Publication 657A
October 5, 1992

METRO LIBRARY
Municipality of Metropolitan Seattle
821 Second Avenue
Seattle, WA 98104

BIOFILTRATION SWALE PERFORMANCE, RECOMMENDATIONS, AND DESIGN CONSIDERATIONS

Primary Water Quality Data (Addendum to Publication 657)

Funded in part by the Washington Department of Ecology's Centennial Clean Water Fund
Grant Tax No. 89-136

Municipality of Metropolitan Seattle
Water Pollution Control Department
821 Second Avenue
Seattle, Washington 98104-1598

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/23/91

Project Name: BIO/Metro/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A005129
Client Identification	000 7-15-91 / a
Sampling Date	7/15/91

PARAMETER	RESULT	Q	D.L.
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	0.64		0.01
Bioavailable Phosphorus	0.088		0.005
Ortho-Phosphate (mg/l)	0.043		0.005
Total Phosphorus (mg/l)	0.33		0.005
Total Suspended Solids (mg/l)	51.		1.0
Turbidity (NTU)	19.		0.01
Total Metals			
Aluminum (mg/l)	1.2		0.01
Copper (mg/l)	0.031		0.002
Iron (mg/l)	2.5		0.01
Lead (mg/l)	0.03		0.02
Zinc (mg/l)	0.25		0.002

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/23/91

Project Name: BIO/Metro/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A005130
Client Identification	200 7-15-91 / a
Sampling Date	7/15/91

PARAMETER	RESULT	Q	D.L.
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	2.1		0.01
Bioavailable Phosphorus	0.070		0.005
Ortho-Phosphate (mg/l)	0.043		0.005
Total Phosphorus (mg/l)	0.25		0.005
Total Suspended Solids (mg/l)	12.		1.0
Turbidity (NTU)	6.8		0.01
Total Metals			
Aluminum (mg/l)	0.40		0.01
Copper (mg/l)	0.012		0.002
Iron (mg/l)	0.57		0.01
Lead (mg/l)	0.02		0.02
Zinc (mg/l)	0.060		0.002

Reported by: Kathy Fugiel

AMTEST

ANALYSIS REPORT

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/ 6/91

Project Name: BIO/Metro/MLT91
Date Sampled: 7/15/91

PARAMETER	UNITS	RESULT
91-A005131		
Client ID: 000 7-15-91 / b		
DISSOLVED METALS		
Aluminum	mg/l	0.19
Copper	mg/l	0.021
Iron	mg/l	0.29
Lead	mg/l	< 0.02
Zinc	mg/l	0.15
91-A005132		
Client ID: 200 7-15-91 / b		
DISSOLVED METALS		
Aluminum	mg/l	0.15
Copper	mg/l	0.021
Iron	mg/l	0.33
Lead	mg/l	< 0.02
Zinc	mg/l	0.072

Reported by: Kathy Fugiel

AMTEST

CLIENT: Metro Water Resources

REPORT TO: Louise Kolzer

DATE RECEIVED: 07/25/91
DATE REPORTED: 08/23/91
PROJECT NAME: BIO/Metro/MLT91

QUALITY CONTROL

PARAMETER	Detection Limit	EPA Method Number
Turbidity (NTU)	0.01	180.1
Total Suspended Solids (mg/L)	1.0	160.2
Nitrate + Nitrite Nitrogen (mg/L)	0.010	353.2
Soluble Reactive Phosphorus (mg/L)	0.005	365.2
Soluble Total Phosphorus (mg/L)	0.005	365.2
Bioavailable Phosphorus (mg/L)	0.005	365.2*
Fecal Coliforms (CFU/100 mls)	2.5	9222B
Oil & Grease (mg/L)	1.0	413.2
Total Petroleum Hydrocarbons (mg/L)	1.0	418.1
Dissolved & Total Zinc (mg/L)	0.002	200.7
Dissolved & Total Copper (mg/L)	0.002	200.7
Dissolved & Total Lead (mg/L)	0.001	239.2
Dissolved & Total Aluminum (mg/L)	0.01	200.7
Dissolved & Total Iron (mg/L)	0.01	200.7

*Modified using Metro Method.

REPORTED BY Kathy Fugiel

KF/pb

METHODOLOGY REPORT

AM TEST IDENTIFICATION NUMBER 91-A005129
CLIENT ID 000 7-15-91 / a

ANALYTE	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Nitrate + Nitrite	353.2	EPA	0.010	7/31/91
Bioavailable Phosphorus				8/21/91
Ortho-Phosphate	365.2	EPA	0.005	7/26/91
Total Phosphorus	365.2	EPA	0.005	7/26/91
Total Suspended Solids	160.2	EPA	1.0	7/31/91
Turbidity	180.1	EPA	0.01	7/30/91
Aluminum	200.7	EPA	0.01	8/ 1/91
Copper	200.7	EPA	0.002	8/ 1/91
Iron	200.7	EPA	0.01	8/ 1/91
Lead	200.7	EPA	0.02	8/ 1/91
Zinc	200.7	EPA	0.002	8/ 1/91
Acid Dig. (Tot Metals)	3010	EPA		7/29/91

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/23/91

Project Name: BIO/Metro/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A005134
Client Identification	000 7-20-91 / a
Sampling Date	7/20/91

PARAMETER	RESULT	Q	D.L.
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	0.21		0.01
Total Oil and Grease (mg/l)	2.2		1.0
Total Petroleum Hydrocarbon (mg/l)	2.2		1.0
Bioavailable Phosphorus	0.071		0.005
Ortho-Phosphate (mg/l)	0.017		0.005
Total Phosphorus (mg/l)	0.092		0.005
Total Suspended Solids (mg/l)	18.		1.0
Turbidity (NTU)	5.7		0.01
Total Metals			
Aluminum (mg/l)	0.60		0.01
Copper (mg/l)	0.002		0.002
Iron (mg/l)	0.92		0.01
Lead (mg/l)	0.02		0.02
Zinc (mg/l)	0.068		0.002

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/23/91

Project Name: BIO/Metro/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A005135
Client Identification	200 7-20-91 / a
Sampling Date	7/20/91

PARAMETER	RESULT	Q	D.L.
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	0.21		0.01
Total Oil and Grease (mg/l)	< 1		1.0
Total Petroleum Hydrocarbon (mg/l)	< 1		1.0
Bioavailable Phosphorus	0.029		0.005
Ortho-Phosphate (mg/l)	0.014		0.005
Total Phosphorus (mg/l)	0.070		0.005
Total Suspended Solids (mg/l)	2.0		1.0
Turbidity (NTU)	0.78		0.01
Total Metals			
Aluminum (mg/l)	0.18		0.01
Copper (mg/l)	< 0.002		0.002
Iron (mg/l)	0.21		0.01
Lead (mg/l)	< 0.02		0.02
Zinc (mg/l)	0.032		0.002

Reported by: Kathy Fugiel

AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

ANALYSIS REPORT

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/ 6/91

Project Name: BIO/Metro/MLT91
Date Sampled: 7/20/91

PARAMETER	UNITS	RESULT
91-A005136		
Client ID: 000 7-20-91 / b		
DISSOLVED METALS		
Aluminum	mg/l	< 0.01
Copper	mg/l	0.002
Iron	mg/l	< 0.01
Lead	mg/l	< 0.02
Zinc	mg/l	0.048
91-A005137		
Client ID: 200 7-20-91 / b		
DISSOLVED METALS		
Aluminum	mg/l	< 0.01
Copper	mg/l	< 0.002
Iron	mg/l	< 0.01
Lead	mg/l	< 0.02
Zinc	mg/l	0.010

Reported by: Kathy Fugiel

AMTEST

CLIENT: Metro Water Resources

REPORT TO: Louise Kolzer

DATE RECEIVED: 07/25/91
DATE REPORTED: 08/23/91
PROJECT NAME: BIO/Metro/MLT91

QUALITY CONTROL

PARAMETER	Detection Limit	EPA Method Number
Turbidity (NTU)	0.01	180.1
Total Suspended Solids (mg/L)	1.0	160.2
Nitrate + Nitrite Nitrogen (mg/L)	0.010	353.2
Soluble Reactive Phosphorus (mg/L)	0.005	365.2
? Soluble Total Phosphorus (mg/L)	0.005	365.2
Bioavailable Phosphorus (mg/L)	0.005	365.2*
Fecal Coliforms (CFU/100 mls)	2.5	9222B
Oil & Grease (mg/L)	1.0	413.2
Total Petroleum Hydrocarbons (mg/L)	1.0	418.1
Dissolved & Total Zinc (mg/L)	0.002	200.7
Dissolved & Total Copper (mg/L)	0.002	200.7
Dissolved & Total Lead (mg/L)	0.001 ←	239.2
Dissolved & Total Aluminum (mg/L)	0.01	200.7
Dissolved & Total Iron (mg/L)	0.01	200.7

*Modified using Metro Method.

KF/pb

REPORTED BY Kathy Fugiel

METHODOLOGY REPORT

AM TEST IDENTIFICATION NUMBER 91-A005134
CLIENT ID 000 7-20-91 / a

ANALYTE	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Nitrate + Nitrite	353.2	EPA	0.010	7/31/91
Total Oil and Grease	413.2	EPA	1.0	8/ 2/91
Petroleum Hydrocarbon-TPH	418.1	EPA	1.0	8/ 2/91
Bioavailable Phosphorus				8/21/91
Ortho-Phosphate	365.2	EPA	0.005	7/26/91
Total Phosphorus	365.2	EPA	0.005	7/26/91
Total Suspended Solids	160.2	EPA	1.0	7/31/91
Turbidity	180.1	EPA	0.01	7/30/91
Aluminum	200.7	EPA	0.01	8/ 1/91
Copper	200.7	EPA	0.002	8/ 1/91
Iron	200.7	EPA	0.01	8/ 1/91
Lead	200.7	EPA	0.02	8/ 1/91
Zinc	200.7	EPA	0.002	8/ 1/91
Acid Dig. (Tot Metals)	3010	EPA		7/29/91

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/27/91

Project Name: BIO/Metro/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A005140
Client Identification	000 7-24-91 / a
Sampling Date	7/24/91

PARAMETER	RESULT	Q	D.L.
Bacteriological			
Fecal Coliforms (CFU/100 ml)	150.		1
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	0.47		0.01
Total Oil and Grease (mg/l)	39.		1.0
Total Petroleum Hydrocarbon (mg/l)	26.		1.0
Bioavailable Phosphorus	0.131		0.005
Ortho-Phosphate (mg/l)	0.031		0.005
Total Phosphorus (mg/l)	0.34		0.005
Total Suspended Solids (mg/l)	180		1.0
Turbidity (NTU)	41.		0.01
Total Metals			
Aluminum (mg/l)	3.0		0.01
Copper (mg/l)	0.013		0.002
Iron (mg/l)	4.5		0.01
Lead (mg/l)	0.05		0.02
Zinc (mg/l)	0.21		0.002

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/27/91

Project Name: BIO/Metro/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A005141
Client Identification	200 7-24-91 / a
Sampling Date	7/24/91

PARAMETER	RESULT	Q	D.L.
Bacteriological			
Fecal Coliforms (CFU/100 ml)	431.		1
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	1.2		0.01
Total Oil and Grease (mg/l)	3.0		1.0
Total Petroleum Hydrocarbon (mg/l)	1.5		1.0
Bioavailable Phosphorus	0.097		0.005
Ortho-Phosphate (mg/l)	0.027		0.005
Total Phosphorus (mg/l)	0.24		0.005
Total Suspended Solids (mg/l)	26.		1.0
Turbidity (NTU)	14.		0.01
Total Metals			
Aluminum (mg/l)	0.76		0.01
Copper (mg/l)	0.009		0.002
Iron (mg/l)	0.99		0.01
Lead (mg/l)	< 0.02		0.02
Zinc (mg/l)	0.073		0.002

AMTEST

ANALYSIS REPORT

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 7/25/91
Date Reported: 8/27/91

Project Name: BIO/Metro/MLT91
Date Sampled: 7/24/91

PARAMETER	UNITS	RESULT
91-A005142		
Client ID: 000 7-24-91 / b		
DISSOLVED METALS		
Aluminum	mg/l	0.22
Copper	mg/l	0.010
Iron	mg/l	0.13
Lead	mg/l	< 0.02
Zinc	mg/l	0.11
91-A005143		
Client ID: 200 7-24-91 / b		
DISSOLVED METALS		
Aluminum	mg/l	0.02
Copper	mg/l	0.013
Iron	mg/l	0.12
Lead	mg/l	< 0.02
Zinc	mg/l	0.055

Reported by: Kathy Fugiel

AMTEST

CLIENT: Metro Water Resources

REPORT TO: Louise Kolzer

DATE RECEIVED: 07/25/91
DATE REPORTED: 08/27/91
PROJECT NAME: BIO/Metro/MLT91

QUALITY CONTROL

PARAMETER	Detection Limit	EPA Method Number
Turbidity (NTU)	0.01	180.1
Total Suspended Solids (mg/L)	1.0	160.2
Nitrate + Nitrite Nitrogen (mg/L)	0.010	353.2
Soluble Reactive Phosphorus (mg/L)	0.005	365.2
Soluble Total Phosphorus (mg/L)	0.005	365.2
Bioavailable Phosphorus (mg/L)	0.005	365.2*
Fecal Coliforms (CFU/100 mls)	2.5	9222B
Oil & Grease (mg/L)	1.0	413.2
Total Petroleum Hydrocarbons (mg/L)	1.0	418.1
Dissolved & Total Zinc (mg/L)	0.002	200.7
Dissolved & Total Copper (mg/L)	0.002	200.7
Dissolved & Total Lead (mg/L)	0.001	239.2
Dissolved & Total Aluminum (mg/L)	0.01	200.7
Dissolved & Total Iron (mg/L)	0.01	200.7

*Modified using Metro Method.

REPORTED BY Kathy Fugiel

KF/pb

cc: City of Bellevue - Dave Renstrom
P.O. Box 90012
Bellevue, WA 98009-9012

METHODOLOGY REPORT

AM TEST IDENTIFICATION NUMBER 91-A005140
CLIENT ID 000 7-24-91 / a

ANALYTE	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Fecal Coliforms	9222D	SM	1	7/25/91
Nitrate + Nitrite	353.2	EPA	0.010	7/31/91
Total Oil and Grease	413.2	EPA	1.0	8/ 2/91
Petroleum Hydrocarbon-TPH	418.1	EPA	1.0	8/ 2/91
Bioavailable Phosphorus				8/27/91
Ortho-Phosphate	365.2	EPA	0.005	7/26/91
Total Phosphorus	365.2	EPA	0.005	7/26/91
Total Suspended Solids	160.2	EPA	1.0	7/31/91
Turbidity	180.1	EPA	0.01	7/30/91
Aluminum	200.7	EPA	0.01	8/ 1/91
Copper	200.7	EPA	0.002	8/ 1/91
Iron	200.7	EPA	0.01	8/ 1/91
Lead	200.7	EPA	0.02	8/ 1/91
Zinc	200.7	EPA	0.002	8/ 1/91
Acid Dig. (Tot Metals)	3010	EPA		7/29/91

7-24-91

NUTRIENT REPORT FOR: BIOFILTRATION

Sample	Station	SDate	Depth	Parameter	<	Conv	Units	QA
9101494	(000)	910724		NO2+3		.861	MG/L	
9101494	(000)	910724		OPO4		.033	MG/L	B
9101496	(200)	910724		NO2+3		1.4	MG/L	
9101496	(200)	910724		OPO4		.010	MG/L	B

Ann Peacock 2322

* MANUAL COLORIMETERIC CALCULATIONS *
* MANUAL COLORIMETERIC METHOD *

ANALYSIS ON TP

PROJECT : B61301 DATE ANALYZED : 910726

FILE : BF_IN_DPO.910724 ANALYST : CCJ
OUT FILE :BF_IN_TPO.910724

READING OF BLANK #1 0.0110
#2 0.0100
#3 0.0130
#4 0.0000
#5 0.0000
#6 0.0000
AVERAGE = 0.0113

STANDARD FOR #1 0.1000 AND READING 0.2080
#2 0.2000 0.4020
#3 0.3000 0.6020
#4 0.0000 0.0000
#5 0.0000 0.0000
AVERAGE FACTOR = 0.5094

STA	SAMPLE NUMBER	HORZ	DEPTH	DATE SAMPLD	VOL USED	WT USED	EXTRA DILUT	NU READING	CAL CONCENTRATION	
000	9101494			910724	0.	0.00	1.0	0.416	0.206 MG/L	QA = *
000	9101494			910724	0.	0.00	1.0	0.828	0.416 MG/L	QA =B
200	9101496			910724	0.	0.00	1.0	0.519	0.259 MG/L	QA = *
200	9101496			910724	0.	0.00	1.0	0.508	0.253 MG/L	QA =B

Lab Dup=

TO: Louise Kulzer

FROM: Greg Ma
Microbiology Section/ELD

RE: Mountlake Terrace Samples

August 26, 1991

On July 26, 1991, we received two (2) water samples labelled "Biofiltration station 000" and "Biofiltration station 200," under Metro Project Code B61301. We were requested to test the samples for fecal coliforms quantitatively as a sample-split with an external laboratory.

The samples were quite turbid, so we opted to perform the analysis by both methods available: membrane filtration and multiple tube fermentation test. Results are as follows:

Fecal Coliforms Recovered From Biofiltration Samples

Sample Number/Site	Membrane *cfu/100ml*	MTFT *MPN/100mll*
9101494 / 000	1,300	500
9104496 / 200	2,200	8,000

The values between the two methods may appear to differ dramatically, but it is important to note that the 95% confidence intervals for the MPN values are 200-1700 for the MPN500 figure, and 3,000-25,000 for the MPN8,000 figure.

What is important to note is that these values are somewhat high, though not exceptionally high, for naturally occurring surface waters. It might be interesting to investigate the identity of these fecal coliforms. *Klebsiella spp.* are known to be associated with vegetation, whereas *Escherichia coli* is more likely associated with mammalian life-forms.

Please feel free to call me if you have questions regarding these results.

Memo

7/23 .40 1:30 - 4:30 .78 peak flow

August 8, 1991

TO: Louise Kulzer

FROM: Phil Almonte

SUBJECT: Trace Metals Results for Mountlake Terrace Biofiltration Project.

Attached are the trace metals results for the following water samples that were collected on July 24, 1991 for the Biofiltration project:

Sample No.	Station	Description	Matrix
9101494	000	Mntlk Terr	Water - Total
9101495	000	Mntlk Terr	Water - Filtered
9101496	200	Mntlk Terr	Water - Total
9101497	200	Mntlk Terr	Water Filtered

All of the elements that were analyzed can be found on each individual sample report. All of the elements were analyzed on the ICP except for Cadmium and lead which were analyzed by graphite furnace.

If you have any questions or would like additional information, please call me at 684-2391.

pa:

METRO

whole

TRACE METALS ANALYSIS REPORT
METRO - ENVIRONMENTAL LABORATORIES

SAMPLE #	STATION #	DESCRIPTION	DATE
9101494	000	MNTLK TERR	910724

AG	= <	0.003	mg/L	ICP
AL	=	4.1	mg/L	ICP
AS	= <	0.05	mg/L	ICP
BA	=	0.095	mg/L	ICP
BE	= <	0.001	mg/L	ICP
CA	=	7.9	mg/L	ICP
CD	=	0.002	mg/L	GRAPHITE FURNACE
CR	=	0.01	mg/L	ICP
CU	=	0.030	mg/L	ICP
FE	=	6.5	mg/L	ICP
K	=	2.	mg/L	ICP
MG	=	2.0	mg/L	ICP
MN	=	0.50	mg/L	ICP
MO	= <	0.02	mg/L	ICP
NA	=	1.7	mg/L	ICP
NI	=	0.02	mg/L	ICP
PB	=	0.087	mg/L	GRAPHITE FURNACE
SB	= <	0.03	mg/L	ICP
SE	= <	0.05	mg/L	ICP
TI	=	0.2	mg/L	ICP
TL	= <	0.2	mg/L	ICP
V	=	0.01	mg/L	ICP
ZN	=	0.28	mg/L	ICP

Filtered

TRACE METALS ANALYSIS REPORT
METRO - ENVIRONMENTAL LABORATORIES

SAMPLE #	STATION #	DESCRIPTION	DATE
9101495	000	MNTLK TERR	910724

AG	= <	0.009	mg/L	ICP
AL	=	0.1	mg/L	ICP
AS	= <	0.05	mg/L	ICP
BA	=	0.020	mg/L	ICP
BE	= <	0.001	mg/L	ICP
CA	=	5.6	mg/L	ICP
CD	= <	0.0005	mg/L	GRAPHITE FURNACE
CR	= <	0.005	mg/L	ICP
CU	=	0.009	mg/L	ICP
FE	=	0.1	mg/L	ICP
K	=	2.	mg/L	ICP
MG	=	0.77	mg/L	ICP
MN	=	0.14	mg/L	ICP
MO	= <	0.02	mg/L	ICP
NA	=	1.6	mg/L	ICP
NI	= <	0.01	mg/L	ICP
PB	= <	0.003	mg/L	GRAPHITE FURNACE
SB	= <	0.03	mg/L	ICP
SE	= <	0.05	mg/L	ICP
TI	= <	0.03	mg/L	ICP
TL	= <	0.2	mg/L	ICP
V	= <	0.01	mg/L	ICP
ZN	=	0.078	mg/L	ICP

Whole

TRACE METALS ANALYSIS REPORT
METRO - ENVIRONMENTAL LABORATORIES

SAMPLE #	STATION #	DESCRIPTION	DATE
9101496	200	MNTLK TERR	910724

AG	= <	0.003	mg/L	ICP
AL	=	1.1	mg/L	ICP
AS	= <	0.05	mg/L	ICP
BA	=	0.028	mg/L	ICP
BE	= <	0.001	mg/L	ICP
CA	=	7.1	mg/L	ICP
CD	=	0.001	mg/L	GRAPHITE FURNACE
CR	= <	0.005	mg/L	ICP
CU	=	0.01	mg/L	ICP
FE	=	1.3	mg/L	ICP
K	=	4.	mg/L	ICP
MG	=	1.7	mg/L	ICP
MN	=	0.11	mg/L	ICP
MO	= <	0.02	mg/L	ICP
NA	=	1.9	mg/L	ICP
NI	= <	0.01	mg/L	ICP
PB	=	0.01	mg/L	GRAPHITE FURNACE
SB	= <	0.03	mg/L	ICP
SE	= <	0.05	mg/L	ICP
TI	=	0.04	mg/L	ICP
TL	= <	0.2	mg/L	ICP
V	= <	0.01	mg/L	ICP
ZN	=	0.066	mg/L	ICP

Filtered

TRACE METALS ANALYSIS REPORT
METRO - ENVIRONMENTAL LABORATORIES

SAMPLE #	STATION #	DESCRIPTION	DATE
9101497	200	MNTLK TERR	910724

AG	= <	0.004	mg/L	ICP
AL	=	0.1	mg/L	ICP
AS	= <	0.05	mg/L	ICP
BA	=	0.020	mg/L	ICP
BE	= <	0.001	mg/L	ICP
CA	=	7.4	mg/L	ICP
CD	=	0.0009	mg/L	GRAPHITE FURNACE
CR	= <	0.005	mg/L	ICP
CU	=	0.01	mg/L	ICP
FE	=	0.2	mg/L	ICP
K	=	5.	mg/L	ICP
MG	=	1.5	mg/L	ICP
MN	=	0.086	mg/L	ICP
MO	= <	0.02	mg/L	ICP
NA	=	2.1	mg/L	ICP
NI	= <	0.01	mg/L	ICP
PB	= <	0.003	mg/L	GRAPHITE FURNACE
SB	= <	0.03	mg/L	ICP
SE	= <	0.05	mg/L	ICP
TI	= <	0.03	mg/L	ICP
TL	= <	0.2	mg/L	ICP
V	= <	0.01	mg/L	ICP
ZN	=	0.048	mg/L	ICP

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 8/ 9/91
Date Reported: 8/29/91

Project Name: BIO/METRO/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A006194
Client Identification	000 8-9-91
Sampling Date	8/ 9/91

PARAMETER	RESULT	Q	D.L.
Bacteriological			
Fecal Coliforms (CFU/100 ml)	10400		1
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	0.31		0.01
Bioavailable Phosphorus	0.058		0.005
Ortho-Phosphate (mg/l)	0.042		0.005
Total Phosphorus (mg/l)	0.095		0.005
Total Suspended Solids (mg/l)	110		1.0
Turbidity (NTU)	32.		0.01
Total Metals			
Aluminum (mg/l)	0.74		0.01
Copper (mg/l)	< 0.002		0.002
Iron (mg/l)	0.69		0.01
Lead (mg/l)	< 0.02		0.02
Zinc (mg/l)	0.071		0.002

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 8/ 9/91
Date Reported: 8/29/91

Project Name: BIO/METRO/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A006195
Client Identification	200 8-9-91
Sampling Date	8/ 9/91

PARAMETER	RESULT	Q	D.L.
Bacteriological			
Fecal Coliforms (CFU/100 ml)	12300		1
Conventionals			
Nitrate + Nitrite Nitrogen (mg/l)	0.57		0.01
Bioavailable Phosphorus	0.023		0.005
Ortho-Phosphate (mg/l)	0.088		0.005
Total Phosphorus (mg/l)	0.11		0.005
Total Suspended Solids (mg/l)	34.		1.0
Turbidity (NTU)	13.		0.01
Total Metals			
Aluminum (mg/l)	0.44		0.01
Copper (mg/l)	< 0.002		0.002
Iron (mg/l)	0.28		0.01
Lead (mg/l)	< 0.02		0.02
Zinc (mg/l)	0.044		0.002

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 8/ 9/91
Date Reported: 9/ 6/91

Project Name: BIO/METRO/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A006196
Client Identification	000 (dissolved metals)
Sampling Date	8/ 9/91

PARAMETER	RESULT	Q	D.L.
Dissolved Metals			
Aluminum (mg/l)	0.37		0.01
Copper (mg/l)	0.007		0.002
Iron (mg/l)	0.01		0.01
Lead (mg/l)	< 0.02		0.02
Zinc (mg/l)	0.023		0.002

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA
98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kolzer

Date Received: 8/ 9/91
Date Reported: 8/27/91

Project Name: BIO/METRO/MLT91

WATER SAMPLES

AM TEST Identification Number	91-A006197
Client Identification	200 (dissolved metals)
Sampling Date	8/ 9/91

PARAMETER	RESULT	Q	D.L.
Dissolved Metals			
Aluminum (mg/l)	0.32		0.01
Copper (mg/l)	< 0.002		0.002
Iron (mg/l)	0.31		0.01
Lead (mg/l)	< 0.02		0.02
Zinc (mg/l)	0.058		0.002

Reported by: Kathy Fugiel

METHODOLOGY REPORT

AM TEST IDENTIFICATION NUMBER 91-A006194
CLIENT ID 000 8-9-91

AMTEST
AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

ANALYTE	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Fecal Coliforms	9222D	SM	1	8/ 9/91
Nitrate + Nitrite	353.2	EPA	0.010	8/19/91
Bioavailable Phosphorus				8/21/91
Ortho-Phosphate	365.2	EPA	0.005	8/ 9/91
Total Phosphorus	365.2	EPA	0.005	8/14/91
Total Suspended Solids	160.2	EPA	1.0	8/12/91
Turbidity	180.1	EPA	0.01	8/16/91
Aluminum	200.7	EPA	0.01	8/21/91
Copper	200.7	EPA	0.002	8/21/91
Iron	200.7	EPA	0.01	8/21/91
Lead	200.7	EPA	0.02	8/21/91
Zinc	200.7	EPA	0.002	8/21/91
Acid Dig. (Tot Metals)	3010	EPA		8/13/91

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

11/ 8/91

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kultzer

Dear Louise Kultzer,

Enclosed please find the analytical data for your Biofilt. Study II project.

The following is a cross correlation of client and laboratory identification for your convenience.

CLIENT ID	AM TEST ID	TEST
200	91-A011120	BACT, CONV, MET,
000	91-A011121	BACT, CONV, MET,

Your 2 water samples were received at AM TEST on 10/25/91.

At the time of receipt, the samples were logged in and properly maintained prior to subsequent analyses.

The analytical procedures used in the laboratory are well documented and are typically derived from the protocols of the EPA, USDA, FDA or the Army Corps of Engineers.

If you should have any questions pertaining to the data package, please feel free to contact me.

Sincerely,

Kathy Fugiel
AM TEST Inc.

BACT = Bacteriological
CONV = Conventionals
MET = Metals
ORG = Organics

ANALYSIS REPORT AMTEST

AmTest Inc.
Professional Analytical Services
14603 N.E. 87th St.
Redmond, WA 98052
Fax: 206 883 3495
Tel: 206 885 1664

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kultzer

Date Received: 10/25/91
Date Reported: 11/ 8/91

Project Name: Biofilt. Study II

WATER SAMPLES

AM TEST Identification Number	91-A011120
Client Identification	200
Sampling Date	10/24/91

PARAMETER	RESULT	Q	D.L.
Bacteriological			
Fecal Coliforms (CFU/100 ml)	48.		1
Conventionals			
Biochemical Oxygen Demand (mg/l)	< 10		10
Chemical Oxygen Demand (mg/l)	19.		10
Nitrate + Nitrite Nitrogen (mg/l)	0.31		0.01
Nitrite Nitrogen (mg/l)	0.034		0.001
Total Oil and Grease (mg/l)	4.6		1.0
Total Petroleum Hydrocarbon (mg/l)	4.6		1.0
Bioavailable Phosphorus	0.042		0.005
Ortho-Phosphate (mg/l)	0.051		0.005
Total Phosphorus (mg/l)	0.096		0.005
Total Suspended Solids (mg/l)	6.0		1.0
Turbidity (NTU)	3.2		0.01
Total Metals			
Aluminum (mg/l)	0.08		0.01
Copper (mg/l)	< 0.002		0.002
Iron (mg/l)	0.05		0.01
Lead (mg/l)	0.001		0.001
Zinc (mg/l)	0.018		0.002

Note: No sample for Oil + Grease submitted. No sheen on either inflow or outflow. Lab request sheet indicates no O/G requested.
LRK

ANALYSIS REPORT AMTEST

Metro Water Resources
Louise Kultzer

Date Received: 10/25/91
Date Reported: 11/ 8/91

WATER SAMPLES

AM TEST Identification Number	91-A011121
Client Identification	000
Sampling Date	10/24/91

PARAMETER	Result	Q	D.L.
Bacteriological			
Fecal Coliforms (CFU/100 ml)	300.		1
Conventionals			
Biochemical Oxygen Demand (mg/l)	< 10		10
Chemical Oxygen Demand (mg/l)	11.		10
Nitrate + Nitrite Nitrogen (mg/l)	0.23		0.01
Nitrite Nitrogen (mg/l)	0.023		0.001
Total Oil and Grease (mg/l)	6.5		1.0
Total Petroleum Hydrocarbon (mg/l)	6.5		1.0
Bioavailable Phosphorus	0.072		0.005
Ortho-Phosphate (mg/l)	0.088		0.005
Total Phosphorus (mg/l)	0.23		0.005
Total Suspended Solids (mg/l)	190		1.0
Turbidity (NTU)	6.2		0.01
Total Metals			
Aluminum (mg/l)	0.53		0.01
Copper (mg/l)	< 0.002		0.002
Iron (mg/l)	0.24		0.01
Lead (mg/l)	0.010		0.001
Zinc (mg/l)	0.050		0.002

Reported by: Kathy Fugiel

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

ANALYSIS REPORT

Metro Water Resources
821 2nd Avenue
MS81
Seattle, WA 98104
Attention: Louise Kultzer

Date Received: 10/28/91
Date Reported: 11/20/91

Project Name: BIO/METRO/MLT91
Date Sampled: 10/24/91

PARAMETER	UNITS	RESULT
91-A011292		
Client ID: 200		
DISSOLVED METALS		
Aluminum	mg/l	< 0.01
Copper	mg/l	0.004
Iron	mg/l	0.02
Lead	mg/l	< 0.001
Zinc	mg/l	0.007
91-A011293		
Client ID: 000		
DISSOLVED METALS		
Aluminum	mg/l	< 0.01
Copper	mg/l	0.002
Iron	mg/l	0.02
Lead	mg/l	< 0.001
Zinc	mg/l	0.021

Reported by: Kathy Fugiel

AMTEST

AmTest Inc.

Professional
Analytical
Services

14603 N.E. 87th St.
Redmond, WA
98052

Fax: 206 883 3495

Tel: 206 885 1664

METHODOLOGY REPORT

AM TEST IDENTIFICATION NUMBER 91-A011120
CLIENT ID 200

ANALYTE	METHOD	METHOD REFERENCE	DETECTION LIMIT	DATE ANALYZED
Fecal Coliforms	9222D	SM	1	10/25/91
Biochemical Oxygen Demand	405.1	EPA	1	10/25/91
Chemical Oxygen Demand	410.4	EPA	10	10/30/91
Nitrate + Nitrite	353.2	EPA	0.010	10/30/91
Nitrite Nitrogen	354.1	EPA	0.001	10/28/91
Total Oil and Grease	413.2	EPA	1.0	11/ 4/91
Petroleum Hydrocarbon-TPH	418.1	EPA	1.0	11/ 4/91
Bioavailable Phosphorus				11/ 7/91
Ortho-Phosphate	365.2	EPA	0.005	10/25/91
Total Phosphorus	365.2	EPA	0.005	10/28/91
Total Suspended Solids	160.2	EPA	1.0	10/30/91
Turbidity	180.1	EPA	0.01	10/28/91
Aluminum	200.7	EPA	0.01	11/ 4/91
Copper	200.7	EPA	0.002	11/ 4/91
Iron	200.7	EPA	0.01	11/ 4/91
Lead	239.2	EPA	0.001	11/ 1/91
Zinc	200.7	EPA	0.002	11/ 4/91
Acid Dig.(Tot Metals)	3010	EPA		10/29/91

AMTEST

METRO Water Resources
Louise Kitzer

Date Received: 10/25/91
Date Reported: 11/08/91
Project: Biofilt. Study II

QUALITY CONTROL - DUPLICATE ANALYSIS

ANALYTE/SAMPLE NUMBERS	DUPLICATE #1 (mg/l)	DUPLICATE #2 (mg/l)	RELATIVE PERCENT DIFFERENCE (%)
Aluminum			
91-A011127	0.36	0.36	0.
Chemical Oxygen Demand			
91-A011182	<10.	<10.	-
Nitrate + Nitrite			
91-A010628	1.78	1.80	1.1
Nitrite			
91-A011182	<0.001	<0.001	-
Total Phosphorus			
91-A010699	0.022	0.022	0.
Ortho Phosphate			
91-A011026	0.052	0.053	1.9
Bioavailable Phosphorus			
91-A011121	0.073	0.074	2.1
Total Suspended Solids			
91-A011026	184.	189.	2.7
Turbidity			
91-A011178	5.8	6.0	3.4
Copper			
91-A011122	<0.002	<0.002	-
Iron			
91-A011122	0.70	0.72	2.8
Lead			
91-A011122	<0.02	<0.02	-
Zinc			
91-A011122	0.007	<0.002	-

NOTE: Most of the Quality Control was performed on non-Metro samples.