegetation growth are more easily, safely and effectively controlled with grazing. The City of Seattle in particular has utilized grazing on City maintained property along I-5 and in other parts of the city. For the case documented in this study the cost of reclamation with grazing was much higher than traditional methods.

Cost Comparison

Several factors contributed to high costs for grazing in this case. Grazing costs include renting and installation/removal of temporary chain link fence and WSDOT traffic control to move the contractor on and off site. (Overtime was required in order to move the contractor on site on a Saturday morning when traffic flow was lowest.)

Urban Roadside Brush and Weed Control Cost Comparison in Average Cost/Acre

Grazing (actual cost)	$11,993
Traditional Methods (estimated WSDOT Maintenance cost)	$4,574

*Estimate detail provided in **Appendix B**.*

Site Access and Traffic Safety

Notable disadvantages of grazing in this case included:

- Moving two truck/trailer combinations on site at a busy intersection was a challenge and required a total of three full traffic stops of five to ten minutes each. Time and equipment for maintenance staff required to assist with traffic control are reflected in the cost comparison.
- The public was attracted to the site and the goats, and some cars were slowing down in traffic, pulling off and parking in non-designated areas. Some people were crossing at non-cross walk locations.

Employee Safety

Grazing is better overall for employee safety. Traditional methods can be a source of employee injury and accidents with the use of power tools and walking on uneven terrain. However, because the goats were unable to eat through some of the larger material that still needed to be removed, and because extra work was required to install fence and provide traffic control, there was some risk from employee exposure to traffic and site work.

Vegetation Control Efficiency and Effectiveness

Traditional methods typically have more advantages and are more effective than grazing in most urban roadside settings based on the following findings:

- Even with grazing as the means of cutting down vegetation, the best IVM treatment would still include chemical treatment of the regrowth. With traditional methods cutting and herbicide application can be conducted at the same time.
- Although the goats killed many of the smaller trees by eating the bark, the standing dead trees still need to be removed by maintenance employees with hand tools.

- Because cutting and chemical treatments can be conducted simultaneously using WSDOT employees and hand tools, and because the goats are limited in the size of vegetation they can eat, traditional methods are typically more efficient and effective in urban roadside settings.

Some of the brush at this site proved too thick for grazing. Grazing contractors typically provide supplemental manual cutting for this type of vegetation as part of their service.

Environmental impacts

The primary environmental concerns considered in comparing grazing to traditional methods in any of the cases studied include air and water quality impacts. For urban roadside brush and weed control the following points are relevant:

- Air quality – The research did not include a study of comparative emissions between grazing animals and power equipment. Further research would be required to evaluate the overall carbon footprint of each method.
- Water quality – Within the three situations evaluated in this study, water quality was evaluated only for stormwater facilities. The site selected for urban roadside brush and weed control did not have any standing or flowing water bodies nearby that could be tested for fecal coliform from animal feces.

Urban Roadside Brush and Weed Control Conclusions

For urban roadside brush and weed control, grazing would only be cost effective and practical in rare cases dependent on site access and fencing requirements. If there were a list of local on-call grazing contractors available to WSDOT in the major urban areas, grazing would become another IVM tool available to the maintenance areas in development and implementation of their IVM plans.

3. Noxious Weed Control in Rangeland

Noxious Weed Control in Rangeland Site Description

This trial tested the use of grazing as a mowing tool as an early season treatment to prevent/delay seed production in an established noxious weed infestation in an Eastern Washington fenced freeway setting with wide right of way.

Site	Location	Size in Acres	Target Vegetation
North Spokane Corridor	US395, MP 164 to 164.5	9.5	Knapweed, common bugloss, rush skeleton weed, and dalmation toadflax.

The areas grazed (shown in green) were along the eastern side of 395. The total area is approximately 9.5 acres.

Noxious Weed Control in Rangeland – Grazing

This trial was conducted utilizing a contractor who stayed on site five days to supervise 125 goats within an already fenced area. The grazing was done late spring/early summer to remove the tops of weed species and forestall normal flowering and seed production. The IVM intent with this type of control was to force the plants into later season flowering and seed production. To complete the IVM treatment and achieve maximum weed control the site would either have to be repeatedly grazed throughout the summer, or treated with broadcast herbicides before setting seed later in the summer.

Noxious Weed Control in Rangeland – Traditional Methods Comparison

The most effective traditional methods in a case like this would not typically include mowing due to the relative high cost of the operation compared to herbicide treatment and the fact that with mechanical mowing plants can still flower and set seed below the four to six inch mowing height. One or two properly timed herbicide applications, one in early summer and (if needed) one in the fall have been

shown to be the most effective control for noxious weeds in a rangeland setting. Therefore the comparative traditional method in this case is a broadcast application of herbicides selective to broadleaf plants made just as the plants are starting to set seed. The IVM prescription with this type of typical treatment would also include checking back in the late season and treating any late emerging seedlings.

Weed growth prior to grazing.

Same view after grazing was complete.

Noxious Weed Control in Rangeland Findings

Grazing in this case proved an effective tool for control but more expensive than traditional methods using herbicides, and limited in the roadside locations where it could be safely utilized.

Cost Comparison

Cost for grazing include only the cost of paying the contractor and the contractor provided some of his own temporary fencing to contain the animals within the larger pre-fenced enclosure. No special traffic control or extra fencing was required in this case.

Cost for traditional methods are based on an estimate generated by the local area maintenance supervisor. Assumptions for herbicide treatment are based on broadcast application of a selective broadleaf product with a pickup mounted sprayer through booms and a hand gun.

Cost per acre is based on treatment of the total 9.5 acres.

Noxious Weed Control in Rangeland Cost Comparison in Average Cost/Acre

Grazing (actual cost)	$525
Traditional Methods (estimated WSDOT Maintenance cost)	$130

*Estimate detail provided in **Appendix C**.*

Site Access and Traffic Safety

There were no significant advantages or disadvantages with grazing as compared to traditional methods with site access and traffic. Although the goats were visible from the highway and bike path no problems with distracted drivers were noted.

Employee Safety

Grazing is better overall for employee safety. Traditional methods can be a source of employee injury and accidents with the use of power tools and walking on uneven terrain.

Effectiveness in Vegetation Control

Grazing proved effective in removing the tops of the target weed species. Two noteable advantages of grazing are:

- There were some weed seeds formed at the time of grazing and the viability of those seeds were likely reduced in the digestive process. Studies have shown the digestive systems on goats to sterilize large percentages of weed seed. Herbicide treatments and/or mechanical mowing may leave viable seeds, mowing may even spread weed seeds.
- When left on site long enough, goats will eat all green plant parts, whereas mechanical mowing will cut the tops of weeds and leave some flower and seed parts still alive and growing.

However, traditional methods using herbicides are more effective in that treatments provide control of the plant tops and roots, as well as preventing some seed germination.

Environmental impacts

The primary environmental concerns considered in comparing grazing to traditional methods in any of the cases studied include air and water quality impacts. For rangeland the following points are relevant:

- Air quality – The research did not include a study of comparative emissions between grazing animals and power equipment. Further research would be required to evaluate the overall carbon footprint of each method.
- Water quality – Within the three situations evaluated in this study, water quality was evaluated only for stormwater facilities. The site selected for urban roadside brush and weed control did not have any standing or flowing water bodies nearby that could be tested for fecal coliform from animal feces.

Noxious Weed Control in Rangeland Conclusions

All things considered it is unlikely that WSDOT would utilize grazing as an IVM tool in rangeland noxious weed control. In most cases the most practical, effective and lowest cost treatment do not utilize mowing but instead apply properly timed, broadcast and spot treatment with herbicides. Because herbicides can achieve control of the root system and in some cases prevent seed germination, they are also capable of longer term control. When mowing is used as an IVM tool in these cases it is most practical and cost effective in flat sites where mowing can be accomplished with wide deck freeway mowers at a cost lower than spraying or grazing. However, there are grazing contractors available to work in Eastern Washington rangeland settings and there may be cases where herbicide use is restricted for some reason and mowing is required. If those situations arise WSDOT Maintenance would have access to grazing contractors and could utilize this as a tool where it makes sense.

OVERALL FINDINGS AND CONCLUSIONS

Grazing with goats is an effective roadside vegetation management tool in a select set of roadside situations and for certain vegetation types, particularly for moderate level reclamation efforts in fenced stormwater treatment facilities. As with any mowing tools, the resulting control is short term and in most cases perennial plant species require an integrated combination of control methods over a period of years to achieve full control. Grazing is not a tool that would be used as a routine roadside maintenance practice, only as one part of a long term control strategy that is focused on achieving the safest, lowest maintenance, most naturally self-sustaining plant community as possible.

To facilitate the use of grazing as an option where practical for targeted vegetation removal in conjunction with prescribed IVM treatments, WSDOT should solicit bids and establish on-call agreements with local grazing contractors in the major metropolitan areas around the state.

With grazing contracts available as a tool, WSDOT can use this to supplement the existing workforce and utilize employees' time to accomplish other priority backlog work. As a result of this study's findings WSDOT's Northwest Region has begun to plan for the use of grazing in stormwater ponds in the coming year.

WSDOT should also inform the Washington Federation of State Employees of the conclusions and recommendations of this report so that it can be considered in employee collective bargaining agreements.

APPENDIX A

Stormwater Treatment Facilities – Grazing Estimate

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18367

DATE:	ORG CODE	LOCATION OF WORK
12/23/2015	445130	8 fenced stormwater facilities - See the body of the report for a list of sites.

DESCRIPTION OF WORK:

Contract grazing for reclamation of Vancouver area swales and ponds. Estimate of grazing contract costs provided by Rent-a-Ruminant LLC. WSDOT labor included to provide traffic control and assist with moving animals on and off site, throughout the season.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Tech. 2	2	10.0	0.0	$758.20
TOTAL LABOR ESTIMATE:				**$758.20**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
			$0.00
TOTAL EQUIPMENT ESTIMATE:			**$0.00**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Contract with Goat Wrangler	1.0	$10,000.00
TOTAL MISCELLANEOUS ESTIMATE:		**$10,000.00**

TOTAL CHARGES: $10,758.20

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/23/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/23/2015

APPENDIX A

Stormwater Treatment Facilities/Swale 1 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18468

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 500 Begin MP: 7.00 End MP: 7.00 Dir: D Description: Swale 1, NE corner 500/503

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is .37 acres in size.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	10.0	0.0	$453.50
Maintenance Tech. 2	4	10.0	0.0	$1,516.40
TOTAL LABOR ESTIMATE:				**$1,969.90**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0506 - 1 Ton; Crew Cab 4x4	1	10.0	$82.40
0535 - ¾ ton; 4x4	1	10.0	$99.40
2102 - Brush Chipper; Trailer Mounted	1	10.0	$33.40
TOTAL EQUIPMENT ESTIMATE:			**$215.20**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$250.00
TOTAL MISCELLANEOUS ESTIMATE:		**$250.00**

TOTAL CHARGES:	**$2,435.10**

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: N Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/29/2015

APPENDIX A

Stormwater Treatment Facilities/Swale 2 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18456

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 500 Begin MP: 7.38 End MP: 7.38 Dir: I Description: Swale 2, north side of highway, heading east from 503.

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced one acre bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest moderately overgrown.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	20.0	0.0	$907.00
Maintenance Tech. 2	4	20.0	0.0	$3,032.80
TOTAL LABOR ESTIMATE:				**$3,939.80**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0508 - 1 Ton; Crew Cab; 4X4; Diesel	1	20.0	$95.60
0537 - ¾ ton; Crew Cab; 4x4	1	20.0	$194.00
2102 - Brush Chipper; Trailer Mounted	1	20.0	$66.80
TOTAL EQUIPMENT ESTIMATE:			**$356.40**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$500.00
TOTAL MISCELLANEOUS ESTIMATE:		**$500.00**

TOTAL CHARGES: **$4,796.20**

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/29/2015

APPENDIX A

Stormwater Treatment Facilities/Swale 3 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18469

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 500 Begin MP: 8.74 End MP: 8.74 Dir: I Description: Swale 3, 500 east, SE corner w/ 152nd.

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is .51 acres.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	10.0	0.0	$453.50
Maintenance Tech. 2	4	10.0	0.0	$1,516.40
TOTAL LABOR ESTIMATE:				**$1,969.90**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0508 - 1 Ton; Crew Cab; 4X4; Diesel	1	10.0	$47.80
0535 - ¾ ton; 4x4	1	10.0	$99.40
2102 - Brush Chipper; Trailer Mounted	1	10.0	$33.40
TOTAL EQUIPMENT ESTIMATE:			**$180.60**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$250.00
TOTAL MISCELLANEOUS ESTIMATE:		**$250.00**

TOTAL CHARGES: $2,400.50

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/29/2015

APPENDIX A

Stormwater Treatment Facilities/Pond 1 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18470

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 503 Begin MP: 2.09 End MP: 2.09 Dir: D Description: Pond 1, across from Saddle Club.

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced stormwater treatment pond. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is .67 acres in size.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	20.0	0.0	$907.00
Maintenance Tech. 2	4	20.0	0.0	$3,032.80
TOTAL LABOR ESTIMATE:				**$3,939.80**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0506 - 1 Ton; Crew Cab 4x4	1	20.0	$164.80
0535 - ¾ ton; 4x4	1	20.0	$198.80
2102 - Brush Chipper; Trailer Mounted	1	20.0	$66.80
TOTAL EQUIPMENT ESTIMATE:			**$430.40**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$250.00
TOTAL MISCELLANEOUS ESTIMATE:		**$250.00**

TOTAL CHARGES: $4,620.20

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/29/2015

APPENDIX A

Stormwater Treatment Facilities/Pond 2 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18472

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 503 Begin MP: 3.15 End MP: 3.15 Dir: I Description: Pond 2

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is 1.22 acres in size.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	30.0	0.0	$1,360.50
Maintenance Tech. 2	4	30.0	0.0	$4,549.20
TOTAL LABOR ESTIMATE:				**$5,909.70**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0502 - ½ Ton; Extended Cab; 4x2 (To be replaced with 0522)	1	30.0	$136.80
0537 - ¾ ton; Crew Cab; 4x4	1	30.0	$291.00
2102 - Brush Chipper; Trailer Mounted	1	30.0	$100.20
TOTAL EQUIPMENT ESTIMATE:			**$528.00**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$750.00
TOTAL MISCELLANEOUS ESTIMATE:		**$750.00**

TOTAL CHARGES: $7,187.70

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: N Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/29/2015

APPENDIX A

Stormwater Treatment Facilities/Pond 3 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18473

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 502 Begin MP: 0.54 End MP: 0.54 Dir: D Description: Pond 3, north side of 502, just east of I-5.

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is 1.1 acres in size.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	20.0	0.0	$907.00
Maintenance Tech. 2	4	20.0	0.0	$3,032.80
TOTAL LABOR ESTIMATE:				**$3,939.80**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0506 - 1 Ton; Crew Cab 4x4	1	20.0	$164.80
0537 - ¾ ton; Crew Cab; 4x4	1	20.0	$194.00
2102 - Brush Chipper; Trailer Mounted	1	20.0	$66.80
TOTAL EQUIPMENT ESTIMATE:			**$425.60**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$500.00
TOTAL MISCELLANEOUS ESTIMATE:		**$500.00**

TOTAL CHARGES: $4,865.40

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/29/2015

APPENDIX A

Stormwater Treatment Facilities/Pond 4 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18475

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 500 Begin MP: 5.35 End MP: 5.35 Dir: I Description: Pond 4, next to SW Region HQ Bldg.

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is .33 acres in size.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	10.0	0.0	$453.50
Maintenance Tech. 2	4	10.0	0.0	$1,516.40
TOTAL LABOR ESTIMATE:				**$1,969.90**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0506 - 1 Ton; Crew Cab 4x4	1	10.0	$82.40
0537 - ¾ ton; Crew Cab; 4x4	1	10.0	$97.00
2102 - Brush Chipper; Trailer Mounted	1	10.0	$33.40
TOTAL EQUIPMENT ESTIMATE:			**$212.80**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$250.00
TOTAL MISCELLANEOUS ESTIMATE:		**$250.00**

TOTAL CHARGES:	**$2,432.70**

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

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APPENDIX A

Stormwater Treatment Facilities/Pond 5 – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18476

DATE:	ORG CODE	LOCATION OF WORK
12/29/2015	445130	SR 500 Begin MP: 5.45 End MP: 5.45 Dir: I Description: Pond 5, off EB onramp in front of YMCA.

DESCRIPTION OF WORK:

Clearing of brush, unwanted trees, and noxious weeds from a fenced bio-swale stormwater treatment facility. Site is approximately 50% overgrown with dense undesirable vegetation and the rest is moderately overgrown. Site is .74 acres in size.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	20.0	0.0	$907.00
Maintenance Tech. 2	4	20.0	0.0	$3,032.80
TOTAL LABOR ESTIMATE:				**$3,939.80**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0505 - 1 Ton; Crew Cab	1	20.0	$167.80
0535 - ¾ ton; 4x4	1	20.0	$198.80
2102 - Brush Chipper; Trailer Mounted	1	20.0	$66.80
TOTAL EQUIPMENT ESTIMATE:			**$433.40**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Vegetation Recycling	1.0	$500.00
TOTAL MISCELLANEOUS ESTIMATE:		**$500.00**

TOTAL CHARGES:	**$4,873.20**

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Vancouver	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/29/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

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APPENDIX B

Urban Roadside Brush Control – Grazing Cost

Washington State Department of Transportation

Expenditure Detail

Description of Work:

Site preparation for goat grazing evaluation project. Rent and install temporary chain link fence. Provide traffic control for moving contractor and animals on and off site. Pay contractor for providing grazing service.

Location Description:

1 acre site, temp. chain link fence installed 2/3 of the perimeter, contractor provided electric fence to secure the remaining perimeter.
I-5/Exit 105, State Capitol Interchange, SE quadrant
Olympic Region, Maintenance Area 1

Actual Labor Costs:		Reg. Hours	O/T Hours	Amount
	Maint. Technichians	77	33	**$5,022**
Actual Equipment Costs:				Amount
	Total Equipment			**$494**
Actual Material Costs:				Amount
	Total Materials			**None**
Payment to Contractors:				Amount
	Fence Rental			**$1,373**
	Grazing Service			**$5,104**
Total Cost:				**$11,993**

APPENDIX B

Urban Roadside Brush Control – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18238

DATE:	ORG CODE	LOCATION OF WORK
12/17/2015	343022	SR 005 Begin MP: 105.00 End MP: 105.00 Dir: I Description: SE quadrant of the State Capitol Interchange (Exit 105)

DESCRIPTION OF WORK:

Comparative estimate for grazing trial. This is an estimate of what it would costto accomplish the same results as goats but using traditional methods.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	20.0		$927.00
Maintenance Specialist 3	1	20.0		$863.20
Maintenance Tech. 2	3	20.0		$2,274.60
TOTAL LABOR ESTIMATE:				**$4,064.80**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0508 - 1 Ton; Crew Cab; 4X4; Diesel	1	20.0	$95.60
0511 - ¼ Ton; Extended Cab; 4x4 (To be replaced with 0515)	1	20.0	$97.00
2102 - Brush Chipper; Trailer Mounted	1	20.0	$66.80
TOTAL EQUIPMENT ESTIMATE:			**$259.40**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Fuel, oil, and blades for trimmers	1.0	$200.00
Herbicide	1.0	$50.00
TOTAL MISCELLANEOUS ESTIMATE:		**$250.00**

TOTAL CHARGES: $4,574.20

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
	Southwest		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/17/2015	Estimate Only: N Revised Estimate: N Work Completed: N Work Completed Date:

Page 1 DATE PRINTED: 12/17/2015

APPENDIX C

Noxious Weed Control in Rangeland – Traditional Maintenance

Washington State Department of Transportation

Expenditure Detail

Description of Work:				
Hire contractor to graze noxious weed species.				
Location Description:				
Two pre-fenced areas were grazed, total area of 9.5 acres US395, MP 164 to 164.5 Eastern Region, Maintenance Area 1				
Actual Labor Costs:		Reg. Hours	O/T Hours	Amount
				None
Actual Equipment Costs:				Amount
	Total Equipment			**None**
Actual Material Costs:				Amount
	Total Materials			**None**
Payment to Contractors:				Amount
	Payment to Contractor			**$5,000**
Total Cost:				**$5,000**

APPENDIX C

Noxious Weed Control in Rangeland – Traditional Maintenance

Washington State Department of Transportation

COST ESTIMATE

Estimate Id: 18247

DATE:	ORG CODE	LOCATION OF WORK
12/17/2015	465120	SR 395 Begin MP: 164.00 End MP: 164.50 Dir: D Description: Two pre-fenced sites north of the freeway, one is 3.5 acres and the other 6 acres.

DESCRIPTION OF WORK:

This is an estimate of cost to achieve weed control with an herbicide application for the same area grazed in the grazing evaluation trials.

ESTIMATE

LABOR DESCRIPTION	QTY	REG. HOURS	O/T HOURS	AMOUNT
Maintenance Lead Tech.	1	10.0		$463.50
Maintenance Tech. 2	1	10.0		$379.10
TOTAL LABOR ESTIMATE:				**$842.60**

EQUIPMENT TYPE	QTY	HOURS	AMOUNT
0537 - ¾ ton; Crew Cab; 4x4	1	20.0	$194.00
2136 - Herbicide Sprayer / Anti-Icing Unit; Skid Mounted; Auxiliary Powered; 500 Gal.; Multiple Product Capability	1	20.0	$65.40
TOTAL EQUIPMENT ESTIMATE:			**$259.40**

MATERIAL TYPE	QTY	AMOUNT
		$0.00
TOTAL MATERIAL ESTIMATE:		**$0.00**

MISCELLANEOUS CHARGES - DESCRIPTION	QTY	AMOUNT
Herbicide	1.0	$140.00
TOTAL MISCELLANEOUS ESTIMATE:		**$140.00**

TOTAL CHARGES: $1,242.00

MAINT. AREA LOCATION:	REGION	CONT. SECTION	WORK ORDER NO:
Area 1 Spokane	Eastern		

CREATED BY:	DATE:	OFFICE USE ONLY:
Ray Willard	12/17/2015	Estimate Only: Y Revised Estimate: N Work Completed: N Work Completed Date:

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> Quote on page 6-17: "*Use of grazing animals will not be a considered weed management tool on state-owned roadsides. High cost of fencing livestock, and liability issues associated with potential livestock incursions with automobiles, restrict use as a roadside vegetation management option.*"

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