



KING COUNTY

1200 King County Courthouse
516 Third Avenue
Seattle, WA 98104

Signature Report

September 7, 2016

Motion 14710

Proposed No. 2016-0279.2

Sponsors Lambert

1 A MOTION approving a report on the road right-of-way
2 drainage trunk line inventory in accordance with 2015/2016
3 Biennial Budget Ordinance 17941, Section 77, as amended
4 by Ordinance 18110, Section 30, Proviso P3.

5 WHEREAS, Ordinance 17941, Section 53, Proviso P1 states that one million
6 dollars could not be expended or encumbered until the executive transmits a drainage
7 trunk line inventory report and a motion that approves the report and the motion is passed
8 by the council, and

9 WHEREAS, much of the county's road drainage system is at or nearing the end of
10 its useful life, and

11 WHEREAS, the largest and most costly components of this aging network are the
12 pipe systems and metal culverts twenty-four inches or larger in diameter, and

13 WHEREAS, the water and land resources division of the department of natural
14 resources and the road services division of the department of transportation have worked
15 together with a consultant to conduct an inventory and business risk assessment of the
16 drainage trunk system within major road rights-of-way in unincorporated King County,
17 and

18 WHEREAS, the inventory report provides information on the location and
19 condition of the drainage trunk system within major road rights-of-way in unincorporated

20 King County, estimates accuracy of the resultant database, analyzes data to assess risks of
21 failure and failure impacts, and includes a prioritized program for maintenance that
22 contains a replacement schedule and costs, and

23 WHEREAS, the executive has transmitted to the council the requested report and
24 motion;

25 NOW, THEREFORE, BE IT MOVED by the Council of King County:

26 The report on the road right-of-way drainage trunk line inventory, submitted as
27 Attachment A to this motion, is hereby approved.
28

Motion 14710 was introduced on 6/6/2016 and passed by the Metropolitan King
County Council on 9/6/2016, by the following vote:

Yes: 9 - Mr. von Reichbauer, Mr. Gossett, Ms. Lambert, Mr. Dunn,
Mr. McDermott, Mr. Dembowski, Mr. Upthegrove, Ms. Kohl-Welles
and Ms. Balducci
No: 0
Excused: 0

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON



J. Joseph McDermott, Chair

ATTEST:



Anne Noris, Clerk of the Council

Attachments: A. Road Right-of-Way Drainage Trunk Line Inventory, dated August 2016

Road Right-of-Way Drainage Trunk Line Inventory

Prepared in accordance with
Ordinance 17941, Section 77, as amended by Ordinance 18110, Section 30, Proviso P3

August 2016



King County

Department of Natural Resources and Parks
Water and Land Resources Division
and
Department of Transportation
Road Services Division

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Introduction

Ordinance 17941, Section 77, as amended by Ordinance 18110, Section 30, Proviso P3 requires the King County Executive to transmit a report to the Council that inventories and assesses the drainage trunk line within major road rights-of-way in unincorporated King County.

Specifically, the Ordinance requires the report to include:

- The location and condition of the drainage trunk system within major road rights-of-way in unincorporated King County;
- The estimated accuracy of the resultant database;
- An analysis of the data to assess risks of failure and failure impacts; and
- A prioritized program for maintenance, including replacement schedule and costs.

This report addresses each requirement under a separate heading that corresponds to the particular requirement.

Executive Summary

The Water and Land Resources (WLR) Division of the Department of Natural Resources and Parks and the Road Services Division (Roads) of the Department of Transportation collaborated on the development of this report. The two agencies hired HDR, Inc. as the prime consultant to conduct an inventory and business risk assessment of the drainage trunk system within major road rights-of-way.

Much of the County's road drainage system is at or nearing the end of its useful life. Since the largest and most costly components of this aging network are the pipe systems and metal culverts 24 inches or larger in diameter, that is where the consultant focused the inventory and assessment. Below are key findings from the consultant.

- There are just under 6,000 drainage assets ≥ 24 " in the road rights-of-way in unincorporated King County.
- About 4 percent of these drainage assets are projected to be in critically poor condition, at imminent threat of failure.
- For the next 10 years, costs of ownership range from \$335 million to \$500 million, depending on level of service provided.
- The lowest level of service evaluated (\$335 million over 10 years) assumes that all failing assets are replaced as they fail. If this level of service is not funded, then the response to failing assets will be less replacement and more road or lane closures or posting of warning signs to manage and minimize risk within available budget.

For the approximately 900 assets (15 percent) that have been mapped and inspected, the consultant identified \$25.7 million in on-going and one-time actions over the next 10 years to mitigate risk. This includes \$6.5 million in immediate preservation actions for 33 mapped and inspected assets verified to be at critical risk.

The results of this study are being used to inform the analysis for the development of the surface water management fee and the 2017/2018 budget proposals for the two participating agencies, WLR and Roads. The consultant's report can be found online at http://your.kingcounty.gov/dnrp/library/water-and-land/stormwater/KC_ROW_Drainage_Assessment_Final_Report.pdf.

Report Requirements

The location and condition of the drainage trunk system within major road rights-of-way in unincorporated King County

Historically when road drainage systems were built, they were not necessarily mapped or recorded. This meant WLR and Roads could not assume the existing inventory was complete. In addition, the condition of the drainage assets that were mapped was not assessed and updated on a regular basis. To undertake the analysis for this report, WLR and Roads directed the consultant to develop different data sets according to three criteria – whether the assets were known, whether they were mapped, and whether their condition was verified by onsite inspection.

The analysis is built on the following data sets of assets:

1. Mapped and inspected to verify condition: Age and material suggested these assets could be of concern, so the consultant inspected them to verify condition (897 assets);
2. Mapped, condition not verified: These assets were not inspected because either they were inaccessible (123 assets) or age and material suggested they were not of concern in the near term (3,315 assets); for purposes of analysis, the asset conditions were presumed based on age and material rather than inspection;
3. Unknown so not mapped and not inspected: Actual location and condition of these assets were not known but were extrapolated using a Geographic Information System (GIS) model that looked at areas of similar zoning and ratios of drainage assets to roadway length (extrapolation model projected approximately 1,627 assets).

To locate and assess drainage assets within major road rights-of-way, the consultant divided the Unincorporated County into 14 areas as shown in Figure 1. Assets in each data set and area were rated critical, high, medium, and low for risk exposure according to the verified, presumed, or extrapolated condition assessment. Critical assets were those considered at imminent threat of failure.

Table 1 shows for each data set the quantity of assets, percent of total drainage assets, number and percent of assets rated critical, and the confidence level in the condition ratings. The condition rating used to determine the confidence level considers the probability of the asset failing.

Figure 1. Map areas used to locate drainage assets in major road rights-of-way.

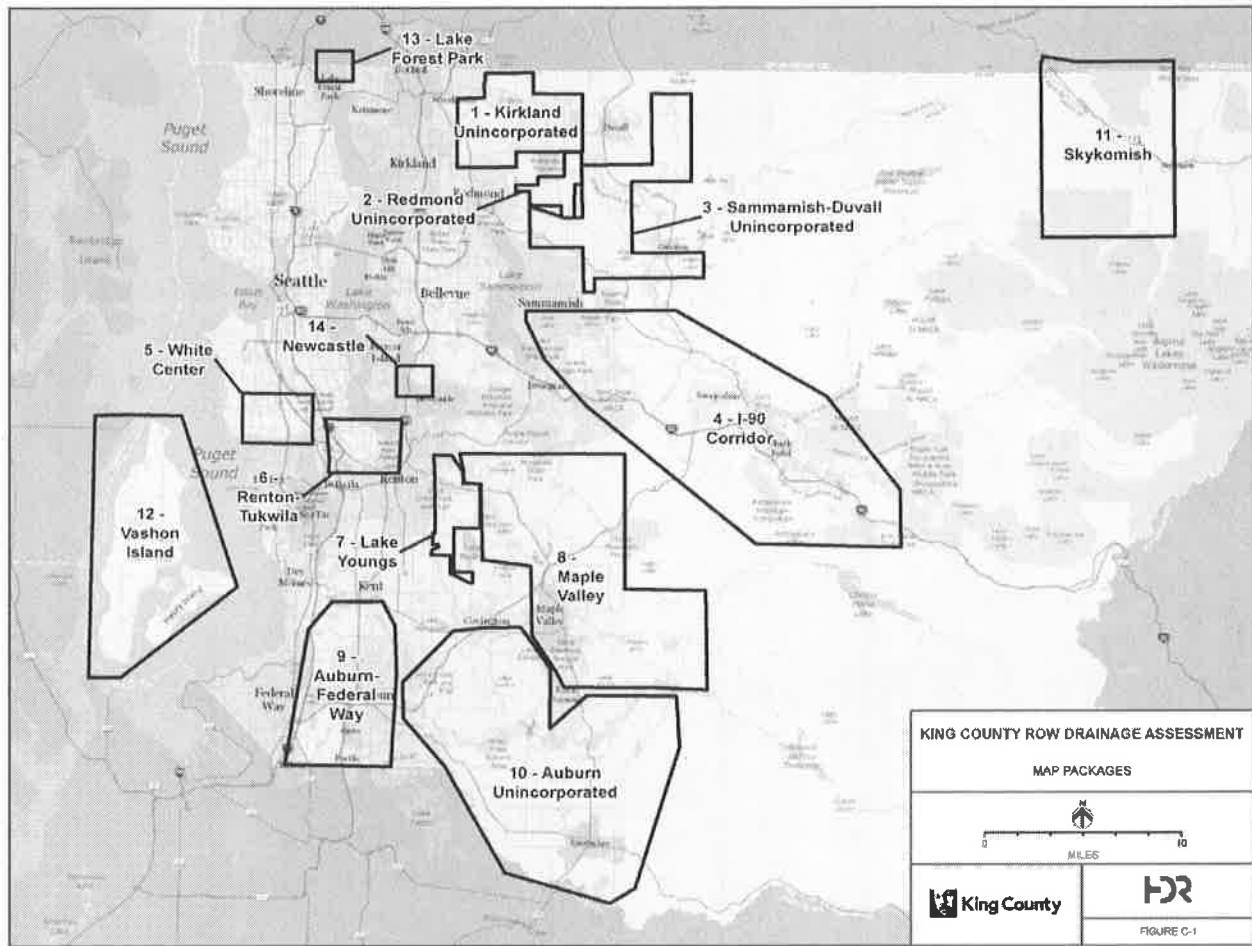


Table 1. Summary of assets by data set.

Data Set	# of Assets in Data Set	% of Total Assets	# of Critical Assets	% of Critical Assets in Data Set	Confidence Level in Condition Rating
Mapped assets, inspected to verify condition	897	~15%	33	~3.7%	71%
Mapped assets, not inspected, condition not verified	3,438	~58%	104	~3%	37%
Unknown and unmapped assets, condition not known	1,627	~27%	102	~6%	6%
TOTAL:	5,962	100%	239	~4%	

The estimated accuracy of resultant database

The estimated accuracy of the database can be measured by the confidence level in the condition ratings for the drainage assets. As shown in Table 1, the confidence level in the condition ratings for the mapped assets that were not inspected by the consultant is roughly half (37 percent) that of those assets the consultant did inspect (71 percent). The confidence level in the condition rating for the extrapolated assets that have not been mapped or inspected is very low (6 percent). This makes sense because field verifying an asset's condition provides greater accuracy than extrapolating an asset's existence, location, and condition through assumptions and GIS projections.

An analysis of the data to assess risks of failure and failure impacts

To assess risks of failure and failure impacts in both the near term and the long term, the consultant projected costs of ownership and business risk exposure for four different levels of service over 10 years and 100 years, using all three data sets of drainage assets ≥ 24 " in the major road rights-of-way in unincorporated King County. The consultant found the highest level of service costs the most to manage in the 10-year timeframe but has the lowest business risk exposure and costs the least over the 100-year timeframe; under this scenario, assets are rehabilitated or replaced before they are expected to fail, which increases the near-term management costs but decreases the long-term costs associated with potential asset collapse, such as for property damage, impacts to adjacent landowners, and possible road closures.

Table 2 below presents the costs of ownership and business risk exposure by levels of service. The table defines each level of service and its respective backlog of uncompleted actions, provides ownership costs over the next 100 years and the next 10 years, and states the 100-year maximum business risk exposure. The business risk exposure runs on a scale of 0 to 100, where 0 is the lowest risk exposure and 100 is the highest.

As Table 2 shows, over 10 years, the lowest level of service (D) costs less than the highest level of service (A); on the other hand, D has a very high maximum risk exposure (81 out of 100). In addition, level of service A costs less over the 100-year timeframe than level of service D when computed in net present value. Level of service B is not included in Table 2 because assumptions upon which it was built treated the backlog of actions inconsistently from the other levels of service, resulting in skewed preservation costs that could not be fairly compared to those of the other levels of service.

Table 2. Costs of ownership by levels of service.

ID	Level of Service	Backlog	Ownership Costs over Next 100 Years, in Net Present Value	100-Year Maximum Business Risk Exposure	Ownership Costs over Next 10 Years, in Real Costs
A	Manage all assets to lowest risk tolerance	Eliminated in first year, none created in future	\$750 M	58	\$500 M
C	Manage critical risk assets	Slowly eliminated, more added over time	\$815 M	66	\$348 M
D	Run assets to failure, respond to emergencies	Grows over time	\$829 M	81	\$335 M

A prioritized program for maintenance, including replacement schedule and costs

In addition to projecting costs and risk levels for both the mapped and extrapolated drainage assets in the major road rights-of-way, the consultant also looked at immediate risk mitigation actions for assets known to be in critical condition. To recommend immediate actions for the mapped assets where the condition was verified through inspection, the consultant estimated costs for one-time preservation actions and ongoing operations. To reduce the likelihood of failures, the focus is on replacing assets in the most critical condition, monitoring assets nearing critical condition, conducting essential maintenance, and expanding what is known about the inventory and condition of the remaining assets.

The recommendations are shown in Table 3 and include only the 897 mapped and inspected assets. Not included are the mapped assets where the condition has not yet been verified and the unknown assets that are unmapped and condition unknown. Exhibit A summarizes mapped and inspected assets by verified condition and recommended mitigation action for each map area.

Table 3. Cost estimate for near-term risk mitigation actions for mapped and inspected assets.

Action	Cost Estimate	Cost Basis
On-going mapping, inventory, and condition assessment	\$2,000,000	10-year cost
Enhanced condition assessment ^a	\$900,000	10-year cost
Routine inspection ^b	\$140,000	10-year cost
Triggered inspection ^c	\$60,000	10-year cost
Maintenance cleaning ^d	\$340,000	10-year cost
Maintenance repair ^e	\$1,720,000	10-year cost
Preservation rehabilitation ^f	\$700,000	one-time cost
Preservation replacement ^g	\$19,880,000	one-time cost
Total Cost	\$25,740,000	

Assumptions used to build the prioritized maintenance program in Table 3:

- a. Enhanced condition assessment for 140 assets every 2 years, 116 assets every 5 years, and 242 assets every 10 years; assigned based on calculated business risk exposure scores.
- b. Routine inspection of 25% of assets each year.
- c. Triggered inspection of 10% of assets each year.
- d. Cleaning of 30% of manhole and catch basin assets and 10% of pipe and culvert assets each year.
- e. Repair of 2% of assets each year.
- f. Rehabilitation of 23 catch basins and 21 pipes with a total length of 1500 feet.
- g. Replacement of 39 culverts, 23 catch basins, 21 pipes with a total length of 1500 feet, and 1 manhole. Includes cost estimates for the NE Union Hill Road @ 225th Ave NE box culvert (\$1.35 M) and S 96th St stormwater pipes projects (\$1.48 M).

Exhibit A

Summary of mapped and inspected assets by condition and recommended mitigation action in each map area

Map Area Risk Exposure	Count of Assets	Percent of System Total
Map Area 1: Kirkland Unincorporated	58	6%
Critical	1	0%
Immediate Preservation	1	0%
High	38	4%
Preservation Rehabilitation	19	2%
Preservation Replacement	5	1%
Enhanced Condition Assessment	14	2%
Medium	9	1%
Preservation Rehabilitation	1	0%
Enhanced Condition Assessment	6	1%
Status Quo	2	0%
Low	10	1%
Status Quo	10	1%
Map Area 2: Redmond Unincorporated	183	20%
Critical	2	0%
Enhanced Condition Assessment	2	0%
High	31	3%
Preservation Rehabilitation	5	1%
Preservation Replacement	2	0%
Enhanced Condition Assessment	24	3%
Medium	60	7%
Enhanced Condition Assessment	6	1%
Status Quo	54	6%
Low	90	10%
Status Quo	90	10%

Map Area Risk Exposure	Count of Assets	Percent of System Total
Map Area 3: Sammamish-Duval Unincorporated	73	80%
Critical	7	1%
Immediate Preservation	5	1%
Enhanced Condition Assessment	2	0%
High	34	4%
Preservation Rehabilitation	11	1%
Preservation Replacement	6	1%
Enhanced Condition Assessment	17	2%
Medium	12	1%
Enhanced Condition Assessment	6	1%
Status Quo	6	1%
Low	20	2%
Status Quo	20	2%
Map Area 4: I-90 Corridor	82	9%
Critical	3	0%
Immediate Preservation	3	0%
High	37	4%
Preservation Rehabilitation	17	2%
Preservation Replacement	5	1%
Enhanced Condition Assessment	15	2%
Medium	17	2%
Enhanced Condition Assessment	6	1%
Status Quo	11	1%
Low	25	3%
Status Quo	25	3%
Map Area 5: White Center	41	5%
Critical	1	0%
Immediate Preservation	1	0%
High	17	2%

Map Area Risk Exposure	Count of Assets	Percent of System Total
Preservation Rehabilitation	10	1%
Preservation Replacement	2	0%
Enhanced Condition Assessment	5	1%
Medium	12	1%
Enhanced Condition Assessment	6	1%
Status Quo	6	1%
Low	11	1%
Status Quo	11	1%
Map Area 6: Renton-Tukwila	58	6%
Critical	2	0%
Immediate Preservation	2	0%
High	26	3%
Preservation Rehabilitation	14	2%
Preservation Replacement	5	1%
Enhanced Condition Assessment	7	1%
Medium	22	2%
Preservation Rehabilitation	4	0%
Enhanced Condition Assessment	5	1%
Status Quo	13	1%
Low	8	1%
Status Quo	8	1%
Map Area 7: Lake Youngs	100	11%
Critical	7	1%
Immediate Preservation	5	1%
Enhanced Condition Assessment	2	0%
High	35	4%
Preservation Rehabilitation	8	1%
Preservation Replacement	5	1%
Enhanced Condition Assessment	22	2%
Medium	25	3%

Map Area Risk Exposure	Count of Assets	Percent of System Total
Preservation Rehabilitation	2	0%
Enhanced Condition Assessment	6	1%
Status Quo	17	2%
Low	33	4%
Status Quo	33	4%
Map Area 8: Maple Valley	117	13%
Critical	4	0%
Immediate Preservation	4	0%
High	40	4%
Preservation Rehabilitation	14	2%
Preservation Replacement	9	1%
Enhanced Condition Assessment	17	2%
Medium	34	4%
Enhanced Condition Assessment	11	1%
Status Quo	23	3%
Low	39	4%
Status Quo	39	4%
Map Area 9: Auburn-Federal Way	66	7%
Critical	1	0%
Immediate Preservation	1	0%
High	15	2%
Preservation Rehabilitation	2	0%
Enhanced Condition Assessment	13	1%
Medium	29	3%
Enhanced Condition Assessment	4	0%
Status Quo	25	3%
Low	21	2%
Status Quo	21	2%
Map Area 10: Auburn Unincorporated	74	8%
High	37	4%

Map Area Risk Exposure	Count of Assets	Percent of System Total
Preservation Rehabilitation	15	2%
Preservation Replacement	9	1%
Enhanced Condition Assessment	13	1%
Medium	31	3%
Preservation Rehabilitation	1	0%
Enhanced Condition Assessment	9	1%
Status Quo	21	2%
Low	6	1%
Status Quo	6	1%
Map Area 11: Skykomish	7	1%
Critical	2	0%
Immediate Preservation	2	0%
High	3	0%
Preservation Rehabilitation	1	0%
Enhanced Condition Assessment	2	0%
Medium	2	0%
Status Quo	2	0%
Map Area 12: Vashon Island	33	4%
Critical	3	0%
Immediate Preservation	3	0%
High	13	1%
Preservation Rehabilitation	6	1%
Preservation Replacement	4	0%
Enhanced Condition Assessment	3	0%
Medium	9	1%
Enhanced Condition Assessment	3	0%
Status Quo	6	1%
Low	8	1%
Status Quo	8	1%
Map Area 13: Lake Forest Park	1	0%

Map Area Risk Exposure	Count of Assets	Percent of System Total
High	1	0%
Preservation Rehabilitation	1	0%
Map Area 14: New Castle	4	0%
High	2	0%
Preservation Rehabilitation	1	0%
Preservation Replacement	1	0%
Medium	2	0%
Preservation Rehabilitation	2	0%
Grand Total	897	100%