AGI
TECHNOLOGIES

Compliance Monitoring Plan
McCollum Park/Emander Landfill
Snohomish County, Washington

February 29, 1996

Prepared For :

Snohomish County Public Works
2930 Wetmore Avenue
Everett, Washington 98201

AGI Project No. 15,512.279

SN 44279

AGI TECHNOLOGIES

A Report Prepared For :

Snohomish County Public Works
2930 Wetmore Avenue
Everett, Washington 98201

COMPLIANCE MONITORING PLAN
McCOLLUM PARK/EMANDER LANDFILL
SNOHOMISH COUNTY, WASHINGTON

February 29, 1996

Alan D. Carey, P.G., CHMM
Senior Geologist

Susan J. Penoyar, P.E.
Associate Engineer

AGI Technologies
300 120th Avenue N.E.
Building 4
Bellevue, Washington 98005
206/453-8383

AGI Project No. 15,512.279

SN 44280

AGI TECHNOLOGIES

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

AGI TECHNOLOGIES

COMPLIANCE MONITORING PLAN

INTRODUCTION

This plan describes compliance monitoring to be implemented as a part of the McCollum Park/Emander Landfill cleanup action. Washington State's Model Toxic Control Act (MTCA) requires compliance monitoring for all cleanup actions under WAC 173-340-410. Compliance monitoring is conducted for three purposes:

- Protection monitoring confirms human health and the environment are adequately protected during the construction phase of a cleanup action.
- Performance monitoring confirms a cleanup action has attained cleanup standards.
- Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been attained.

Snohomish County implemented site cleanup in Autumn 1995. Therefore, this plan describes performance monitoring which will confirm whether cleanup standards have been attained. This plan was prepared with reference to Washington Department of Ecology's (Ecology) *Guidance on Sampling and Data Analysis Methods* (Publication No.94-49).

LANDFILL HISTORY

The Emander Landfill operated from about 1948 to 1967. Extent of refuse and physical features of McCollum Park as of February 1995 are shown on **Figure 1**. Landfill contents include domestic refuse, demolition debris, septage, and waste petroleum fuel products. In 1969, the landfill and surrounding property were dedicated as a county park, and the former landfill was regraded and used for youth soccer and baseball. In 1990, Snohomish County (County) approved the McCollum Park Master Plan which called for constructing a Park-and-Ride lot, bicycle track, and ball fields in the portion of the park overlying the landfill. The Final Supplemental Environmental Impact Statement (March 1994) described measures to be taken to mitigate landfill impacts on the environment, including: installing a synthetic liner over the landfill; constructing a landfill gas management system; adding additional soil over the landfill to compress the refuse (preloading) prior to construction, and making drainage and stormwater improvements.

In November 1994, during preloading operations, a sludge-like material rose to the ground surface. Chemical analyses of the sludge showed elevated concentrations of petroleum hydrocarbons, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and metals. In April and June 1995 sludge emerged at two additional locations near the first emergence. The Washington State Department of Ecology (Ecology) completed a Site Hazard Assessment in January 1995 and placed the landfill on the Washington State Hazardous Site List.

REMEDIAL INVESTIGATION

AGI Technologies conducted a Remedial Investigation (RI) of the landfill in 1995. The RI evaluated the sludge as a contaminant source, and impacts of the landfill on groundwater, surface water, and sediment.

RI Monitoring and Sampling Network

The RI groundwater monitoring network (see **Figure 2**) consists of eight wells screened across or near the water table (shallow wells), one well screened mid-aquifer (intermediate well), and nine wells screened near the base of the aquifer (deep wells). Shallow upgradient wells are BH-8 and MW10, deep upgradient wells are MW13 and MW14.

The RI surface water monitoring network consists of four staff gauges in North Creek and a staff gauge in a seep located on the property to the south of McCollum Park. RI surface water samples were collected from North Creek (three locations), two of its tributaries, and the seep. Locations of surface water monitoring and sampling stations used for compliance monitoring are shown on **Figure 3**.

Groundwater and Surface Water Occurrence and Movement

The RI identified a single aquifer beneath the landfill with a saturated thickness of about 90 feet. Groundwater flows generally south, with a minor western component. North Creek is the primary surface water feature in the vicinity of the landfill. The McGill Street retention pond, located about 2.5 miles north of the landfill, comprises North Creek's headwaters. North Creek drains into the Sammamish River just east of Bothell, about 8.5 miles south of the landfill. Upstream and adjacent to the landfill, North Creek carries primarily surface water runoff from roadside ditches and retention ponds associated with I-5. During the wet season, these retention ponds are replenished by precipitation and provide the reach of North Creek adjacent to the landfill with a base flow on the order of 1 to 2 cubic feet per second. As these upstream retention basins drain in the late spring and summer, North Creek is typically dry upstream of SG3 (see **Figure 3**). The exception to this typical dry season condition follows storm events when, for a brief period, North Creek carries surface water runoff before returning to its dry condition. North Creek is effluent (gains water from the aquifer) south of SG3. This segment of the stream channel receives groundwater discharge and forms the extreme headwaters of North Creek during the late spring and early summer months. In June 1995, this discharge was estimated at approximately 2 gallons per minute. As the dry season progressed in 1995, and water table elevations continued to decline, North Creek's extreme headwaters migrated southward outside of the RI surface water monitoring network. This is a seasonal pattern and will be repeated in future years; however, the time and duration of the period where groundwater impacted by the landfill forms the extreme headwaters of North Creek will likely vary. Groundwater also discharges at a seep south of the landfill (SG6, see **Figure 3**).

Summary of RI Groundwater Chemistry Results

RI groundwater and surface water samples were collected in February, March, and August 1995. The RI identified low levels (<5 micrograms per liter [μg/L]) of polyaromatic hydrocarbons (PAHs), chlorinated ethenes (including vinyl chloride), aromatic hydrocarbons (including benzene), and fuel hydrocarbons in shallow monitoring wells downgradient of the landfill, with the highest concentrations seen at BH-5 and BH-7. Leachate impact indicator parameters including chloride, chemical oxygen demand, ammonia, sulfate, and total organic carbon were also generally elevated in these wells when compared to upgradient shallow wells. In addition, unfiltered groundwater samples from BH-5 and BH-7 showed significantly elevated concentrations of barium, calcium, magnesium, and manganese compared to upgradient shallow wells.

The RI found less impact from the landfill in the deep groundwater wells with the exception of vinyl chloride in MW16 and MW18, where concentrations up to 45 μg/L were recorded.

Summary of RI Surface Water Chemistry Results

RI surface water data from February and March 1995 did not indicate that the landfill had impacted North Creek. Surface water data for August 1995 was not obtained because North Creek was dry within the area of the RI surface water monitoring network. The greatest potential impact to North Creek from the landfill is expected in the late spring or early summer, after stormwater retention ponds upstream of the landfill have drained and groundwater discharge into North Creek's stream bed between SG3 and SG4 forms the extreme headwaters of North Creek.

Surface water samples were collected from the seep in March and August 1995. Major cation concentrations in the seep were elevated relative to groundwater, indicating possible impacts from the landfill.

Local Groundwater Use

Most residences in the area obtain their water from the Alderwood or Silver Lake water districts; however, groundwater is used for domestic water supply at six residences on Heatherwood Drive. The nearest well is located about 1,400 feet south of the landfill's southern extent. The County has been sampling two of the wells on Heatherwood Drive since 1992. Impact from the landfill has not been detected.

FEASIBILITY STUDY

The Feasibility Study (FS) recommended the following process options as the preferred cleanup action for McCollum Park and the Emander Landfill: grading and surface water controls; revegetation; impermeable landfill cap; in-situ sludge stabilization; active landfill gas collection and thermal treatment, and long-term groundwater monitoring.

Selected cleanup levels for groundwater were determined by evaluating the most stringent Applicable or Relevant and Appropriate Requirement (ARAR), the apportioned risk-based MTCA Method B Cleanup Level, MTCA Method A (for fuel hydrocarbons), and practical quantitation limit (PQL) for each contaminant of concern. The ARAR and apportioned Method B (or Method A for

fuel hydrocarbons) level were compared, the more stringent of these values was selected as the cleanup level unless the PQL was greater than this value, in which case the PQL was selected due to technical limitations. **Table 1** lists exceedances of selected cleanup levels.

CLEANUP ACTION

The following components of the cleanup action were completed by late Autumn 1995:

- Approximately 4,100 cubic yards of sludge was stabilized in situ by adding and mixing Portland cement.
- The landfill was regraded and subsurface drainage systems added to direct surface water runoff away from the landfill.
- The entire landfill (except that portion underlying SE 128th Street) was covered with an impermeable cap. Landfill cap design includes a levelling course, 60-mil textured high-density polyethylene (HDPE) liner, a protection/drainage soil layer, and a topsoil layer.
- Portions of the capped landfill were paved. Unpaved portions of the landfill surface were revegetated to minimize erosion.
- An active landfill gas extraction system was installed. Captured landfill gas is treated by flaring or thermal oxidation.

GROUNDWATER PERFORMANCE MONITORING

Monitoring Schedule

Performance monitoring will consist of collecting groundwater samples from monitoring wells on a quarterly basis for a minimum of 3 years. Each groundwater sampling round shall be completed within a 4 day period. The monitoring schedule for the first three years is as follows:

Year	Designation	Date	
First	QM-1	December 1995	
	QM-2 H	March 1996	
	QM-3	June 1996	
	QM-4 H	September 1996	— Annual w/ stats
Second	QM-5	December 1996	
	QM-6 H	March 1997	
	QM-7	June 1997	
	QM-8 H	September 1997	— Annual w/ stats
Third	QM-9	December 1997	**SN 44287**
	QM-10 H	March 1998	
	QM-11	June 1998	
	QM-12 H	September 1998	— Annual w/ stats

13 Dec 98 — 19 JUNE 00
14 mar 99 — 20 SEP 00
15 June 99 — 21 DEC 00
16 sept 99 — 22 MAR 01
17 Dec 99 — 23 JUNE 01
18 mar 00 — 24 SEP 01

H = Heatherwood

One Heatherwood Drive domestic well (see **Figure 4**) will be sampled on a semi-annual basis, beginning with QM-2.

Analytic Methods

Samples will be analyzed for the following parameters:

Parameter	Methods
Volatile Organic Compounds	EPA Method 524.2
Metals	EPA 6010/7000 Series
Semivolatile Organic Compounds (QM-10 only)	EPA 8270
Petroleum Hydrocarbons (QM-10 only)	WTPH-D
Geochemical Indicators	EPA 6010
Leachate Indicators:	
Ammonia	EPA 350.1
Total Organic Carbon	EPA 415.1
Total Dissolved Solids	EPA 160.1

Analytic schedules are discussed in the following section and are shown on **Tables 2** and **3**. Individual compounds and detection limits are shown on **Table 4**. Samples collected for metals and geochemical indicator parameters analysis will be filtered. Specific conductance, pH, temperature, and water levels will be measured in the field.

Analytic Schedules

Table 2 lists the analytic schedule for QM-1, -2, -3, and -4. Subsequent analytic schedules will be reviewed on an annual basis and may change based on analysis of data. Criteria for changing subsequent analytic schedules are discussed below in the data analysis and reporting section of this plan. Any changes to the schedule will be made only with the written approval of Ecology.

Groundwater samples will be collected from the monitoring wells shown on **Figure 2**. The location of the Heatherwood Drive domestic well to be sampled semi-annually is shown on **Figure 4**.

More comprehensive groundwater sampling will be performed during QM-10 to provide assurance cleanup actions described in this Cleanup Action Plan have not impacted groundwater quality in some unanticipated fashion. The analytic schedule for QM-10 (shown on **Table 3**) adds VOC analyses for all monitoring wells, and SVOCs and fuel hydrocarbons for BH-5, -6, and -7. QM-10 was selected because RI data indicates concentrations of organic compounds, particularly VOCs, are highest in the spring. Also, QM-10 is scheduled to occur 3 years after the second round of RI groundwater sampling. These two data sets will provide a good comparison between groundwater conditions before and after cleanup.

Groundwater Sampling Protocols

All groundwater monitoring wells are equipped with dedicated Hydrostar sampling pumps. Groundwater monitoring activities shall follow the field procedures described in the *Environmental Monitoring Manual for the Snohomish County Department of Public Works* (EMM). The EMM describes specific techniques for:

- Obtaining groundwater level measurements
- Well purging
- Sample collection
- Field water quality measurements
- Approved methods of sample preservation
- Field quality control
- Equipment decontamination
- Documentation and chain-of-custody records

Groundwater Elevation Monitoring

Groundwater elevations will be measured at all monitoring wells and selected gas probes, as shown on **Figure 2**. Monitoring well elevation data is presented on **Table 5**. Monitoring frequency will be monthly for one year following the commencement of RI field work, through February 1996. Following the initial year of monthly monitoring, groundwater elevations will be measured in conjunction with quarterly groundwater sampling rounds. Surface water elevations will be measured at selected staff gauges at the same time, and all water elevation measurements will be made on the same day.

SURFACE WATER PERFORMANCE MONITORING

Monitoring Schedule

Surface water samples are currently scheduled to be collected during QM-11 only.

Sample Locations

Surface water samples will be collected from North Creek and the seep. Surface water sample locations (SW5 and SW6) are shown on **Figure 3**.

Care should be taken to ensure the surface water sample from North Creek (SW5) represents groundwater discharge and not surface water runoff flowing from off-site. The appropriate conditions for collecting the North Creek sample exist when:

- North Creek is dry at the culvert crossing 128th Street SE.
- The northern and southern tributaries (see **Figure 3**) are dry.
- Groundwater is seeping into the creek bed between SG3 and SG4 where there is observable flow in North Creek at SW5.

Observations made during the RI indicate these conditions are most likely to occur during the late spring or summer. The collection of the surface water sample from North Creek during QM11 must be timed to occur when these conditions exist.

Analytic Methods

Surface water samples will be collected at groundwater discharge locations. Surface water samples will be analyzed by the same analytical methods described for groundwater.

Surface Water Sampling Protocols

All surface water monitoring activities shall follow the field procedures described in the EMM. The EMM outlines specific techniques for:

- Obtaining field water quality measurements
- Sample collection
- Approved methods of sample preservation
- Field quality control
- Equipment decontamination
- Documentation and chain-of-custody records

Surface Water Elevation Monitoring

Surface water elevations will be measured at staff gauges SG1, -2, -3, -4, and -6, as shown on **Figure 3**. Staff gauge elevation data is presented on **Table 6**. Monitoring frequency will be monthly for one year following the commencement of RI field work, through February 1995. Following the initial year of monthly monitoring, surface water levels will be measured in conjunction with groundwater elevation monitoring sampling. For each monitoring or sampling round, all groundwater and surface water measurements will be made on the same day.

SEDIMENT PERFORMANCE MONITORING

Monitoring Schedule

The purpose of sediment monitoring is to assess the long-term impacts of the landfill to North Creek sediment in the area of groundwater discharge. The sediment sample will be collected during QM-11, concurrent with the collection of the North Creek surface water sample (SW5).

Analytic Methods

The sediment sample will be analyzed for the following parameters:

Parameter	Methods
SVOCs	EPA Method 8270
Metals	EPA Method 6010/7000 Series
Polychlorinated Biphenyls (PCBs)	EPA Method 8080
Total Organic Carbon	Standard Method 5310B
Particle Size	Puget Sound Estuary Program Method

Individual compounds and detection limits are shown on **Table 4.**

Sample Location

The sediment sample will be collected from North Creek at the SD5 location, as shown on **Figure 5.**

Sediment Sampling Protocols

The sediment sample shall be collected in accordance with the Puget Sound Estuary Program's (PSEP) *Recommended Protocols for Measuring Sediment Conventional Variables in Puget Sound* (1986). At the SD5 location, sediment subsamples will be collected from a 1-square-foot area using a stainless steel corer that meets PSEP guidelines. Corer penetration depths shall be approximately 15 centimeters (cm): 10 cm sediment with 5 cm overlying water. Subsamples shall be examined for acceptability before the overlying water is siphoned off, and then mixed to the total volume (approximately 2 liters) required for particle sized and chemical analyses. Acceptability criteria are as follows:

- The corer is not overfilled with sample material such that the sediment surface is in contact with the top of the corer.
- The specified penetration depth is achieved.
- Overlying water is present and not excessively turbid.
- The sediment surface appears relatively undisturbed.

Equipment decontamination, field documentation, and chain-of-custody procedures will be consistent with those described in the EMM.

PERFORMANCE MONITORING DATA ANALYSIS AND REPORTING

Performance monitoring reports will be prepared on a quarterly basis. Annual reports will include data analyses. Once tabulated, quarterly and annual reports shall be attached to the County's next monthly report submitted to Ecology. The following sections describe performance monitoring report contents.

Quarterly Reports

Quarterly reports shall include:

- Tabulated chemical data and field measurements.
- Copies of laboratory reports.
- A water table map incorporating surface water and shallow groundwater elevations. An example from the RI is included as **Figure 6.**
- A potentiometric map showing groundwater elevations of the nine deep wells. An example from the RI is included as **Figure 7.**

Annual Reports

Annual reports shall be prepared following QM-4, -8, and -12. Annual reports shall include the information described above in the **Quarterly Reports** section. Annual report data analysis and reporting objectives and requirements are as follows:

- Examine seasonal trends of chemical concentrations.
- Statistically analyze data according to the guidance, methods, and procedures found in two Ecology documents: *Guidance on Sampling and Data Analysis Methods* (Publication 94-49) and *Statistical Guidance for Ecology Site Managers* (Publication 92-54). Statistical analyses will be performed using MTCAStat.
- Make recommendations for the next year's performance monitoring analytic schedule and methods. Recommendations may be made to discontinue from the next year's monitoring schedule wells and/or parameters which are statistically below selected cleanup levels or upgradient concentrations. Monitoring will continue on wells which exceed selected cleanup levels or upgradient concentrations. Selected cleanup levels are found on **Table 1.** Any changes to the following year's monitoring schedule will be made with the written approval of Ecology.

CONFIRMATIONAL MONITORING

The QM-12 annual report will contain recommendations for either continuing the performance monitoring program or initiating confirmational monitoring. Ecology and the County will meet to discuss these recommendations and establish the type of monitoring program to be conducted in the future.

DISTRIBUTION

3 Copies

Snohomish County Solid Waste Division
14528 Highway 9
Snohomish, Washington 98290

Attention: Mr. Dave Schonhard

AGI TECHNOLOGIES

mg-N/L

Table 1
Groundwater Quality Exceeding Selected Cleanup Levels
Snohomish Co. Public Works Dept./McCollum Park and Emander Landfill RI/Compliance Monitoring Plan
Snohomish County, Washington

Contaminant of Concern	Date Sampled	Selected Cleanup Level	Exceedance Location								
			Shallow Wells								Intermediate Well
			BH-3	BH-5	BH-6	BH-7	BH-8	MW9	MW10	MW11	MW17
Volatile Organic Compounds (ppb)											
Benzene	2/95	1.5		3.0		1.7					
	3/95			3.1							
	8/95										
1,4-Dichlorobenzene	2/95	1.8									
	3/95			2.5							
	8/95										
Vinyl Chloride	2/95	0.2				1.0				0.4	
	3/95			0.3	0.8	0.3		1.3			
	8/95					0.3					
Semivolatile Organic Compounds (ppb)											
bis(2-ethylhexyl)phthalate	2/95	5.6									
	3/95					9.0					
	8/95										
Metals (ppm)											
Aluminum	2/95	0.05		5.3	0.47	6.8	1.2	150	11	12	
	3/95		0.72	0.73	1.8	31	6.3	28	19	0.11	
	8/95		0.15	0.061	1.3	6.1	4.0	7.2	2.8	19	4.9
Arsenic	2/95	0.005		0.024	0.0083			0.019			
	3/95			0.011	0.0094	0.010					
	8/95			0.012	0.0078	0.014					
Chromium - total	2/95	0.05						0.39			
	3/95					0.063	0.053	0.21	0.051		
	8/95							0.083			
Iron	2/95	0.3		23	2.0	6.3	1.2	140	4.8	6.1	
	3/95		0.94	9.1	2.7	22	5.9	27	13		
	8/95			9.2	1.4	7.5	3.4	9.6	1.8	8.8	8.4
Lead	2/95	0.015						0.037			
	3/95										
	8/95										
Manganese	2/95	0.02	0.11	4.5	0.87	12	0.032	2.3	0.14	0.17	
	3/95		0.086	4.4	0.63	8.8	0.12	0.59	0.32	0.031	
	8/95		0.099	5.0	0.57	8.1	0.069	0.23	0.043	0.24	10
Nickel	2/95	0.08						0.36			
	3/95					0.19		0.13	0.064		
	8/95										
Vanadium	2/95	0.112						0.44			
	3/95										
	8/95										
Groundwater Quality Indicators											
Nitrate as Nitrogen (mg/L)	2/95	4.3									
	3/95								14.0		
	8/95										
Specific Conductivity (µmhos/cm)	2/95	700									
	3/95			912		722					
	8/95			1,000		895					1,216
TPH (mg/L)	2/95	1									
	3/95			1.1							
	8/95										

SN 44296

AGI TECHNOLOGIES

Table 1
Groundwater Quality Exceeding Selected Cleanup Levels
Snohomish Co. Public Works Dept./McCollum Park and Emander Landfill RI/Compliance Monitoring Plan
Snohomish County, Washington

Contaminant of Concern	Date Sampled	Selected Cleanup Level	Exceedance Location									
			Deep Wells									
			MW12	MW13	MW14	MW15	MW16	MW18	MW19	MW20	MW21	Cook
Volatile Organic Compounds (ppb)												
Benzene	2/95	1.5										
	3/95											
	8/95											
1,4-Dichlorobenzene	2/95	1.8										
	3/95											
	8/95											
Vinyl Chloride	2/95	0.2					45					
	3/95						43					
	8/95						14	30				
Semivolatile Organic Compounds (ppb)												
bis(2-ethylhexyl)phthalate	2/95	5.6										
	3/95											
	8/95											
Metals (ppm)												
Aluminum	2/95	0.05	2.7									
	3/95		17	0.075		31						
	8/95		5.4					0.35	0.85	2.70	0.86	
Arsenic	2/95	0.005					0.0058					
	3/95					0.0064	0.0096					
	8/95						0.0210	0.013			0.0053	
Chromium - total	2/95	0.05										
	3/95		0.086									
	8/95										0.18	
Iron	2/95	0.3	4.8									
	3/95		27			15						
	8/95		8.3					1.8	1.4	4.7	2.6	
Lead	2/95	0.015										
	3/95											
	8/95											
Manganese	2/95	0.02	0.17		0.065	0.051	2.1					
	3/95		0.52		0.047	0.39	3.0					
	8/95		0.18		0.041		3.3	4.2	0.61	0.69	0.20	
Nickel	2/95	0.08										
	3/95		0.11			0.085						
	8/95										0.089	
Vanadium	2/95	0.112										
	3/95											
	8/95											
Groundwater Quality Indicators												
Nitrate as Nitrogen (mg/L)	2/95	4.3										
	3/95					7.5						
	8/95											
Specific Conductivity (µmhos/cm)	2/95	700										
	3/95						765					
	8/95						785					
TPH (mg/L)	2/95	1										
	3/95	1										
	8/95											

Notes:

Shaded value indicates maximum exceedance for each contaminant of concern.
a) 1.1 mg/L diesel.

ppb - Parts per billion.
ppm - Parts per million.

SN 44297

snohomis\512-274\EXCDCOMP.XLS

AGI TECHNOLOGIES

Table 2
Analytic Schedule
Performance Monitoring Rounds QM−1,−2,−3, and −4
Snohomish Co. Public Works Dept./McCollum Park/ Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Well I.D.	Analytical Parameter					
	VOCs	Metals	Geochemical Indicators	Leachate Indicators	Field Parameters	Comments
Shallow Wells						
BH−3	x	x	x	x	x	
BH−5	x	x	x	x	x	
BH−6	x	x	x	x	x	
BH−7	x	x	x	x	x	
BH−8		x	x	x	x	Upgradient well
MW9	x	x	x	x	x	
MW10		x	x	x	x	Upgradient well
MW11	x	x	x	x	x	
MW17		x	x	x	x	Intermediate well
Deep Wells						
MW12		x	x	x	x	
MW13		x	x	x	x	Upgradient well
MW14		x	x	x	x	Upgradient well
MW15		x	x	x	x	
MW16	x	x	x	x	x	
MW18	x	x	x	x	x	
MW19		x	x	x	x	
MW20		x	x	x	x	
MW21		x	x	x	x	
Heatherwood Dr.	x	x	x	x	x	

snohomis\512−279\anschd.wk1

Notes:

The Heatherwood Drive well will be sampled semi−annually. Snohomish Health District will arrange sampling. Snohomish County will provide bottles and assist sampling.

SN 44298

AGI TECHNOLOGIES

Table 3
Analytic Schedule
Performance Monitoring Round QM–10
Snohomish Co. Public Works Dept./McCollum Park/ Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Well I.D.	Analytical Parameter							
	VOCs	Metals	SVOCs	WTPH–D	Geochemical Indicators	Leachate Indicators	Field Parameters	Comments
Shallow Wells								
BH–3	x	x			x	x	x	
BH–5	x	x	x	x	x	x	x	
BH–6	x	x	x	x	x	x	x	
BH–7	x	x	x	x	x	x	x	
BH–8	x	x			x	x	x	Upgradient well
MW9	x	x			x	x	x	
MW10	x	x			x	x	x	Upgradient well
MW11	x	x			x	x	x	
MW17	x	x			x	x	x	Intermediate well
Deep Wells								
MW12	x	x			x	x	x	
MW13	x	x			x	x	x	Upgradient well
MW14	x	x			x	x	x	Upgradient well
MW15	x	x			x	x	x	
MW16	x	x			x	x	x	
MW18	x	x			x	x	x	
MW19	x	x			x	x	x	
MW20	x	x			x	x	x	
MW21	x	x			x	x	x	
Heatherwood Dr.	x	x			x	x	x	

snohomis\512–279\schd–10.wk1

Notes:

The Heatherwood Drive well will be sampled semi–annually. Snohomish Health District will arrange sampling. Snohomish County will provide bottles and assist sampling.

SN 44299

AGI TECHNOLOGIES

Table 4
Groundwater and Surface Water Sampling – Analytical Methods, Detection and Quantitation Limits
Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Parameters	Extraction and Analytical Method [a]	Reporting Limit
Volatile Organic Compounds		(µg/L)
Benzene	EPA 5030/524.2	0.2
Chlorobenzene	EPA 5030/524.2	0.2
Ethylbenzene	EPA 5030/524.2	0.2
Styrene	EPA 5030/524.2	0.2
Toluene	EPA 5030/524.2	0.2
Xylenes (meta + para; ortho)	EPA 5030/524.2	0.2
Bromobenzene	EPA 5030/524.2	0.2
Bromodichloromethane	EPA 5030/524.2	0.2
Bromoform	EPA 5030/524.2	1
Bromomethane	EPA 5030/524.2	0.4
Butyl benzene	EPA 5030/524.2	0.2
sec–Butyl benzene	EPA 5030/524.2	0.2
tert–Butyl benzene	EPA 5030/524.2	0.2
Carbon Tetrachloride	EPA 5030/524.2	0.3
Chloroethane	EPA 5030/524.2	0.4
Chloroform	EPA 5030/524.2	0.2
Chloromethane	EPA 5030/524.2	0.2
2–Chlorotoluene	EPA 5030/524.2	0.2
4–Chlorotoluene	EPA 5030/524.2	0.2
Dibromochloromethane	EPA 5030/524.2	0.4
1,2–Dibromochloropropane	EPA 5030/524.2	2.5
1,2–Dichlorobenzene	EPA 5030/524.2	0.3
1,3–Dichlorobenzene	EPA 5030/524.2	0.2
1,4–Dichlorobenzene	EPA 5030/524.2	0.2
1,1–Dichloroethane	EPA 5030/524.2	0.2
1,2–Dichloroethane	EPA 5030/524.2	0.2
1,1–Dichloroethene	EPA 5030/524.2	0.5
trans–1,2–Dichloroethene	EPA 5030/524.2	0.2
cis–1,2–Dichloroethene	EPA 5030/524.2	0.2
1,2–Dichloropropane	EPA 5030/524.2	0.2
1,3–Dichloropropane	EPA 5030/524.2	0.2
2,2–Dichloropropane	EPA 5030/524.2	0.2
1,1–Dichloropropene	EPA 5030/524.2	0.2
cis–1,3–Dichloropropene	EPA 5030/524.2	0.2
trans–1,3–Dichloropropene	EPA 5030/524.2	0.2
Ethylene dibromide	EPA 5030/524.2	0.2
Hexachlorobutadiene	EPA 5030/524.2	0.4
Isopropylbenzene	EPA 5030/524.2	0.2
4–Isopropyltoluene	EPA 5030/524.2	0.2
Methylene chloride	EPA 5030/524.2	1.0
Napthalene	EPA 5030/524.2	1.0
n–Propylbenzene	EPA 5030/524.2	0.2
1,1,2,2–Tetrachloroethane	EPA 5030/524.2	0.2
Tetrachloroethene	EPA 5030/524.2	0.4
1,2,3–Trichlorobenzene	EPA 5030/524.2	0.2

SN 44300

AGI TECHNOLOGIES

Table 4
Groundwater and Surface Water Sampling – Analytical Methods, Detection and Quantitation Limits
Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Parameters	Extraction and Analytical Method [a]	Reporting Limit
Volatile Organic Compounds (cont.)		(µg/L)
1,2,4–Trichlorobenzene	EPA 5030/524.2	0.2
1,1,1–Trichloroethane	EPA 5030/524.2	0.2
1,1,2–Trichloroethane	EPA 5030/524.2	0.2
Trichloroethene	EPA 5030/524.2	0.2
Freon 113	EPA 5030/524.2	0.2
1,3,5–Trimethylbenzene	EPA 5030/524.2	0.2
1,2,4–Trimethylbenzene	EPA 5030/524.2	0.2
Vinyl chloride	EPA 5030/524.2	0.2
Dibromomethane	EPA 5030/524.2	0.4
Dichlorodifluoromethane	EPA 5030/524.2	0.5
1,1,1,2–Tetrachloroethane	EPA 5030/524.2	0.2
Trichloromonofluoromethane	EPA 5030/524.2	0.5
1,2,3–Trichloropropane	EPA 5030/524.2	1.0
Metals		(mg/L)
Antimony	EPA 3050/6010	0.050
Arsenic	EPA 3050/7060	0.005
Barium	EPA 3050/6010	0.010
Beryllium	EPA 3050/6010	0.005
Cadmium	EPA 3050/7131	0.0002
Chromium	EPA 3050/6010	0.010
Cobalt	EPA 3050/6010	0.010
Copper	EPA 3050/6010	0.010
Lead	EPA 3050/7421	0.003
Nickel	EPA 3050/6010	0.010
Selenium	EPA 3050/7740	0.005
Silver	EPA 3050/6010	0.005
Semivolatile Organic Compounds		(µg/L)
Acid Compounds		
Benzoic acid	EPA 3520/8270	25
2–Chlorophenol	EPA 3520/8270	5
4–Chloro–3–methylphenol	EPA 3520/8270	5
2,4–Dichlorophenol	EPA 3520/8270	5
2,4–Dimethylphenol	EPA 3520/8270	5
2,4–Dinitrophenol	EPA 3520/8270	25
4,6–Dinitro–2–methylphenol	EPA 3520/8270	25
2–Methylphenol (o–cresol)	EPA 3520/8270	5
4–Methylphenol (p–cresol)	EPA 3520/8270	5
2–Nitrophenol	EPA 3520/8270	5
4–Nitrophenol	EPA 3520/8270	25
Pentachlorophenol	EPA 3520/8270	5
Phenol	EPA 3520/8270	5
2,4,5–Trichlorophenol	EPA 3520/8270	25
2,4,6–Trichlorophenol	EPA 3520/8270	5

SN 44301

AGI TECHNOLOGIES

Table 4
Groundwater and Surface Water Sampling – Analytical Methods, Detection and Quantitation Limits
Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Parameters	Extraction and Analytical Method [a]	Reporting Limit
Semivolatile Organic Compounds (cont.)		(µg/L)
Base/Neutral Compounds		
Acenaphthene	EPA 3520/8270	5
Acenaphthylene	EPA 3520/8270	5
Aniline	EPA 3520/8270	5
Anthracene	EPA 3520/8270	5
Benzo (a) anthracene	EPA 3520/8270	5
Benzo (b) fluoranthene	EPA 3520/8270	5
Benzo (k) fluoranthene	EPA 3520/8270	5
Benzo (g,h,i) perylene	EPA 3520/8270	5
Benzo (a) pyrene	EPA 3520/8270	5
Benzyl alcohol	EPA 3520/8270	5
bis (2–Chloroethoxy) methane	EPA 3520/8270	5
bis (2–Chloroethyl) ether	EPA 3520/8270	5
bis (2–Chloroisopropyl) ether	EPA 3520/8270	5
bis (2–Ethylhexyl) phthalate	EPA 3520/8270	5
4–Bromophenyl–phenylether	EPA 3520/8270	5
Butylbenzylphthalate	EPA 3520/8270	5
4–Chloroaniline	EPA 3520/8270	5
2–Chloronaphthalene	EPA 3520/8270	5
4–Chlorophenyl–phenylether	EPA 3520/8270	5
Chrysene	EPA 3520/8270	5
Dibenzo (a,h) anthracene	EPA 3520/8270	5
Dibenzofuran	EPA 3520/8270	5
3,3–Dichlorobenzidine	EPA 3520/8270	10
1,2–Dichlorobenzene	EPA 3520/8270	5
1,3–Dichlorobenzene	EPA 3520/8270	5
1,4–Dichlorobenzene	EPA 3520/8270	5
Diethylphthalate	EPA 3520/8270	5
Dimethylphthalate	EPA 3520/8270	5
Di–n–butylphthalate	EPA 3520/8270	5
2,4–Dinitrotoluene	EPA 3520/8270	5
2,6–Dinitrotoluene	EPA 3520/8270	5
Di–n–octylphthalate	EPA 3520/8270	5
Fluoranthene	EPA 3520/8270	5
Fluorene	EPA 3520/8270	5
Hexachlorobutadiene	EPA 3520/8270	5
Hexachlorobenzene	EPA 3520/8270	5
Hexachlorocyclopentadiene	EPA 3520/8270	5
Hexachloroethane	EPA 3520/8270	5
Indeno (1,2,3–cd) pyrene	EPA 3520/8270	5
Isophorone	EPA 3520/8270	5
2–Methylnaphthalene	EPA 3520/8270	5
Naphthalene	EPA 3520/8270	5
2–Nitroaniline	EPA 3520/8270	25
3–Nitroaniline	EPA 3520/8270	25
4–Nitroaniline	EPA 3520/8270	25

SN 44302

AGI TECHNOLOGIES

Table 4
Groundwater and Surface Water Sampling – Analytical Methods, Detection and Quantitation Limits
Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Parameters	Extraction and Analytical Method [a]	Reporting Limit
Semivolatile Organic Compounds (cont.)		(µg/L)
Base/Neutral Compounds (cont.)		
Nitrobenzene	EPA 3520/8270	5
n–Nitrosodimethylamine	EPA 3520/8270	7.5
n–Nitrosodiphenylamine	EPA 3520/8270	5
n–Nitroso–di–n–propylamine	EPA 3520/8270	7.5
Phenanthrene	EPA 3520/8270	5
Pyrene	EPA 3520/8270	5
1,2,4–Trichlorobenzene	EPA 3520/8270	5
		(mg/L)
Petroleum Hydrocarbons	WTPH–D	0.25
Geochemical Indicators		(mg/L)
Calcium	EPA 3050/6010	0.100
Iron	EPA 3050/6010	0.050
Magnesium	EPA 3050/6010	0.050
Manganese	EPA 3050/6010	0.010
Potassium	EPA 3050/6010	0.200
Sodium	EPA 3050/6010	0.050
Leachate Indicators		(mg/L)
Ammonia	EPA350.1 [b]	0.2
Total Organic Carbon	EPA 415.1	0.5
Total Dissolved Solids	EPA 160.1	50
Field Parameters		
pH	Field Determined	N/A
Temperature (Celsius)	Field Determined	0.1
Specific Conductance (umhos)	Field Determined	10

snohomis\512–279\gwsw–adq.wk1

Notes:

a) All methods are taken from SW–846, 3rd Edition (1986) unless otherwise noted.
b) Methods for Chemical Analyses of Water and Wastes, EPA–600/4–79–020 (1983).
N/A – Not applicable.
mg/L – Milligrams per liter is approximately equivalent to parts per million, depending on density of water sample.
µg/L – Micrograms per liter is approximately equivalent to parts per billion, depending on density of water sample.

SN 44303

AGI TECHNOLOGIES

Table 5
Groundwater Monitoring Well and Gas Probe Elevation Data
Snohomish Co. Public Works Dept./McCollum Park and Emander Landfill RI
Snohomish County, Washington

Well Number	Date Completed	Consultant	Well Status	Ground Elevation (feet)	Top of Casing Elevation* (ft MSL)	Total Boring Depth (ft bgs)	Screen Zone		Portion of Aquifer Monitored
							Depth (ft bgs)	Elevation (feet)	
BH–5	03/21/94	AGI	Active	384.0	385.33	15.5	15.5 – 5.5	368.5 – 378.5	Upper
BH–6	03/21/94	AGI	Active	380.4	381.80	13.0	13.0 – 3.0	367.4 – 377.4	Upper
BH–7	03/22/94	AGI	Active	382.6	383.95	14.0	14.0 – 4.0	368.6 – 378.6	Upper
BH–8	03/22/94	AGI	Active	394.3	395.71	22.0	22.0 – 12.0	372.3 – 382.3	Upper
MW9	01/26/95	AGI	Active	374.1	375.68	10.3	5.0 – 10.0	364.1 – 369.1	Upper
MW10	02/07/95	AGI	Active	393.6	394.70	25.0	23.0 – 13.0	370.6 – 380.6	Upper
MW11	01/30/95	AGI	Active	400.3	400.10	29.3	29.0 – 14.0	371.3 – 386.3	Upper
MW12	02/04/95	AGI	Active	384.3	386.31	100.0	99.0 – 89.0	285.3 – 295.3	Lower
MW13	02/07/95	AGI	Active	393.7	394.98	115.0	110.0 – 100.0	283.7 – 293.7	Lower
MW14	01/30/95	AGI	Active	392.4	393.65	108.0	70.0 – 60.0	322.4 – 332.4	Lower
MW15	02/01/95	AGI	Active	400.5	401.86	125.5	120.0 – 110.0	280.5 – 290.5	Lower
MW16	02/04/95	AGI	Active	382.1	383.68	99.0	94.0 – 84.0	288.1 – 298.1	Lower
MW17	07/11/95	AGI	Active	385.3	386.91	45.8	45.0 – 35.0	340.3 – 350.3	Intermediate
MW18	07/10/95	AGI	Active	382.5	383.88	99.0	97.0 – 87.0	285.5 – 295.5	Lower
MW19	07/18/95	AGI	Active	377.6	379.37	93.0	91.0 – 81.0	286.6 – 296.6	Lower
MW20	07/14/95	AGI	Active	381.6	383.50	94.6	93.0 – 83.0	288.6 – 298.6	Lower
MW21	07/25/95	AGI	Active	427	425.55	152.0	149.0 – 139.0	278 – 288	Lower
GP–15	12/15/92	AGI	Active	±387.5	387.39	15.3	15.0 – 5.0	372.39 – 382.39	Upper
GP–18	12/16/92	AGI	Active	±399	398.93	25.3	25.0 – 5.0	373.93 – 393.93	Upper

snohomis\512–279\mw–elev.wk1

Notes:

* Benchmark: TBM–128.3; the top bolt on the crown of a fire hydrant located on the north side of 128th Street S.E. at the point of the intersection curve next to the north end of the mobile home park. Elevation 401.25 feet; USGS datum 1927.

ft bgs – Feet below ground surface.

ft MSL – Feet above Mean Sea Level.

AGI TECHNOLOGIES

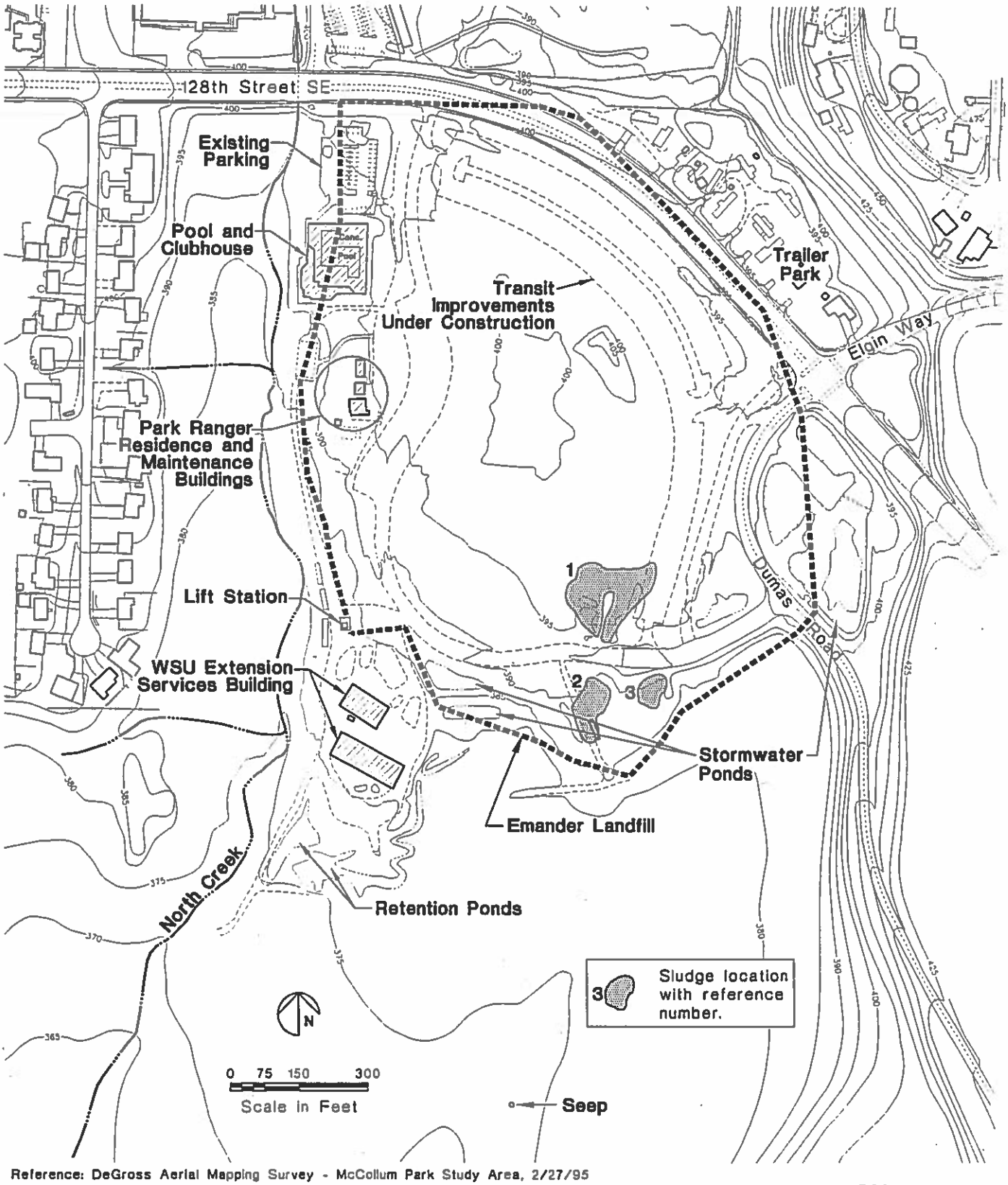
Table 6
Staff Gauge Elevation Data
Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill/Compliance Monitoring Plan
Snohomish County, Washington

Staff Gauge	Measuring Point Elevation
SG1	386.15
SG2	378.22
SG3	373.69
SG4	368.70
SG6	372.08

snohomis\512-279\staff.wk1

Notes:

Elevations are surveyed to common benchmark with monitoring wells, see Table 4.
Measuring point elevation refers to the 0.00 mark of staff guage.



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95

SN 44307

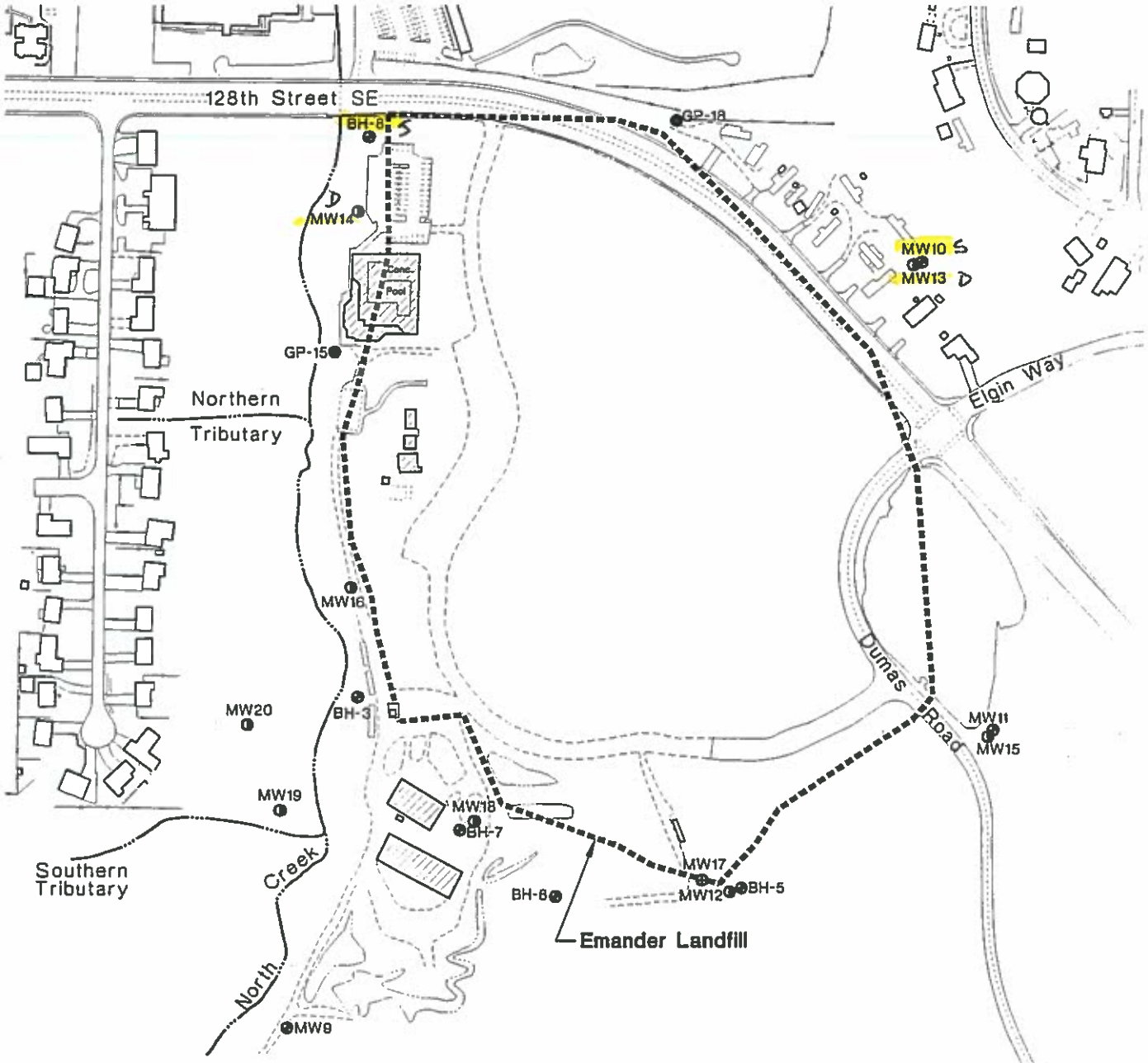
Site Features - February 1995

FIGURE 1

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

AGI TECHNOLOGIES

plate-s1.dwg	PROJECT NO. 15,512.279	DRAWN ALW	DATE 17 Apr 95	APPROVED ADC	REVISED BJA	DATE Feb 96



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95

UPGRADIENT

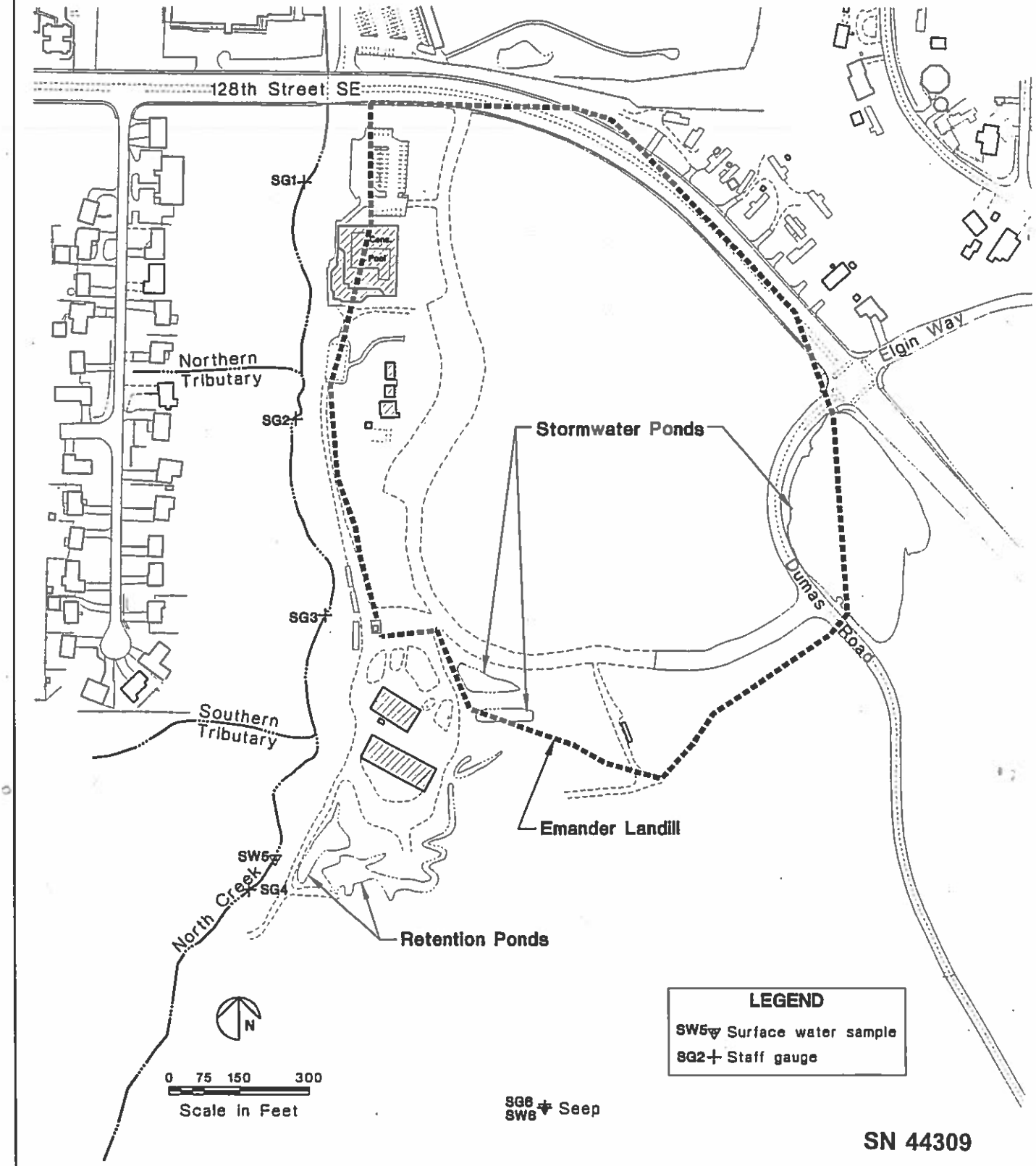
Groundwater Monitoring Well Locations

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

FIGURE **2**

AGI TECHNOLOGIES

plate-e2.dwg	PROJECT NO. 15,512.279	DRAWN ALW	DATE 17 Apr 95	APPROVED	REVISED BJA	DATE Feb 96



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95

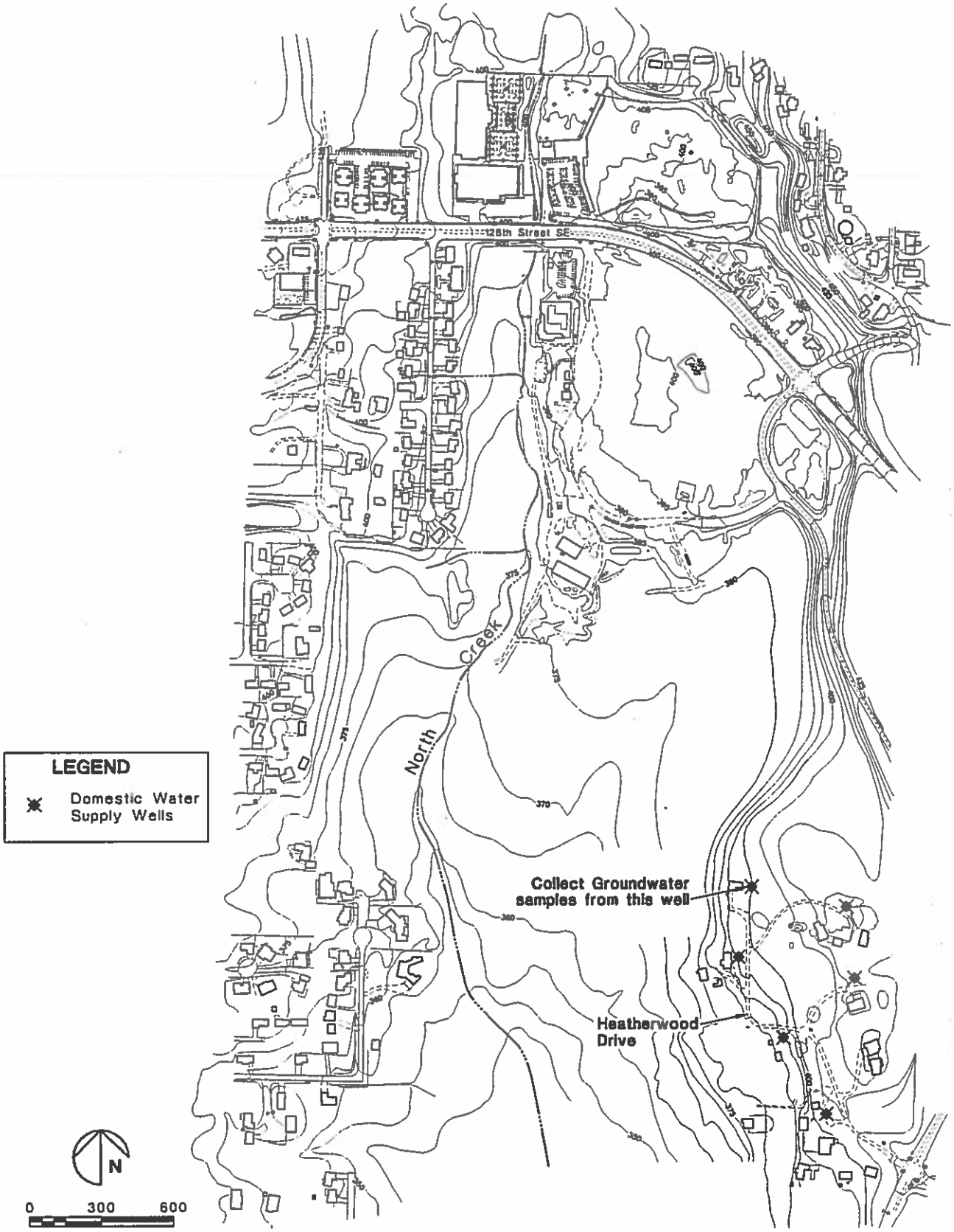
Surface Water Sample and Staff Gauge Locations

FIGURE 3

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

AGI TECHNOLOGIES

	PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
plate-e3.dwg	15,512.279	ALW	17 Apr 95	ADC	BJA	Feb 96



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95.

SN 44310

Heatherwood Drive Domestic Water Supply Wells

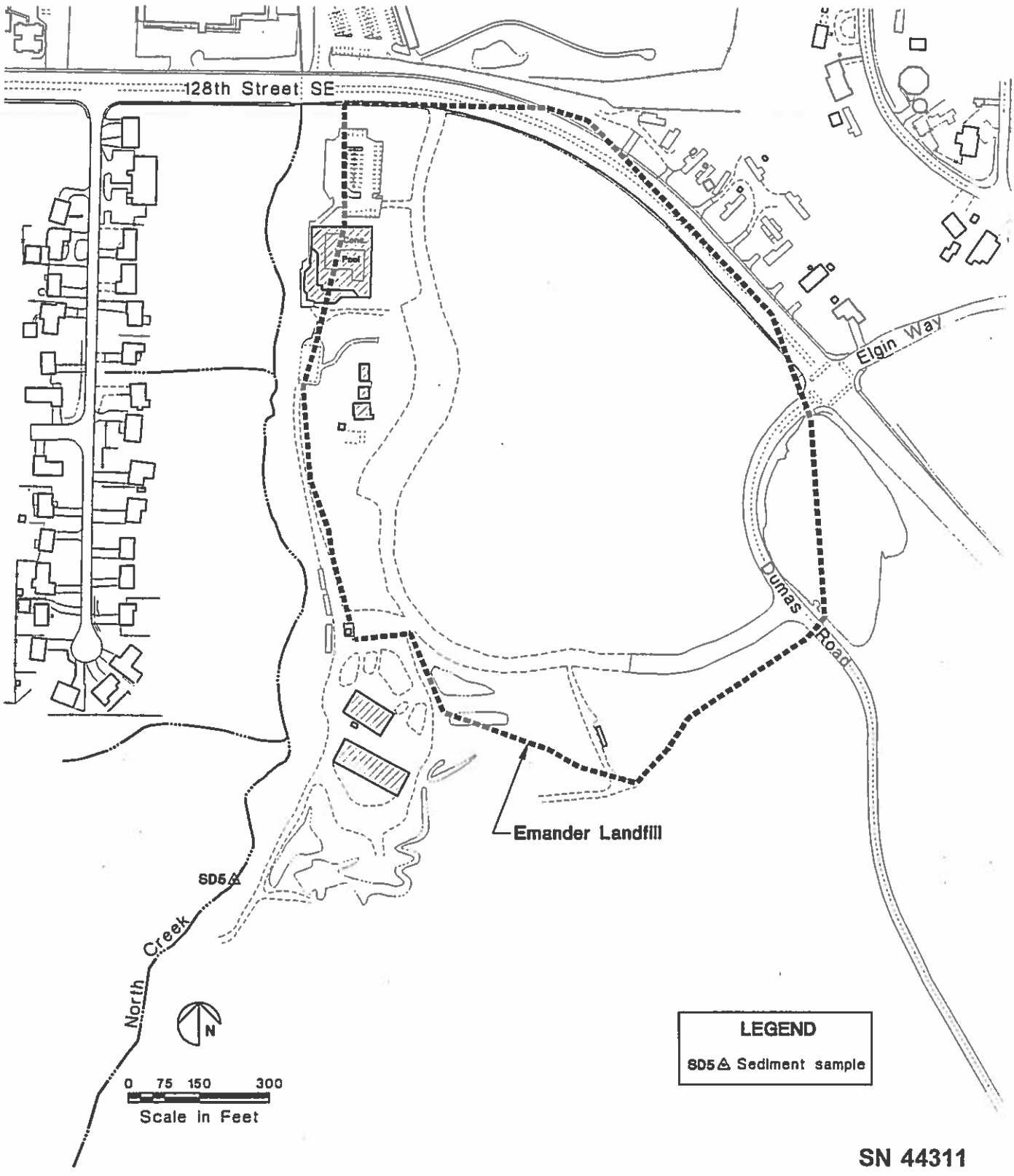
FIGURE 4

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

AGI TECHNOLOGIES

PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
15,512.279	ALW	17 Mar 95	ADC	BJA	Feb 96

plate-e4.dwg



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95

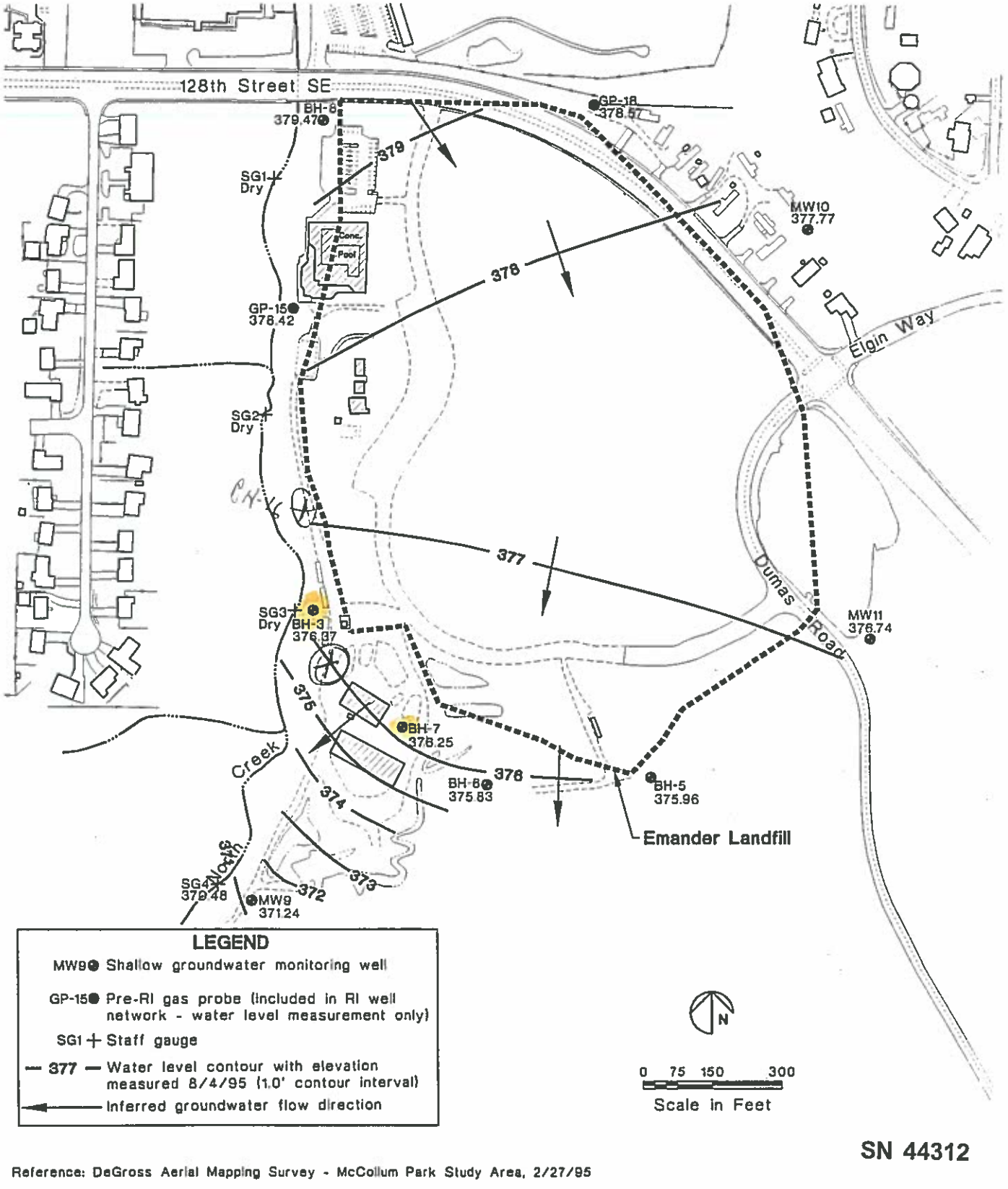
AGI TECHNOLOGIES

Sediment Sample Location

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

FIGURE **5**

	PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
plate-e5.dwg	15,512.279	ALW	17 Apr 95	ADC	BJA	Feb 96



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95

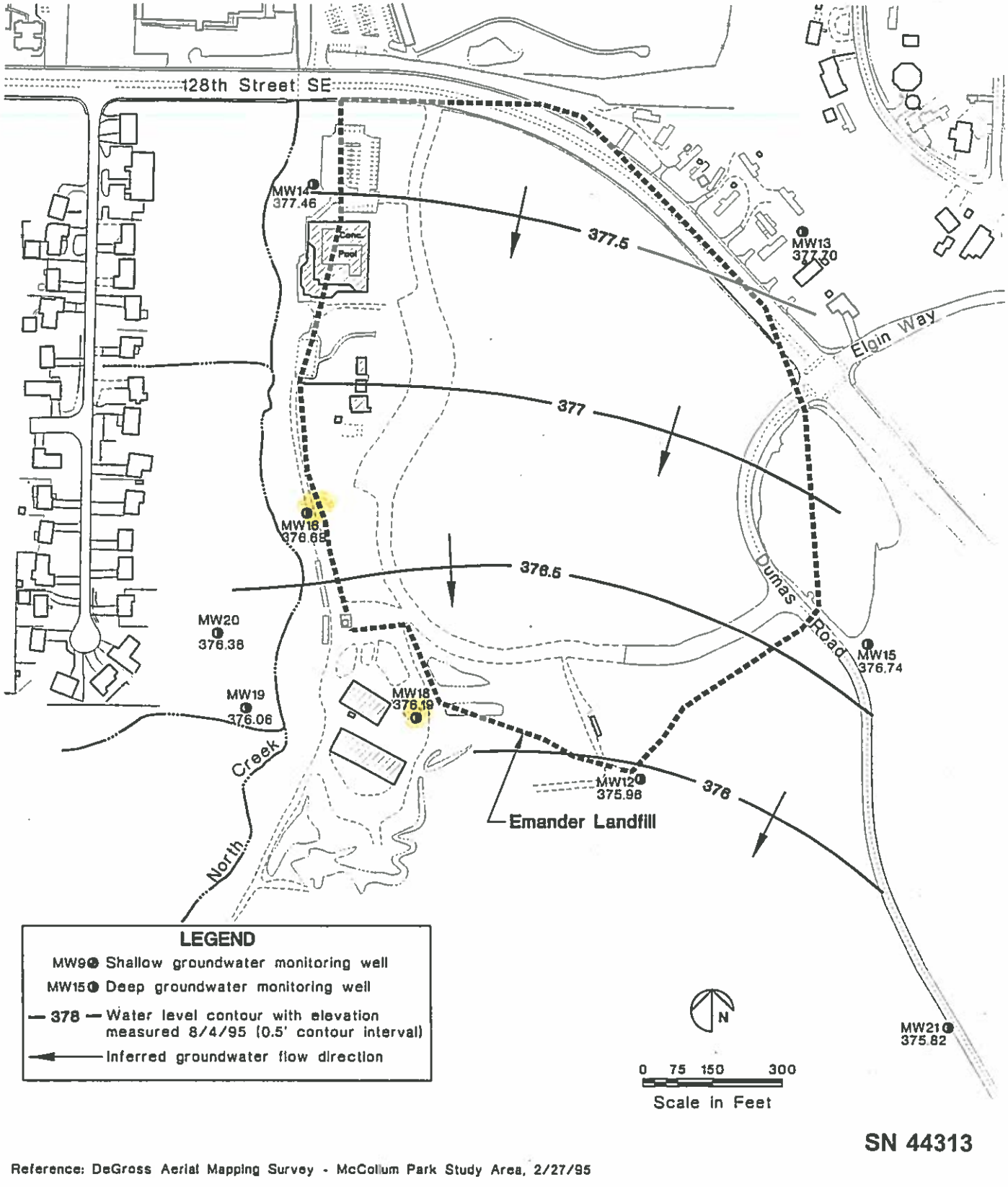
Water Table Surface - August 1995

FIGURE 6

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

AGI TECHNOLOGIES

PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
plate-e6.dwg	15,512.279	ALW	10 Oct 95	APC	BJA	Feb 96



Reference: DeGross Aerial Mapping Survey - McCollum Park Study Area, 2/27/95

Potentiometric Surface - Deep Wells - August 1995

FIGURE 7

Snohomish Co. Public Works Dept./McCollum Park/Emander Landfill Compliance Monitoring Plan
Snohomish County, Washington

AGI TECHNOLOGIES

plate-e7.dwg	PROJECT NO.	DRAWN	DATE	APPROVED	REVISED	DATE
	15,512.279	ALW	17 Apr 95	APC	BJA	Feb 96