

Conductor Replacement Strategy

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- Sampling / Tests

Introduction

- Transmission system comprised of 18,000 km of overhead lines Includes 69kV, 138 kV, 230 kV and 500 kV voltage levels.
- Sampling and test strategy.
- Conductor replacement Strategy.

Previous work

- EPRI – Parameters that influence the aging and degradation of the overhead conductor
- Ontario Hydro – Conductor aging and estimating the remaining useful life of the overhead conductor.
- Ontario Hydro demonstrated that single layer cores have shorter life (Approximately 12 years shorter life than multiple core conductor).

Previous work

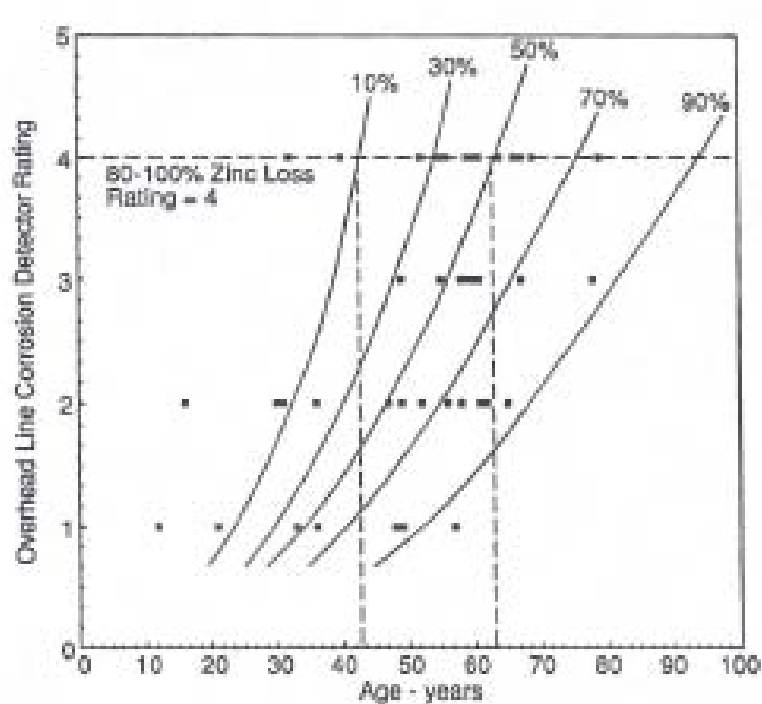
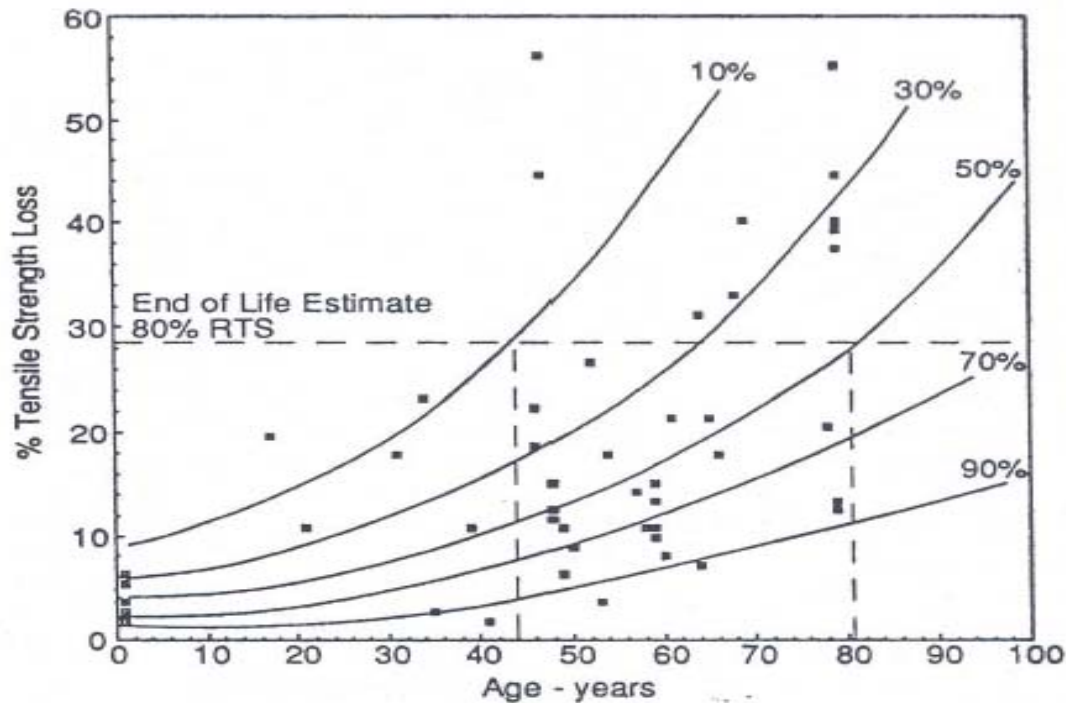


Figure 4-4 - Corrosion detector ratings plotted versus age for 77 ACSR conductor samples

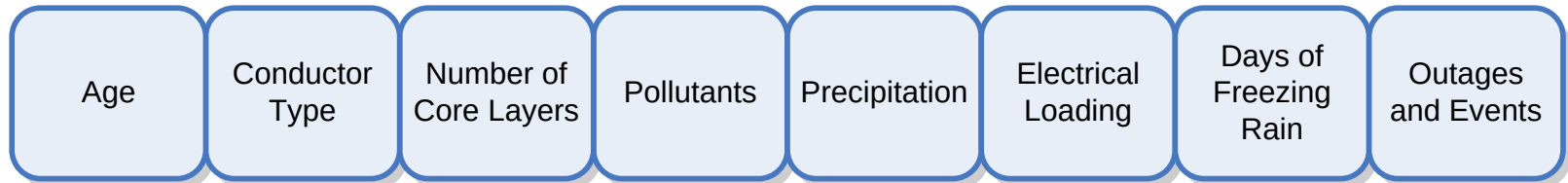
Previous work



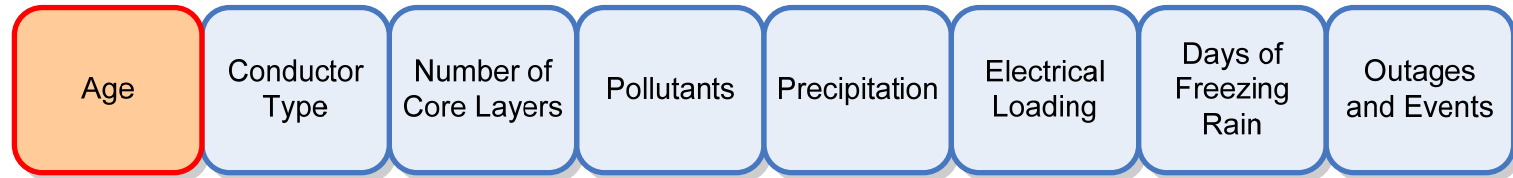
Tensile strength loss plotted versus age for 50 ACSR conductor samples

Degradation Parameters

The following parameters were included to prioritise the conductors.

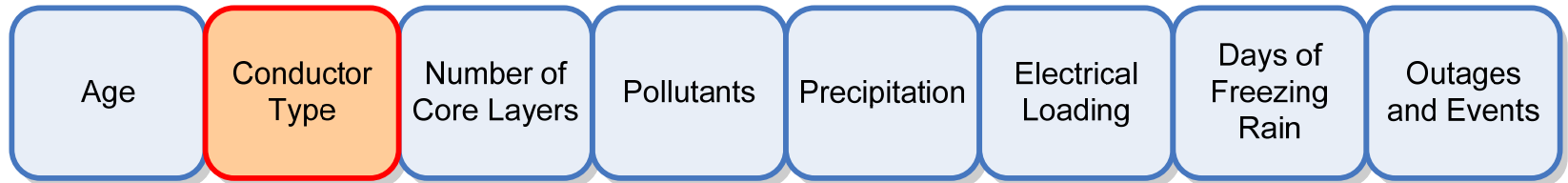


Degradation Parameters



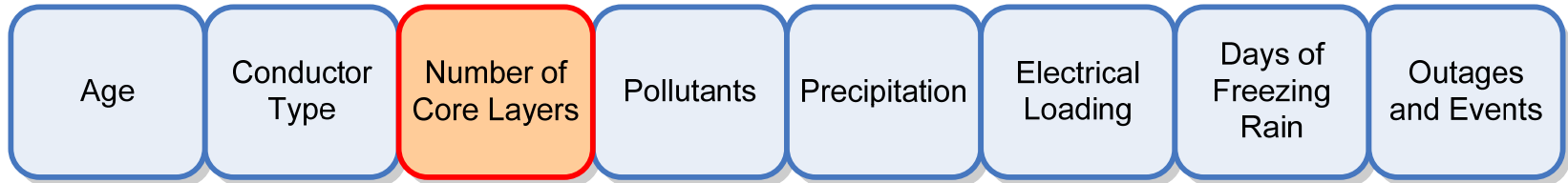
- The conductors on the BCTC system vary from a few years to 86 years of age.

Degradation Parameters



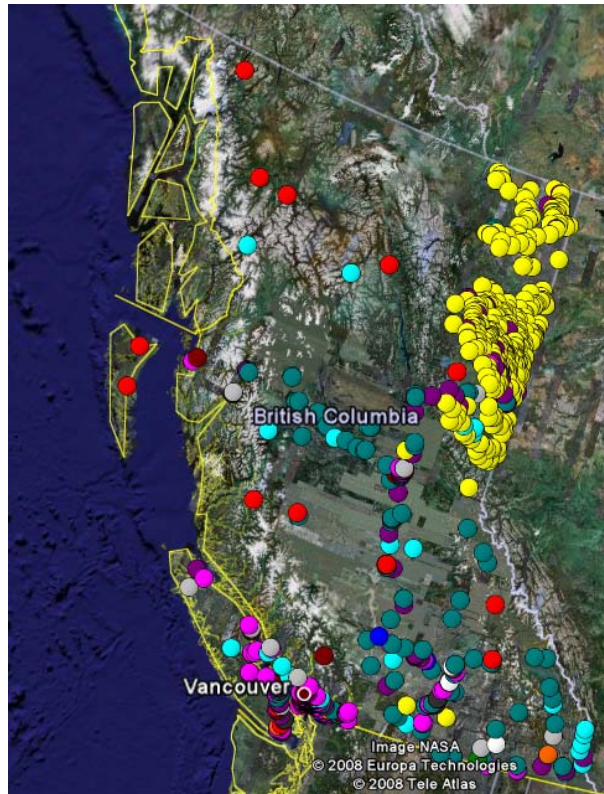
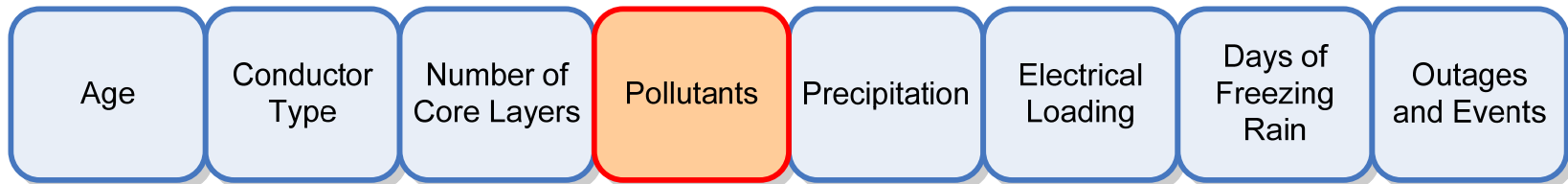
- The Focus is only on ACSR Overhead conductor.
- The conductor types were identified.

Degradation Parameters



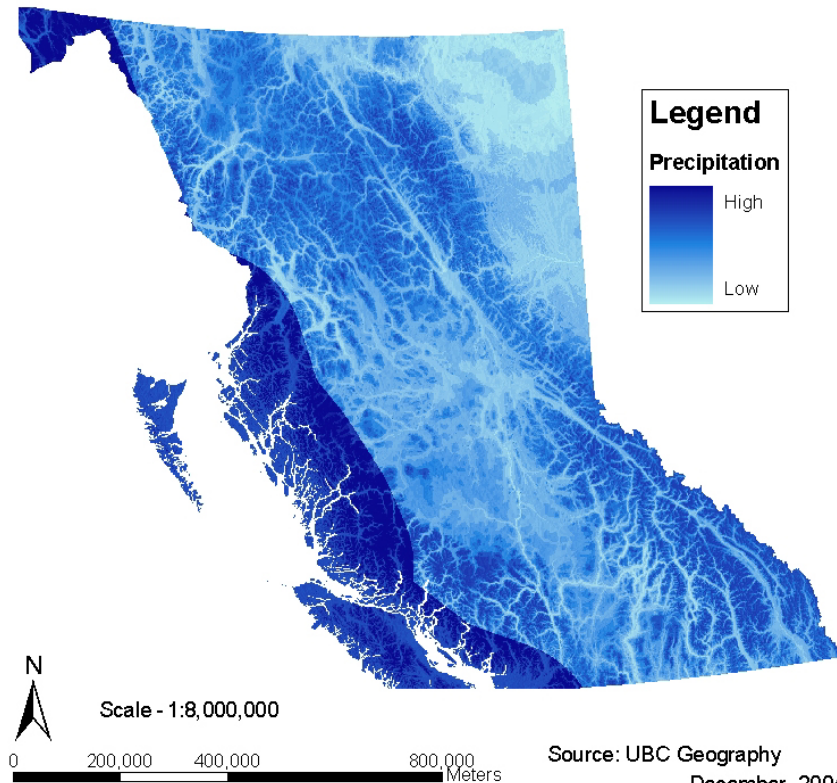
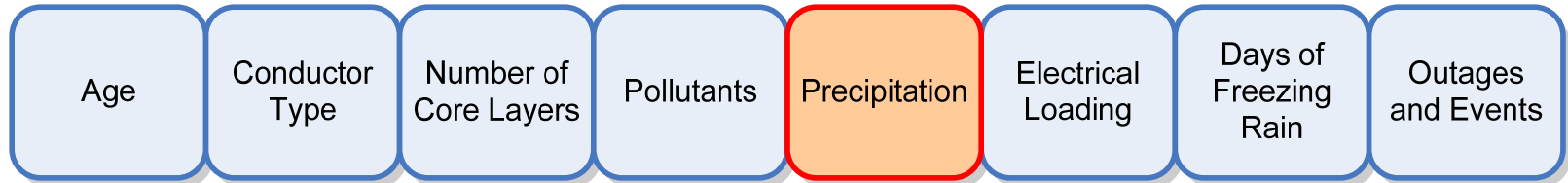
- The ACSR conductor types that have a single layer which exist in the BCTC system are: Merlin, Penguin, Quail, Raven, and Sparrow.
- Single core conductors were identified on 31 circuits operated at 138kV or 69kV.

Degradation Parameters



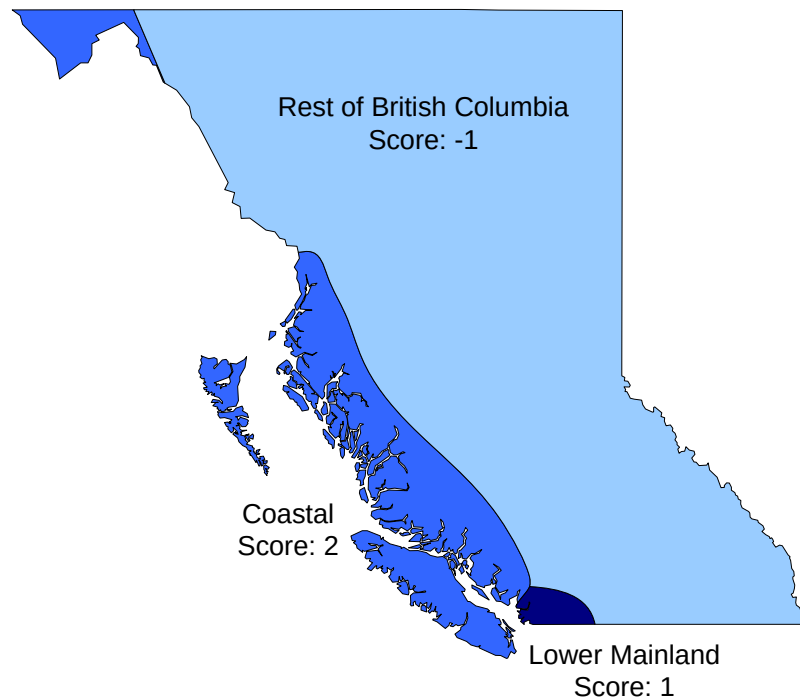
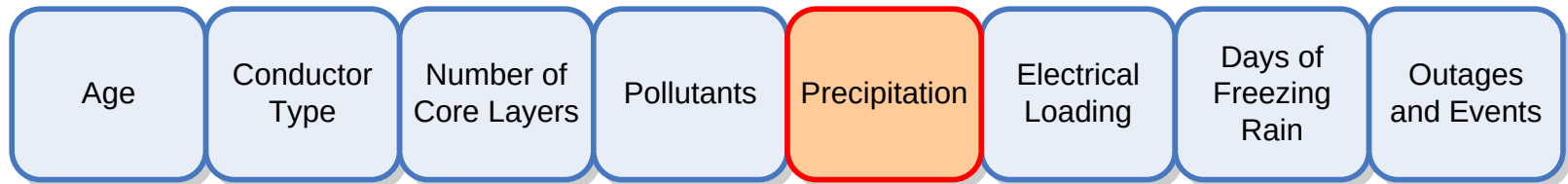
- Distance from these point sources to BCTC Transmission Circuits.
- A database that contains the chemical composition and magnitude of emission from each source.
- The following Chemical Compounds were considered:
 - Sulfur Dioxide (SO₂)
 - Nitrogen Dioxide (NO₂)
 - Particulate Matter

Degradation Parameters

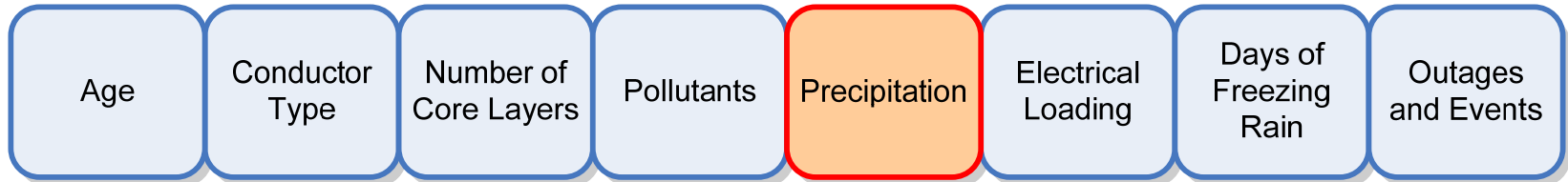


Source: UBC Geography
December, 2004

Degradation Parameters

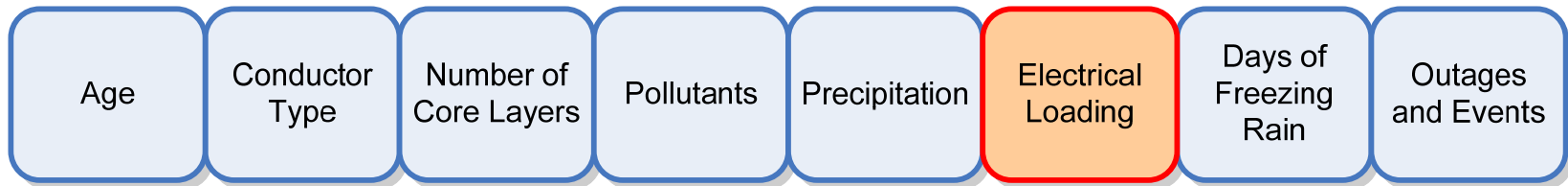


Degradation Parameters



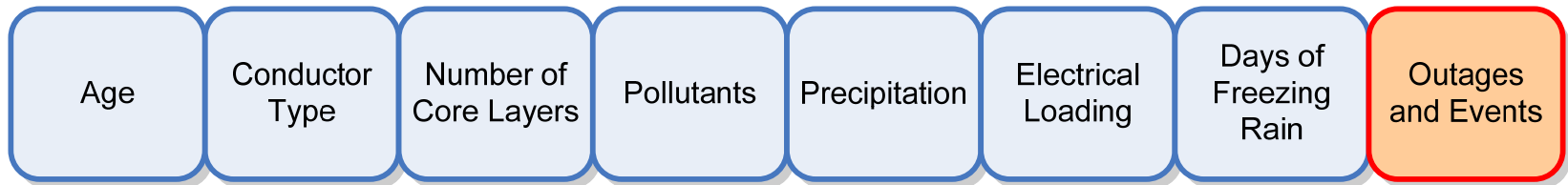
- Circuits are grouped by geographical areas such as FVT, MET, SVI, etc.
- The area rank is calculated by overlapping areas with precipitation map (Scale of 0-4).

Degradation Parameters



- The maximum rating of each circuit.
- The Actual rating of each circuit.

Degradation Parameters



To capture how many incidents each line had experienced which could potentially lead to conductor damage the following were looked at:

- Conductor defects report from STARR
- Lightning events from CROW
- Weather related outages from CROW

Conductor Ranking

Get Top Circuits

Degradation Factors Weighting

Loading	Pollution	Precipitation	Icing Days	Defects	Lighting	Weather
0.5	4	1	0.5	0.5	0.5	0.5

System Importance Factors

Radial	Operations Level	Criticality level
1	0.5	0.5

no. of Circuits
15

Year
2008

Conductor Ranking

Circuit	Section		Conductor			
	From	To	Conductor	Conductor Type	Code Name	no. of core strands
1L112	NEX Tap	IPH Tap	336.4 MCM LINNET ACSR	ACSR	LINNET	7
1L31	WFR 132	GIB 132A	135 mm ACSR PARTRIDGE	ACSR	PARTRIDGE	7
60L281	ELK 66	0/16	1-3/0 PIGEON ACSR	ACSR	PIGEON	1
60L290	ELK	WIN	1/0 ACSR RAVEN	ACSR	RAVEN	1
1L105	DMR	PAL	397.5 MCM IBIS ACSR	ACSR	IBIS	7
1L114	DMR	PAL	397.5 MCM IBIS ACSR	ACSR	IBIS	7
2L1	FCN 230	RBW 230-1	403 mm ACSR CONDOR	ACSR	CONDOR	7

Conductor Ranking

Demographics					
In Service Date	Age	Conductor Length (km)	Region	Area	Radial
1955	53	15.96	TVI	SVI	Y
1955	53	62.39	LMT	NSP/SSC	N
1922	86	62.28	SIT	CKT	N
1938	70	3.8	SIT	CKT	N
1947	61	20.81	TVI	SVI	N
1947	61	20.8	TVI	SVI	N
1948	60	137.61	LMT	NSP	N

Conductor Ranking

Area Scores			Rating and Loading (A)		Ranking	
Coastal	LM	Other	Winter (A)	AVG Loading	Operating Level	Criticality Rating
1			730.00	214.34	4	A
1	1		915.00	95.67	4	A
		1	822.00	57.37	4	B/C
		1	270.00	23.20	4	C
1			805.00	191.37	4	B
1			805.00	198.28	4	B
1	1		884.00	227.38	1	B/C

Conductor Ranking

Air Pollutants					Defects and Events		
Distance from Industrial	SO2	NO2	Particulate Matter	Icing Days	Defects Index	Lightning	Adverse Weather
335.40	2715.00	301.74	407.42	0.00	3	1	1
658.98	692.44	1261.67	453.30	0.00	3	5	7
653.04		140.58		0.00	0	10	22
860.22		140.58		0.00	0	4	2
83.99	224.52	280.69	35.45	0.00	7	0	3
103.93	224.52	280.69	35.45	0.00	0	0	1
				1.00	7	3	9

Conductor Ranking

Radial Rank	Icing Rank	Length rank	core strands rank	Area rank	Age rank	Loading rank	Operating Level rank
1.00	0.00	0.884020057	0	0.75	0.62	0.29	0.25
0.00	0.00	0.546617252	0	1	0.62	0.10	0.25
0.00	0.00	0.547416612	1	0	1.00	0.07	0.25
0.00	0.00	0.972385728	1	0	0.81	0.09	0.25
0.00	0.00	0.848775525	0	0.75	0.71	0.24	0.25
0.00	0.00	0.848848194	0	0.75	0.71	0.25	0.25
0.00	0.22	0	0	1	0.70	0.26	1

Conductor Ranking

	0	1	0.66	0.33				
Criticality Rating rank	Polution rank	SO2 Index	NO2 Index	Particulate Matter Index	Defects rank	Lightning rank	Weather rank	ranking
0.8	0.72	1.00	0.21	0.90	0.375	0.047619048	0.043478261	2.927
0.8	0.58	0.26	0.88	1.00	0.375	0.238095238	0.304347826	2.079
0.2	0.03	0.00	0.10	0.00	0	0.476190476	0.956521739	1.657
0	0.03	0.00	0.10	0.00	0	0.19047619	0.086956522	1.608
0.4	0.12	0.08	0.20	0.08	0.875	0	0.130434783	1.507
0.4	0.12	0.08	0.20	0.08	0	0	0.043478261	1.488
0.2	0.00	0.00	0.00	0.00	0.875	0.142857143	0.391304348	1.449

Conductor Ranking



Sampling / Test

- Many samples have been taken and tested in the lab.
- Research to explore the current non destructive test devices.
- Develop a new or use one of the existing technologies and modify it to meet our needs.

Questions?