A Comparison of Roadside Maintenance Practices – Impacts of Herbicide Use on Cost and Results

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Washington State Department of Transportation
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I Analysis and Comparison

A. Reasons for the Comparison Study

The Washington State Department of Transportation (WSDOT) currently uses herbicides in combination with other mechanical, manual, and horticultural methods to:

- Eliminate vegetation at the edge of pavement
- Control and eradicate noxious and nuisance weed species
- Control trees and brush when they grow too close to traffic

The use of herbicides for these purposes is common practice in the majority of other state departments of transportation, and in most county roads departments around the country. However, as a result of localized concerns over environmental and human health hazards, herbicide use has been restricted or eliminated by some government agencies. There are currently six counties in Washington State with restrictive policies on the use of herbicides for roadside maintenance.

WSDOT has been petitioned to stop using herbicides in the counties where herbicide use is restricted on county roads. This report contains an analysis of the estimated costs of a decision by WSDOT to stop using herbicides in Clallam, Jefferson, Island, Snohomish, and Thurston Counties. San Juan County also does not use herbicides when maintaining roadsides, but WSDOT does not maintain any highways in that county. This report also includes limited discussion of the potential benefits and adverse impacts that may result from programs operating with or without the use of herbicides.

B. How the Study was Developed

The intent of this report is primarily to evaluate the costs to state highway maintenance and operations, if WSDOT were to maintain roadsides without the use of herbicides. The cost analysis is based on the estimated cost for WSDOT to replicate a program typical to that of the "no-spray" counties. This estimate is applied only to state highways in counties where herbicides have been restricted. A discussion of comparative results is included in this report, based on observation and opinions of those involved with county or state roadside maintenance. Translation of these resulting factors into quantifiable costs/savings or degrees of relative risk would require additional data collection and long-ranging field studies, and is therefore beyond the scope of this report.

Information on county practices and resulting consequences was gathered through a survey of county maintenance personnel in the five counties considered. Four WSDOT maintenance areas with highways in the five

counties were also surveyed to determine typical practices as well as average efficiencies for activities in question. Survey questions and responses are included as **Appendix B, Survey Responses**.

In order to increase the accuracy of the comparison, roadside vegetation management activities were divided into three types: Gravel shoulder maintenance, noxious weed control, and tree, brush and nuisance weed control. Comparison is made between practices associated with each set of activities. Methods for calculation and estimating are based on the most accurate way of estimating current WSDOT costs in relation to the projected costs WSDOT would realize in replicating a semblance of practices in the no-spray counties. Comparative practices are discussed in **Section III**, methods of comparison and calculation are described in **Section IV**.

Limited access highways such as Interstate 5 and US 101 in Thurston County are not included in this comparison. This is due to the fact that roadside maintenance requirements and practices on these high-speed roadways vary considerably from those on secondary highways and county roads, and are therefore not as comparable.

The report was then developed based on average costs per centerline mile of various activities comparing what WSDOT currently spends to manage roadside vegetation along secondary roads in the five counties listed above, with the estimated cost WSDOT would realize to maintain those same roadsides utilizing methods typical of the no-spray counties. Projected impacts to the highway infrastructure and traffic operations experienced in the five counties are also discussed in comparison with those resulting from current WSDOT practices.

There are a total of 1,022 non-limited access centerline miles of state highways in the five counties. A breakdown of centerline miles for the four WSDOT maintenance areas with highways in the five counties is given in **Appendix C, State Highway Mileage Summary**.

C. Herbicide Effects on Human Health and the Environment

The decisions to stop the use of herbicides on county roads stem from questions of toxicological impacts on humans, wildlife, and aquatic systems. Concurrent with this report, WSDOT completed an independent evaluation of the risks associated with common herbicide products and methods of roadside application used in maintenance of state highway roadsides.

The information gathered through both the risk assessment and this comparison report will be weighed together with further study of long-term

results to highway safety and maintenance, to determine if any change in current policy and practice is warranted.

II Overall Objectives of Roadside Vegetation Management

Regardless of the methods used to maintain roadsides, state and local agencies are responsible for balancing the protection of public safety, worker safety, the environment, and preservation of the highway infrastructure with the efficient use of public resources. In evaluating the consequences of a decision to stop using herbicides, this report assumes that WSDOT would continue to deliver roughly the same level of service in roadside maintenance as with the current program. Program delivery is categorized under the following prioritized roadside maintenance objectives:

A. Traffic Safety

The overriding objective in roadway design and maintenance is safety. With regard to roadside maintenance this translates into:

- Visibility at curves, corners and intersections
- Allowing free drainage of surface water from the pavement during rainstorms to reduce the potential for vehicle hydroplaning
- Providing a reasonably safe set back for obstructions to vehicles leaving the road in the case of accidents
- Removing all trees and limbs when they are likely to fall on the roadway
- Keeping trees back from the highways where possible to reduce shading and improve air circulation, which contributes to the control of snow and ice
- Minimizing the amount of time maintenance crews must spend on the road
- Minimizing the potential for wildlife road-kill
- Minimizing the potential for fire starts

B. Compliance with Legal Obligations

Aside from the legality associated with safety and liability issues connected with the elements under Traffic Safety above, the primary legal obligation relating to roadside maintenance is:

- Control of state and county designated noxious weed species wherever they occur

C. Preservation of the Highway Infrastructure

Unchecked vegetative growth contributes to the deterioration of pavement and roadside hardware, in addition to impacting the efficiency of highway maintenance activities related to roadside hardware and bridge ends. Vegetation management contributes to highway preservation through:

- Elimination or management of vegetation at the edge of pavement to reduce the rate of pavement deterioration from vegetation growing

through the edge of pavement and from retention of surface water and saturation of the sub-grade.

- Elimination or management of vegetation around the base of guardrail and other roadside hardware reduces moisture retention and rate of deterioration of wood and metal components.

D. Environmental Protection/Preservation

Roadway placement, operations, and maintenance all have an impact on the environment. Roadside vegetation provides an opportunity for mitigation of a number of roadway and traffic related environmental impacts. Maintenance practices in relation to roadside vegetation are conducted to maximize these environmental benefits. Therefore, actions are planned and carried out to:

- Promote naturally self-sustaining plant communities to the greatest degree possible
- Help prevent surface erosion and slope failures
- Preserve wetlands and wildlife habitat as appropriate
- Preserve and conserve native plants and wildflowers

E. Enhancing Visual Quality

The inherent visual quality of the vegetation and surrounding landscape in our state is generally desirable. Although actions relating only to the objective of enhancing or preserving visual quality are not as important as those listed above, they do contribute to the overall quality of life and a positive image for the State of Washington. Therefore, when funding and resources allow, actions are taken to:

- Control nuisance weeds
- Maintain a neat and cared for appearance through mowing and trimming operations
- Manage vegetation to open desirable views and screen undesirable views

It is assumed that aside from cost considerations most of the above-mentioned objectives could be met by WSDOT without the use of herbicides. The only exceptions are the control of noxious weeds as required by state law, and the control of nuisance weeds.

Without the use of herbicides the suppression and/or eradication of noxious and nuisance weeds is not practical or economically feasible. With mowing and hand pulling as the only tools remaining to control noxious weeds, WSDOT would not be able to comply with state law. Control of some locations/species of noxious weeds would not be possible.

Control of established infestations of nuisance weed species such as Scotch broom, Himalayan blackberry, Japanese knotweed, and Canadian thistle is not practical without the use of herbicides, due to the large populations of these plants on the right of way. Therefore, it is assumed that without herbicides as a management tool, these weeds would only be mowed and trimmed where possible, and allowed to remain on the highway right of way in other areas, competing with desirable native species.

III Current Roadside Vegetation Management Practices

For the purposes of this comparison, roadside vegetation management activities are grouped in three distinct types: Shoulder maintenance, noxious weed control, and tree, brush, and nuisance weed control.

Shoulder Maintenance
This is routine maintenance of vegetation from the edge of the roadway pavement outward to distances of two to eight feet. The width of the road shoulder will vary dependent on factors such as the width of the overall ROW, the design of the road, configuration of the back slope, and/or the presence of drainage ditches.

Noxious Weed Control
This is controlling the establishment and proliferation of noxious weed species specifically listed under state and county noxious weed laws. Control of noxious weeds occurs wherever they are present on the ROW. Noxious weed control is mandated by law due to the invasive nature and inherent adverse impacts of these plants to natural biodiversity, property use, and/or toxicity to animal and humans.

Tree, Brush and Nuisance Weed Control
This is maintenance and control of trees, tree limbs, brush, and weeds that are adversely impacting or have the potential to impact operational and visual aspects of the roadway or surrounding land use. These activities occur as needed throughout the ROW.

A. Current County Practices

County road maintenance personnel were surveyed regarding a variety of issues related to the establishment of their respective county's restricted herbicide-use policies and its implications on vegetation management activities. The survey responses are summarized below.

1. Island County

Island County established a restricted herbicide-use policy in 2002. The County is now in the process of converting to grass-covered road shoulders. The majority of shoulder maintenance will be comprised of mowing the grass. Since Island County's switch to a restricted herbicide policy is so recent, they do not have experience on how many times per year each road shoulder will need to be mowed. Accumulated vegetation and soil at the edge of the pavement is currently scraped away at the edge of the pavement to allow for stormwater drainage from the pavement. This practice is commonly referred to as "pulling shoulders". Island County has historically pulled shoulders in concert with their summer paving and oiling program for those sections being resurfaced. This frequency may change in the future as they continue to implement the

restricted herbicide policy. Hydroseeding new grass on shoulders is currently implemented on an as-needed basis. Noxious weed control is carried out by Island County road maintenance personnel. Spot applications of herbicides will be used for noxious weed control but only as a last resort. Encroaching and undesirable vegetation will be cut back during the fall months with a side arm rotary mower. Undesirable trees are trimmed, topped, or fell as needed for four to six weeks per year. No overall results of the restricted use herbicide were noted due to the negligible time elapsed since policy establishment. Expected results include reduced herbicide use, increased ponding water issues, and increased vegetation management costs from more frequent mowing and labor-intensive activities.

2. Clallam County

Clallam County established a restricted herbicide-use policy in 1990. Since then, the county has maintained grass-covered road shoulders. Shoulders are mowed three times per year. The shoulders need to be pulled approximately once every three years to ensure stormwater drainage from the pavement. Hydroseeding of grass to exposed soil is periodically conducted in sensitive areas to minimize erosion and sedimentation. Noxious weed control is accomplished with herbicide treatments and hand pulling by prison work crews as coordinated and applied by County Weed Board personnel. Encroaching and undesirable vegetation is cut back annually with side arm mowers. Since the restricted herbicide-use policy was established, herbicide use has decreased, additional money needed to be spent on new equipment, shoulders have to be pulled more often, more vegetation is growing through the pavement edges. It has also been observed that trees and brush grow back towards the roadway more rapidly.

3. Jefferson County

Jefferson County established a restricted herbicide-use policy in 1980. Since then, the county has maintained grass-covered road shoulders. Shoulders are mowed three times per year. The shoulders need to be pulled approximately once every three years to ensure stormwater drainage from the pavement. Noxious weed control has not been a high priority in this county and a weed board has only been organized in recent years. Encroaching and undesirable vegetation is side trimmed approximately once every three years. Since the restricted herbicide-use policy was established, herbicide use has decreased, costs of vegetation management have increased, and there has been an increase of ponding water at the edge of the pavement.

4. Snohomish County

Snohomish County established a restricted herbicide-use policy in 1992. Since then, the county has maintained grass-covered road shoulders. Shoulders are mowed twice per year. The shoulders have been pulled

approximately once every five to seven years to ensure stormwater drainage from the pavement. Noxious weed control is accomplished with spot herbicide applications and hand pulling conducted by County Weed Board personnel. Encroaching and undesirable vegetation is side trimmed either annually or once every two years dependant on the condition of a specific roadside location. Hazard trees are felled as needed. Since the restricted herbicide-use policy was established, herbicide use has decreased. The frequency of mowing, shoulder pulling, and brush cutting has increased dramatically and there has been an increase in the frequency and duration of ponding water on the pavement edge. This has led to an accelerated rate of pavement wear and failure, especially in the outer wheel path due to saturated subgrade from impeded surface drainage. Additionally, there have been problems managing vegetation around guardrail, bridge approaches and other roadside structures.

5. Thurston County

Thurston County established a restricted herbicide-use policy in 1989 and it was later revised in the early 1990's. Since then, the county has maintained grass-covered road shoulders. Shoulders are mowed twice per year. The shoulders are pulled when roads are re-surfaced. Noxious weed control is conducted by the County Weed Board using herbicides, only if approved through a county herbicide approval process. Encroaching and undesirable vegetation is mowed year-round on an as-needed basis. Hazard trees are felled and hydroseeding is conducted on an as-needed basis for exposed soils. Since the restricted herbicide-use policy was established, herbicide use has decreased, vegetation management costs have increased, and an increase in ponding water at the edge of pavement has occurred.

B. Current WSDOT Practices in the Five Counties

Personnel from the four WSDOT Maintenance areas that coincide with the herbicide use-restricted counties were surveyed regarding their roadside vegetation management practices. Since the four maintenance areas follow WSDOT departmental vegetation management policies, practices were fairly uniform and are singularly summarized below.

A three-foot average width vegetation-free gravel zone is maintained at the edge of the pavement. This is accomplished with annual applications of a residual herbicide. The remainder of the shoulder is typically maintained as a grass stand with mowing at a frequency of once per year or every other year. Shoulders are pulled on average once every six years. Noxious weed control is carried out by WSDOT personnel using herbicide applications as well as other mechanical, manual, biological, and cultural methods. Encroaching brush and trees are controlled by a combination of mowing, side trimming, hand cutting, and herbicide applications. Mechanical brush and tree control is carried out approximately once every

five years on any given section of roadside. Herbicide applications are made on an as-needed basis either as foliar applications for trimming branches or eliminating seedlings, or in combination with cutting activities as cut surface applications to eliminate re-growth.

IV Comparative Costs and Results

A. Cost Comparison

Conclusions on cost differences have been reached with regard to each of the three distinct types of roadside vegetation management activities described above. Initial cost to purchase additional equipment is also included as a separate line item.

1. Shoulder Maintenance

Eliminating the use of residual, non-selective herbicides for maintenance of a vegetation free zone at the pavement edge without affecting the level of service would result in the need for more frequent mowing and shoulder blading activities. A contributing difference between state and county roads for this activity is that state highways have a significantly greater amount of guardrail present. It is estimated that an average of 10% of all shoulders on non-Interstate state highways in these five counties have guardrail present. Without the use of herbicides, mowing and removing soil buildup from around the base of guardrails requires detailed and labor-intensive activities. It is assumed that in lieu of maintaining a vegetation free condition around the base of guardrail with residual herbicide applications, WSDOT would hand mow vegetation in these locations on a regular basis.

The comparative practices and costs are calculated as follows. Costs have been rounded to the nearest dollar. Detail of the labor, equipment and material costs, together with average productivity estimates are shown in **Appendix A, Maintenance Activity Cost Calculations**.

Current WSDOT Costs:

- Annual residual herbicide application –
  $75 per centerline mile X **1,022 miles** **$76,650**
- Annual one-pass shoulder mowing –
  $200 per centerline mile X **1022** miles **$204,400**
- Shoulder pulling once every 6 years (16.7% of the system each year) in areas without guardrail,
  $1,717 per centerline mile X **920** miles (90% of centerline miles X **.167** **$263,800**
- Shoulder pulling once every 6 years (16.7% of the system each year) in areas with guardrail,
  $25,500 per centerline mile X **102** miles (10% of centerline miles X **.167** **$434,367**
- Total current annual cost for shoulder maintenance **$979,217**

Projected WSDOT Cost for Shoulder Maintenance without Herbicide:

- One pass shoulder mowing (Average of 2.5 times per year) - **$200** per centerline mile X **1,022 miles** X **2.5** **$511,000**
- Mowing by hand, under and around guardrail (Average of 2.5 times per year) - **$1,129** per centerline mile X **102 miles** (10% of centerline miles) X **2.5** **$287,895**
- Annual shoulder pulling once every 3 years (33% of the system each year) in areas without guardrail – **$1,717** per centerline mile X **920 miles** (90% of centerline miles) X **.33** **$521,281**
- Annual shoulder pulling once every 3 years (33% of the system each year) in areas with guardrail – **$24,700** per centerline mile X **102 miles** (10% of centerline miles) X **.33** **$831,246**
- Total annual cost for shoulder maintenance without herbicides **$2,151,422**

2. Noxious Weed Control

It was found that even in the counties where herbicide use is restricted for other types of roadside vegetation management, herbicides are still used by most counties in varying degrees for the control of noxious weeds. This is due to the fact that herbicides sometimes present the only viable option in complying with state law for the control of noxious weed species.

Therefore, it is assumed for the purposes of this comparison that regardless of a decision to limit herbicide use, limited, selective applications of herbicides would continue to be used by WSDOT for the legally mandated control of designated noxious weeds. These applications would be considered as part of Integrated Vegetation Management (IVM) solutions, intended to achieve long-term control of noxious weeds and reduce the need for herbicide use over time.

Given these facts, it is assumed that for the costs and activities associated with the control of noxious weeds where required by law, WSDOT would not change current policy and practice with regard to the use of herbicides. Therefore, costs and results would not change.

3. Tree, Brush and Nuisance Weed Control

WSDOT currently uses herbicides in combination with mowing, mechanical trimming and hand cutting operations to control encroaching vegetation growth, emerging undesirable trees and brush, and other invasive plants classified as nuisance weeds. The supplemental use of herbicide for these activities contributes to the efficiency and effectiveness of maintenance operations. Elimination of herbicides as a tool in the

subject county programs has resulted in annual trimming and hedging operations to manage these plants. Nuisance weeds such as Scotch broom, Himalayan blackberry, and Canadian thistle, where they occur, are typically mowed when they are near the road surface, and elsewhere left to grow and spread. They may be cut or pulled by hand if outside normal mowing patterns when funding is available.

The major difference between state and no-spray county programs for this set of activities is the frequency of need for maintenance attention in any given location. Supplementing mowing and trimming activities with selective foliar or basal stump herbicide treatments allows maintenance to reduce the rate of grow-back. This in turn reduces the need for annual trimming in many locations and allows for the establishment of slower growing but desirable native species. Along county roads, large trees are more commonly left to grow closer to the road and overhang.

The comparison of program costs for these activities was based on a three year average of WSDOT historic costs for these activities on secondary (non-Interstate) highways, as opposed to the estimated cost to replicate the most typical semblance of current county programs as indicated by the survey results. Since the various methods are difficult to extract from total operational costs, it was more accurate and efficient to use historic averages extracted from the accounting system as a basis for estimating the current WSDOT costs.

County programs typically keep trees and brush back from the road through side trimming of brush and tree limbs. The comparative estimate is based on a slightly increased frequency for WSDOT if herbicide use is eliminated. In addition, due primarily to the fact that state highway rights of way are typically wider than county roads, it has also been assumed that the state would continue to periodically use hand cutting and side arm mowing to selectively clear large trees and undesirable brush from portions of Zone 3. This would be done to preserve the current level of service on state highways with regard to the control of overhanging trees and brush. These activities are referred to in the Projected WSDOT Costs as **Major Selective Tree and Brush Removal**.

The comparative costs for these activities are calculated as follows. Detail of the basis for the current WSDOT historic average costs, as well as labor and equipment costs, together with average productivity estimates for the no-herbicide alternative are shown in **Appendix A, Tree, Brush and Nuisance Weed Control Calculations**.

Current WSDOT Costs:

- Average program consists of annual selective trimming of tree limbs and brush (once every five years) annual selective and broadcast herbicide applications (once every five years) and annual major selective tree and brush removal (once every ten years)
- Annual average costs for the WSDOT maintenance areas for 1022 centerline miles in the five counties **$406,068**

Projected WSDOT Costs for Tree, Brush and Nuisance Weed Control without Herbicides:

- Trimming encroaching vegetation once every two years (50% of centerline miles per year)
  $693 per centerline mile X **1,022** miles X **.5** **$354,123**
- Major selective tree and brush removal once every ten years (10% of centerline miles per year)
  $2,459 per centerline mile X **1,022** miles X **.1** **$251,310**
- Total annual cost for tree, brush and nuisance weed control without the use of herbicides **$605,433**

4. Initial Purchase of Additional Equipment

Additional equipment would be required in each of the four maintenance areas to accomplish the additional mowing cycles and annual trimming operations. The amount of additional equipment is based on the miles of secondary state highway in the counties and the distribution of the roads within the WSDOT maintenance areas. Additional equipment needs would be as follows:

NW Region Area 2 (Island County) – 1 shoulder mower, 1 reach mower, 1 small tractor
NW Region Area 3 (Snohomish County) – 2 shoulder mowers, 2 reach mowers, 1 small tractor
Olympic Region Area 1 (Thurston County) – 2 shoulder mowers, 1 reach mower, 1 small tractor
Olympic Region Area 3 (Clallam and Jefferson Counties) – 2 shoulder mowers, 2 reach mowers, 1 small tractor

Unit costs for equipment purchase:

- Shoulder mowers typically consist of a tractor with a side mounted 8-foot wide mowing deck. Unit cost..... **$85,000**

- Reach mowers typically consist of a tractor with a side mounted 26-foot arm and a 6-foot wide mowing head. Unit cost..... **$90,000**

- Small tractors consist of a Bobcat or similar four-wheel drive front loader with a special blade attachment to remove soil build up from around the base of guardrail. Unit cost **$42,000**

- Total initial cost to purchase new equipment **$1,303,000**

Total Added Cost to Maintain without Herbicides
Based on the assumptions and estimates above, the total addition annual cost to maintain all secondary state highways in the five counties without herbicides would be **$1,371,570**

The first year implementation would include equipment purchase costs. Total cost for the first year of implementation would be **$2,674,570**

The resulting amount of additional labor would also necessitate the hiring of 5 additional full time employees.

This report assumes that the cost of noxious weed control would remain the same. Therefore, these additional cost represent increases for shoulder maintenance and tree, bush and nuisance weed control. **For these maintenance items the estimated added annual cost given above is approximately double that of current costs.**

B. Discussion of Results

1. Shoulder Maintenance Process

There are a number of inter-related benefits and adverse impacts that arise in discussion about different methods of maintaining road shoulders. Some of these issues are fairly evident as to whether they are a benefit or an adverse impact associated with a maintenance method. Other issues are debatable or require additional research to determine if they are truly a benefit or an adverse impact. Some issues are dependant on a variety of trade-offs as to whether they should be considered a benefit or an adverse impact. The following issues related to results of differing shoulder maintenance practices were brought up in the course of gathering comparative cost information:

a) Surface Drainage

The most notable advantage is the facilitation of surface drainage of runoff during storm events, by reducing the build up of vegetation and debris at the pavement edge. This contributes to traffic safety by reducing the potential for loss of vehicle control from hydroplaning. Vegetation at the edge of pavement will slow down or prevent

sheetflow of stormwater proceeding from the paved surface on down the slope of the roadside and in some cases may result in the channeling of water down the pavement edge to point discharges in low areas.

b) Worker and Traffic Safety

The frequency and total time spent by maintenance crews for overall shoulder maintenance is less, thereby reducing the chance for traffic impacts and risk to maintenance employees and the public from accidents. However, this is only an advantage if these risks outweigh any potential risk to maintenance employees from the handling and use of herbicides presents chemical risks to the health of applicators.

c) Pavement Life

The free drainage of water from the edge of pavement in the ground is believed by many to prolong the life of pavement at the edges. When moisture is retained at the edge of pavement, particularly during freeze/thaw events, asphalt and chip sealed road surfaces are more prone to crack and ravel over time. Others believe that healthy soils and grasses at the edge of pavements facilitate percolation and removal of water through the soils and lends stability to the shoulder to minimize erosion.

d) Maintenance of Roadside Hardware

Having this section of shoulder free of vegetation contributes to ease of maintenance around roadside hardware (guardrails and delineators).

e) Fire Starts

The additional width of vegetation free area may also contribute to a reduced chance of fire starts from lit cigarettes and hot vehicles pulling off on the shoulder.

f) Wildlife Roadkill

Because deer and elk tend to graze grass along the edge of the road, some people feel the additional width of vegetation free area provides additional buffer between traffic and these animals. The vegetation free area may also improve visibility and reduce the chance of accidents from large animals on the road or near traffic.

g) Relative Toxicity

The main adverse impact associated with herbicide use is the potential human health and environmental impacts from herbicides used for shoulder residual applications. Others will argue that increased mechanical means of vegetation management also pose potential risks to human health and the environment. These potential risks include exposure to gasoline, diesel, exhaust fumes, and hydraulic oil.

Conclusions from the updated risk assessment show a low to very low potential risk to the public, wildlife and aquatic systems for the products and methods of application in this activity. Potential benefits from utilizing a no spray approach to shoulder maintenance do not appear to make a clear case for a full-scale shift to such an approach. Due to the complex and variable nature of this issue, further evaluation and monitoring of potential benefits and adverse impacts will be helpful to add to our body of knowledge.

2. Noxious Weed Control Process

In discussing results for noxious weed control activities, it is assumed that even in counties with no-spray roadside maintenance policies, the county and the state would use similar integrated vegetation management treatments for these weeds. This is due to the aggressive nature of some noxious weeds and the lack of alternative options that are effective in their control. Herbicides would continue to be used in combination with other tools in order to achieve effective control. This in turn would result in a long-term decrease in the need control these weeds over time.

3. Tree, Brush and Nuisance Weed Control Process

The primary advantage of herbicide use in combination with mechanical methods for these activities is increased efficiency and effectiveness. This translates mainly into cost savings as indicated in the cost comparison findings above. However, due to the fact that maintenance funding is limited, these savings in efficiency and effectiveness translate directly into improved program delivery in these areas.

Regardless of overall cost considerations, on county roadsides not currently infested with weeds and established with mature native vegetation, the annual mechanical trimming programming is very successful and has resulted in sections of county roadside that contain stable communities of native vegetation. However, where weed infestations exist and where the native vegetation has been disturbed by roadway construction or neighboring development, the counties have less ability to successfully reestablish a stable native plant community using only mechanical and hand cutting methods.

In addition the following specific issues were raised related to results of differing tree and brush control practices in the course of gathering comparative cost information:

a) <u>Traffic and Worker Safety</u>

Improved traffic and worker safety may be achieved through the ability to more effectively provide longer-term

control of encroaching vegetation and hazardous trees. The increased presence of mowing equipment on the highway shoulder impacts traffic operations. This impact increases with higher volume and higher speed roadways.

b) Nuisance Weed Control

Without herbicides as a tool it is difficult and costly to eradicate nuisance brush such as Scotch broom, Japanese knotweed, and Himalayan blackberry. In most cases on county roads where these species are present they are simply kept back from traffic through annual mowing and allowed to spread where not mowed.

c) Herbicide Toxicity

Some methods of herbicide treatment for tree and brush control if not carefully executed may result in application to fruit of Himalayan blackberry which may then be picked and eaten. Also when longer distance broadcast applications are made in proximity to environmentally sensitive areas, there is a chance of off target exposure. However, WSDOT takes precautions in these instances to ensure public and environmental safety.

The only factor suggesting an elimination of herbicides for the management of trees, brush and nuisance weeds is warranted is the concern over impacts on human health and the environment. Conclusions from the updated risk assessment show a low to very low potential risk to the public, wildlife and aquatic systems for the products and methods of application in this activity.

V Final Conclusion and Recommendations

This report concludes that an integrated roadside vegetation management that includes an herbicide component costs less than a no-spray program. The benefits and adverse impacts from the two vegetation management approaches are complex and varied. While benefits and adverse impacts were discussed in the course of gathering information to document comparative program costs, delineation of these items is not included in this project's scope of work.

Based on the findings of this report and the updated information on risk assessment for the herbicides and application methods currently used by WSDOT, it is recommended that the agency continue in implementing the preferred alternative identified in the WSDOT 1993 Environmental Impact Statement for Roadside Vegetation Management. The continued development and implementation of roadside management plans and the use of an IVM activity planning and tracking system, if combined with a stable funding base, will allow WSDOT to develop more stable and low maintenance roadsides over time. This will in turn minimize the need for herbicide use.

In response to the petition that WSDOT discontinue herbicide use in the five counties, it is recommended that the agency prioritize the development and implementation of Integrated Roadside Vegetation Management Plans for those counties.

APPENDIX A

Annual Residual Herbicide Application

Labor & Equipment		Cost/Hour	
Shoulder Residual:	**10 Hour Work Day**	**Labor & Equipment**	**Daily Costs**
	2 Hours Mobilization	$101.92	$203.84
	7 Hours Operation	$101.92	$713.44
	1 Hour Stand-By	$90.48	$90.48
		Total L&E per day=	**$1,007.76**
			divided by
Miles Accomplished per day (see productivity estimate)=			**35**
Labor & Equipment Cost/Centerline Mile=			**$28.79**

Shoulder Residual:		
Material	**Unit/Acre**	**Cost/Acre**
Oust	3 dry ounces	$30.45
Diuron	6 pounds	$23.82
Roundup-Pro	32 liquid ounces	$8.96
Total Material Cost/Acre =		**$63.23**

Square Foot per Acre	43560
Spray Width (divide)	3
Linear Feet Coverage	**14520**
LF in Mile (divide)	5280
Linear Miles Coverage	**2.75**
Divide by 2 to cover both sides of road	2
Centerline Miles Covered	**1.375**

Total Material Cost/Acre =	$63.23	
Centerline Miles Covered (divide) =	1.375	
Material Cost/Centerline Mile =		**$45.99**
Total Activity Cost/Centerline Mile =		**$74.78**

Shoulder Mowing

Labor & Equipment		Cost/Hour	
Shoulder Mowing:	**10 Hour Work Day**	**Labor & Equipment**	**Daily Costs**
	2 Hours Mobilization	$111.79	$223.58
	7 Hours Operation	$125.27	$876.89
	1 Hour Stand-By	$96.65	$96.65
		Total L&E per day=	**$1,197.12**
			divided by
Miles Accomplished per day (see productivity estimate) =			**6**
Activity Cost/Centerline Mile =			**$199.52**

Blading or Pulling Shoulders (no guardrail)

Labor & Equipment		Cost/Hour	
Pulling Shoulders:	10 Hour Work Day	Labor & Equipment	Daily Costs
	2 Hours Mobilization	$243.85	$487.70
	7 Hours Operation	$242.96	$1,700.72
	1 Hour Stand-By	$215.11	$215.11
		Total L&E per day=	**$2,403.53**
			divided by
Miles Accomplished per day (see productivity estimate)=			**1.4**
Activity Cost/Centerline Mile =			**$1,716.81**

Blading or Pulling Shoulders (under guardrail)

Labor & Equipment		Cost/Hour	
Pulling Shoulders:	10 Hour Work Day	Labor & Equipment	Daily Costs
	2 Hours Mobilization	$158.63	$317.26
	7 Hours Operation	$143.49	$1,004.43
	1 Hour Stand-By	$131.77	$131.77
		Total L&E per day=	**$1,453.46**
			divided by
Miles Accomplished per day (see productivity estimate)=			**0.057**
Activity Cost/Centerline Mile =			**$25,499.30**

Hand Mowing Around Guardrail

Labor & Equipment		Cost/Hour	
Hand Mowing:	10 Hour Work Day	Labor & Equipment	Daily Costs
	2 Hours Mobilization	$56.46	$112.92
	7 Hours Operation	$56.46	$395.22
	1 Hour Stand-By	$56.46	$56.46
		Total L&E per day=	**$564.60**
			divided by
Miles Accomplished per day (see productivity estimate)=			**0.5**
Hand Mowing Around Guardrail Cost/Centerline Mile=			**$1,129.20**
Total Secondary Miles in 4 WSDOT Maint. Areas		**2.5 Times Per Year**	**10% GR**
1021.67		**2554.18**	**255.42**
Cost/Mile	**Miles/Year**	**Total Approximate Annual Cost**	
$1,129.20	**255.42**	**$288,418.01**	

Current Average WSDOT Cost for Tree, Brush, and Nuisance Weed Control

Olympic Region Area 1 - Tacoma/Olympia

Org	Work Op*	FY 2000	FY 2001	FY2002
4351	1611	105,722	203,807	254,447
4351	1625	203,267	372,001	378,304
4351	1641	721	1,846	3,683
4351	1651	6,573	1,009	484
4351	1699	50,384	34,541	25,078
Totals		**$366,665**	**$613,204**	**$661,995**

Average Annual Cost '00-'02
$547,288

NW Region Area 2 - Mt. Vernon

Org	Work Op*	FY 2000	FY 2001	FY2002
4152	1611	74,138	86,354	118,890
4152	1625	97,593	133,026	266,689
4152	1641	4,038	4,298	7,165
4152	1651	-	0	134
4152	1699	96,134	113,091	98,717
Totals		**$271,903**	**$336,769**	**$491,594**

Average Annual Cost '00-'02
$366,755

Olympic Region Area 3 - Port Angeles

Org	Work Op*	FY 2000	FY 2001	FY2002
4353	1611	67,214	74,415	74,809
4353	1625	330,836	500,672	468,465
4353	1641	158	240	272
4353	1651	-	260	
4353	1699	1,249	-	-
Totals		**$399,457**	**$575,586**	**$543,546**

Average Annual Cost '00-'02
$506,196

NW Region Area 3 - Everett

Org	Work Op*	FY 2000	FY 2001	FY2002
4153	1611	81,582	117,453	74,274
4153	1625	194,237	108,084	207,787
4153	1641	749	220	837
4153	1651			25
4153	1699	86,792	111,974	121,810
Totals		**$363,360**	**$337,731**	**$404,733**

Average Annual Cost '00-'02
$368,608

Total Average - 4 Maint. Area Costs: Year 2000, 2001, 2002

$447,212 Ave. Annual Cost

Total Road Miles in 4 Maint. Areas =	**1125.10**
Total Secondary Road Miles in 4 Maint. Areas =	**1021.67**
Secondary Road Mile Percentage =	**90.80%**

Average Annual Expenditure on Secondary Road Miles

Ave. Annual Cost Times Secondary Road Mile % =	**$406,068**

Average Cost Per Mile for Tree, Brush, & Nuisance Weed Control

Average Annual Expenditures Divided by Secondary Road Miles =	**$397.00**

* Work operation numbers are used by WSDOT to track various types of activity groups. For this table, activities are defined as:

1611 Nuisance Weed Control
1625 Control of Veg. Obstructions (Hazards)
1641 Seeding and Planting
1651 Fertilizing and Liming
1699 Misc. Roadside Maintenance (Including equipment and material charges)

Trimming Encroaching Vegetation

Labor & Equipment		Cost/Hour	
Trimming Veg:	10 Hour Work Day	Labor & Equipment	Daily Costs
	2 Hours Mobilization	$113.53	$227.06
	7 Hours Operation	$126.70	$886.90
	1 Hour Stand-By	$98.39	$98.39
		Total L&E per day=	**$1,212.35**
			divided by
Miles Accomplished per day (see productivity estimate)=			**1.75**
Activity Cost/Centerline Mile=			**$692.77**

Major Selective Tree and Brush Removal

Labor & Equipment		Cost/Hour	
Selective Removal:	10 Hour Work Day	Labor & Equipment	Daily Costs
	2 Hours Mobilization	$113.53	$227.06
	7 Hours Operation	$129.13	$903.91
	1 Hour Stand-By	$98.39	$98.39
		Total L&E per day=	**$1,229.36**
			divided by
Miles Accomplished per day (see productivity estimate)=			**0.5**
Activity Cost/Centerline Mile=			**$2,458.72**

ACTIVITY COST ESTIMATE

OPERATION

Shoulder Mowing

PURPOSE

Shoulers must be mowed to keep vegetation from growing over the edge of pavement and into the traveled lanes. This is done to allow for site distance at corners and intersections as well as reduce the potential for fire starts.

DESCRIPTION OF WORK PERFORMED:

When guardrail is present, a side arm boom attacted to a tractor is utilized, in all other areas a side mounted drop-down mowing deck is utilized. Equipment costs and productivity for these two attachments are the same. A pick-up truck with an arrow board is utilized for transporting additional labors and for traffic control. Mobilization will be accomplished with the use of a truck and trailer.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG.	O.T.	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Technician 3	Equipment Operator	1.0		28.96	28.96
3	Maintenance Technician 2	Laborer/Flagger	2.0		26.58	53.16
4						
5						
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			82.12
13						
14			LABOR TOTAL			82.12
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	17-07 Tractor Mower	28.62	1.0		3.62	32.24
17	05-06 Pick-up Truck		1.0		3.30	3.30
18						
19						
20	**Mobilization**					
21	08-18 Truck, Loadal	15.14/hour to operate plus	1.0		4.19	4.19
22	10-01 Trailer, Lowboy		1.0		3.42	3.42
23						
24						
25						
26			EQUIPMENT SUBTOTAL			43.15
27						
28			EQUIPMENT TOTAL			43.15
29	**MATERIALS:**					
30						
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$96.65
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$111.79
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$125.27

ACTIVITY COST ESTIMATE

OPERATION

Blading or Pulling Shoulders (no guardrail)

PURPOSE

Soil and vegetation buildup at the edge of pavement necessitate this activity to allow for uniform drainage from the edge of pavement, into the drainage system. If a vegetation free zone is not maintained, this activity must be done more frequently.

DESCRIPTION OF WORK PERFORMED:

Motor Grader with Self Propelled Conveyor and multiple Dump Trucks utilized in this operation.
Pick up Truck and Tractor with broom attachment will also be used.
Mobilization will be accomplished with the use of a truck and trailer.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG	Number of Workers O.T	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Lead Technician	Equipment Operator	1.0		30.24	30.24
3	Maintenance Technician 3	Equipment Operator	1.0		28.96	28.96
4	Maintenance Technician 2	Laborer/Flagger	2.0		26.58	53.16
5	Maintenance Technician 2	Truck Driver	2.0		26.58	53.16
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			165.52
13						
14			LABOR TOTAL			165.52
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	11-06 Motor Grader	14.25	1.0		6.30	20.55
17	20-30 Conveyor, Self Propelled		1.0		8.14	8.14
18	06-13 Dump Trucks	11.72	2.0		4.92	33.28
19	05-06 Pick-up Truck		1.0		3.30	3.30
20	17-20 Tractor (for broom)		1.0		2.58	2.58
21	18-31 Broom Attachment		1.0		1.98	1.98
22						
23	**Mobilization**					
24	08-18 Truck, Loadal	15.14/hour to operate plus	1.0		4.19	4.19
25	10-01 Trailer, Lowboy		1.0		3.42	3.42
26			EQUIPMENT SUBTOTAL			77.44
27						
28			EQUIPMENT TOTAL			77.44
29	**MATERIALS:**					
30						
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$215.11
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$243.85
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$242.96

ACTIVITY COST ESTIMATE

OPERATION

Blading or Pulling Shoulders (under guardrail)

PURPOSE

Soil (and vegetation) buildup at the edge of pavement necessitate this activity to allow for uniform drainage from the edge of pavement, into the drainage system. If a vegetation free zone is not maintained, this activity must be done more frequently.

DESCRIPTION OF WORK PERFORMED:

Bobcat (small tractor) is utilized in combination with a state fabricated attachment to perform this operation. A Dump Truck and Pick-up Truck will also be utilized as well as another Truck and Trailer for mobilization.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG	Number of Workers O.T.	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Technician 3	Equipment Operator	1.0		28.96	28.96
3	Maintenance Technician 2	Laborer/Flagger	2.0		26.58	53.16
4	Maintenance Technician 2	Truck Driver	1.0		26.58	26.58
5						
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			108.70
13						
14			LABOR TOTAL			108.70
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	Bobcat use w/new purchase	TEF assumed Rental Rate	1.0		2.68	2.68
17	06-13 Dump Truck	11.72	1.0		4.92	16.64
18	05-06 Pick-up Truck		1.0		3.30	3.30
19						
20						
21						
22						
23	**Mobilization**					
24	08-18 Truck, Loadal	15.14/hour to operate plus	1.0		4.19	4.19
25	10-01 Trailer, Lowboy		1.0		3.42	3.42
26			EQUIPMENT SUBTOTAL			30.23
27						
28			EQUIPMENT TOTAL			30.23
29	**MATERIALS:**					
30						
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$127.21
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$154.07
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$138.93

ACTIVITY COST ESTIMATE

OPERATION

Residual Herbicide Application

PURPOSE

Maintaining a vegetation free shoulder allows for uniform surface drainage, reduces ponding on the shoulders, keeps vegetation out from under guardrail, contributes to longer pavement life, and reduces the potential for fire starts.

DESCRIPTION OF WORK PERFORMED:

1000 gallon spray truck is utilized one pass per year. A pick-up truck with arrow board will be used for traffic control on secondary highways.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG	Number of Workers O.T.	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Technician 3	Equipment Operator	1.0		28.96	28.96
3	Maintenance Technician 2	Laborer/Flagger	2.0		26.58	53.16
4						
5						
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			82.12
13						
14			LABOR TOTAL			82.12
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	08-29 1000gal. Herbicide Truck	11.44	1.0		5.06	16.50
17	05-06 Pick-up Truck		1.0		3.30	3.30
18						
19						
20						
21						
22						
23	**Mobilization**					
24						
25						
26			EQUIPMENT SUBTOTAL			19.80
27						
28			EQUIPMENT TOTAL			19.80
29	**MATERIALS:**					
30	Oust, Diuron, Roundup-Pro	See Attachment for Rates				
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$90.48
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$101.92
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$101.92

ACTIVITY COST ESTIMATE

OPERATION

Hand Mowing Around Guardrail

PURPOSE

Hand trimming around guardrail will be needed when not maintaining a vegetation free shoulder with the use of herbicides.

DESCRIPTION OF WORK PERFORMED:

Two laborers with hand trimmers and pickup truck.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG	Number of Workers O.T.	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Technician 2	Laborer	1.0		26.58	26.58
3	Maintenance Technician 2	Laborer/Flagger	1.0		26.58	26.58
4						
5						
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			53.16
13						
14			LABOR TOTAL			53.16
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	Gas Weed Eater	No TEF info	2.0		0.00	0.00
17	05-06 Pick-up Truck		1.0		3.30	3.30
18						
19						
20						
21						
22						
23	**Mobilization**					
24						
25						
26			EQUIPMENT SUBTOTAL			3.30
27						
28			EQUIPMENT TOTAL			3.30
29	**MATERIALS:**					
30						
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$56.46
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$56.46
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$56.46

ACTIVITY COST ESTIMATE

OPERATION

Trimming Encroaching Vegetation

PURPOSE

Mechanical trimming is utilized to keep brush and tree limbs back from the road edge to provide for site distance. It is also utilized to remove young trees with the potential of becoming obstructions to errant vehicles.

DESCRIPTION OF WORK PERFORMED:

A tractor mounted side arm brush cutter will be utilized for trimming activities.
A pick-up truck with arrow board will be used for traffic control as well as a truck and trailer for mobilization.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG.	O.T.	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Technician 3	Equipment Operator	1.0		28.96	28.96
3	Maintenance Technician 2	Laborer/Flagger	2.0		26.58	53.16
4						
5						
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			82.12
13						
14			LABOR TOTAL			82.12
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	17-11 Brush Cutter	28.31	1.0		5.36	33.67
17	05-06 Pick-up Truck		1.0		3.30	3.30
18						
19						
20						
21						
22						
23	**Mobilization**					
24	08-18 Truck, Loadal	15.14/hour to operate plus	1.0		4.19	4.19
25	10-01 Trailer, Lowboy		1.0		3.42	3.42
26			EQUIPMENT SUBTOTAL			44.58
27						
28			EQUIPMENT TOTAL			44.58
29	**MATERIALS:**					
30						
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$97.52
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$112.66
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$126.70

ACTIVITY COST ESTIMATE

OPERATION

Major Tree and Brush Removal

PURPOSE

A portion of the right of way is cleared on an annual basis to selectively elimate undesirable trees and nuisance vegetation.

DESCRIPTION OF WORK PERFORMED:

A tractor mounted brush cutter is used to mow brush and smaller undesirable vegetation. Larger undesirable trees are cut by hand and either removed or chipped on site.

	WORKMAN AND/OR EQUIPMENT WORKING	OCCUPATION OF WORKMAN OR EQUIPMENT SIZE	Number of Workers REG.	O.T.	RATE	AMOUNT
1	**LABOR:**					
2	Maintenance Technician 3	Operator	1.0		28.96	28.96
3	Maintenance Technician 2	Laborer/Flagger	2.0		26.58	53.16
4						
5						
6						
7						
8						
9						
10						
11						
12			LABOR SUBTOTAL			82.12
13						
14			LABOR TOTAL			82.12
15	**EQUIPMENT:**	**Operational Rate (If Applicable)**				
16	17-11 Tractor; 26' boom w/brush head	28.31	1.0		5.36	33.67
17	21-02 Industrial Chipper		1.0		2.43	2.43
18	05-06 Pick-up Truck		1.0		3.30	3.30
19						
20						
21						
22						
23	**Mobilization**					
24	08-18 Truck, Loadal	15.14/hour to operate plus	1.0		4.19	4.19
25	10-01 Trailer, Lowboy		1.0		3.42	3.42
26			EQUIPMENT SUBTOTAL			47.01
27						
28			EQUIPMENT TOTAL			47.01
29	**MATERIALS:**					
30						
31						
32			MATERIALS SUBTOTAL			
33						
34			MATERIALS TOTAL			
35						
36						
37					**Total Stand-By Hourly Rate**	$98.39
Calculated By	Date	Checked By			**Total Mobilization Hourly Rate**	$113.53
Maurice Perigo	5/6/2003	Date:			**Total Operational Hourly Rate**	$129.13

WSDOT - Productivity Estimate

Productivity:

How many Miles (both sides) / Day do you typically accomplish in performing the following tasks, including clean-up?

	NW Region Area 2	NW Region Area 3	Oly Region Area 1	Oly Region Area 3
Blading (No Guardrail):	1 mile	1 to 2 miles	1 to 2 miles	1 to 2.5 miles
Blading under Guardrail:	300 feet			
Shoulder Mowing:	5 to 6 miles	10 miles	2 to 3 miles	5 to 7.5 miles
Trimming - Minor:	1 mile		1 mile	2 to 5 miles
Z-1 Herbicide Application:	40 miles	36 miles	38 to 45 miles	15 to 30 miles
Brush Control - Major:				0.5 miles
Hand Trim Around Guardrail:				0.5 miles

	Average Productivity of Maintenance Areas Surveyed
Blading (No Guardrail):	1.4 miles per day
Blading under Guardrail:	300 feet per day
Shoulder Mowing:	6 miles per day
Trimming - Minor:	1.75 miles per day
Z-1 Herbicide Application:	35 miles per day
Brush Control - Major:	0.5 miles per day
Hand Trim Around Guardrail:	0.5 miles per day

Budget on Secondary Roads:

In your opinion, would the money you spend from your budget for secondary road miles is spent in proportion to the amount of total road miles in your area?

	NW Region Area 2		NW Region Area 3		Oly Region Area 1		Oly Region Area 3	
	Total Miles	Secondarys	Total Miles	Secondarys	Total Miles	Secondarys	Total Miles	Secondarys
Budget Spent in Proportion to Type	311.25	287.76	221.4	196.94	311.5	256.02	280.95	280.95
of Miles in Maint. Area:	Yes	92.50%	see FIRS	89%	Yes	82.20%	Yes	100%

APPENDIX B

Roadside Vegetation Management - County Survey Responses

Program Background Questions	Island County	Clallam County	Jefferson County	Snohomish County	Thurston County
A1. In what year did your county policy for herbicide use change?	*2002*	*1990*	*1980*	*1992*	*The first policy for Pesticide use in Thurston County was adopted in 1989. It was later revised in the early 90's although am not sure which year.*
A2. What process have you adopted to address noxious weed control?	*Noxious weeds outside county owned properties R/W are addressed by the Noxious Weed Board. Those inside the R/W are still addressed by county road crew herbicide applicators as a spot spray treatment, but only as a last resort.*	*Weed board does some spraying, organizes hand pulling by prisoners.*	*Machine mowing and noxious weed group.*	*Noxious Weed Control Board, Noxious Weed Coordinator-Sonny Gohrman, 360-862-7523. Spot spraying using handheld equipment and backpack sprayers. Herbicide: Roundup, Rodeo, 2,4-D, Amine, Transline, Crossbow, Weedmaster.*	*We fund the County's weed agency to provide for control and monitoring efforts along our roads. Herbicides are used if approved through a county screening process.*
A3. What issues were encountered in your switch to a no-spray program?	*Budget, new equipment, more mowing and long term deterioration of shoulders, pavement, etc...Really, more issues than I care to list.*	*$330,000 to gear up, still sprayed pits and quarries, limited application on gravel road reclamation in early years.*	*Public*	*Dramatically increased frequency of mowing, shoulder pulling, and brush cutting. Impeded drainage resulting in standing water on roadway.*	*Funding was and is still an issue. We went from a chemical control program to a mechanical program within a years time. A lot of trial and error for the first ten or so years.*
A4. What is the typical width, from the edge of paved shoulder to right-of-way, that is maintained along your roadsides?	*Vary from none to 8-10 feet. Would guess the average width is 2-4 feet through out the county.*	*2 to 15 feet, minimal to bottom of ditch, when the R/W exists, they mow it out.*	*4 - 6 feet*	*2-4ft shoulder + ditch. Varies 6-15ft total distance from edge of pavement to back of ditch.*	*10 feet.*
A5. How do you determine the level of service or success of the maintenance activities in your area?	*Public Feedback. Population concentration, type of traffic also determine level of service.*	*Complaints, priority on arterials, then access roads.*	*good*	*Measured accomplishment and visual assessment.*	*Level of service is based on road classification, budget issues and citizen response.*

Roadside Vegetation Management - County Survey Responses

Shoulder Maintenance	Island County	Clallam County	Jefferson County	Snohomish County	Thurston County
B1a. Describe the process for maintaining shoulders along the roadways in your county with regards to Mowing.	*Frequency: Too early to tell. Labor: 4 road districts with 4 road crews, each have 4 mowers and operators. Temp help is brought in for summer activities. Total of 50 employees in all four road shops to include laborers, truck drivers, operators, mechanics, foremen and supervisors.*	*Frequency: 3 times/year. Labor: 8 people, 8 mowers and no traffic control except on bad corners. Equipment: 3 dedicated tractors (side drop down), 5 other convertibles.*	*Frequency: 3 times/year. Labor: 3 operators. Equipment: 3 mowers.*	*Frequency: approx. 5 times/year. Labor: Operator and shadow vehicle + driver. Equipment: Tractor mounted mower.*	*Frequency: Most shoulders get mowed twice/year. Equipment: We have 4 shoulder mowers which operate from May to October. 5 Slope mowers which operate year round. Slope mowers usually make 2-3 passes in order to mow most of the R/W. The vegetation staff consists of 17 full time employees which includes traffic control personnel.*
B1b. Describe the process for maintaining shoulders along the roadways in your county with regards to Pulling Shoulders.	*Frequency: Currently once a year to coincide with our summer Paving and Oiling program. May Change in the future. Labor: 2-3 flaggers/laborers, 3-4 drivers, 2-3 operators. Equipment: Athey Forcefeed loader, 3-4 Dump trucks, Broce Broom, 2-3 pick ups, and 1-2 PCMS.*	*Frequency: 1 time/3 years. Labor: 215 labor days typical. Equipment: Grader, pick up broom, 3 ten yard dump trucks, belt loader, water truck flush, two pick ups with flagging - 10 people to operate.*	*Frequency: As needed or approx. 1 time/3years. Labor: 5 operators, 2 flaggers. Equipment: Grader, Belt loader, 2 Dump trucks, Sweeper.*	*Frequency: 1 time every 5-7 years. Labor: 2 laborers, 6 operators, 2 flaggers. Equipment: Motor grader, Belt loader, 3 Dump trucks, Sweeper.*	*Blading, because of the cost of labor and equipment needed to perform this task, is generally done only on shoulders of roads that are to be resurfaced in a given year.*
B1c. Describe the process for maintaining shoulders along the roadways in your county with regards to Cultural Practices.	*Hydroseeding on an as-needed basis.*	*Hydroseeding in sensitive areas.*			
B2. As a result of not maintaining a vegetation free shoulder, has there been any notable increase in problems such as ponding water, wildlife road kill, fire starts, etc.?	*Not at this time as we are not far enough into this "No-Spray" program. We do expect to have problems down the road.*	*More frequent pulling, vegetation growing through edge.*	*Ponding Water*	*Notable difference in the amount of standing water and length of time it stays on pavement. Accelerated pavement wear and failure, especially the outer wheel path where the subgrade tends to be saturated due to impeded drainage.*	*Ponding water is something that we have seen a definite increase in since the policy was adopted. Other issues such as road kill and fires are unknown.*

Roadside Vegetation Management - County Survey Responses

Tree and Brush Control	Island County	Clallam County	Jefferson County	Snohomish County	Thurston County
C1a. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Mowing/Trimming encroaching vegetation.	*Frequency: Each of our road districts spends approx. 4-6 weeks a year tree trimming, topping, chipping, and falling as needed. We use the fall months to cut brush on the backslopes with our roatary boom mower. Labor: 2-3 flaggers, 1 operator, 1 truck driver, 2-3 laborers. Equipment: Hi-Ranger basket truck, chipper truck with canopy, industrial chipper, 1-2 pick-ups, PCMS on occasion.*	*Frequency: 1 time/year, side trim. Labor: 4 mowers & people, 1/3 time working in a year. Equipment: Side arms converted (same as mowing eq. Above.)*	*Frequency: 1 time/3 years. Labor: 3 operators, 6 flaggers. Equipment: 3 brush cutters.*	*Frequency: 0.5 to 1 time/year. Labor: 1 operator, 1 laborer, 2 flaggers. Equipment: Tractor mounted brush cutter, shadow vehicle.*	*Encroaching vegetation is dealt with on an as-needed basis using either slope mower or the brush crew. Both of these practices need traffic control and are done year round.*
C1b. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Hazard Tree removal.	*Frequency: As-needed. Labor: Same as annual trimming program. Equipment: Same as annual trimming program.*	*Frequency: 5 times/year through the area. Labor: 4 to 6 people. Equipment: Drought, chain saw, chipper, dump truck.*		*Frequency: As needed. Labor: 5-6 laborers. Equipment: Aerial boom/bucket truck, chain saws, trimmers, chipper.*	*Hazard trees are removed as needed.*
C1c. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Cultural Practices.				*N/A*	*We have our own hydroseeder which is used on an as-needed basis.*
C2. Are there any notable disadvantages in maintaining Tree and Brush without the use of herbicides?	*Actually, Island Co. historically has used very little herbicides for tree and brush control. The brush mowing and tree trimming program has been effective to this point.*	*Grow back.*	*Costs.*	*Trees and brush are generally manageable without herbicides, with the exception being around guardrail, bridge approaches and other roadside structures.*	*No.*

Roadside Vegetation Management - County Survey Responses

Overall Costs	Island County	Clallam County	Jefferson County	Snohomish County	Thurston County
D1. How many miles of roadway do you maintain in your county?	*Approx. 588 road miles. / 1176 lane miles.*	*530 miles*	*390 miles*	*Approx. 1650 centerline miles.*	*2000*
D2. What is your total annual budget for roadside maintenance?	*$5,433,378 total maintenance $927,910 for shoulders $727,885 for vegetation.*	*5 million in 2002*	*$500,000*	*$25 million annual maintenance budget.*	*Vegetation budget is around $750,000 per year.*
D3. What type of maintenance is performed on your machinery on a regular basis?	*Standard servicing of the equipment based on hours.*	*Preventative program works well.*	*New blades, regular service.*	*Regular scheduled equipment maintenance, repairs performed as needed.*	*Varies, most of our equipment is new and maintenance is limited.*
D4. Does equipment breakdown and repair have an impact on program delivery?	*It is not a factor with us as most of our equipment is not that old and we have an aggressive maintenance program.*	*They have back up equipment if one breaks down.*	*No*	*Generally only short term delays, no measurable programmatic impacts.*	*Yes, can slow down production.*
D5. How many employee hours get charged to roadside maintenance activities during the calendar year?	*Approx. 12,000 employee hours on vegetation, 11,500 hours on shoulder type activities, 9,000 hours on ditch cleaning, per year.*	*8300 hours*	*15,624 hours*	*Approx. 150,000 employee hours charged to roadside maintenance activities.*	*About 30,000 hours for vegetation staff.*
D6. In order to determine the relationship between vegetation on the shoulders and pavement life we are considering paving cycles. Please explain your typical paving practices for various road types in your county, for example; overlay cycle, and/or chip seal cycle frequencies.	*Our chip seal life cycle is 5-7 years and our paving life cycle is 10-12 years. This does vary of course but does reflect our overall resurfacing cycle. Since we are just beginning the "No Spray" program, it is too early yet to determine what impacts this will have on our pavement life cycles.*	*99% pre level and oil on a three year cycle depending on use all chip seal.*	*Chip Seal - 1 time/8-10years. Overlay - 1 time/15-20years.*	*Overlays and chip seals are scheduled using a pavement management system, with pavement condition being the basis for decision making. In very general terms, the cycle for chip seal on rural roads is 7-10 years; overlays are 12-15 years on arterials and 20-30 years on residential streets.*	*Chip seal every 4-6 years. Overlays every 8-10 years.*

Roadside Vegetation Management - WSDOT Survey Responses

Shoulder Maintenance	Northwest Region Area 2	Olympic Region Area 3	Northwest Region Area 3	Olympic Region Area 1
A1a. Describe the process for maintaining shoulders along the *secondary* roadways in your area with regards to Herbicide Application.	*Once a year, (approx 1&1/2 days) (1-Lead Tech)(2-Tech 2's), 1 large herbicide truck, 1 backup truck. Herbicide is applied at a width of 2' Round up Pro, Direx 4L, Oust, Water, Telar is horse tail is present.*	*Once a year, area wide. 1 operator, 1 driver & buffer truck driver. Flat bed spray truck with monroe sprayer & raven console 3' width.*	*Frequency: Once/year. Labor: Usually 2-Tech 2's. Equipment: 1,000 gallon truck mounted sprayer. Width: 2-4ft zone 1. Material: Roundup pro, Landmark and Direx 4L.*	*Annually, 6 FTE. Spray truck (2), Attenuator (2), 3ft diurex roundup oust.*
A1b. Describe the process for maintaining shoulders along the *secondary* roadways in your area with regards to Mowing between shoulder and ditch, if any.	*Once a year in some areas, (approx 15 days) 1-Tech 3, 2-Tech 2's(flaggers), Mower with brush arm and pick up truck for traffic control.*	*Once or twice a year depending on location. 1 operator, 2 flaggers. Side arm mower (Alamo, Tiger)*	*Frequency: Usually once/year on about half of our secondaries. The other half aren't mowed at all. Labor: 1-Tech 2or3, Approx. 75% of the time, traffic control is required and would add 2 more Tech 2's.*	*Annually, 1 FTE, 2 weeks.*
A1c. Describe the process for maintaining shoulders along the *secondary* roadways in your area with regards to Pulling Shoulders.	*2-3 day a year on a limited portion of the highway. (Only those spots that are real bad.) Equipment: Grader, Atheys, Sweeper, Guardrail truck(for deliniator replacement), Operators for this equipment. 5-10yard dump trucks, 3-traffic control people, lead tech, VMS Board.*	*Infrequent, once every 5 years. 3 operators, 4-5 truck drivers and traffic control. Athey, Graders, belt loader, trucks.*	*Frequency: Once/3-5 years. Labor: 5-Tech 2's, 1-Tech 3, and 1-Lead Tech. Equipment: Athey belt loader, motor grader, 2-6*13 dump trucks and 1-5 series light truck.*	*Annually, specific areas only 9 FTE, 2 graders, 1 Athey, 4 dumptrucks, 1 month typically.*
A1d. Describe the process for maintaining shoulders along the *secondary* roadways in your area with regards to Cultural Practices.	*None*	*None*	*Very little, if any on our secondary roads.*	*Annually, 3 FTE, 1 month, 1 ton truck, 1 attenuator, Hydroseeder or mulcher or vertablaster.*

Roadside Vegetation Management - WSDOT Survey Responses

Tree and Brush Control	Northwest Region Area 2	Olympic Region Area 3	Northwest Region Area 3	Olympic Region Area 1
B1a. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Mowing/Trimming encroaching vegetation.	*Once a year, (approx 30 days) in selected areas. Brush mowing requires mower (plus operator) 2 flaggers and their pickup.*	*When and where needed, every five years or so. 1 operator, 2 flaggers. Reach mower or brushslayer.*	*Frequency: On an ongoing basis during the growing season. Labor: 1-Tech 3, & 1-Tech 2. Approx 50% of the time, traffic control is required and would add 2-Tech 2's.*	*Annually, Usually this is done early spring through summer. We utilize 2 full correction crew along with up to 6 FTE. We have 2 triple deck mowers, one side arm with brown mower, chipper. Last two years we have rented highlift to trim trees. Attenuator, 1 ton.*
B1b. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Herbicide Application.	*Consists of approx 3 days and 3 employees/day. 2 pickup trucks and 1 portable spray tank using Garlon and Krenite.*	*Once per year where needed, for scotch broom and other nuisance weeds. 1 operator, 1 driver, 1 buffer truck driver. Equipment is same as B1a. Veteran 720 or Vengeance or Garlon4 and Redi-Vert.*	*Frequency: Once a year or as needed. Labor: 2-Tech 2's, approx 25% of the time traffic control is required and would add 2-tech 2's. Equipment: 1,000 gallon truck mounted sprayer. When traffic control is required, it would add a 5 series light truck, or an 8 series attenuator truck. Material: One or all of the following, Garlon, Krenite, and Transline.*	*Annually from June through August. We operate two spray trucks along with two attenuators in the tight areas we may also use a shadow vehicle. We run a crew of 6-8 for this operation. We use garlon or crossbow about 96 oz/acre or Veteran at 128oz/acre.*
B1c. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Hazard Tree Removal.	*Every fall approx 10 days. Boom truck (plus operator), 2 flaggers with their pickup. 2 hand held radios, 3 employees pulling brush, 1 lead tech, 3 chain saws.*	*When and where needed. Labor and equipment is dependant on size of tree and location, 4-6 people.*	*Frequency: As needed. Labor: 4-Tech 2's, or a tree contractor. Equipment, 6 series dump truck, 5 series light truck, chain saws, wedges and etc.*	*Once a year, 4 FTE. They probably will do this 3 weeks out of the year. Chipper, 6 yard dump, 1 ton, attenuator.*
B1d. Describe the process for maintaining encroaching vegetation and hazard trees along your roadways with regards to Cultural Practices.	*None*	*None*	*Mostly as needed in areas that have little or no desirable vegetation after the trees/brush is removed.*	*Annually, Any ground disturbed during growing season will get hydroseeded, during winter it will get straw mulched and in the spring these areas will get fertilized until a healthy strand has emerged. This operation takes 3-FTE's about 2 weeks. 1 ton, attenuator, mulcher or hydroseeder.*

Roadside Vegetation Management - WSDOT Survey Responses

Overall Costs	Northwest Region Area 2	Olympic Region Area 3	Northwest Region Area 3	Olympic Region Area 1
C1. What type of maintenance is performed on your machinery on a regular basis?	*Ask Teff*	*Some machinery is more maintenance intensive than others.*	*Cleaning, greasing/oiling, sharpening and knife/blade replacement.*	*Prior to operating a piece of equipment we do a preoperation greasing and fluid check which usually takes about 1/2 hour. Oil change at the most twice a year.*
C2. How many FTE's do you have dedicated to roadside maintenance annually?	*None of our FTE's are dedicated to a roadside position, we have to use regular road maintenance FTE's to do roadside work.*	*No employees are dedicated solely to roadside maintenance. We have approx. 26 Techs, and about 25% of their time is spent on roadside.*	*We have no FTE's solely dedicated to roadside maintenance. We have several who specialize in it, but they perform other duties as well.*	*We have 6-8 full time FTE in the roadside program. For the last 8 months we have only had 6 but we have two positions we are waiting to fill that typically are not vacant.*
Follow Up Questions				
D1a. In your expert opinion, how many miles/hour or miles/day do you accomplish in performing the following tasks, including clean-up: Blading, Shoulder Mowing, Trimming, Z-1 Herbicide Application?	*Blading: 1 mile, both sides. Shoulder mowing: 5 miles, both sides. Trimming: 1 mile, both sides. Z-1 Herb. App: 40 miles, both sides.*	*Blading: 1 to 2.5 miles, both sides. Shoulder Mowing: 5 to 7.5 miles, both sides. Trimming: with boom mower 2 to 5 miles, with slayer 1/2 mile. Z-1 Herb. App: 15 to 30 miles.*	*Blading: 1 to 3 shoulder miles. Shoulder Mowing: 4 to 5 miles/hour. Trimming: N/A. Z-1 Herb. App: 12 to 14 miles/hour.*	*Blading: 2 to 2.5 Miles. Shoulder Mowing: 5 to 6 Miles. Trimming: 1 Mile. Z-1 Herb. App: 75 to 90 Miles.*
D1b. We have the exact figure of you total Roadside Vegetation Management Budget and also you total Road Miles and of that, Secondary Road Miles so the question is; in your expert opinion, would you say that the money you spend from your budget for secondary road miles is spent in proportion to the amount of total road miles? If not, what percentage would you say you spend on secondary roadways out of your budget?	*Proportionate - 92.5%.*	*All Secondary Roadway - 100%.*	*No Answer*	*Proportionate - 82%*
D1c. In your expert opinion, what percentage of secondary roads get tree and brush control each year?	*12.5% each year.*	*50% selective trim each year.*	*No Answer*	*Herbicide tree and brush control is about 95% coverage each year. Mechanical means are only able to cover about 50% each year.*

APPENDIX C

Clallam County

State Route	RRT/RRQ Identifier	Begin SRMP	End SRMP	Length
101	MAINLINE	184.62	274.65	89.66
101	COPRTANG	249.65	251.32	1.67
110	MAINLINE	0.00	11.10	11.10
110	SPMORA	7.80	10.47	2.67
112	MAINLINE	0.00	61.08	61.29
113	MAINLINE	0.00	9.98	9.98
117	MAINLINE	0.00	1.40	1.40
Total				**177.77**

Island County

State Route	RRT/RRQ Identifier	Begin SRMP	End SRMP	Length
020	MAINLINE	12.88	41.90	28.91
525	MAINLINE	8.48	30.52	22.03
532	MAINLINE	0.00	2.91	2.91
Total				**53.85**

Jefferson County

State Route	RRT/RRQ Identifier	Begin SRMP	End SRMP	Length
019	MAINLINE	0.00	14.09	14.09
020	MAINLINE	0.00	12.56	12.57
101	MAINLINE	144.35	148.03	3.68
101	MAINLINE	151.43	184.62	33.02
101	MAINLINE	274.65	314.63	39.97
104	MAINLINE	0.20	14.67	14.47
116	MAINLINE	0.00	9.83	9.83
Total				**127.63**

Snohomish County

State Route	RRT/RRQ Identifier	Begin SRMP	End SRMP	Length
002	MAINLINE	0.00	40.72	40.67
002	COEVRETT	0.77	1.64	0.87
005	MAINLINE	177.76	217.66	39.89
009	MAINLINE	0.00	37.73	37.64
092	MAINLINE	0.00	8.26	8.25
096	MAINLINE	0.00	6.75	6.75
099	MAINLINE	43.50	55.41	11.90
104	MAINLINE	24.45	28.23	3.70
203	MAINLINE	17.99	24.17	6.19
204	MAINLINE	0.00	2.35	2.38
405	MAINLINE	25.02	30.32	5.30
522	MAINLINE	13.45	24.68	11.23
524	MAINLINE	0.00	14.56	14.68
524	SPCEDRWY	4.64	5.14	0.50
524	SP3RDAVE	0.00	0.70	0.70
525	MAINLINE	0.00	8.47	8.64
525	SPPAINE	5.59	6.45	0.86
526	MAINLINE	0.00	4.52	4.52
527	MAINLINE	1.30	11.92	10.62
528	MAINLINE	0.00	3.46	3.46
529	MAINLINE	0.00	4.92	4.92
529	MAINLINE	3.74	6.69	2.95
529	SPEVERET	0.38	0.58	0.20
530	MAINLINE	16.95	20.79	3.84
530	MAINLINE	20.90	52.75	31.61
531	MAINLINE	0.00	9.88	9.88
532	MAINLINE	2.91	10.09	7.18
Total				**279.33**

Thurston County

State Route	RRT/RRQ Identifier	Begin SRMP	End SRMP	Length
005	MAINLINE	85.51	114.93	29.42
008	MAINLINE	10.54	20.67	10.13
012	MAINLINE	38.84	46.62	7.78
101	MAINLINE	356.92	361.40	4.48
101	MAINLINE	361.52	367.41	5.89
121	MAINLINE	0.00	7.67	7.67
507	MAINLINE	5.44	30.67	25.23
510	MAINLINE	0.01	15.67	13.07
Total				**103.67**

APPENDIX D

APPENDIX E