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REPORT ON

CRITICAL ELEMENTS ANALYSIS
PINEWOOD FACILITY
SUMTER, SOUTH CAROLINA

Submitted to:

Kestrel Horizons as Trustee for the Pinewood Site Custodial Trust
20-B Creekview Court
Greenville, SC 29615

Submitted by:

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April 30, 2007 063-3496A

Kestrel Horizons, LLC
20-B Creekview Court
Greenville, SC 29615

Attn: William A. Stephens, P.E.
Principal

RE: CRITICAL ELEMENTS ANALYSIS
PINEWOOD FACILITY, SUMTER, SOUTH CAROLINA

Dear Mr. Stephens:

Attached is Golder Associates Inc's (Golder's) Critical Elements Analysis report for the Pinewood Facility. Golder continues to appreciate the opportunity to work with Kestrel Horizons on this interesting project. If you have any questions about the report, please call.

Very truly yours,

GOLDER ASSOCIATES INC.

Claudia M. Moeller, P.E.
Senior Engineer

Gary H. Collison, P.E.
Principal and Practice/Program Leader

CMM/GHC

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General Conclusions

- One of the more significant factors noted for most all of the landfill Section cells is that their bottoms (floors) have been constructed below the groundwater table. This creates inward hydraulic pressure (gradient) over most of the Secondary liners and over the Section I Primary liner. These inward gradients significantly inhibit advective migration of leachate from the landfills. However, over the long term, they will likely add to the volume of leachate, particularly in Section I because it has what is likely the least robust lining system of the three landfill Sections.

- The November 2006 topographic map provides evidence of low areas on the cover surfaces of each of the Pinewood Landfills where water may not drain properly.

Section I – Specific Conclusions

- Average leachate production rates are more than twice those in Section II. Because it was constructed, operated and closed between 22 and 29 years ago, Section I does not appear to be performing as well as Section II, but is likely performing as well as might be expected given the components and methods used in its construction, operation and closure. The higher leachate rates are ascribed to the lower effectiveness of the cover system in reducing rainfall infiltration and to inflow of groundwater.

- A new cover system could be constructed on Section I and this would potentially reduce leachate production in half. However, this is financially sound only if the cost of treating or disposing of the Section I leachate increases to at least two (2) times the current amounts (refer to Leachate Treatment Evaluation Report).

- The likelihood for leachate migration along the northwest side of Cell 1A into the sand lenses of the Opaline Claystone is considered low. Leachate would preferentially drain down in the inside of the landfill side slope rather than flow sideways through the liner with little lateral driving head.

Section II– Specific Conclusions

- Section II appears to be performing as would be expected for a landfill constructed to relatively modern standards that has been closed for 15 to 20 years.

- Cells 2A and 2B only have a Primary liner and LCRS. Cells 2C through 2G include Primary and Secondary composite liner systems using HDPE geomembranes with a Primary LCRS and a Secondary LDS.

- The final cover system constructed on Section II includes low permeability soil and a HDPE geomembrane. There is no internal drainage layer in the cover system on Cells 2A and half of Area 2B, but the remaining Section II cover includes one. This drainage layer does not have an outlet to effectively discharge the water that is collected within the layer, and water will tend to collect at the toe of the slopes and can back-up and saturate the overlying soil well up the side slopes. This increases the potential for infiltration through the cover and results in wet areas near the slope toes that can become damaged during routine maintenance of the cover.

- The total average Primary LCRS pumping rates are comparable to the published rates for other closed landfill cells in the southeast. The flows in the secondary system of Section II are also comparable to the rates noted by EPA for most cells containing hazardous waste in the southeast closed more than six years. Both the Primary and Secondary pumping rates show decreases over time, which is also consistent with the EPA data.

- The likelihood for leachate migration from Section II through the southern slope of Cell 2A and the east and west slopes of Cell 2B into the sand lenses of the Opaline Claystone is considered remote for the same reasons as discussed for Section I.

- There are no monitoring wells screened in the upper zone of the Opaline Claystone along the southern slope of Cell 2A and the east and west slopes of Cell 2B, therefore a release from these cells would not be detected.

<u>Section III– Specific Conclusions</u>

- Performance of Section III cannot be precisely evaluated because of operating conditions during the Safety Kleen bankruptcy and because it was recently closed, but the leachate rates are decreasing rapidly and the components used to construct the liner and cover system would be expected to yield performance equal to, and perhaps better than, Section II.

- The cover system includes a composite liner and a drainage layer, but, as in Section II, this layer has no outlet.

- The total Primary LCRS pumping rates from before to immediately after the recent closure of Section III fluctuate widely. These wide fluctuations and high pumping rates are ascribed to operation and closure activities during the bankruptcy period beginning in 2000 and the filling and closure activities of Cell 3B Extension and Cell 3C that began in 2005 and that were completed in early 2006.

- The leachate pumping rates are what should have been expected given the operating and closure practices. The pumping rates have been decreasing and are expected to continue to decrease over the next several years. Based on EPA reported data, it may take five years or more for the rates to stabilize.

- The potential for surface water infiltration through the anchor trenches was evaluated. The perimeter ditch and the anchor trench along the toe of the Closure Cell cover system are at approximately the same elevation and are in close proximity, and the Primary and Secondary liners are not welded together at Section III. If water is allowed to pond continuously along the Cell 3C perimeter ditch, infiltration may occur.

- Around the remainder of Section III, the anchor trench and the bottom of the ditches are separated both vertically and horizontally by earth fill, therefore it is not expected that infiltration of ponded water in the ditches will be a source of liquids in the Secondary Systems of Cells 3A and 3B.

Recommendations Applicable To All Areas

- The leachate pumping rate data provides excellent input to the performance of the landfill cover and liner systems. Accurate leachate data should continue to be collected and should be evaluated at least annually.

- The data reviewed for this analysis indicates numerous spikes for all of the Sections. A significant spike could be an indication of a broken seal between the sump and the cover, and therefore the connection between the sump and the cover geomembrane should be inspected for leaks.

- It appears that the leachate in some sumps has become more viscous, described as being "gummy" or "stringy". This is known to be caused by the release of carbon dioxide (CO_2) as leachate enters the sump, which in turn increases the pH. With the pH change and in the presence of oxygen, the leachate becomes more viscous. The solution is to eliminate the oxygen (air) by installing a "P" trap in the riser from the sump pump and by installing a top on the outer casing and sealing the top to the sides of the outer casing, along with any penetrations of the top or the outer casing. If viscous leachate residue has built up in the sump, Glycholic acid can be introduced to break it down into a pumpable liquid.

- The cover surface topography should be regularly reviewed to identify and repair any depressions so that water does not pond.

- Flat ditches along the toe of the landfills need be re-designed or modified to the degree practicable, to reduce the potential to pond water.

- In those locations where ditches are near-horizontal or do not drain properly, it may be possible to redesign the roads such that the inside ditch is filled, the road is raised vertically and cross-sloped toward the outside of the road, and the outside ditch is enlarged and regarded to properly drain. This may require that the stormwater conveyance systems at and around the toes of the landfill cover slopes (including the existing culverts and drop inlets) be evaluated in detail and possibly redesigned. Specific locations of these conditions are discussed in the report.

- There appears to be some uncertainty that drop inlets along the northern boundary of the site route stormwater to Pond B. This should be confirmed.

- The drawings for Sections I and II are not of the quality and accuracy as the drawings for Section III. Also, the drawings are on different coordinate systems. All drawings should be produced in the same coordinate system and properly scaled, and the waste limit, anchor trenches locations, limits of the cover system, and the location of structures be identified and located.

<u>Recommendations Specific to Section I</u>

- Because reliable pumping rates are available only since about the second quarter of 2005, and because some of the individual sump rates have wide fluctuations compared to others, it is recommended that the reliable rates be monitored for two to three years before using the data to pursue an evaluation of the financial viability of a new cover.

- Groundwater monitoring along the northwest boundary of Cell 1A (between Cell 1A and the FFB Channel) is appropriate for detecting a leachate release. However, the existing 300-foot monitoring wells spacing may be too wide to adequately monitor the area and the spacing should be evaluated by the Pinewood groundwater team.

- Consideration should be given to redirecting the stormwater from the top of the slopes that bound the landfill along the south and southeast sides. This stormwater could be diverted along the road at the top of the slope, instead of directing it towards Section I and along the toe of the cover system.

Recommendations Specific to Section II

- The installation of a toe drain for the Section II cover system is recommended. The installed cost of a two-inch PVC pipe placed in a shallow a gravel trench and surrounded with a geotextile fabric is estimated to be on the order of $30.00 per foot. The perimeter of the cover in Section II is about 5,200 feet, therefore the cost of this drain would be on the order of $156,000.

- It is recommended that monitoring wells be considered to monitor the shallow Opaline Claystone along the southern slope of Cell 2A and the east and west slopes of Cell 2B with the spacing between wells evaluated as recommended for Section I.

- Stormwater from the southern portion of the cover is routed to an area between the south access road and Pond A. At this location the water does not drain. This area needs to be regraded, and a ditch designed to direct flow to Pond A.

Recommendations Specific to Section III

- The installation of a toe drain for the Section III cover system is recommended. The perimeter of the cover in Section III, about 4,000 feet, would be approximately $120,000.

- It is noted in the November 2006 aerial photograph that portions of the cover directly on Area 3C, the Closure Cell, are not vegetated. To avoid erosion of the cover soils, this area needs to be stabilized with grass or erosion control mats.

- To avoid surface water infiltration into the Secondary LDS, the perimeter ditches should be maintained so that they properly drain. However, if in the future it is found that this infiltration mechanism becomes a chronic source of liquids into the Secondary LDS, the run-on (flat) area of the anchor trenches can be exposed and the top of the Primary geomembrane can be cut and the cut edge welded to the Secondary geomembrane.

1.0 INTRODUCTION

1.1 Purpose and Scope

In December 2003, the Pinewood Site Custodial Trust was formed and Kestrel Horizons, LLC (Kestrel) of Greenville, South Carolina, as approved by the South Carolina Department of Health and Environmental Control (SCDHEC), became the Trustee. The Primary mission of Kestrel as Trustee is to insure the responsible use of Trust funds in carrying out the activities required to complete closure of the Pinewood Facility (Pinewood) and to care for and monitor the Site in accordance with the applicable laws, regulations, permits and agreements. As Trustee, Kestrel is responsible to oversee consultants, contractors and suppliers who provide services in study, design, construction, remediation, operation, maintenance, transportation, disposal, and monitoring for the Pinewood Site.

In the third quarter of 2006, Kestrel retained Golder Associates Inc. (Golder) to carry out a Critical Element Analysis of the landfills, known as Sections I, II and III, and a Leachate Treatment Evaluation. The Critical Element Analysis is a design and post-closure maintenance review to 1Dentify critical elements of post-closure operations and maintenance (O&M) to achieve, to the degree practicable, continued performance of the landfill liner and cover systems in accordance with the original design intent and construction. In addition, the Critical Elements Analysis has considered potential mechanisms for leachate release from the landfill cells to the upper sand layers of the Opaline Claystone, and potential options for either addressing those releases should they be detected or installing corrective measures in advance that can be activated to control/capture such releases should they occur. The Leachate Treatment Evaluation is a study to evaluate the potential for on-Site treatment of leachate with the goal of reducing future post-closure operations costs. The Leachate Treatment Evaluation report is submitted under separate cover.

Based on discussions with Kestrel and Golder's participation in the September 2006 Green Team Review, the Critical Elements Analysis has focused on the following:

- Interaction of surface water with the cover and liner systems and review of Site surface water drainage to determine ways to mitigate adverse interactions;
- Review of leachate pumping records to determine if there is evidence of ingress of surface water or groundwater into the leachate collection and detection systems and if so, suggest ways to reduce that ingress; and

- Provide conceptual approaches, and discuss the pros and cons, of preventing or curing potential releases of leachate from the landfills through and/or above the shallow groundwater that might enter the deeper surface water ditches.

To perform its Critical Elements Analysis, Golder used information provided by Kestrel, including the as-build drawings of the covers, liners and leachate collection systems; 2006 topographic mapping; and the leachate pumping data. In its analysis, Golder is relying on Kestrel's and DHEC's understandings of the landfill systems and of the hydrogeologic regime and groundwater monitoring system. Golder's scope does not include an evaluation of the hydrologic system or the groundwater monitoring or leachate chemistry data.

1.2 Background

1.2.1 Geological Setting

A generalized stratigraphic column of the geology at Pinewood is shown on Figure 1-1. The upper formation is the Lang Syne which is underlain by the Sawdust Landing and Upper Black Creek formations. The Lang Syne is about 60 feet thick at Pinewood and the upper part of the formation is known as the massive Opaline Claystone. The landfill sections are constructed within the Opaline Claystone.

Groundwater occurs in the Lang Syne under water table conditions within the undifferentiated sediments in the fractured upper part of the Opaline Claystone unit that locally contains sand lenses. The Transitional Lang Syne is considered the uppermost aquifer. The Primary and Secondary Sawdust Landing units are the second and third aquifers, respectively. The Black Creek formation is the fourth aquifer. Groundwater monitoring wells are located within each of the water bearing units.

1.2.2 Section I Description

The Section I landfill consists of five disposal cells (Cell 1A through 1E) that occupy between 2.5 and 6.6 acres each, for a total of approximately 19 acres. Section I is the oldest landfill at the Pinewood, having been constructed and operated between 1978 and 1984 and closed between 1980 and 1985. The maximum thickness of waste placed in Section I was on the order of 45 feet. Hazardous wastes disposed in Section I included liquids, which were later banned by the United States Environmental Protection Agency (EPA) from land disposal.

A French drain was built along the perimeter of Cell 1E to control groundwater seepage during construction. The French drain consists of a gravel trench and pipe (with intermediate manholes) installed along the top of the Opaline Claystone, beginning in the northernmost corner of Cell 1E with a bottom level at about 117 feet mean seal level (MSL) and extending along the southern and western sides of Cell 1E down to approximate elevation 100 feet MSL. The Section I French drain connects to a site-wide French drain that collects shallow groundwater from sand lenses within the upper Opaline Claystone and directs the collected water to Pond A.

Section I was excavated to a depth approximately 20 feet below the top of the massive Opaline Claystone, with elevations ranging from approximately 80 to 82 feet MSL. The containment system of Section I consists of a compacted clay liner placed to a reported minimum permeability of 1×10^{-7} centimeters per second (cm/sec), overlain by a 30-mil thick chlorosulphonated polyethylene (CSPE) geomembrane (trade named Hypalon®). The Hypalon® extended along the bases and the slopes of the disposal areas and was anchored in one-foot deep by one-foot wide anchor trenches. The clay liner is five feet thick on the bottom and the side slopes of the disposal areas. In the upper portion of the Cell 1E side slopes, where the upper Opaline Claystone contained sand lenses, the slope was laterally over-excavated and replaced by a 10-foot thick clay liner segment. The available as-built drawings for Cell 1B, 1C, and 1D do not indicate that the upper Opaline Claystone was over excavated and replaced with a thickened clay segment. There are apparently no as-built drawings for Cell 1A.

A two-foot thick layer of sand was placed on the Hypalon® as a protective cover layer and a Primary leachate collection and removal system (LCRS) was installed within the protective cover layer. The Primary LCRS reportedly consists of gravel surrounding eight-inch corrugated high density polyethylene (HDPE) pipes to carry leachate to sumps constructed in the center of the disposal cells. Each disposal cell contains three or four low sump areas, for a total of 16 sumps in Section I. Leachate from each Primary LCRS sump is removed by pumps placed inside 48-inch diameter vertical concrete riser pipes.

The cover system of Section I consists of the following layers, from top to bottom:

- Six-inch thick topsoil layer;
- Two-foot thick (minimum) protective soil layer;

- Two-foot thick clay cover layer (with a maximum hydraulic conductivity of 1×10^{-6} cm/sec);
- 20-mil thick polyvinyl chloride (PVC) geomembrane that was spliced to the bottom Hypalon® liner, and
- One-foot thick sandy clay layer directly over the waste.

The Section I cover was constructed to slope upwards at a five percent slope from the perimeter toward the center. Stormwater flows from the cover to a perimeter ditch that directs runoff to Pond A. Section I is currently well vegetated.

1.2.3 Section II Description

The Section II landfill consists of seven disposal cells (Cell 2A through 2G) ranging from 4.4 to 8.5 acres in size, for a total of approximately 41 acres. Section II was constructed between 1985 and 1991 and the Cells were closed between 1986 and 1993. The maximum thickness of waste placed in Section II is about 75 feet. Similar to Section I, the Section II disposal Cells were excavated 10 to 20 feet below the surface of the massive Opaline Claystone.

The first two cells, Cells 2A and 2B, of Section II were constructed with a single composite liner overlain by a Primary LCRS. The liner system for Cells 2A and 2B included a compacted clay liner overlain by an 80-mil thick HDPE geomembrane. As in Cell 1E of Section I, the clay liner is five (5) feet thick on the bottom of the disposal areas and on the lower portions of the side slopes, and ten (10) feet thick in the upper portion of the side slopes where the upper Opaline Claystone contained sand lenses. The Primary LCRS consists of a one-foot foot thick sand layer above the 80-mil HDPE liner. Slotted four-inch diameter corrugated HDPE pipes were placed in gravel trenches within the sand layer. Hazardous waste disposed of in Cells 2A and 2B included drummed liquids that were later banned from land disposal by EPA.

In response to changes in the Resource Conservation and Recovery Act (RCRA), and state regulations, Cells 2C through 2G were constructed with double composite liner systems. The upper system is the Primary leachate collection and removal system (Primary LCRS). The lower is the Secondary leak detection system (Secondary LDS). The combined liner/leachate systems include the following components, from top to bottom:

- Primary LCRS:

  - One-foot thick sandy clay protective cover layer;
  - One-foot thick gravel drainage layer;
  - Cushion geotextile (to protect the geomembrane from being punctured by the overlaying gravel)
  - 80-mil thick HDPE geomembrane; and
  - Five-foot thick compacted Primary clay liner with a minimum permeability of $1x10^{-7}$ cm/sec;
- Secondary LDS:
  - One-foot thick gravel layer across the base of the landfill Areas and a geocomposite on the side slopes (the LDS);
  - 80-mil thick HDPE Secondary geomembrane; and
  - Three-foot thick compacted Secondary clay liner with a minimum permeability of $1x10^{-7}$ cm/sec. In Cells 2C and 2D the Secondary clay liner is 8.5 and 7.0 feet thick, respectively, along the western slopes and above the massive Opaline Clay);

The Primary and Secondary HDPE geomembranes were connected by a flap at the top of the interior side slopes (known as a "cut-off strip").

The bases of the Cells of Section II are graded to direct leachate towards leachate sumps. Leachate from each Primary LCRS sump is removed by pumps placed inside 48-inch diameter vertical concrete riser pipes. In Cells 2C to 2G, the Secondary LDS sumps are located below the Primary LCRS sumps.

Cell 2B, which was single lined, and Cell 2C, which was the first double-lined area at Pinewood, were separated by a compacted soil layer built on top of the sloped surface of waste that had been placed in Cell 2B. The Secondary liner and LDS of Cell 2C were then constructed over top of this soil layer. Thus, part of Cell 2C overlies part of Cell 2B.

The cover system constructed on Cells 2A and 2B consists of the following layers, beginning with the uppermost layer:

- Six inches of topsoil (vegetated);
- Two feet of sandy clay;
- 20 mil polyethylene (PE) vapor layer (overlapped, not welded);

- Two feet of clay with a minimum permeability of $1x10^{-7}$ cm/sec;
- 40 mil thick HDPE geomembrane, which was welded to the Primary 80 mil HDPE geomembrane liner; and
- Two feet of intermediate cover.

The cover system constructed on Cells 2C through 2G is slightly different from the cover built on Cells 2A and 2B, and consists of the following layers beginning with the uppermost layer:

- Six inches of topsoil (vegetated);
- 18 inches of protective soil/drainage layer;
- A single sided geocomposite drain;
- 20 mil thick HDPE or very low density polyethylene (VLDPE) vapor barrier (leistered but not welded);
- Two feet of clay with a minimum permeability of $1x10^{-7}$ cm/sec; and
- 30 mil thick HDPE geomembrane welded to the cut-off flap that was previously welded to the HDPE geomembrane of the Primary and Secondary liner systems.

The cover of Section II is currently vegetated and generally drains towards perimeter ditches. Runoff from the northern half of Section II drains to ditches that direct flow to Pond B. Runoff from the southern half of Section II drains to a portion of the perimeter ditch that generally directs flow to Pond A.

1.2.4 Section III Description

Section III consists of four disposal cells, (Cells 3A, 3B, 3B Extension and 3C), ranging from about 6 to 11.4 acres in size, for a total area of about 23 acres. Section III of Pinewood was operated for disposal of non-hazardous and hazardous waste until 2000, when the owner (Safety Kleen) went bankrupt. At that time, disposal Cells 3A and 3B had been constructed and closed, and Cell 3B Extension was open and partially filled with waste.

In 2005 the cell east of Cell 3B, known as Cell 3B Extension, which had been partially filled, and the future cell south of Cells 3A and 3B, known as Cell 3C or the Closure Cell, were filled with soil and closed. Before filling, a double composite liner, similar to that already in place in Cells3A, and 3B, and 3B Extension was installed in the Closure Cell. The Closure Cell and the upper portion of Cell 3B Extension were filled with approximately 750,000 cubic yards of soil, including more than

100,000 cubic yards of remediated soil that had been affected by oil recycling operations in the 1970's not related to the hazardous waste landfill operation. These soils were required to meet strict standards before being placed in the landfill, as no materials defined as solid waste (hazardous or non-hazardous) were allowed to be placed in the landfill during closure.

The bottom of Section III was constructed to elevations lower than those of Sections I and II. The bottom elevations in Section III range from 55 to 64 feet MSL. The liners and leachate systems consist of the following layers (from top to bottom):

- Primary liner and LCRS System:
  - On the bottom, a one-foot thick protective cover soil layer underlain by a geotextile filter over top of a one-foot thick gravel drain layer underlain by a geotextile, with 6-inch diameter HDPE collection pipes;
  - On the side slopes, a two-foot thick protective cover soil layer underlain by a geocomposite drain layer that drains into the gravel layer of the bottom;
  - 80 mil thick HDPE geomembrane liner, and
  - Five-foot thick compacted clay liner with a minimum permeability of 1×10^{-7} cm/sec.

- Secondary liner and LDS:
  - On the bottom, a one-foot thick gravel drain layer underlain by a geotextile filter, with 6-inch diameter HDPE collection pipes
  - On the side slopes, a geocomposite drain layer;
  - 80 mil thick HDPE geomembrane liner; and
  - Three-foot thick compacted clay liner with a minimum permeability of 1×10^{-7} cm/sec.

The Primary and Secondary geomembrane liners were anchored at the top of the slope in side-by-side trenches, two feet deep and one foot wide. The two liners are not welded together.

Once the disposal areas of Section III had been brought to final grade, the cover system was completed with the following layers (from top down):

- Six inches of topsoil;
- 18 inches of protective soil cover/drainage layer;
- Double-sided geocomposite drain layer;
- 60 mil thick texture HDPE geomembrane (welded to the Primary geomembrane); and

- Two-foot thick compacted clay with a minimum permeability of 1 x 10^{-7} cm/sec.

Surface water runoff from the northern portion of Section III drains to perimeter ditches that direct the flow to a storm sewer that discharges to Pond B. Runoff from the eastern and southern portions drains to the First Flush Basin.

The closure of Section III of the landfill was completed in the first quarter of 2006. As of November 2006, the cover over Cells 3A, 3B and 3B Extension were vegetated. However, a portion of the Closure Cell (Cell 3C) was bare at that time.

2.0 ANALYSES

2.1 Sump Pumping Rates

2.1.1 General

Golder used the flow data available for Sections I, II, and III, including pumping data from the LDS sumps in Sections II and III, to generally assess the potential effectiveness of the existing final cover systems in minimizing rainfall infiltration into the waste mass and becoming leachate. Golder points out that there is no means to accurately determine the amount of water from surface or groundwater infiltration contributing to the total leachate volume. Furthermore, calculation estimates of the contribution to leachate from these sources (excepting the obvious when the landfill bottom is above groundwater levels) is approximate at best, and heavily influenced by assumptions made in the calculations for permeability of the various cover and liner materials. The groundwater inflow calculations should be viewed to indicate whether groundwater flow is inward to the landfill and, if so, that there is likely a measurable contribution from groundwater in the leachate. Consequently, comparison of pumping rates from landfill to landfill and to published data from other sites has been used for the assessment.

2.1.2 Summary Plots of Pumping Rates

Using Pinewood records, the quarterly average Primary Leachate Collection and Removal System (LCRS) and Secondary Leachate Detection System (LDS) pumping rates for the five year period between the fourth quarter of 2001 and September 2006, normalized to a gallon per acre per day (gpad) basis, were plotted for each Section, Cell and individual Sump. Section I and Cells 2A and 2B of Section II have no Secondary LDS because they pre-date federal and state regulations requiring a Secondary LDS. Kestrel Horizons has indicated that there were calibration errors of the reported pumping volumes for Section I prior to about the second quarter of 2005, but the amount of error has not been quantified. Therefore, the pumping data for Section I are presented as reported.

Summary plots of the pumping data are presented on the following figures:

- Figure 2-1 Total Primary and Secondary Sumps Flow Rates, Sections I, II and III
- Figure 2-2 Primary Sumps Flow Rates, Sections I, II and III
- Figure 2-3 Secondary Sumps Flow Rates, Sections II and III
- Figure 2-4 Primary Sumps Flow Rates, Section I, All Sumps
- Figure 2-5 Primary Sumps Flow Rates, Section II, All Sumps
- Figure 2-6 Primary Sumps Flow Rates, Section III, All Sumps

- Figure 2-7 Secondary Sumps Flow Rates, Section II, All Sumps
- Figure 2-8 Secondary Sumps Flow Rates, Section III, All Sumps

In addition to the summaries listed above, the data and plots for each sump are provided in Appendix A. For comparison of the data between Sumps, Cells and Sections, the scale is kept the same to the degree practicable on the summary plots on Figures 2-1 through 2-8. For the summary plots of total LCRS flow rates in Sections I, II and III on Figures 2-1, 2-2 and 2-3 the vertical scale extends to 300 gpad. This same scale is used for the LCRS sump flow rates for Sections I and II and for the LDS sump flow rates for Sections II and III (Figures 2-4, 2-5, 2-7, and 2-8). Because of the higher LCRS volumes in Section III, the LCRS scale extends to 900 gpad on Figure 2-6.

A similar scale convention is used for the individual sump plots, but the scales are different. For the LCRS sumps in Sections I and II, the scale extends to 150 gpad. Because of the higher LCRS flow rates in Section III, the LCRS scale for the individual sump plots extends to 1,500 gpad. The scale for the Secondary LDS flow rates for individual sumps in both Sections II and III extends to 150 gpad.

For reference, monthly rainfall is included on each plot in inches. For the period the fourth quarter of 2001 through September 2003 the rainfall was obtained from records at the nearby Shaw Air Force Base airport. For the period the fourth quarter of 2003 through September 2006 the rainfall data is from Pinewood on-site records.

Monthly rainfall volume was also used to estimate the average volume (in gallons per year) of leachate that is produced from direct rainfall into the open top of the Primary leachate collection system riser pipes.

2.1.3 Section I Leachate Pumping Rates

The Section I landfill is the oldest of the three landfill sections and was closed between 1980 and 1985. The quarterly average LCRS pumping rates for Section I are shown on Figures 2-1 and 2-2 and the individual sump flow rates are summarized on Figure 2-4.

Beginning in the spring of 2005, the quarterly average total pumping rate for Section I appears higher than for previous periods (see Figure 2-1), which is also reflected in the records for most of the individual sumps (see Figure 2-4 and Appendix A-1). Prior to the second quarter of 2005 the average pumping rate was between about 12 and 25 gpad (between about 0.17 and 0.34 inches of leachate per year per unit area) and after the second quarter of 2005 the rate is between about 25 and 38 gpad between about 0.34 and 0.51 inches of leachate per year per unit area). . Kestrel Horizons has indicated that this apparent increase was due to calibration errors of the reported pumping volumes prior to about the second quarter of 2005. Consequently, the pumping records cannot be used to infer that there was an occurrence, such as increased infiltration, that caused the apparent increase. The rates since the second quarter of 2005 are considered to be more representative of the rates for the entire period.

Even when considering the calibration errors of the pumping rates measured, the reported sump rates are relatively steady over the five-year period, with most being below 50 gpad. The pumping rate of six of the sixteen sumps is occasionally over 50 gpad, however, Sumps 1D2P and 1D3P have flow rates that fluctuate considerably over most of the period. There is no obvious explanation for these fluctuations and they do not appear to follow rainfall patterns that would suggest leakage into the sumps from the surface. Also, there are no obvious surface depressions around the sump riser pipe locations.

The volume of leachate from direct rainfall into the open top of the vertical riser pipes was estimated to range from 0.02 gallons per sump per day to 1.23 gallons per sump per day. In Section I, where there are sixteen (16) risers, the estimated volume of leachate from rainfall was approximately 4,000 gallons in 2002, 6,000 gallons in 2003, 4,400 gallons in 2004, 4,700 gallons in 2005, and 5,000 gallons in 2006.

2.1.4 Section II Sumps Pumping Rates

2.1.4.1 General

The quarterly average total LCRS pumping rates for Section II are shown on Figures 2-1 and 2-2. On Figure 2-2, the LCRS pumping rates for Cells A and B are plotted separately from those of Cells C through G.

The total LDS flow rates for Cells C through G are shown on Figures 2-1 and 2-3. As noted in Section II.1.2, Cells A and B have no LDS because they were constructed before the federal and state regulations required it.

Individual LCRS sump flow rates are summarized on Figure 2-5 and presented for the individual sumps in Appendix A-1. Secondary LDS sump flow rates are summarized on Figure 2-7 and presented in Appendix A-2.

2.1.4.2 Section II LCRS Pumping Rates

The total LCRS pumping rates for Section II are shown on Figures 2-1 and 2-2 and individual sump flow rates are shown on Figure 2-5. Overall, the total LCRS pumping rates are less than about 15 gpad (about 0.20 inches of leachate per year per unit area) and show a slight decreasing trend over time.

In contrast to most of the sump flow rates, the pumping rates for Sumps 2G2P and 2G3P show slightly increasing trends beginning in the first quarter of 2004 for Sump 2G2P and the third quarter of 2005 for Sump 2G3P. There are no obvious explanations for these slight increases.

With the exception of a few short periods, the pumping rates for all but two of the sumps are below 25 gpad for each quarter over the last five-year period (see Figure 2-5). The exceptions are Sumps 2B2P and 2F3P. The pumping rates for these two sumps are generally above 25 gpad with 2F3P reporting between about 50 and 70 gpad for several periods. The elevated pumping rates for these two sumps do not appear to follow rainfall patterns that would suggest leakage into the sumps from the surface. Furthermore, Sump 2B2P is in the center of Section II and lies beneath the area where Cell C overlies Cell B, which should yield a low flow to the sump rather than a high flow. There is no obvious explanation for the pumping rate fluctuations at these two sumps.

The total quarterly flow rate from LCRS sumps in Cells A and B is slightly higher than the total quarterly flow rate from Cells C thru G, but lower than the total flow rate of Section I. The total LCRS quarterly pumping rate ranges from a low of 8 gpad (2nd quarter 2006) to a high of 16 gpad (2nd quarter 2003) for Areas A and B. Conversely, the total LCRS quarterly pumping rate ranges from a low of 5.5 gpad (1st quarter 2006) to a high of 13.5 gpad (2nd quarter 2003) for Cells C to G.

In Section II, where there are twenty-one (21) risers, the estimated volume of leachate from direct rainfall into the risers was approximately 5,200 gallons in 2002, 8,100 gallons in 2003, 5,800 gallons in 2004, 6,200 gallons in 2005, and 6,500 gallons in 2006.

2.1.4.3 Section II Secondary LDS Pumping Rates

The total LDS pumping rates for Section II are shown on Figures 2-1 and 2-3 and individual sump flow rates are shown on Figure 2-7. Overall, the total LDS sump flow rates are less than about 6 gpad (about 0.08 inches of leachate per year per unit area) and show a slight decreasing trend over time similar to the rates for the Primary LCRS.

For the quarterly periods, most of the pumping rates for the individual LDS sumps are lower than about 10 gpad, with many being near zero (see Figure 2-7). The notable exceptions are Sumps 2G1S and 2G3S. Quarterly pumping rates for these two sumps fluctuate from near zero to as high as about 38 gpad. However, both sumps appear to have reduced pumping rates more in line with the average for the other sumps since the fourth quarter of 2004 for Sump 2G1S and since the fourth quarter of 2005 for Sump 2G3S. The pattern of the earlier pumping fluctuations does not appear to directly follow rainfall patterns. Furthermore, the pumping fluctuation patterns do not follow the pumping patterns of the overlying Primary LCRS Sumps 2G1P and 2G3P.

2.1.5 <u>Section III Sump Pumping Rates</u>

2.1.5.1 General

The quarterly average total Primary LCRS pumping rates for Section III are shown on Figures 2-1 and 2-2. The total Secondary LDS flow rates are shown on Figures 2-1 and 2-3. Individual Primary LCRS sump flow rates are summarized on Figure 2-6 and presented in Appendix A-1. Secondary LDS sump flow rates are summarized on Figure 2-8 and presented in Appendix A-2.

2.1.5.2 Section III Primary LCRS Pumping Rates

As shown on Figures 2-1 and 2-2, the total LCRS pumping rates fluctuate widely from just under 100 gpad to over 270 gpad (about 1.4 to 3.7 inches of leachate per year per unit area). These are flow rates from before to immediately after the recent closure of Section III.

Section III has eight LCRS sumps. Of these, Sumps 3C1P and 3C2P were constructed during the closure of Cell 3B Extension and 3C, and pumping rate records begin in the first quarter of 2005. The records for these two sumps indicate that pumping rates have been decreasing since the second quarter of 2005 when the closure of Section III was initiated. In the second quarter of 2005 the Sump 3C1P rate was about 530 gpad and Sump 3C2P had a rate of about 900 gpad. These rates both dropped to about 125 gpad by the third quarter of 2006.

The other six sumps in Section III have pumping records for the last five years. Of these six sumps, Sumps 3A1P, 3A2P and 3B2P indicate fairly low pumping rates compared to the other sumps in Section III. With few exceptions, the quarterly rates for these three sumps are below 125 gpad. These comparatively low rates are understandable for Sump 3A2P, but not for Sumps 3A1P and 3B2P. Sumps 3A1P and 3B2P are near what was the exposed waste face that existed at the time of the Safety Kleen bankruptcy, whereas Sump 3A2P is near the area of Section III that had been partially covered at the time. Higher rates of infiltration would have occurred through the exposed waste face than through the covered area.

The pumping rates for the remaining three sumps in Section III, Sumps 3A3P, 3B3P and 3B1P have very different patterns. The rate for Sump 3B3P increased from about 100 gpad to about 440 gpad from the fourth quarter of 2001 to the third quarter of 2003, and has since decreased to about 30 gpad. The rate for Sump 3A3P was similar, but delayed about a year, being near zero until the third quarter of 2003 (it may not have been pumped or rates measured), increasing to 550 gpad in the third quarter of 2004 and then decreasing to just below 250 gpad in third quarter of 2006. The rate for Sump 3B1P peaked at 1,785 gpad in the second quarter of 2002, dropped to about 95 gpad the third quarter of 2002, increased again to 1,140 gpad in the third quarter of 2003, and then decreased to below about 125 gpad since the second quarter of 2004.

The wide fluctuations and high pumping rates in Section III are ascribed to operation and closure activities, or lack thereof, during the bankruptcy period beginning in 2000 and the filling and closure activities of Cell 3B Extension and Cell C that began in 2005 and that were completed in early 2006.

In Section III, where there are eight (8) risers, the estimated volume of leachate from direct rainfall into the risers was approximately 2,400 gallons in 2005, and 2,500 gallons in 2006.

2.1.5.3 Section III LDS Pumping Rates

Overall, the total LDS pumping rates in Section III are below about 6 gpad (about 0.08 inches of leachate per year per unit area). However, high pumping rates were reported at three of the sumps. Pumping rates for Sump 3A1S have ranged from about 4 to 18 gpad over the five-year period, with no apparent correlation to rainfall or fluctuations in Primary Sump 3A1P.

Pumping rate records for Sumps 3C1S and 3C2S begin in the first quarter of 2005 corresponding to closure activities. The pumping rates for these two Secondary LDS sumps increase to peaks of 69 gpad at Sump 3C1S and 181 gpad at 3C2S in the third quarter of 2005. Kestrel has indicated that it suspects that surface water entered the Secondary system during the construction and filling period, possibly because the anchor trenches were not under final cover at the time. This explanation is reasonable since the pumping rates in these sumps dropped to about 7 gpad in the third quarter of 2006, which are more in line with the other sumps. .

2.2 Groundwater Flow into the Sumps

2.2.1 General

The Pinewood landfill bottoms have been constructed at or below the groundwater levels in the geologic units. Consequently, depending on groundwater level fluctuations, there may be an inward gradient from the groundwater regime into the landfill.

The potential for groundwater flow into the different landfill Section areas has been evaluated based on available construction as-built information and groundwater level elevations as reported in the 2005 Annual Groundwater Detection Monitoring Report. The calculations are presented in Appendix B. The calculations are based on the average elevation of the Primary liner for Section I and Cells 2A and 2B of Section II and the Secondary liner for the remainder of Section II and for Section III (i.e., the calculations assume that the gravel drain layer is empty). The calculations are based on the average elevation of the top of the gravel layer of the LCRS or LDS across the floor of the landfill areas, using the Primary LCRS elevations for Section I and Cells 2A and 2B of Section II and the Secondary LDS for the remainder of Section II and for Section III (i.e., the calculations assume that the lowest gravel drain layer is full of liquid). The groundwater levels were the lowest and highest levels recorded from the nearest monitoring wells over the past five years. The groundwater levels were generally those from monitoring wells in the upper aquifer (Transitional Lang Sine) or upper water bearing unit (Opaline Claystone).

The magnitude of groundwater inflow is highly dependent on the permeability of the clay and geomembrane components of the of the bottom liner. The clay liners for all of the landfills were reportedly placed at a maximum permeability of $1x10^{-7}$ cm/sec. With this as a maximum placement value, the average placement value would have been statistically lower and a value of $5x10^{-8}$ cm/sec is considered a reasonable estimate for that average. Also, the clay liner has likely consolidated under load of the waste since placement, further decreasing its permeability. Consequently, a permeability of $1x10^{-8}$ cm/sec has been selected for the inflow estimate calculations.

The geomembrane liners for the various landfill Sections vary. Section I has a 30-mil thick Hypalon®, which would not be used in a modern landfill. Sections II and III have 80-mil thick HDPE liners that would be appropriate for modern landfills. Permeability estimates for geomembrane materials range from about $1x10^{-12}$ to $1x10^{-14}$, depending on the type of material and its thickness. However, for estimating the potential for flow through geomembranes, the material permeability is usually increased to provide an allowance for less than perfect installation (e.g., seaming irregularities, pinholes, etc.). For the calculations, a liner permeability of $1x10^{-10}$ cm/sec has been selected as reasonable for the Section I Hypalon®, and $1x10^{-11}$ cm/sec for the Section II and III HDPE. Golder points out that arguments can be made for varying the selected clay and geomembrane permeabilities, potentially by orders of magnitude either higher or lower. Furthermore, the calculations cannot account for unknown mounding of liquids in the landfills, and assume there is none. Consequently, the results of the calculations should be viewed as representing the order of magnitude of potential groundwater inflow and not as accurate estimates of actual inflows.

2.2.1 Section I Groundwater Inflow

The groundwater in the sand lenses of the upper portion of the Opaline Claystone is intercepted by a French drain that is parallel to the boundary of Cell 1E of Section I. The site-wide French drain also intercepts the groundwater along the southwestern boundary of Section I. The bottom elevation of these French drains range from about 117 feet MSL to about 100 feet MSL. Groundwater collected in these drains flows by gravity to Pond A.

Groundwater levels from the Transitional Lang Syne (TLS) are higher than the base of Section I (See Calculation in Appendix B), but are lower than the levels in the Opaline Claystone. Consequently, the groundwater levels in the Opaline Claystone are used to calculate the potential for groundwater inflow.

Groundwater levels in wells screened in the Opaline Claystone surrounding Section I have ranged from about 93 to 111 feet MSL over the last five years. The average floor elevation of the Section I areas is about 88 to 89 feet MSL. Therefore, the calculations indicate that there is an inward gradient at, and consequent potential for groundwater flow into, the Primary LCRS of Section I. The potential groundwater flow rate is estimated to range from about 9 gpad to as much as 39 gpad.

2.2.2 Section II Groundwater Inflow

Along the northern boundary of Section II, the groundwater in the sand lenses of the upper portion of the Opaline Claystone is intercepted by the site-wide French drain installed parallel to the property line. The bottom elevation of the French drain ranges from about 107 feet MSL on the northeast corner of Section II to about 90 feet MSL at the northwestern end of the drain. Groundwater collected in these drains flows by gravity towards Pond B.

There is only one monitoring well screened in the Opaline Claystone close to the boundary of Section II. This well is west of Cells 2D and 2E, and the reported groundwater levels range from 102 to 107 feet MSL in the last five years. Other water levels used in the calculations were obtained from wells screened in the TLS unit and the water level elevations range from 78 to 108 feet MSL. The average elevation of the Primary LCRS gravel in Cells 2A and B and the Secondary LDS in the remaining cells in Section II ranges from 86 to 101 feet MSL.

The calculations indicate that with the high TLS groundwater levels there is an inward gradient at, and consequent potential for groundwater flow into, nearly all of Section II. The exceptions are sump cells (sump cells meaning the area of the landfill draining to a particular sump) 2A3P and 2B3P where there is no inward gradient. With the low TLS groundwater levels, the gradient varies for the individual sump cells.
Groundwater flows into the Primary LCRS of Cells 2A and 2B were estimated to range from about 9 gpad to as much as 13 gpad. Groundwater flows into the Secondary LDS of Cells 2C and 2G were estimated to range from about 2 gpad to as much as 21 gpad.

Given that the above inflow estimates are based on the TLS groundwater levels and that the levels in the overlying Opaline Claystone and sediments are expected to be higher based on comparable levels elsewhere at the site, it is likely that the Secondary liner of nearly all of Section II is under an inward gradient most of the year. Thus, the inflow pressure and flow may be more persistent than indicated by the calculations.

A summary of the estimated gradient directions for the high and low TLS groundwater levels are summarized in the table shown below:

Section II Inward Gradient for High and Low TLS Groundwater Levels

Sump Cell	High TLS	Low TLS
2A1P	Yes	No
2A2P	Yes	No
2A3P	No	No
2B1P	Yes	No
2B2P	Yes	No
2B3P	No	No
2C1S	Yes	Yes
2C2S	Yes	Yes
2C3S	Yes	Yes
2D1S	Yes	Yes
2D2S	Yes	Yes
2D3S	Yes	Yes
2E1S	Yes	No
2E2S	Yes	No
2E3S	Yes	No
2F1S	Yes	No
2F2S	Yes	No
2F3S	Yes	Yes
2G1S	Yes	Yes
2G2S	Yes	No
2G3S	Yes	No

2.2.3 Section III Groundwater Inflow

Similar to Section II, the groundwater in the sand lenses of the upper portion of the Opaline Claystone is intercepted by the site-wide French drain installed parallel to the property line north of Section III. The bottom elevation of the French drain ranges from about 112 feet MSL at the northeast corner to about 107 feet MSL at the northwest corner of Section III. Groundwater collected in these drains flows by gravity towards Pond B.

There are no wells screened in the Opaline Claystone close to the boundary of Section III, thus the water levels used in the calculations for Section III were obtained from wells screened in the TLS unit with reported water level elevations that range from 78 to 90 feet MSL. The average Secondary LDS gravel elevation of the Section III cells ranges from 59 to 83 feet MSL.

The calculations indicate that with the low and high reported groundwater levels in the TLS there is an inward gradient within all areas, except for Cell 3C with the reported low groundwater level. Groundwater inflows into the Secondary LDS in Section III were estimated to range from about 9 gpad to as much as 25 gpad.

Given that the above inflow estimates are based on the TLS groundwater levels and that the levels in the overlying Opaline Claystone and sediments are expected to be higher based on comparable levels elsewhere at the site, it is likely that the inflow gradient is higher than estimated for Section III. Thus, the inflow pressure and flow may be more persistent than indicated by the calculations.

2.3 Stormwater Conveyance System Assessment

One of the main functions of stormwater management at a landfill facility is to minimize infiltration, (and thus leachate production) into the disposal areas. To the degree practicable, surface water should be directed away from the disposal areas and not allowed to pond on the covers or in the perimeter ditches surrounding the disposal areas.

At Pinewood, the potential interaction between the stormwater conveyance system on and around the landfills with the cover and liner systems has been assessed by evaluating the current topography of the site to determine the direction of stormwater runoff from the cover systems and from the perimeter ditches.

There are locations on site where, because of the near-horizontal topography, water does not drain properly, and thus has the potential to infiltrate into the ground and into the sand lenses within the upper portion of the Opaline Claystone. In these areas, the potential for surface water to travel horizontally into the LCRS or the LDS of the landfills has been estimated by comparing the locations of the ditch bottoms with respect to the liner anchor trenches and the existing French drains.

The information used for this evaluation consisted of site drawings, both "as-built" and design drawings, available for the landfill sections in different formats. Most of the available drawings for Sections I and II and portions of Section III are scanned figures provided in Adobe electronic files. Information about Section 3B Extension and the Closure Cell, and the existing stormwater conveyance piping (culverts, drop inlets, storm sewers) was provided in AutoCAD electronic files, as was the topographic map of the site as it existed in November 2006.

Due to the scale distortions that result when drawings are scanned, and inconsistencies in the coordinate system used in the different drawings, the exact location of the anchor trenches for each Section could not be defined with certainty. The AutoCAD drawing that included the stormwater conveyance system did not exactly match the AutoCAD drawing of the existing topography of the site, and some interpretation of the system had to be made.

Despite the variations in available drawings, and applying judgment to estimate the relative location of trenches and ditches, a sufficient understanding of the system has been obtained and is described in the following sections and further discussed in Section 3.0.

2.3.1 Section I Surface Water Drainage

Stormwater from Section I flows to a perimeter ditch that discharges to Pond A. Figure 2-9 illustrates the general flow direction as interpreted to exist in November 2006. On the west and on the south sides, Section I is bounded by a 20 to 25 foot high slope. Stormwater runoff from areas above this slope flows towards the perimeter ditches of Section I.

The bottom of the ditches constructed along the perimeter of Section I and the geomembrane anchor trenches appear to be generally at about the same elevations, but separated horizontally by the width of the clay side-slope liner built on the side slopes of Section I.

A road to access the sump risers has been built on the surface of the Section I cover. There are also five earthen berms that cover the pipes that carry leachate from the sump risers to the leachate storage tanks.

The November 2006 topographic map shows that there are at least six locations on the cover of Section I where drainage is poor. Five of these locations are adjacent to sump riser pipes (Sumps 1B1, 1B2, 1C1, 1D1, and 1E1). There is also a near-horizontal area in the southeastern corner of the Section I cover, which appears to be poorly drained.

There are three areas along the eastern ditch of Cell 1D and 1E (on both sides of the road) where the topographic map indicates culverts in low areas, but the topographic map also indicates standing water in these areas (See Figure 2-9).

2.3.2 Section II Surface Water Drainage

Stormwater drains from the Section II cover to perimeter ditches that direct the flow to Ponds A and B. Figure 2-10 illustrates the general flow direction as interpreted to exist as of November 2006.

The bottoms of the ditches constructed along the southern perimeter of Cell 2A and the geomembrane anchor trench appear to be vertically separated by about five feet of fill (i.e., the anchor trench is five feet below the bottom of the southern perimeter ditch). Around the rest of Section II, the ditch and the anchor trenches are generally at the same elevation, but offset laterally. Similar to Section I, the western slope of Section II has a thickened clay liner along the upper side slopes (10 feet thick in Cells 2A and 2B, 8.5 feet thick Secondary clay liner in Cell 2C, and 7 feet thick Secondary clay liner in Cell 2D), constructed to detain seepage from the sand lenses in the upper portion of the Opaline Claystone. The surface water ditches appear to be located outside of the limits of the thickened side-slope liners.

Roads have been built on the surface of Section II to access the sump risers. Earthen berms cover the pipes that carry leachate from the sump risers to the leachate storage tanks. The November 2006 topographic map shows that there are at least fourteen locations on the cover of Section II where water may not be properly drainaing due to depressions in the cover surface. Five of these locations are adjacent to Primary sump riser pipes (Sumps 2A1, 2C3, 2C1, 2E2, and 2F2).

The topographic map also indicates poor drainage along portions of the northern, western and southern perimeter ditches. The three Secondary sumps of Cells 2D, 2E, and 2F, and the two northernmost Secondary sumps of Cell 2G are located adjacent to ditches were the topographic map indicates poor drainage. There is a short ditch crossing built at each Secondary sump riser location for access purposes. There are culverts installed under these crossings, however, the topographic map indicates poor drainage in these areas.

There is a near-horizontal area shown on the topographic map south of Section II between the access road and a soil stockpile (See Figure 2-10). There appears to be no drainage structure in this area to divert stormwater.

2.3.1 Section III Surface Water

Stormwater drains from Section III to a perimeter ditches that discharge to the First Flush Basin, as well as to Ponds B and Pond A. Figure 2-11 illustrates the general flow direction as interpreted to exist as of November 2006.

The ditches around Cells 3A and 3B (including the 3B Extension) along the northern and eastern boundaries of Section III were built on fill placed to construct the cover system and are located about five feet higher than, and about 35 feet horizontally from, the geomembrane anchor trenches. Around Cell 3A, the perimeter ditches were built on natural ground approximately seven feet away from the liner anchor trenches.

Similar to the other two landfills, roads have been built on the surface of the Section III to access the sump risers. Earthen berms cover the pipes that carry leachate from the sumps to the leachate storage tanks. The November 2006 topographic map shows that there are at least three locations on the cover of Section III where water may not drain. These locations are adjacent to Primary sump risers 3A3, 3B2, and 3C2.

The topographic map also indicates poor drainage along portions of the northern, eastern and southern perimeter ditches. The three Secondary sump risers of Cell 3B and the two Secondary sump risers of Cell 3C are located adjacent to ditches were the topographic map indicates areas of poor or no drainage. As in Section II, there is a short ditch crossing built at each Secondary sump riser location for access. There are culverts installed under these crossings, however, the topographic map indicates that water may not be draining properly at these locations.

3.0 DISCUSSION

3.1 GENERAL BACKGROUND

3.1.1 Liner Systems Performance

The integrity of the individual components and the effectiveness of the bottom liner systems in a landfill can only be assessed through the continuing evaluation of their intended performance. The sole purpose of composite liner systems is the collection of leachate within the landfill and removal of the leachate before it builds up on the liner. The less leachate head on the liner, the lower the likelihood that leachate may migrate through the liner system to the environment.

Composite liners can leak as a result of several factors. For example, geomembranes can be damaged during manufacturing (pinholes), during installation (damaged by installation personnel or machinery, or inadequate seams) or during placement of the layers above the geomembrane (by construction equipment). After a 10-year long study of the rates of deterioration of HDPE geomembranes, Hsuan and Koerner (GRI White Paper No. 6 dated June 7, 2005), report that the lifetime of a buried geomembrane may be in the range 270 to 450 years, as a result of the breakdown of the polymers within the geomembrane. However, even before polymer deterioration begins, studies have shown that various types of organic solvents, such as the chlorinated solvents, benzene, TCE and its degradation products such as vinyl chloride, etc., can permeate through a geomembrane in a shorter period of time by diffusion. This process does not damage the liner and the amount of material transported by diffusion is extremely small. Research on the longevity of liners other than HDPE geomembrane has not been done and for disposal of hazardous wastes, HDPE has become the standard material selected for liner use. Material other than HDPE has been used in landfill covers and for non-landfill purposes.

Compacted clay liners are commonly constructed to have a permeability equal to or less than 1×10^{-7} cm/sec at the time of construction. After construction and during filling of the landfill cells, the permeability of compacted clay liners generally decrease due to the consolidation of the clay as it is loaded by the waste placed on it. Even though the permeability of compacted clay liners is low, liquids can flow through the liners, although at low volumetric rates (flux).

3.1.2 Cover Systems Performance and HELP Analysis

There is a significant amount of information regarding the performance of landfill cover systems, mostly because the behavior and performance of these systems can be more readily observed than for liner systems. In landfills designed under RCRA Subtitle C regulations, the final covers generally include a compacted clay/geomembrane layer constructed on top of the final layer of waste, to minimize the potential for moisture to infiltrate into the landfill and generating leachate. Also a drainage layer and a protective/vegetative cover layer are placed above the composite low-permeability layer to remove water that has infiltrated through the upper soil layer. The purpose of the drainage layer is to reduce the potential for water head build-up on the clay/geomembrane layer and thus reduce the potential for infiltration into the landfill.

The effectiveness of cover systems is influenced by several factors. Similar to liner systems, geomembranes can be damaged during manufacturing, during installation, or during placement of the layers above the geomembrane. Vegetation with deep roots may also clog drainage layers and penetrate geomembranes.

The compacted clay portion of a cover system can be affected by differential settlement or by desiccation if it is not covered by a thick soil cover or a geomembrane. Albright, Benson, Gee, et al. (November 2006) recently completed a study of an eighteen-inch thick clay cover constructed in southern Georgia for a period of four years to evaluate its hydraulic performance. Field and laboratory permeability tests conducted immediately after construction and four years later indicated that the permeability of the layer had increased three orders of magnitude, i.e. from 10^{-7} cm/sec to 10^{-4} cm/sec. Other studies also suggest that the low permeabilities of soil covers are affected by wet/dry cycles, freeze/thaw cycles and animal burrowing.

Drainage layers are generally installed on cover systems to remove water that infiltrates into the upper soil/vegetative layers. The water collected in the drainage layer is generally drained from the layer at the toe of the cover slope or at intermediate points along the cover. If a drainage layer within a cover system clogs due to soil or root intrusion or, its drainage capacity is under-designed, the upper layers of the system can become saturated and slide on the geosynthetics. Water build-up in the drain layer increases the hydraulic head on the composite liner and thus the potential for water infiltration into the waste.

As an additional point of reference, an analysis of potential infiltration through a cover was performed using the Hydrologic Evaluation of Landfill Performance (HELP) model using a theoretical cover system that would meet the current requirements of RCRA Subtitle C under weather conditions representative of the Sumter County area. The results of this analyses is included in Appendix C and indicates that about 17 gpad (about 0.23 inches of water per day per unit area) would infiltrate such a cover system. Thus, if the Pinewood landfill covers were all built to current standards, this is the order of magnitude of water that, according to the HELP model, would infiltrate and eventually become leachate.

3.1.3 Leachate Production Rates

EPA's publication titled "Assessment and Recommendations for Improving the Performance of Waste Containment Systems," December 2002, reports leachate flow volumes obtained from studies of several closed hazardous waste disposal cells located in the southeastern United States, all having both Primary and Secondary liner and leachate systems. Based on the results of the studies, the report indicates that leachate generation rates decrease after the final cover system is placed on the waste. Published studies report that flow rates decrease by approximately one to three orders or magnitude within one year after closure and by up to two orders of magnitude after ten years of closure. Six years after closure, LCRS flow rates in these cells reportedly ranged from almost zero up to 88 gpad, with most reporting less than 20 gpad. Six years and longer after closure, the data is limited to six cells from a single facility, but the trend of decreasing LCRS flow rate continued, and the flow rates became almost negligible after nine years post-closure. The studies do not indicate whether the bottom of these cells might be subject to groundwater inflow.

The published data for Secondary LDS flows for hazardous waste landfills located in the southeast indicates that the flows range from less than 1 gpad up to about 34 gpad. Most of the reported flows showed decreasing trends with time, as might be expected as the consolidation and construction water are permanently removed from the system. Most of the Secondary LDS flows from cells that had been closed for more than six years generally reported flows below 10 gpad. The published data does not indicate if the cells might be subject to groundwater inflow and the potential source of liquids into each of the Secondary LDS is not discussed.

EPA also reports that liner and cover systems that were constructed without third party CQA report higher leakage rates than those that were built under the observation of a third-party CQA professional.

During the Green Team Meeting, it was noted that the leachate in some sumps has become more viscous, described as being gummy or stringy. Specific sumps were not 1Dentified and this condition has not been accounted for in the leachate pumping record evaluation, but a possible solution is provided for whichever sumps have been impacted. In Golder's experience, this is caused by the release of carbon dioxide (CO_2) as leachate enters the sump, which in turn increases the pH. With the pH change and in the presence of oxygen, the leachate becomes more viscous. The cure is to first eliminate the oxygen (air). This can be done by installing a "P" trap in the riser from the sump pump and by installing a top on the outer casing and sealing the top to the sides of the outer casing, along with sealing any penetrations of the top or the outer casing. Over time, the leachate in the sumps should stay more liquid. If viscous, gummy leachate residue has built-up in the sump, Glycholic acid can be introduced to break it down into a pumpable liquid.

3.1.4 Groundwater Inflow

The shallow groundwater levels at Pinewood have been affected by construction of a several French drains, ponds or basins, and, of course by the landfills. However, most of the landfill areas were constructed with their lower bottom drainage systems at or below recorded high groundwater levels that have been reported in monitoring wells located around the perimeter of the landfill areas and screened in the upper hydrogeologic units underlying the site. When the groundwater levels are above the liners, either the Secondary liner or the Primary liner for landfill areas having no Secondary liner, there is an inward hydraulic gradient. An inward gradient retards, or can even prevent, outward migration of leachate from the landfill. However, with an inward gradient there is the potential for groundwater inflow into the lowest liner collection system, thus creating liquid in the lowest system that has to be removed. At Pinewood, it should be expected that groundwater inflow will perpetually generate leachate in the Primary LCRS in Section I and most of Cells 2A and 2B, and liquids in the Secondary LDS of portions of Section II and most of Section III.

Because of groundwater inflows, the presence of liquid in the Secondary LDS does not necessarily indicate a leak in the overlying Primary liner. Chemical analysis is required to determine if liquid in the Secondary LDS might be from the Primary system. Also, because at Pinewood there is historic evidence of organic chemicals in the shallow groundwater from prior operations, even low concentrations of man-made organic chemicals detected in the Secondary LDS may not be evidence of a leak in the Primary liner.

3.1.5 Stormwater Management

Stormwater conveyance at Pinewood is challenging due to the lack of topographic relief across the site. Because the potential for infiltration into a landfill increases when water becomes ponded on or in close proximity to the landfill, it is important that a low-maintenance, effective stormwater control system be put in place to direct runoff away from the landfill areas.

The November 2006 topographic map indicates low areas and/or poor drainage on the cover and around all three of the landfills. The low areas on the covers appear to be mostly at the toes of the berms that cover the leachate header lines, and most of these areas appear to have outlets in the form of culverts. Low areas on the cover are relatively easy to remedy, and should be remedied, by adding fill and/or regrading the affected areas. Depressions will likely continue to develop on the cover surface of the landfills with long-term compression of the underlying waste. The cover surface topography should be regularly reviewed to 1Dentify and repair any depressions so that water drains away from the landfill. Since these conditions apply to three landfills, it is not discussed in detail for individual Sections.

As shown on Figures 2-9 to 2-11, there are several areas around the landfills that are lower than the surrounding areas with no surface drainage outlet, and most appear to have either a culvert or a drop inlet that, if functioning properly, should drain the affected area. Examples are locations where culverts have been installed to access the Secondary LDS sump risers from the perimeter access roads, or to access the Primary sump risers on the landfill cover. If water ponds behind these structures, it is an indication that they are either not sized properly, do not have the proper grades, the ditches are deeper than the inlets to the culverts, or the culverts are clogged. These conditions should be easy to remedy, and should be remedied, on a case-by-case basis.

Currently, all of the landfills have ditches running along both sides of the perimeter access roads. The original design drawings for some of the landfills show the roadside ditches as planned only along the outer side of these access roads. In those locations where ditches are near-horizontal or for other reasons do not drain properly, it may be possible to redesign the roads such that the inside ditch is filled, the road is raised vertically and cross-sloped toward the outside of the road, and the outside ditch is enlarged and regarded to drain properly . This may require that the stormwater conveyance systems at and around the toes of the landfill cover slopes (including the existing culverts and drop inlets) be evaluated in detail and possibly redesigned. Specific locations of these conditions are discussed in the following sections for each landfill section.

3.2 Section I

3.2.1 Section I Liners, Covers and Leachate

Because the Section I landfill was built before the Hazardous and Solid Waste Amendments (HSWA) of the RCRA regulations went into effect, there is no Secondary LDS in Section I. The Primary LCRS consists of a single composite liner that on the floor of the landfill includes a five-foot thick clay liner overlain by a 30-mil Hypalon® geomembrane. There is limited information about the actual construction methods used to install the Section I liner system. However, placement and compaction of clay soil was a well-known technology at the time of construction and existing records indicate that the soil liner was placed and compacted in a manner conducive to obtaining a low permeability layer. Unlike the soil liner, it is more likely that the quality of the Hypalon® installation was low in comparison to current industry standards and it may not meet the expected low permeability. The relevance of the integrity of the liner in Section I relates to the potential for migration of leachate out of the landfill and migration of groundwater into the landfill.

The final cover system constructed on Section I is unconventional compared to modern standards in that it was designed and built with the 20-mil thick PVC geomembrane placed beneath, rather than above, the low permeability clay layer. Records available documenting the construction of the cover system on Section I indicate that the clay soil was classified as a CH (Unified Soil Classification System) with liquid limits on the order of 52, and a plasticity index about 28. The soil was reportedly placed in 12-inch thick loose lifts, compacted, and its density tested with a Nuclear gauge. Shelby tubes were pushed into each lift to obtain samples for laboratory for permeability testing.

The construction activity of compacting a clay soil layer above a geomembrane increases the likelihood of damaging the geomembrane. This is one reason why the clay layers are usually built below the geomembranes. Also, if pushed too far, the Shelby tubes and Nuclear gauge rods pushed into the clay for testing the initial layer could have penetrated the geomembrane. For these reasons, the integrity of the PVC cap on Section I is questionable.

Given that the clay liner is not overlain by a geomembrane (or a vapor barrier), it is expected that the clay soil component of the Section I cover has not retained its as-constructed permeability. As such, the permeability of the existing clay soil layer is probably higher than as-constructed. Consequently, infiltration through the cover is likely more than might be inferred by having a traditional low permeability cover. This provides additional reasons to develop good drainage of stormwater off of the Section I cover.

As discussed in Section 2.1.3, the total average Primary LCRS leachate production rate for Section I, using the more representative data since the second quarter of 2005, is between about 25 and 38 gpad (between about 0.34 and 0.51 inches of leachate per year per unit area) and there is no apparent trend in the rate. Thus, the pumping records cannot be used to infer that there was an occurrence, such as increased infiltration, that caused the apparent increase. Consequently, the rates since the second quarter of 2005 are considered to be more representative of the rates for the entire period. The reported leachate pumping records from individual Section I sumps indicate that six of the sumps produce more than 50 gpad (see Section 2.1.3). While there is no obvious explanation for these higher rates, the surface water seal between the cover and the riser pipes should be checked.

The groundwater infiltration analysis for Section I suggests that the inward hydraulic gradient could create groundwater inflow rates range from about 9 gpad to as much as 39 gpad, which are comparable to the reported leachate pumping rates. This result should not be interpreted as indicating that the leachate in Section I is entirely from groundwater inflow. As noted in Section 2.1.1, the calculated estimates of the contribution to leachate from groundwater is approximate at best and heavily influenced by assumptions made in the calculations of the permeability of the liner materials. Even though the accuracy of the calculation results are indeterminable, the results indicate that groundwater flow is inward to the landfill and given the materials used in constructing the Section I liner system, there is likely a measurable contribution to the leachate from groundwater inflow. As long as the Primary LCRS is pumped, groundwater inflow is expected. Even though the inward gradient contributes to the volume of leachate, it also significantly inhibits the potential for advective migration of leachate into the groundwater system.

In comparison to Section I, the total average Section II Primary LCRS pumping rates are less than about 15 gpad and the total Secondary LDS pumping rates are less than about 6 gpad, a total of about 21 gpad, and both are showing a slight decreasing trend over time (see Section 2.1.4). Given that both landfill Sections are exposed to the same weather and generally the same groundwater regime, the difference in leachate production between these two landfills on a per-acre basis are ascribed to the differences in the cover and liner of Section I compared to the more modern cover and liners of Section II. These differences include the fact that the Section I cover has no internal drainage layer, and with the relatively low angle slopes of the surface of the cover, the hydraulic head infiltration of into the soil would be higher than for Section II. This condition would create a higher hydraulic head on the Section I cover that increases the potential for infiltration and leachate.

Given that Section I has been closed for over 20 years, the magnitude of future leachate production rates are not expected to decrease significantly, and could increase with very long-term deterioration of the cover and/or liner systems. Since it is impracticable to improve the liner system, the practical approach to reduce the potential for future leachate production is to improve the cover system. The order of magnitude costs of a modern geosynthetic composite cover with an internal drainage layer, such as the cover on Section III, is estimated to cost in the range of $130,000 to $180,000/acre in 2007 dollars, which would be between about $2.5 and $3 million. The cost would be quite dependent on the price of locally available clay and protective layer soil for the cover and it may be cost effective to strip the present cover and reclaim some of the material. The estimated cost of a new cover should be compared to the estimated future cost of leachate treatment and disposal to determine its financial viability. Because reliable pumping rates are available only since about the second quarter of 2005, and because some of the individual sump rates have wide fluctuations compared to others, it is recommended that the reliable rates be monitored for two to three years before using the data to decide on the financial viability of a new cover.

3.2.2 Section I Stormwater

Even though stormwater drainage is poor along the ditches, infiltration through the anchor trenches into the landfill is unlikely because the anchor trench is built within the clay liner and the cover and liner geomembranes were designed to be connected. However, the water poorly drained from the southern ditch running parallel to the access road is in very close proximity to the Section I French drain, and thus surface water may be infiltrating into the drain. This may only be a concern if, for instance, stormwater runoff carries materials such as fertilizer or oil that leaked form a piece of equipment into the drain. If these were to be 1Dentified in a water sample obtained from the French drain, it may be wrongly inferred that there is leak in the liner of Section I. It appears that there is a drop inlet or culvert in the lowest part of this area, so it is possible that some regrading, together with the potential relocation or reconstruction of some culverts may be sufficient to improve drainage.

It may also be advantageous to divert stormwater that is currently directed towards the landfill from areas above the slopes located around the southeastern boundary of the landfill. This would reduce the volume of water that, because of its proximity to the landfill, has the potential to infiltrate.

3.2.3 Section I Leachate Release Concerns

Kestrel expressed questions about the potential for a leachate release from Section I along the upper portion of the side slopes where the slopes intersect the upper portion of the Opaline Claystone which contains horizontal sand lenses. The question was expressed for the potential for leachate to migrate laterally within a cell, and then through the side-slope liner system and to the environment through the sand lenses, particularly from the northwest side of Section I at Cell 1A and the southwest side of Section I along Cells 1A through 1D because there is no surrounding drain that captures water from the sand lenses. The outer sides of Section I Cell 1E are surrounded by the French Drain and the upper portion of the Opaline Claystone at Cell 1E was over-excavated such that the clay liner is 10 feet thick through the upper portion of the Opaline Claystone. Groundwater along the remainder of the northeast side of Section I, at Cells 1A through 1D, flows toward and is collected in the First Flush Basin as indicated by the January 2007 potentiometric water table map. Although there are pipes from the Section I Cell E French Drain and the perimeter French drain, along the southwest side of Section I at Cells 1A through 1D, the pipes associated with these two drains at this location are conveyance pipes; they are not perforated and the gravel bedding extends only about a foot above the pipes with the remaining trench backfill apparently being material that was excavated during installation of the trenches. There is also no drain along the northwest side of Section I at Cell 1A. Currently there are several Opaline Claystone monitoring wells along the southwest sides of Cells 1A through 1D and along the access road between Cell 1A and the large stormwater channel, and these wells are spaced about 300 feet apart.

The likelihood that leachate would migrate to the groundwater through the upper part of the side slopes of Section I as described above is considered low. Leachate would preferentially drain down in the inside of the landfill side slope rather than flow sideways through the liner with little lateral driving head (somewhat analogous to surface water infiltration being much greater on near-horizontal surfaces compared to steeply sloped surfaces). This same mechanism applies even to perched leachate within the waste mass. Consequently, the likelihood of this leachate migration mechanism is considered low. The likelihood would increase if the leachate level in the landfill would rise high enough to impart an outward gradient across the upper part of the side slope. However, significant decreases in leachate pumping rates would be expected (i.e., the system is clogged) for leachate to rise to such a level and monitoring the pumping rates is recommended as an indicator of such clogging. Groundwater monitoring in this area is appropriate for detecting such a release. However, it is suspected that the existing 300-foot monitoring well spacing may be too wide to adequately monitor the area and Kestrel should have the spacing evaluated by the Pinewood groundwater team. In the event of a release along the northwest side of Cell 1A as described above, it is likely that there would be sufficient time to install corrective measures before the release became a threat to human health and the environment. However, Kestrel should verify this with the Pinewood groundwater team. Appropriate remedial measures might include a permeable trench to collect the groundwater so it can be removed for on-site or off-site treatment or a slurry wall to reduce the potential for migration.

3.3 Section II

3.3.1 Section II Liners, Covers and Leachate

The Primary composite liner and LCRS of Section II was built to more modern standards than that of Section I, and included an 80-mil HDPE geomembrane rather than the 30-mil Hypalon® geomembrane. The clay soil component is ten (10) feet thick in the upper portion of the Cells 2A and 2B side slopes, and five (5) feet thick in the lower portion of the side slopes and across the bottom. In response to HSWA of RCRA, Cells 2C to 2G were constructed with a Secondary composite liner and LDS below the Primary liner system as described in Section 1.2.3. The relevance of the integrity of the liner in Section II relates to the potential for migration of leachate out of the landfill and migration of groundwater into the landfill.

The final cover system constructed on Section II includes more modern 30 (Cells 2C through 2G) and 40-mil (Cells 2A and 2B) thick HDPE geomembranes rather than the 20-mil thick PVC geomembrane used for Section I. However, it was also unconventional compared to modern standards in that it was designed and built with the HDPE geomembrane beneath rather than above the compacted low permeability clay layer. The composite cover system on Section II also includes a 20-mil thick PE (Cells 2A and 2B) or HDPE (Cells 2C through 2G) geomembrane that was laid on top of the clay component as a vapor barrier. Records available documenting the construction of the

Section II cover system indicate that the clay soil was placed in 12-inch thick loose lifts, compacted, and its density tested with a Nuclear gauge. Shelby tubes were pushed into each lift to obtain samples for laboratory for permeability testing.

As discussed for Section I, placing and compacting the clay on a geomembrane, as well pushing Shelby tubes and Nuclear gauge rods into the initial lift of clay for testing could have damaged the underlying HDPE geomembrane. For these reasons, the integrity of the HDPE cap on Section II may be suspect, but it is likely better than the cap on Section I because of the different geomembrane materials and thicknesses, as well as the likelihood that all parties involved in the installation were more experienced.

The vapor barrier placed above the clay layer of the Section II cover, even though the seams were lapped and not sealed, may have allowed the clay layer to retain its moisture better than the clay layer on Section I. Although the clay soil component of the Section II cover may have undergone some desiccation and may not have retained its as-constructed permeability, it likely has a lower permeability than the clay layer on the Section I cover. Thus, infiltration through the Section II cover is likely closer to that inferred by the HELP analysis discussed in Section 2.2.1 than for Section I. Even so, good drainage of stormwater off of the Section II cover should be maintained.

There is no internal drainage layer in the cover system on Cells 2A and half of Cell 2B, but the remaining Section II cover includes one. However, this drainage layer does not have an outlet to effectively discharge the water that is collected in the layer. Without an outlet (generally consisting of a gravel toe drain with a permeability higher than that of the drainage layer), water tends to collect at the toe of the slopes and can back-up and saturate the overlying soil well up the side slopes. From a practical point of view, these areas are probably wet for long periods and could easily be damaged when the surface of the cover is being mowed or accessed by vehicles or equipment. Also, the wet soils promote the development of deeper vegetation roots, which in turn, can clog the drainage layer. In these areas, the hydraulic head on the cover components is not effectively dissipated and also tends to remain high. At other facilities, this condition has resulted in cover instability and sliding failures. However, the slopes at those other facilities have been steeper than the side slopes at Pinewood.

As discussed in Section 2.1.4, the total average Section II Primary LCRS pumping rates are less than about 15 gpad and show a slight decreasing trend over time. This average Primary rate is comparable to the published flow rates for other closed landfill cells in the southeast (see Section 3.1.3). Also, the published data indicates that the Primary flow rates decreased over time, as have the Section II rates.

As noted in Section 2.1.4, with the exception of a few short periods, the pumping rates for all but two of the Section II Primary sumps are below 25 gpad for each quarter over the last five-year period. The exceptions are Sumps 2B2P and 2F3P with pumping rates generally above 25 gpad and with 2F3P reporting rates between about 50 and 70 gpad for several periods. Sump 2B2P is in the center of Section II and lies beneath the area where Cell 2C overlies Cell 2B, which should yield a low flow to the sump rather than a high flow. The elevated pumping rates for these two sumps do not appear to follow rainfall patterns that would suggest leakage into the sumps from the surface. Although there is no obvious explanation for these higher rates and they do not appear to follow rainfall patterns, the surface water seal between the cover and the riser pipes should be checked.

The flows in the secondary system of Section II are generally below 6 gpad and also show a decrease over time. This average Secondary rate is also comparable to the EPA published rates for most cells in the southeast closed more than six years. Also, the published data indicates that the Primary flow rates decreased over time, as have the Section II rates. As noted in Section 2.2.2, the groundwater inflow pressure and flow may be more persistent than indicated by the calculations. This is because the inflow estimates are based on the TLS groundwater levels but the groundwater levels in the overlying Opaline Claystone and sediments are expected to be higher based on comparable levels elsewhere at the site. Consequently, it is expected that groundwater flows into the Secondary LDS are occurring and will continue to occur as long as the system is pumped on a regular basis. Even though the inward gradient contributes to the volume of leachate, it also significantly inhibits the potential for advective migration of leachate into the groundwater system.

The total quarterly flow rate from Primary LCRS sumps in Cells 2A and 2B is slightly higher than the total quarterly flow rate from Cells 2C thru 2G, but is lower than the total flow rate of Section I. This may be caused by groundwater inflow into Cells 2A and 2B. In the other cells of Section II groundwater infiltration is cut off from the Primary LCRS system by the Secondary LDS.

Based on the leachate pumping records and the composition of the liner and clover systems, Section II appears to be performing as should be expected. Given that the cells of Section II have been closed for between 10 to over 20 years, the magnitude of future leachate production rates are not expected to decrease significantly, but could increase with very long-term deterioration of the cover and/or liner systems. The only improvements recommended for Section II at this point are to improve the stormwater drainage to improve drainage on and around the landfill.

3.3.2 Section II Stormwater

The ditch running along the western boundary of Section II (between Section II and Pond B) has very little, and in some portions nearly no, flow line slope, and the topographic map indicates the potential for standing water. However, as with Section I, infiltration through the anchor trenches into either the Primary LCRS (in Cell 2B) or the Secondary LDS (in Cells 2C and 2D) of the landfill is unlikely because the Primary and Secondary liner geomembranes are welded to one another and to the cover geomembrane. Depending on the location along the ditch, infiltration is more likely through the Secondary sump riser boots where the risers penetrate the cover geomembrane, if there were a defect in the Secondary riser boots.

Even though infiltration through the anchor trenches appears unlikely, the drainage along the western boundary should be improved. One option would be to fill the ditch and redesign the road with only an outer ditch, and possibly downslope pipes. This would result in the removal of all the access crossings and culverts and stormwater would sheet flow over the road. The surface of the new road would need to be constructed such that it would not eroded by the sheet flow. Alternatively, the ditch could be divided in small sections between the existing culverts. Each small section would be regraded (added fill to create a slight slope toward the low end) and drained through individual drop inlets that would replace the existing culverts and re-direct the flow under, and to the other side of, the road where the terrain slopes towards Pond B. These structures would require hydraulic design of the individual channels and drop inlets.

Although not as severely as along the west side, the topography of the ditches that run along the northern boundary of Section II, especially close to the Secondary sump risers appears to be relatively flat. The runoff from these ditches would generally be directed under the road towards two drop inlets located between the road and the property fence. A note on one of the drawings indicated that it is not certain if pipes from these drop inlets carry flow to Pond B, although they could carry flow to the perimeter French drain. The as-built drawings provided for the perimeter French drain, although not clear, show three manholes, but these manholes do not seem to be in the same location as the drop inlets. The discharge point from these pipes should be confirmed. Because there is limited space along the north side, filling the inside ditch and redesigning the road with an outer ditch may be the best option to keep stormwater away from the Section II cover. This would also result in the removal of all the access crossing and culverts, and the new road would need to be surfaced such that it is not eroded by sheet flow from the cover. The capacity of the drop inlet would also have to be checked.

The topographic map also indicates that water is also getting trapped in an area north of the southern access road on the cover of Section II. This area needs to be regraded to direct this flow down to the perimeter ditch, which appears to be draining properly an this location, but directs the runoff under the road towards an area between the southern edge of the access road and a soil stockpile, where there is no outlet. This area needs to be drained, and this may be done by some regrading and constructing a ditch that slopes toward the south where Pond A is located.

3.3.3 Section II Leachate Release Concerns

Kestrel expressed concern about the potential for leachate release from Section II through the southern slope of Cell 2A and the east and west slopes of Cell 2B. These cells do not have a Secondary liner and LDS to provide detection or collection of a release of leachate through the Primary liner. The concern is primarily in regard to a release along the upper portion of the side slopes where the slopes intersect the sediments and upper portion of the Opaline Claystone with sand lenses. The concern was expressed for the potential for leachate to migrate laterally through the side-slope Primary liner system and to the environment through the sand lenses. There is no French drain along these areas to capture water from the sand lenses.

For the same reasons discussed for Section I, the likelihood of this leachate migration mechanism is considered low, but would increase if the leachate level in the landfill would rise high enough to impart an outward gradient across the upper part of the side slope. However, significant decreases in leachate pumping rates would be expected (i.e., the system is clogged) for leachate to rise to such a level and monitoring the pumping rates is recommended as an indicator of such clogging. Groundwater monitoring of the shallow Opaline Claystone in this area would be appropriate for detecting such a release, but such wells are currently not in place. Therefore, it is recommended that monitoring wells be considered in this area with the spacing between wells evaluated as recommended for Section I.

In the event of a release along the southern slope of Cell 2A and the east and west slopes of Cell 2B as described above, it is likely that there would be sufficient time to install corrective measures before the release became a threat to human health and the environment. However, Kestrel should verify this with the Pinewood groundwater team. Appropriate remedial measures might include a permeable trench to collect the groundwater so it can be removed for on-site or off-site treatment or a slurry wall to reduce the potential for migration.

3.4 Section III

3.4.1 Section III Liners, Covers and Leachate

Section III of Pinewood was operated for disposal of non-hazardous and hazardous waste until 2000, when the owner (Safety Kleen) went bankrupt. At that time, disposal Cells 3A and 3B had been constructed and operated, but only portions of these cells had been closed. In 2005 the area east of Cell 3B, known as the 3B Extension, which had been partially filled, and the area south of Cell 3A and 3B, known as Cell 3C or the Closure Cell, were filled with more than 40 feet of soil and closed.

All of Section III has both Primary and Secondary liners and leachate systems constructed of modern components, including 80-mil thick HDPE liners. The systems are similar to those of Section II, but use geocomposite layers along the inner side slopes rather than gravel drain layers. The Primary and Secondary geomembrane liners were anchored at the top of the slope in side-by-side trenches, two feet deep and one foot wide. The two liners are not welded together.

The cover for Section III is a modern, more conventional, composite system with a double-sided geocomposite drain layer over a 60-mil thick textured HDPE that is underlain by a two-foot thick low permeability clay layer. The HDPE cap of the cover is welded to the Primary HDPE liner. With the HDPE placed above the clay layer, it seals the clay layer to preserve its permeability and there are no concerns about possible penetrations of the HDPE from the testing of the clay layer. Consequently, the Section III cover is expected to limit infiltration better than the Section II cover.

Cells 3A and 3B were partially closed in 1994 and 1998, respectively. These closures, however, only covered the north and west slopes of the waste above the original ground surface. The closure of the remainder of Section III occurred in 2005, so most of the landfill was essentially open to direct rainfall for seven to ten years. It is also reported by Kestrel that during the filling and final closure of

Section III a substantial volume of water was ponded on the soil being placed in the landfill and was essentially left in the landfill when closed.

As discussed in Section 2.1.5.2, the total Primary LCRS pumping rates from before to immediately after the recent closure of Section III fluctuate widely from just under 100 gpad to over 270 gpad (about 1.4 to 3.7 inches of leachate per year per unit area). Individual Primary sump rates have been as high as 1,785 gpad.

Overall, the total LDS pumping rates in Section 3 are below about 6 gpad (about 0.08 inches of leachate per year per unit area). However, high pumping rates were reported at three of the sumps. Pumping rates for Sump 3A1S have ranged from about 4 to 18 gpad over the five-year period, with no apparent correlation to rainfall or fluctuations in Primary Sump 3A1P. Pumping rate records for Sumps 3C1S and 3C2S begin in the first quarter of 2005 corresponding to closure activities. The pumping rates for these two sumps increase to peaks of 69 gpad at Sump 3C1S and 181 gpad at 3C2S in the third quarter of 2005, and have since dropped to about 7 gpad by the third quarter of 2006. Sumps 3C1S and 3C2S are located in Cell 3C, which is the southern portion of Section III, and Sump 3A1S is located in the southern portion of Cell 3A, adjacent to Cell 3C. As discussed in Section 2.1.5, some of these initial high flows are attributed to direct infiltration of stormwater into the secondary system during construction of the Closure Cell.

The wide fluctuations and high pumping rates in Section III are ascribed to operation and closure activities, or lack thereof, during the bankruptcy period beginning in 2000 and the filling and closure activities of Cell 3B Extension and Cell 3C that began in 2005 and that were completed in early 2006. These high rates are likely not indicative of poor performance of the landfill lining systems or the cover. Overall, the pumping rates are what should be expected given the operating and closure practices. The pumping rates have been decreasing and are expected to continue to decrease over the next several years. Using EPA reported data, it may take five years or more for the rates to stabilize. Assuming that the cover system is not damaged, it is expected that the Section III pumping rates will approach and may be lower than those of Section II on a unit areas basis.

The calculations indicate that with the low and high reported groundwater levels in the TLS there is an inward gradient within all cells, except for Cell 3C with the reported low groundwater level. Groundwater inflows into the Secondary LDS in Section III were estimated to range from about 9 gpad to as much as 25 gpad. Even though the accuracy of the calculation results are indeterminable, the results indicate that groundwater flow is generally inward and there could be a measurable contribution to the leachate from groundwater inflow. As long as the Primary LCRS is pumped, groundwater inflow is expected. Even though the inward gradient contributes to the volume of leachate, it also significantly inhibits the potential for advective migration of leachate into the groundwater system. Given that the above inflow estimates are based on the TLS groundwater levels and that the levels in the overlying Opaline Claystone and sediments are expected to be higher based on comparable levels elsewhere at the site, it is likely that the inward gradient estimates are actually higher and that the inflow pressure and flow may be more persistent than indicated by the calculations.

3.4.2 Section III Stormwater

The potential for surface water infiltration through the anchor trenches was initially noticed during the construction of the cover system on the last portion of Section III. It is reported that during a rainfall event, a large volume of water ponded in one area adjacent to the exposed anchor trenches of Cell 3C, the Closure Cell. It is believed that some of this water flowed under the primary anchor trench and infiltrated into the Secondary LDS at Sumps 3C1S and 3C2S. The Primary and Secondary liners are not welded together at Section III. The perimeter ditch and the anchor trench along the toe of the Closure Cell cover system are at approximately the same elevation and are in close proximity. Because of this geometry, there is an opportunity for this to occur again if surface water is allowed to pond in the ditches for long periods of time. It would be unlikely for a similar situation to occur in Cells 3A and 3B because the roadside ditches are built on compacted fill that separates and raises the ditch area several feet from the anchor trenches.

To avoid surface water infiltration into the Secondary LDS, the perimeter ditches should be maintained so that they drain properly. However, if in the future it is found that this infiltration mechanism becomes a chronic source of liquids into the Secondary LDS, the run-on (flat) area of the anchor trenches can be exposed and the top of the Primary geomembrane can be cut and the cut edge welded to the Secondary geomembrane. This will not affect the integrity of the geomembranes because once a landfill is filled and closed, the anchor trench serves no mechanical purpose (i.e., the geomembrane no longer needs to be anchored at the top of the slope) since the geomembrane is kept in place by the load from the overlying soil layers and waste.

The topographic map also indicates poor drainage in the ditches between the access points to the Cell 3B Secondary sump risers along the northern property line. The runoff from these ditches appears to be generally directed under the road towards an inlet located between the road and the property fence. This discharge location of this drop inlet is noted on the drawing as being questionable and should be confirmed. As with the ditch running along the northern boundary of Section II, filling the inside ditch and redesigning the road with an outer ditch may be the best option to keep stormwater away from the Section III cover. This would also result in the removal of all the access crossing and culverts, and as indicated for Section II, the new road would need to be surfaced so that it would not be eroded by sheet flow from the cover. The capacity of the drop inlet would also have to be checked.

Along the eastern and southern boundary of Section III, the roadside ditches that run along the toe of the cover system are drained by culverts over short distances. The flat topography along these ditches may be an indication that the culverts do not have sufficient capacity, or that the ditches are deeper than the inlets to the culverts. Some regrading to increase the flow slope along the ditches may also improve the drainage in these areas. The ditches do not necessarily need to have a constant depth, especially when they are drained over short distances. The upstream depth of the ditch could be shallow as long as the depth increases as it approaches the culvert. Culverts could also be installed under the southern portion of the access road to drain the ditch over short distances.

4.0 SUMMARY AND RECOMMENDATIONS

4.1 General

Golder performed a critical element analysis of the Pinewood Site hazardous waste disposal landfills for the purpose of assessing the interaction between the liner and cover systems, the stormwater management system, and the groundwater levels within the geologic units at the site. The analysis has focused on the potential for surface water and groundwater to migrate into the waste mass as well as the potential release of leachate into the shallow groundwater and deeper ditches. Also, the overall stormwater management system has been reviewed to determine if modifications might reduce the potential for stormwater infiltration into the landfills.

A large number of documents were provided by Kestrel for Golder's use during the review. The information most heavily relied on included:

- Design and as-built figures and drawings – (See Appendix D for select Figures);
- Records of some of the construction activities;
- Basic understanding of the geologic units;
- Groundwater elevations in monitoring wells and potentiometric maps; and
- Records of leachate pumping rates.

Based primarily on leachate pumping rates, the overall impression of the three landfills at Pinewood is that Section II appears to be performing as would be expected for a landfill constructed to relatively modern standards that has been closed for 15 to 20 years. Performance of Section III cannot be precisely evaluated because of operating conditions during the Safety Kleen bankruptcy and because it was just closed in early 2006, but the leachate rates are decreasing rapidly and the modern components used to construct the liner systems and cover system would be expected to yield performance equal to and perhaps a bit better than Section II. Section I, because it was constructed, operated and closed between 22 and 29 years ago does not appear to be performing as well as Section II, but is likely performing as well as might be expected given the components and methods used in its construction, operation and closure.

One of the more significant factors noted for most all of the landfill Section cells is that their bottoms (floors) have been constructed below the groundwater table. This creates inward hydraulic pressure (gradient) over most of the Secondary liners and over the Section I Primary liner. These inward gradients significantly inhibit advective migration of leachate from the landfills. However, over the long term, they will likely add to the volume of leachate, particularly in Section I because it has what is likely the most permeable lining system.

The leachate pumping rate data provides excellent input to the performance of the landfill cover and liner systems. Accurate leachate data should continue to be collected and should be evaluated at least annually. The data reviewed for this analysis indicates numerous spikes for all of the Sections. To some degree, these spikes can be expected since neither the waste nor drainage from the waste is uniform. However, when there is a significant spike it could be an indication of a broken seal between the sump and the cover. If higher than normal flow rates continue that cannot be explained by other reasons, the connection between the sump and the cover geomembrane should be inspected for leaks.

During the Green Team Meeting, it was noted that the leachate in some sumps has become more viscous, described as being gummy or stringy. Specific sumps were not 1Dentified and this condition has not been accounted for in the leachate pumping record evaluation, but a possible solution is provided for whichever sumps have been impacted. In Golder's experience, this is caused by the release of carbon dioxide (CO_2) as leachate enters the sump, which in turn increases the pH. With the pH change and in the presence of oxygen, the leachate becomes more viscous. The cure is to first eliminate the oxygen (air). This can be done by installing a "P" trap in the riser from the sump pump and by installing a top on the outer casing and sealing the top to the sides of the outer casing, along with any penetrations of the top or the outer casing. Over time, the leachate in the sumps should stay more liquid. If viscous, gummy leachate residue has built-up in the sump, Glycholic acid can be introduced to break it down into a pumpable liquid.

Because the potential for infiltration into a landfill increases when water becomes ponded on or in close proximity to the landfill, it is important that a low-maintenance, effective stormwater control system be put in place to direct runoff away from the landfill areas. The November 2006 topographic map provides evidence of poor drainage on and adjacent to the Pinewood landfills. Because of the low relief at Pinewood, addressing proper drainage in existing ditches may be challenging. The general recommendation is that these areas be modified to eliminate, to the degree practicable, improper drainage conditions.

The November 2006 topographic map indicates that the low areas on the covers appear to be mostly at the toes of the berms that cover the leachate header lines, and most of these areas appear to have outlets in the form of culverts. Low areas on the cover are relatively easy to remedy, and should be remedied, by adding fill and/or regrading the affected areas. Depressions will likely continue to develop on the cover surface of the landfills with long-term compression of the underlying waste. The cover surface topography should be regularly reviewed to 1Dentify and repair any depressions so that water drains properly. Since these conditions apply to three landfills, it is not discussed in detail for individual Sections.

There are several areas around the landfills that are lower than the surrounding areas with no surface drainage outlet, and most appear to have either a culvert or a drop inlet that, if functioning properly, should drain the affected area. Examples are locations where culverts have been installed to access the Secondary LDS sump risers from the perimeter access roads, or to access the Primary sump risers on the landfill cover. If water is detained behind of these structures, it is an indication that they are either not sized properly, do not have the proper grades, the ditches are deeper than the inlets to the culverts, or the culverts are clogged. These conditions should be easy to remedy, and should be remedied, on a case-by-case basis.

Currently all of the landfills have ditches running along both sides of the perimeter access roads. The original design drawings for some of the landfills show the roadside ditches as planned only along the outer side of these access roads. In those locations where ditches are near-horizontal or for other reasons do not drain properly, it may be possible to redesign the roads such that the inside ditch is filled, the road is raised vertically and cross-sloped toward the outside of the road, and the outside ditch is enlarged and regarded to properly drain. This may require that the stormwater conveyance systems at and around the toes of the landfill cover slopes (including the existing culverts and drop inlets) be evaluated in detail and possibly redesigned. Specific locations of these conditions are discussed in the following sections for each landfill Section

In performing this data review and analysis, it became apparent that the drawings for Sections I and II are not of the quality and accuracy as the drawings for Section III. Furthermore, the drawings are on different coordinate systems. Consequently, the three-dimensional boundaries of the waste limits, anchor trenches and edges of the covers could not be accurately determined in many cases making it difficult to determine the proximity of features and thus difficult to conclusively evaluate potential stormwater interactions. It is recommended that all drawings be reproduced in the same coordinate system and all boundaries and structures properly 1Dentified and located. This will facilitate and improve the efficiency and accuracy of future evaluations and assessments of the interaction stormwater and landfill containment systems.

4.2 Section I

The liner and cover systems of the Section I landfill were constructed before promulgation of modern hazardous waste disposal regulations. Section I has a single composite liner system using 30-mil thick Hypalon® as the geomembrane material. The cover system includes a 20-mil thick PVC geomembrane placed beneath rather than above the low permeability clay layer. . The bottom of Section I was constructed below the groundwater table so there is an inward groundwater gradient. Even though the accuracy of the groundwater inflow calculation estimates are indeterminable, the results indicate that groundwater flow is inward to the landfill and given the materials used in constructing the Section I liner system, there is likely a measurable contribution to the leachate from groundwater inflow. Leachate pumping rates in Section I are higher than in Section II, which is a more modern landfill, and higher than reported for other modern hazardous waste landfills in the southeastern United States. As long as the Primary LCRS is pumped, groundwater inflow is expected. The higher leachate rates are ascribed to the lower effectiveness of the cover system in reducing rainfall water infiltration and to inflow of groundwater. Even though the inward gradient contributes to the volume of leachate, it also significantly inhibits the potential for advective migration of leachate into the groundwater system.

Given that Section I has been closed for over 20 years, the magnitude of future leachate production rates are not expected to decrease significantly, and could increase with very long-term deterioration of the cover and/or liner systems. Given that it is impracticable to improve the liner system, the practical approach to reduce the potential for future leachate production is to improve the cover system. The order of magnitude costs of a modern geosynthetic composite cover with an internal drainage layer, such as the cover on Section III, is estimated to cost in the range of $130,000 to $180,000 per acre in 2007 dollars, which would be between about $2.5 and $3 million. The cost would be quite dependent on the price of locally available clay and protective layer soil for the cover and it may be cost effective to strip the present cover and reclaim some of the material. The estimated cost of a new cover should be compared to the estimated future cost of leachate treatment and disposal to determine its financial viability. Because reliable pumping rates are available only since about the second quarter of 2005, and because some of the individual sump rates have wide fluctuations compared to others, it is recommended that the reliable rates be monitored for two to three years before using the data to decide on the financial viability of a new cover.

It was also noted that the flow rates in sumps 1D2P and 1D3P were significantly larger than the leachate flow rate in the other sumps. The connection between the riser and the cover geomembrane at these locations should be checked to see if there is some defect that is allowing direct flow from the surface of the cover into the sump riser outside annulus down through the waste and into the sump.

In addition to the general recommendations for stormwater control and drainage, for Section I consideration should be give to redirecting the stormwater from the top of the slopes that bound the landfill along the south and southeast sides. This stormwater could be diverted the along the road at the top of the slope, instead of directing it towards Section I and along the toe of the cover system. In addition, there is poor drainage existing along the southern ditch that runs parallel to the access road is in very close proximity to the Section I French drain, and thus surface water may be infiltrating into the drain. This may only be a concern if, for instance, stormwater runoff carries materials such as fertilizer or oil that leaked from a piece of equipment into the drain. If these were to be 1Dentified in a water sample obtained from the French drain, it may be wrongly inferred that there is leak in the liner of Section I. It appears that there is a drop inlet or culvert in the lowest part of this area, so it is possible that some regrading, together with the potential relocation or reconstruction of some culverts may be sufficient to prevent future ponding.

Regarding specific concerns related to a potential release along the northwest side of Cell 1A into the sand lenses of the Opaline Claystone, the likelihood for leachate migration by this pathway is considered low. Leachate would preferentially drain down in the inside of the landfill side slope rather than flow sideways through the liner with little lateral driving head. Groundwater monitoring in this cell is appropriate for detecting such a release. However, it is suspected that the existing 300-foot monitoring wells spacing may be too wide to adequately monitor the cell and Kestrel should have the spacing evaluated by the Pinewood groundwater team.

In the event of a release along the northwest side of Area 1A, it is likely that there would be sufficient time to install corrective measures before the release became a threat to human health and the environment. However, Kestrel should verify this with the Pinewood groundwater team.

Appropriate remedial measures might include a permeable trench to collect the groundwater so it can be removed for on-site or off-site treatment or a slurry wall to reduce the potential for migration.

4.3 Section II

The liner systems in Section II Cells 2A and 2B were built before promulgation of the HSWA of RCRA and only have a Primary liner and LCRS. Cells 2C through 2G were constructed to the HSWA of RCRA and include Primary and Secondary composite liner systems using HDPE geomembranes with a Primary LCRS and a Secondary LDS. The final cover system constructed on Section II includes modern HDPE geomembranes, but like Section I is unconventional compared to modern standards in that it was designed and built with the HDPE geomembrane beneath rather than above the compacted low permeability clay layer.

There is no internal drainage layer in the cover system on Cells 2A and half of Cell 2B, but the remaining Section II cover includes one. However, this drainage layer does not have an outlet to effectively discharge the water that is collected in the layer. Without an outlet water tends to collect at the toe of the slopes and can back-up and saturate the overlying soil well up the side slopes. This can lead to an increased potential for infiltration through the cover and wet areas near the slope toes that can become damaged by equipment or trigger minor slope instabilities, although the potential for slope instability for Pinewood is low because of the relatively low-angle slopes. The installation of a toe drain for the Section II cover system is recommended. The installed cost of a two-inch PVC pipe placed in a shallow a gravel trench and surrounded with a geotextile fabric is estimated to be on the order of $30.00 per foot. The perimeter of the cover in Section II is about 5,200 feet, therefore the cost of this drain would be on the order of $156,000.

The total average Section II Primary LCRS pumping rates are less than about 15 gpad and show a slight decreasing trend over time. This average Primary rate is comparable to the published 20 gpad rate for other closed landfill cells in the southeast. The flows in the secondary system of Section II are generally below 6 gpad and also show a decrease over time. This average Secondary rate is also comparable to the 10 gpad rate noted by EPA for most cells in the southeast closed more than six years. Both the Primary and Secondary pumping rates show decreases over time, which is also consistent with the EPA data.

The flow rates in sumps 2G2P, 2G3P, 2B2P and 2F3P were higher than the leachate flow rates in the other sumps. These locations should be checked to see if there is a leak in the connection between the cover system and the sump riser.

The majority of Section II was constructed to a depth that creates an inward hydraulic gradient over most of the landfill using high TLS groundwater levels. With the low TLS groundwater levels, the gradient varies across Section II. However, the inflow estimates are based on the TLS groundwater levels but the groundwater levels in the overlying Opaline Claystone and sediments are expected to be higher based on comparable levels elsewhere at the site. Consequently, it is expected that groundwater flows into the Secondary LDS are occurring and will continue to occur as long as the system is pumped on a regular basis. Even though the inward gradient contributes to the volume of leachate, it also significantly inhibits the potential for advective migration of leachate into the groundwater system.

In addition to the general recommendations for stormwater control and drainage, following are specific recommendations for Section II:

- There appears to be some uncertainty that drop inlets along the northern boundary of the site route stormwater to Pond B. This should be confirmed.
- Along the northern boundary the ditches that run on the inside edge of the access road should be removed and the road rebuilt as discussed in the general comments in Section 4.1.
- Along the western boundary the ditch and the road may be redesigned as described in the general comments in Section 4.1, or, alternatively, individual outlets should be properly designed and installed at the low end of the small portions of ditch, to redirect the runoff under the road and towards the west where Pond B is located.
- Stormwater from the southern portion of the cover is routed to an area between the south access road and Pond A. At this location the water does not drain. This area needs to be regraded, and a ditch designed to direct flow to Pond A.

Regarding specific concerns related to a potential release from Section II through the southern slope of Cell 2A and the east and west slopes of Cell 2B into the sand lenses of the Opaline Claystone, the likelihood for leachate migration by this pathway is considered remote for the same reasons as discussed for Section I. The clay liner is about 10 feet thick in this area where the Opaline Claystone was laterally over-excavated and leachate would preferentially drain down in the inside of the landfill side slope rather than flow sideways through the liner with little lateral driving head. Groundwater monitoring of the shallow Opaline Claystone in this area would be appropriate for detecting such a release, but such wells are currently not in place. Therefore, it is recommended that monitoring wells be considered in this area with the spacing between wells evaluated as recommended for Section I.

In the event of a release along the southern slope of Cell 2A and the east and west slopes of Cell 2B as described above, it is likely that there would be sufficient time to install corrective measures before the release became a threat to human health and the environment. However, Kestrel should verify this with the Pinewood groundwater team. Appropriate remedial measures might include a permeable trench to collect the groundwater so it can be removed for on-site or off-site treatment or a slurry wall to reduce the potential for migration.

4.4 Section III

Section III of Pinewood was operated for disposal of non-hazardous and hazardous waste until 2000, when the owner (Safety Kleen) went bankrupt. At that time, disposal Cells 3A and 3B had been constructed and operated, but only portions of these cells had been closed. In 2005 the area east of Cell 3B, known as the 3B Extension, which had been partially filled, and the area south of Cells 3A and 3B, known as Cell 3C or the Closure Cell, were filled with more than 40 feet of soil and closed.

The liners and cover system of Section III were designed and constructed per current HSWA and RCRA regulations and with modern components. Section III has both Primary and Secondary liners constructed with 80-mil thick HDPE liners. The Primary and Secondary geomembrane liners were anchored at the top of the slope in side-by-side trenches, two feet deep and one foot wide, but are not welded together. The bottom liner systems include both a leachate collection and leak detection system.

The cover for Section III is a modern, more conventional, composite system with a double-sided geocomposite drain layer over a 60-mil thick textured HDPE that is underlain by a two-foot thick low permeability clay layer. The HDPE cap of the cover is welded to the Primary HDPE liner. The cover system includes a composite liner and a drainage layer, but, as in Section II, this layer has no outlet. The cost to install a toe drain around the perimeter of the Section III cover, about 4,000 feet, would be approximately $120,000. The Section III cover is expected to limit infiltration better than the Section II cover.

The total Primary LCRS pumping rates from before to immediately after the recent closure of Section III fluctuate widely from just under 100 gpad to over 270 gpad (about 1.4 to 3.7 inches of leachate per year per unit area). Individual Primary sump rates have been as high as 1,785 gpad. Overall, the total LDS pumping rates in Section 3 are below about 6 gpad (about 0.08 inches of leachate per year per unit area). However, high pumping rates were reported at Sumps 3A1S, 3C1S and 3C2S.

The wide fluctuations and high pumping rates in Section III are ascribed to operation and closure activities, or lack thereof, during the bankruptcy period beginning in 2000 and the filling and closure activities of Cell 3B Extension and Cell 3C that began in 2005 and that were completed in early 2006. These high rates are likely not indicative of poor performance of the landfill lining systems or the cover. Overall, the pumping rates are what should have been expected given the operating and closure practices. The pumping rates have been decreasing and are expected to continue to decrease over the next several years. Using EPA reported data, it may take five years or more for the rates to stabilize. Assuming that the cover system is not damaged, it is expected that the Section III pumping rates will approach and may be lower than those of Section II on a unit areas basis.

The calculations indicate that with the low and high reported groundwater levels in the TLS there is an inward gradient within all areas, except for Cell 3C with the reported low groundwater level. Given that the above inflow estimates are based on the TLS groundwater levels and that the levels in the overlying Opaline Claystone and sediments are expected to be higher based on comparable levels elsewhere at the site, it is likely that the inward gradient estimates are actually higher and that the inflow pressure and flow may be more persistent than indicated by the calculations. As long as the Secondary LDS is pumped, groundwater inflow is expected. Even though the inward gradient contributes to the volume of leachate, it also significantly inhibits the potential for advective migration of leachate into the groundwater system.

In addition to the general recommendations for stormwater control and drainage, following are specific recommendations for Section III:

- It is noted in the November 2006 aerial photograph that portions of the cover directly on Cell 3C, the Closure Cell, are not vegetated. To avoid erosion of the cover soils, this area needs to be stabilized with grass or erosion control mats.
- Along the northern boundary the ditches that run on the inside edge of the access road should be removed and the road rebuilt as discussed in the general comments in Section 4.1. Also, the discharge location of the drop inlet in this area is noted on the provided drawing as being questionable and should be confirmed.

The potential for surface water infiltration through the anchor trenches was initially noticed during the closure of Section III, high volumes of water were reported in the Secondary LDS at Sumps 3C1S and 3C2S. It is believed that this was surface water that had been ponded in the area and that the water entered the Secondary LDS by flowing under the Primary liner anchor trench. The perimeter ditch and the anchor trench along the toe of the Closure Cell cover system are at approximately the same elevation and are in close proximity, and the Primary and Secondary liners are not welded together at Section III. To avoid surface water infiltration into the Secondary LDS, the perimeter ditches should be maintained so that they properly drain. However, if in the future it is found that this infiltration mechanism becomes a chronic source of liquids into the Secondary LDS, the run-on (flat) area of the anchor trenches can be exposed and the top of the Primary geomembrane can be cut and the cut edge welded to the Secondary geomembrane. This will not effect the integrity of the geomembranes because once a landfill is filled and closed, the anchor trench serves no mechanical purpose (i.e., the geomembrane no longer needs to be anchored at the top of the slope) since the geomembrane is kept in place by the load from the overlying soil layers and waste.

GOLDER ASSOCIATES, INC.

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Senior Engineer

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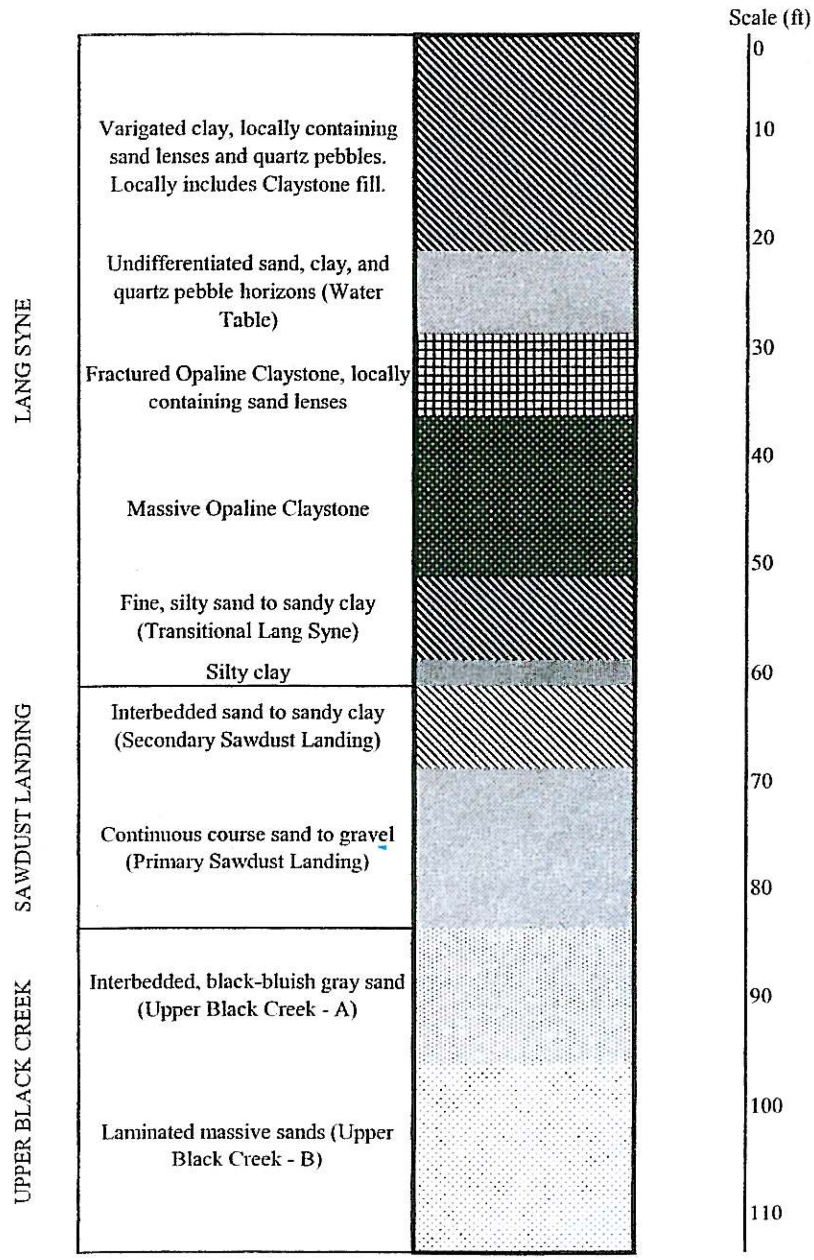
Practice/Program Leader and Principal

FIGURES



REFERENCES

"FIRST QUARTER 2006 DETECTION MONITORING REPORT, PINEWOOD SITE SCD 070 375 985, PINEWOOD, SOUTH CAROLINA, APRIL 2006", SUBMITTED BY GENERAL ENGINEERING & ENVIRONMENTAL, LLC.

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
△	-	-	-	-		

PROJECT

KESTREL HORIZONS, LLC / PINEWOOD / SC

TITLE

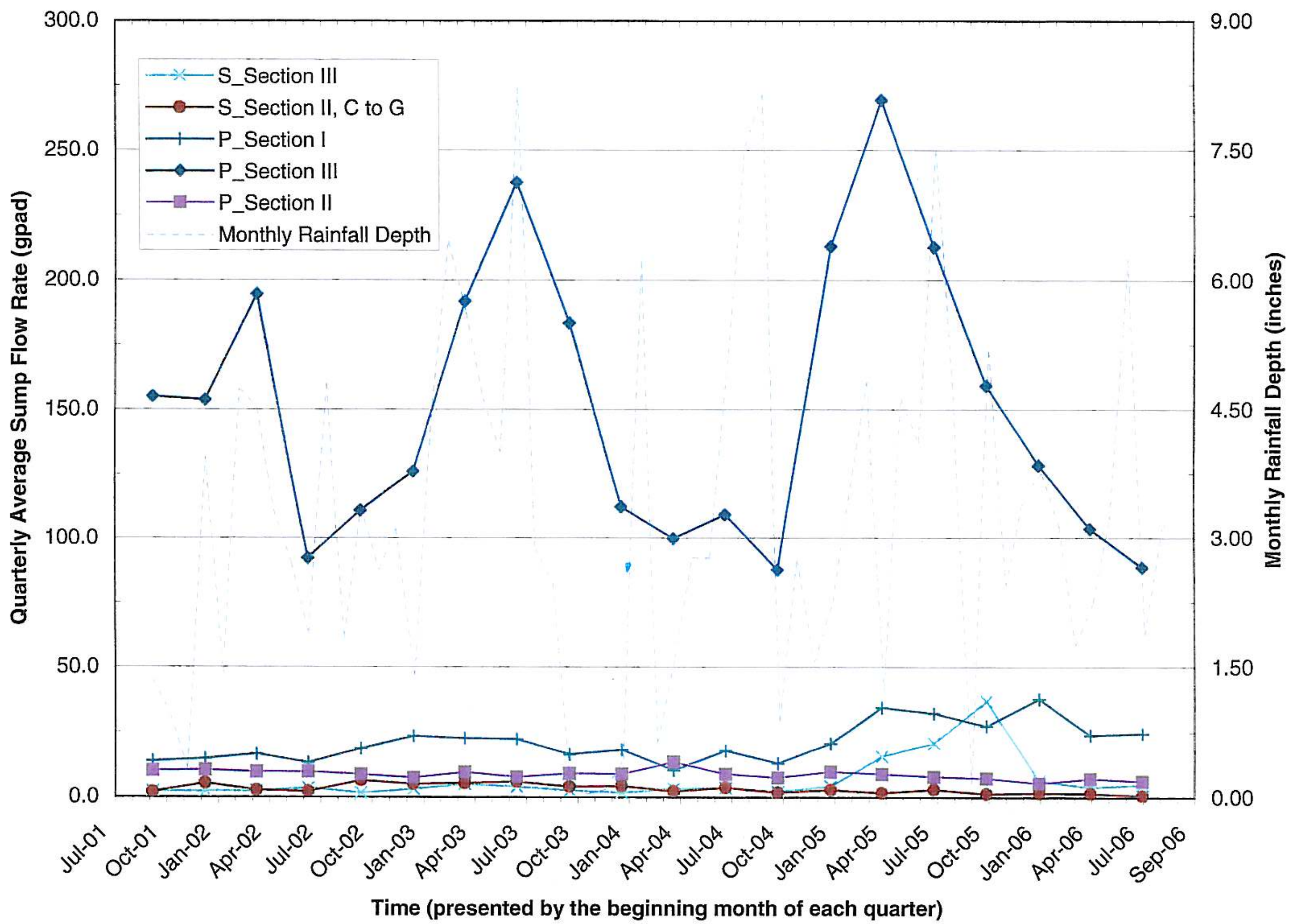
GENERALIZED STRATIGRAPHIC COLUMN OF THE PINEWOOD SITE

Golder Associates
Atlanta, Georgia

PROJECT No.		063-3496	FILE No.	0633496-002
DESIGN	-	-	SCALE AS SHOWN	REV. -
CADD	RJC	01/07	**FIGURE 1-1**	
CHECK	CJ	4/07		
REVIEW	R	4/07		

Drawing file: 0633496-002 Gen Geo Sec.dwg Apr 06, 2007 - 9:57am

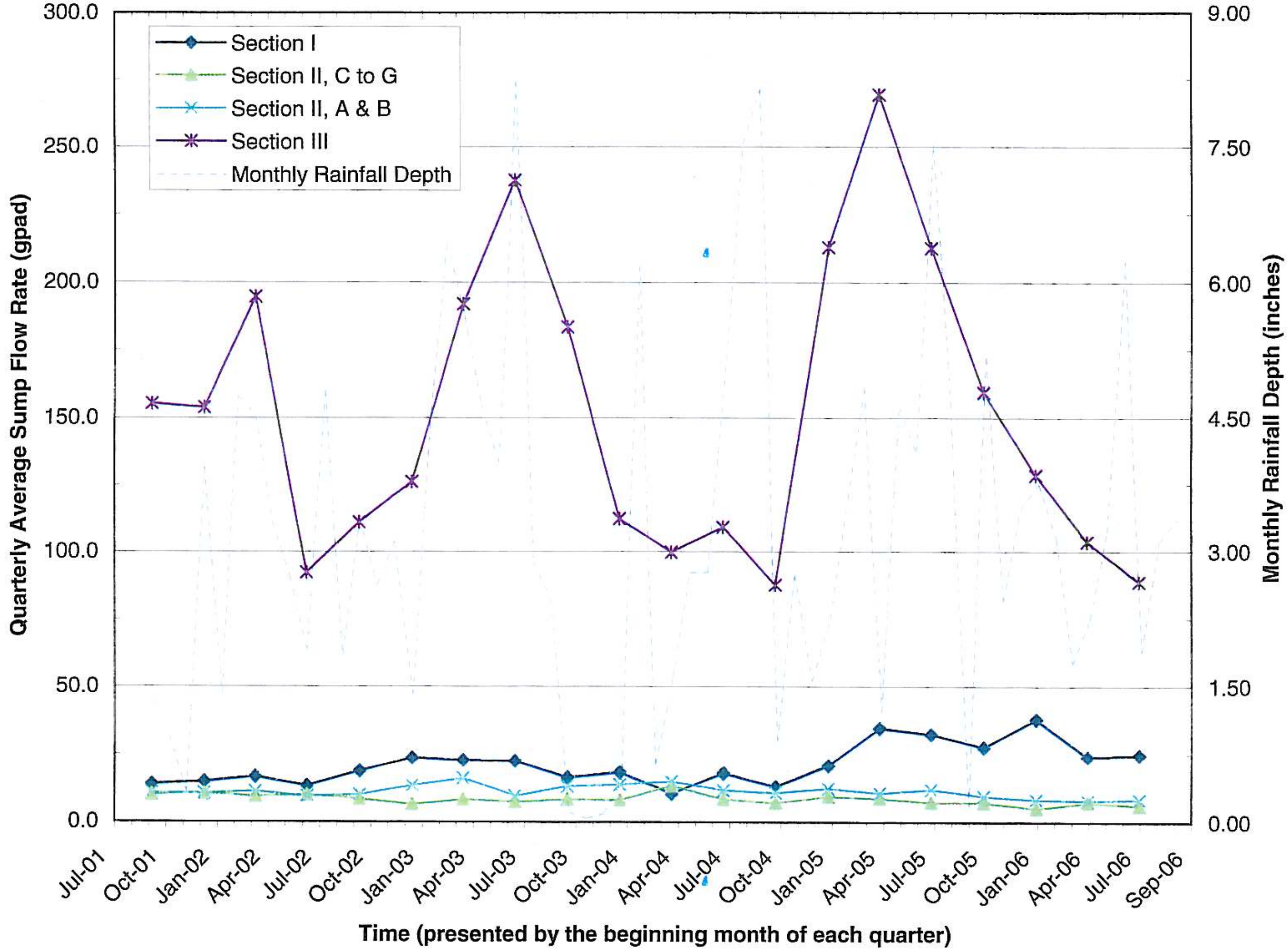
FIGURE 2-1 TOTAL PRIMARY AND SECONDARY SUMPS FLOW RATES, SECTIONS I, II AND III



File: Pinewood Quarterly Average Primary and Secondary Sump Flow Rates.xls
Sheet: P & S,Sections I, II, III_chart

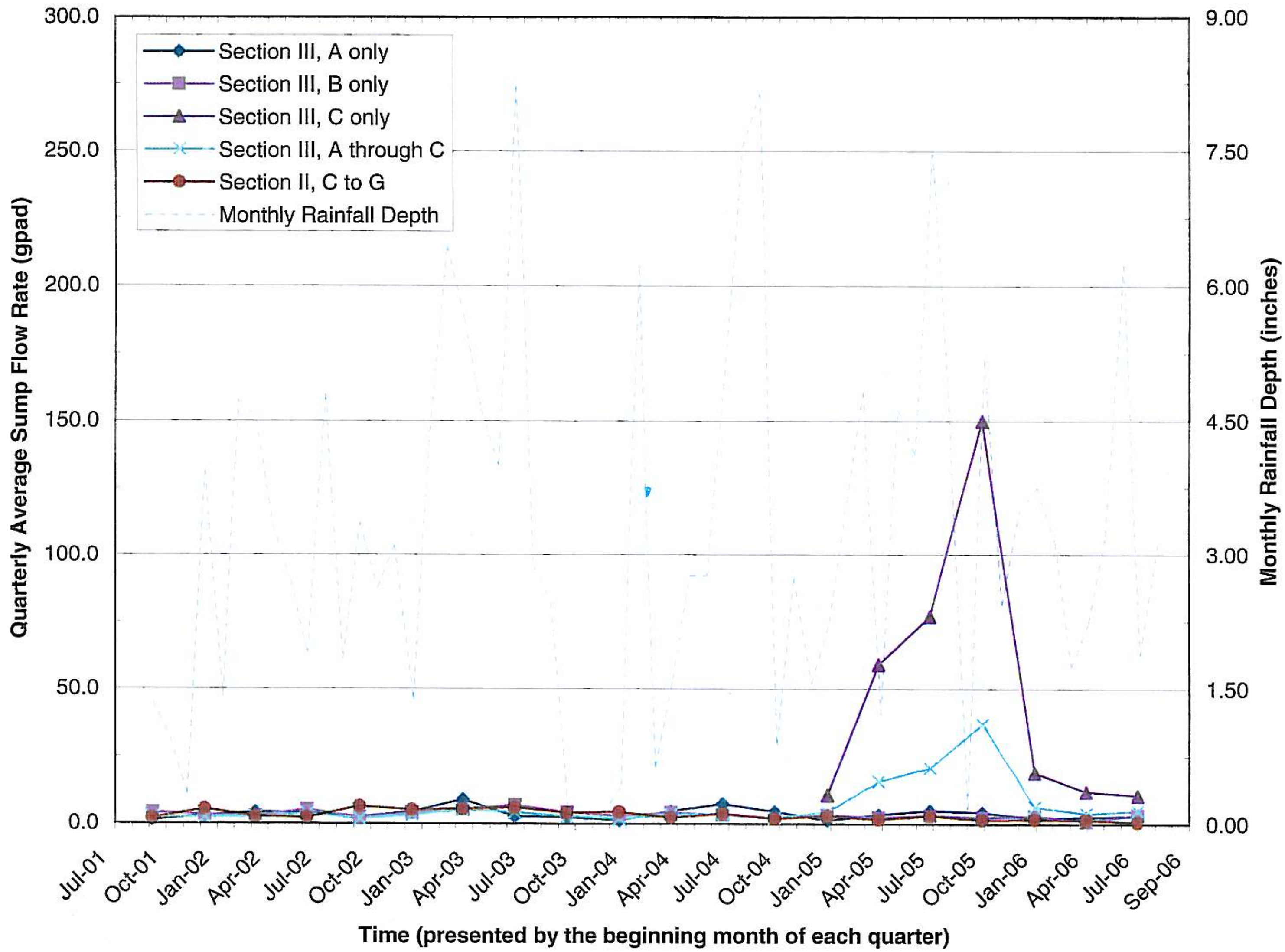
Golder Associates

FIGURE 2-2 PRIMARY SUMPS FLOW RATES, SECTIONS I, II AND III



File: Pinewood Quarterly Average Primary and Secondary Sump Flow Rates.xls
Sheet: Primary_I, II, and III_Chart

FIGURE 2-3 SECONDARY SUMPS FLOW RATES, SECTIONS II & III



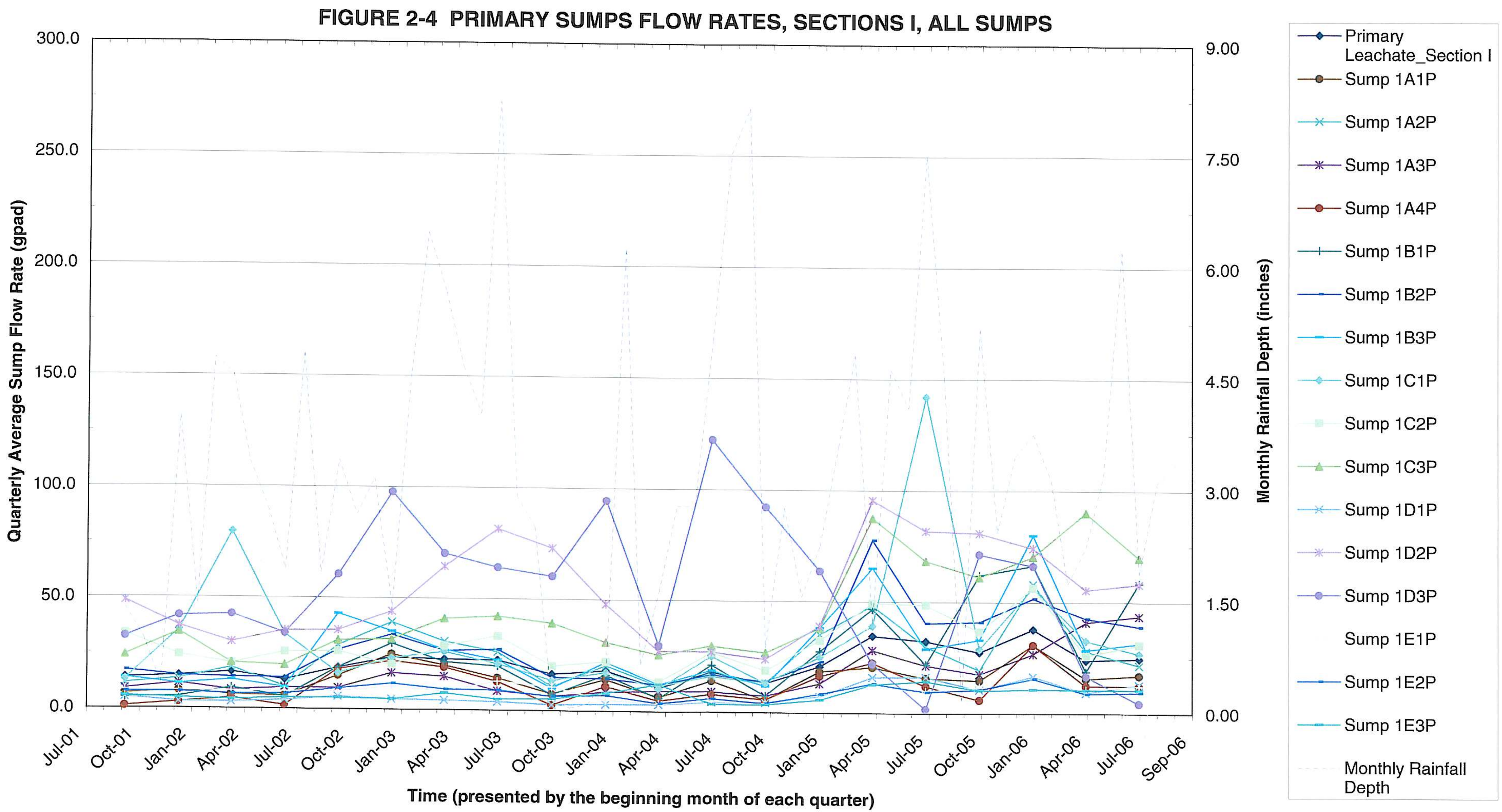


FIGURE 2-4 PRIMARY SUMPS FLOW RATES, SECTIONS I, ALL SUMPS
Quarterly Average Sump Flow Rate (gpad)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)
Primary Leachate_Section I
Sump 1A1P
Sump 1A2P
Sump 1A3P
Sump 1A4P
Sump 1B1P
Sump 1B2P
Sump 1B3P
Sump 1C1P
Sump 1C2P
Sump 1C3P
Sump 1D1P
Sump 1D2P
Sump 1D3P
Sump 1E1P
Sump 1E2P
Sump 1E3P
Monthly Rainfall Depth

FIGURE 2-5 PRIMARY SUMPS FLOW RATES, SECTIONS II, ALL SUMPS

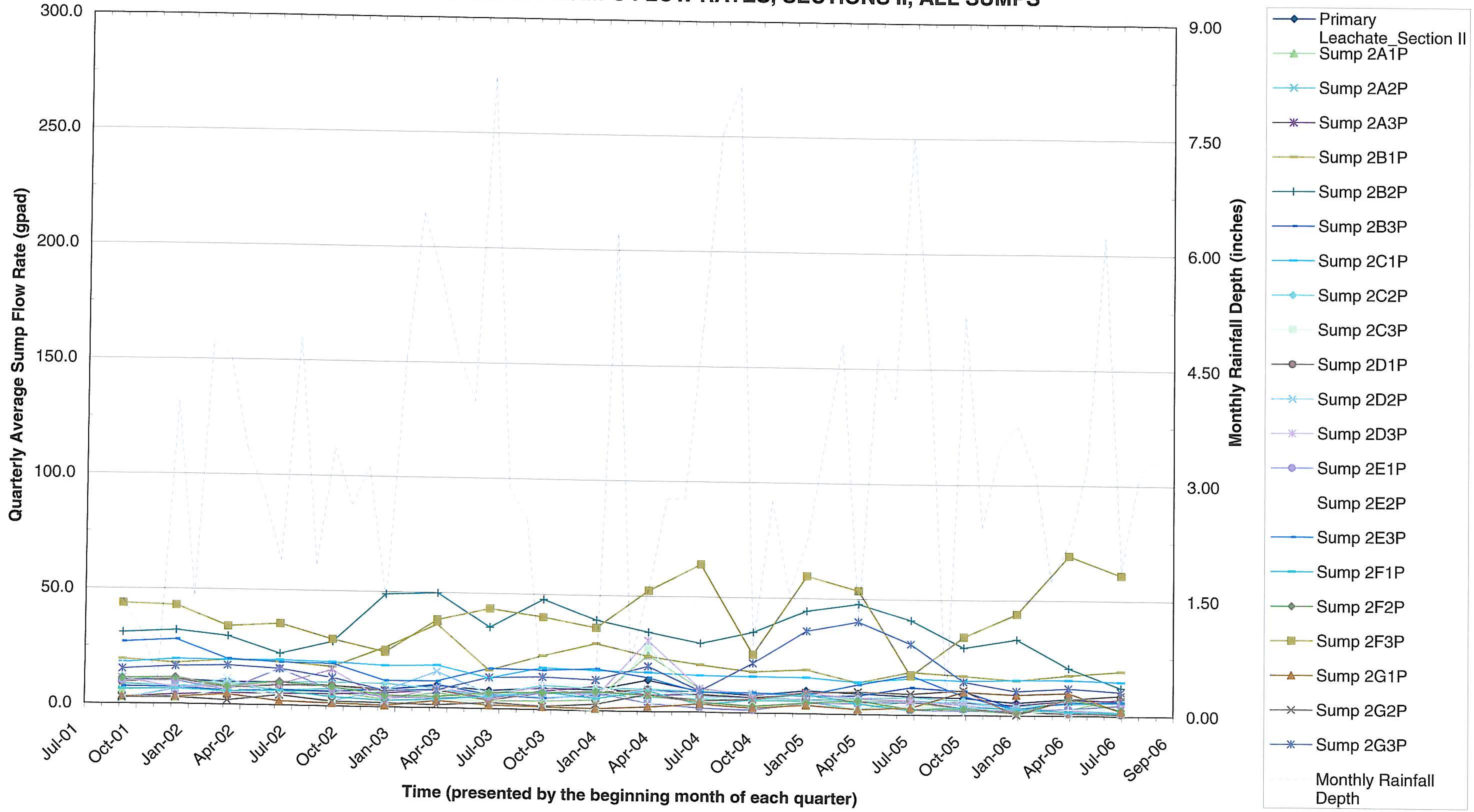


FIGURE 2-6 PRIMARY SUMPS FLOW RATES, SECTIONS III, ALL SUMPS

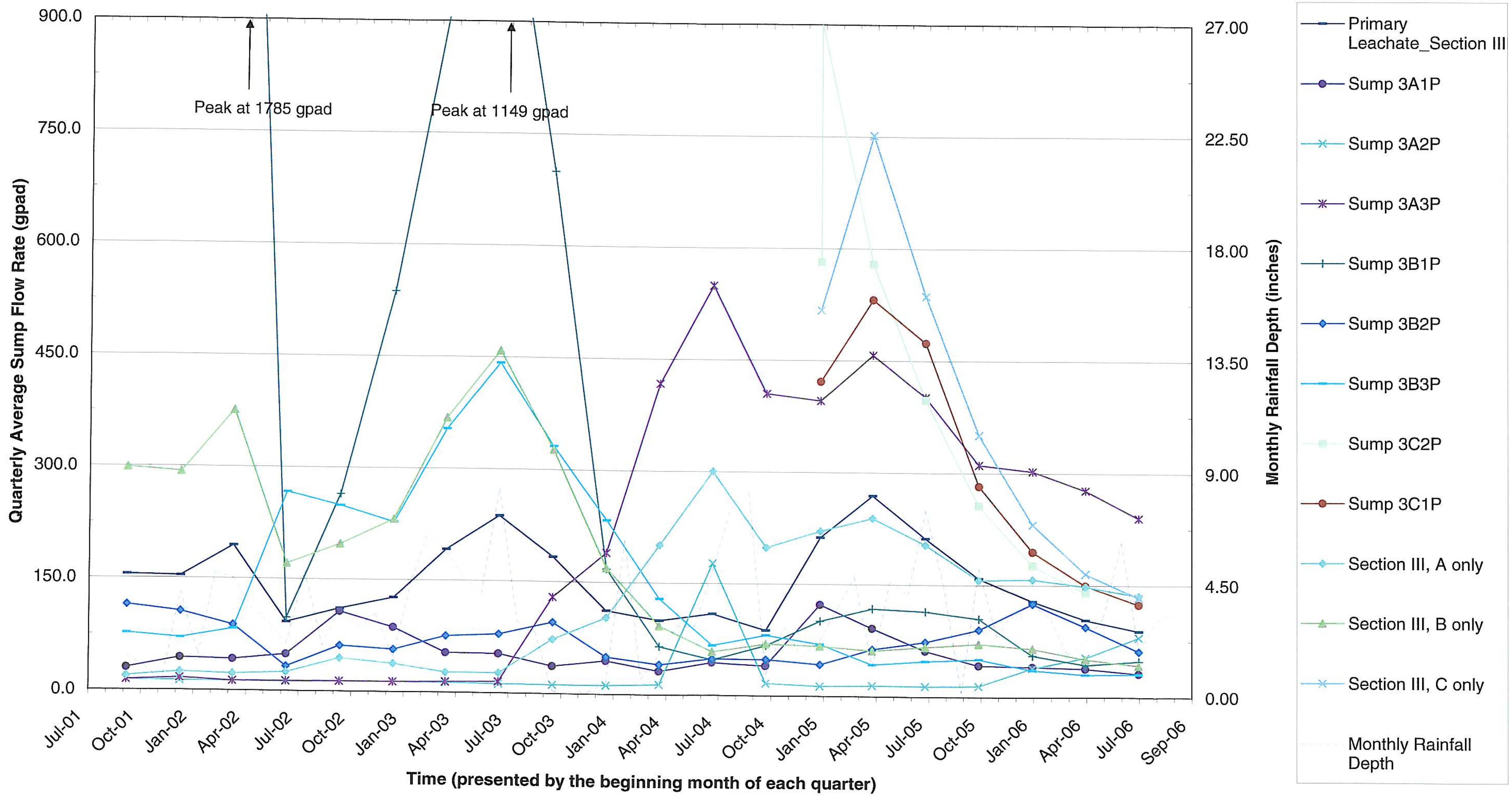
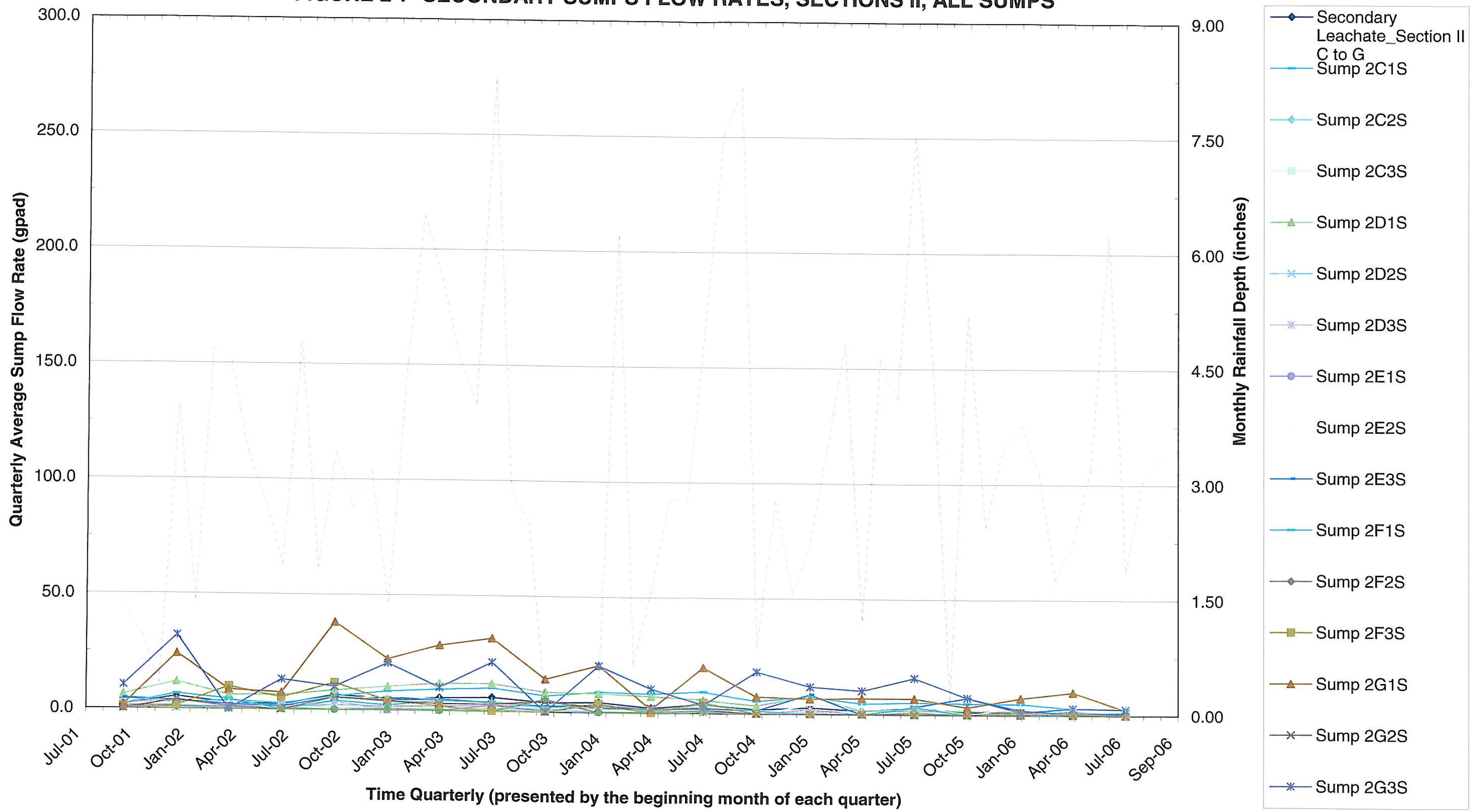


FIGURE 2-7 SECONDARY SUMPS FLOW RATES, SECTIONS II, ALL SUMPS



File: Section II_Quarterly Average Secondary Leachate
Sheet: Secondary_Section II_Chart

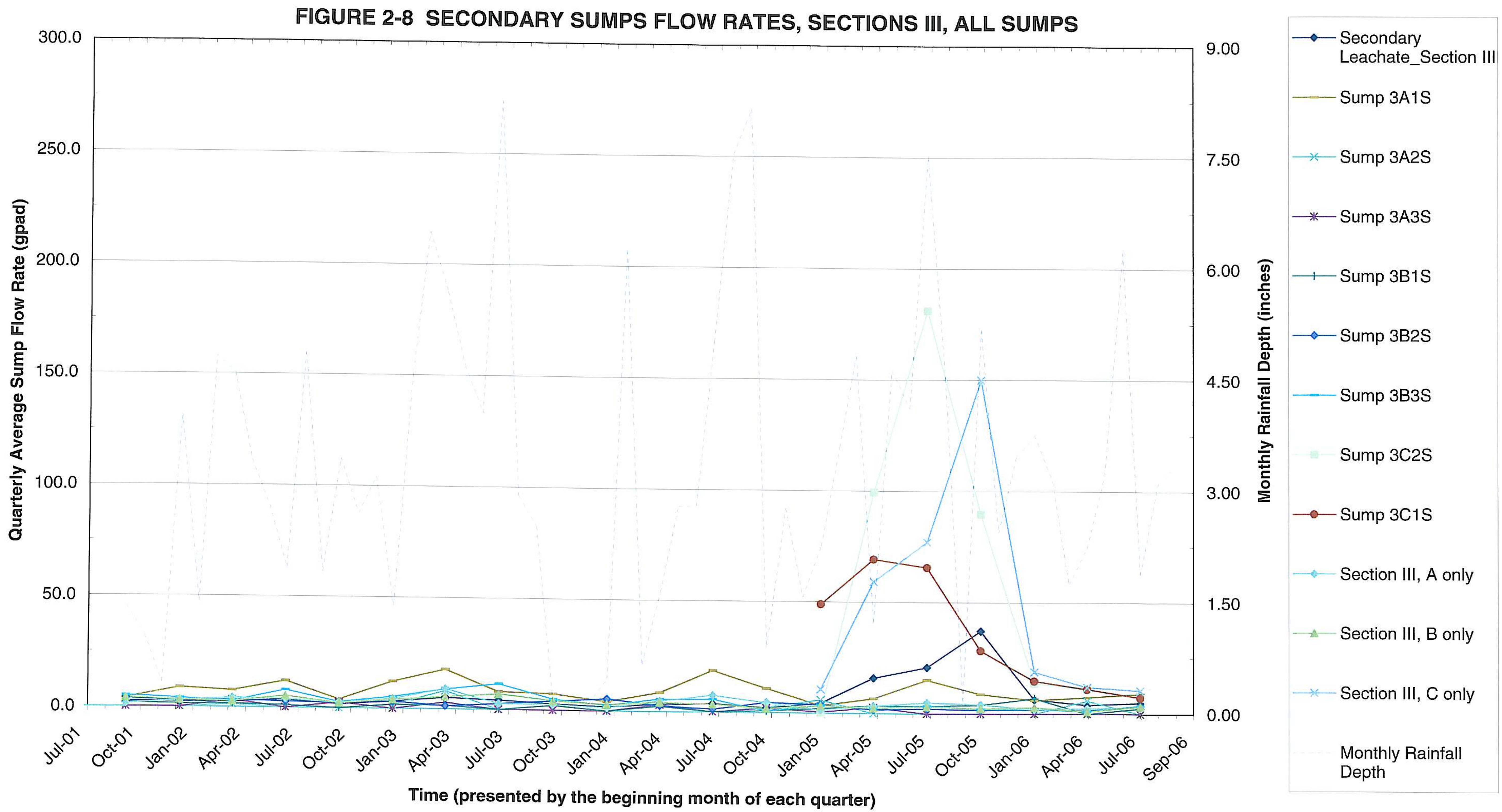
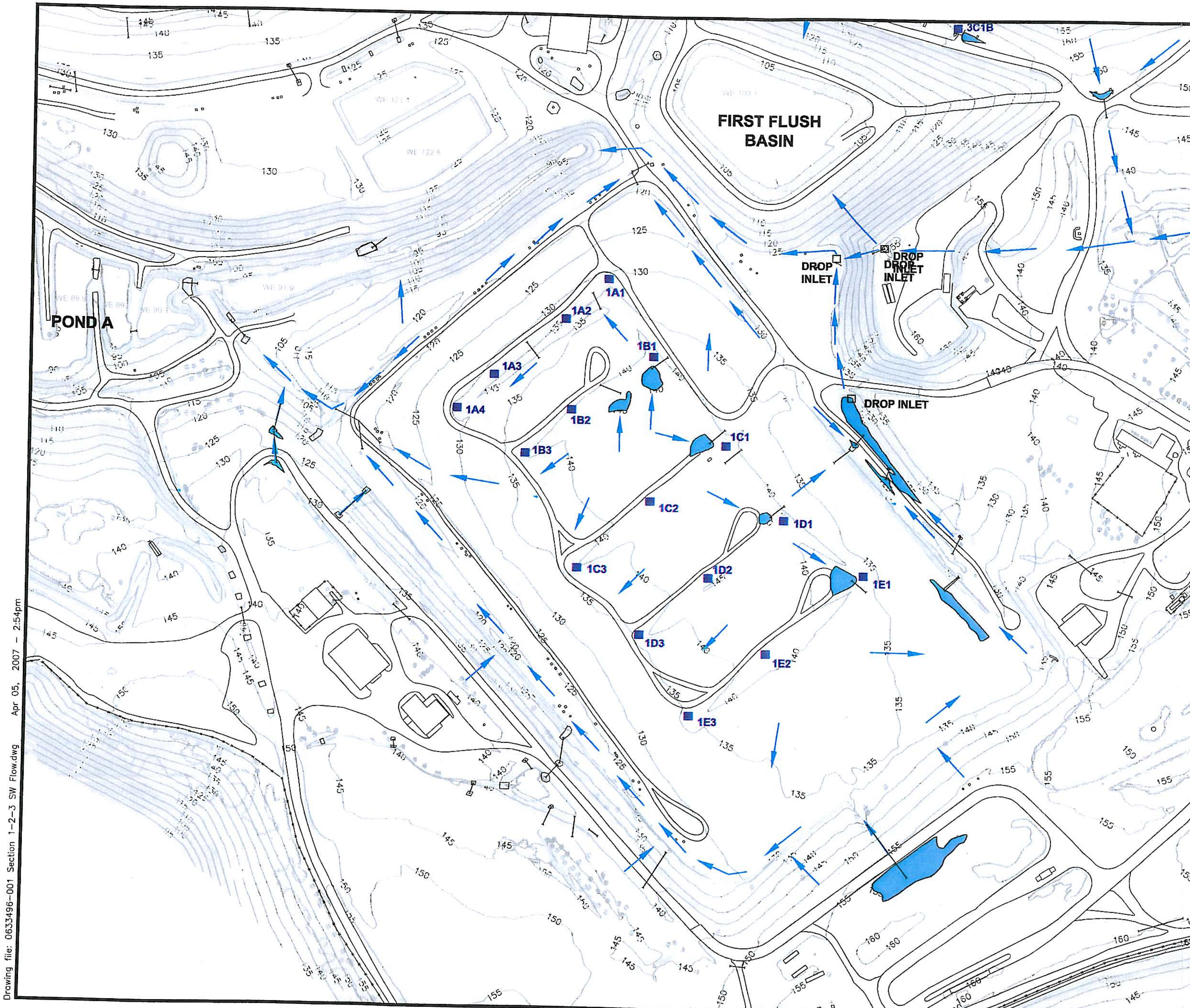


FIGURE 2-8 SECONDARY SUMPS FLOW RATES, SECTIONS III, ALL SUMPS
Quarterly Average Sump Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Time (presented by the beginning month of each quarter)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Secondary Leachate_Section III
Sump 3A1S
Sump 3A2S
Sump 3A3S
Sump 3B1S
Sump 3B2S
Sump 3B3S
Sump 3C2S
Sump 3C1S
Section III, A only
Section III, B only
Section III, C only
Monthly Rainfall Depth



LEGEND

1A1 ■	APPROX. SUMP RISER LOCATION AND NAME
(blue shape)	LOW SPOT OR POORLY DRAINED AREA
(arrow)	FLOW DIRECTION

REFERENCES

TOPOGRAPHIC MAP COMPILED BY PHOTOGRAMMETRIC METHODS BY GEODATA CORP., DATE OF PHOTOGRAPHY NOVEMBER 10, 2006. GEODATA CORP JOB # 07004.

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SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
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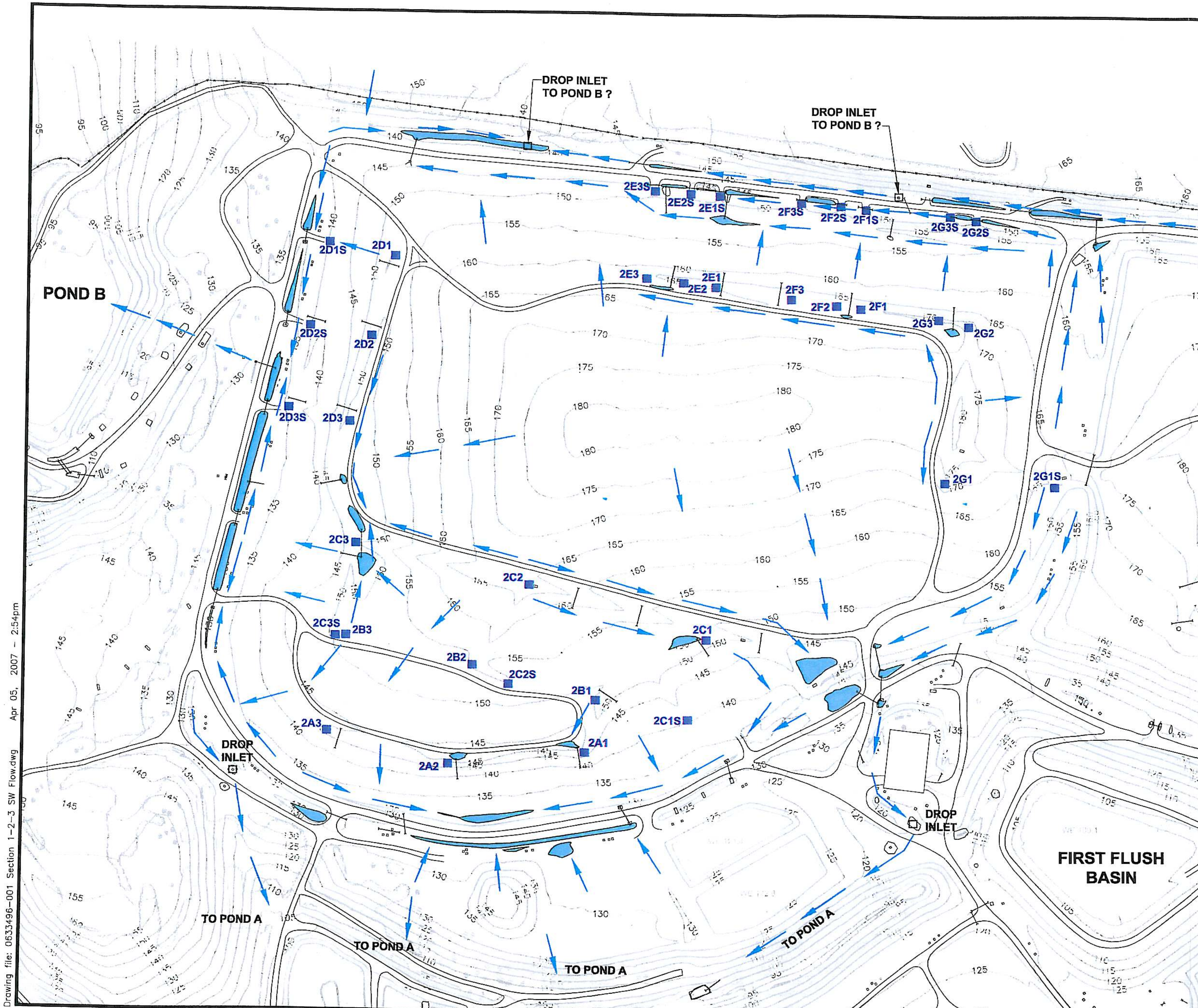
PROJECT
KESTREL HORIZONS, LLC / PINEWOOD / SC

TITLE
SECTION I GENERAL STORM WATER FLOW DIRECTION

Golder Associates
Atlanta, Georgia

PROJECT No.	063-3496		FILE No.	0633496-001
DESIGN	-	-	SCALE AS SHOWN	REV. -
CADD	RJC	01/07		
CHECK			**FIGURE 2-9**	
REVIEW				

Drawing file: 0633496-001 Section 1-2-3 SW Flow.dwg Apr 05, 2007 - 2:54pm



LEGEND

2A1 ■	APPROX. SUMP RISER LOCATION AND NAME
	LOW SPOT OR POORLY DRAINED AREA
	FLOW DIRECTION

NOTES

1. RISERS LABELED WITH AN "S" AT THE END ARE FROM SECONDARY SOURCES.

REFERENCES

TOPOGRAPHIC MAP COMPILED BY PHOTOGRAMMETRIC METHODS BY GEODATA CORP., DATE OF PHOTOGRAPHY NOVEMBER 10, 2006. GEODATA CORP JOB # 07004.

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SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
△	–	–	–	–		

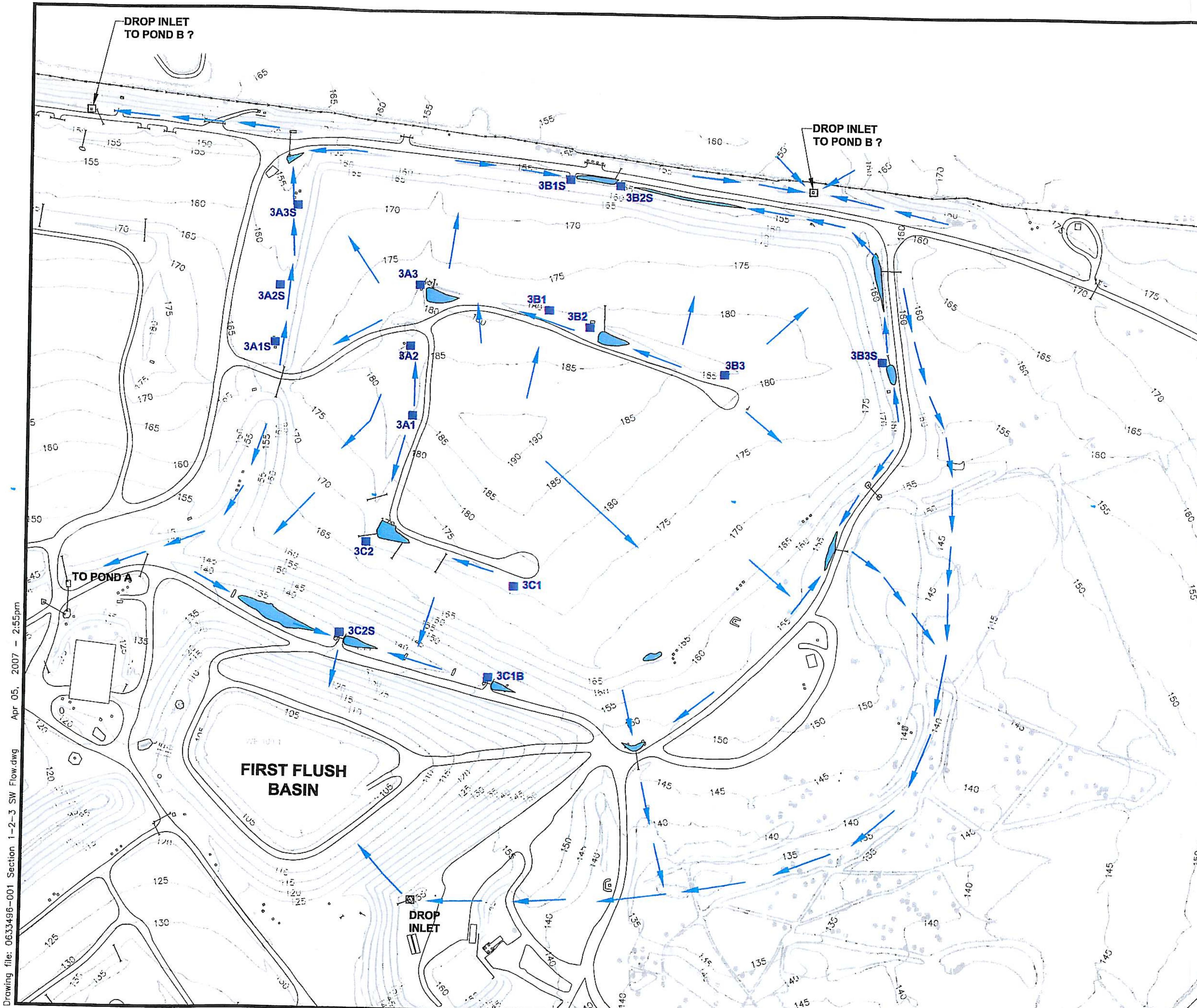
PROJECT
KESTREL HORIZONS, LLC / PINEWOOD / SC

TITLE
SECTION II
GENERAL STORM WATER FLOW DIRECTION

Golder Associates
Atlanta, Georgia

PROJECT No.	063-3496		FILE No.	0633496-001
DESIGN	–	–	SCALE AS SHOWN	REV. –
CADD	RJC	01/07	FIGURE 2-10	
CHECK	RJ	4/07		
REVIEW				

Drawing file: 0633496-001 Section 1-2-3 SW Flow.dwg Apr 05, 2007 - 2:54pm



Drawing file: 0633496-001 Section 1-2-3 SW Flow.dwg Apr 05, 2007 - 2:55pm

LEGEND

3A1 ■	APPROX. SUMP RISER LOCATION AND NAME
	LOW SPOT OR POORLY DRAINED AREA
	FLOW DIRECTION

NOTES

1. RISERS LABELED WITH AN "S" AT THE END ARE FROM SECONDARY SOURCES.

REFERENCES

TOPOGRAPHIC MAP COMPILED BY PHOTOGRAMMETRIC METHODS BY GEODATA CORP., DATE OF PHOTOGRAPHY NOVEMBER 10, 2006. GEODATA CORP JOB # 07004.

200 0 200
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
–	–	–	–	–	–	–

PROJECT
KESTREL HORIZONS, LLC / PINEWOOD / SC

TITLE
SECTION III
GENERAL STORM WATER FLOW DIRECTION

Golder Associates
Atlanta, Georgia

PROJECT No.	063-3496		FILE No.	0633496-001
DESIGN	–	–	SCALE AS SHOWN	REV. –
CADD	RJC	01/07	**FIGURE 2-11**	
CHECK				
REVIEW		4/07		

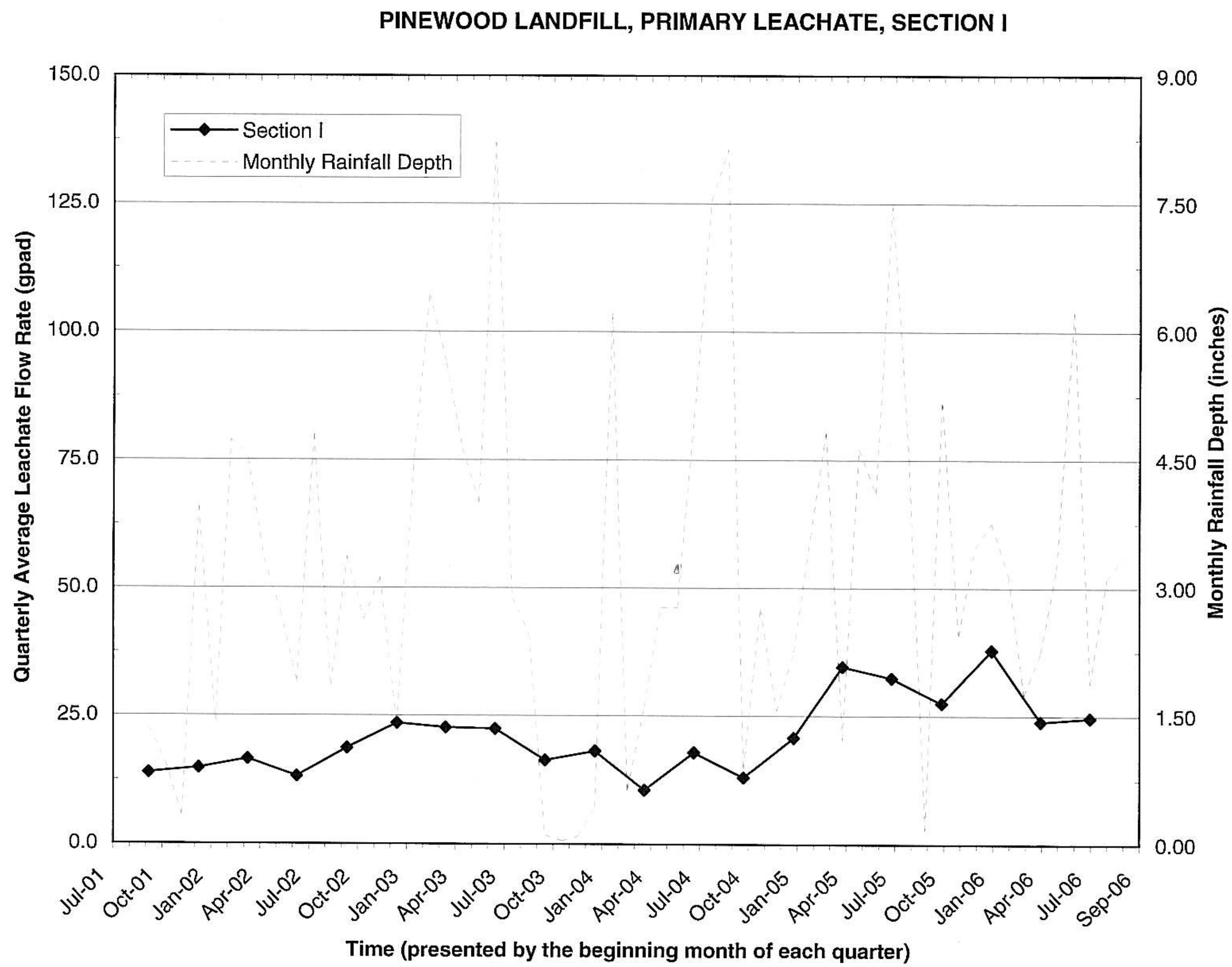
APPENDIX A

Plotted Leachate Pumping Rates

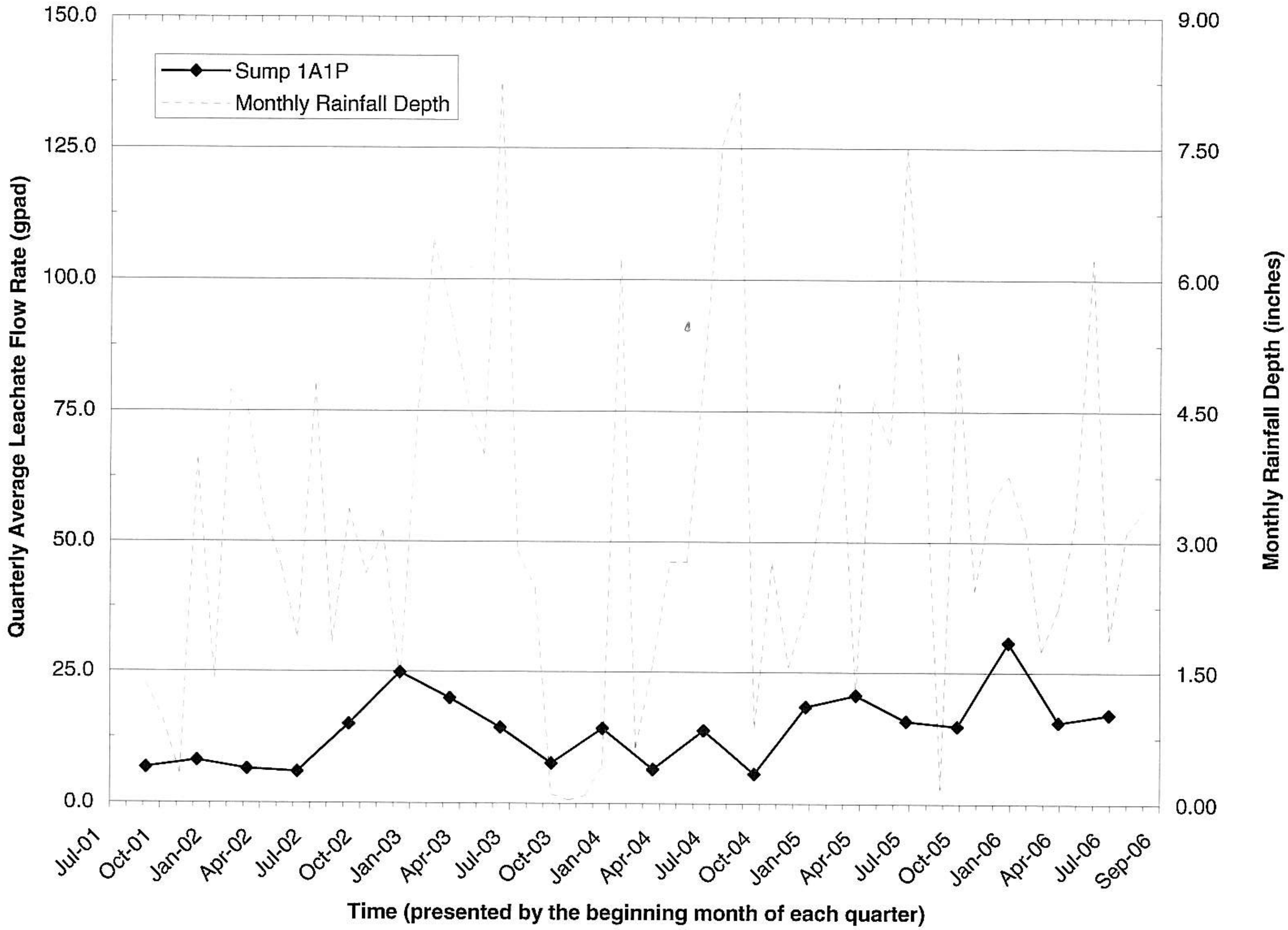
APPENDIX A-1

Primary Leachate Collection and Removal System

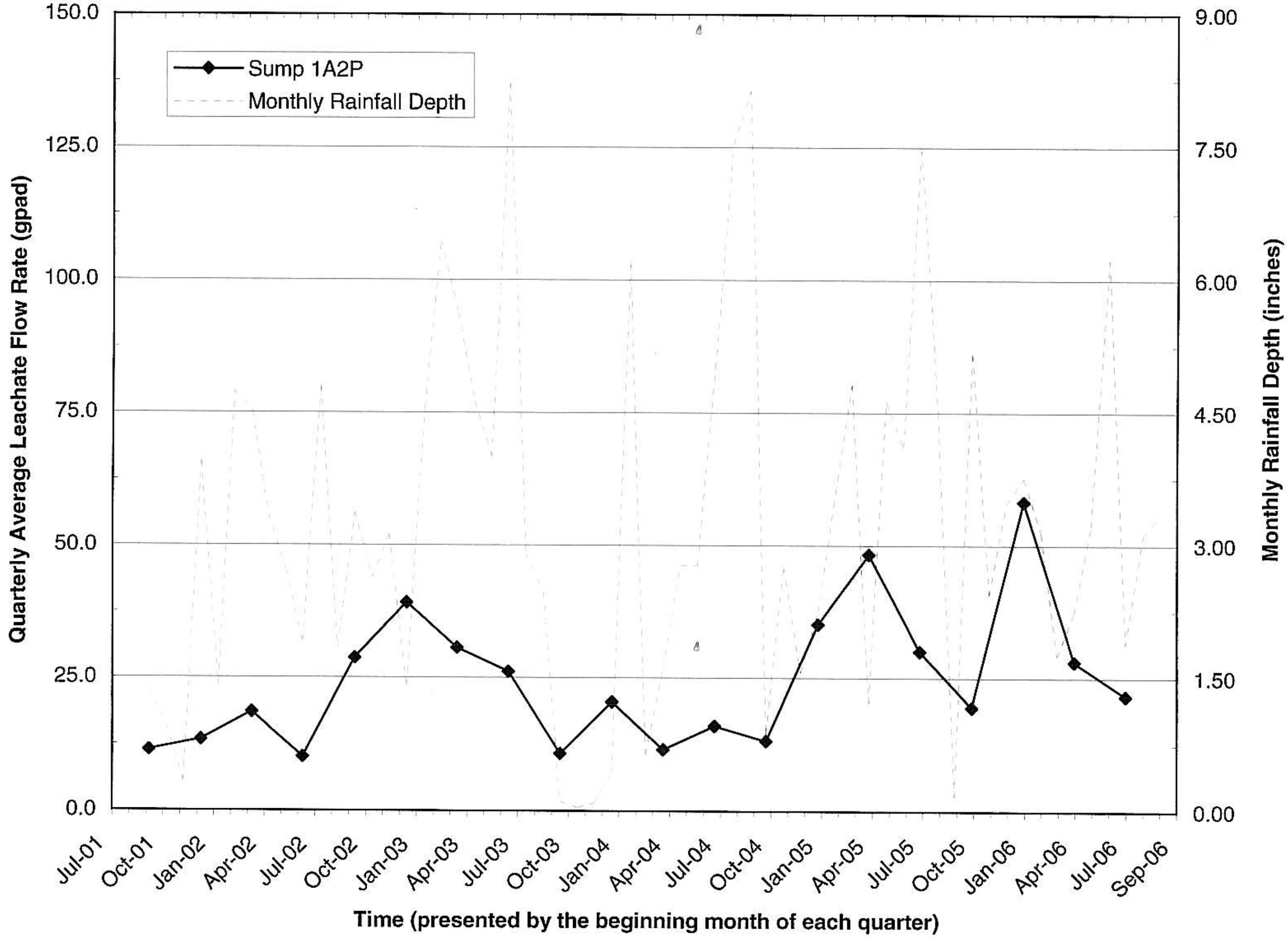
Section I

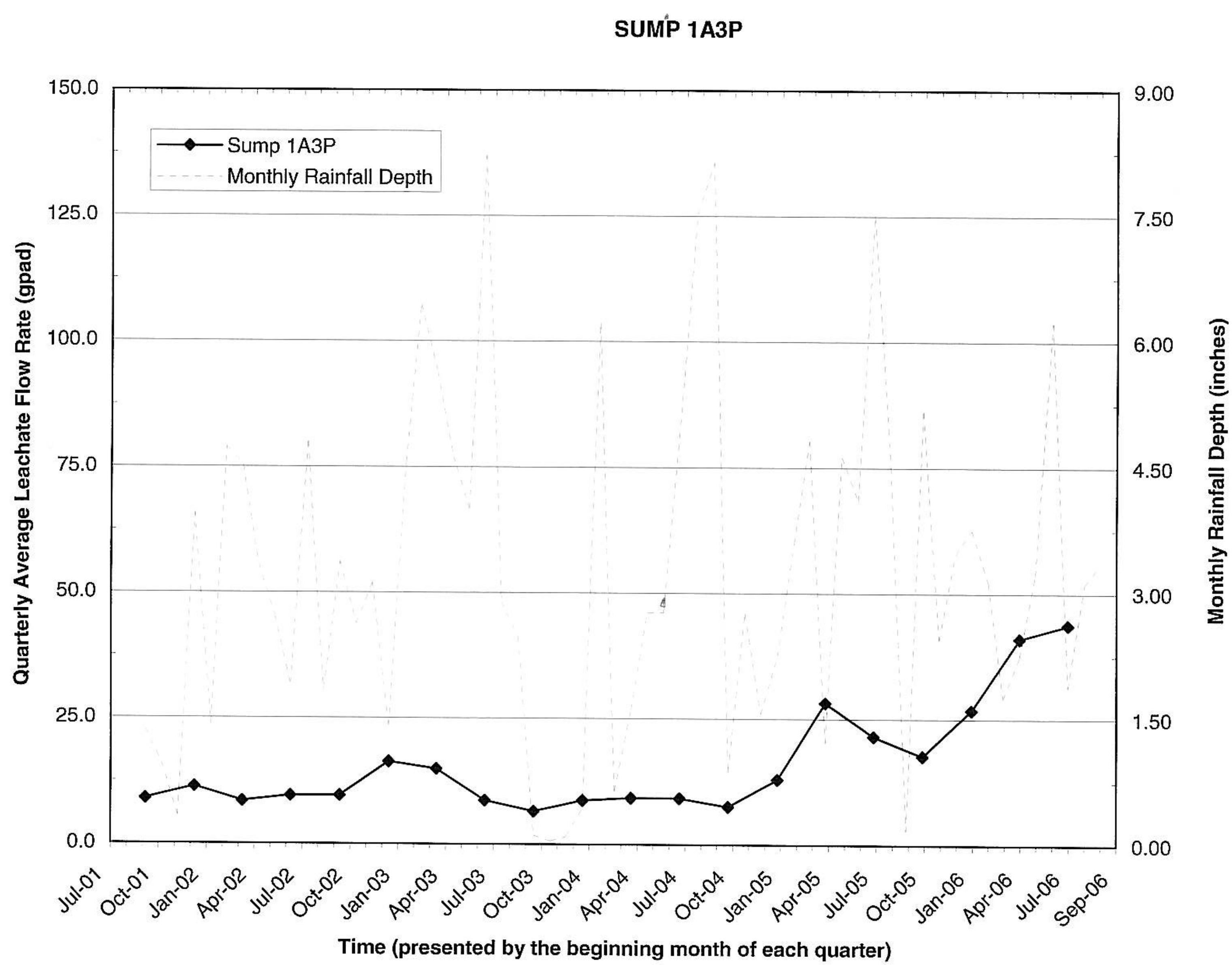

PINEWOOD LANDFILL, PRIMARY LEACHATE, SECTION I
Section I
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 1A1P

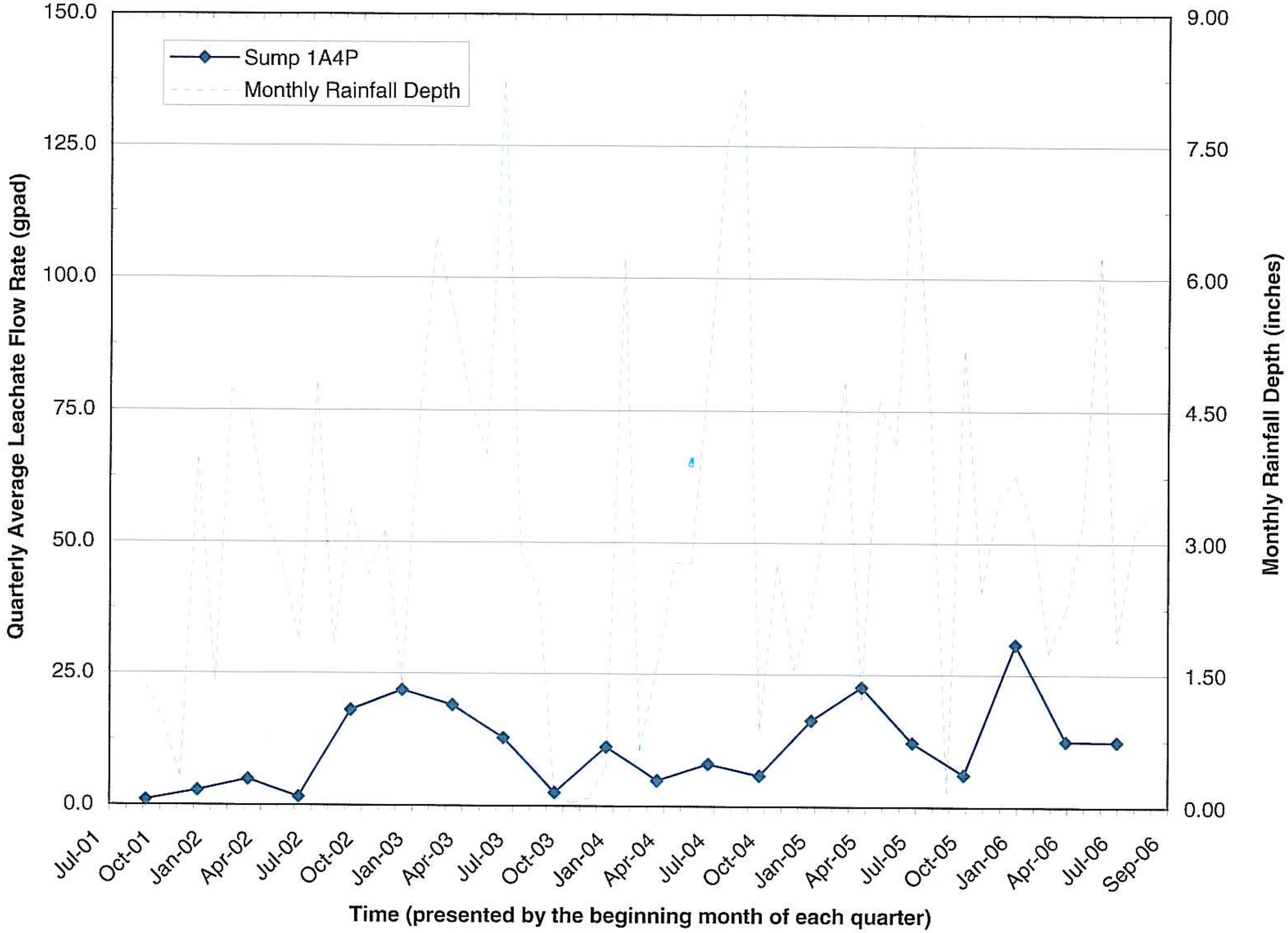

Sump 1A1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 1A2P

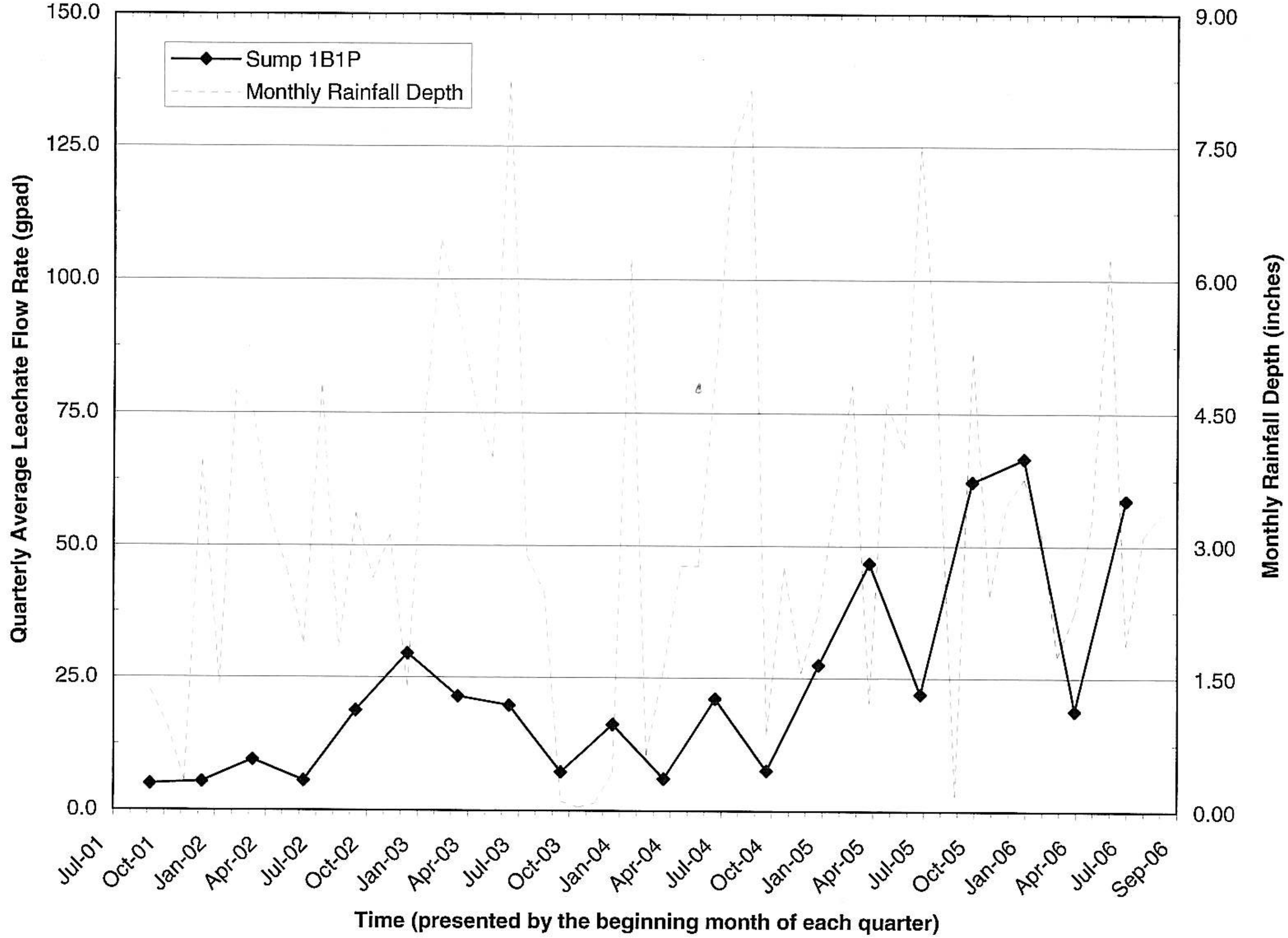

Sump 1A2P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

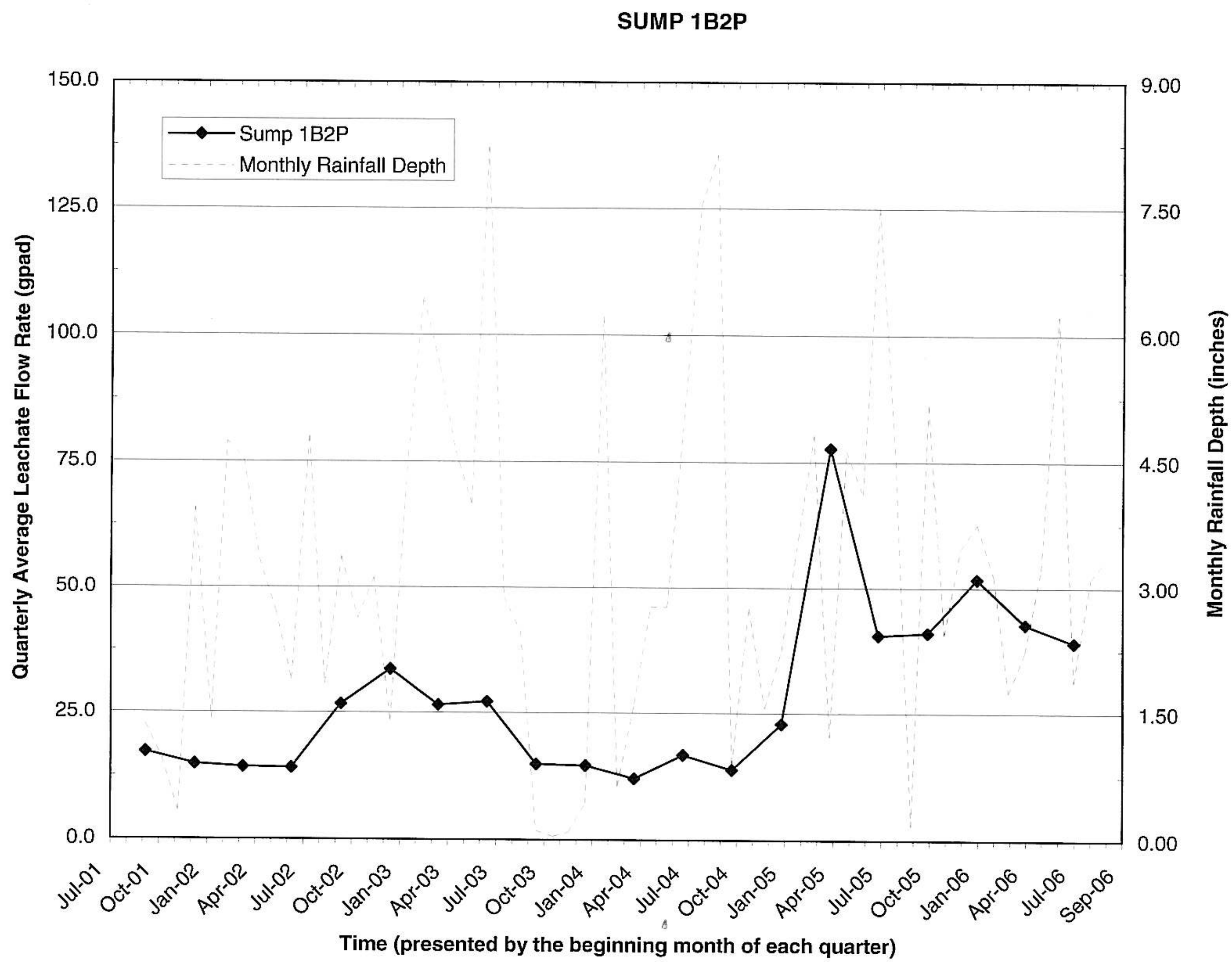

SUMP 1A3P
Sump 1A3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

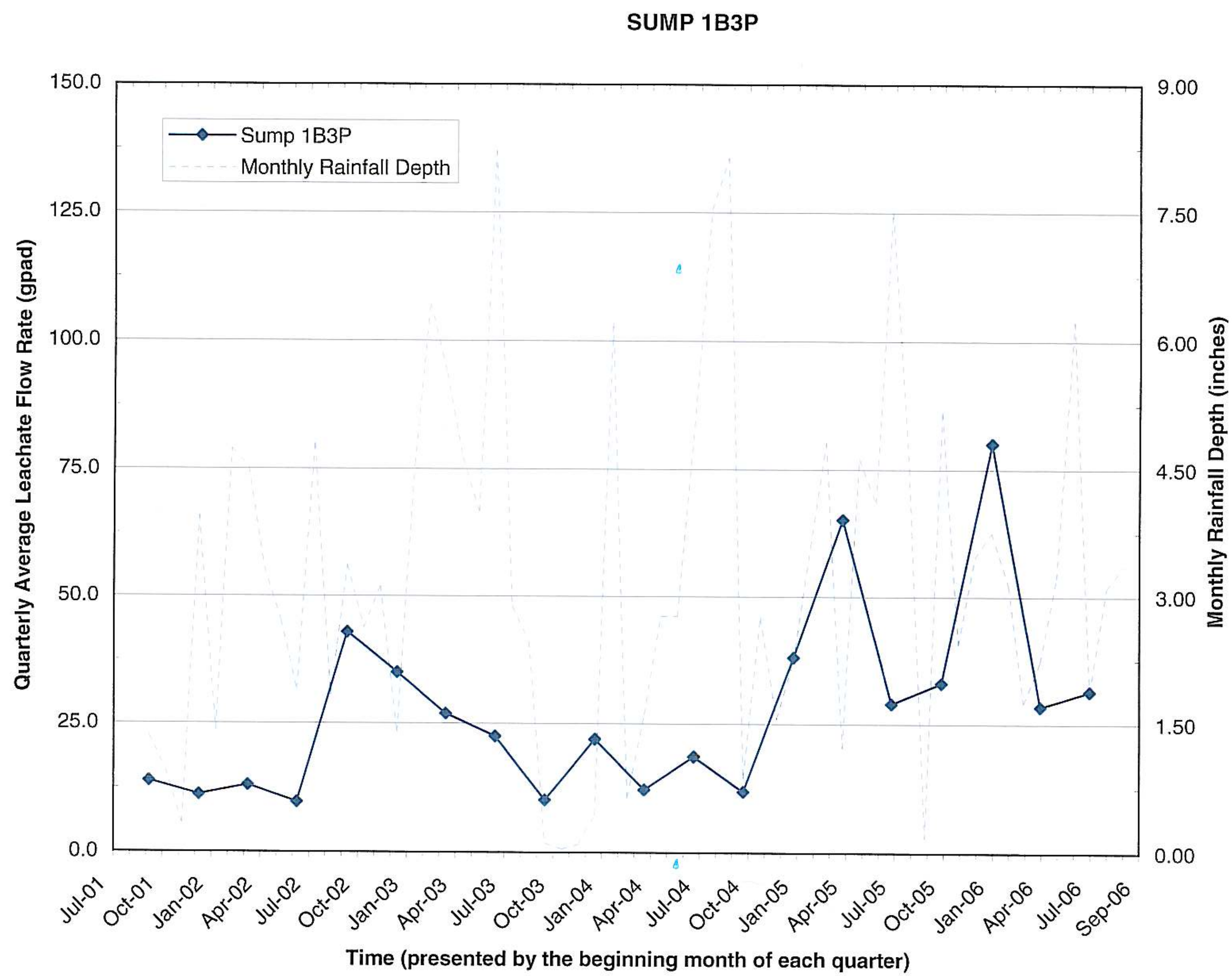
SUMP 1A4P

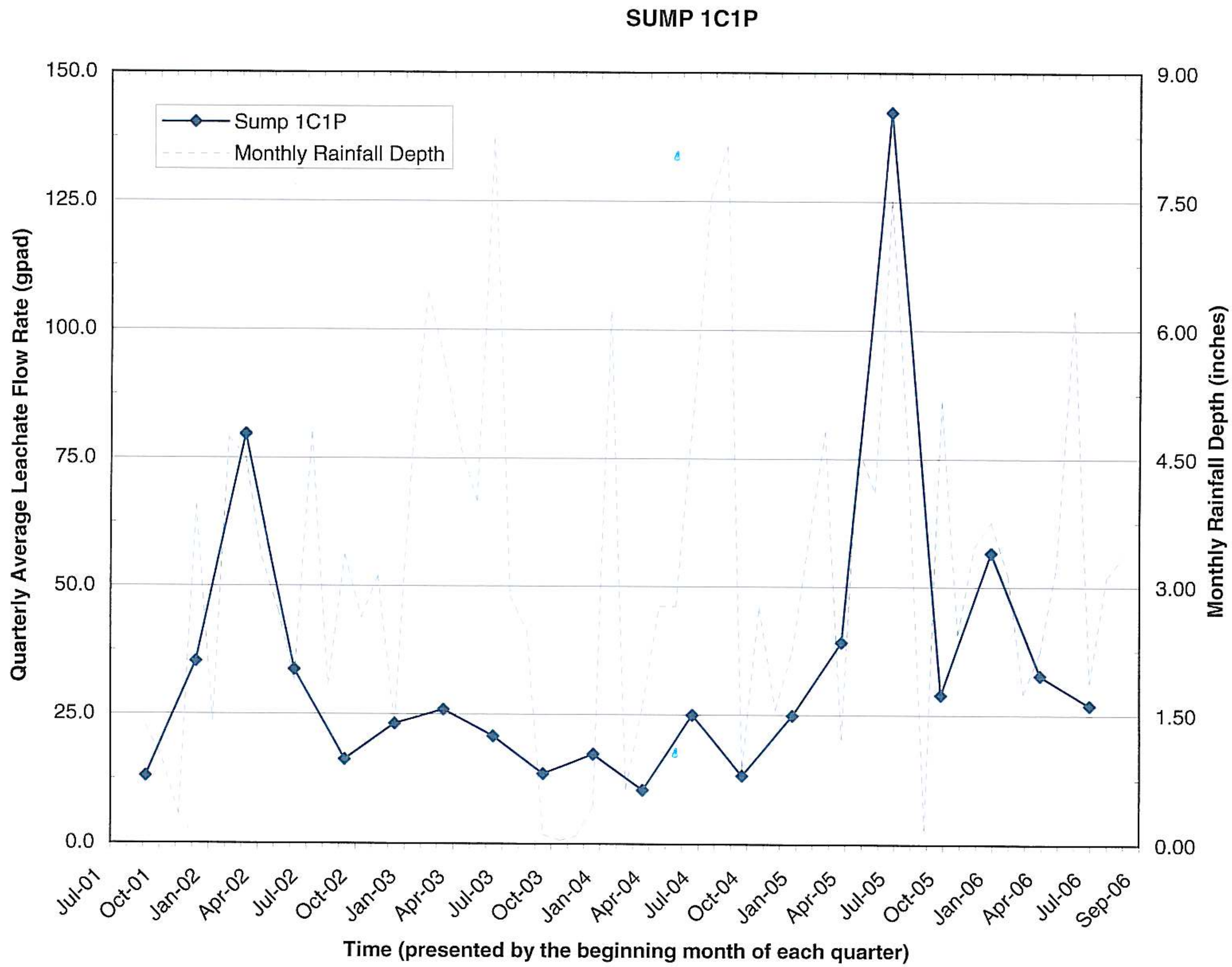

Sump 1A4P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 1B1P

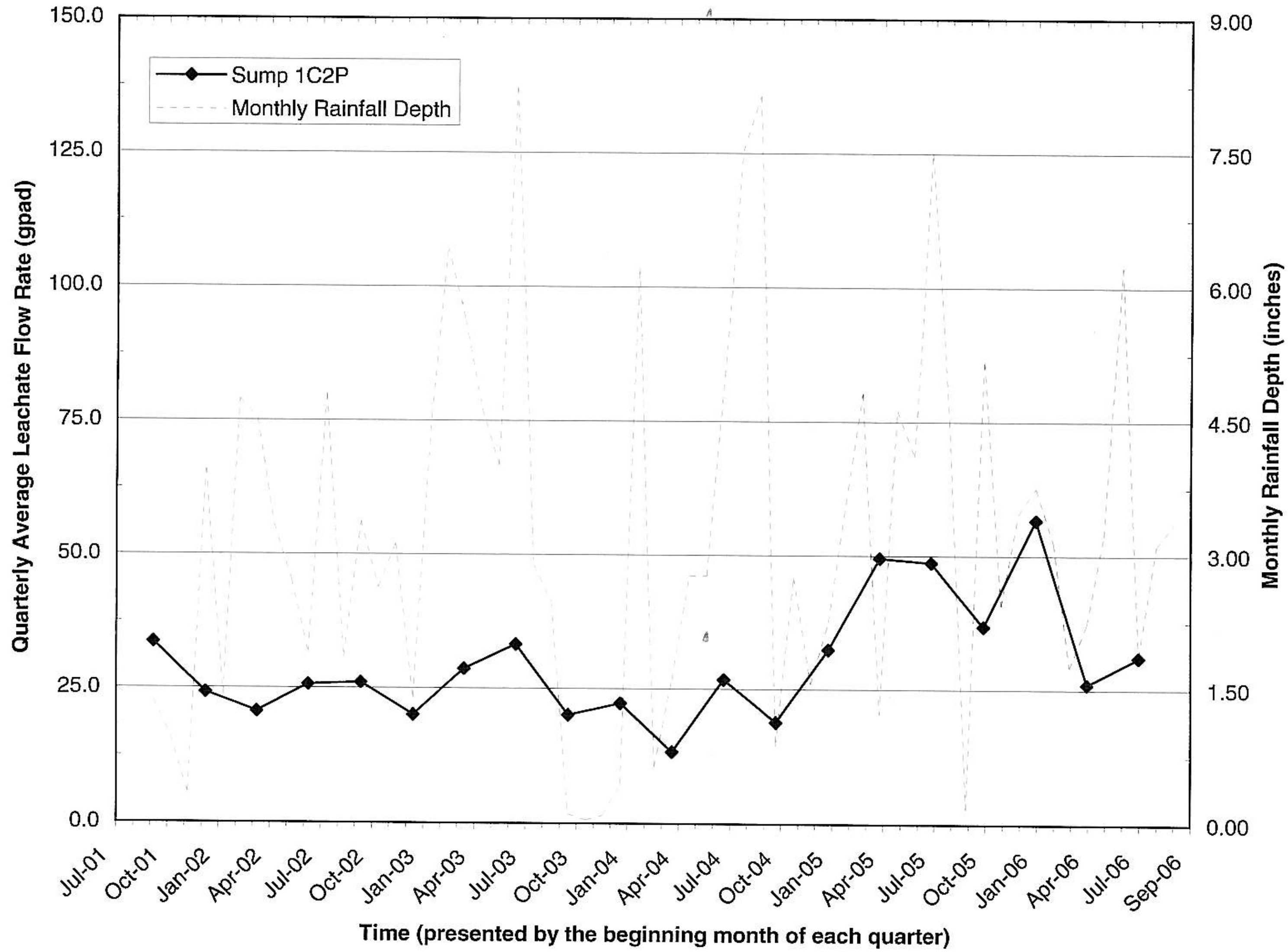

Sump 1B1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 1B2P
Sump 1B2P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

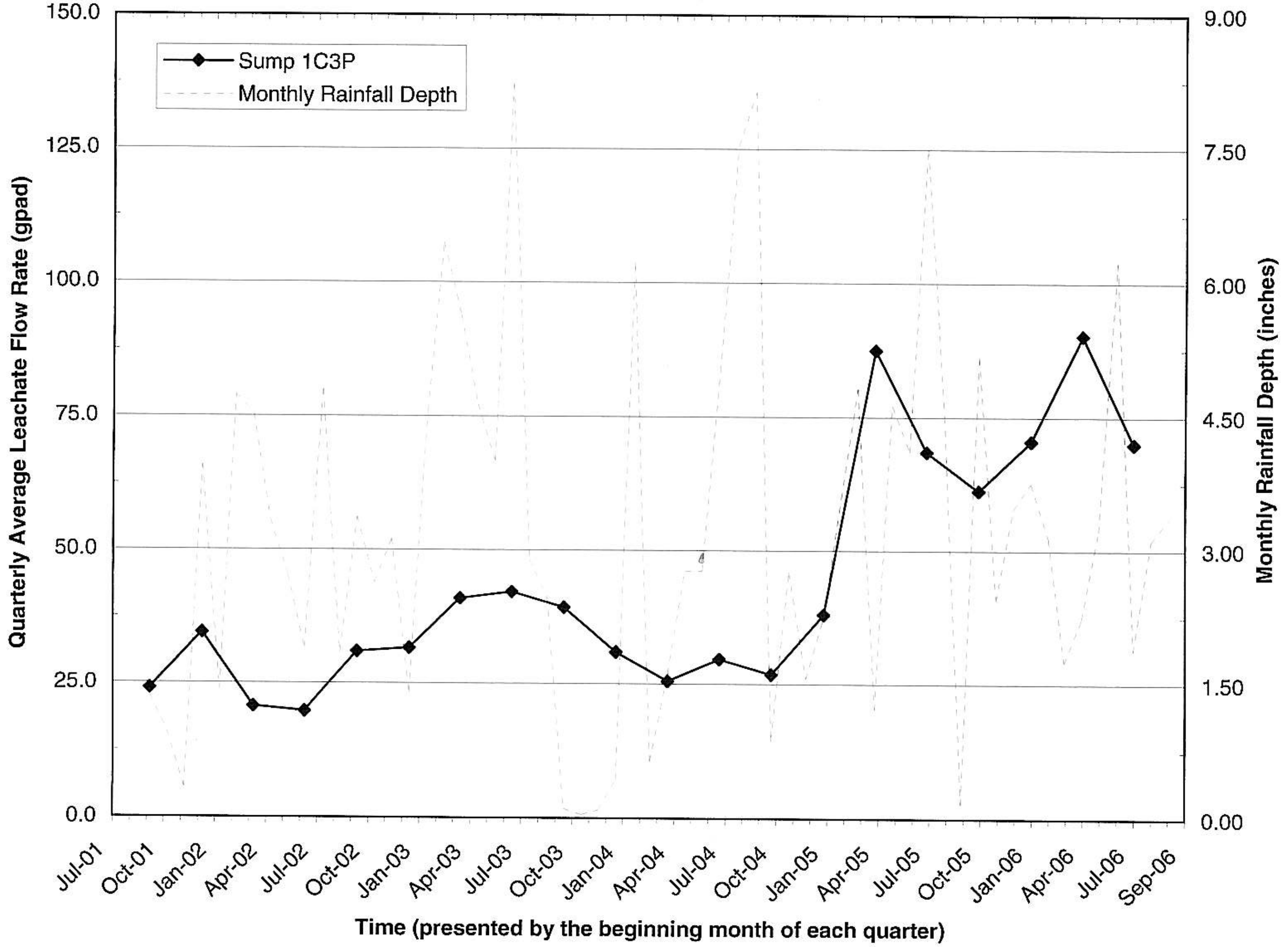

SUMP 1B3P
Sump 1B3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 1C1P
Sump 1C1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

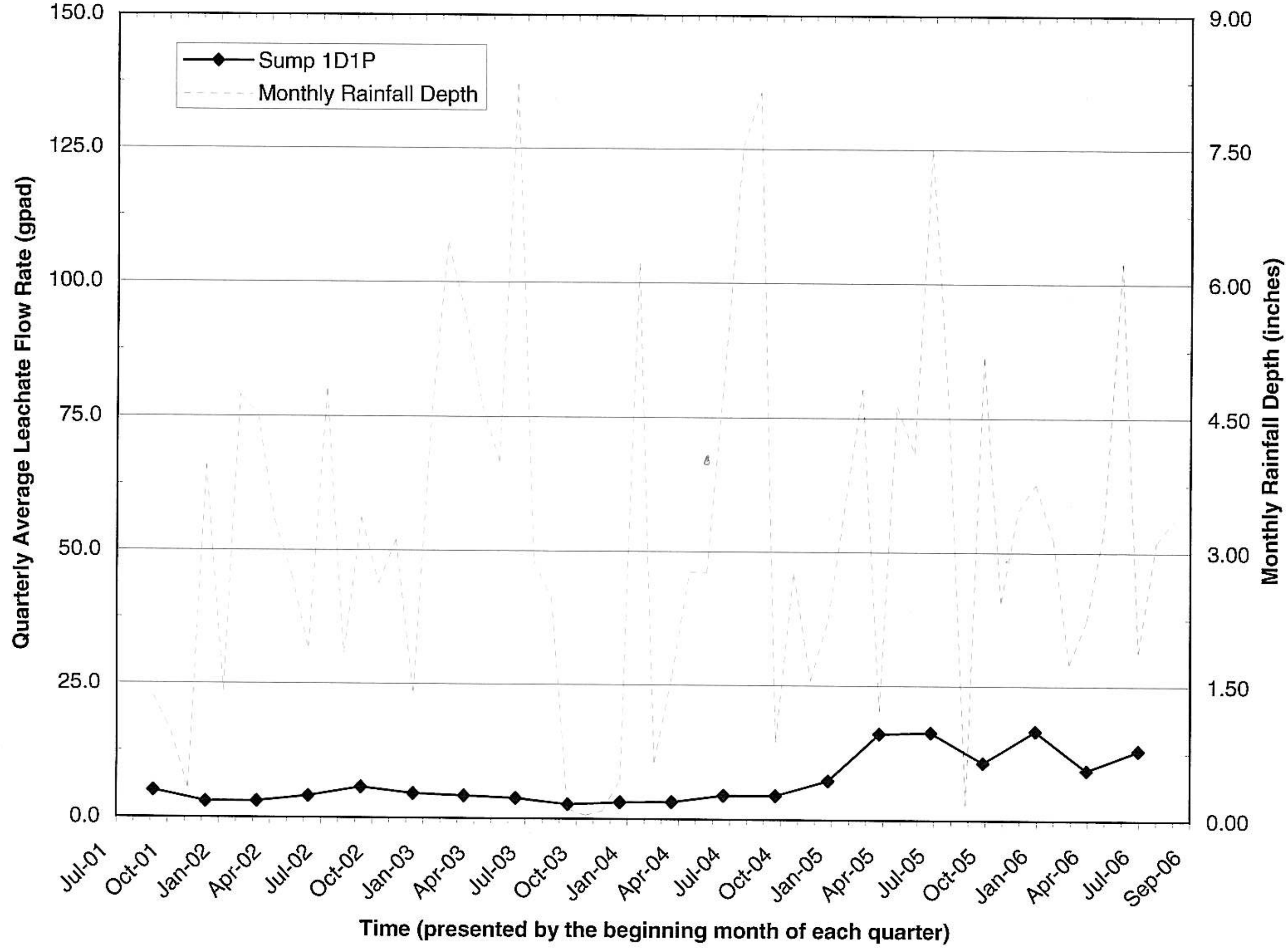
SUMP 1C2P


Sump 1C2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

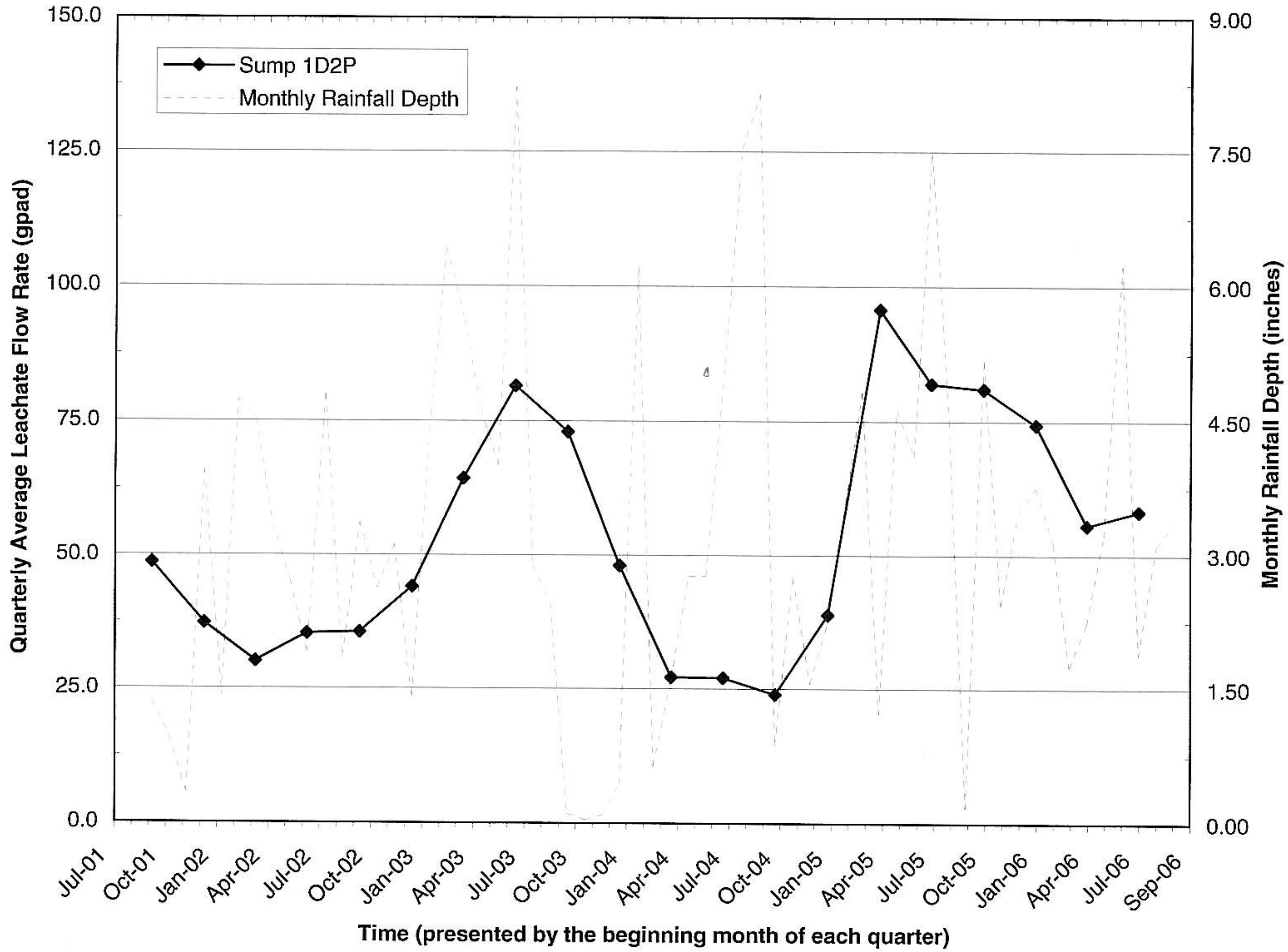
SUMP 1C3P


Sump 1C3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

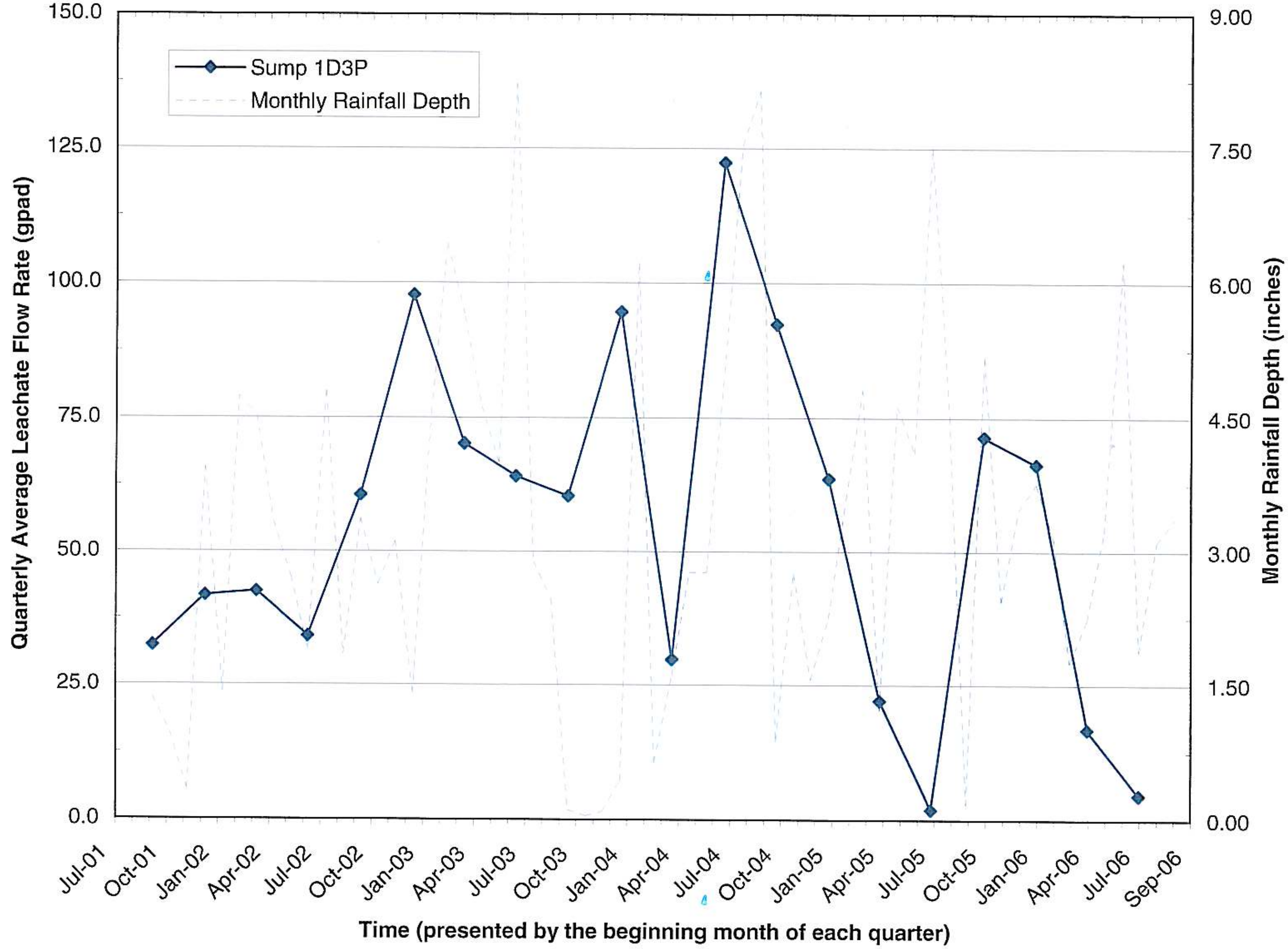
SUMP 1D1P


Sump 1D1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 1D2P


Sump 1D2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 1D3P



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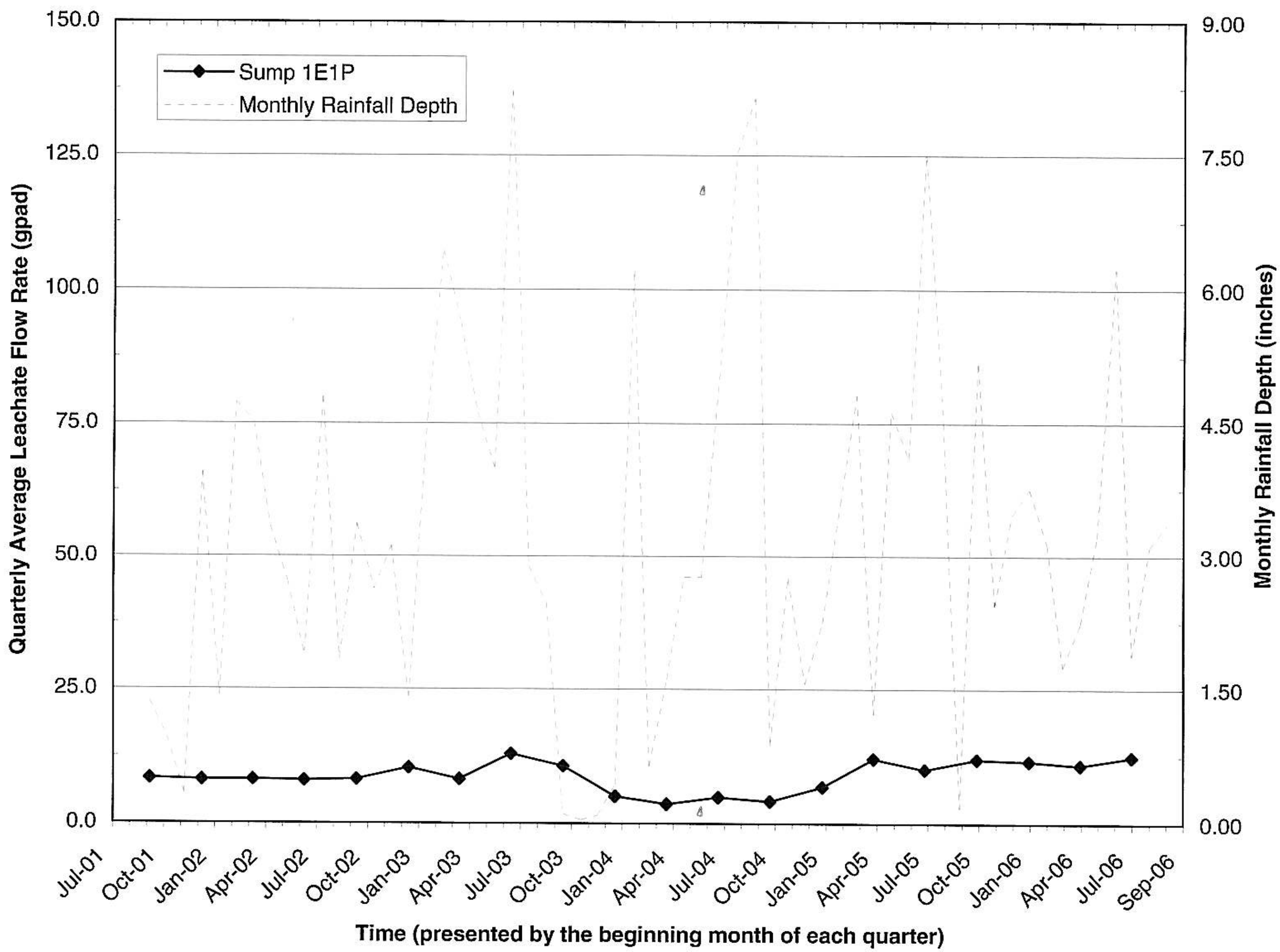
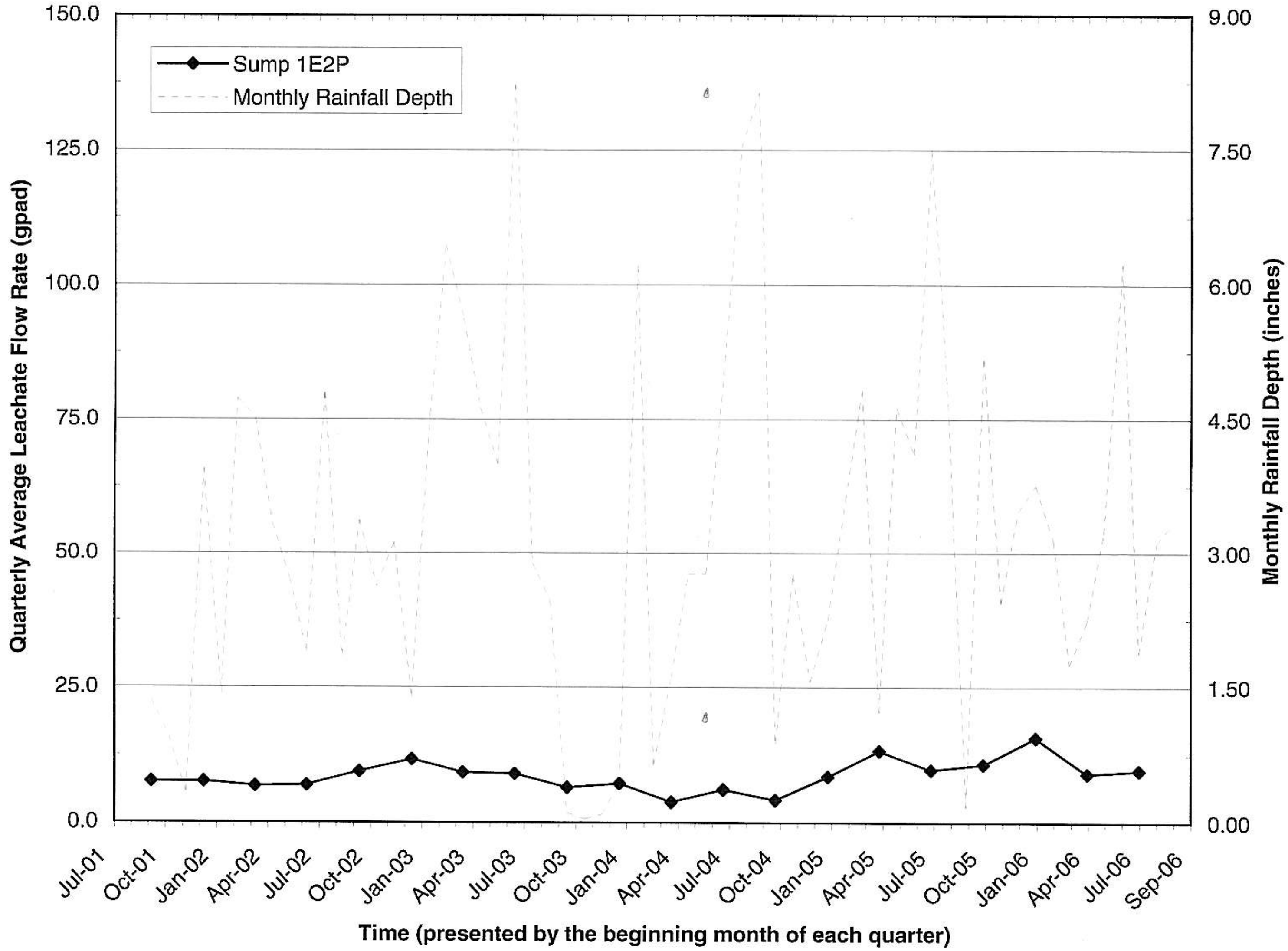
Sheet: 1D3P_Chart

SUMP 1E1P



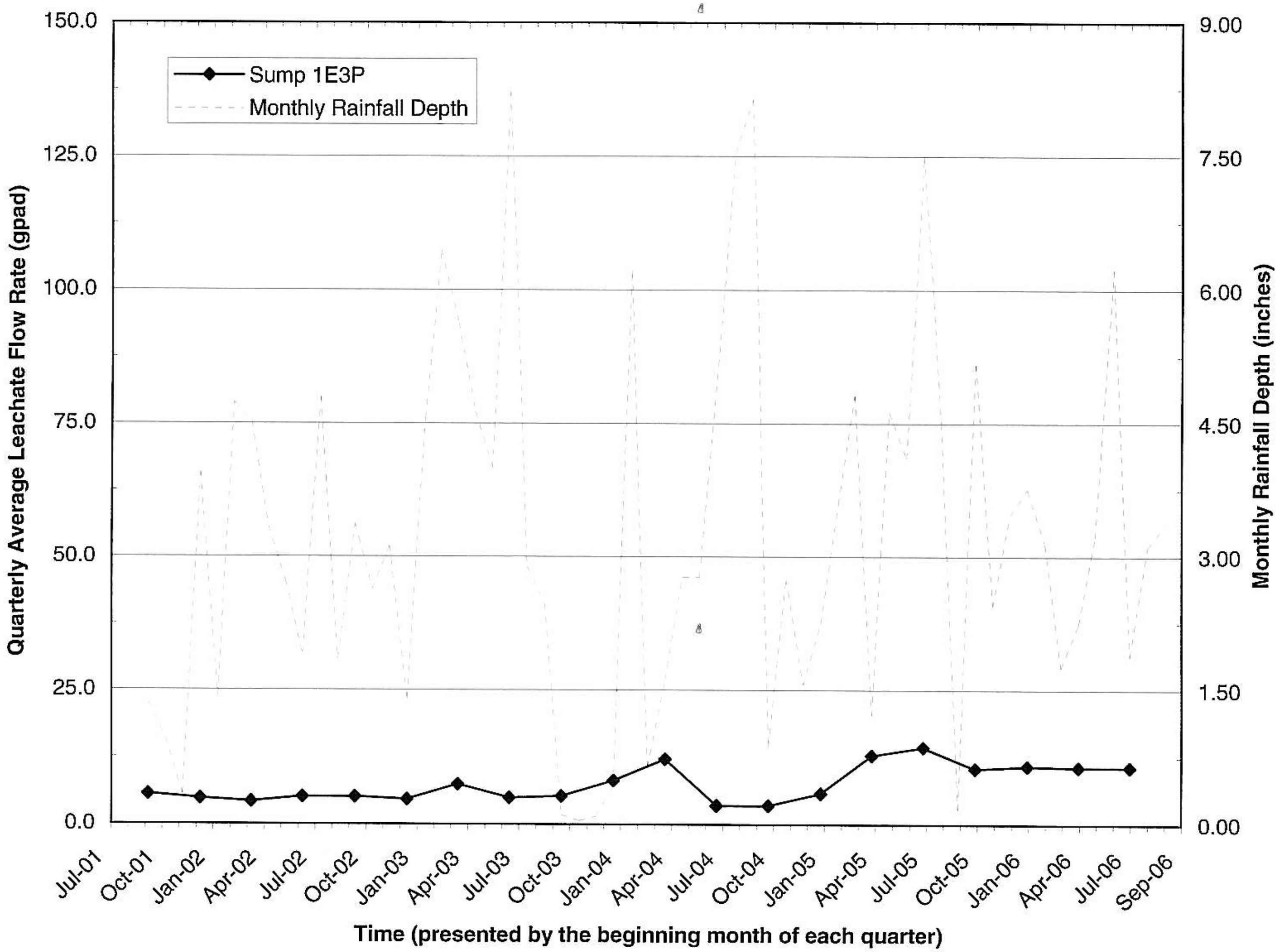
Sump 1E1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 1E2P



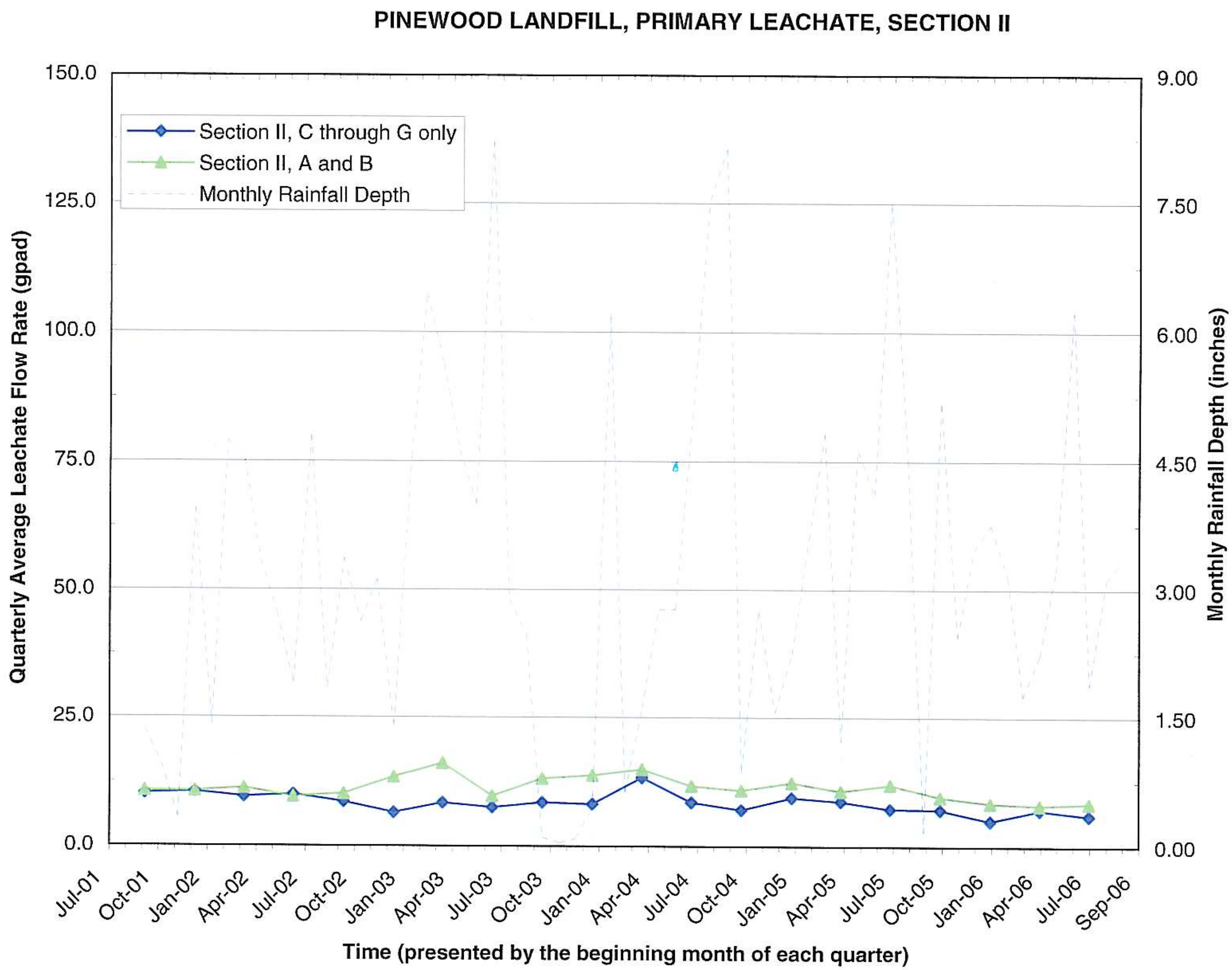
File: Section I_Quarterly Average Primary Leachate.xls
Sheet: 1E2P_Chart

SUMP 1E3P

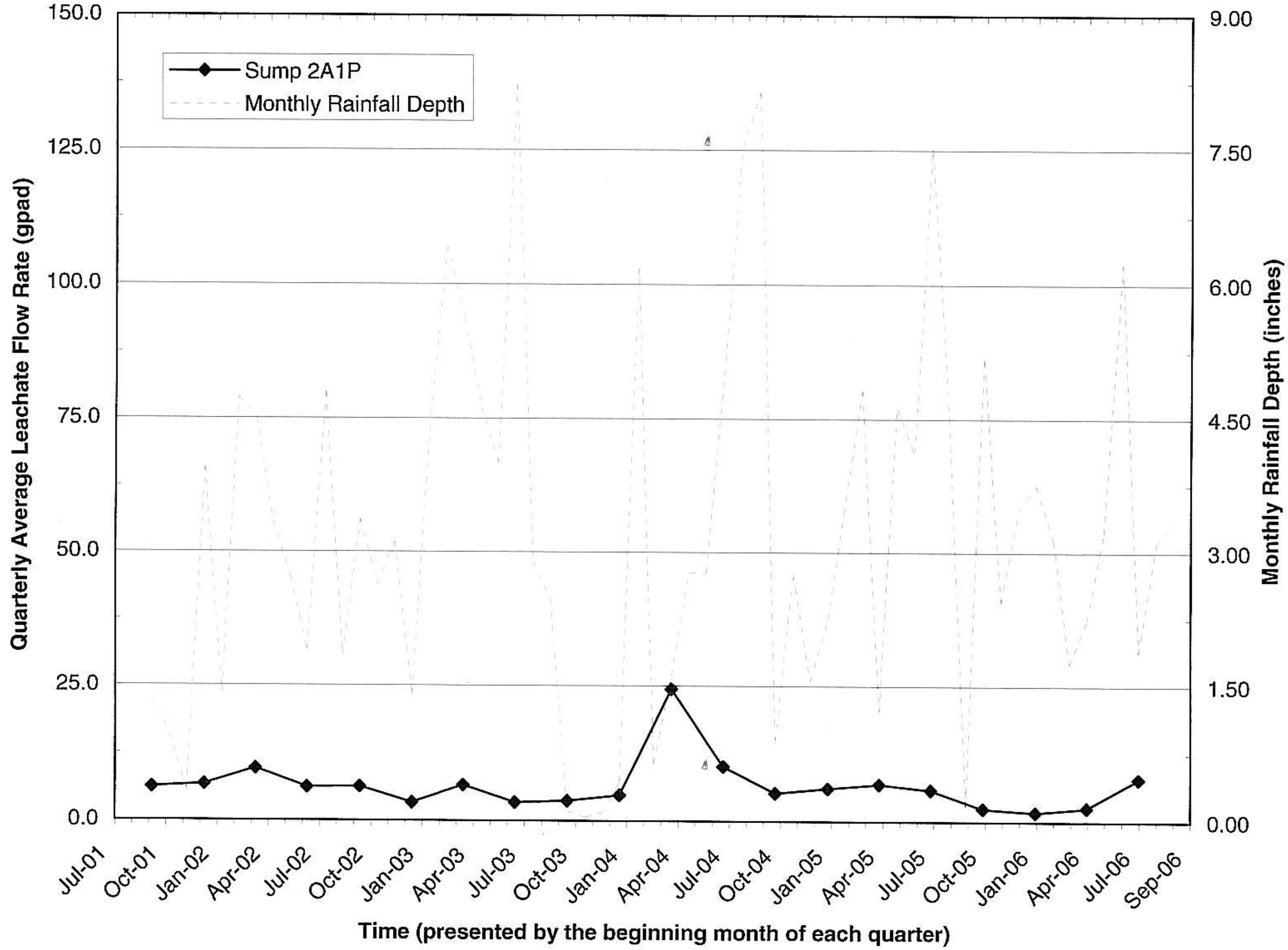


Sump 1E3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

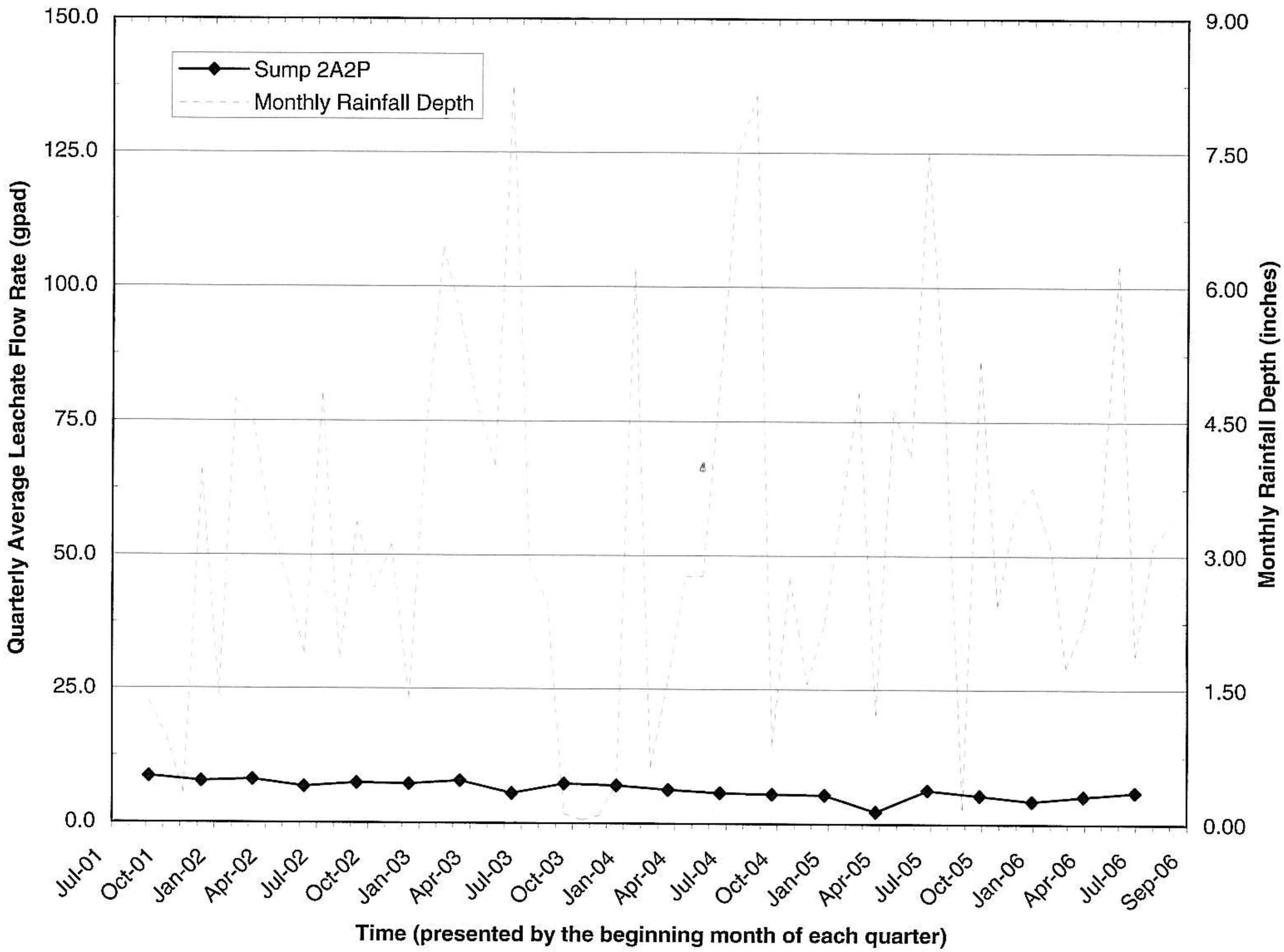
Section II


PINEWOOD LANDFILL, PRIMARY LEACHATE, SECTION II
Section II, C through G only
Section II, A and B
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01 Oct-01 Jan-02 Apr-02 Jul-02 Oct-02 Jan-03 Apr-03 Jul-03 Oct-03 Jan-04 Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Sep-06
Time (presented by the beginning month of each quarter)

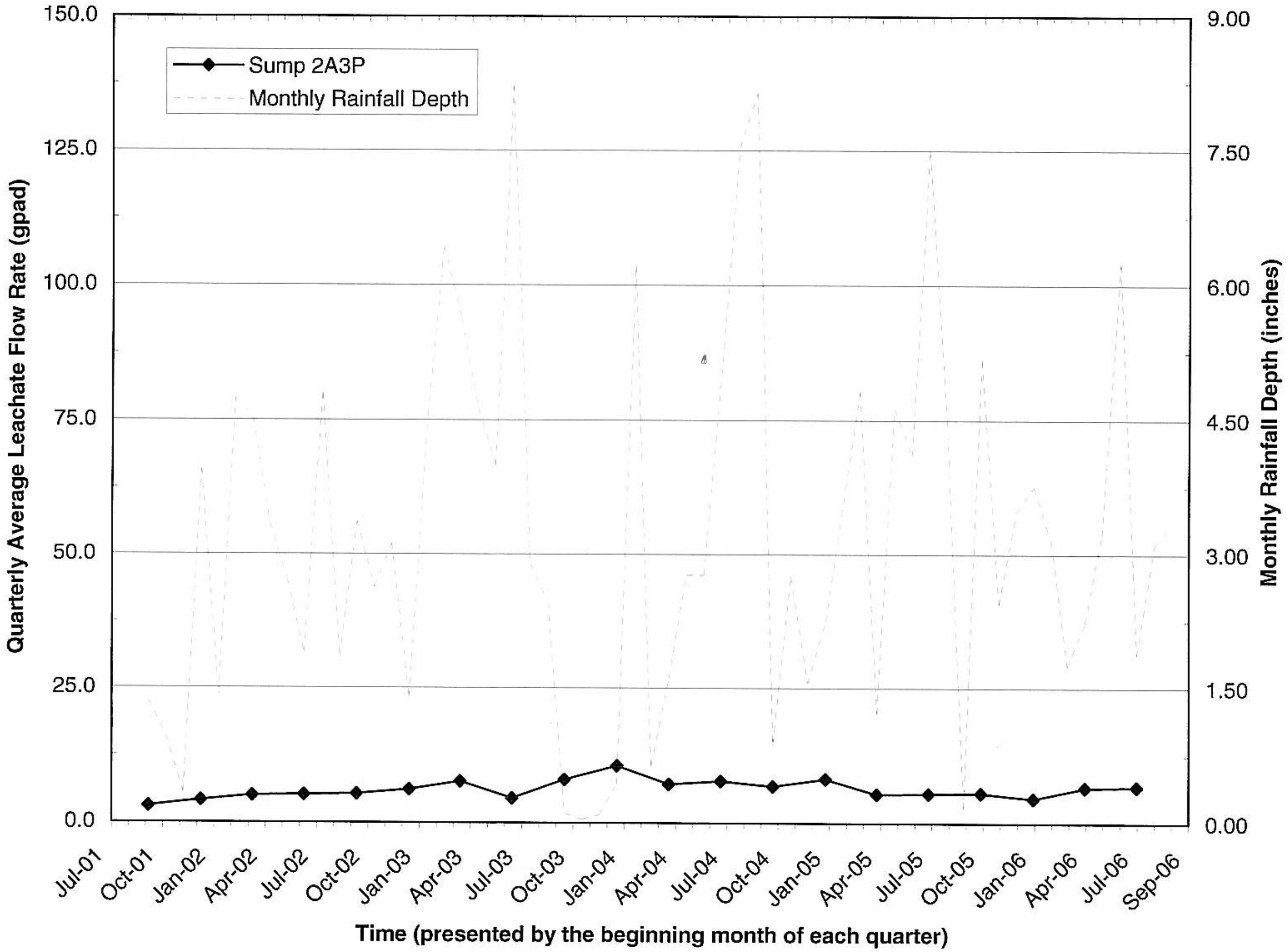
SUMP 2A1P

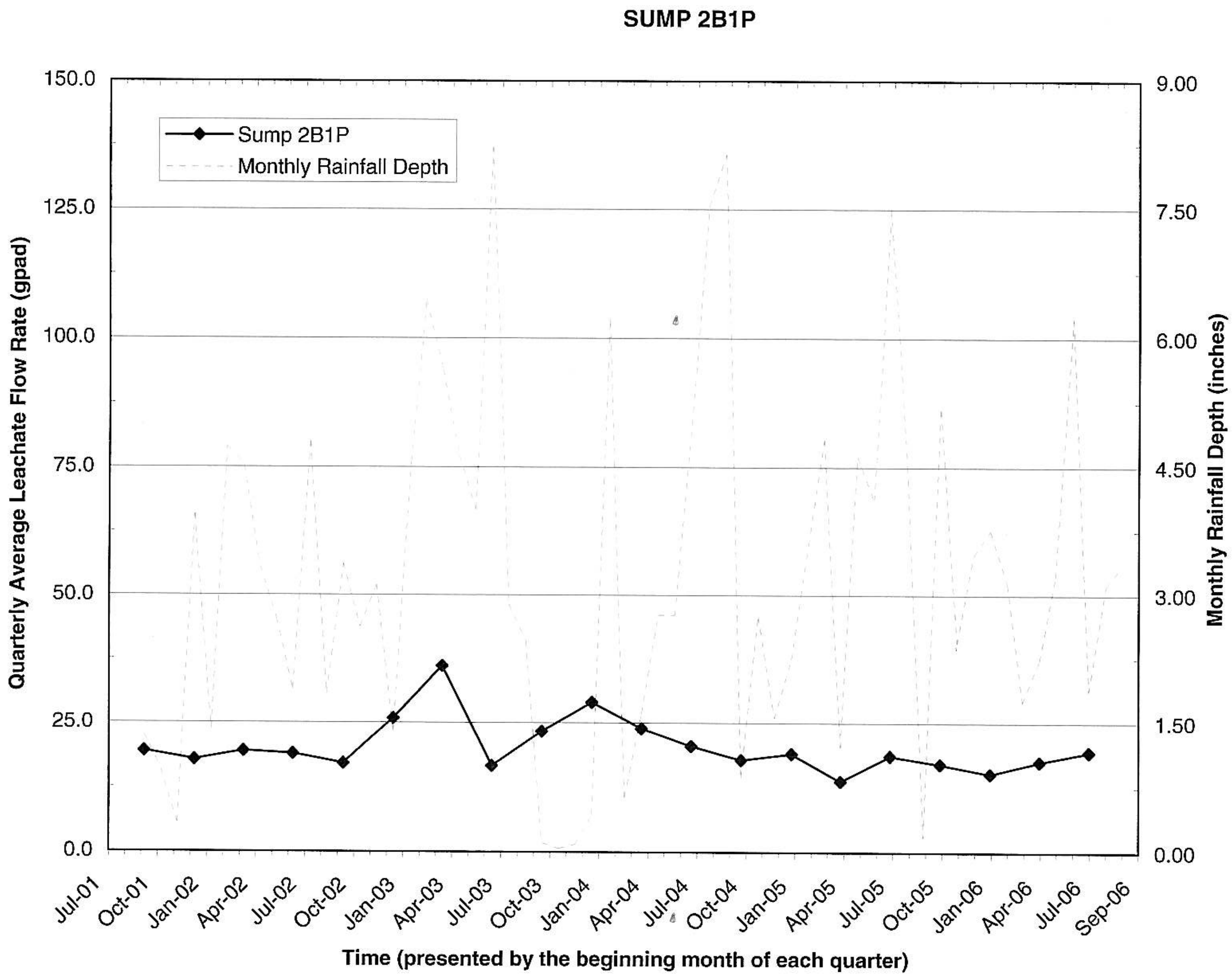

Sump 2A1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2A2P

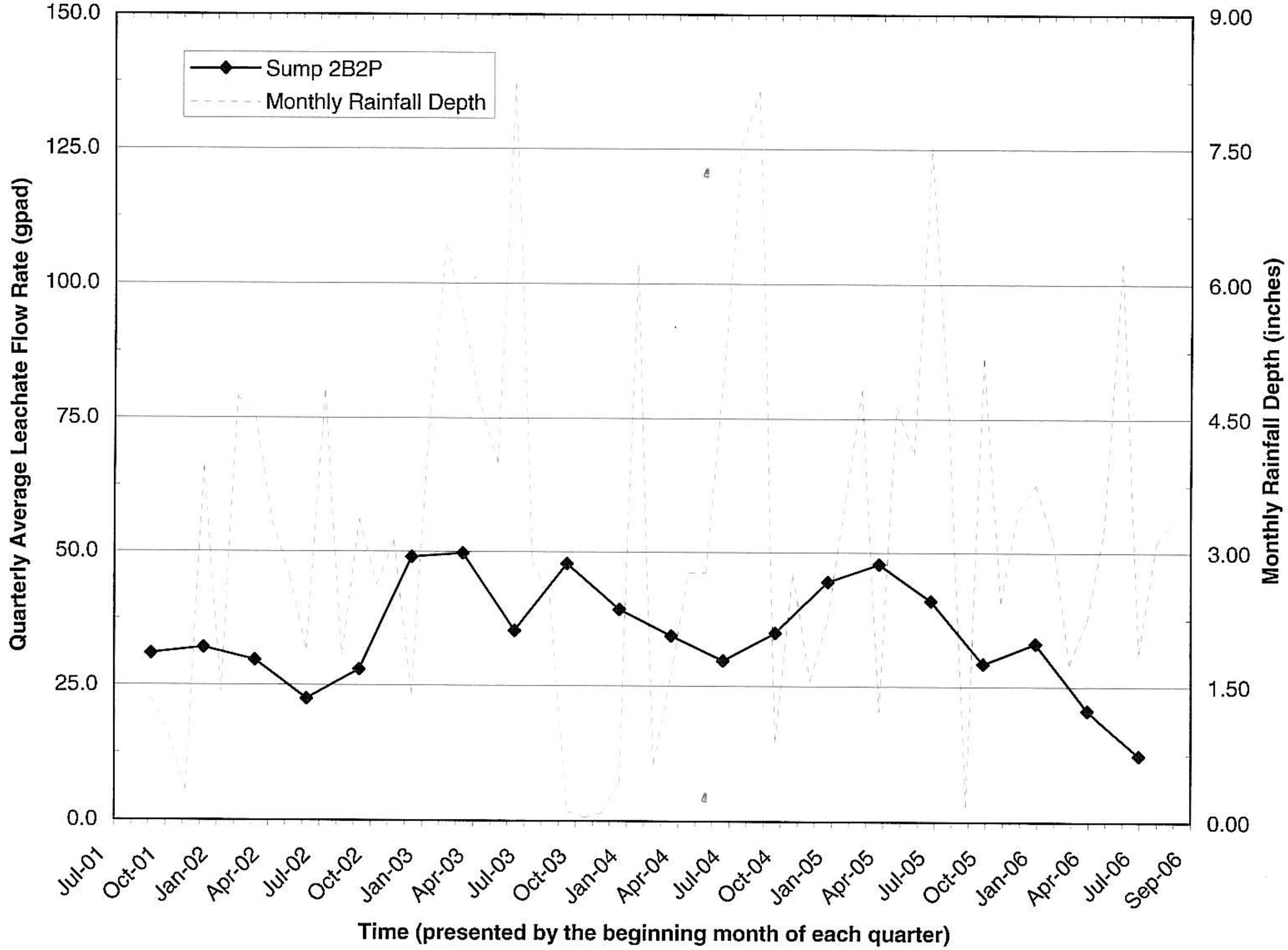

Sump 2A2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2A3P

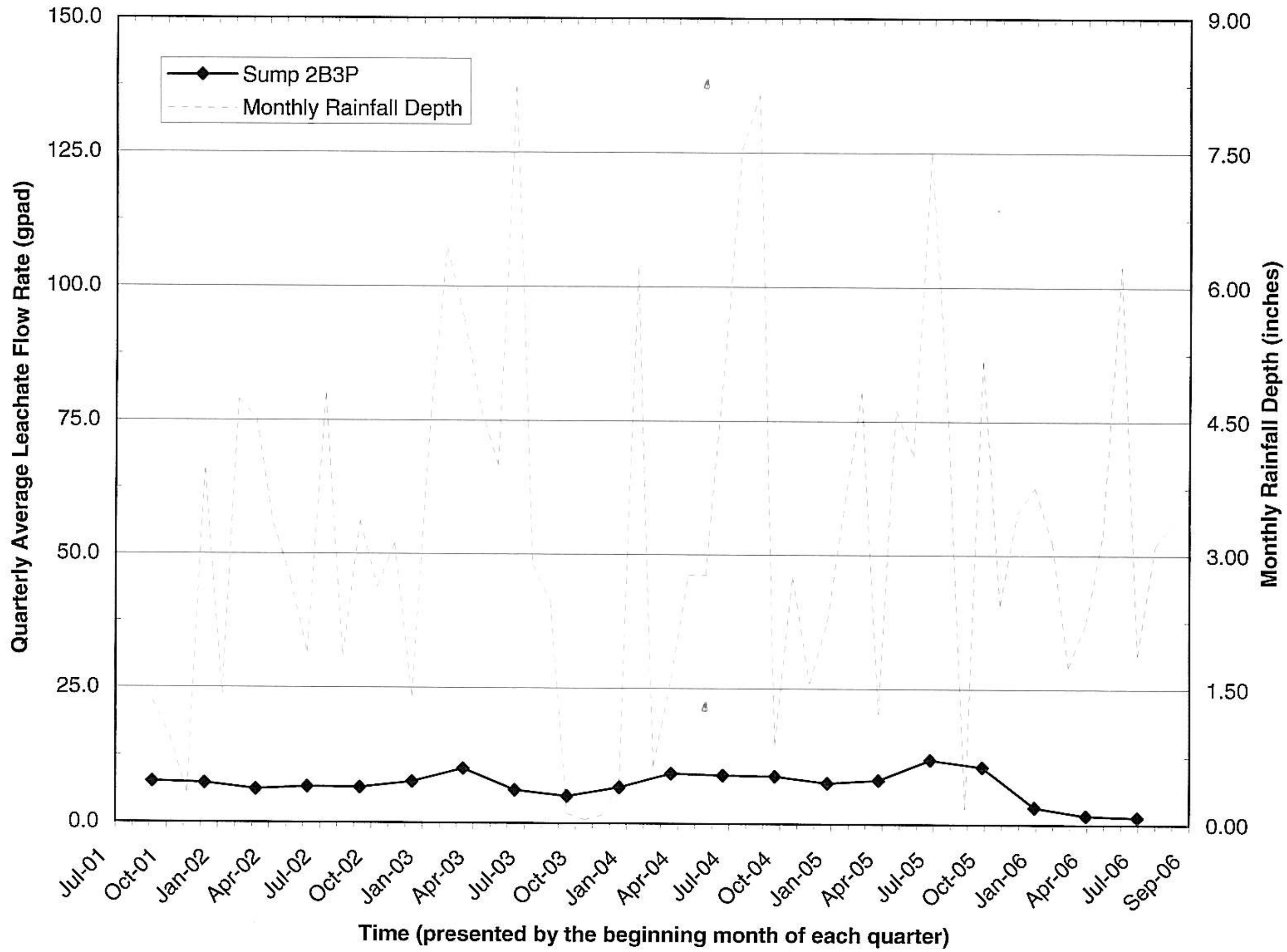

Sump 2A3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 2B1P
Sump 2B1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

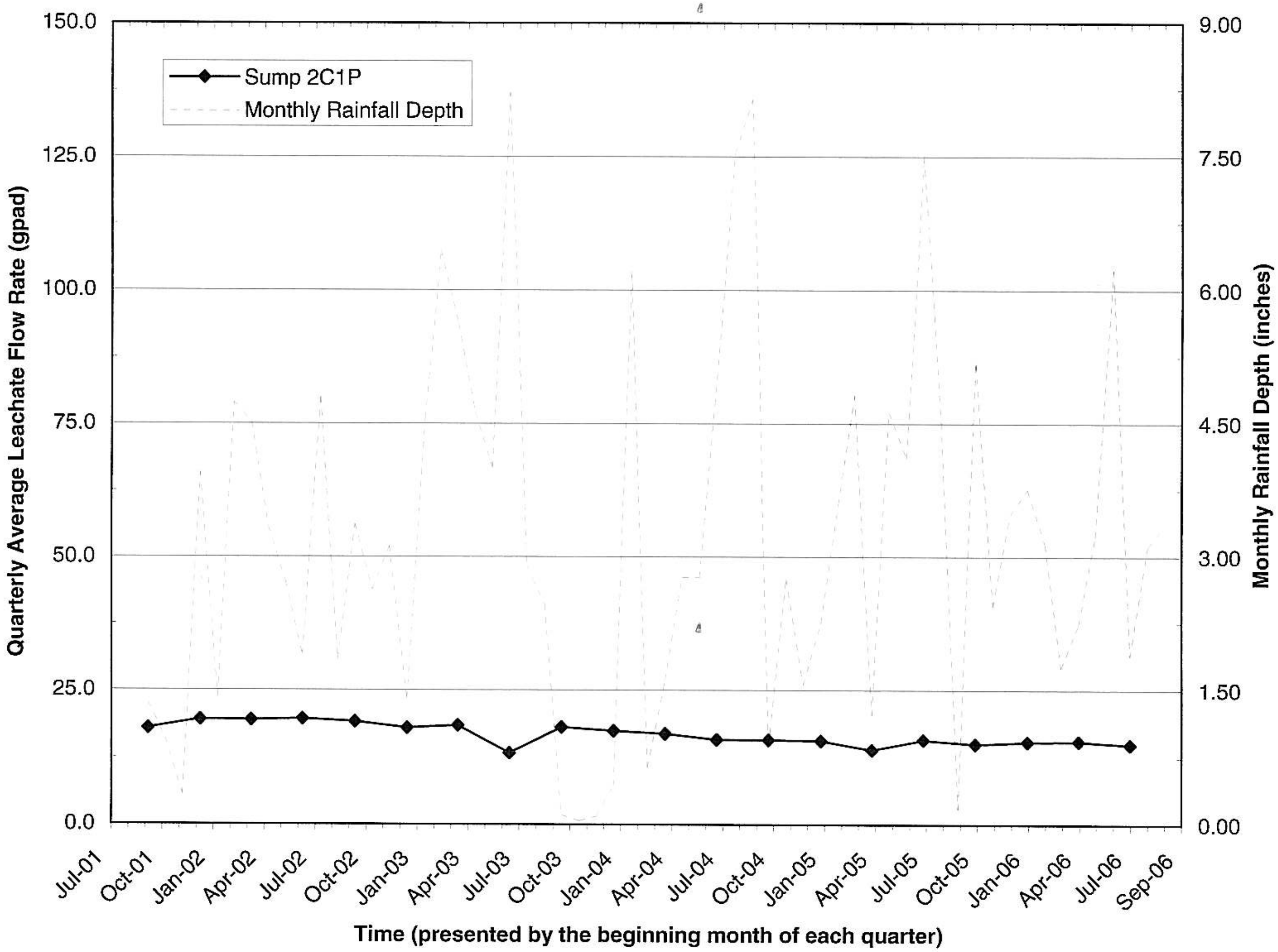
SUMP 2B2P


Sump 2B2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

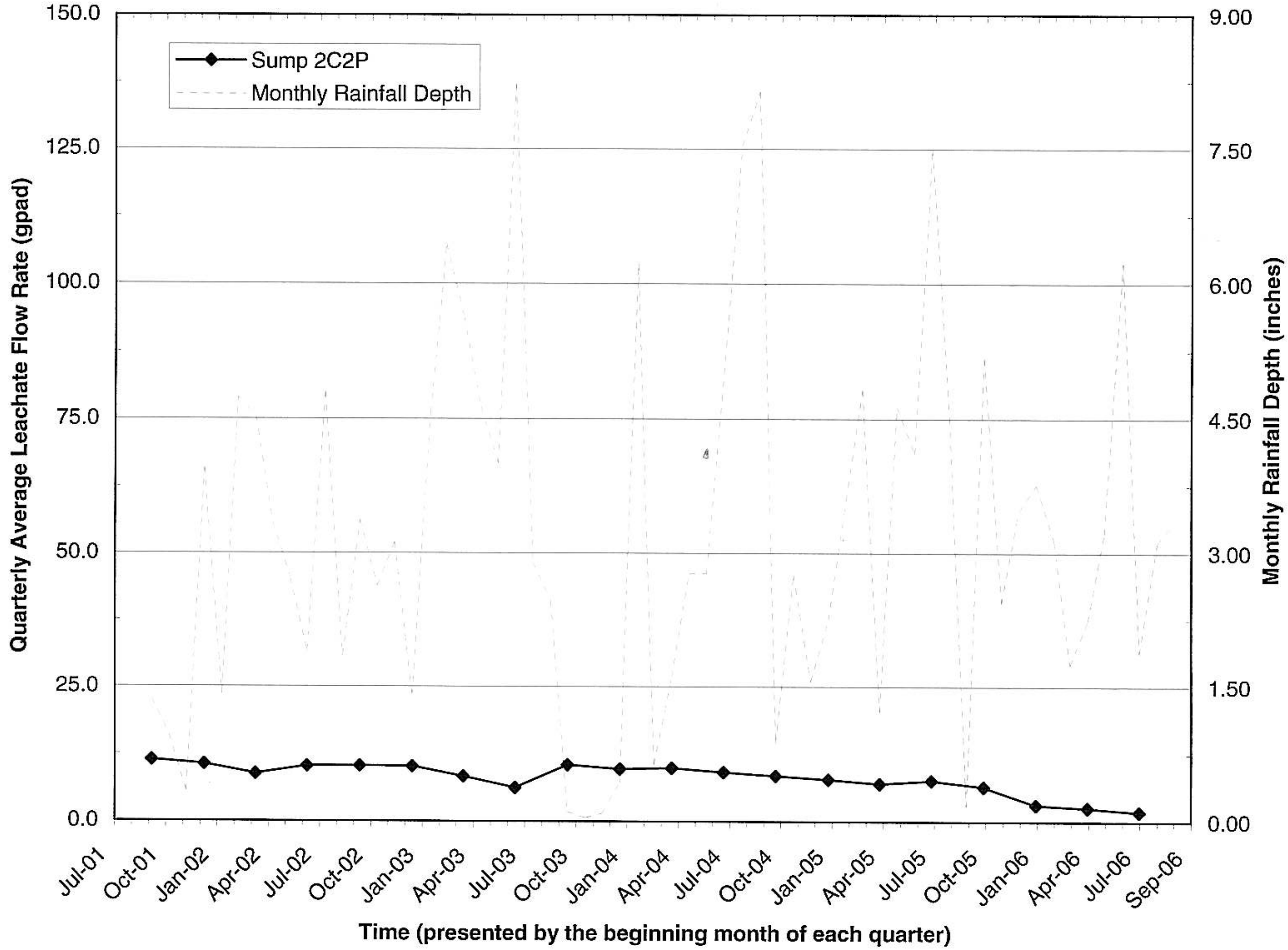
SUMP 2B3P


Sump 2B3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2C1P

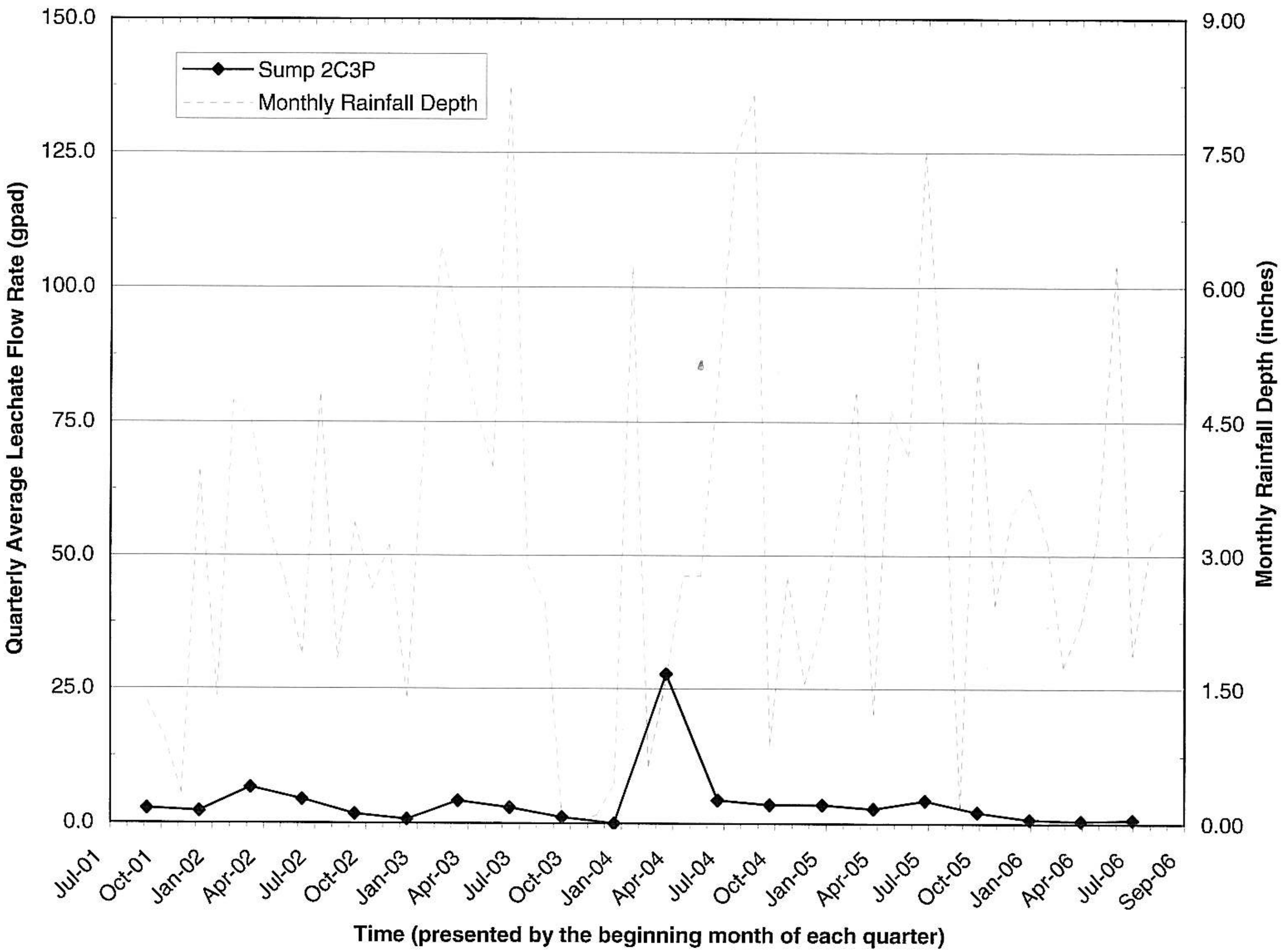

Sump 2C1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2C2P

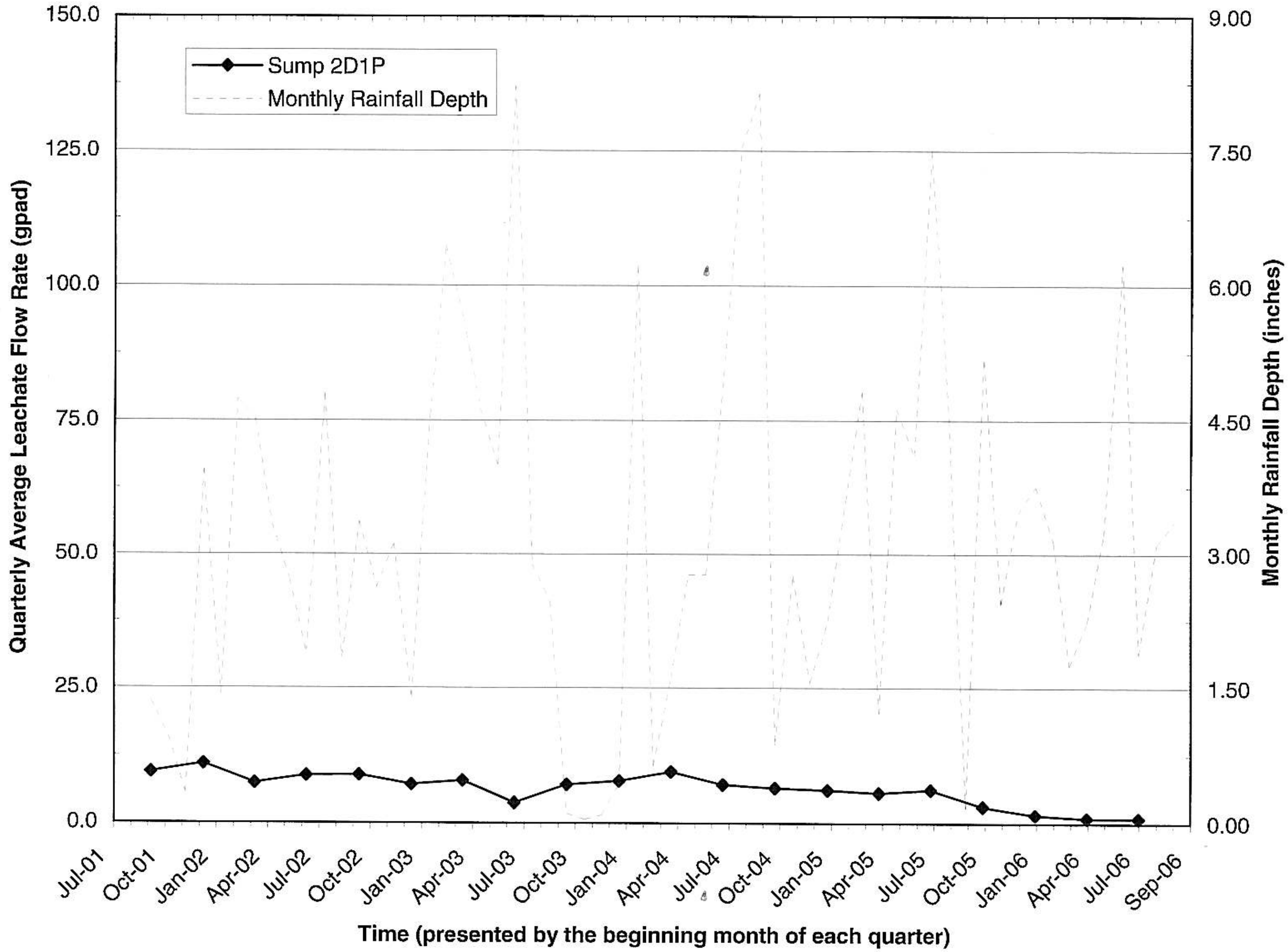


Sump 2C2P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01 Oct-01 Jan-02 Apr-02 Jul-02 Oct-02 Jan-03 Apr-03 Jul-03 Oct-03 Jan-04 Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Sep-06
Time (presented by the beginning month of each quarter)

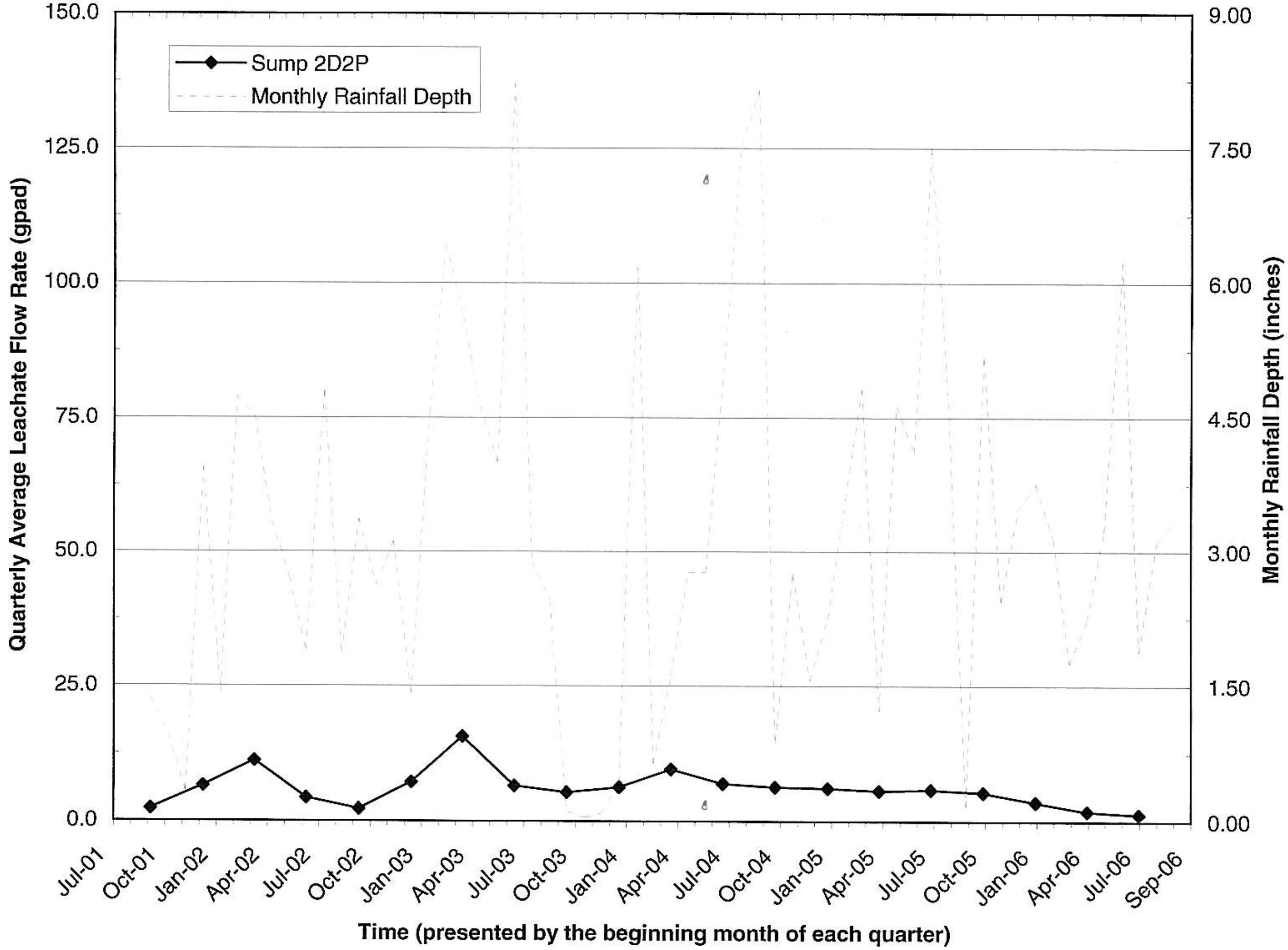
SUMP 2C3P


Sump 2C3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

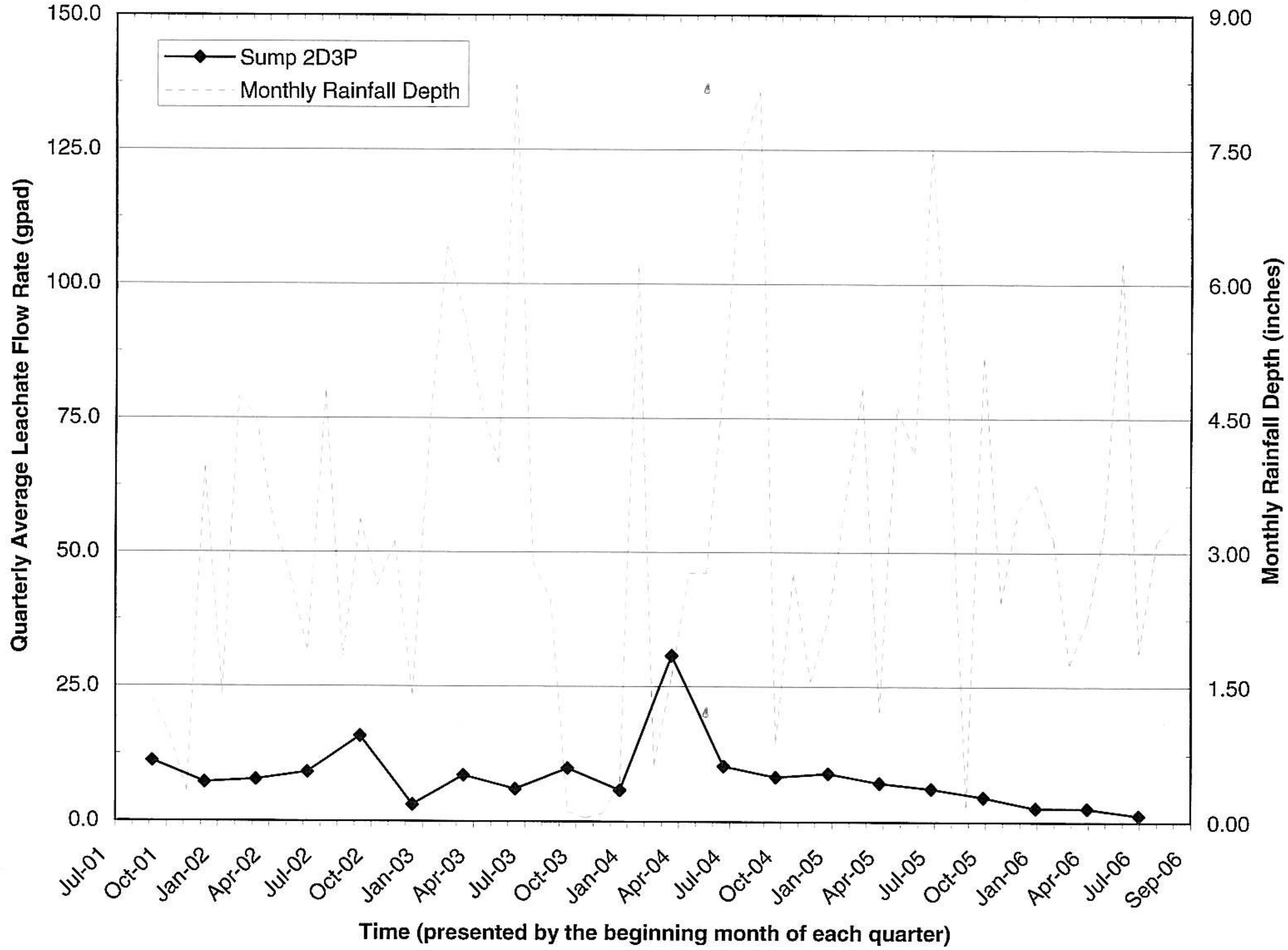
SUMP 2D1P

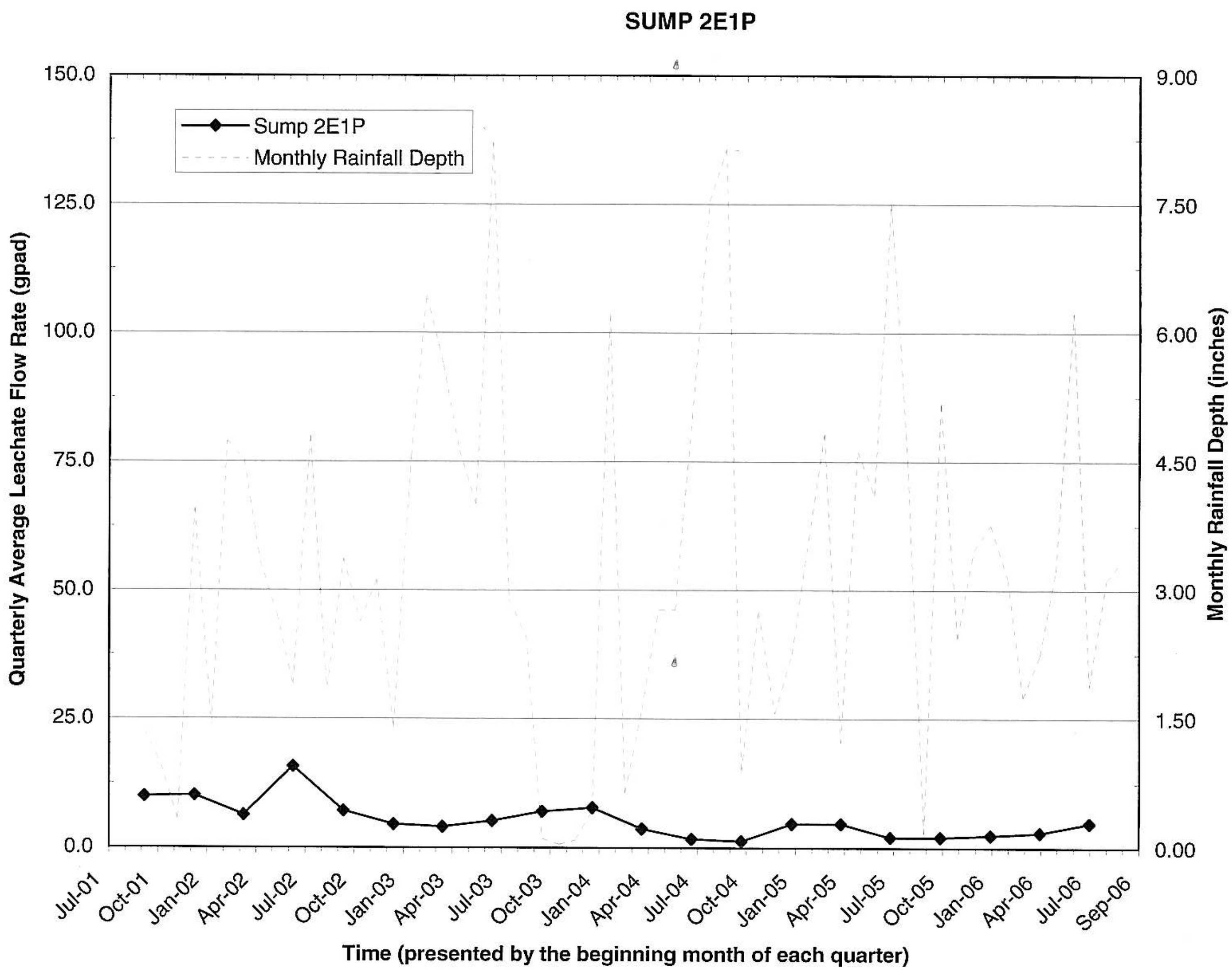

Sump 2D1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2D2P

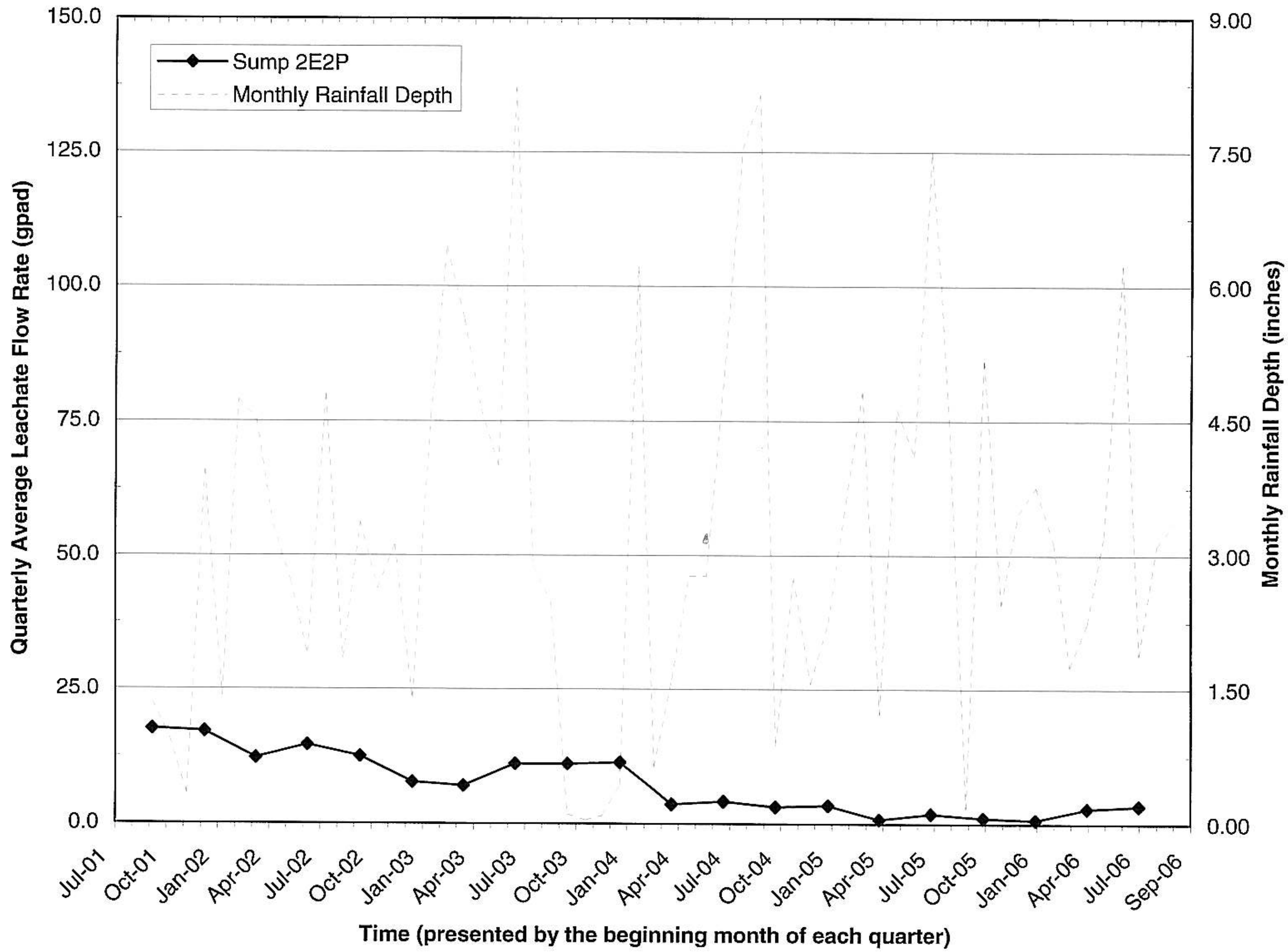

Sump 2D2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2D3P

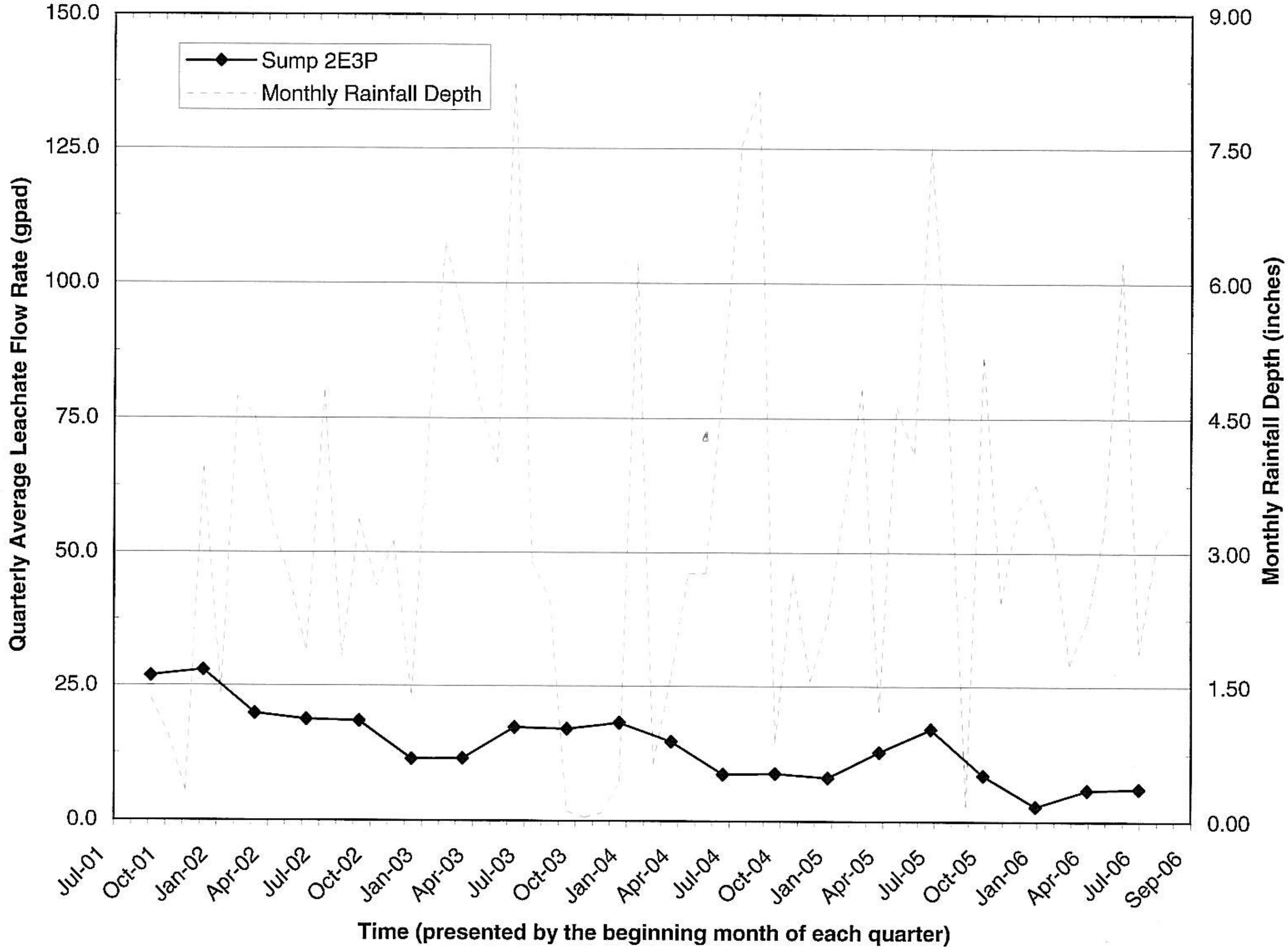

Sump 2D3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

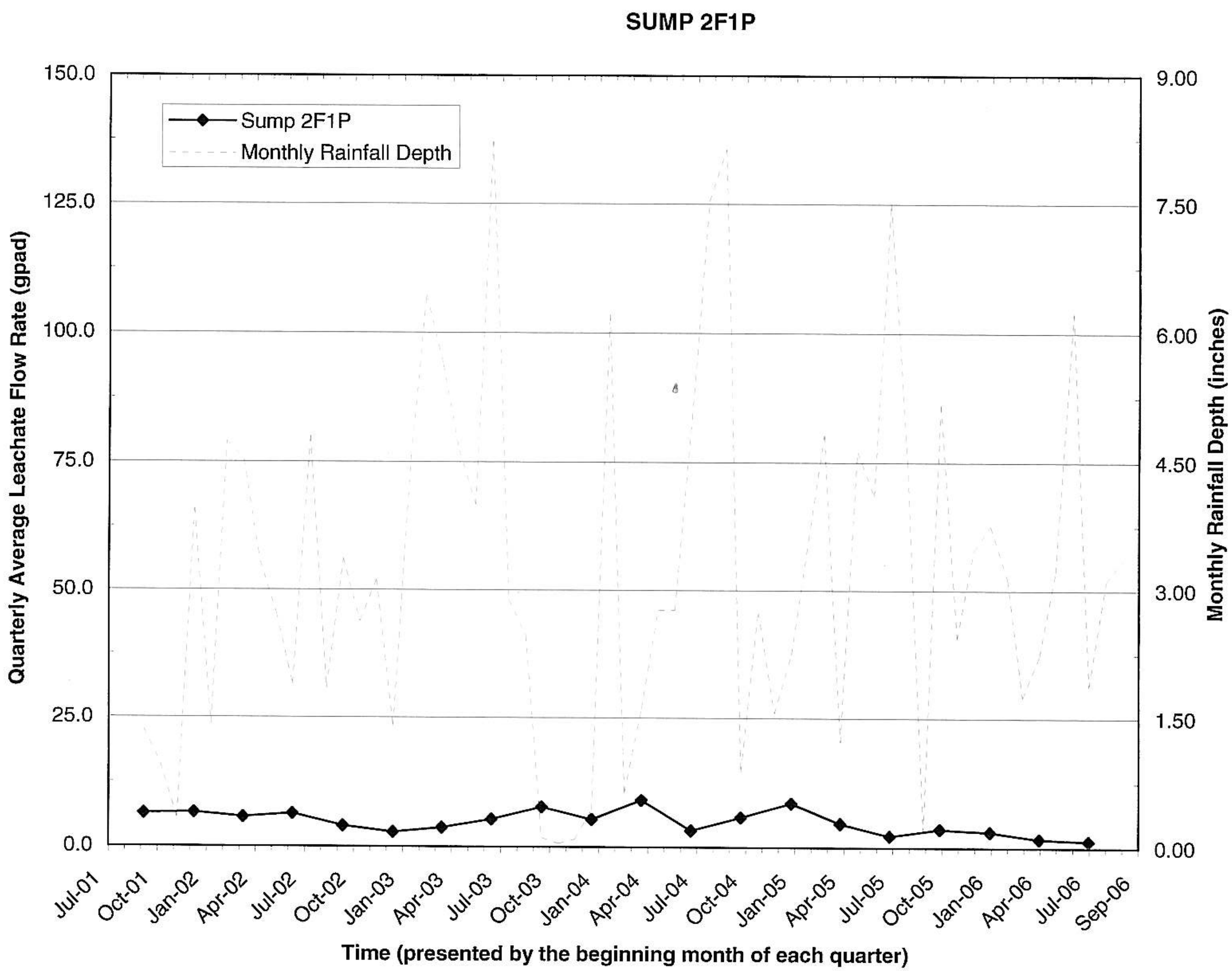

SUMP 2E1P
Sump 2E1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2E2P

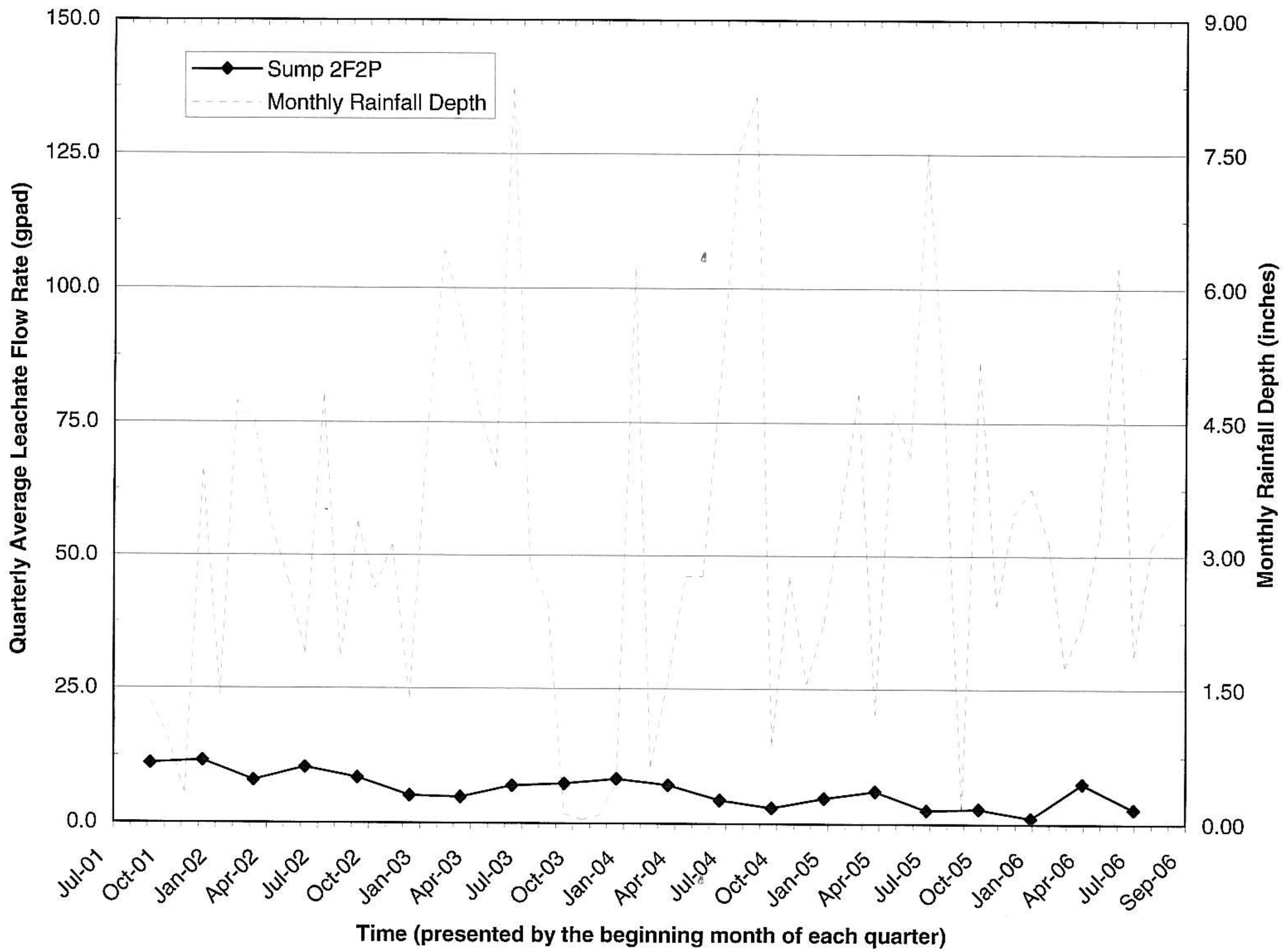

Sump 2E2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

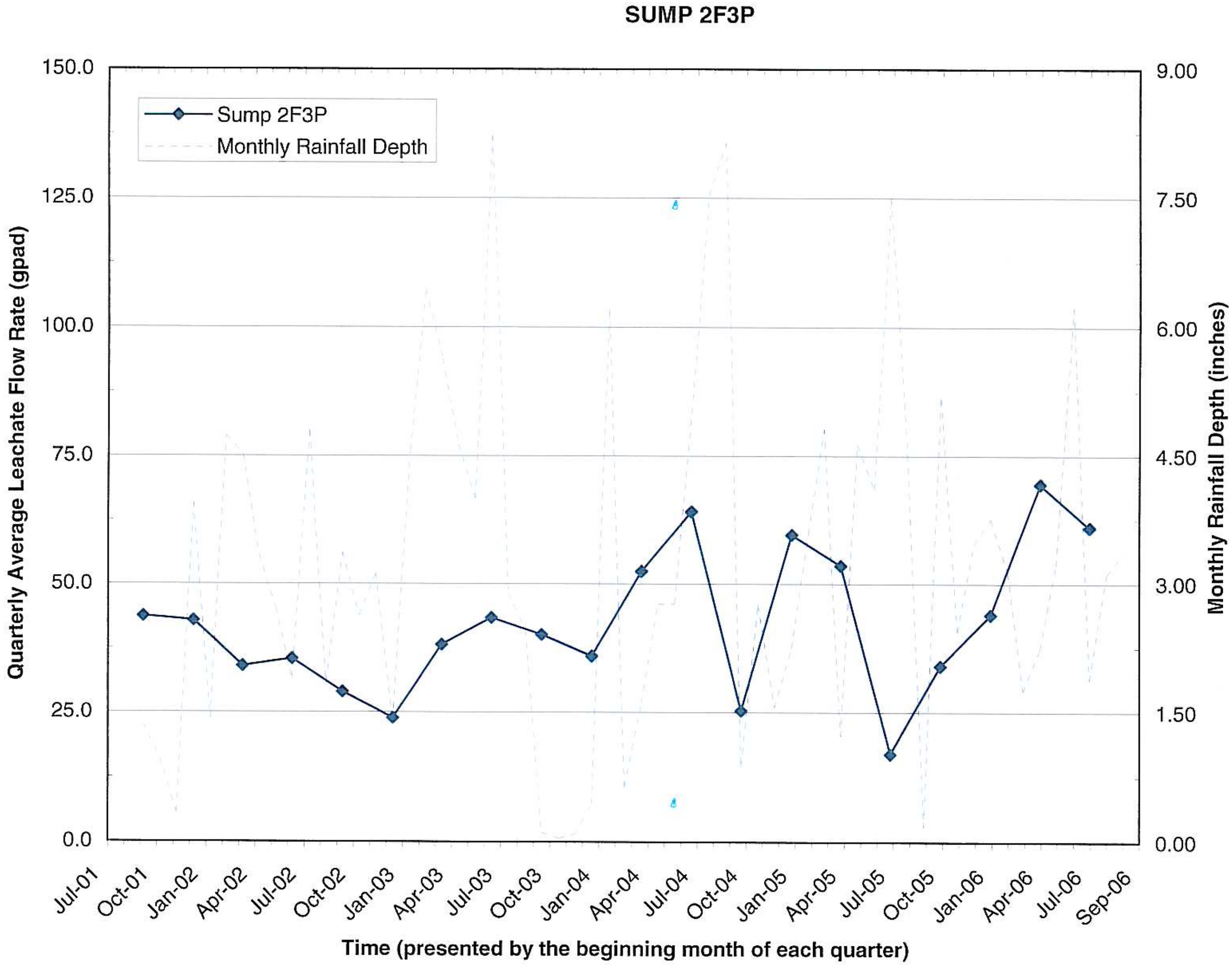
SUMP 2E3P


Sump 2E3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

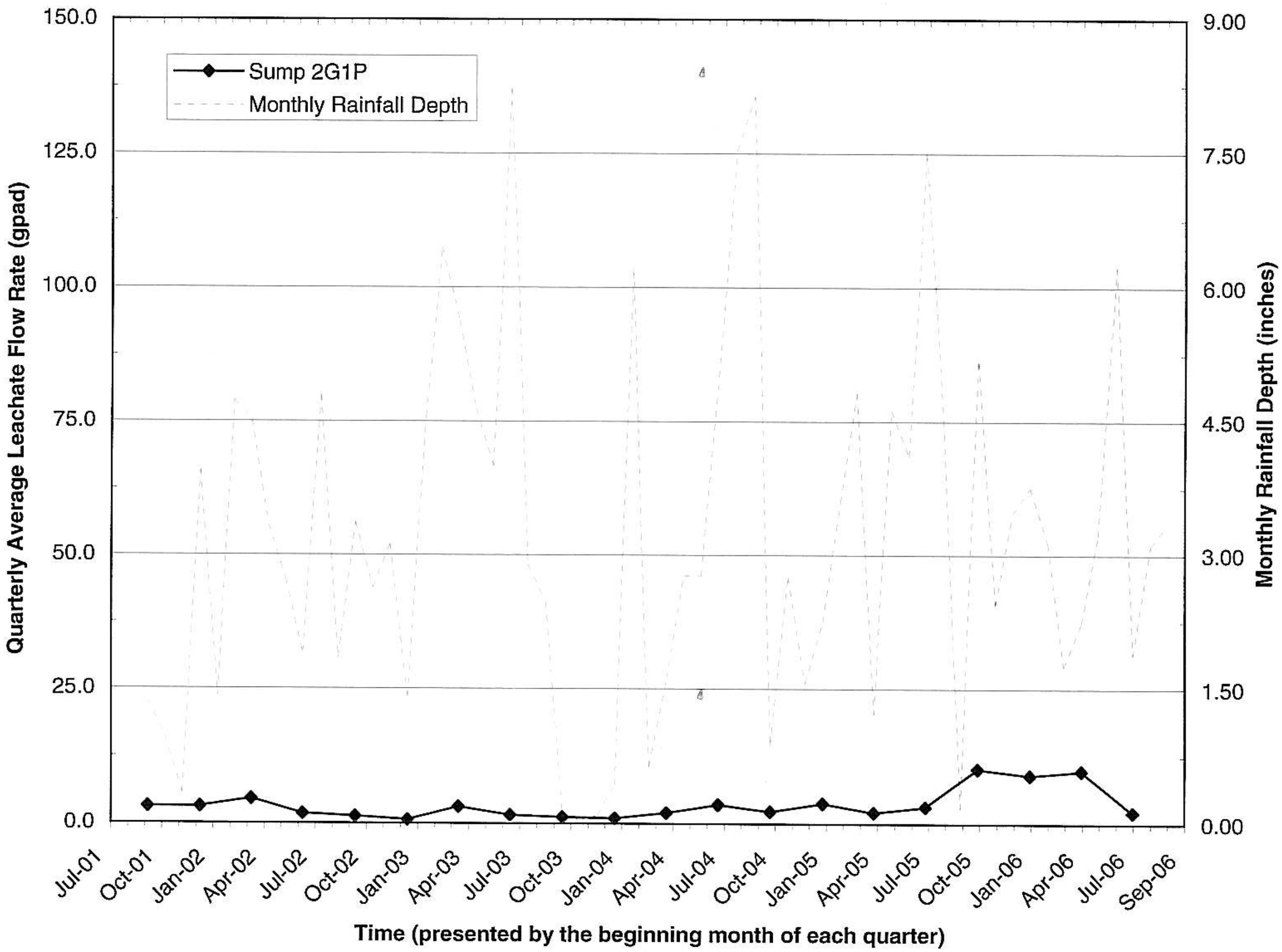

SUMP 2F1P
Sump 2F1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2F2P

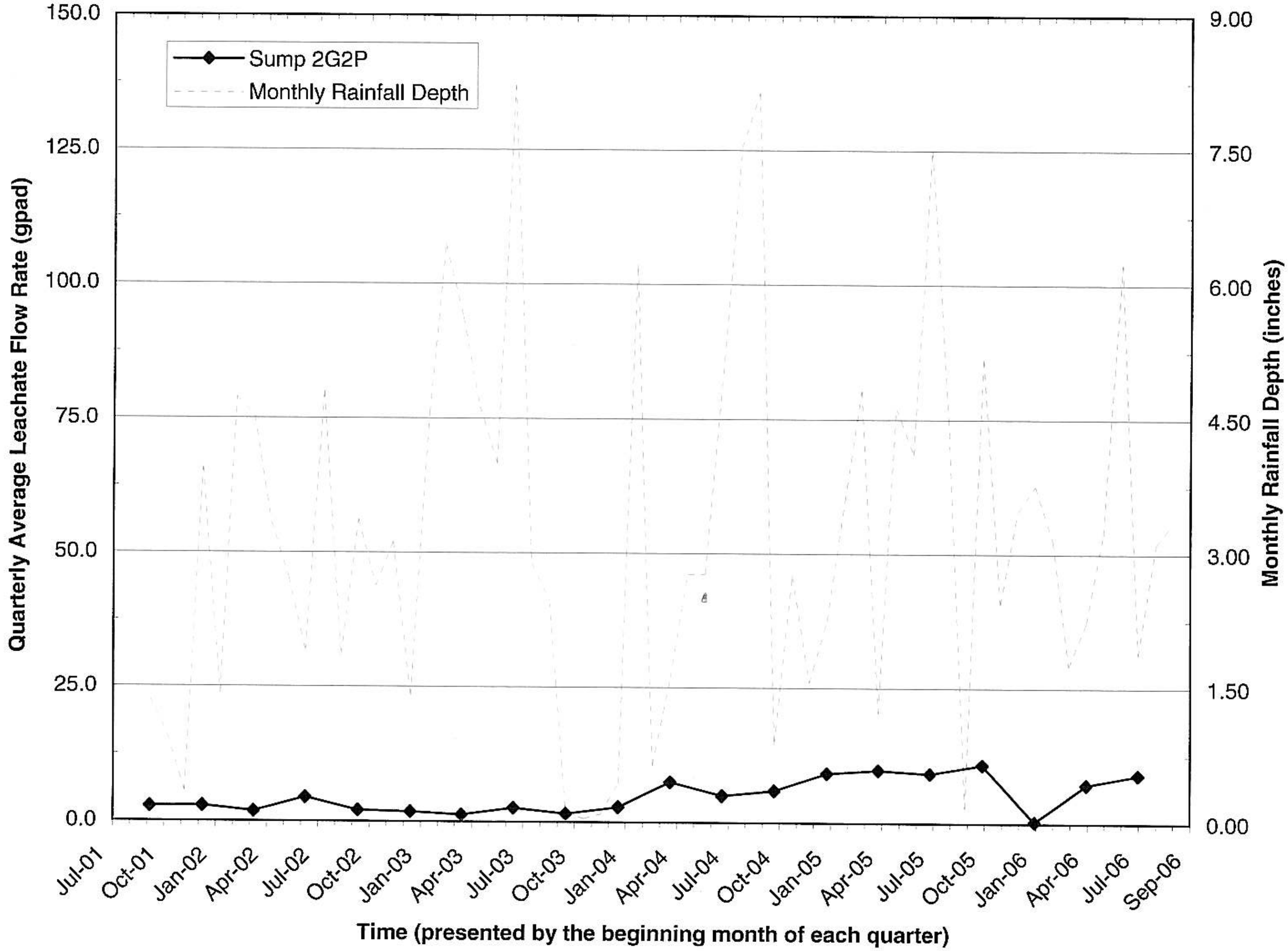

Sump 2F2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 2F3P
Sump 2F3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
0.0
25.0
50.0
75.0
100.0
125.0
150.0
0.00
1.50
3.00
4.50
6.00
7.50
9.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

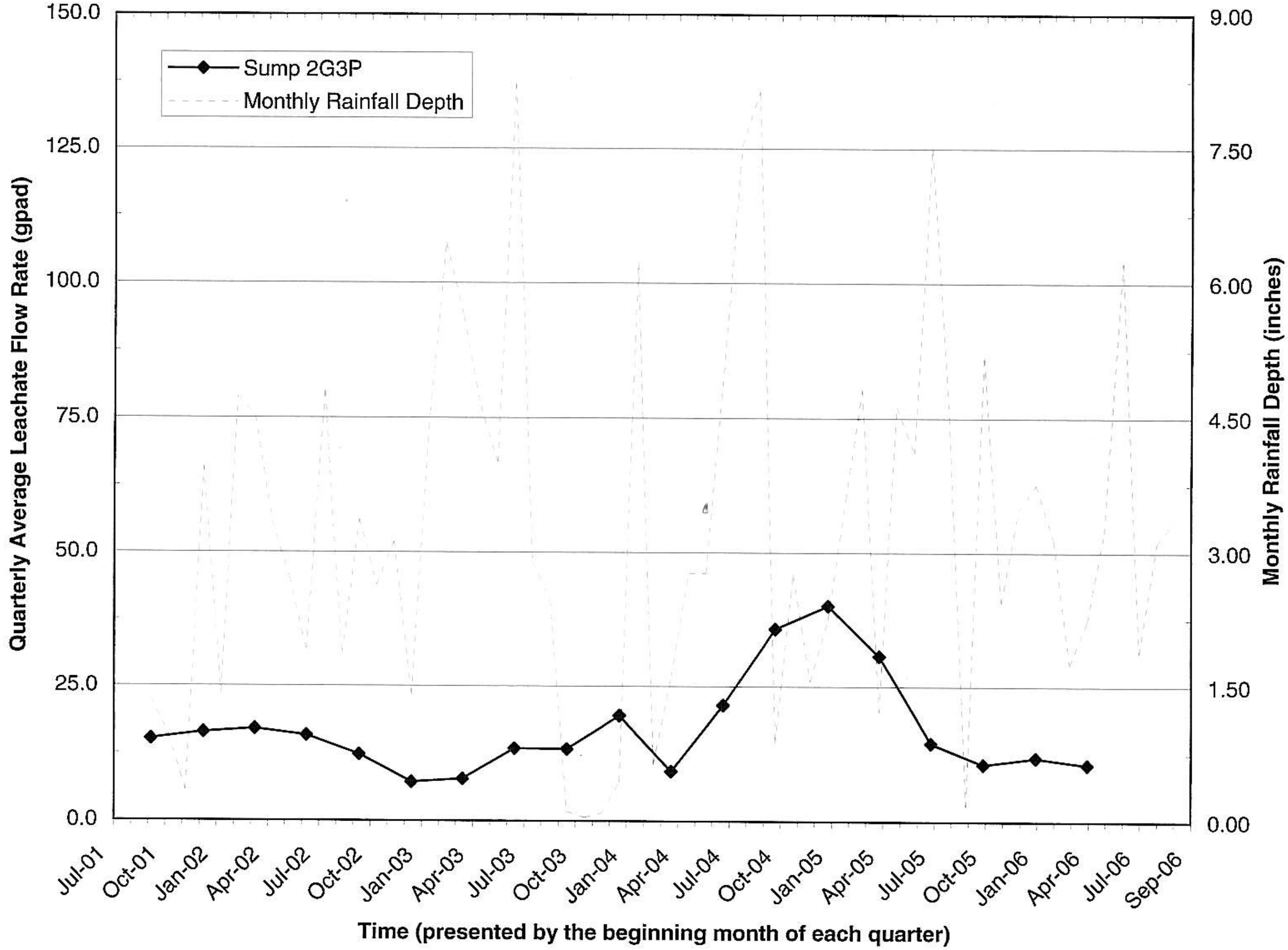
SUMP 2G1P


Sump 2G1P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2G2P

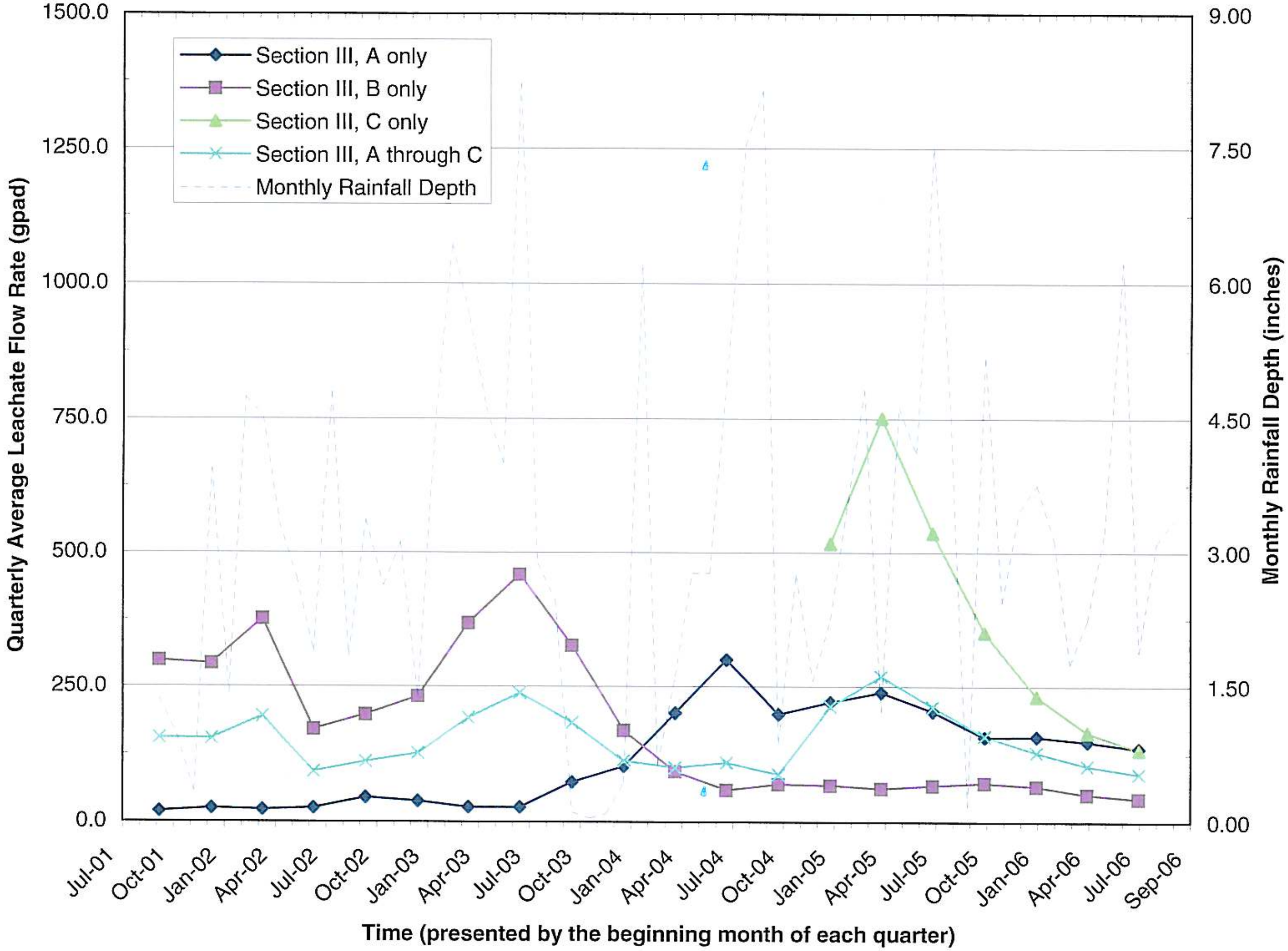

Sump 2G2P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 2G3P

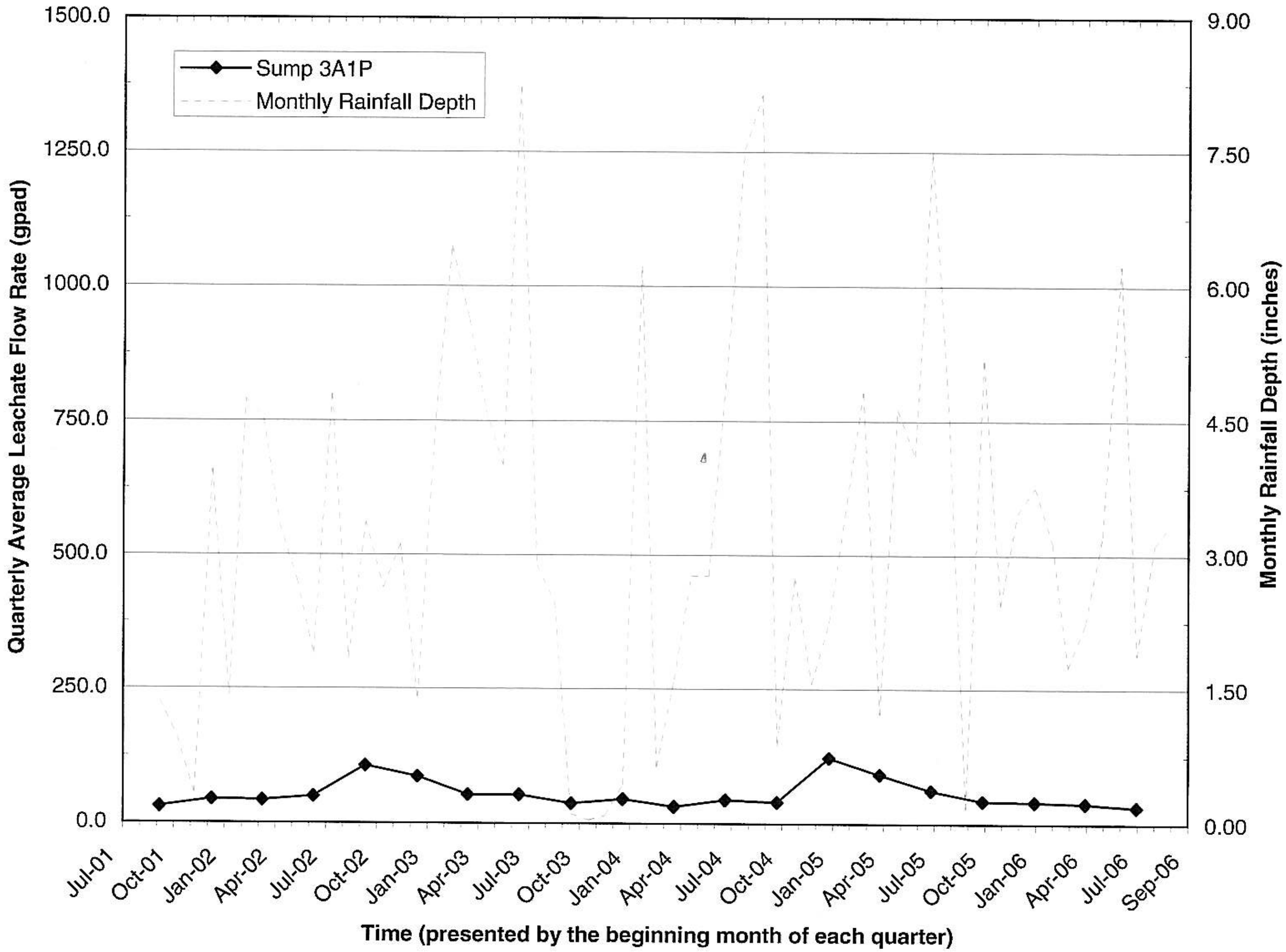

Sump 2G3P
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

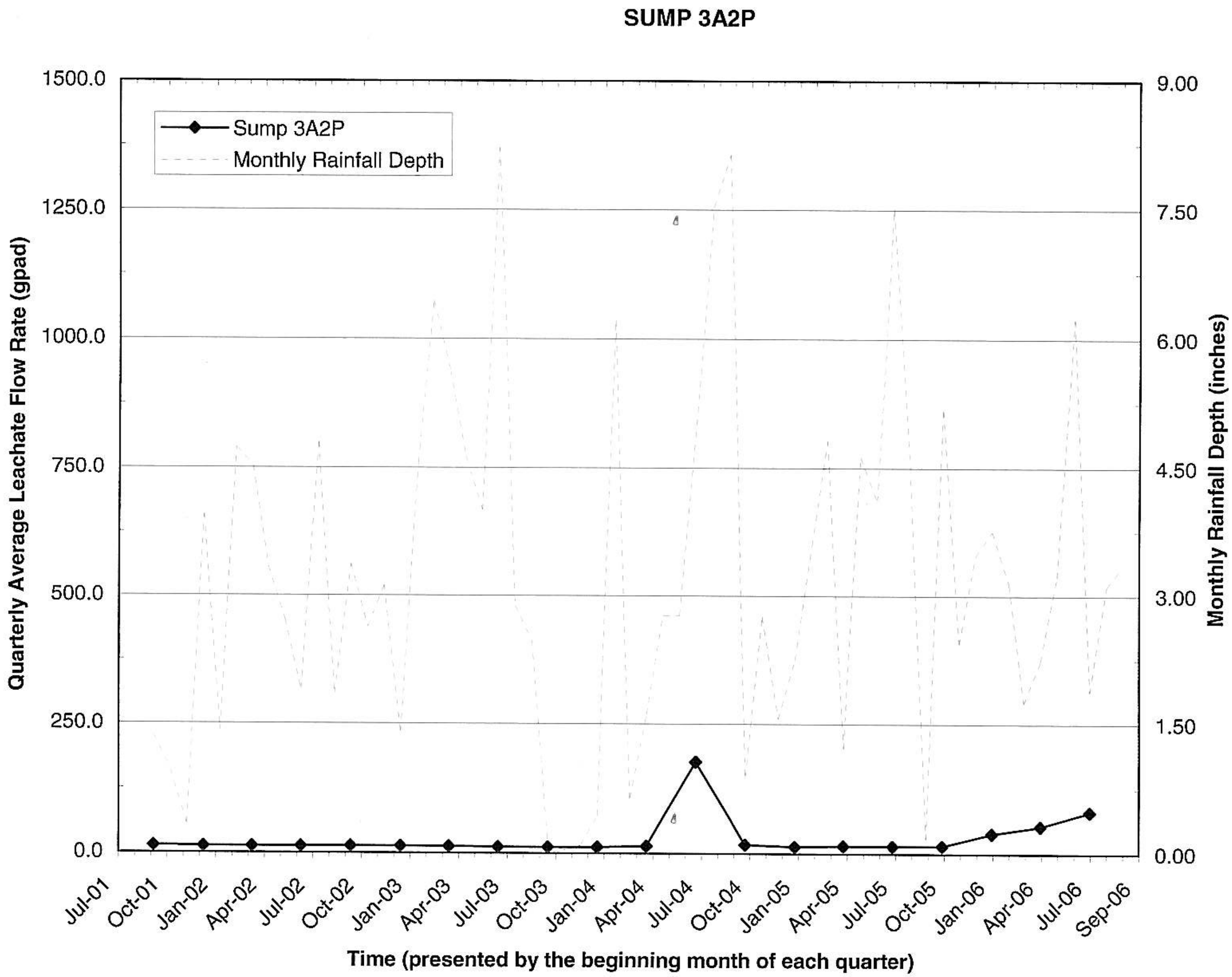
Section III

PINEWOOD LANDFILL, PRIMARY LEACHATE, SECTION III

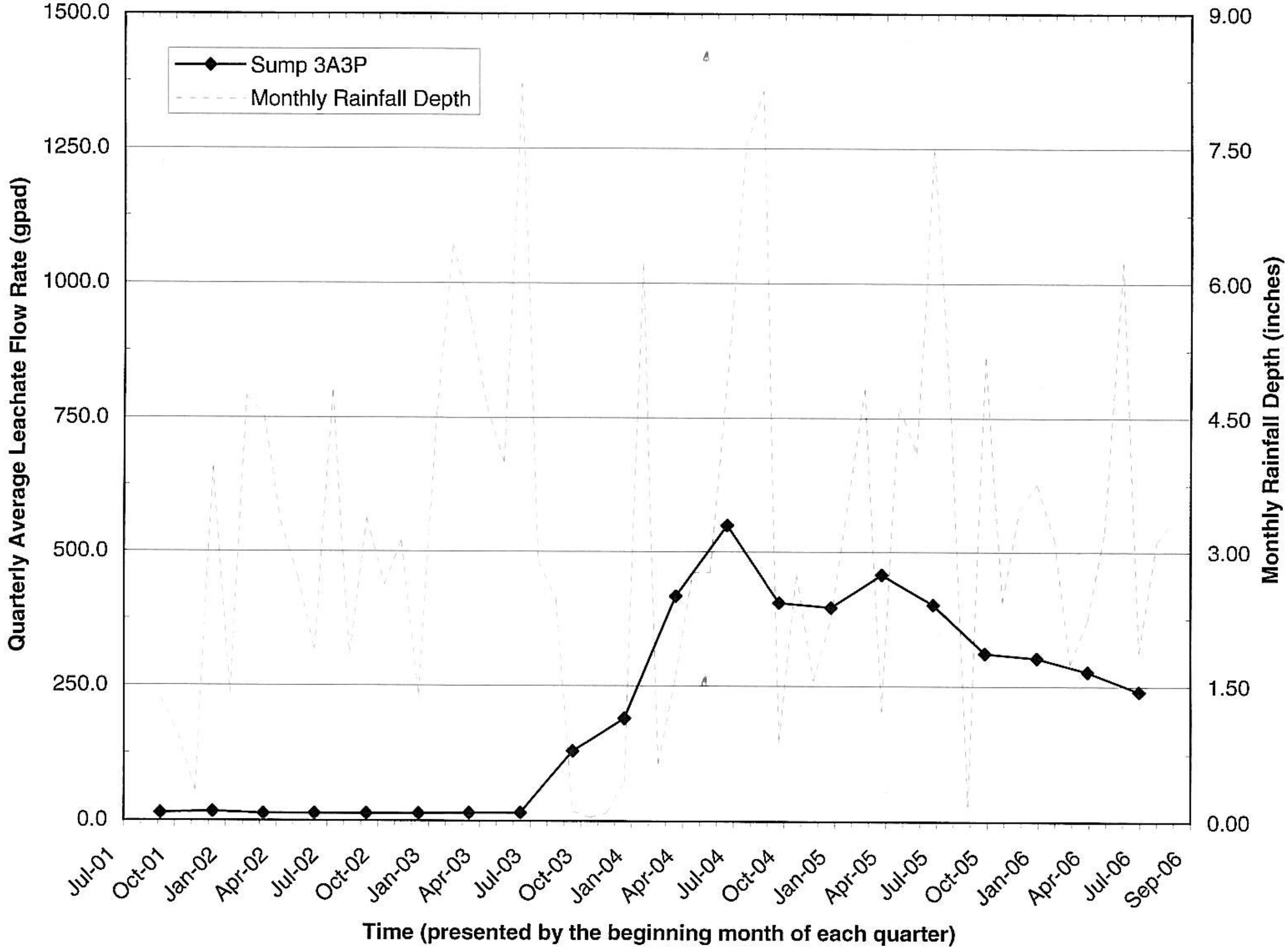


SUMP 3A1P

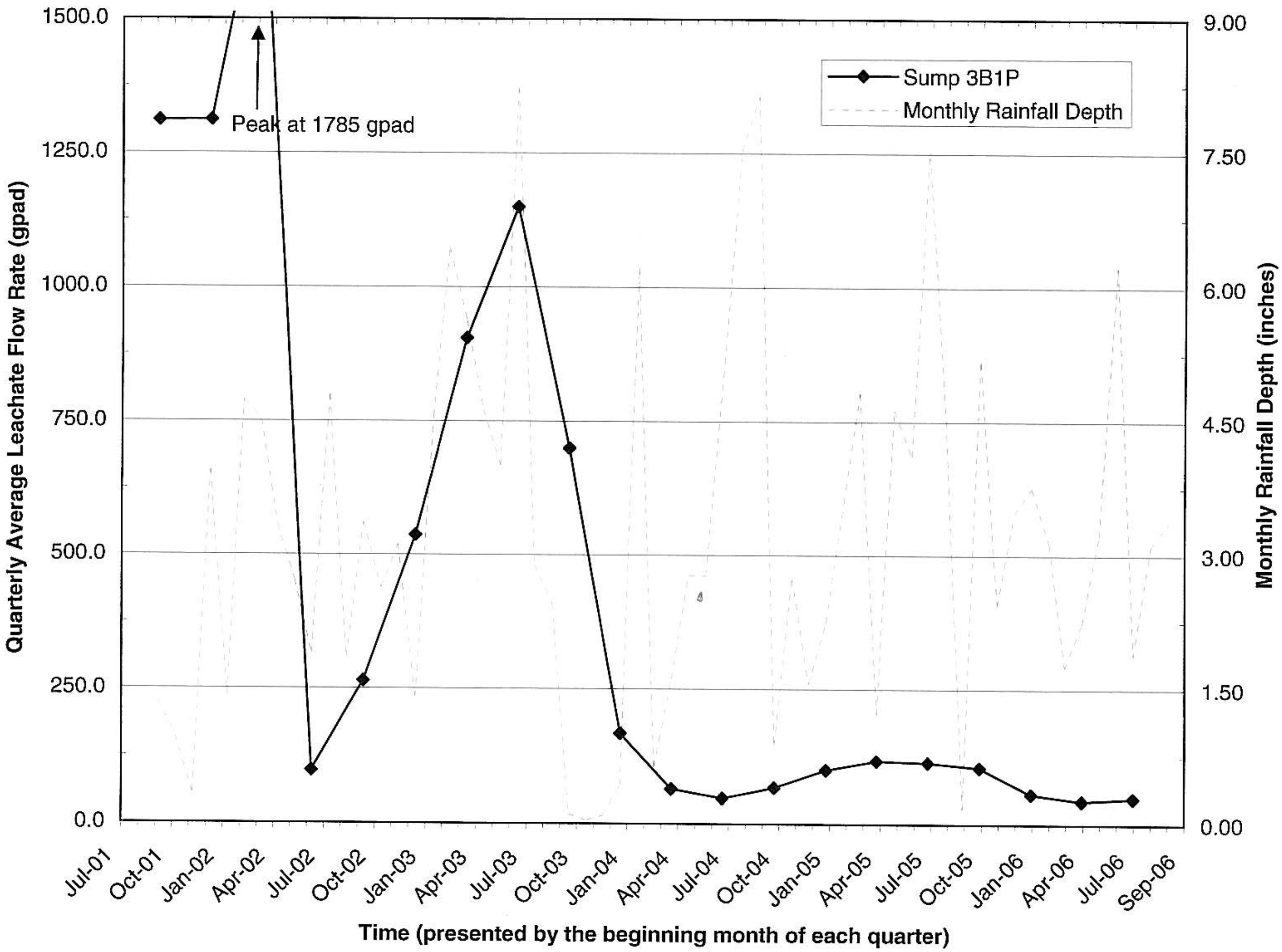

Sump 3A1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 3A2P
Sump 3A2P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

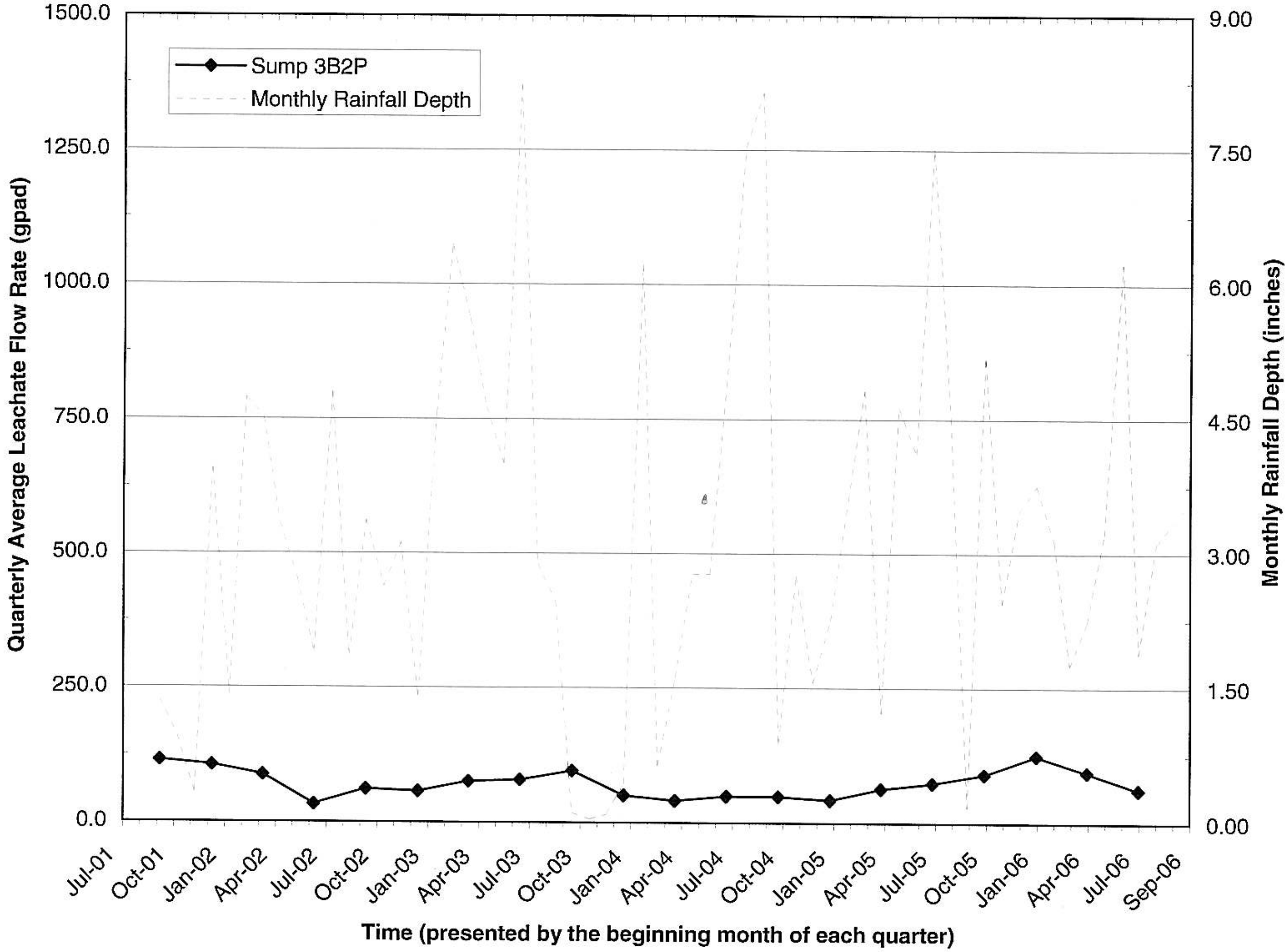
SUMP 3A3P


Sump 3A3P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

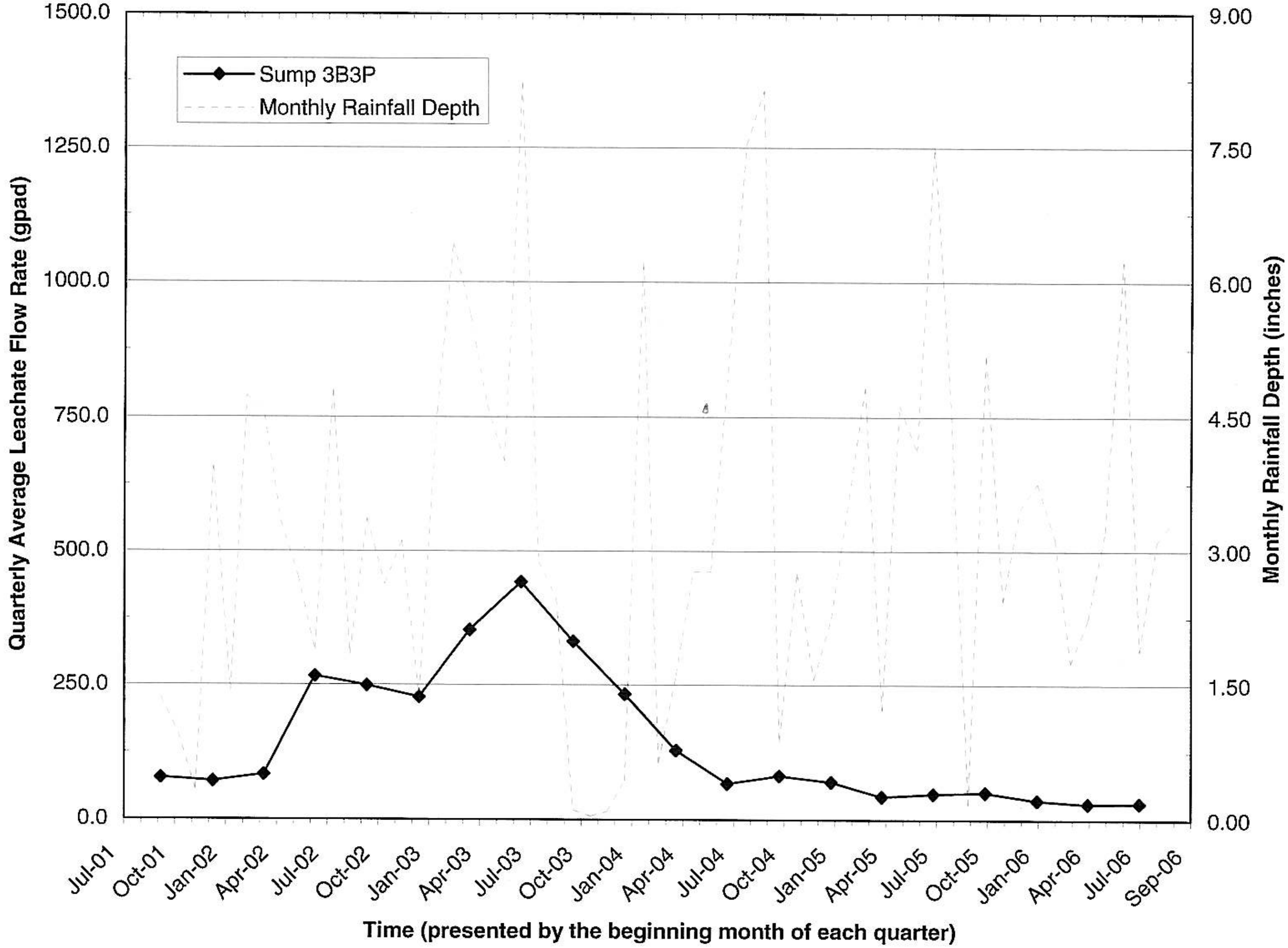
SUMP 3B1P


1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Peak at 1785 gpad
Sump 3B1P
Monthly Rainfall Depth
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

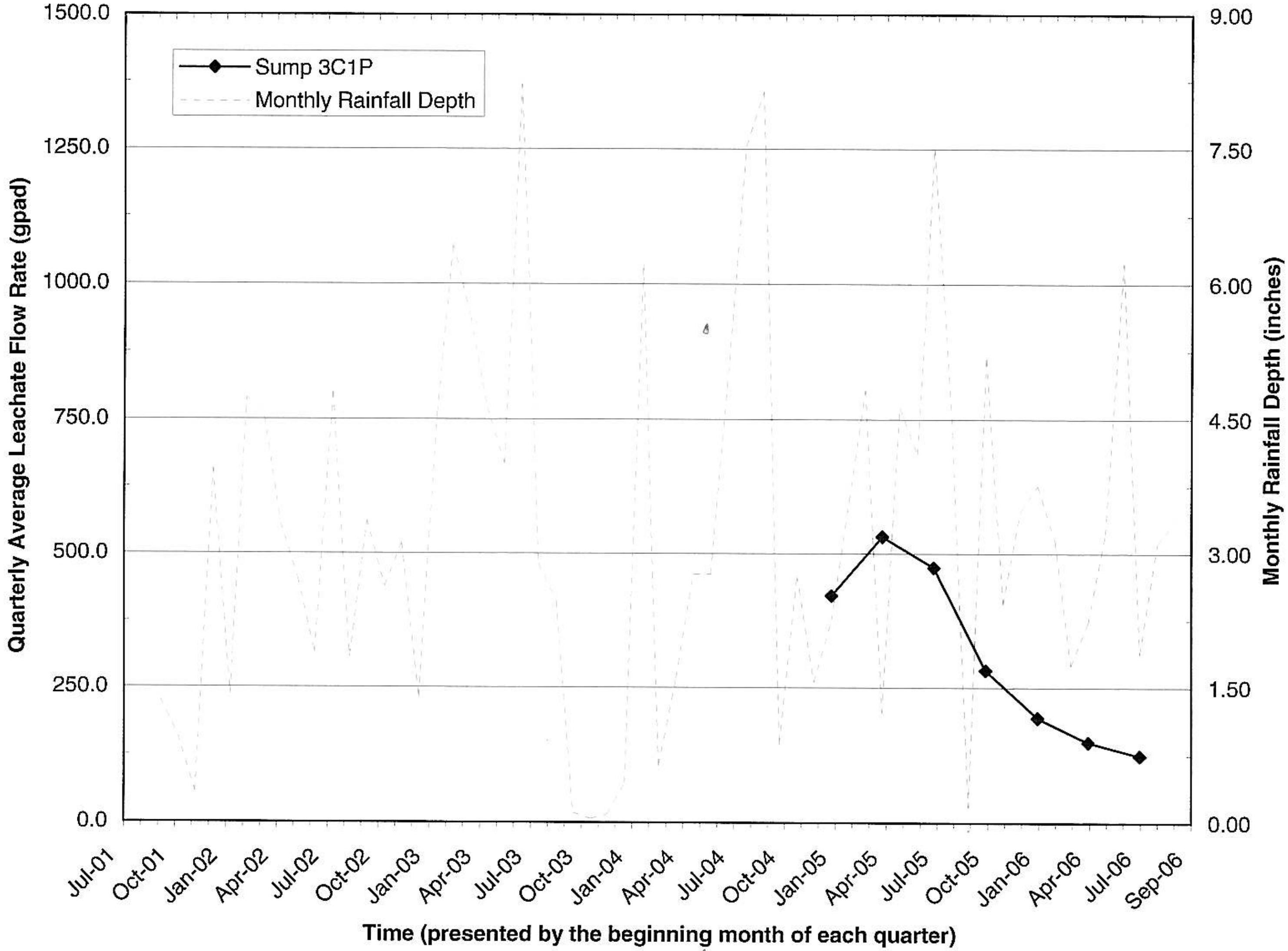
SUMP 3B2P


Sump 3B2P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

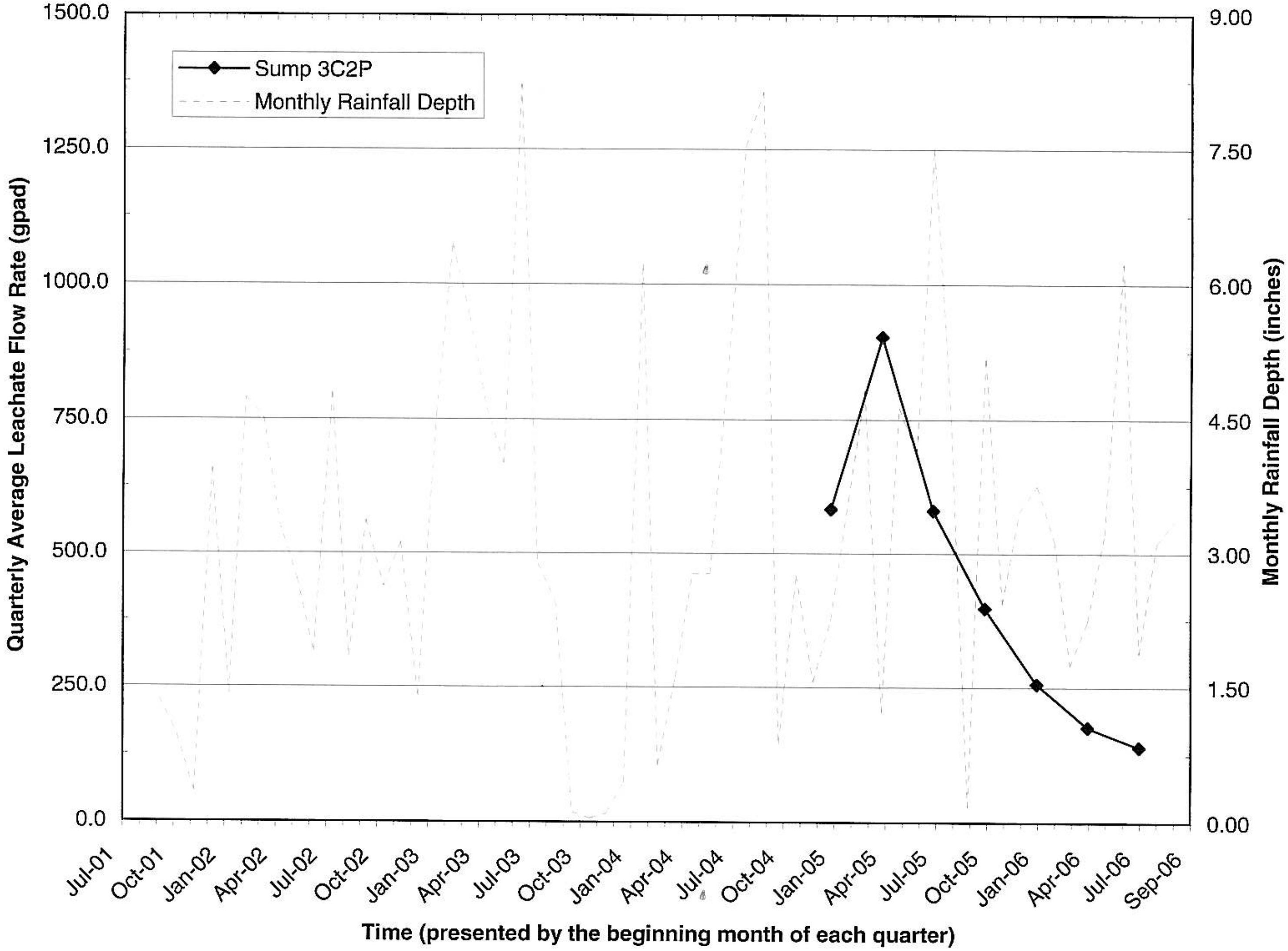
SUMP 3B3P


Sump 3B3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

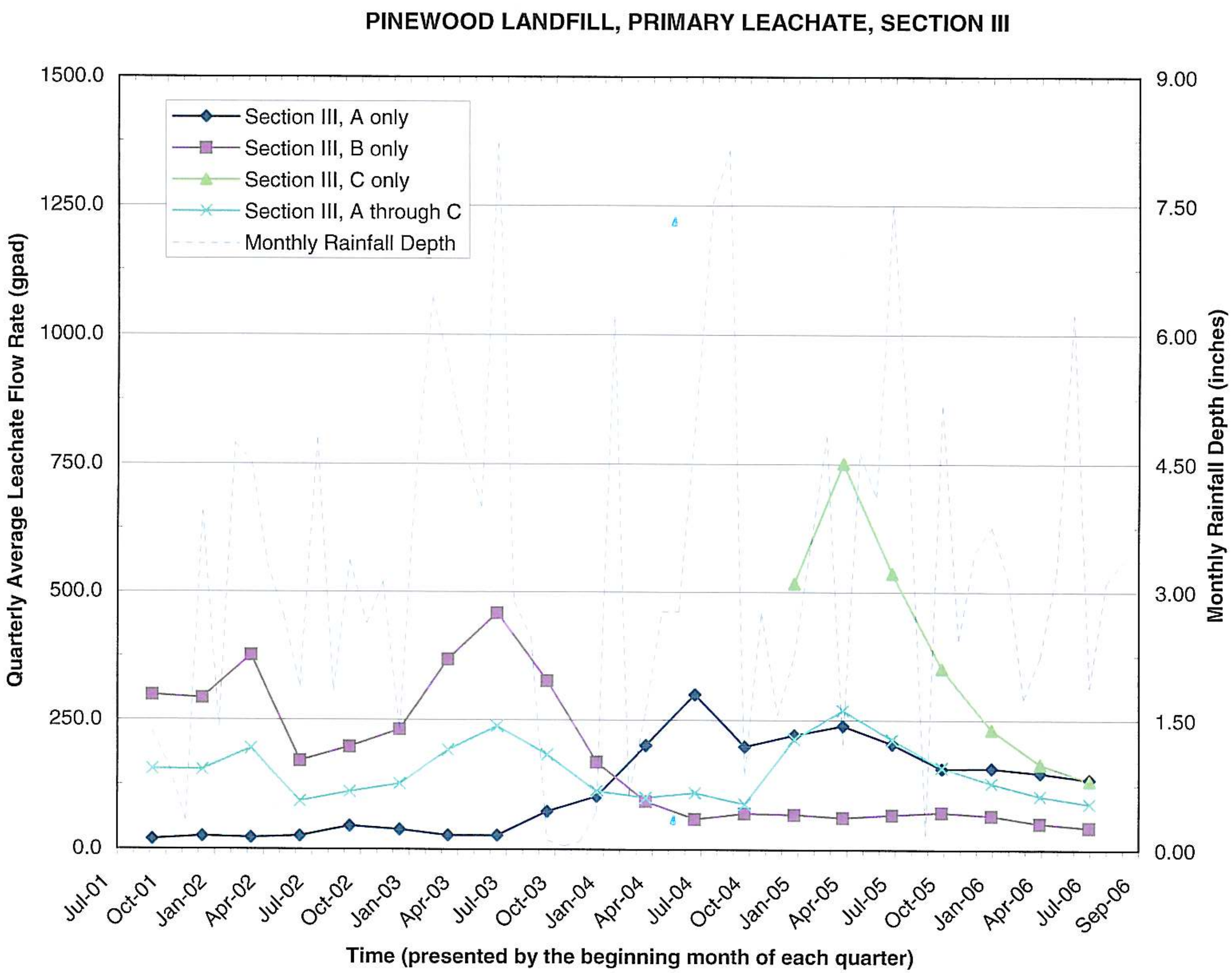
SUMP 3C1P

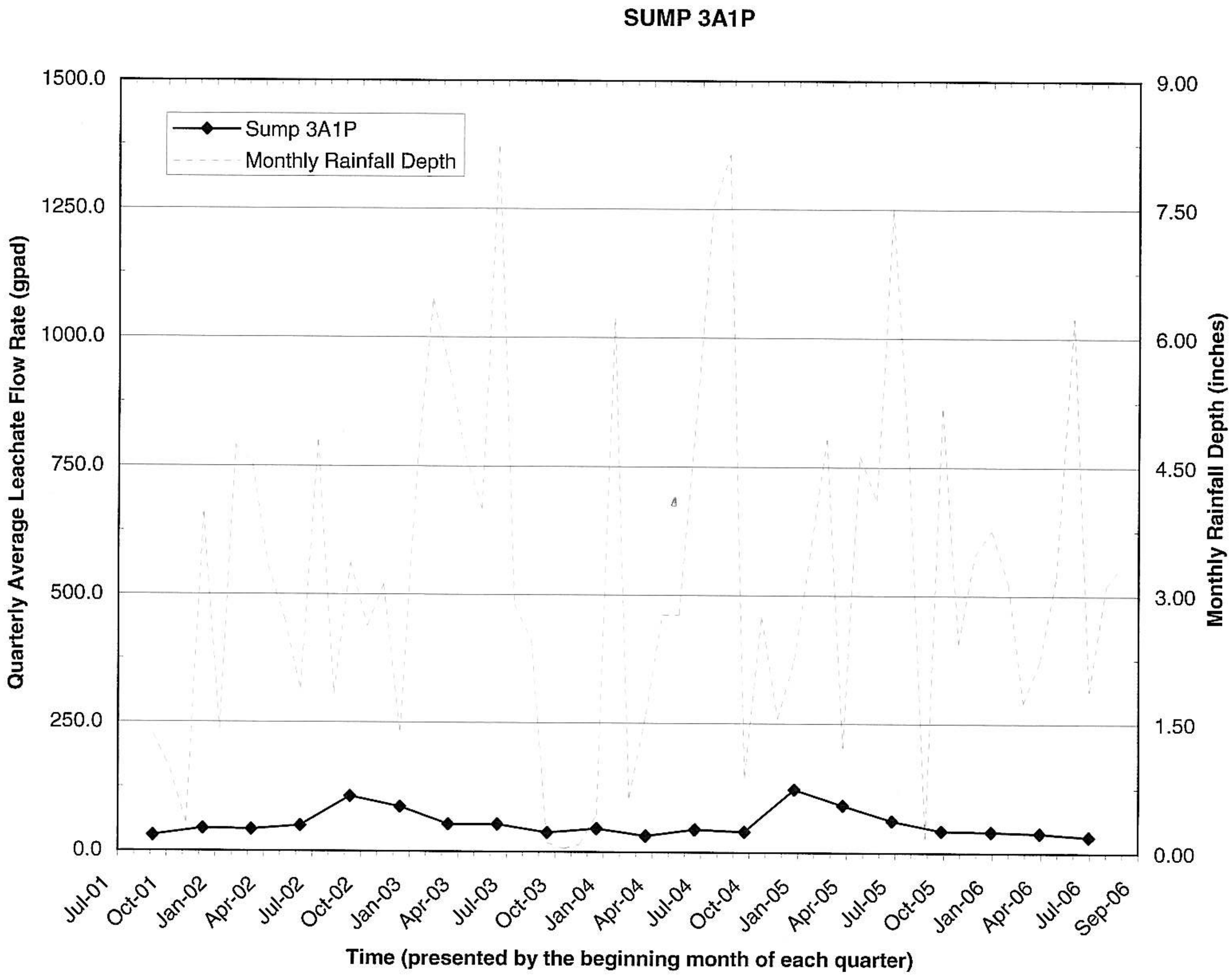

Sump 3C1P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3C2P

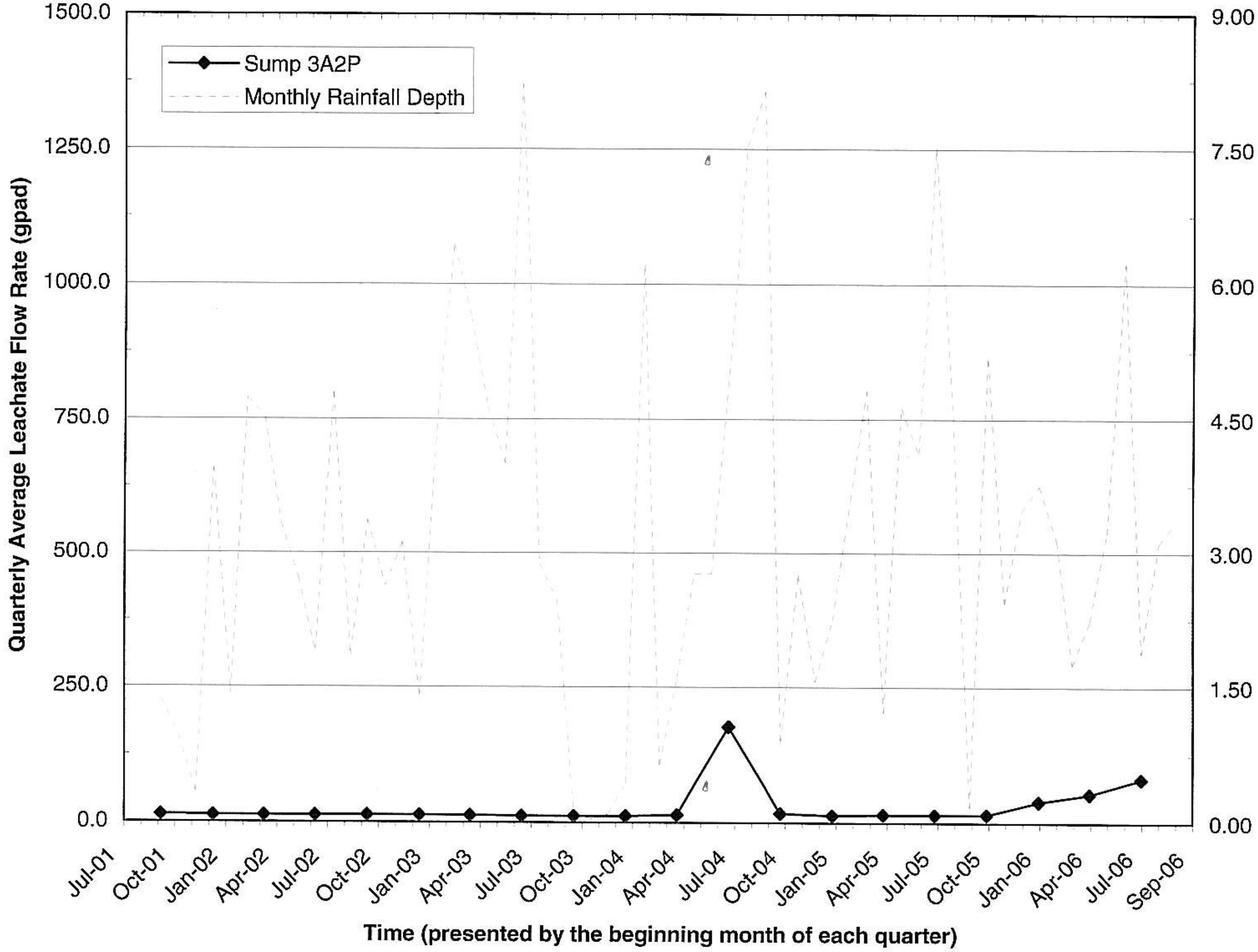

Sump 3C2P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

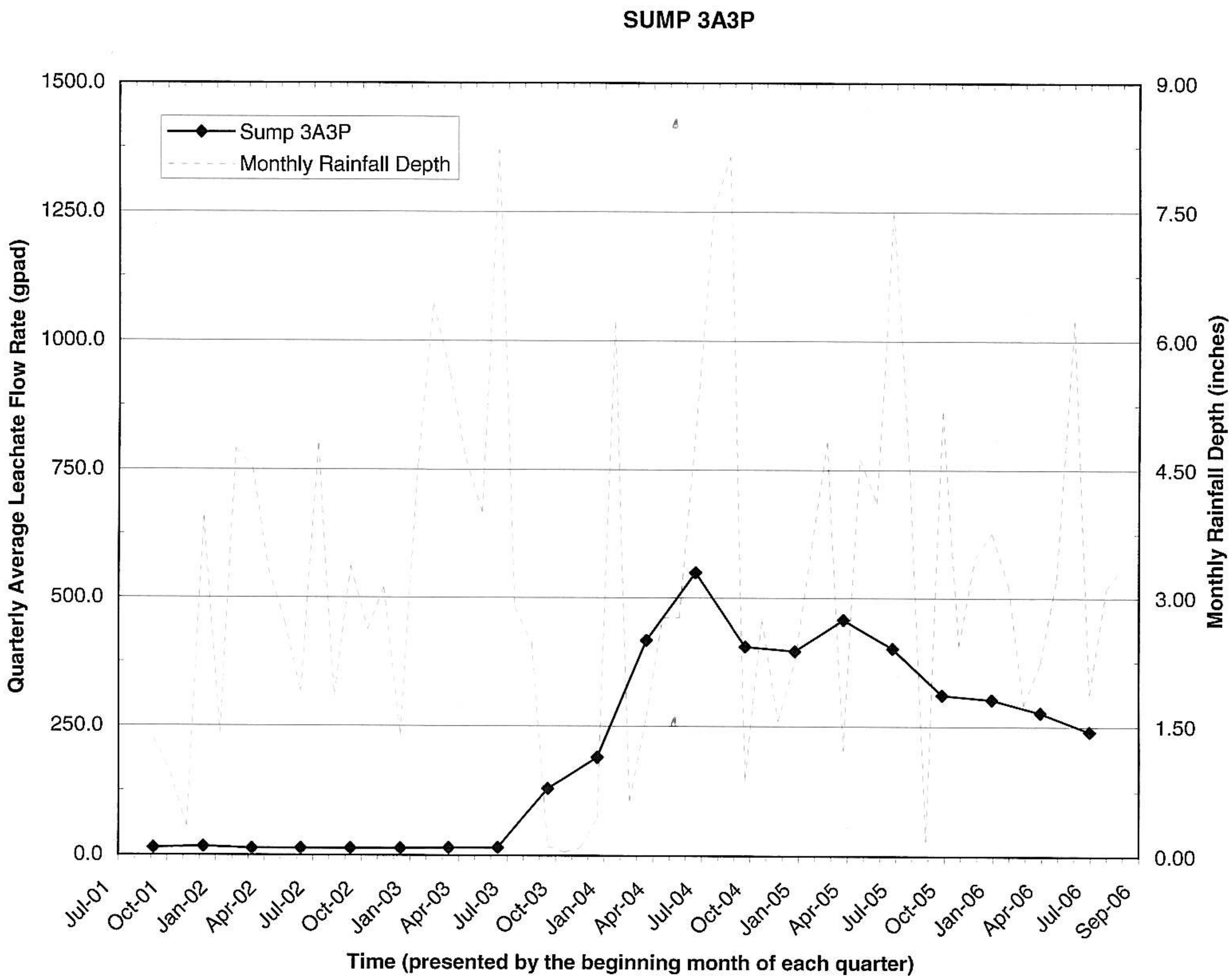
Section III


PINEWOOD LANDFILL, PRIMARY LEACHATE, SECTION III
Section III, A only
Section III, B only
Section III, C only
Section III, A through C
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

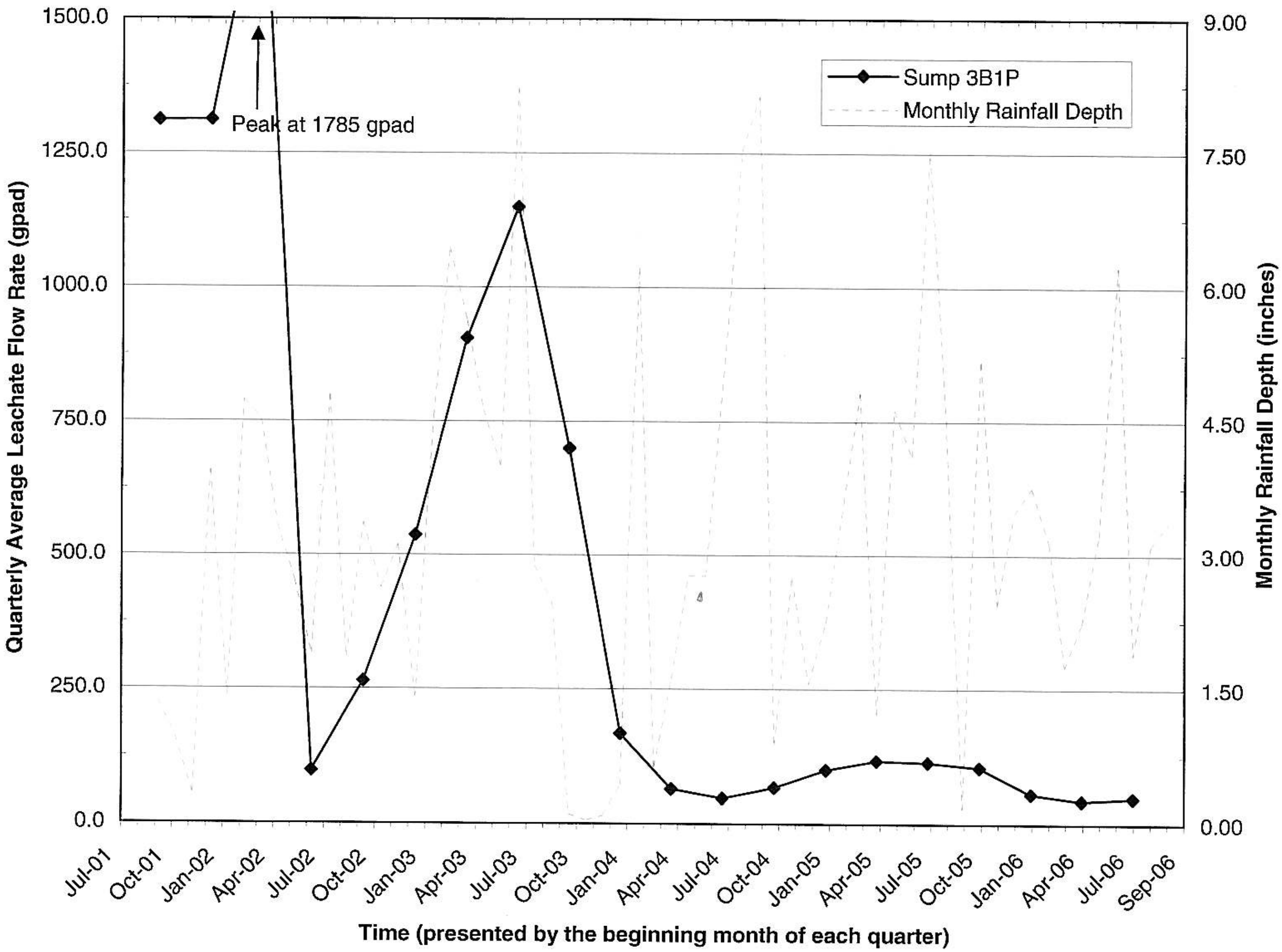

SUMP 3A1P
Sump 3A1P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3A2P

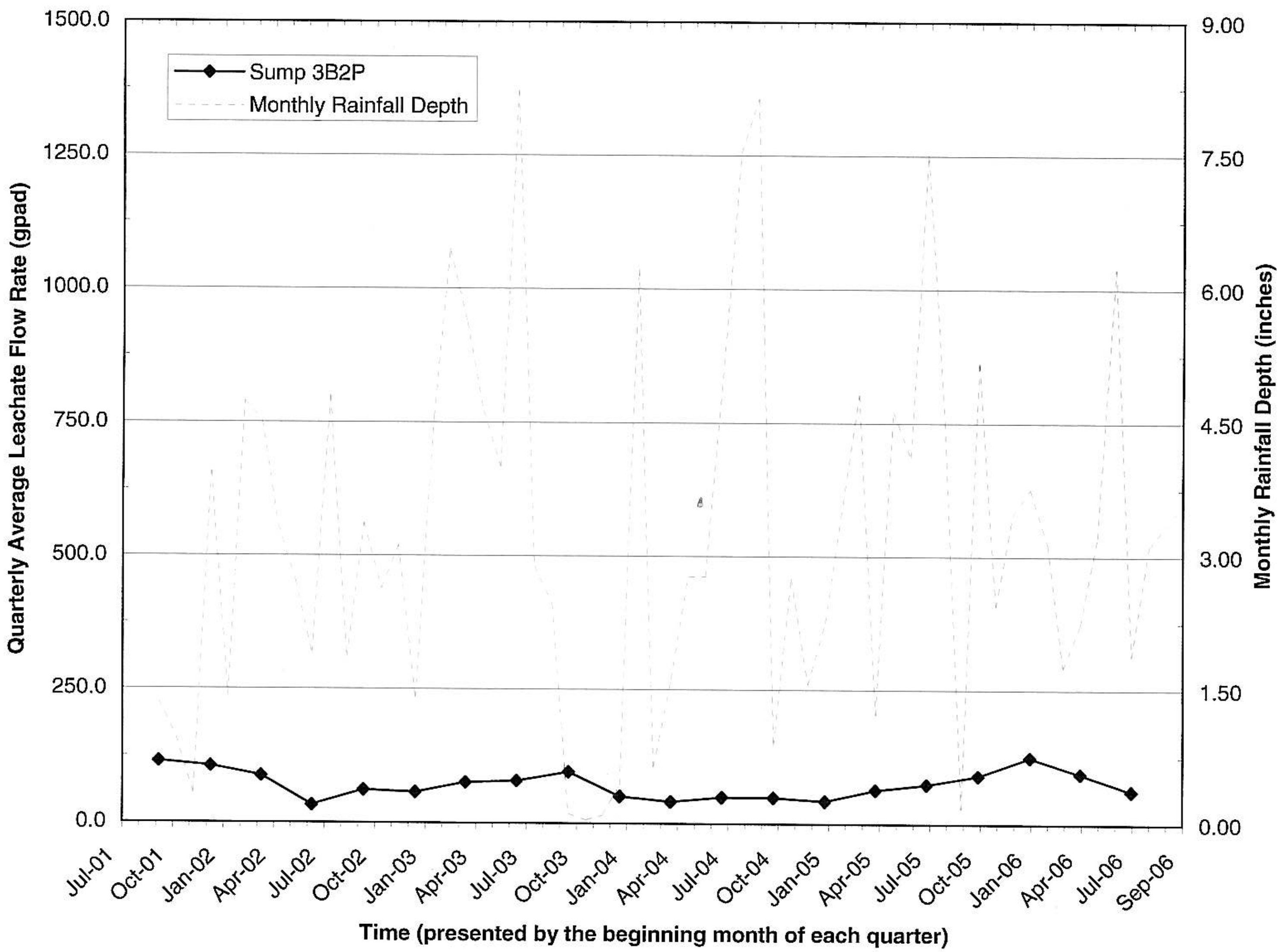

Sump 3A2P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

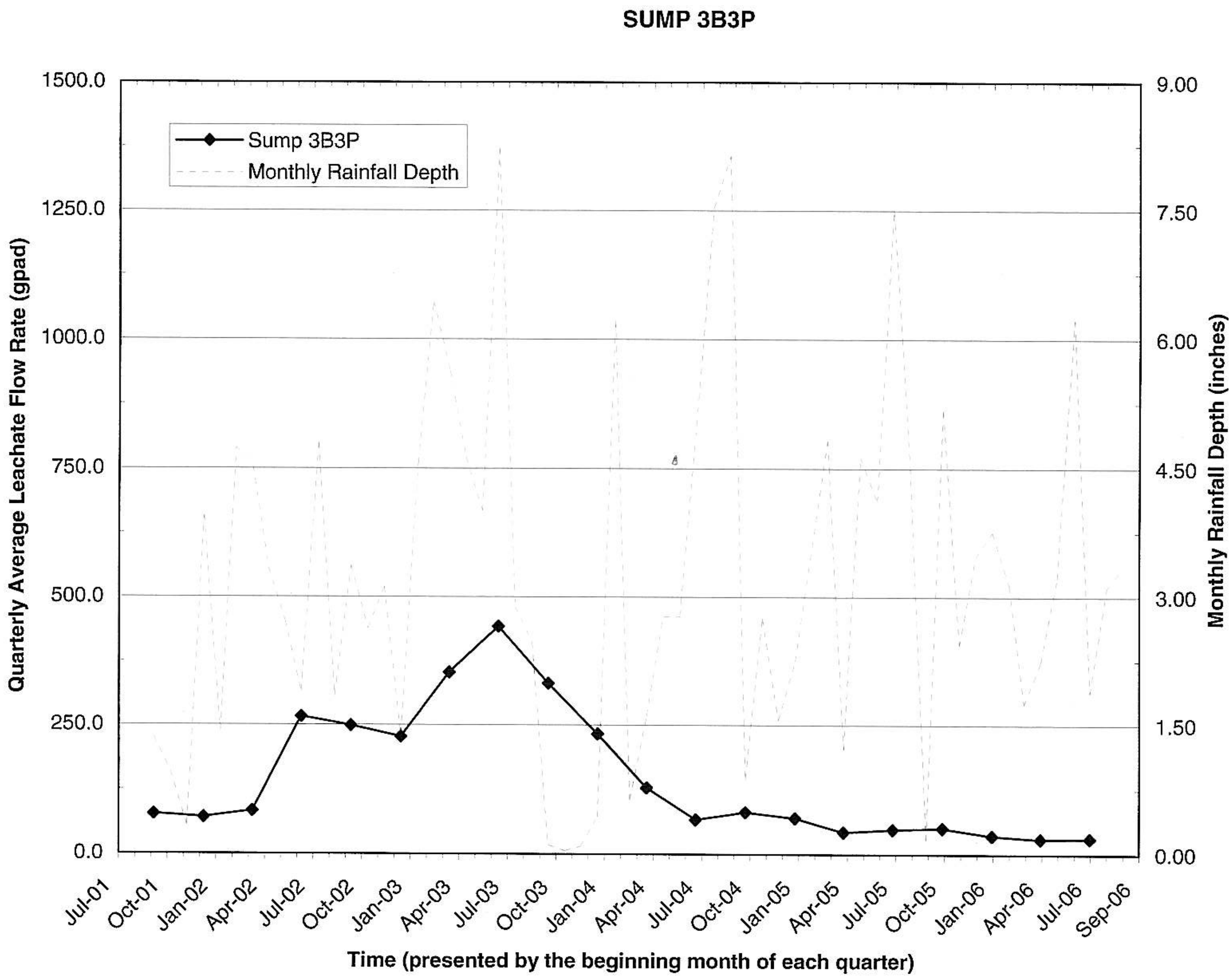

SUMP 3A3P
Sump 3A3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3B1P

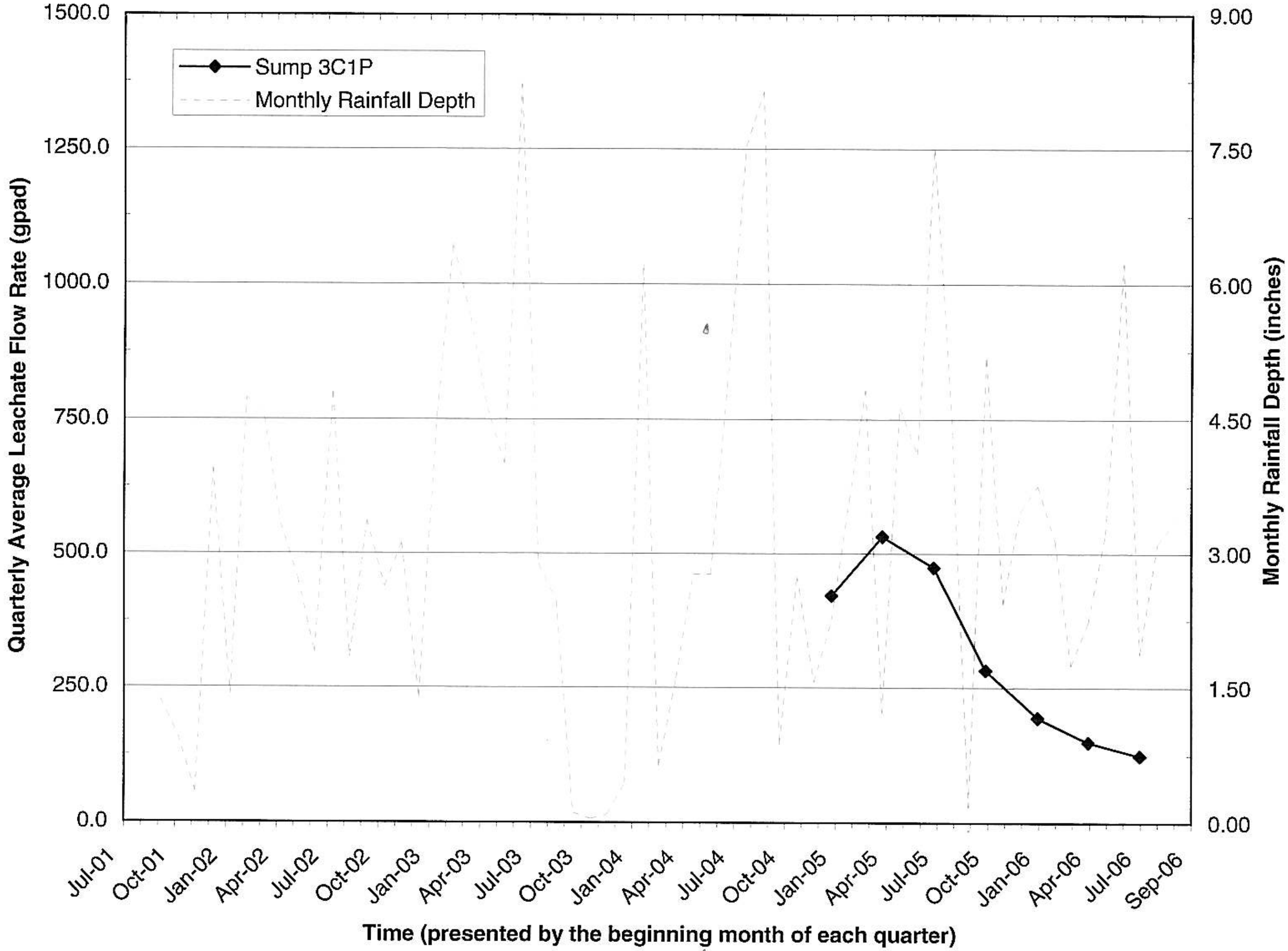

Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Sump 3B1P
Monthly Rainfall Depth
Peak at 1785 gpad
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3B2P

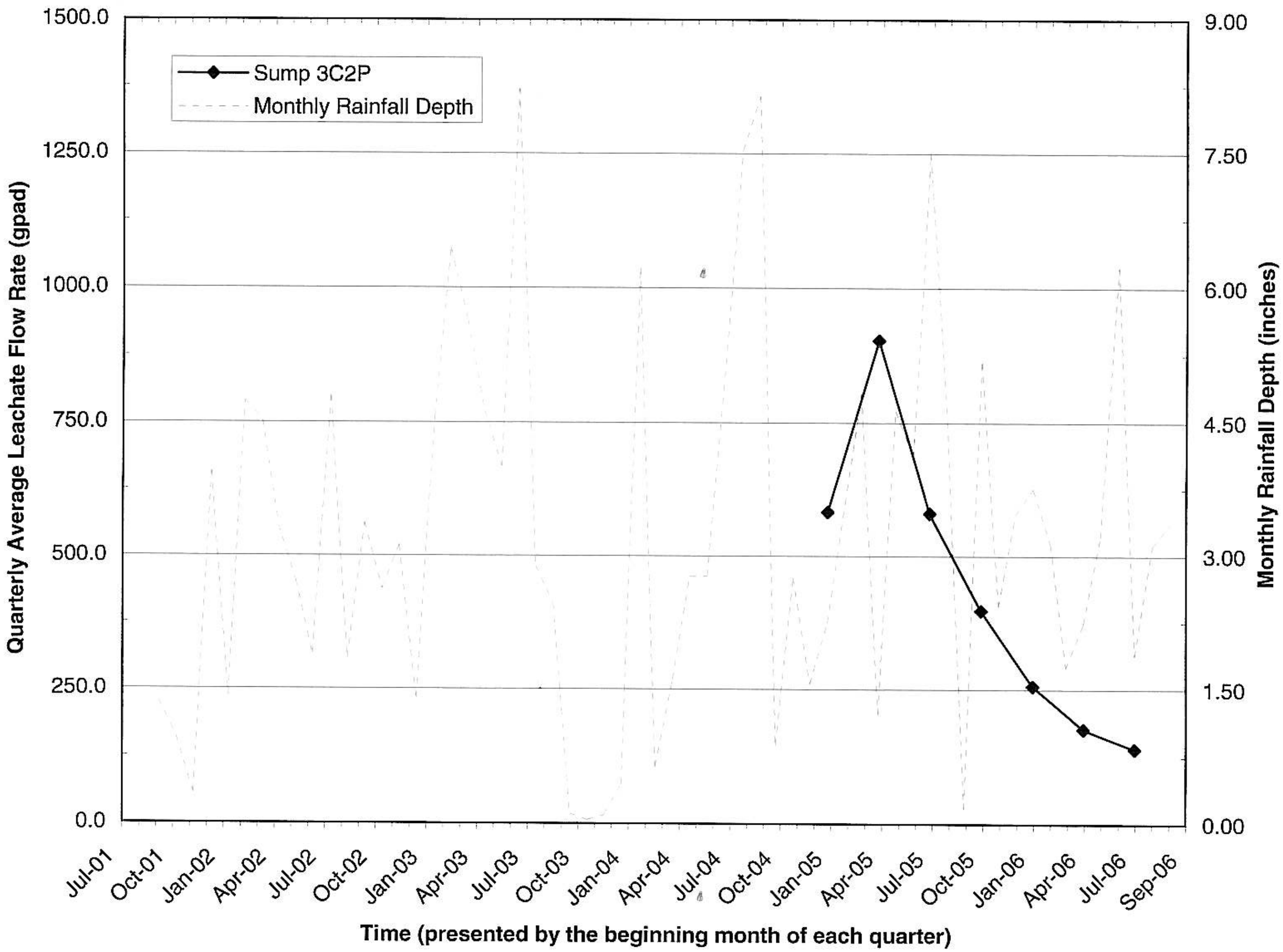

Sump 3B2P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 3B3P
Sump 3B3P
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3C1P


Sump 3C1P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

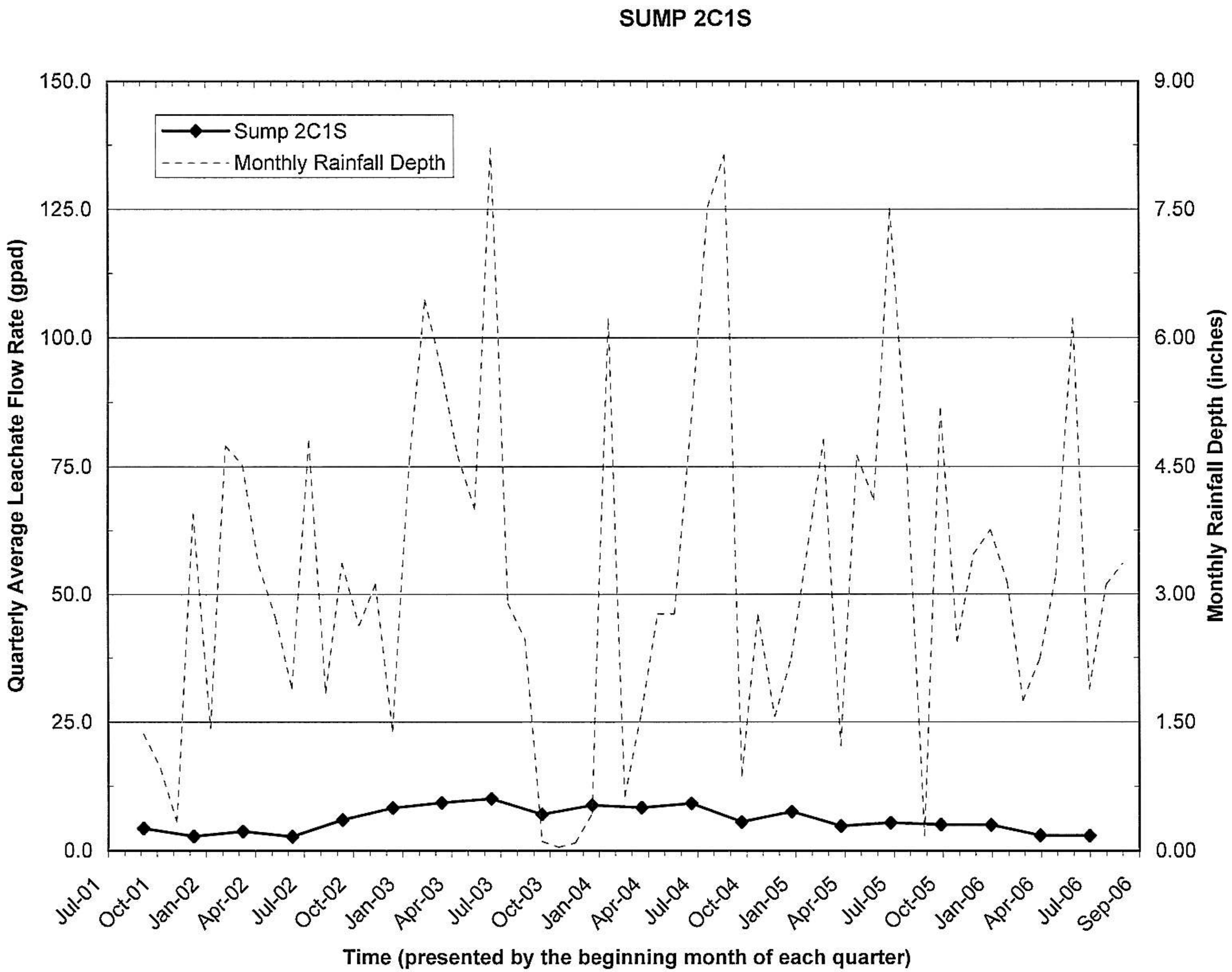
SUMP 3C2P


Sump 3C2P
Monthly Rainfall Depth
1500.0
1250.0
1000.0
750.0
500.0
250.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

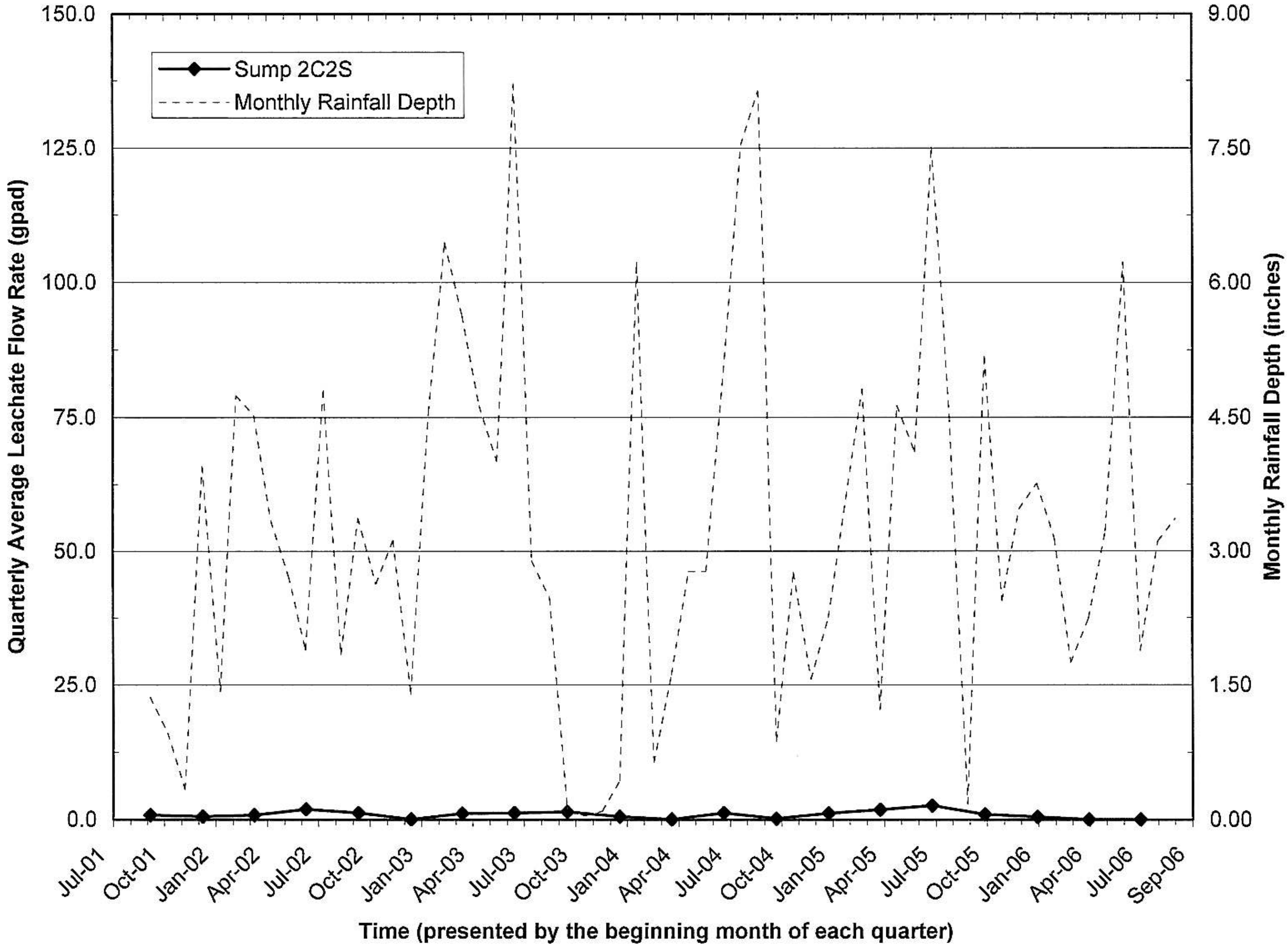
APPENDIX A-2

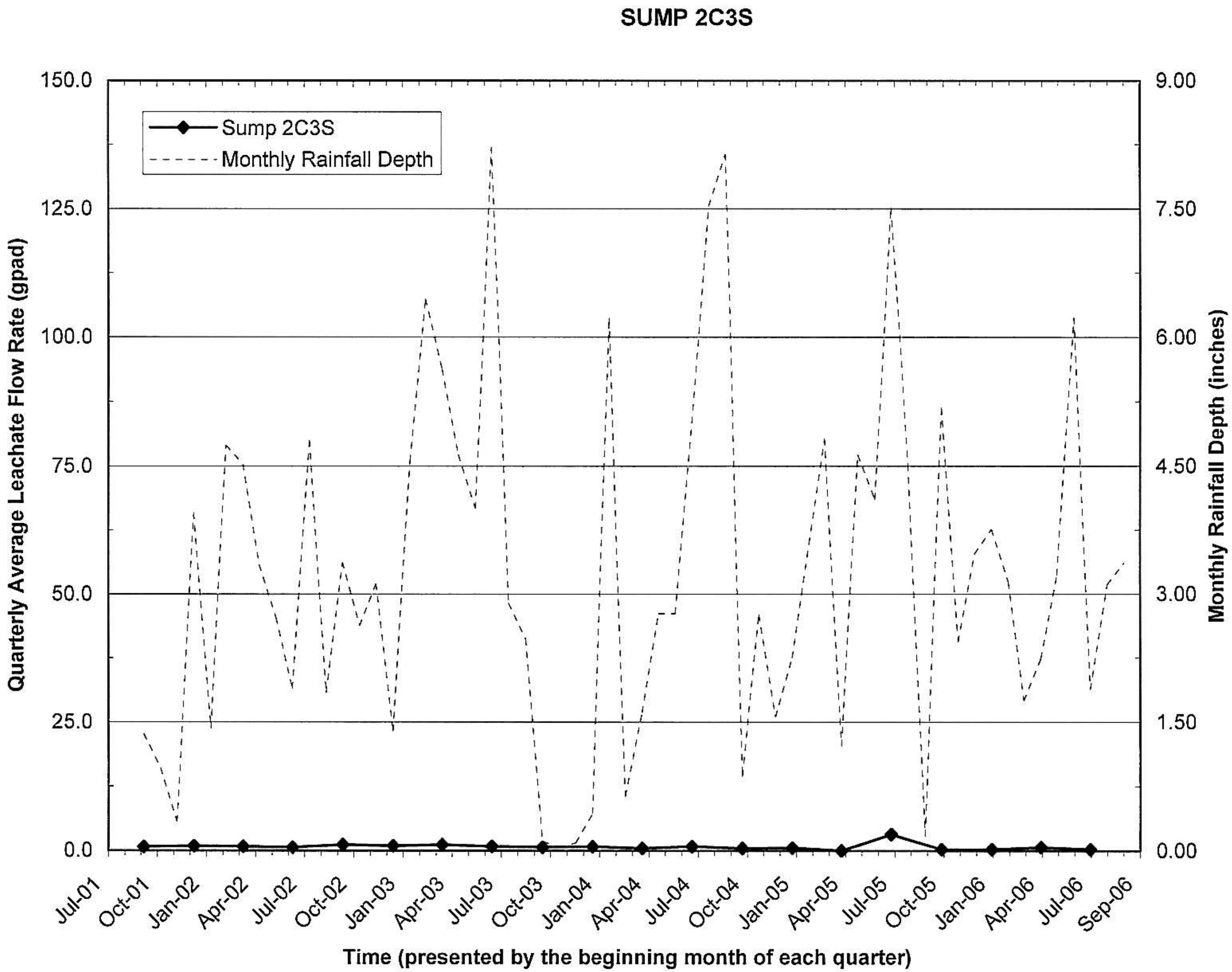
Secondary Leachate Detection System

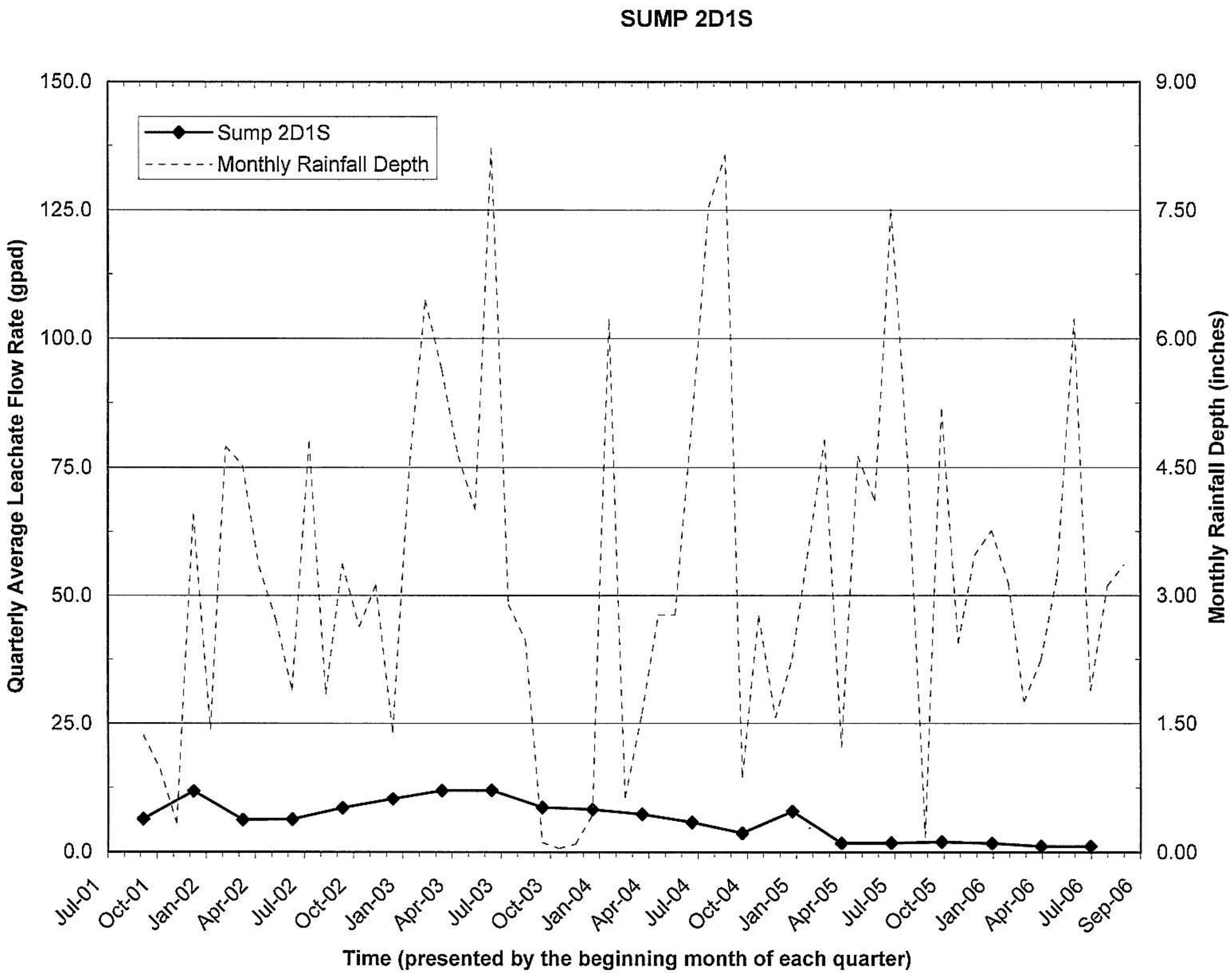
Section II


SUMP 2C1S
Sump 2C1S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01 Oct-01 Jan-02 Apr-02 Jul-02 Oct-02 Jan-03 Apr-03 Jul-03 Oct-03 Jan-04 Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Sep-06
Time (presented by the beginning month of each quarter)

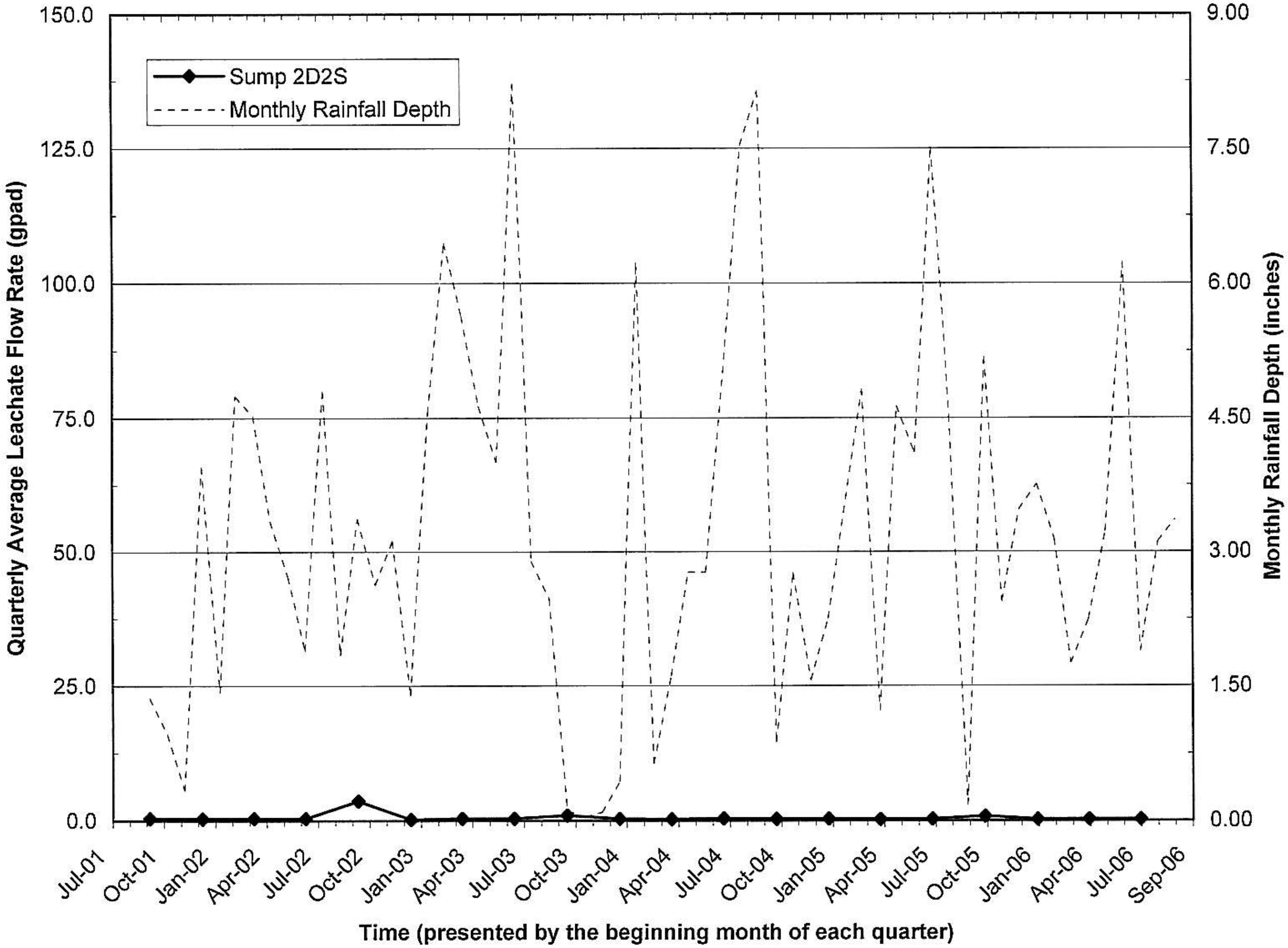
SUMP 2C2S


Sump 2C2S
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01 Oct-01 Jan-02 Apr-02 Jul-02 Oct-02 Jan-03 Apr-03 Jul-03 Oct-03 Jan-04 Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Sep-06
Time (presented by the beginning month of each quarter)


SUMP 2C3S
Sump 2C3S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 2D1S
Sump 2D1S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

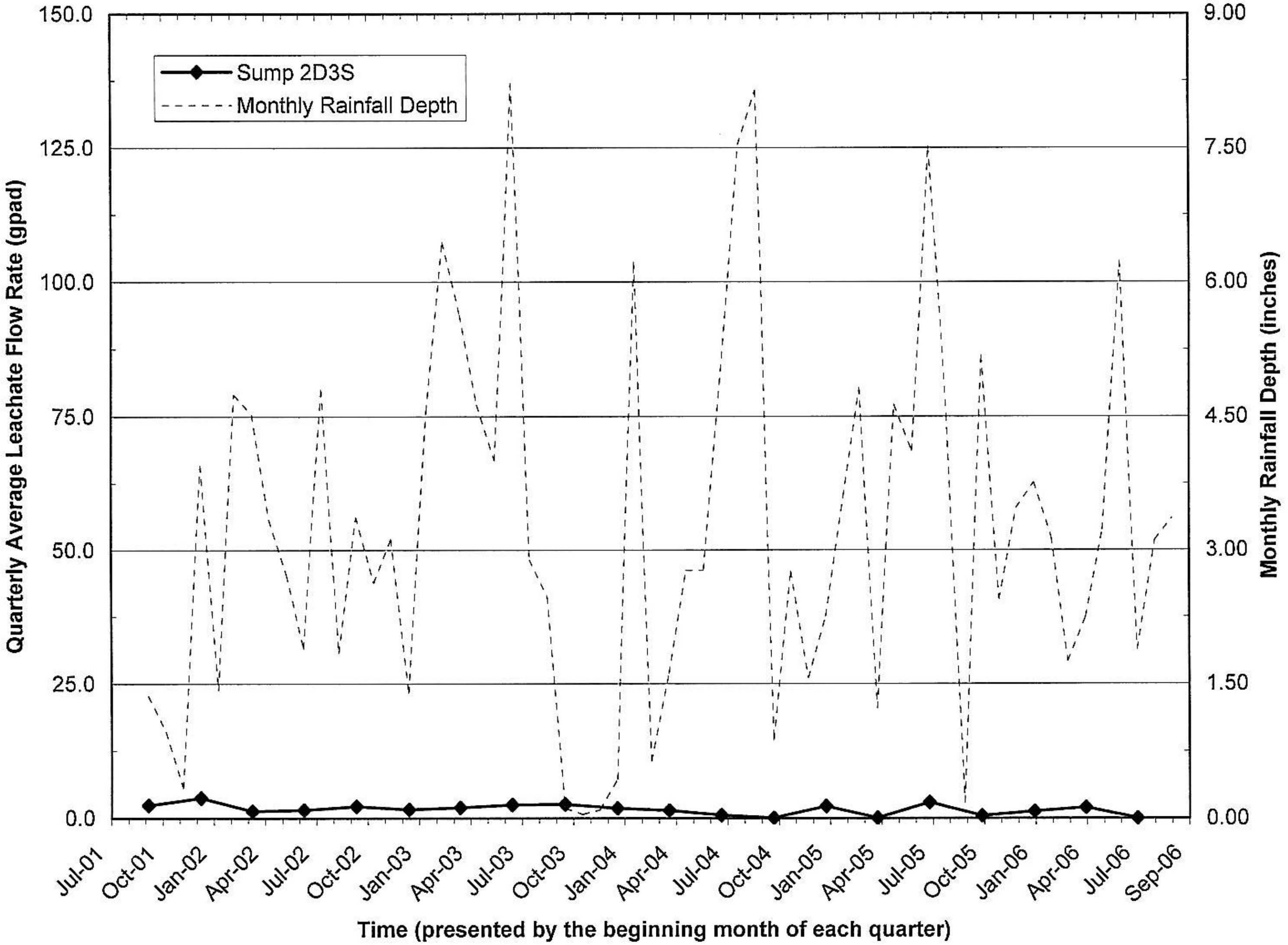
SUMP 2D2S



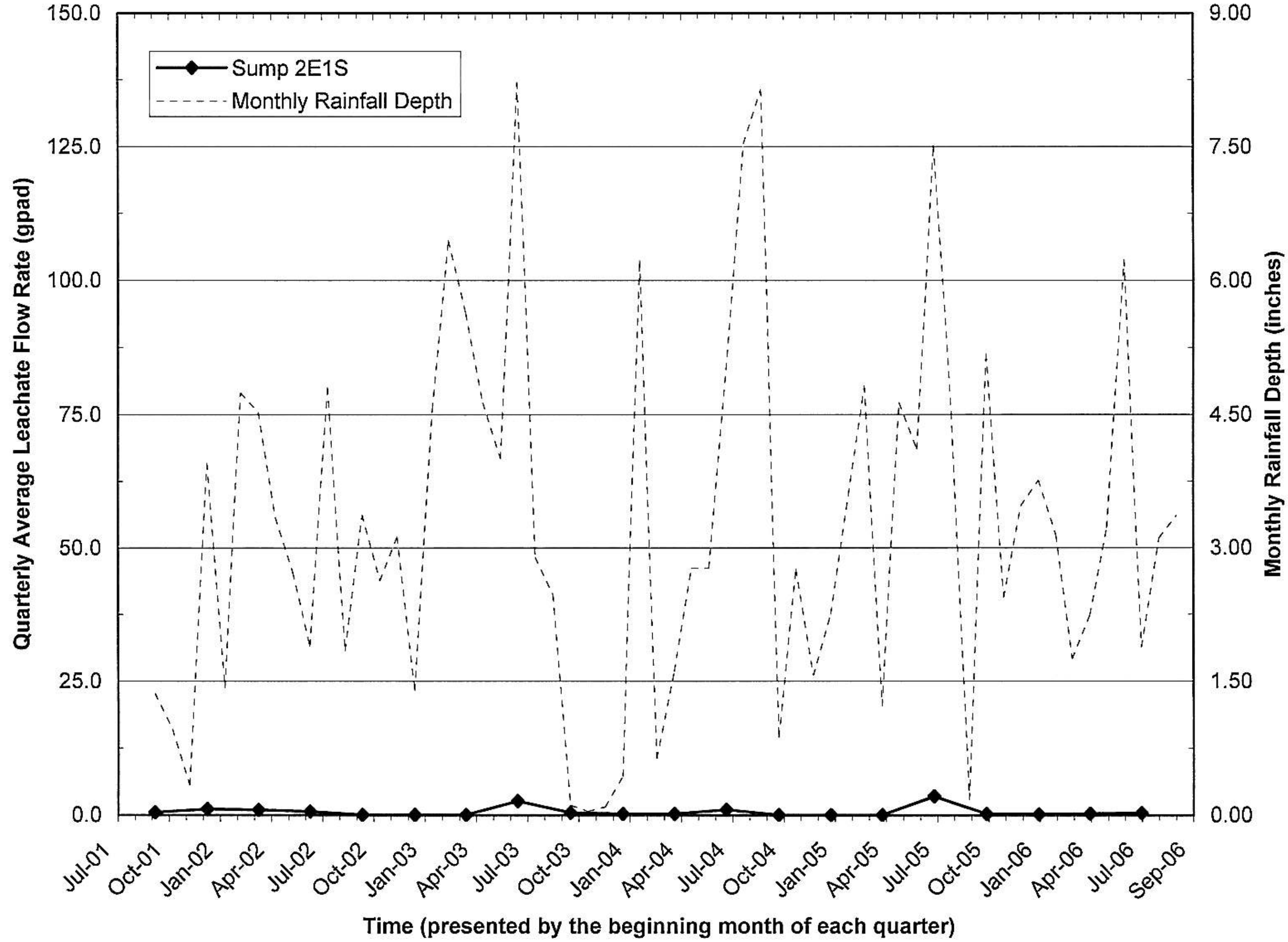
File: Section II_Quarterly Average Secondary Sump Flow Rates.xls
Sheet: 2D2S_Chart

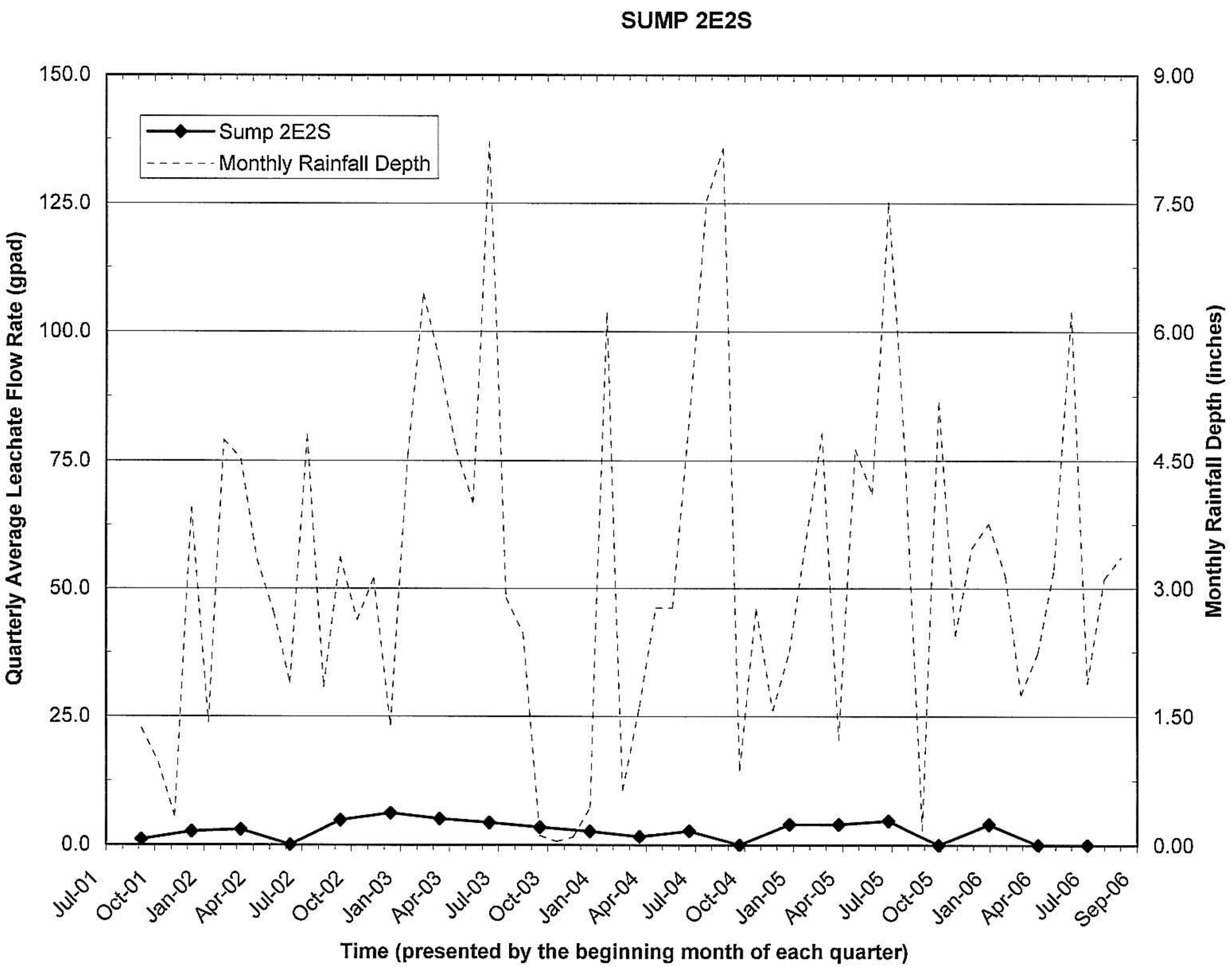
Golder Associates

SUMP 2D3S

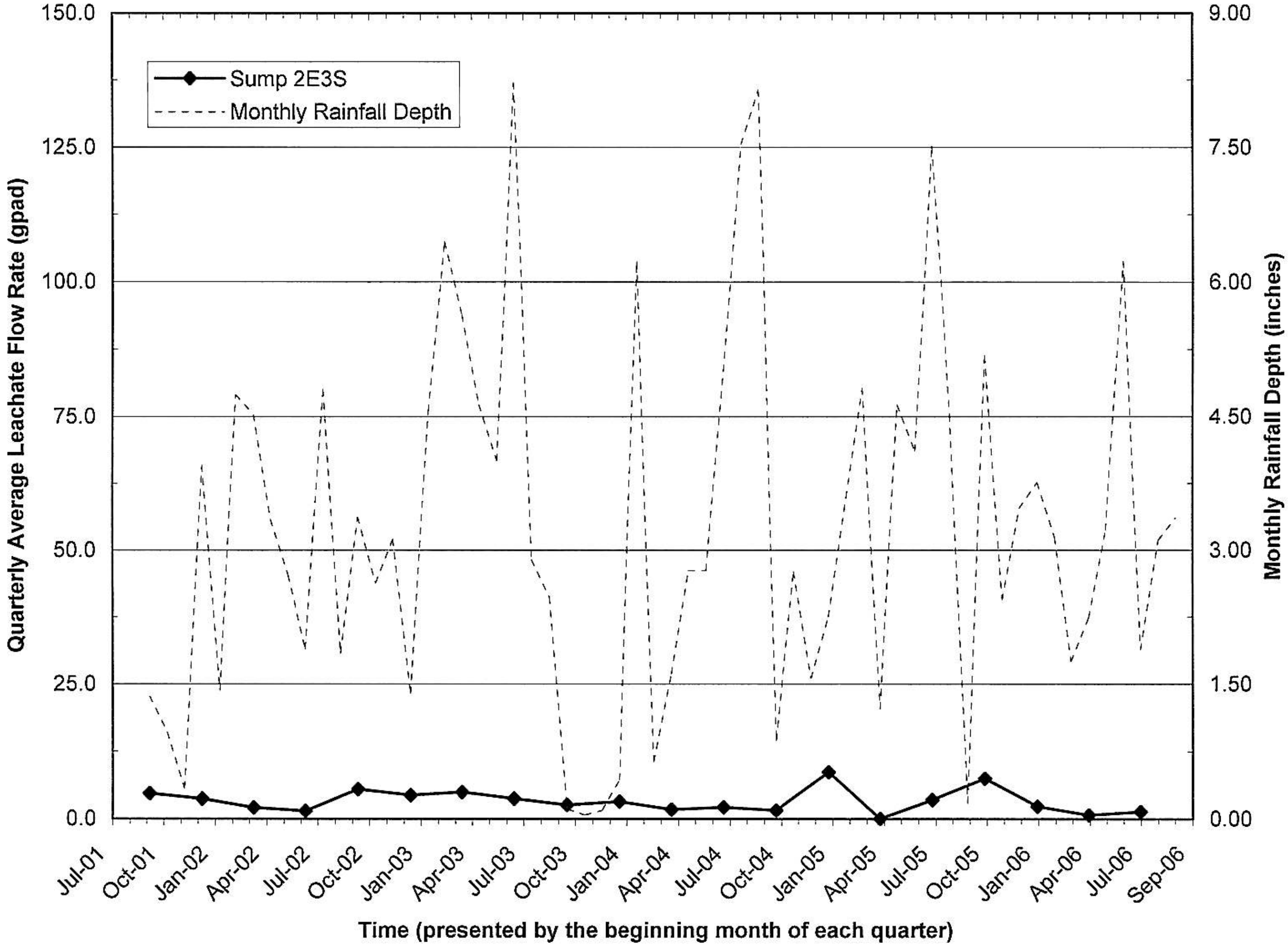

Sump 2D3S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

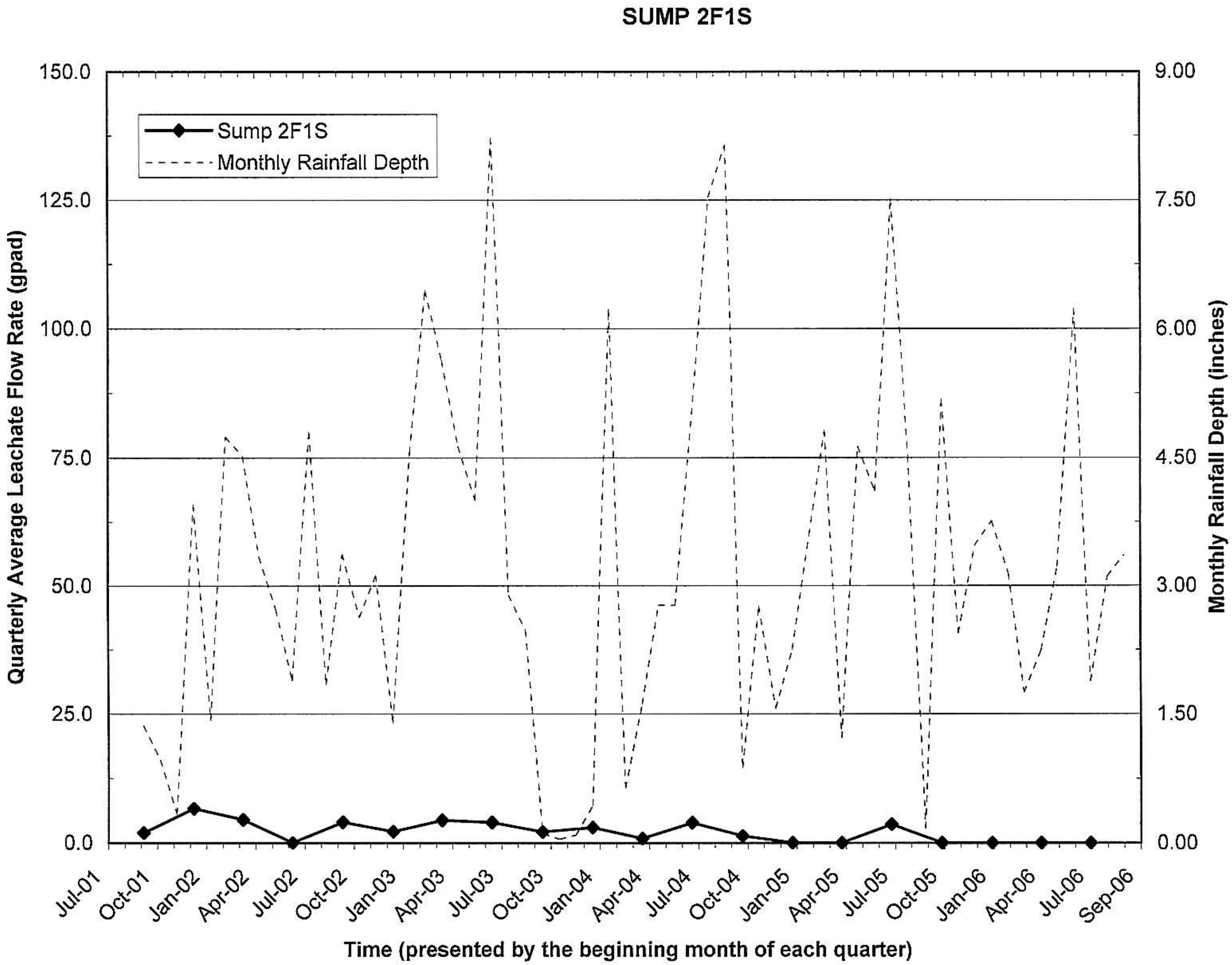
SUMP 2E1S

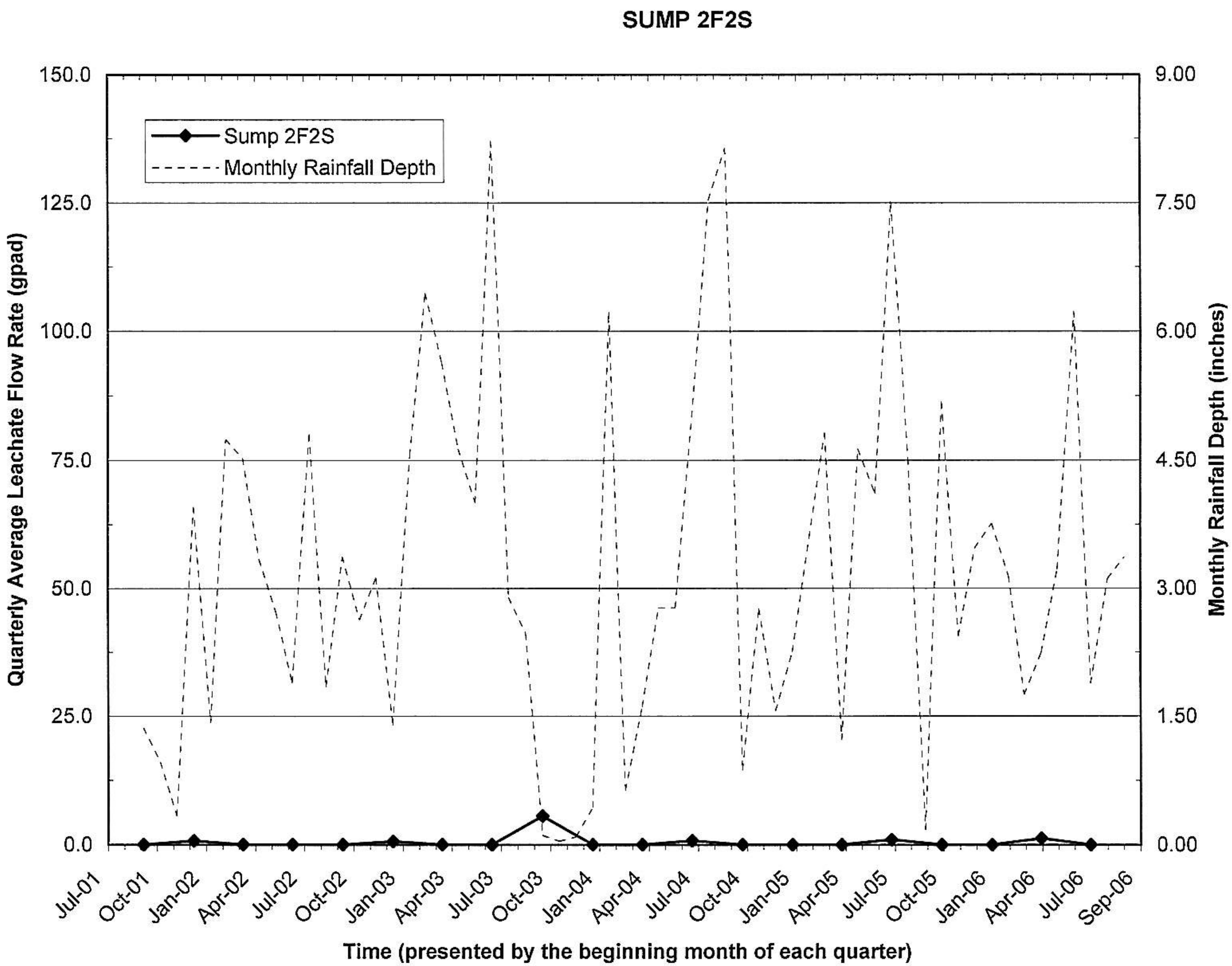

Sump 2E1S
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 2E2S
Sump 2E2S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

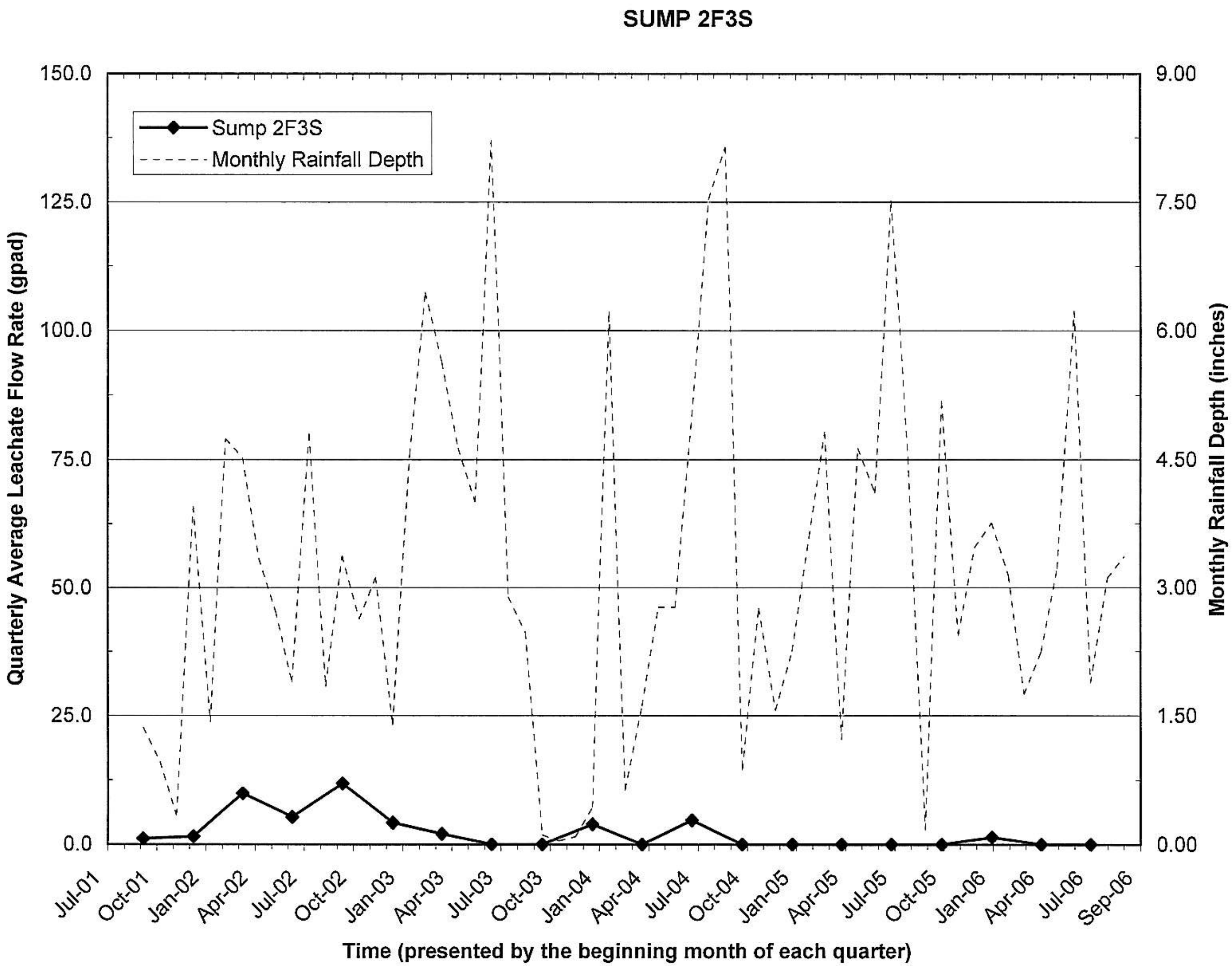
SUMP 2E3S

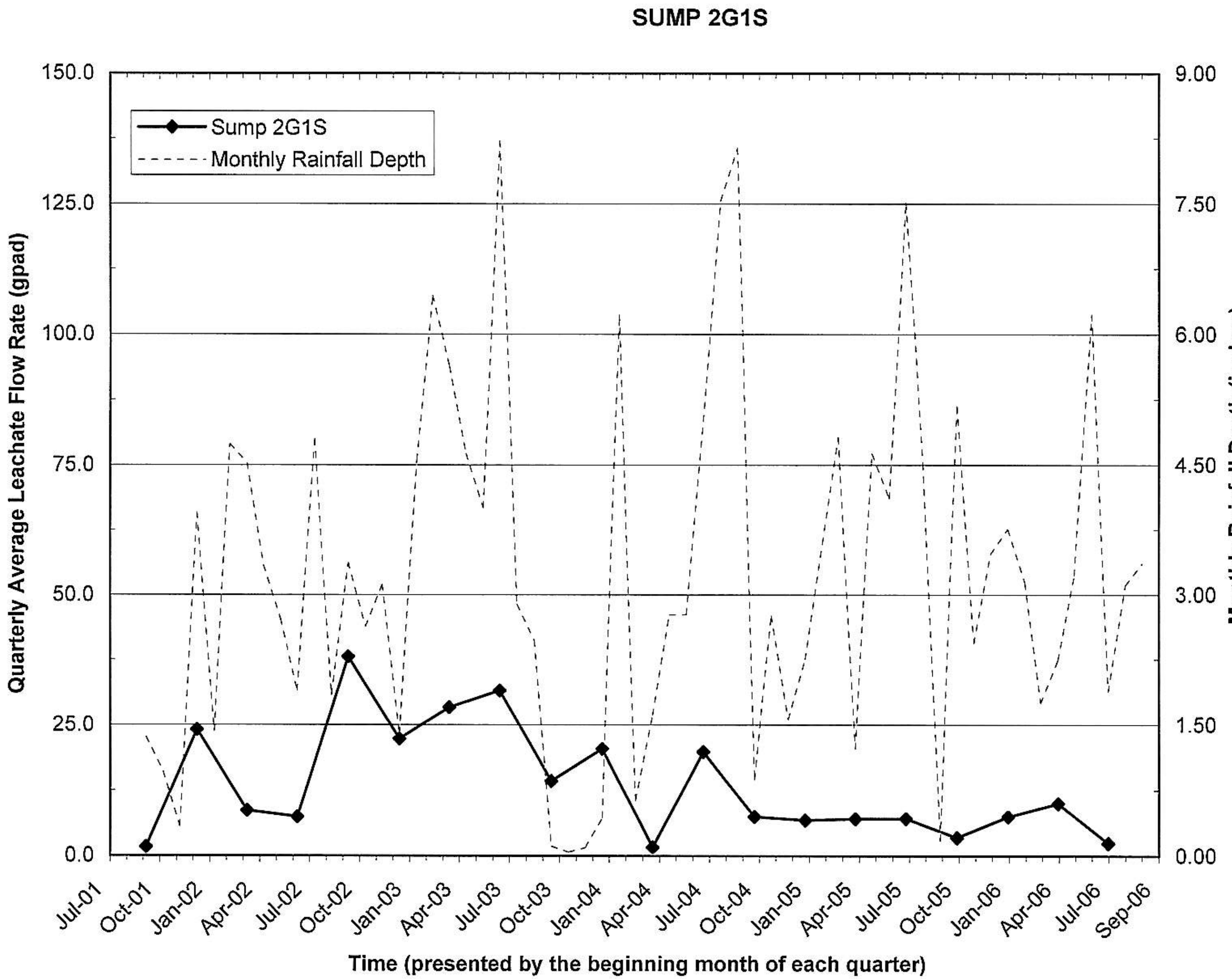

Sump 2E3S
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

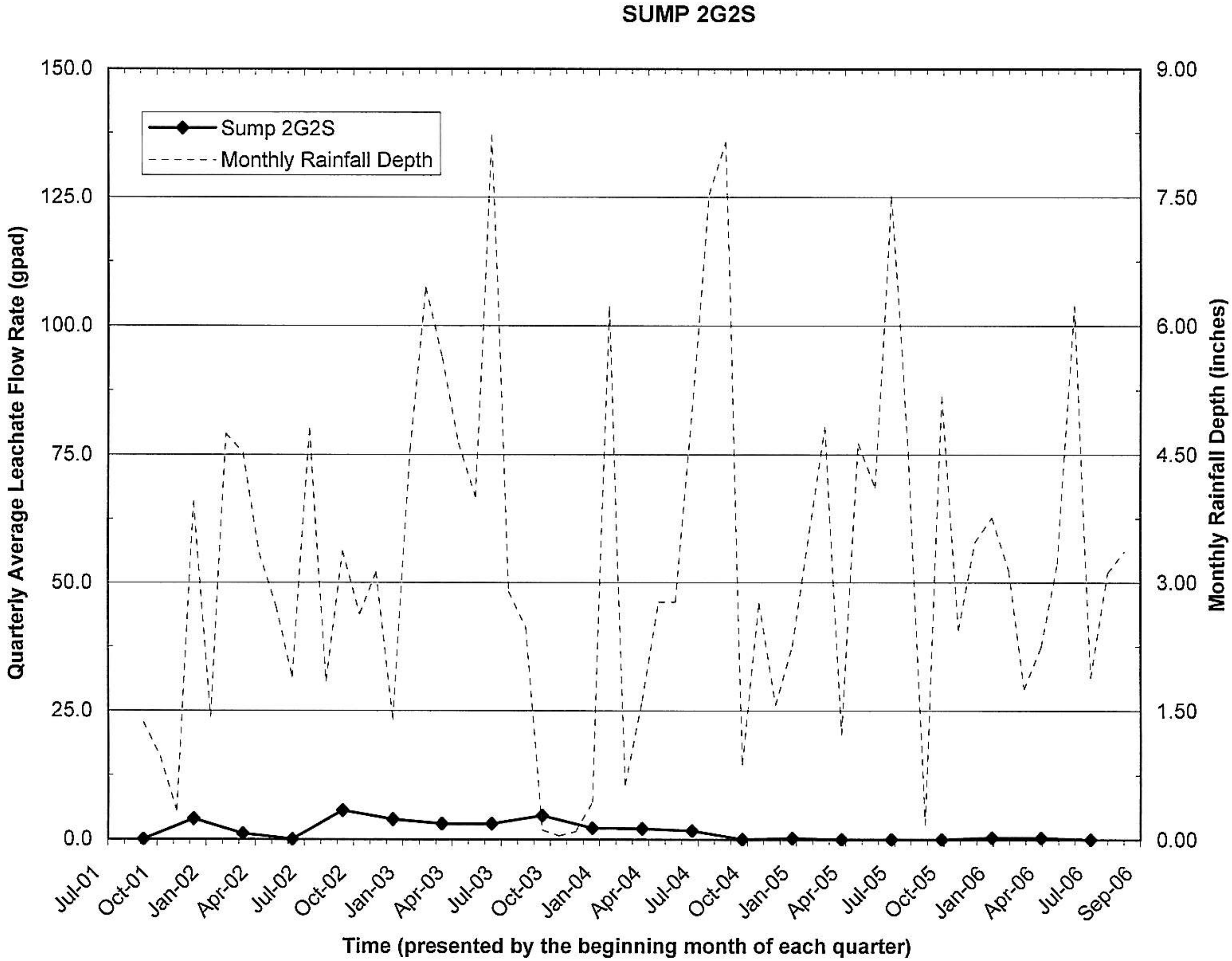

SUMP 2F1S
Sump 2F1S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)



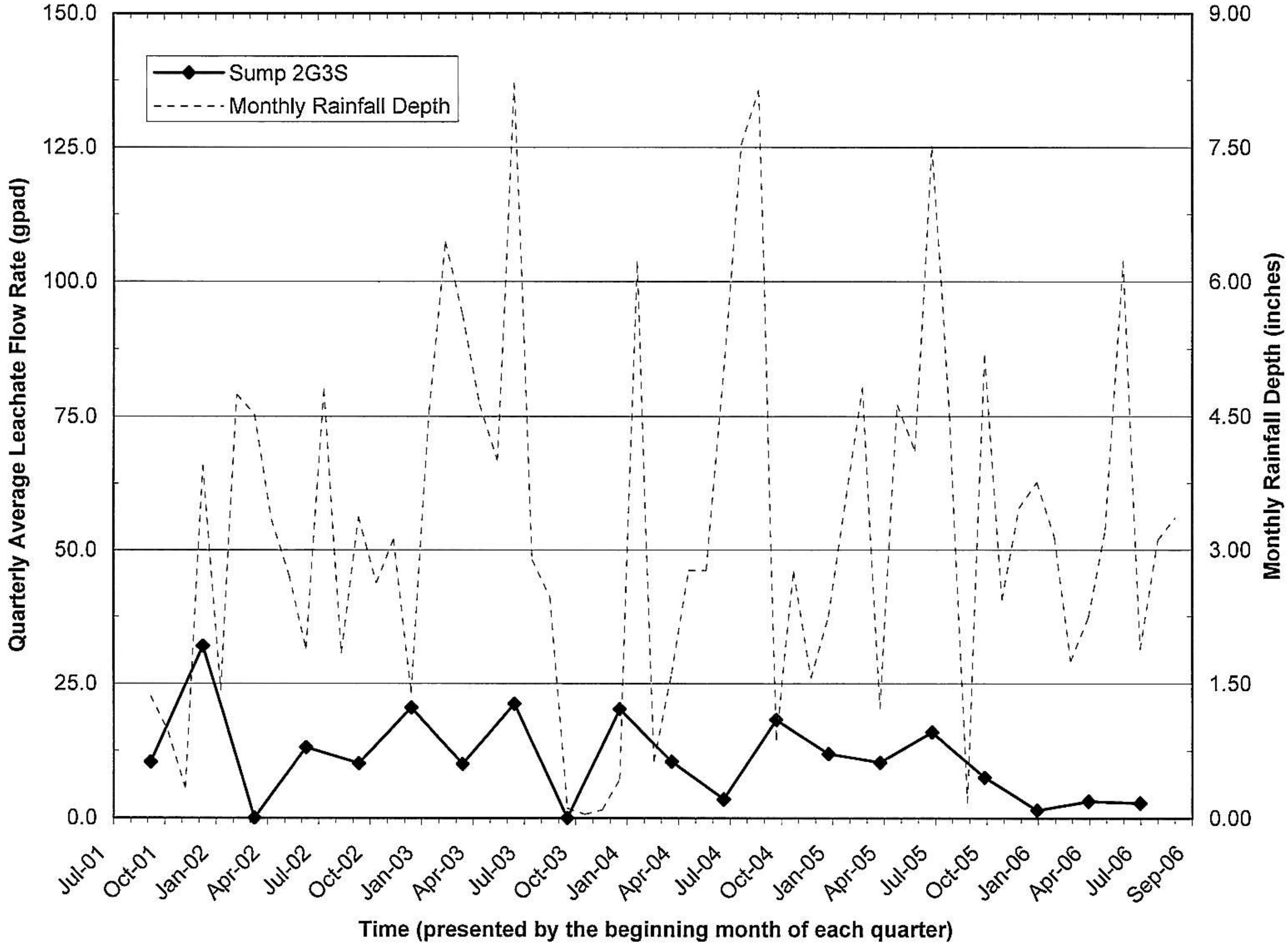
File: Section II_Quarterly Average Secondary Sump Flow Rates.xls
Sheet: 2F2S_Chart

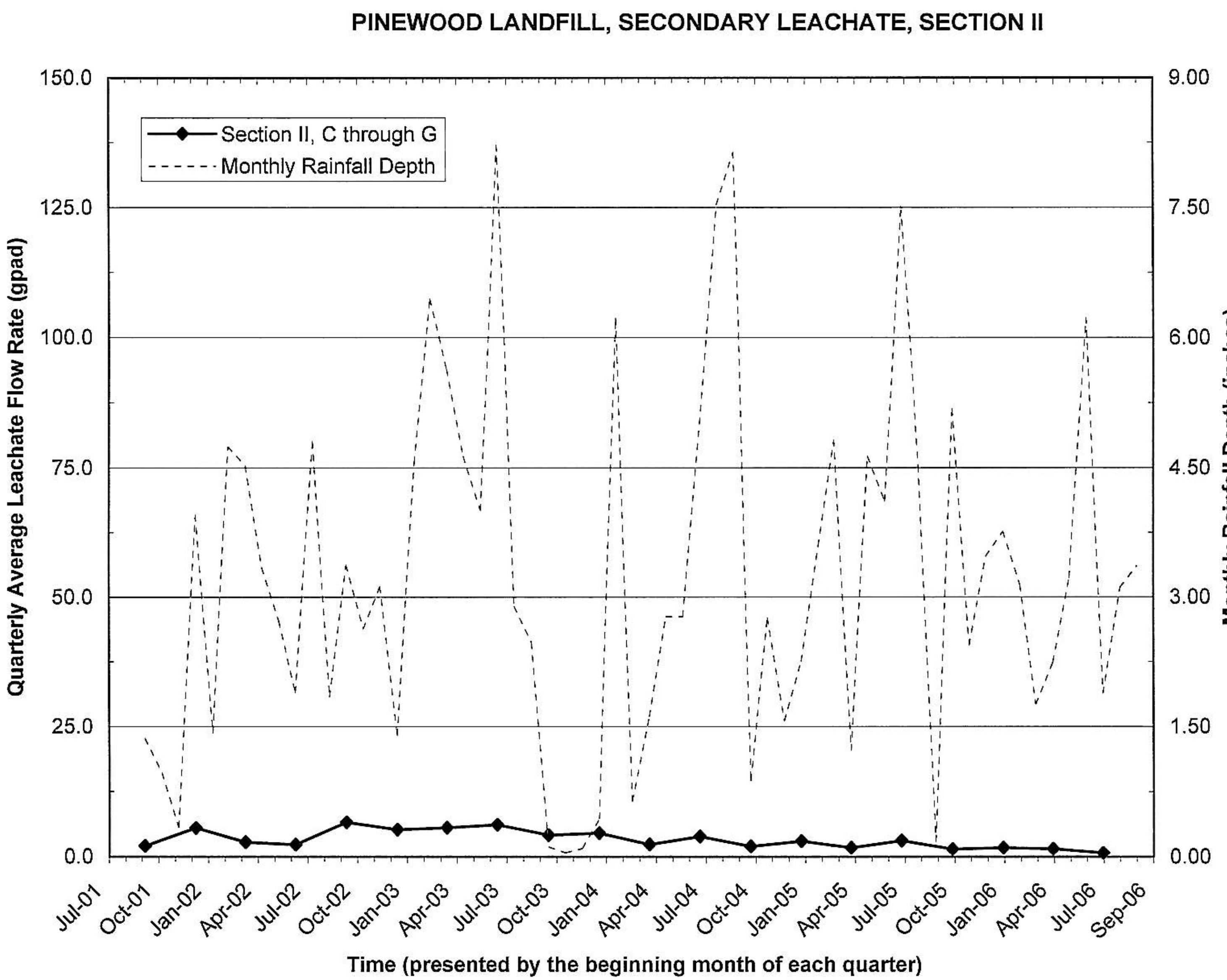

SUMP 2F3S
Sump 2F3S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 2G1S
Sump 2G1S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

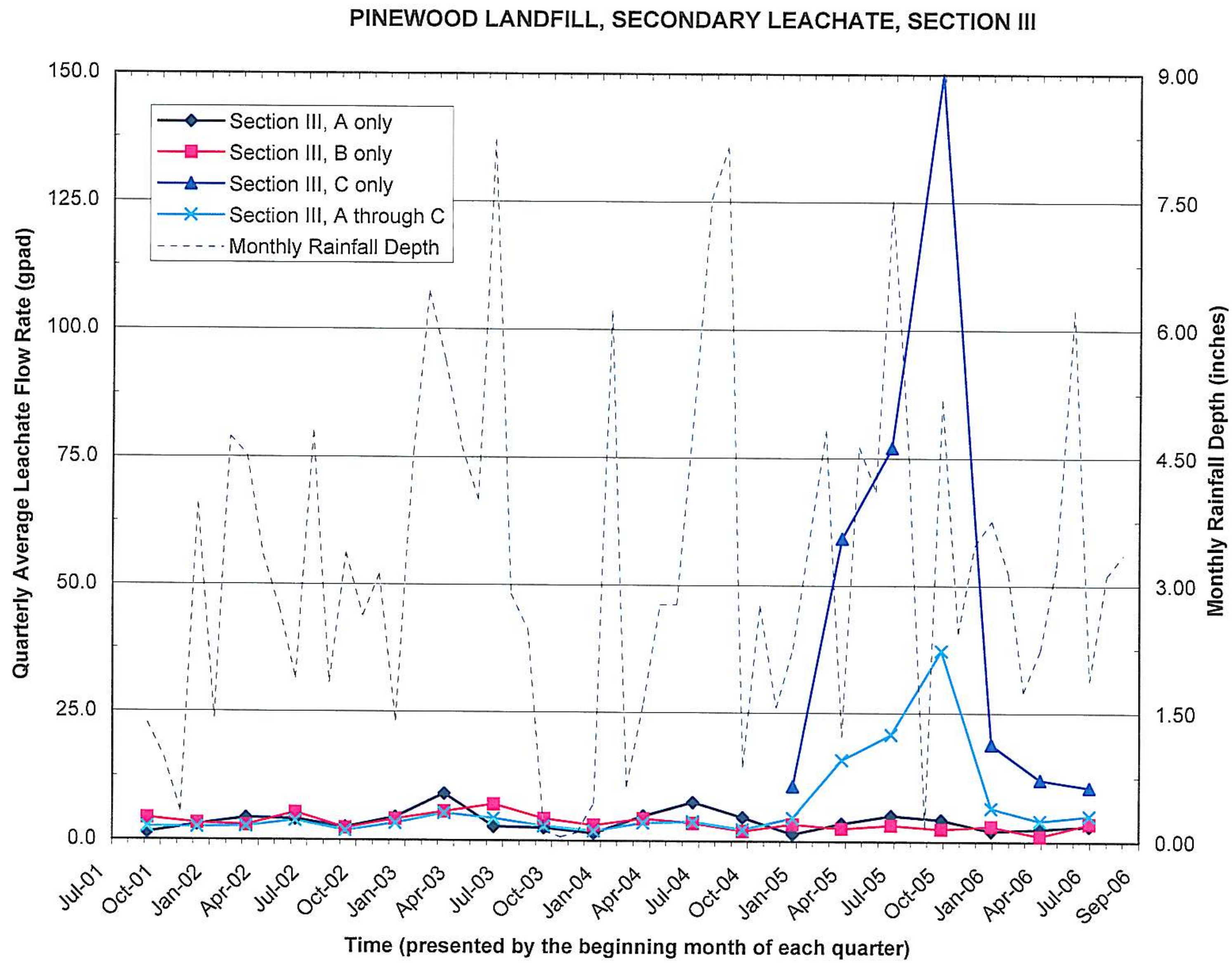

SUMP 2G2S
Sump 2G2S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

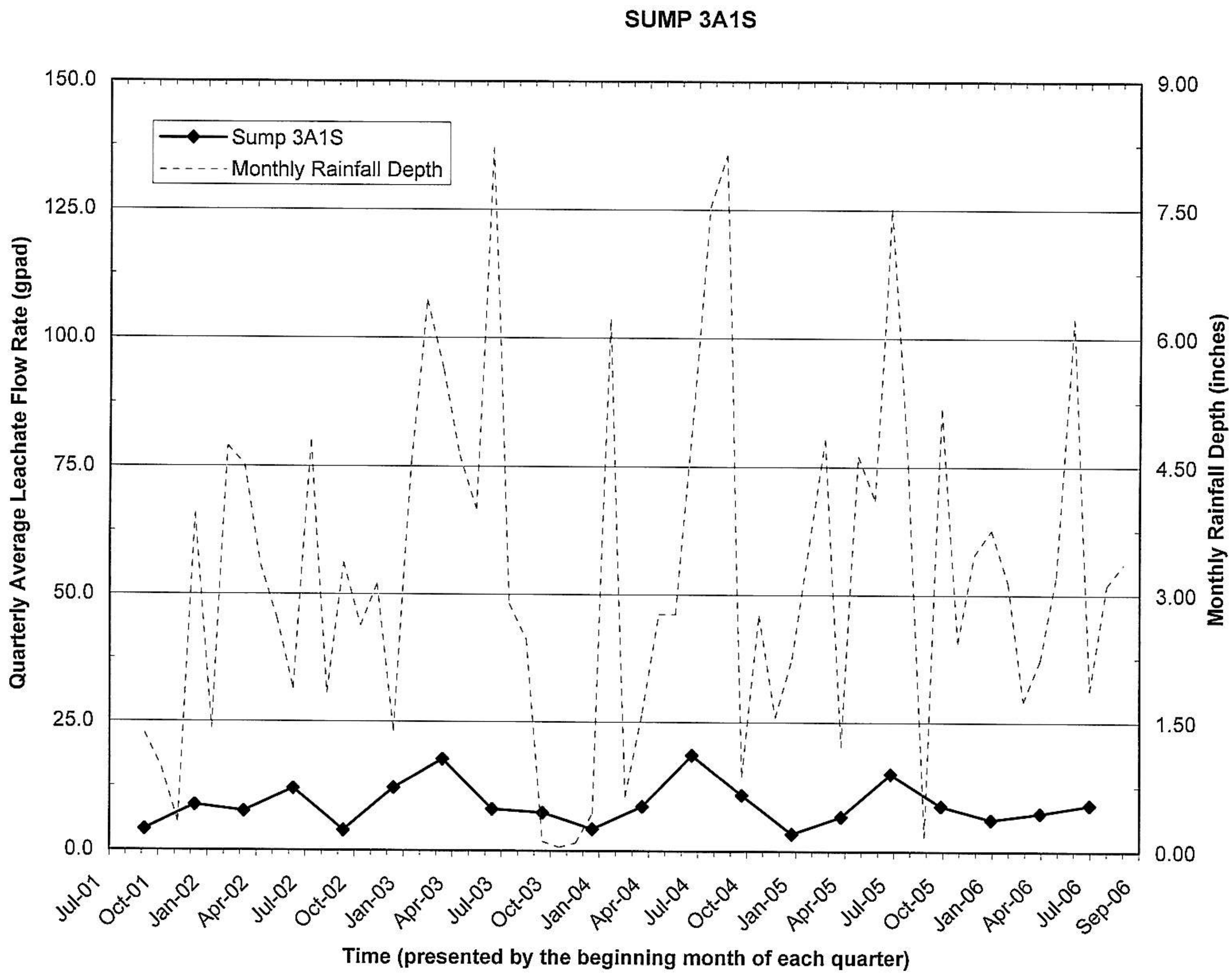
SUMP 2G3S


Sump 2G3S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

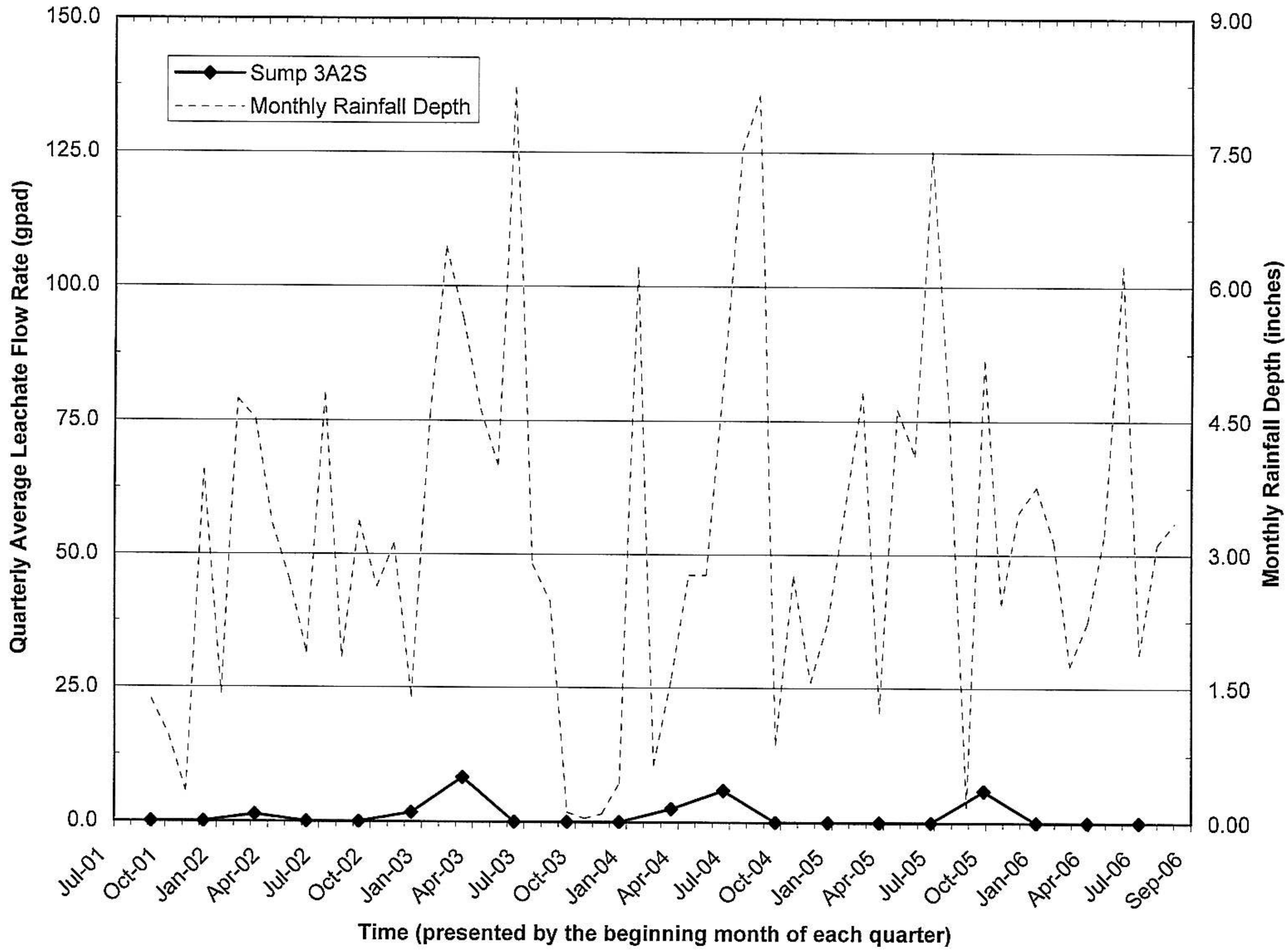

PINEWOOD LANDFILL, SECONDARY LEACHATE, SECTION II
Section II, C through G
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

Section III

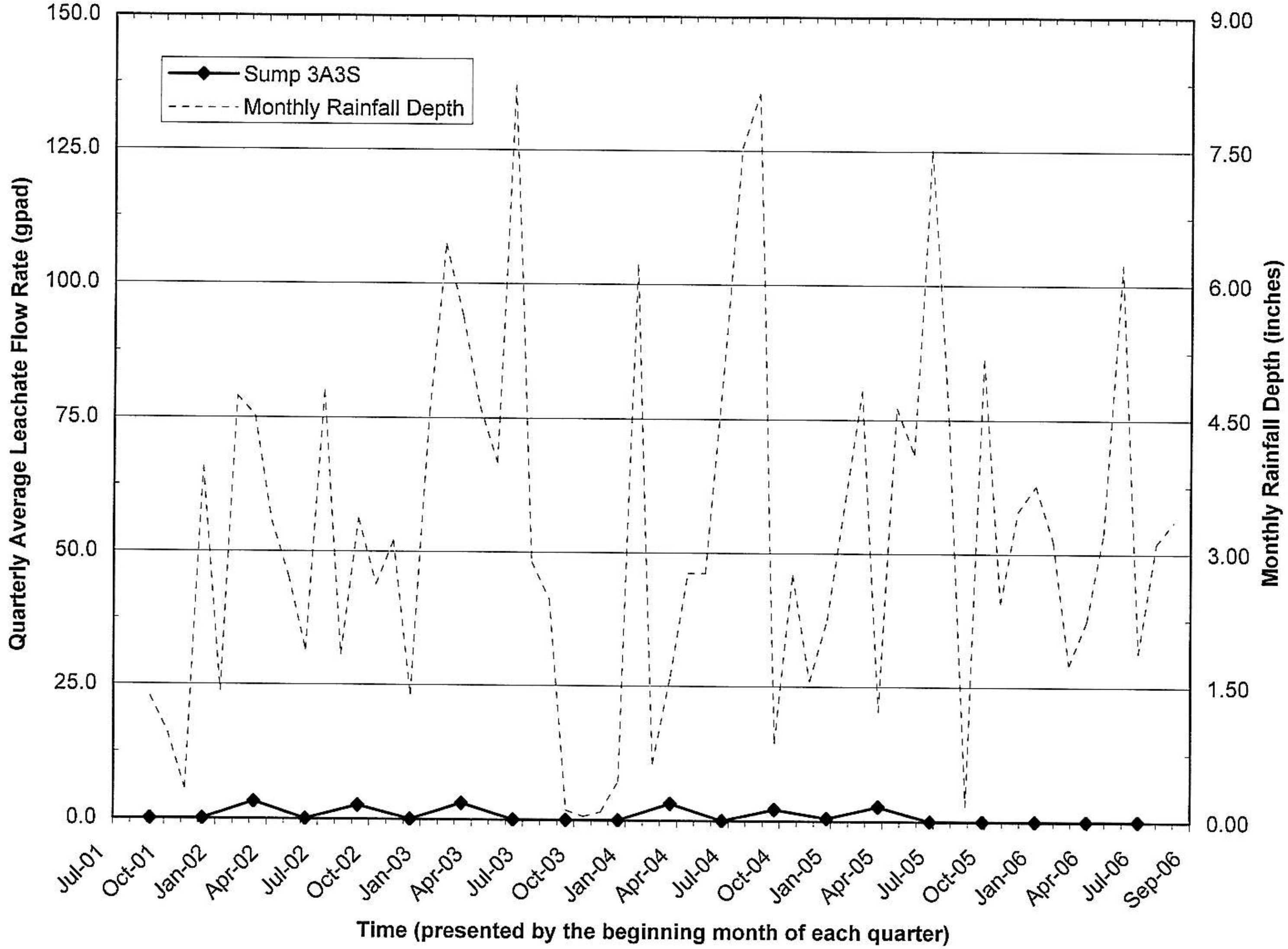

PINEWOOD LANDFILL, SECONDARY LEACHATE, SECTION III
Section III, A only
Section III, B only
Section III, C only
Section III, A through C
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

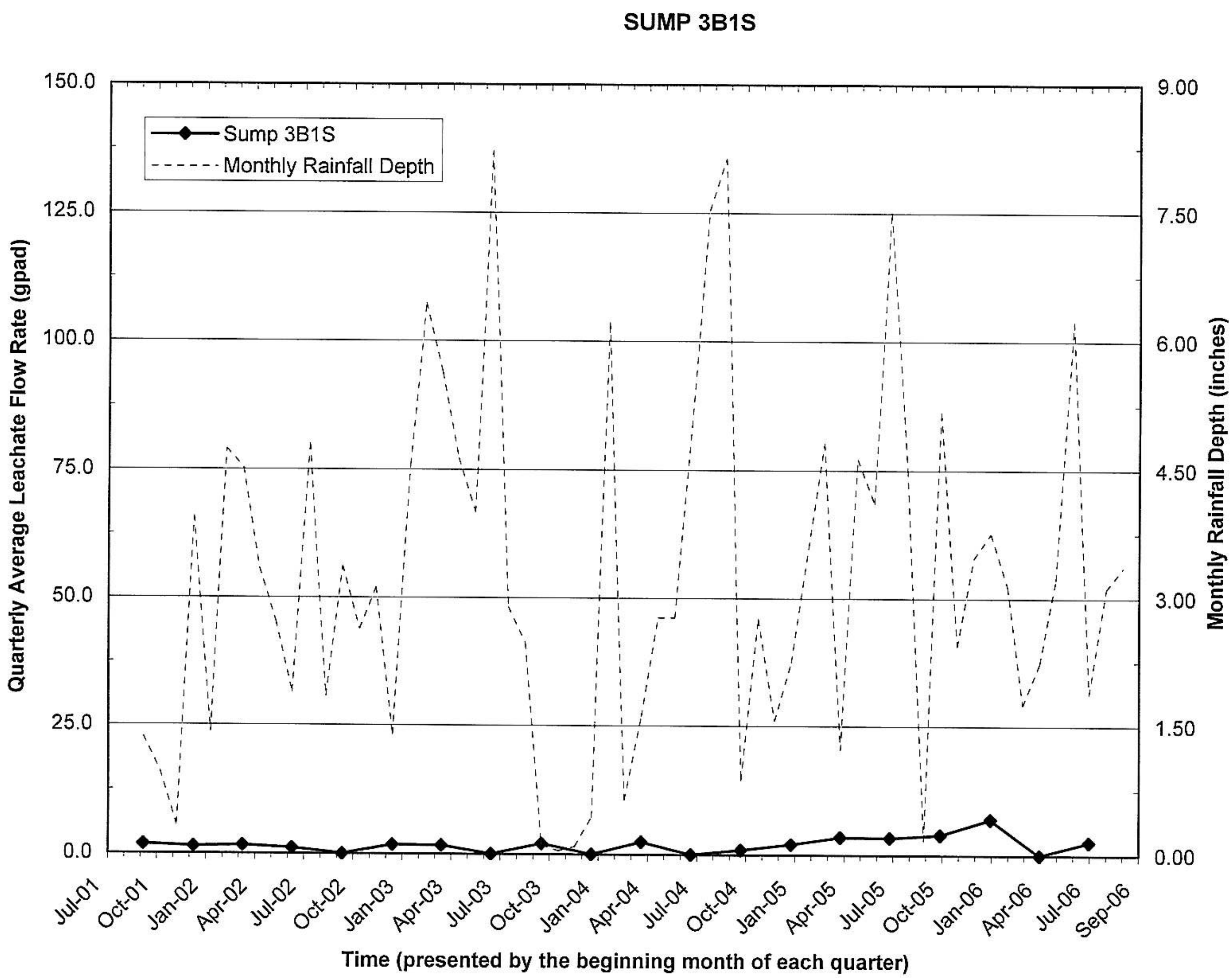

SUMP 3A1S
Sump 3A1S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

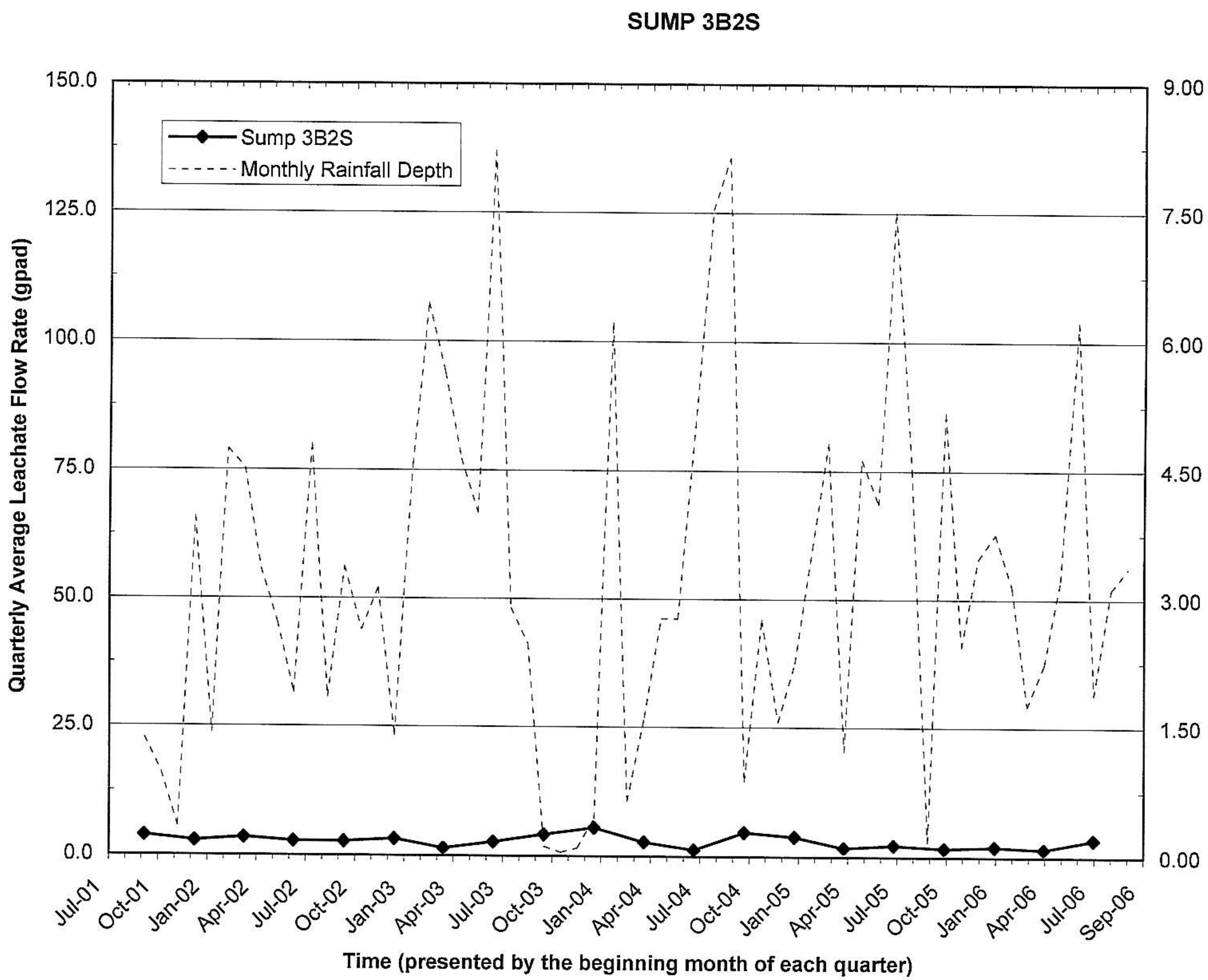
SUMP 3A2S


Sump 3A2S
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

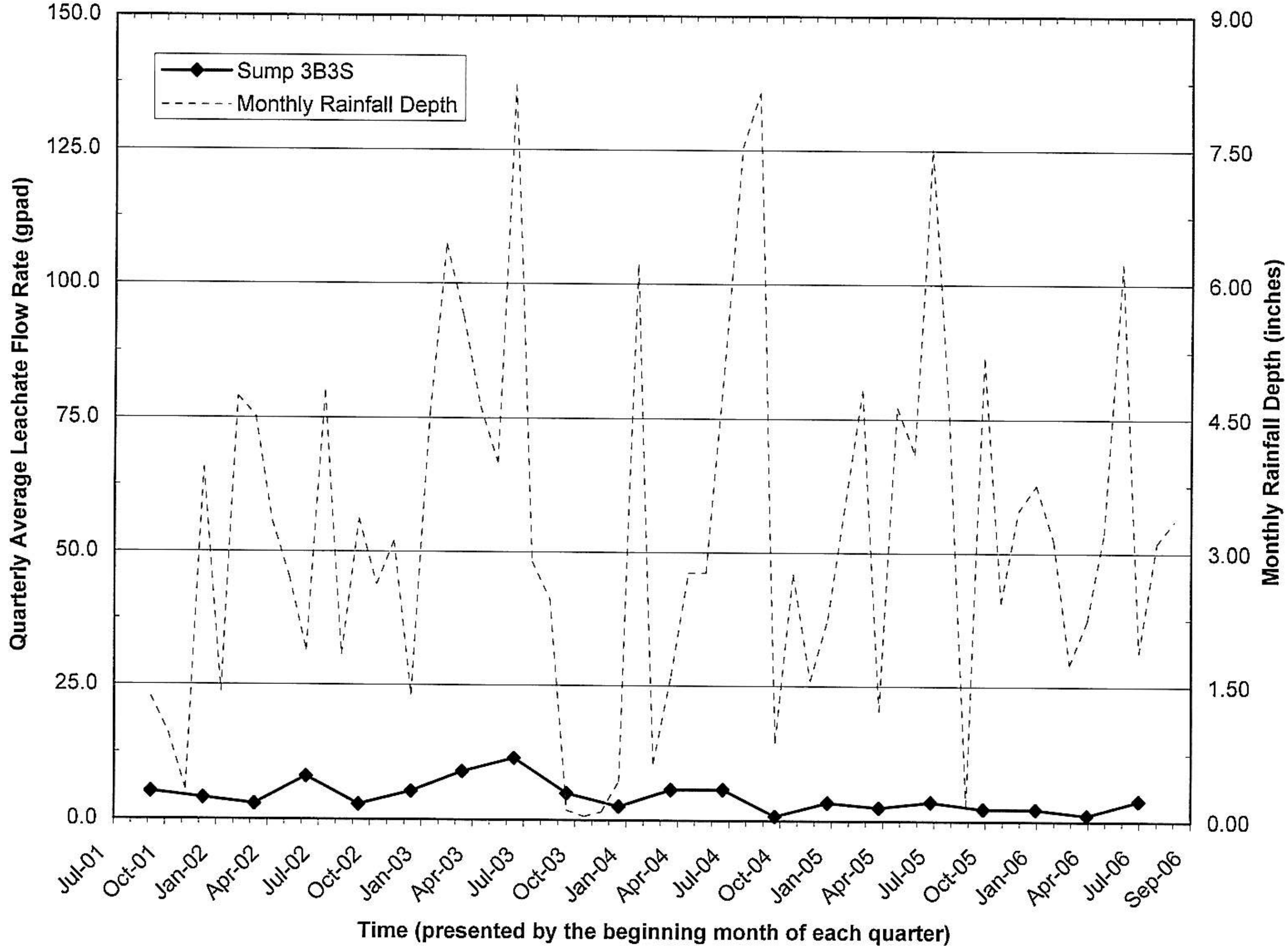
SUMP 3A3S


Sump 3A3S
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 3B1S
Sump 3B1S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)


SUMP 3B2S
Sump 3B2S
Monthly Rainfall Depth
Quarterly Average Leachate Flow Rate (gpad)
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Monthly Rainfall Depth (inches)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Jul-01 Oct-01 Jan-02 Apr-02 Jul-02 Oct-02 Jan-03 Apr-03 Jul-03 Oct-03 Jan-04 Apr-04 Jul-04 Oct-04 Jan-05 Apr-05 Jul-05 Oct-05 Jan-06 Apr-06 Jul-06 Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3B3S



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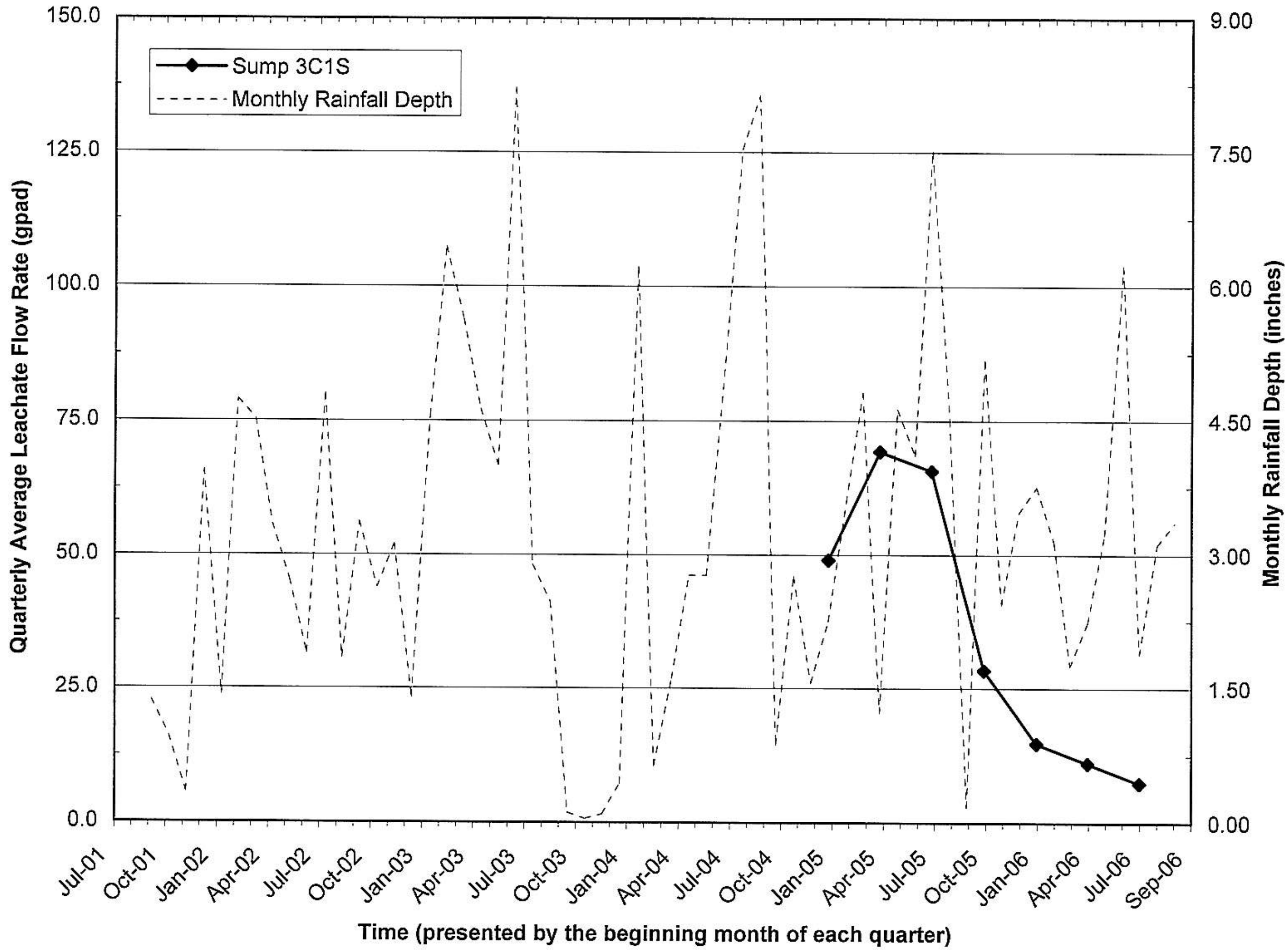
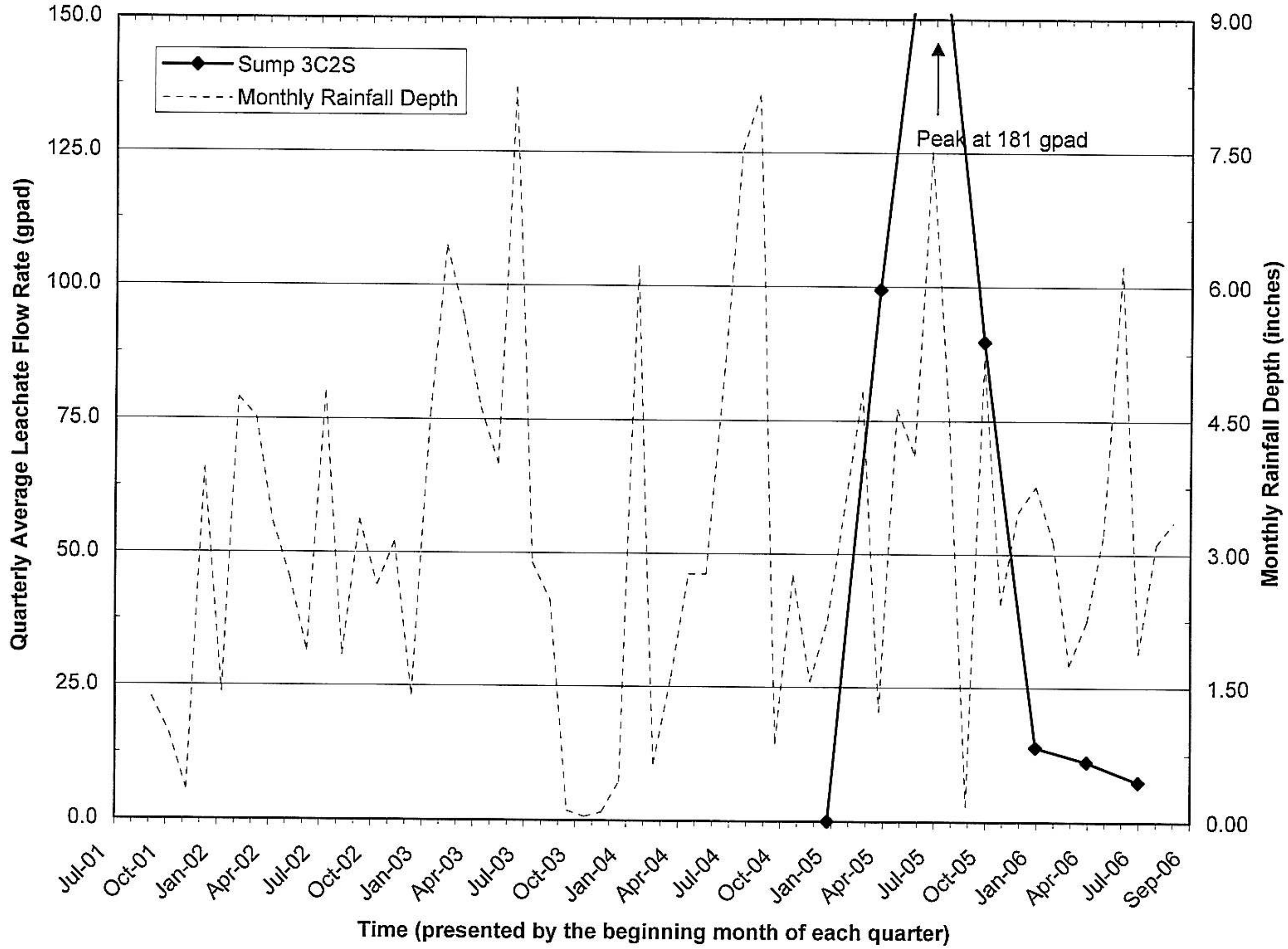
Sheet: 3B3S_Chart

SUMP 3C1S


Sump 3C1S
Monthly Rainfall Depth
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Quarterly Average Leachate Flow Rate (gpad)
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

SUMP 3C2S


Sump 3C2S
Monthly Rainfall Depth
Peak at 181 gpad
150.0
125.0
100.0
75.0
50.0
25.0
0.0
9.00
7.50
6.00
4.50
3.00
1.50
0.00
Quarterly Average Leachate Flow Rate (gpad)
Monthly Rainfall Depth (inches)
Jul-01
Oct-01
Jan-02
Apr-02
Jul-02
Oct-02
Jan-03
Apr-03
Jul-03
Oct-03
Jan-04
Apr-04
Jul-04
Oct-04
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Sep-06
Time (presented by the beginning month of each quarter)

APPENDIX B

Groundwater Flow Evaluation

Golder Associates	Subject: Groundwater flow Evaluation					
	Job No.	063-3496A	By:	CJW	Date	Page 1 of 5 1/11/2007
	Ref.	Kestrel Pinewood LF, SC	Chk'd:	cmm	Sheet	
			Rev:	GHC		

OBJECTIVE

Evaluate the potential for Groundwater flow into each Cell, based on the construction as-built information and groundwater levels available.

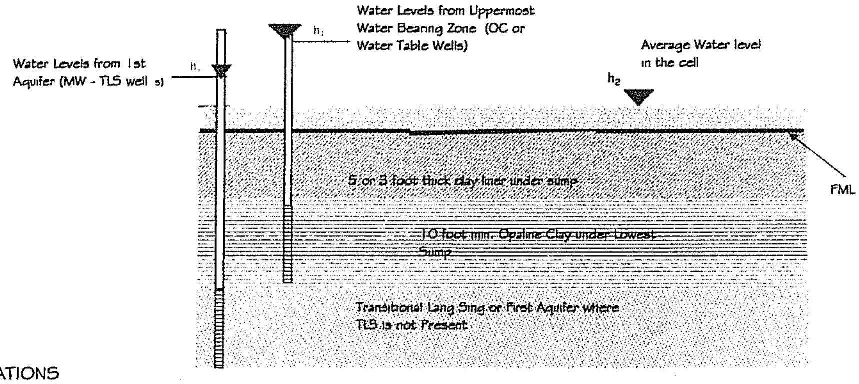
APPROACH

1. Obtain the average elevation of the top of the liner (primary or secondary if one was built) from construction/design information available. Obtain groundwater elevations (use last 5 years) from wells screened (below each Cell) in the upper aquifer (Transitional Lang Sine) or water bearing unit (Opaline Clay) located near each Cell from the Groundwater Detention Monitoring Reports.

2. Use Darcy's Law of Flow to estimate the quantity of groundwater flow through each Cell.

GROUNDWATER INFORMATION

See summary of groundwater elevations on Groundwater Reference Tables, sheet 5 of 5.



CALCULATIONS

The following calculation is an example of how Darcy's Law is used in this calculation package to estimate groundwater flow into the Cells and the time this may take.

Darcy Flow:

$Q = k \times i \times A$

Q = rate of flow (cm3/sec)

k = coefficient of permeability of the liner system (see attached equivalent permeability calculation).

i = $(h_1 - h_2)/L$ where h_1 and h_2 are the elevations of the GW from the aquifer and at the top of the Cell.

A = flow Area (Cell area)

The flow path L, in the equation above, is the thickness of the liner for that respective Cell (either 3 or 5 feet). Water levels in the Opaline Clay are only available around Section I, therefore it is assumed that the water levels in the TLS wells are representative of the water levels in the Opaline clay for Sections II and III

Example of Calculation (see table for calculation at each Cell)

For a 5 foot thick liner (assume Δh = 3 feet), the following illustrates the calculation performed:

Q_{flow} = $K{*}i{*}A$ = 9.53E-09 cm/sec x 3/5 *A = 5.72E-09 cm/sec*A

4.94E-04 cm/day*A

1.62E-05 ft/day*A

For 1 acre (43560 sq. ft.) Q_{flow} = 0.71 ft3/day or 5.28 gallons per acre per day (gapd)

Golder Associates	Subject: Groundwater flow Evaluation					
	Job No.	063-3496A	By:	CJW	Date	1/11/2007
	Ref.	Kestrel Pinewood LF, SC	Chk'd:	cmm	Sheet	Page 3 of 5
			Rev:	GHC		

Calculation table (Section 2C to 2G Secondary Cells):

Liner hydr. Conductivity k = 3.11E-09 cm/sec - see equiv. liner calculation for 3 ft thick liner

L= Liner thickness = 3.00 ft

Cell bottom Area = 43,560.00 sq. ft. Sump Elevation is approximately floor elevation minus 4 ft.

Cell ID(1)	Cell Base Elevation (average) (ft)	Min. Groundwater Elevation (2) (ft)	Max. Groundwater Elevation (2) (ft)	Min. GW flow Rate (gpad)	Max. GW flow Rate (gpad)	Referenced GW Wells
IIC, 1S	90	97	108	6.7	16.8	MW48TR
IIC, 2S	90	95	101	4.3	10.8	MW48TR/27BTR
IIC, 3S	90	92	95	1.9	4.8	MW27BTR
IID,1S	101	102	107	1.0	5.7	OC8
IID.2S	101	102	107	1.0	5.7	OC8
IID.3S	101	102	107	1.0	5.7	OC8
IIE,1S	95	90	99	NA	3.4	OC8T/MW89T
IIE.2S	95	90	99	NA	3.4	OC8T/MW89T
IIE,3S	91	90	99	NA	7.2	OC8T/MW89T
IIF,1S	92	90	99	NA	6.2	OC8T/MW89T
IIF,2S	92	90	99	NA	6.2	OC8T/MW89T
IIF,3S	88	90	99	1.9	10.1	OC8T/MW89T
IIG.1S	88	108	110	19.2	21.1	MW81T
IIG.2S	89	78	90	NA	1.0	MW89T
IIG,3S	86	78	90	NA	3.8	MW89T

Calculation table (Section 3 Secondary Cells):

Liner hydr. Conductivity k = 3.11E-09 cm/sec - see equiv. liner calculation for 3 ft thick liner

L= Liner thickness = 3 ft

Cell bottom Area = 43,560.00 sq. ft. Sump Elevation is approximately floor elevation minus 3 ft.

Cell ID(1)	Cell Base Elevation (average) (ft)	Min. Groundwater Elevation (2) (ft)	Max. Groundwater Elevation (2) (ft)	Min. GW flow Rate (gpad)	Max. GW flow Rate (gpad)	Referenced GW Wells
IIIA,1S	66	79	90	12.4	23.0	MW101T
IIIA,2S	64	78	90	13.4	24.9	MW89T
IIIA,3S	70	78	90	7.7	19.2	MW89T
IIIB,1S	73	79	90	5.7	16.3	MW101T
IIIB,2S	59	79	90	19.2	29.7	MW101T
IIIBX, 3S	68	78	90	9.1	21.1	MW116T
IIIC, 1S	83	79	90	.	6.7	MW101T
IIIC, 2S	70	79	90	8.6	19.2	MW101T

(1) Cell IDs follows the Cell where it is located. P designates a primary Cell and S designates a Secondary Cell

(2) Last 5 years minimum and maximum groundwater elevations near each specific Cell.

Golder Associates	Subject: Groundwater flow Evaluation				
	Job No. 063-3496A	By:	CJW	Date	~~Page 5 of 5~~ 1/11/2007
	Ref. Kestrel Pinewood LF, SC	Chk'd:	cmm	Sheet	
		Rev:	GHC		

Groundwater Reference Tables:

(based on last 5 years GW data in applied wells)

Section I

Well ID	Min. GW Elevation	Time @ Min. GW El.	Max. GW Elevation	Time @ Max. GW El.	Near by Sumps	Screened Elv. (ft)
WT32	118.00	Oct-05	120.2	Jul-03	1D1	
WT 27	107.50	Dec-05	114.00	Apr-03	1A1	
OC9	99.50	Feb-03	100.5	Jan-04/Apr-05	1E3	85to 95
OC6	93.00	Oct-02	98.0	Dec-03	1E3	79 to 84
OC4	97.00	Oct-02	102.0	Jan-04	1D3/1E3	77 to 82
OC16	103.00	Jan-06	110.5	May-03	1E1	82 to 92
OC15	107.50	Oct-05	110.0	Mar-03	1C1	78.5 to 88
OC14	97.50	Jan-06	102.50	May-03	1B1	74 to 83
OC13	95.00	Aug-05	105.00	Dec-03	1A1	82 to 92
OC12	99.50	Jul-05	104.0	Feb-04	1A2/1A3	84 to 94
OC11	98.00	Sep-04	100.0	Dec-03/Mar-05	1B3/1C3	77 to 87
OC10	98.00	Sep-04/Oct-05	100.0	Dec-03	1D3	78 to 88
MW9A	N/A, GW below pea gravel base				1C3	
MW73T	89.00	Jan-06	95.0	Oct-01	1B1/1C1	
MW5A	100.00	Jan-06	102.5	Jul-03	1E3	
MW45T	96.00	Jul-05	101.0	Oct-03	1A3/1A4	
MW43T	92.00	Jul-05/Jan-06	95.0	Apr-04	1A4	
MW42TR	89.00	Dec-02/Jan-06	92.0	Oct-03	1B3	
MW16TR	90.00	Apr-05	103.5	Oct-03	1A1	
MW134T	91.50	Jan-06	98.0	Jul-03	1E1	
MW132T	102.00	Apr-02/Jan-06	104.0	Jul-03	1E1	
MW131T	101.00	Apr-02	103.0	Jul-03	1D1	

Section II

Well ID	Min. GW Elevation	Time @ Min. GW El.	Max. GW Elevation	Time @ Max. GW El.	Near by Sumps	Screened Elv. (ft)
OC8	102.00	Jan-02	107.0	Feb-03	2D1/2D2	91 to 96
MW89T	78.00	Jan-05	87.50	Jul-03	2G2/2G3	50 to 51
MW81T	108.00	Apr-05	110.00	Oct-05	2G1/2C1	68 to 73
MW61T	100.50	Oct-02	102.5	Aug-03	2D1	78 to 83
MW51T	92.00	Apr-05	110.0	Jun-03	2A1/2B1	
MW50T	91.00	Apr-05	111.0	Sep-03	2B1	69 to 74
MW49T	92.50	Apr-05	110.0	Aug-03	2B1/2C1	
MW48TR	97.00	Sep-05	107.5	Oct-03	2C1	70 to 72
MW29	94.00	Nov-01	98.0	Mar-03	2D2/2D3	
MW28A	92.50	Oct-02	97.0	Aug-03	2D3	80 to 85
MW27BTR	92.00	Oct-02	95.0	Jul-03	2C3	80 to 85
MW26ATR	87.00	Aug-02	93.5	Apr-03	2B3/2C3	80 to 85
MW24TR	84.50	Oct-02	88.5	Apr-03	2A3/2B3	
MW23ATR	84.50	Sep-02	89.0	Mar-03	2A3	76 to 81
MW22TR	85.00	Sep-02	89.0	Apr-03	2A3	
MW21	86.00	Jan-06	89.0	Oct-03	2A2/2A3	
MW20A	89.00	Oct-05	100.0	Aug-03	2A2/2B2	72 to 75
MW19A	88.50	Oct-05	105.0	Oct-03	2A1	68 to 73
MW127T	90.00	Oct-05	104.5	Oct-03	2A1/2B1	

Section III

Well ID	Min. GW Elevation	Time @ Min. GW El.	Max. GW Elevation	Time @ Max. GW El.	Near by Sumps	Screened Elv. (ft)	
MW89T	79.00	Jan-04	87.00	Jul-03	3A2/3A3	50 to 55	GW fluc. Significantly
MW81T	108.50	Apr-05	110.00	Oct-05	3C2		GW fluc. Significantly
MW116T	77.50	Jan-04	90.0	Jun-05	3B3		GW fluc. Significantly
MW101T	79.00	Dec-04	90.0	Apr-05	3C1	47 to 57	GW fluc. Significantly
PSDL1	94.00	Jan-06	98.5	Oct-01	3A3/3B1/3B2		

APPENDIX C

HELP Run

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                 HELP MODEL VERSION 3.07 (1 November 1997)                **
**                 DEVELOPED BY ENVIRONMENTAL LABORATORY                    **
**                   USAE WATERWAYS EXPERIMENT STATION                      **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:      C:\WHI\UNSAT22\data\P456.VHP\_weather1.dat
TEMPERATURE DATA FILE:        C:\WHI\UNSAT22\data\P456.VHP\_weather2.dat
SOLAR RADIATION DATA FILE:    C:\WHI\UNSAT22\data\P456.VHP\_weather3.dat
EVAPOTRANSPIRATION DATA:      C:\WHI\UNSAT22\data\P456.VHP\_weather4.dat
SOIL AND DESIGN DATA FILE:    C:\WHI\UNSAT22\data\P456.VHP\I_386016.inp
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TIME:   7:49     DATE:  11/ 6/2006


******************************************************************************

     TITLE:  EPA Cover System Model

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER WERE
              COMPUTED AS NEARLY STEADY-STATE VALUES BY THE PROGRAM.


                                   LAYER  1
                                   --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   7
           THICKNESS                  =      15.24   CM
           POROSITY                   =       0.4730 VOL/VOL
           FIELD CAPACITY             =       0.2220 VOL/VOL
           WILTING POINT              =       0.1040 VOL/VOL
           INITIAL SOIL WATER CONTENT =       0.3307 VOL/VOL
           EFFECTIVE SAT. HYD. COND.  =  0.520001164800E-03 CM/SEC
         NOTE:  SATURATED HYDRAULIC CONDUCTIVITY IS MULTIPLIED BY  5.00
                  FOR ROOT CHANNELS IN TOP HALF OF EVAPORATIVE ZONE.
```

LAYER 2

TYPE 1 - VERTICAL PERCOLATION LAYER
MATERIAL TEXTURE NUMBER 4

THICKNESS	=	60.96 CM
POROSITY	=	0.4370 VOL/VOL
FIELD CAPACITY	=	0.1050 VOL/VOL
WILTING POINT	=	0.0470 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4383 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.170000000000E-02 CM/SEC

LAYER 3

TYPE 2 - LATERAL DRAINAGE LAYER
MATERIAL TEXTURE NUMBER 1

THICKNESS	=	30.48 CM
POROSITY	=	0.4170 VOL/VOL
FIELD CAPACITY	=	0.0450 VOL/VOL
WILTING POINT	=	0.0180 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4170 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.100000000000E-01 CM/SEC
SLOPE	=	2.50 PERCENT
DRAINAGE LENGTH	=	182.9 METERS

LAYER 4

TYPE 4 - FLEXIBLE MEMBRANE LINER
MATERIAL TEXTURE NUMBER 37

THICKNESS	=	0.10 CM
POROSITY	=	0.0000 VOL/VOL
FIELD CAPACITY	=	0.0000 VOL/VOL
WILTING POINT	=	0.0000 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.0000 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.200000000000E-10 CM/SEC
FML PINHOLE DENSITY	=	7.41 HOLES/HECTARE
FML INSTALLATION DEFECTS	=	7.41 HOLES/HECTARE
FML PLACEMENT QUALITY	=	3 - GOOD

LAYER 5

TYPE 3 - BARRIER SOIL LINER
MATERIAL TEXTURE NUMBER 29

THICKNESS	=	30.48 CM
POROSITY	=	0.4510 VOL/VOL
FIELD CAPACITY	=	0.4190 VOL/VOL
WILTING POINT	=	0.3320 VOL/VOL
INITIAL SOIL WATER CONTENT	=	0.4510 VOL/VOL
EFFECTIVE SAT. HYD. COND.	=	0.680000000000E-06 CM/SEC

GENERAL DESIGN AND EVAPORATIVE ZONE DATA

NOTE: SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT SOIL DATA BASE USING SOIL TEXTURE # 7 WITH A GOOD STAND OF GRASS, A SURFACE SLOPE OF 2.% AND A SLOPE LENGTH OF 30. METERS.

SCS RUNOFF CURVE NUMBER	=	69.14	
FRACTION OF AREA ALLOWING RUNOFF	=	100.0	PERCENT
AREA PROJECTED ON HORIZONTAL PLANE	=	0.4047	HECTARES
EVAPORATIVE ZONE DEPTH	=	55.9	CM
INITIAL WATER IN EVAPORATIVE ZONE	=	22.877	CM
UPPER LIMIT OF EVAPORATIVE STORAGE	=	24.968	CM
LOWER LIMIT OF EVAPORATIVE STORAGE	=	3.495	CM
INITIAL SNOW WATER	=	0.000	CM
INITIAL WATER IN LAYER MATERIALS	=	58.213	CM
TOTAL INITIAL WATER	=	58.213	CM
TOTAL SUBSURFACE INFLOW	=	0.00	MM/YR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM Columbia SC

STATION LATITUDE	=	34.04	DEGREES
MAXIMUM LEAF AREA INDEX	=	4.50	
START OF GROWING SEASON (JULIAN DATE)	=	69	
END OF GROWING SEASON (JULIAN DATE)	=	323	
EVAPORATIVE ZONE DEPTH	=	22.0	INCHES
AVERAGE ANNUAL WIND SPEED	=	6.90	MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	67.00	%
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	69.00	%
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	77.00	%
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	73.00	%

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Columbia SC

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
4.38	3.99	5.16	3.59	3.85	4.45
5.35	5.56	4.23	2.55	2.51	3.50

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Columbia SC

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
44.70	47.10	54.50	63.80	71.50	77.70
81.00	80.20	74.80	63.40	53.90	46.70

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING COEFFICIENTS FOR Columbia SC AND STATION LATITUDE = 33.94 DEGREES

AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 20

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	4.35	3.64	5.06	3.92	3.71	5.19
	5.91	5.66	5.30	3.22	2.27	3.49
STD. DEVIATIONS	2.43	1.56	2.85	2.59	2.21	2.14
	2.89	3.05	3.06	2.64	1.32	1.73
RUNOFF						
TOTALS	0.526	0.282	0.741	0.162	0.076	0.001
	0.068	0.164	0.467	0.078	0.002	0.074
STD. DEVIATIONS	0.811	0.506	1.633	0.358	0.327	0.003
	0.190	0.523	1.364	0.240	0.005	0.262
EVAPOTRANSPIRATION						
TOTALS	1.496	1.863	3.034	4.335	5.074	5.010
	4.840	4.679	3.328	1.656	0.895	0.961
STD. DEVIATIONS	0.235	0.329	0.612	0.769	1.619	1.519
	1.568	1.298	1.245	0.524	0.123	0.209
LATERAL DRAINAGE COLLECTED FROM LAYER 3						
TOTALS	1.0296	0.9848	1.1210	1.0747	1.0308	0.9455
	0.9449	0.9282	0.8774	0.9167	0.8786	0.9358
STD. DEVIATIONS	0.2265	0.1778	0.1191	0.0746	0.0619	0.0474
	0.0475	0.1066	0.1453	0.1887	0.1943	0.2135
PERCOLATION/LEAKAGE THROUGH LAYER 5						
TOTALS	0.0222	0.0222	0.0259	0.0246	0.0202	0.0160
	0.0145	0.0143	0.0139	0.0160	0.0155	0.0175
STD. DEVIATIONS	0.0099	0.0088	0.0072	0.0049	0.0041	0.0032
	0.0030	0.0059	0.0072	0.0084	0.0078	0.0093

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 4						
AVERAGES	26.5567	28.9949	30.9940	30.4463	24.2216	19.9452
	17.4875	17.1454	17.1726	19.1764	19.2266	20.9333
STD. DEVIATIONS	11.7613	11.3580	8.5400	5.9175	4.8745	3.9386
	3.6179	7.0288	8.8063	9.9645	9.6028	11.0958

****

AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 20

	INCHES		CU. FEET	PERCENT
PRECIPITATION	51.71	(10.169)	187712.3	100.00
RUNOFF	2.641	(3.1890)	9586.03	5.107
EVAPOTRANSPIRATION	37.172	(5.4212)	134930.45	71.882
LATERAL DRAINAGE COLLECTED FROM LAYER 3	11.66804	(1.06887)	42354.061	22.56329
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.22280	(0.05197)	808.758	0.43085
AVERAGE HEAD ON TOP OF LAYER 4	22.692	(5.261)		
CHANGE IN WATER STORAGE	0.009	(4.7567)	32.99	0.018

****

****

PEAK DAILY VALUES FOR YEARS 1 THROUGH 20 and their dates (DDDYYYY)

	(INCHES)	(CU. FT.)	
PRECIPITATION	6.01	21815.82449	2740013
RUNOFF	3.641	13216.66352	2450003
DRAINAGE COLLECTED FROM LAYER 3	0.04177	151.62785	2290003
PERCOLATION/LEAKAGE THROUGH LAYER 5	0.001140	4.13976	2290003
AVERAGE HEAD ON TOP OF LAYER 4	42.000		
MAXIMUM HEAD ON TOP OF LAYER 4	55.108		
LOCATION OF MAXIMUM HEAD IN LAYER 3 (DISTANCE FROM DRAIN)	207.4 FEET		
SNOW WATER	1.75	6353.5049	140019
MAXIMUM VEG. SOIL WATER (VOL/VOL)		0.4468	
MINIMUM VEG. SOIL WATER (VOL/VOL)		0.0625	

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

****

****

FINAL WATER STORAGE AT END OF YEAR 20

LAYER	(INCHES)	(VOL/VOL)
1	2.1659	0.3610
2	10.5185	0.4383
3	5.0040	0.4170
4	0.0000	0.0000
5	5.4120	0.4510
SNOW WATER	0.000	

****
****

APPENDIX D

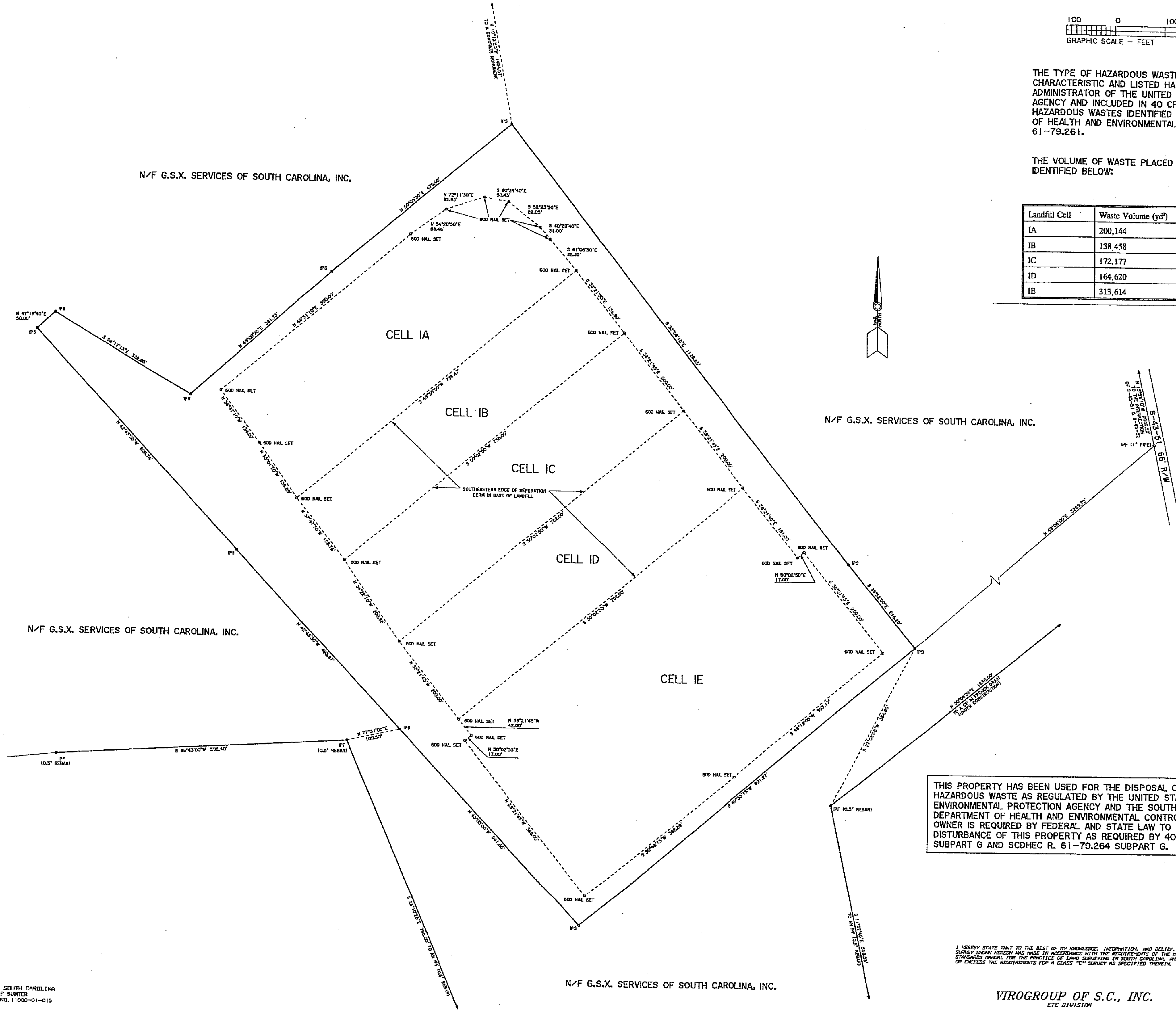
Select Reference Figures

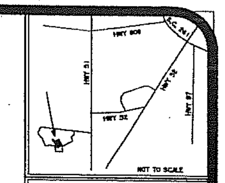
APPENDIX D-1

Select Section I Figures

01044

100 0 100 200 300
GRAPHIC SCALE – FEET 1" = 100'





LOCATION MAP

THE TYPE OF HAZARDOUS WASTE DISPOSED WITHIN EACH CELL INCLUDES CHARACTERISTIC AND LISTED HAZARDOUS WASTES AS IDENTIFIED BY THE ADMINISTRATOR OF THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND INCLUDED IN 40 CFR 261, AND CHARACTERISTIC AND LISTED HAZARDOUS WASTES IDENTIFIED BY THE SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL AND INCLUDED IN R. 61-79.261.

THE VOLUME OF WASTE PLACED INTO EACH LANDFILL CELL IS AS IDENTIFIED BELOW:

Landfill Cell	Waste Volume (yd^3)	Waste Volume (Ac-ft)
IA	200,144	124.1
IB	138,458	85.8
IC	172,177	106.7
ID	164,620	102.0
IE	313,614	194.4

LEGEND:
IPF = IRON PIN FOUND
IPS = IRON PIN SET (0.5" REBAR)
CM = CONCRETE MONUMENT
o = CALCULATED POINT
—x—x— = FENCE
N/F = NOW OR FORMERLY

REFERENCE PLATS:

PLAT PREPARED FOR GSX SERVICES OF S.C., INC., BY ROBERT G. MATHIS DATED JULY 24, 1987 RECORDED IN PLAT BOOK 89 PAGE 398.
ALSO, PLAT PREPARED FOR DARGAN P. ELLIOTT BY W. B. SYKES DATED AUGUST 7, 1963, RECORDED IN PLAT BOOK Z 27 PAGE 80. ALSO, PLAT PREPARED FOR GSX SERVICES OF S.C., INC., BY ENVIRONMENTAL TECHNOLOGY ENGINEERING, INC., DATED MAY 12, 1992, RECORDED IN PLAT BOOK 92 PAGE 912.

NOTES:

1. NO IMPROVEMENTS SHOWN.

2. 600 NAILS WERE SET IN LIEU OF 24" LONG MONUMENTS TO PREVENT POSSIBLE DAMAGE TO THE LINER SYSTEM.

3. ALL DIVISION LINES WERE ESTABLISHED FROM AS-BUILT PLANS PREPARED BY ROBERT G. MATHIS, RLS #8371.

4. SECTION I CONTAINS 29.85 ACRES.

THIS PROPERTY HAS BEEN USED FOR THE DISPOSAL OF HAZARDOUS WASTE AS REGULATED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AND THE SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL. THE OWNER IS REQUIRED BY FEDERAL AND STATE LAW TO RESTRICT DISTURBANCE OF THIS PROPERTY AS REQUIRED BY 40 CFR 264 SUBPART G AND SCDHEC R. 61-79.264 SUBPART G.

STATE OF SOUTH CAROLINA
COUNTY OF SUMTER
TAX MAP NO. 11000-01-015

I HEREBY STATE THAT TO THE BEST OF MY KNOWLEDGE, INFORMATION, AND BELIEF, THE SURVEY SHOWN HEREON WAS MADE IN ACCORDANCE WITH THE REQUIREMENTS OF THE MINIMUM STANDARDS MANUAL FOR THE PRACTICE OF LAND SURVEYING IN SOUTH CAROLINA, AND MEETS OR EXCEEDS THE REQUIREMENTS FOR A CLASS "C" SURVEY AS SPECIFIED THEREIN.

VIROGROUP OF S.C., INC.
ETE DIVISION
1445 Pisgah Church Road
Lexington, S.C. 29072
TEL. 803-957-6270

DENNIS G. JOHNS, P.L.S. REG. NO. 8102

Virogroup of S.C., Inc. – ETE Division
Consulting Engineers, Surveyors, and Hydrogeologists
1445 Pisgah Church Road, Lexington, S.C., 29072
(803) 957-6270

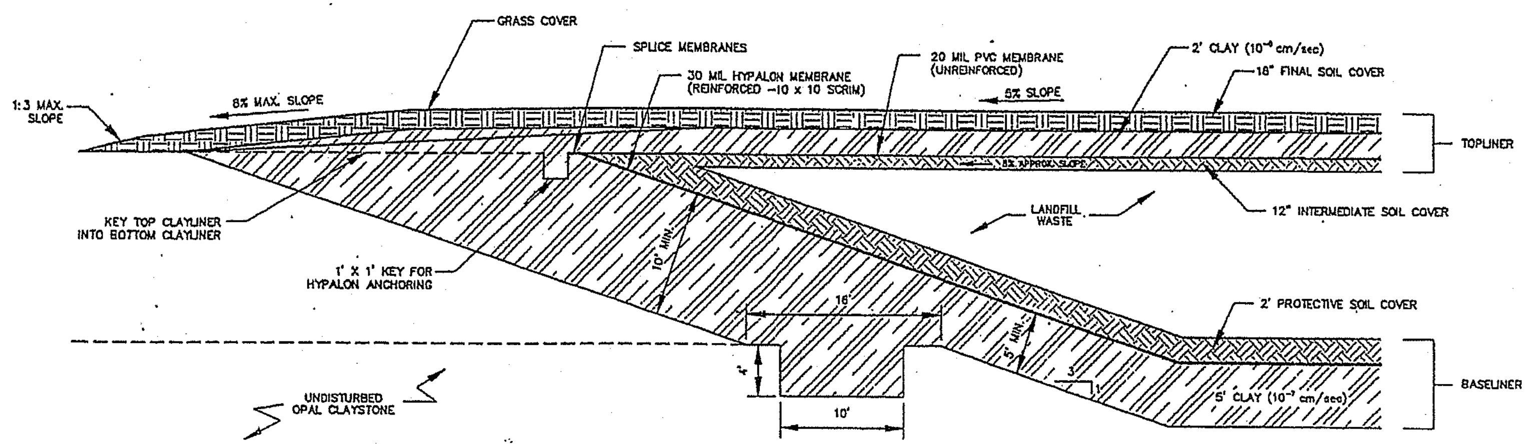
PLAT PREPARED FOR
LAIDLAW ENVIRONMENTAL SERVICES OF SOUTH CAROLINA, INC.

SOUTH CAROLINA CERTIFICATE OF AUTHORIZATION VIROGROUP OF S.C., INC. NO. 000712

LANDFILL SECTION I

DRAWN BY:	MHH	DATE:	MAY 11, 1994
DESIGNED BY:		CADD NO.:	22588.CRD SEC2BOUN.PLT
APPROVED BY:	DGJ	PROJECT NO.:	12-02164.35
SCALE:	1" = 200'	SHEET NO.:	1 OF 1

B



BASELINER AND TOPLINER SYSTEM

N.T.S.

NO.	REVISION	DATE	BY

ViroGroup Air • Water • Soil TECHNOLOGY

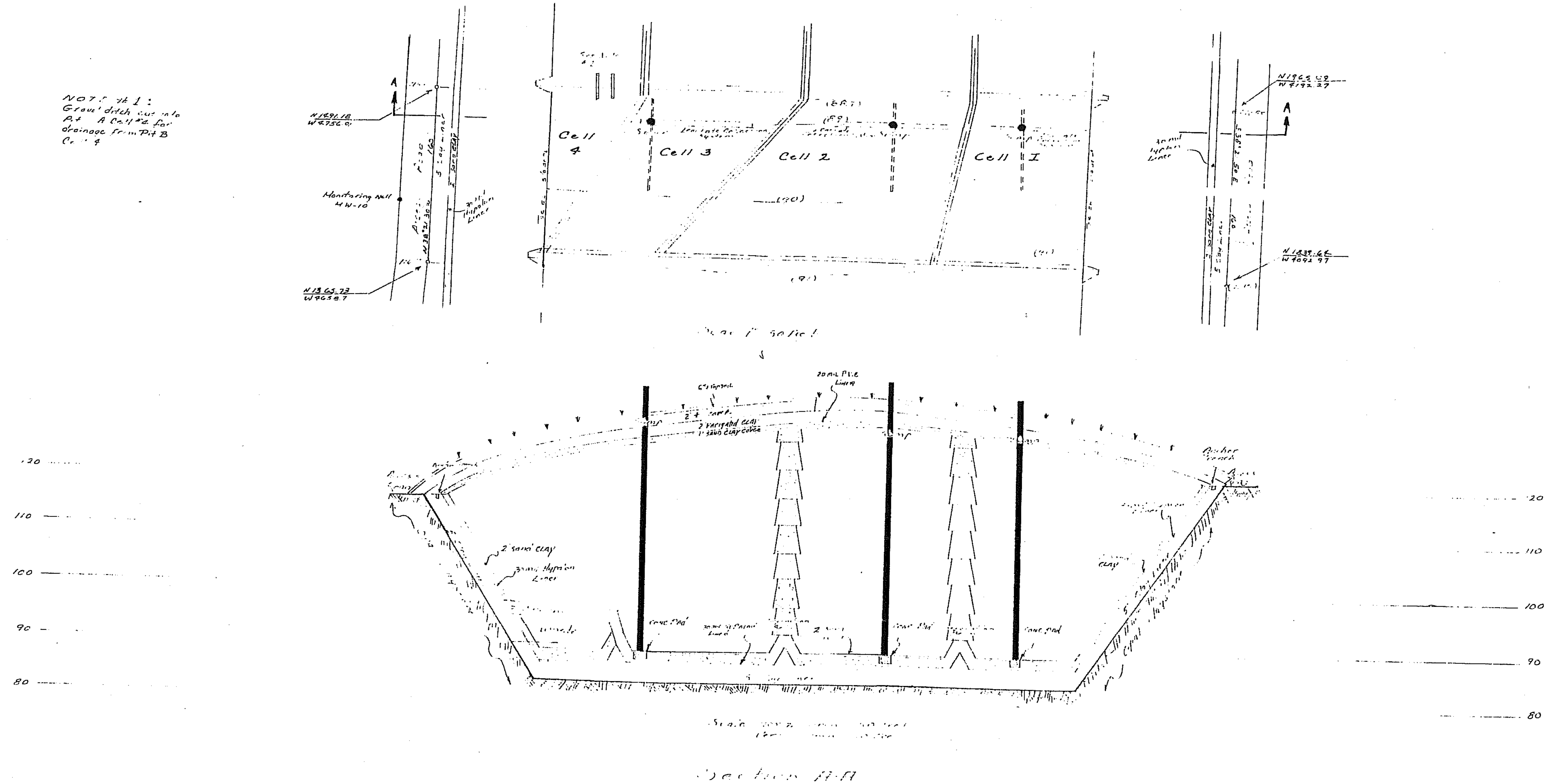
ViroGroup, Inc.
1443 Fleet Church Road
Ladyston, SC 29072
Phone 803-957-1370
FAX 803-957-3446
Watts 1-800-706-0654

LAIDLAW

PINEWOOD SECURE LANDFILL
PINEWOOD, SOUTH CAROLINA

TYPICAL CROSS-SECTION
LANDFILL SECTION I

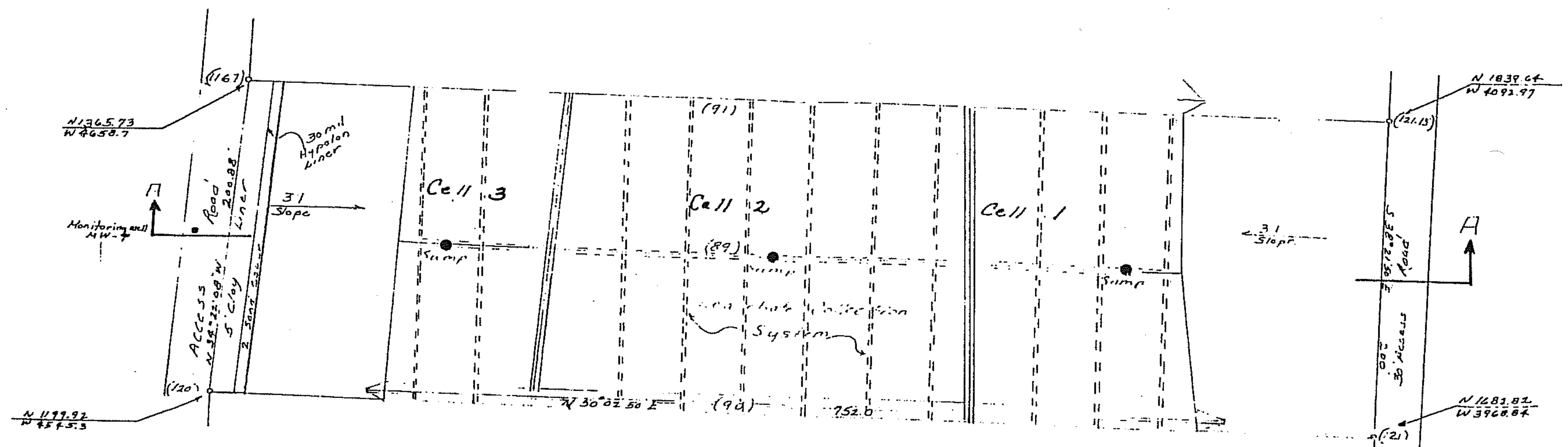
DRAWN BY:	CAB	DATE:	8/24/95
CHECKED BY:	DML	CADD NO.	SECT1
APPROVED BY:		PROJECT NO.	
SCALE:	N.T.S.	SHEET NO.	1 OF 4



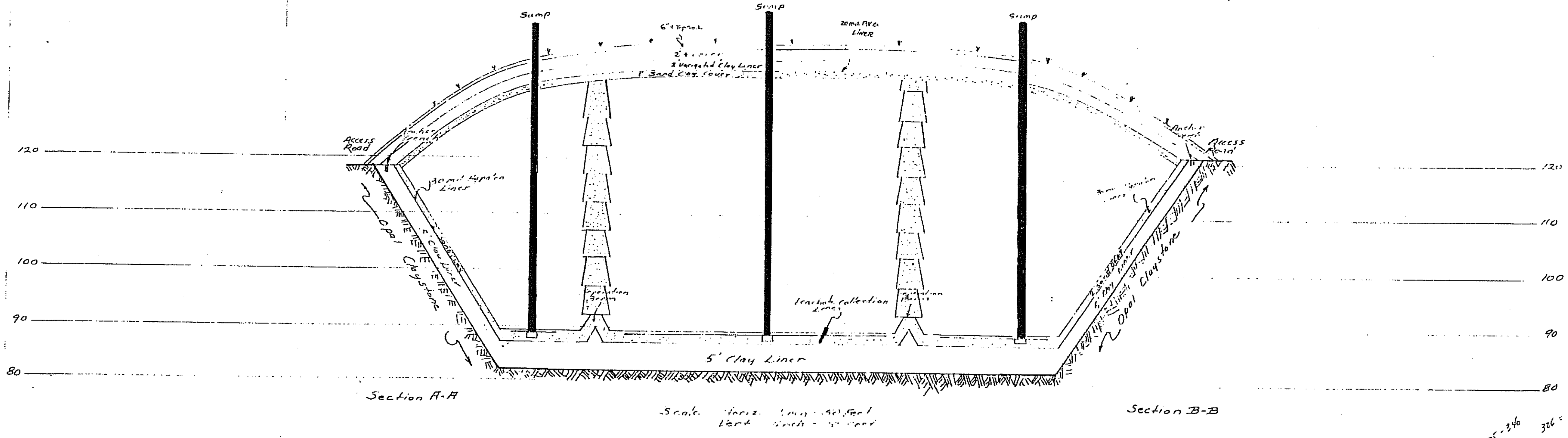
PINEWOOD SECURE LANDFILL
Section I Pit B
Completed as built

Robert G. Mathis
Manning, South Carolina
January 24, 1986

01039



Scale 1 inch = 50 Feet



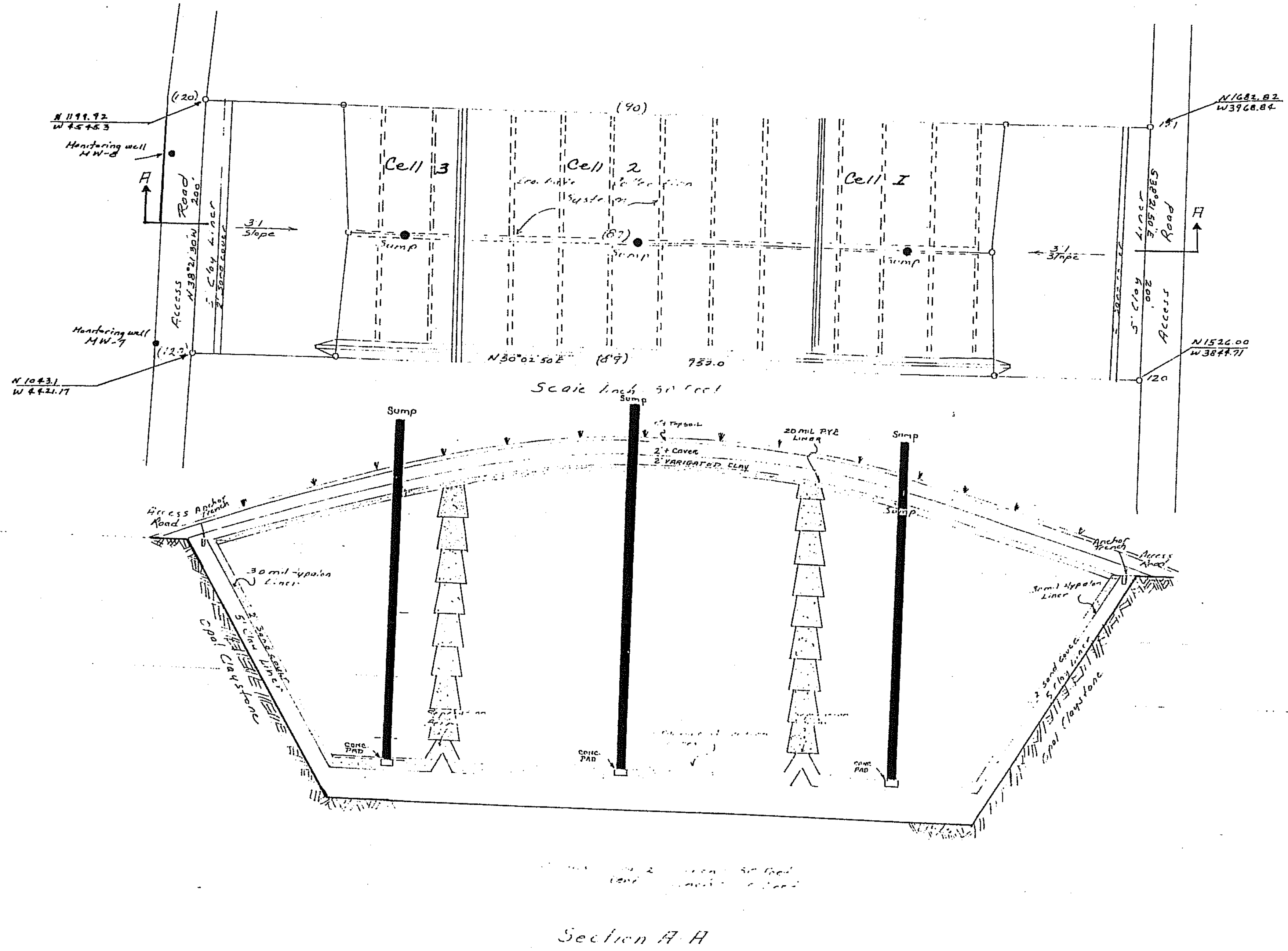
Section A-A

PINEWOOD SECURE LANDFILL

Section I Pit C

Completed As Built

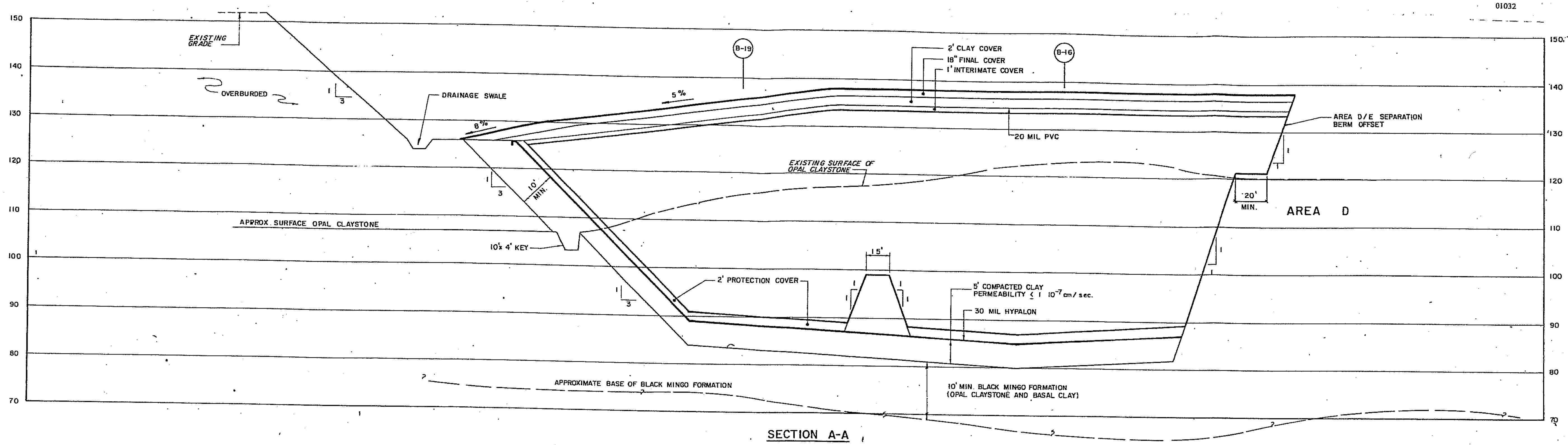
Robert G. Mathis
Manning, South Carolina
January 24, 1986



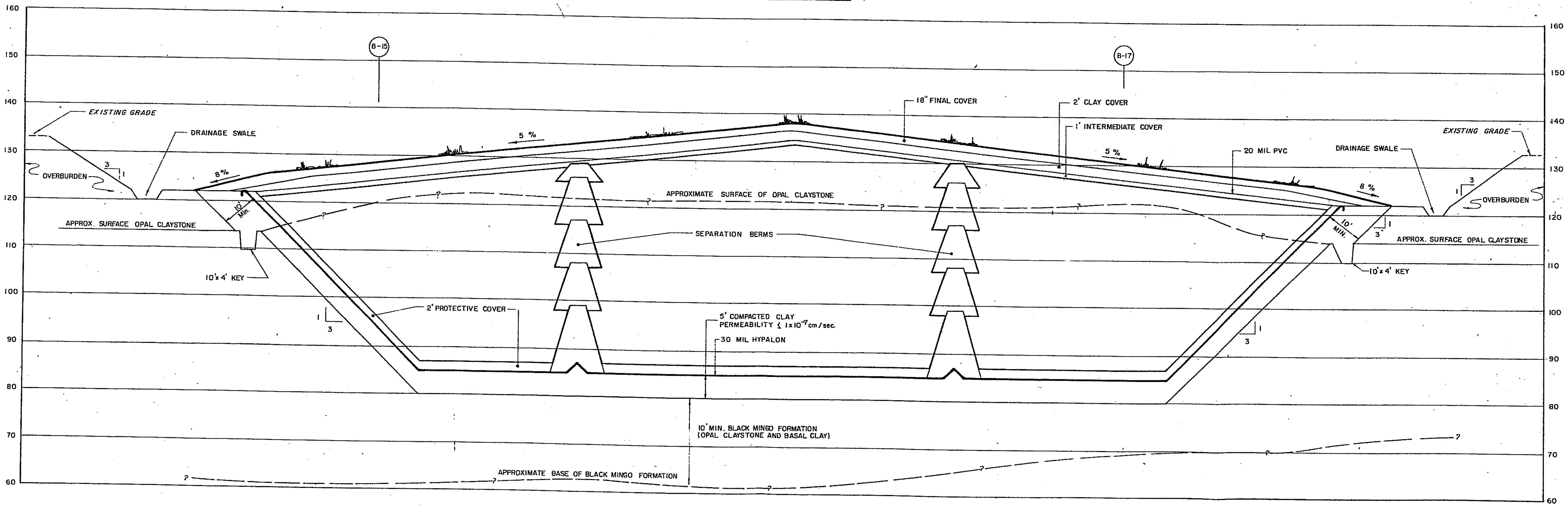
PINEWOOD SECURE LANDFILL
Section I Pit D
Completed as built

Rob
Mo
Jr

01032

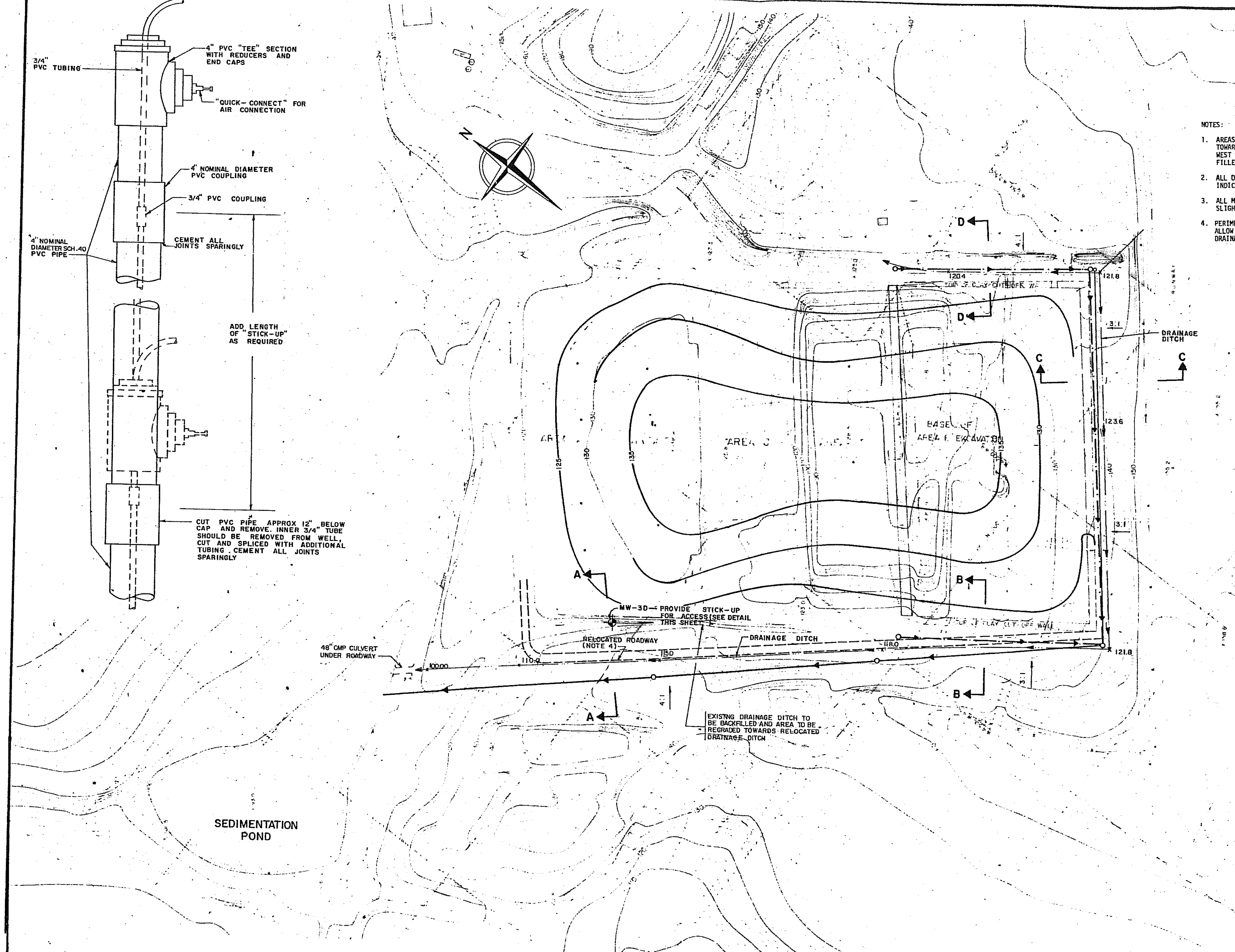


SECTION A-A



SECTION B-B

WEHRAN ENGINEERING CONSULTING ENGINEERS	Drawn by: FDG, MPF, XLR Checked by: D.J.P. Date: 11/18/82	Scales VERTICAL 10 0 10 HORIZONTAL 30 0 30	SALVATORE V. ARLOTTA, JR. P.E. S.C.P.E. Lic. No. 8528 Date: 18 Jan. 82	SOUTH CAROLINA SCA SERVICES, INC. SECTION I AREA E PINEWOOD, SUMTER COUNTY, SOUTH CAROLINA	CROSS SECTIONS	Sheet 10 of 14 Project No. 02368093



NOTES:

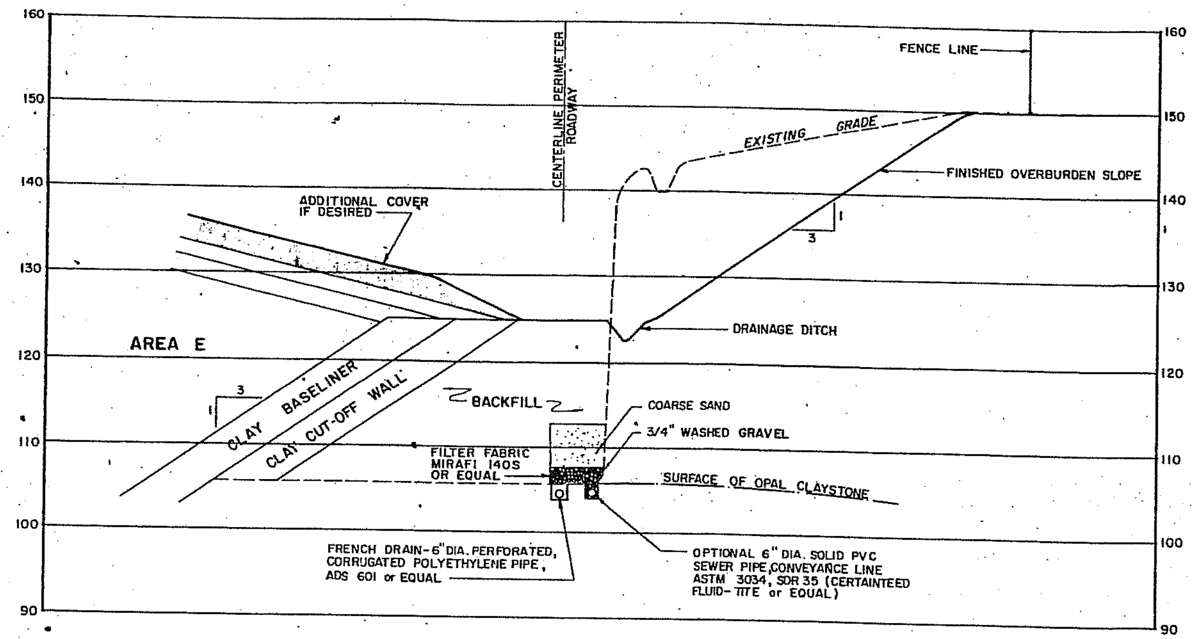
1. AREAS AROUND THE PERIMETER OF THE COMPLETED LANDFILLS ARE TO BE GRADED TOWARDS THE DRAINAGE DITCH AS SHOWN. PATICULARLY IN THE AREA ALONG THE WEST SIDE OF AREAS A, B AND C, THE EXISTING DRAINAGE DITCH SHOULD BE FILLED AND THE SURFACE GRADED TOWARD THE PROPOSED DITCH.
2. ALL OVERBURDEN SLOPES SHOULD BE REGRADED TO THE GRADES AND SLOPES INDICATED AND VEGETATED.
3. ALL MANHOLES SHOULD BE CONSTRUCTED SO THAT THE RIMS AND COVERS PROTRUDE SLIGHTLY ABOVE THE SURROUNDING FINAL GRADES TO REDUCE INFILTRATION.
4. PERIMETER ACCESS ROAD SHOULD BE GRADED TOWARDS DRAINAGE DITCH TO ALLOW RUNOFF FROM COMPLETED LANDFILL AREAS TO FLOW UNIMPEDED INTO DRAINAGE DITCH.

LEGEND

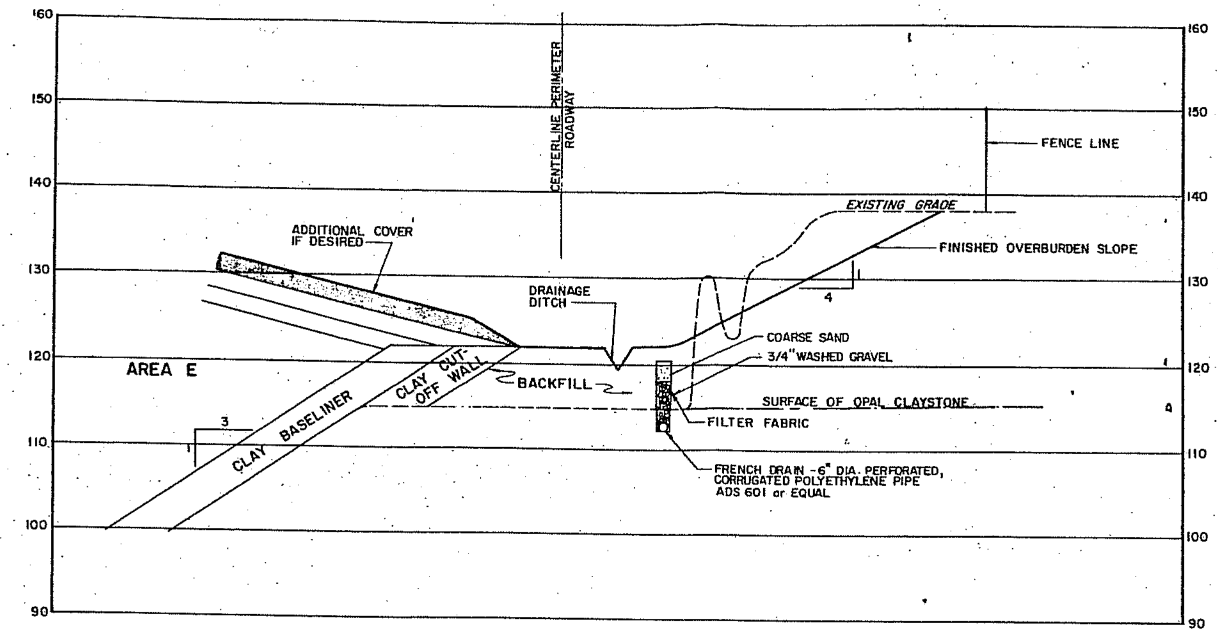
- LOCATION OF MONITORING WELL
- PERIMETER ACCESS ROAD
- FRENCH DRAIN
- 6" PVC PIPELINE
- MANHOLE
- RELOCATED DRAINAGE DITCH
- 4:1 COMPLETED OVERBURDEN SLOPE
- x125.0 ELEVATION OF DITCH INVERT

WEHRAN ENGINEERING CONSULTING ENGINEERS	Drawn by: FDG Checked by: DJP Date: 6/1/82	Scales 1"=100'	SALVATORE V. ARLOTTA, JR., P.E 2 Jun 82 SC P.E Lic No. 8528 Date	SOUTH CAROLINA SCA SERVICES, INC. GROUND-WATER COLLECTION SYSTEM AREA E PINEWOOD, SUMTER COUNTY SOUTH CAROLINA	FINAL GRADING AND CLOSURE PLAN	Sheet 2 of 6 Project No

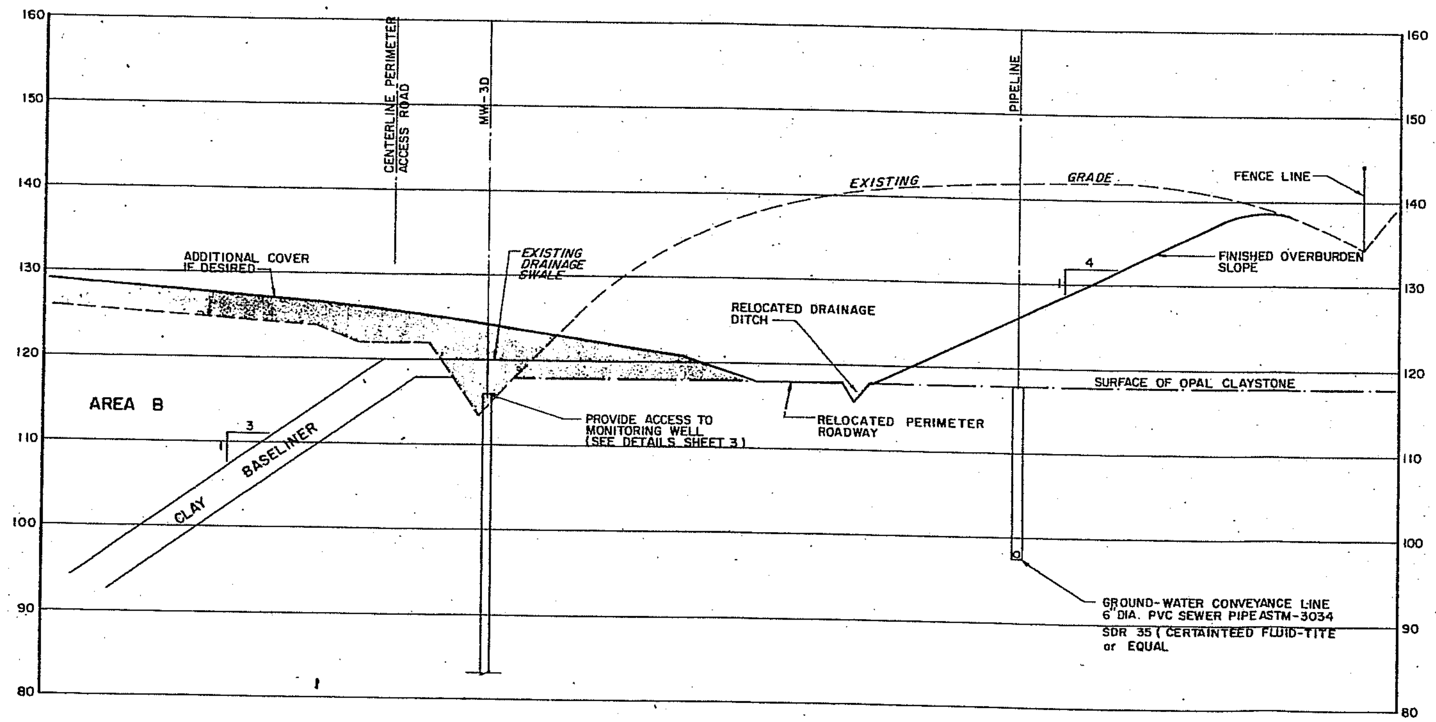
01003



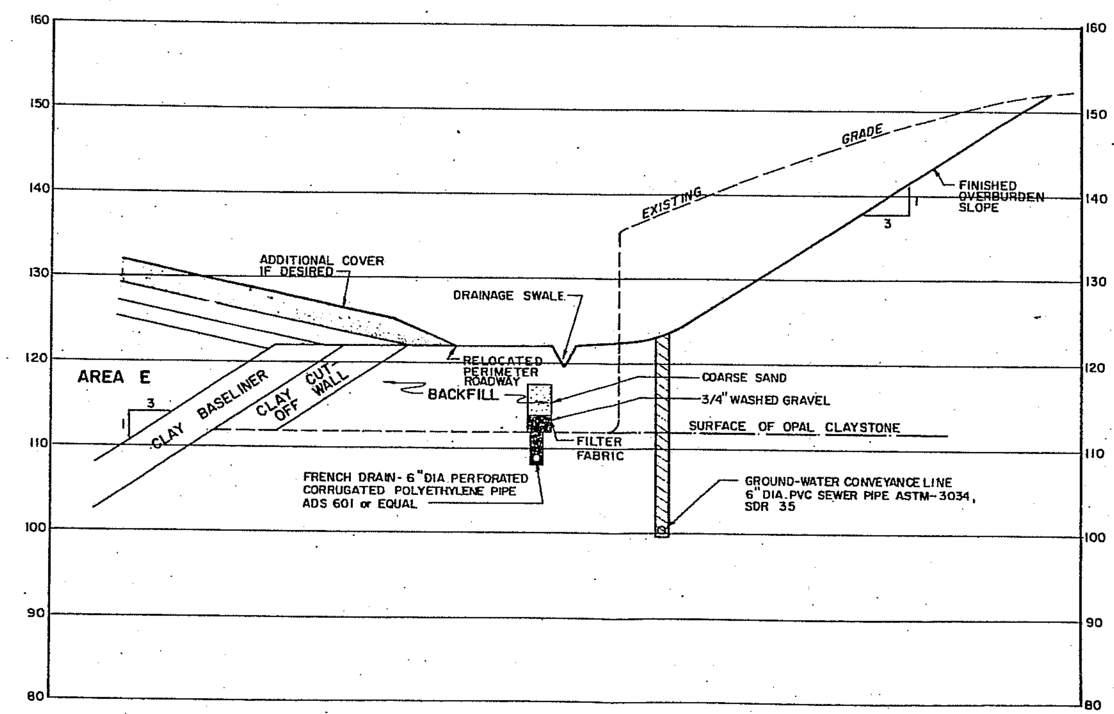
SECTION C-C



SECTION D-D



SECTION A-A

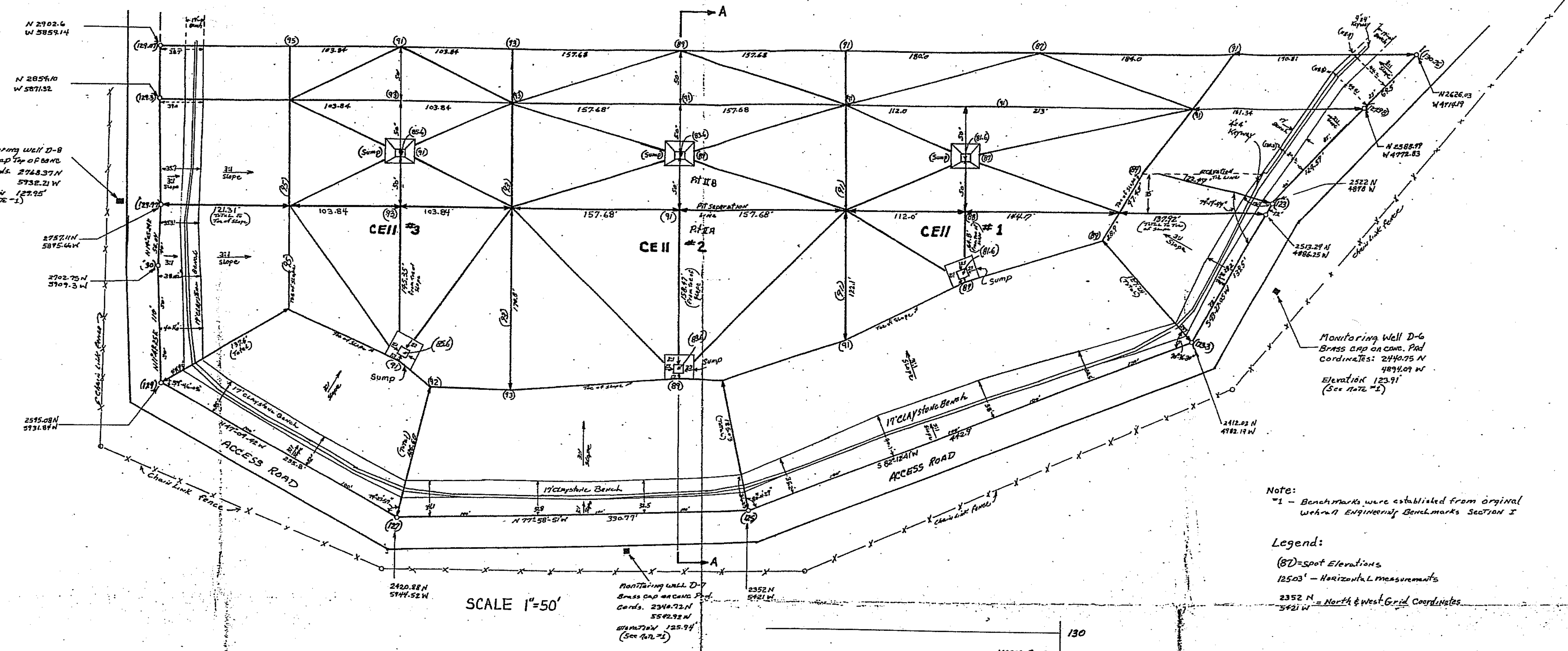


SECTION B-B

WEHRAN ENGINEERING CONSULTING ENGINEERS	Drawn by: D.G.T. Checked by: D.J.P. Date: 6/1/82	Scales VERTICAL 1"=10' HORIZONTAL 1"=20'	SALVATORE V. ARLOTTA, JR., P.E. Salvatore V Arlotta Jr 2 Jun 82 S.C.P.E. Lic. No. 8528 Date	SOUTH CAROLINA SCA SERVICES, INC. GROUND-WATER COLLECTION SYSTEM AREA E PINEWOOD, SUMTER COUNTY SOUTH CAROLINA	CROSS SECTIONS	Sheet 5 of 6 Project No. 02362152

APPENDIX D-2

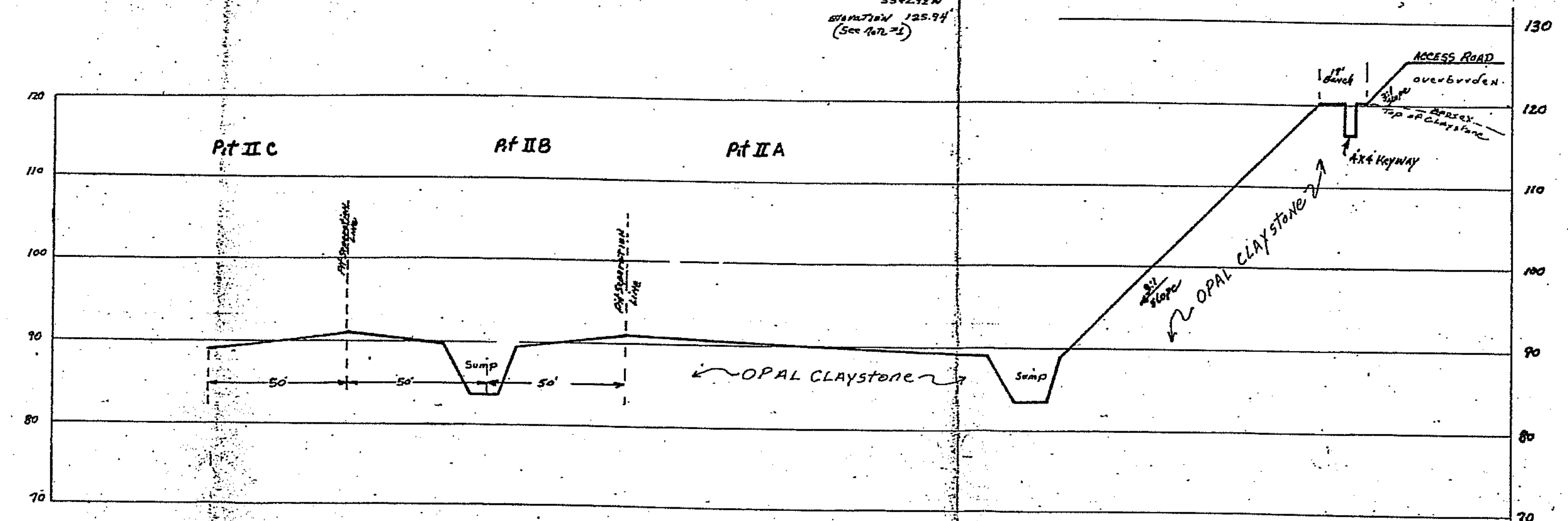
Select Section II Figures



Note:
*1 - Benchmarks were established from original Wehran Engineering Benchmarks Section I

Legend:

(87) = Spot Elevations
125.03' - Horizontal measurements
2352 N / 5421 W = North & West Grid Coordinates



SECTION A-A
Scale
Horiz 1"=30'
Vert 1"=10'

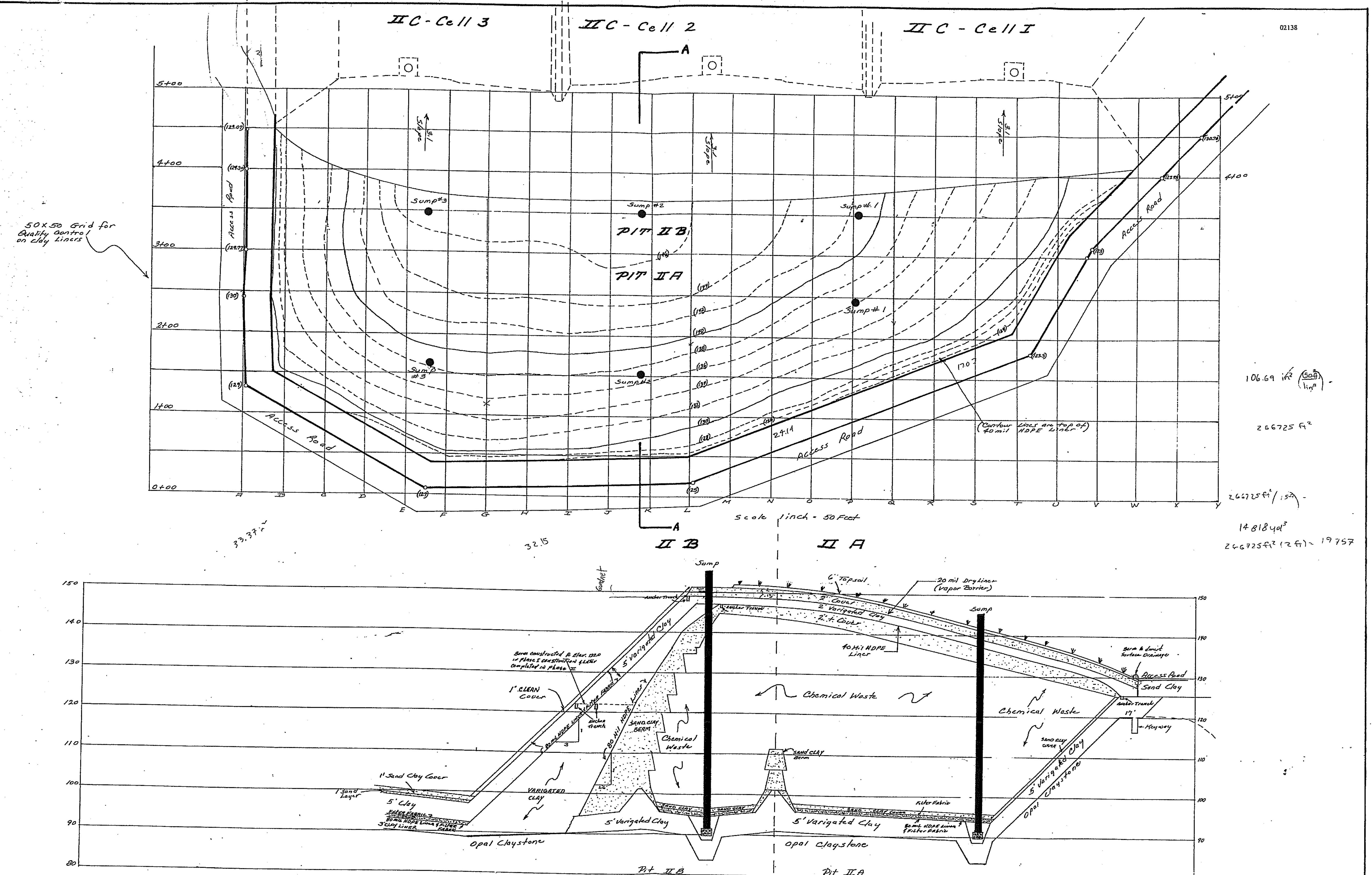
South CAROLINA, SCA SERVICES INC.
EXCAVATION AS-BUILT
SECTION-II PIT-A + B

PINEWOOD SUMTER COUNTY SOUTH CAROLINA

Note:
Pit IIB Added
August 28, 1984

Robert G Mathis
103 SUNSET DRIVE
MANNING, South CAROLINA
JUNE 21, 1984
Robert G. Mathis
S.C. R.L.S. No. 8371

02138



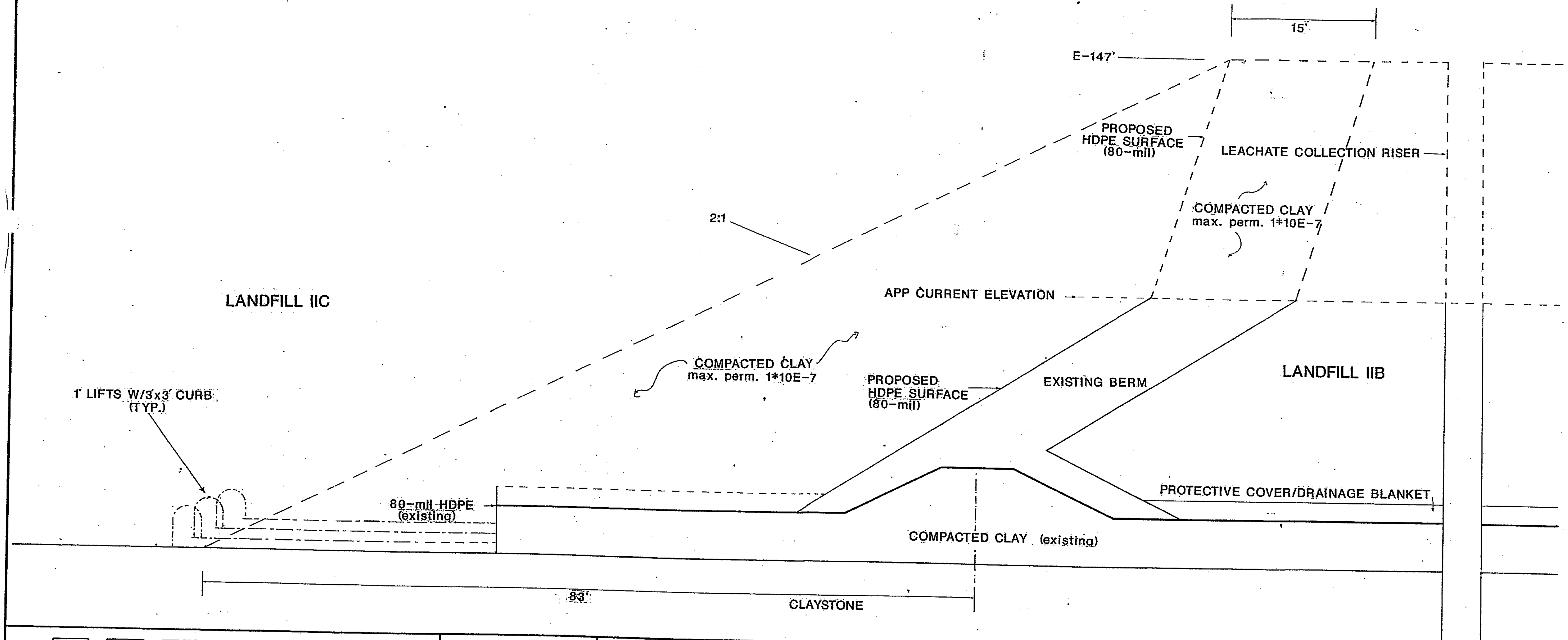
SECTION A-A
Scale - Horiz. 1" = 30 feet
Vert. 1" = 10 feet

PINEWOOD SECURE LANDFILL
AS BUILT IIA-IIB CAP

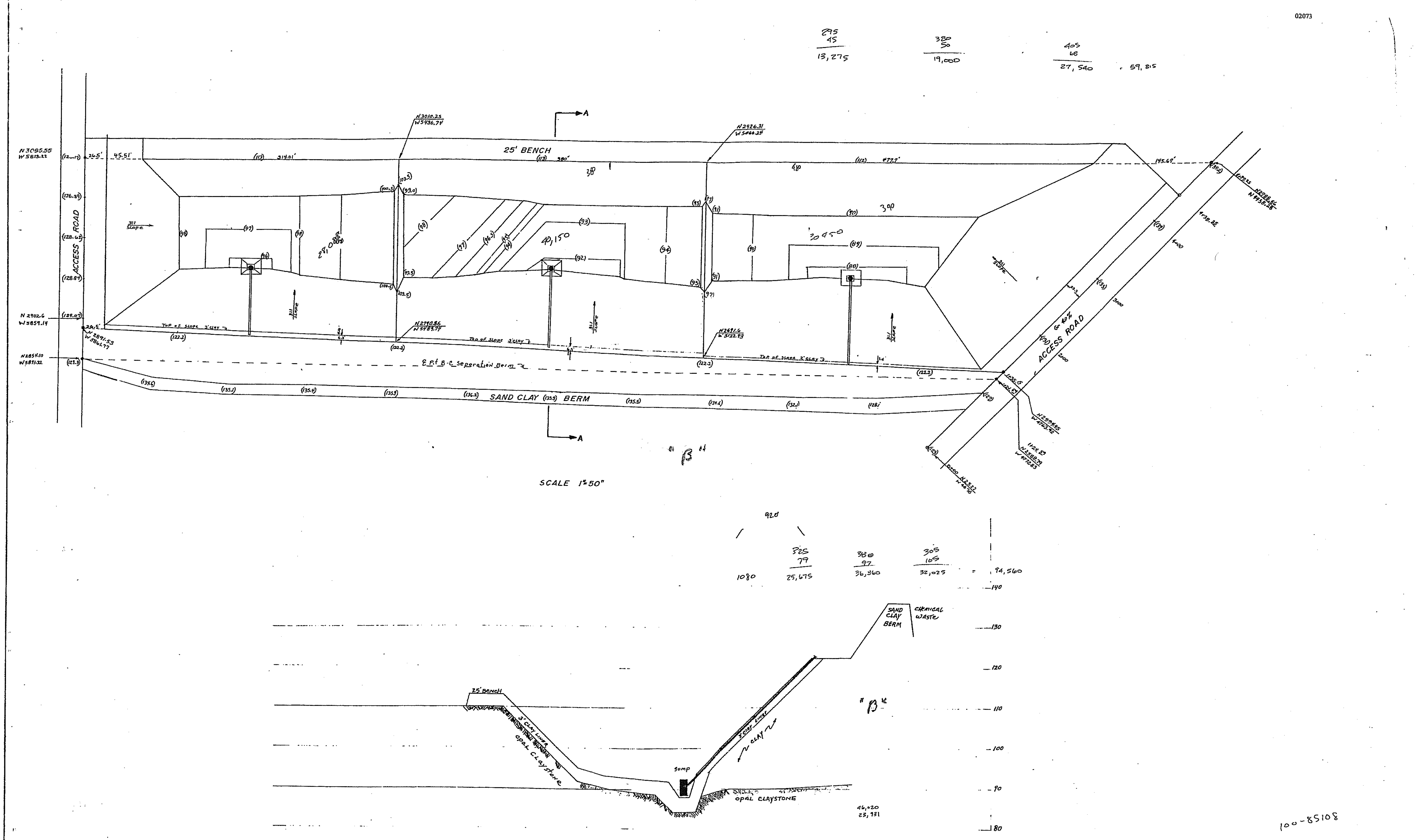
Robert G. Mathis
Robert G. Mathis
R.L.S. # 8301

Sept. 25, 1986

02132

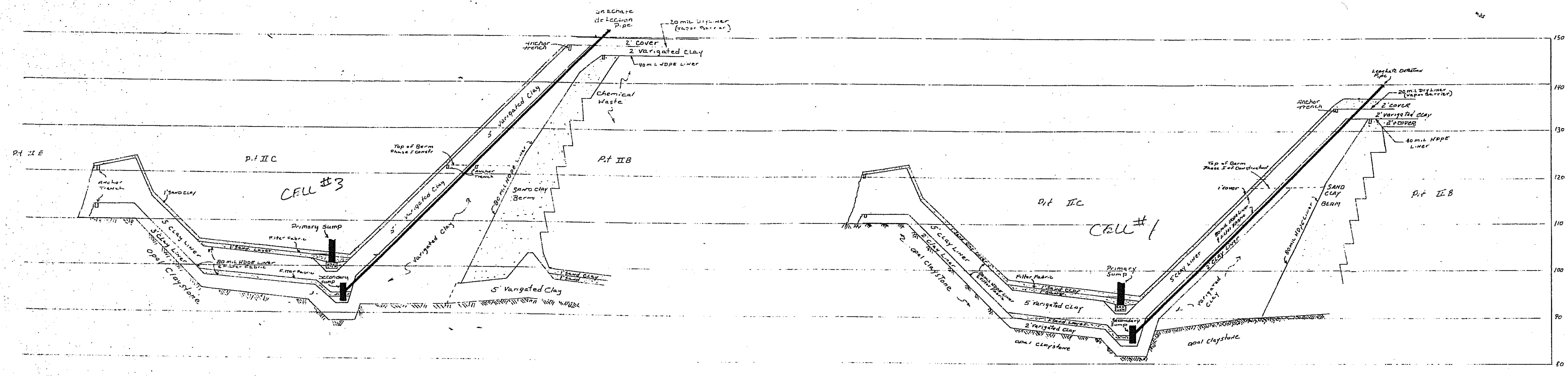


ETE ENVIRONMENTAL TECHNOLOGY ENGINEERING, INC.	Drawn by: Checked by: Date:	Scales 1"=5'	EARL M. WILLIAMS, JR. Earl M. Williams, Jr. 3/3/95 SCPE # 7518	GSX CORP. PINEWOOD SECURE LANDFILL PINEWOOD SUMTER COUNTY SOUTH CAROLINA	OPERATIONAL BERM B-C ELEVATION VIEW	Sheet 2 of 3 Project Nº



PINEWOOD SECURE LANDFILL
AS-BUILT SECTION II PIT "C"
SECONDARY LINER

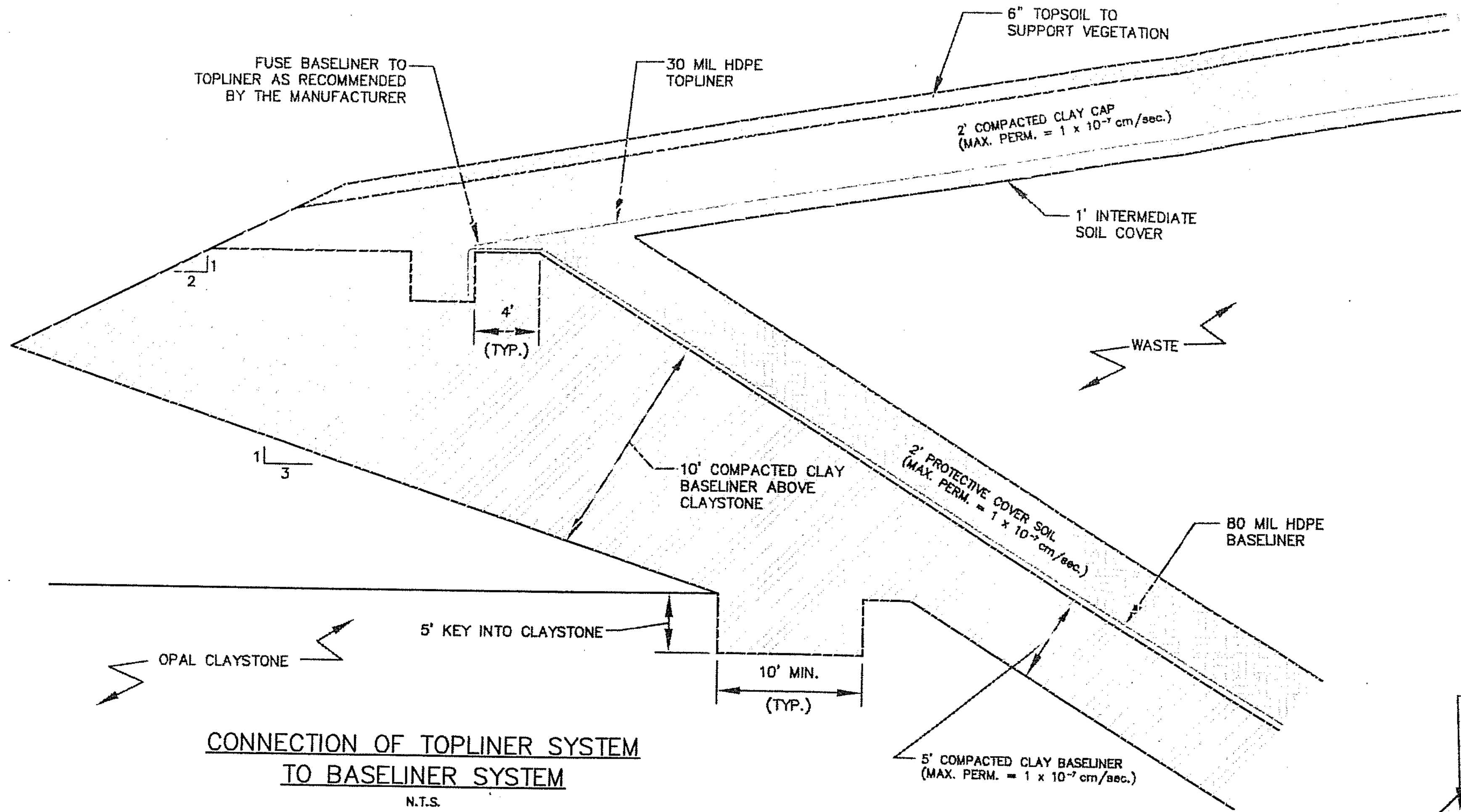
Robert L. Mathis
Oct. 4, 1985
S.C.R.L.S. #8371



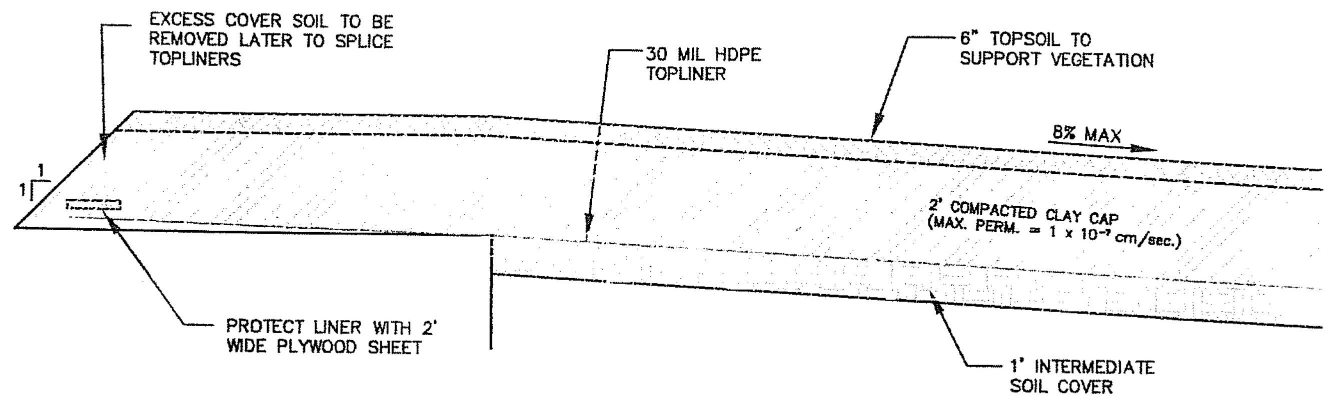
SECTION E-E
Scale: Vert. 1" = 10'
Horiz. 1" = 30'

SECTION D-D
Scale: Vert. 1" = 10'
Horiz. 1" = 30'

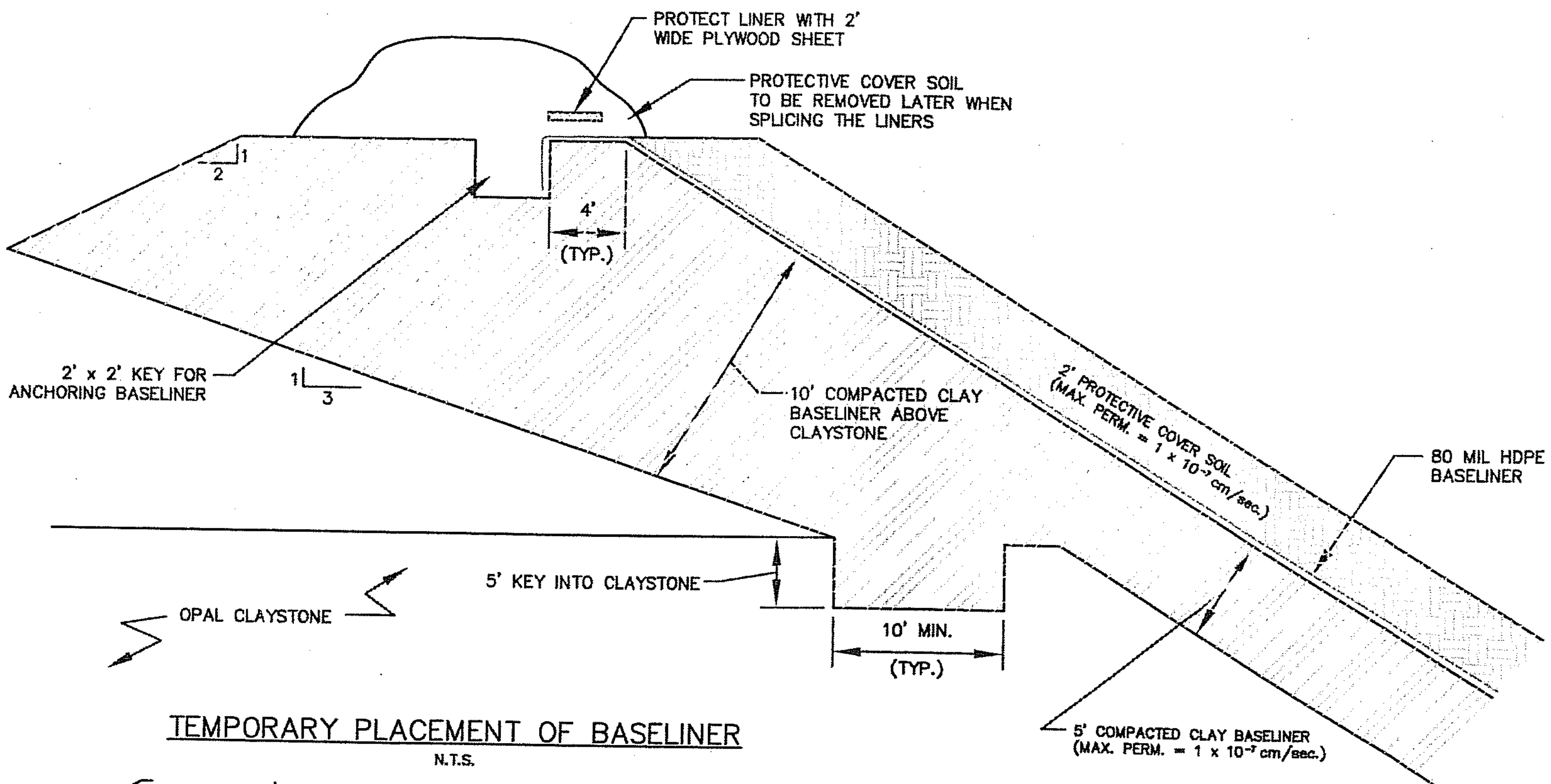
PINEWOOD SECURE LANDFILL
AS-BUILT SECTION II PIT "C"



CONNECTION OF TOPLINER SYSTEM
TO BASELINER SYSTEM
N.T.S.



TEMPORARY PLACEMENT OF TOPLINER
N.T.S.



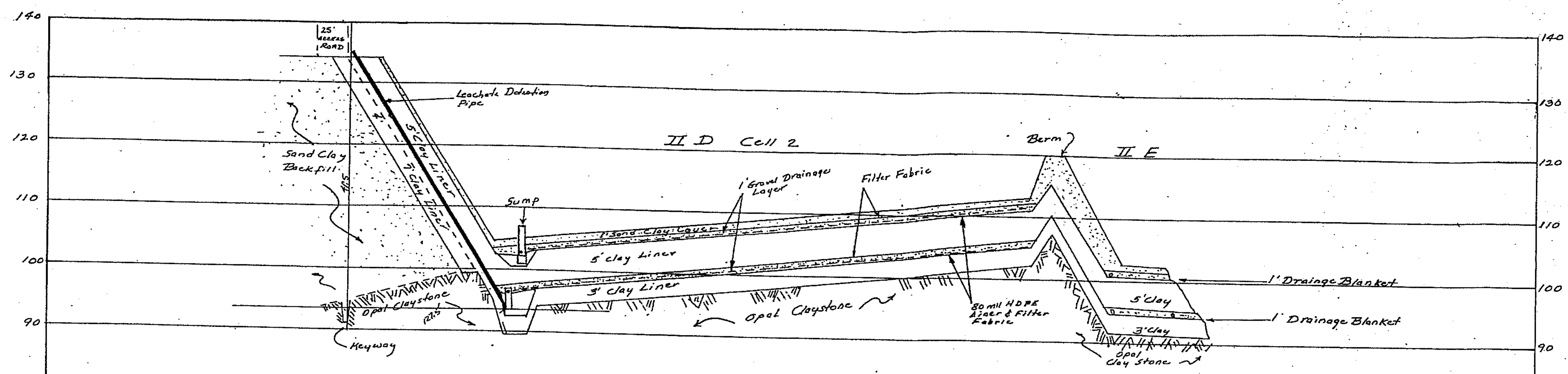
TEMPORARY PLACEMENT OF BASELINER
N.T.S.

TYPICAL CROSS SECTIO
LANDFILL SECTION IIA &

DRAWN BY:	CAB	DATE:	8/24/
DESIGNED BY:	DML	CADD NO:	
APPROVED BY:		PROJECT NO:	
SCALE:	N.T.S.	SHEET NO. 2	OF 4

Xref I 1117Vlo

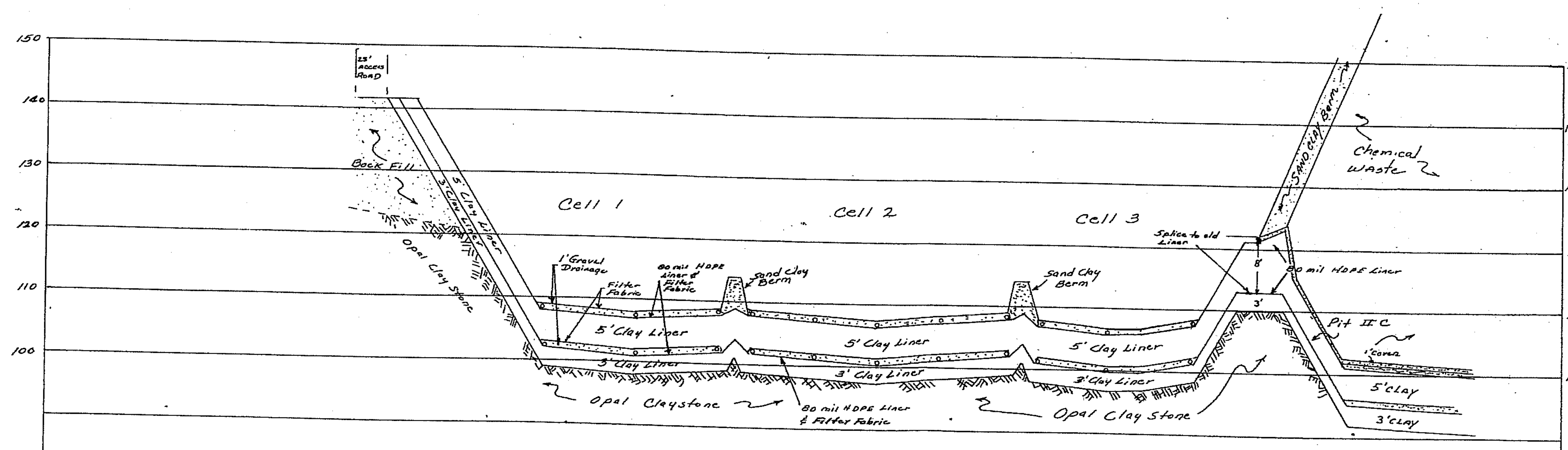
02140



SECTION A-A

Scale
Horiz. 1" = 50 Feet
Vert. 1" = 10 Feet

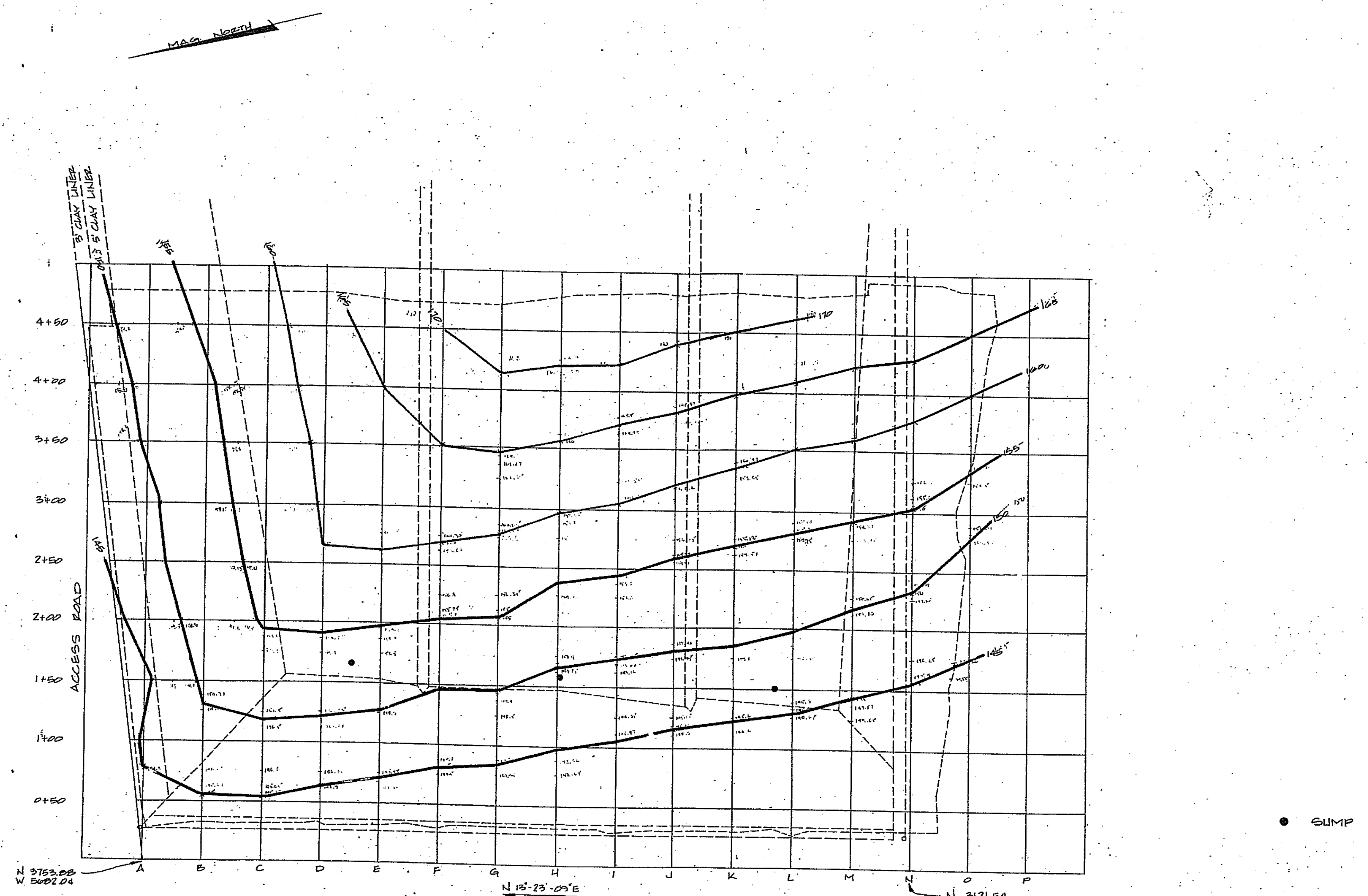
II D



SECTION B-B

Scale
Horiz 1" = 50 Feet
Vert. 1" 10 Feet

Robert B Mathis RLS #8371 Jan 26, 1987



NO.	REVISION	DATE	BY

02309

Environmental Technology Engineering, Inc.
Consulting Engineers & Hydrogeologists
P.O. Box 1887 • 1445 Pisgah Church Rd.
Lexington, S.C. 29072
(803) 957-6270

GSX SERVICES OF SOUTH CAROLINA

SECTION IID "AS-BUILT"

IID CAP

TOP SOIL COVER

SCALE: AS SHOWN

DESIGNED:

DRAWN: TBW

APPROVED:

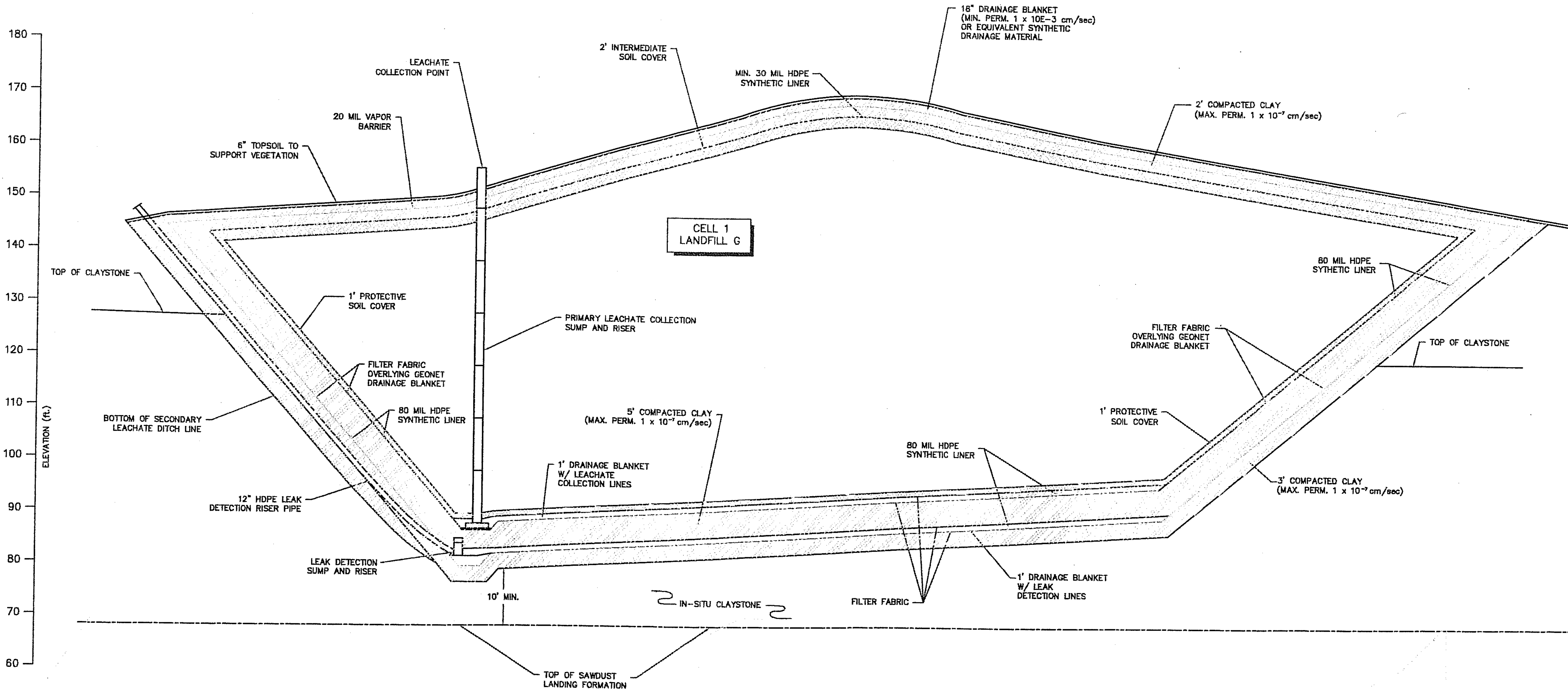
DATE: 7/17/89

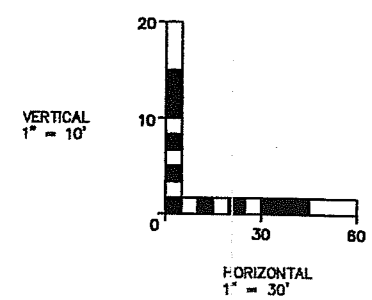
PROJECT NO. 100-88136

SHEET NO. OF

american blueprint of columbia

NO.	REVISION	DATE	BY

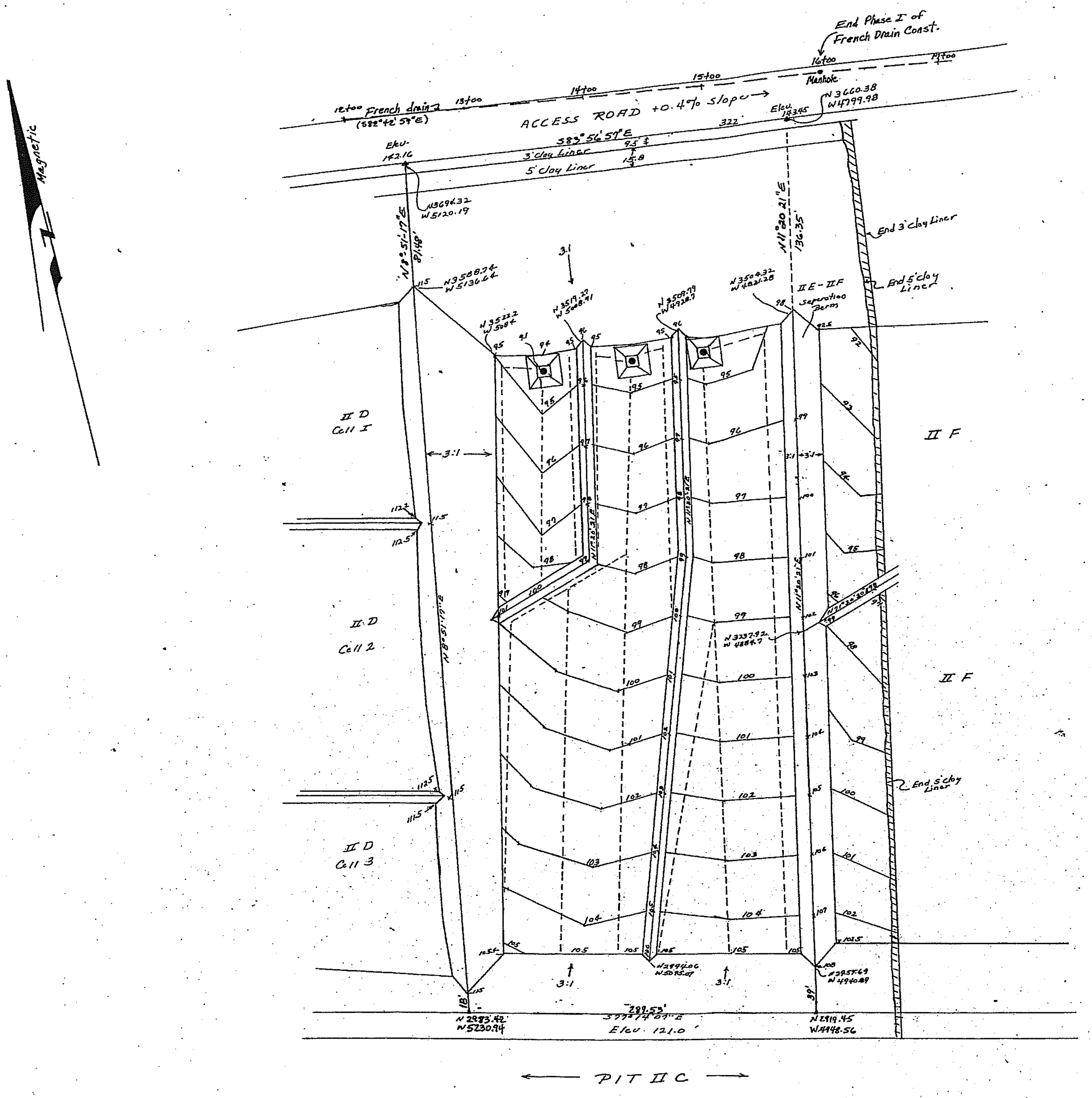




TYPICAL CROSS-SECTION LANDFILL SECTION IIC – IIG

DRAWN BY:	ASJ	DATE:	8/22/89
DESIGNED BY:	DML	CADD NO:	10013016
APPROVED BY:		PROJECT NO:	100-88130
SCALE:	AS SHOWN	SHEET NO.	3 OF 4

02145

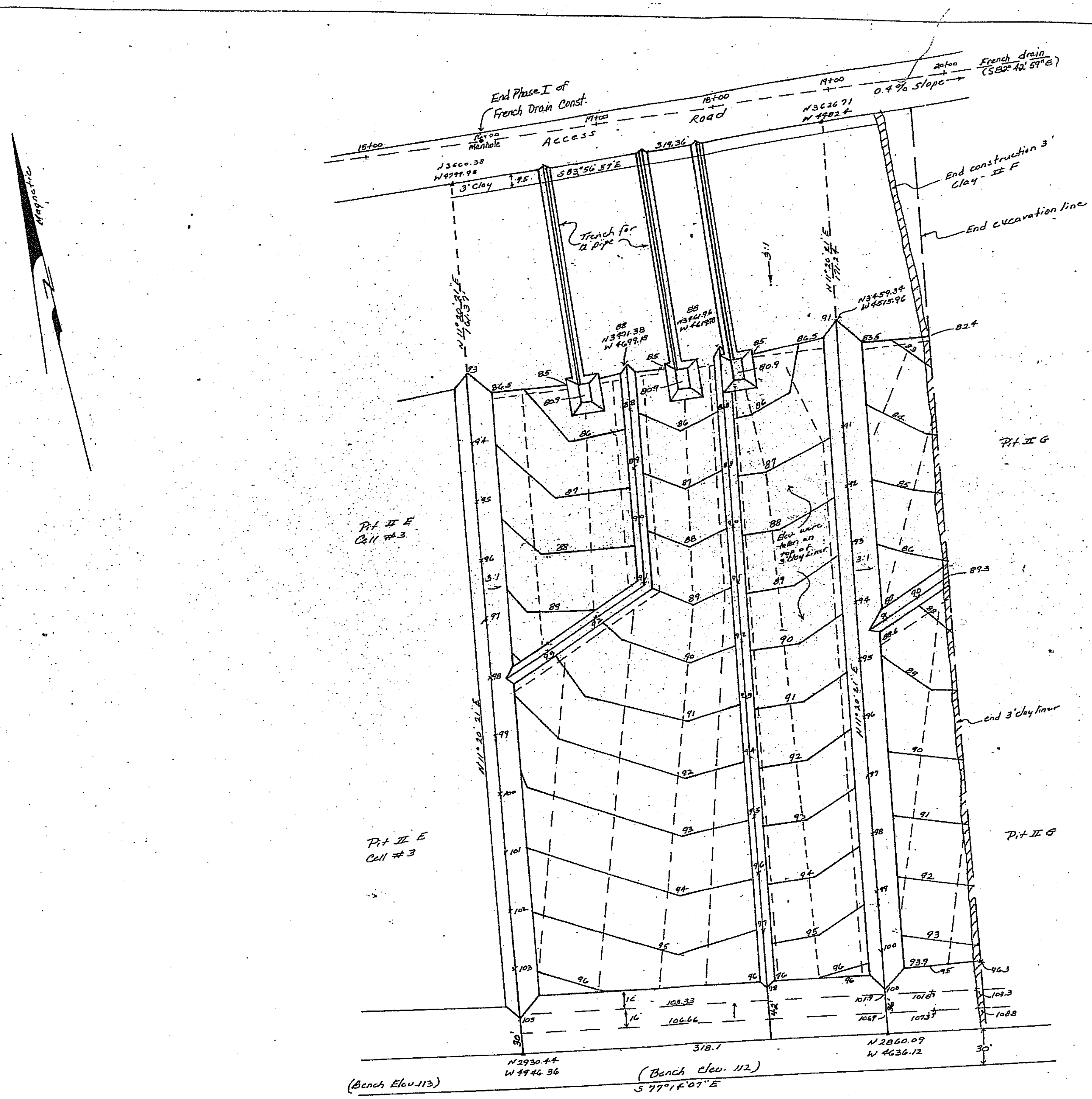


PINEWOOD SECURE LANDFILL
SECTION II, PIT "E", AS-BUILT
PRIMARY LINER & LEACHATE
COLLECTION SYSTEM

1" = 50'
October 21, 1988

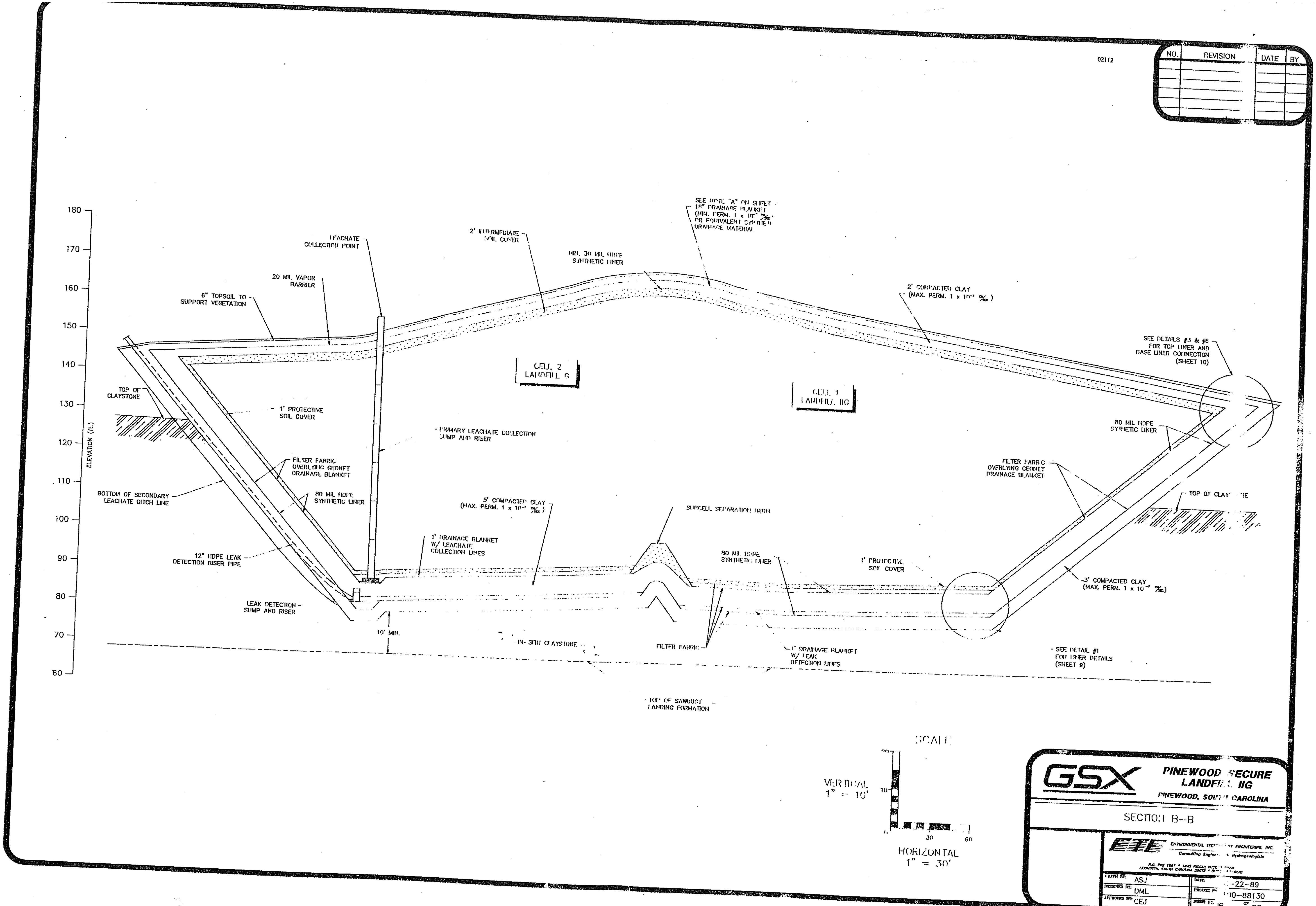
Robert B. Mathis
RLS #8371

02148



PINEWOOD SECURE LANDFILL
SECTION II, PIT "F", AS-BUILT
SECONDARY LINER & LEACHATE
DETECTION SYSTEM.
1" = 50'

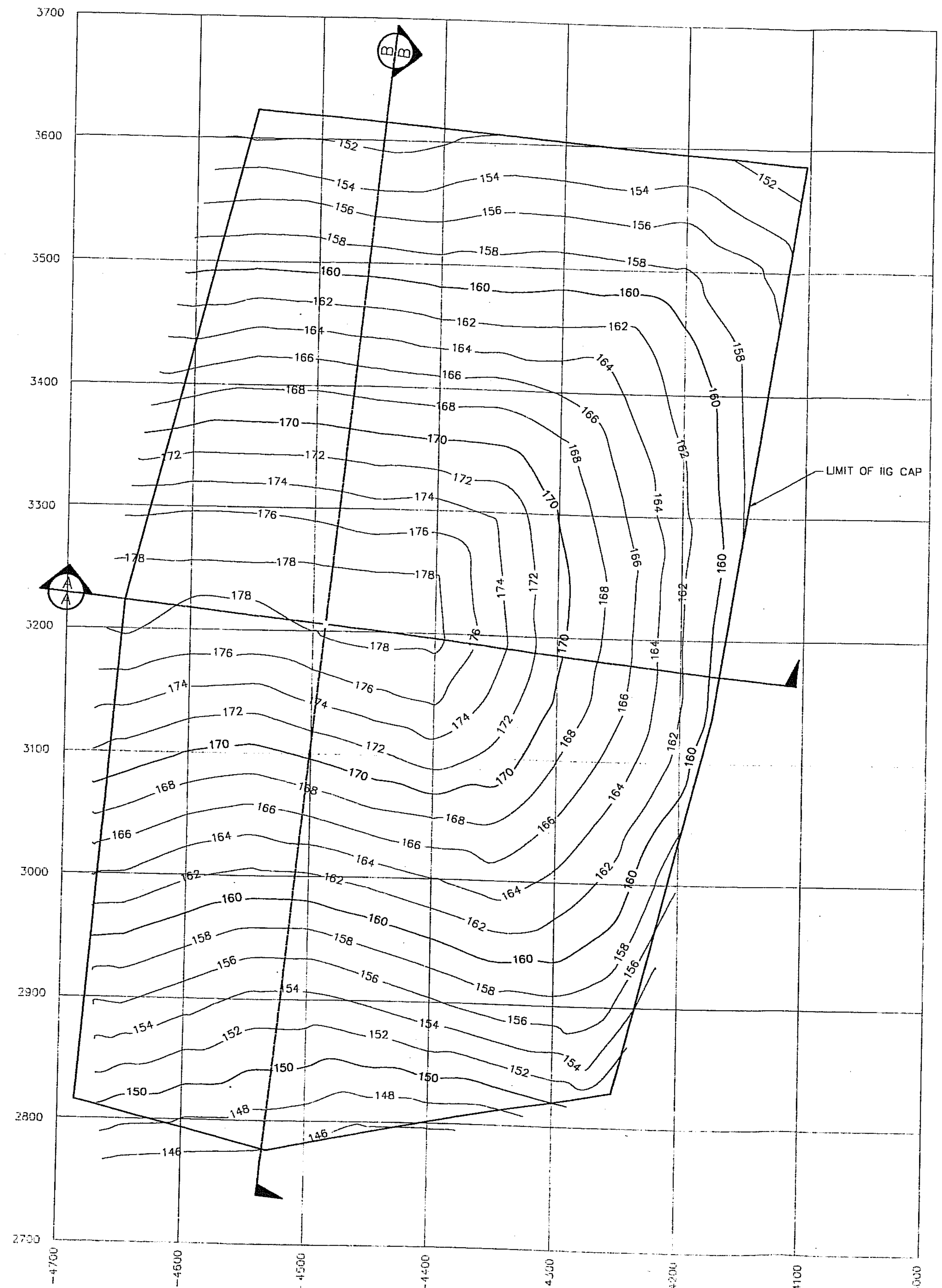
Robert J. Mathis
RLS #8371



02112
NO.
REVISION
DATE
BY
ELEVATION (ft.)
LEACHATE COLLECTION POINT
2' INTERMEDIATE SOIL COVER
MIN. 30 MIL HDPE SYNTHETIC LINER
20 MIL VAPOR BARRIER
6" TOPSOIL TO SUPPORT VEGETATION
2' COMPACTED CLAY
CELL 2 LANDFILL G
CELL 1 LANDFILL IIG
TOP OF CLAYSTONE
1' PROTECTIVE SOIL COVER
PRIMARY LEACHATE COLLECTION SUMP AND RISER
80 MIL HDPE SYTHETIC LINER
FILTER FABRIC OVERLYING GEONET DRAINAGE BLANKET
BOTTOM OF SECONDARY LEACHATE DITCH LINE
80 MIL HDPE SYNTHETIC LINER
5' COMPACTED CLAY
SUBCELL SEPARATION BERM
1' DRAINAGE BLANKET W/ LEACHATE COLLECTION LINES
12" HDPE LEAK DETECTION RISER PIPE
80 MIL HDPE SYNTHETIC LINER
1' PROTECTIVE SOIL COVER
3' COMPACTED CLAY
LEAK DETECTION SUMP AND RISER
10' MIN.
IN- SITU CLAYSTONE
FILTER FABRIC
1' DRAINAGE BLANKET W/ LEAK DETECTION LINES
SEE DETAIL #1 FOR LINER DETAILS (SHEET 9)
TOP OF SAWDUST LANDING FORMATION
SCALE
VERTICAL 1" = 10'
HORIZONTAL 1" = 30'
GSX
PINEWOOD SECURE LANDFILL IIG
PINEWOOD, SOUTH CAROLINA
SECTION B--B
ENVIRONMENTAL TECHNOLOGY ENGINEERING, INC.
Consulting Engineers Hydrogeologists
DRAWN BY: ASJ
DESIGNED BY: DML
APPROVED BY: CEJ
DATE: -22-89
-00-88130
16 OF 20

NO.	REVISION	DATE	BY

02170



SURVEYOR STATEMENT
THIS MAP IS AN ACCURATE REPRESENTATION OF THE AS-BUILT CONDITION AT THE FINAL PHASE OF CONSTRUCTION. ALL FIELD WORK AND DATA REDUCTION WAS PERFORMED UNDER MY SUPERVISION.

DENNIS G. JOHNS, P.L.S. REG.# 8102

GRAPHIC SCALE
0 25 50 100 150 200

ViroGroup Air•Water•Soil TECHNOLOGY

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LAIDLAW

PINEWOOD SECURE LANDFILL
PINEWOOD, SOUTH CAROLINA

II G
CAP

FIGURE A-3
TOPOGRAPHY OF PROTECTIVE SOIL COVER

DRAWN BY:	JKB	DATE:	8/23/93
DESIGNED BY:	KCC	CADD NO:	10018925
APPROVED BY:	KCC	PROJECT NO:	12-02189
SCALE:	1" = 50'	SHEET NO.	OF

APPENDIX D-3

Select Section III Figures

NOTES:

1. SITE CONTOURS ON THIS MAP WERE SURVEYED BY JAY S. JOSHI OF CONSTRUCTION SUPPORT SERVICES IN SEPTEMBER OF 2000.

2. THIS IS A CONCEPTUAL DRAWING AND NOT ISSUED FOR ACTUAL CONSTRUCTION.

3. LANDFILL CELLS IIIA & IIIB WERE PREVIOUSLY CLOSED BASED ON APPROVED CLOSURE PLAN.

4. THIS TOPOGRAPHIC DRAWING WAS PREPARED BY DESIGN DRAFTING TECHNOLOGIES ON DECEMBER 11, 2000.

LEGEND:

- – – – – CELL DIVIDER LINE
- 2FT EXISTING CONTOURS
- 10FT EXISTING CONTOURS

	BY	DATE
DRAWN	ELH	2-21-02
CHECKED	FK	2-21-02
APPROVED	FK	2-21-02
APPROVED		
REVISION	0	

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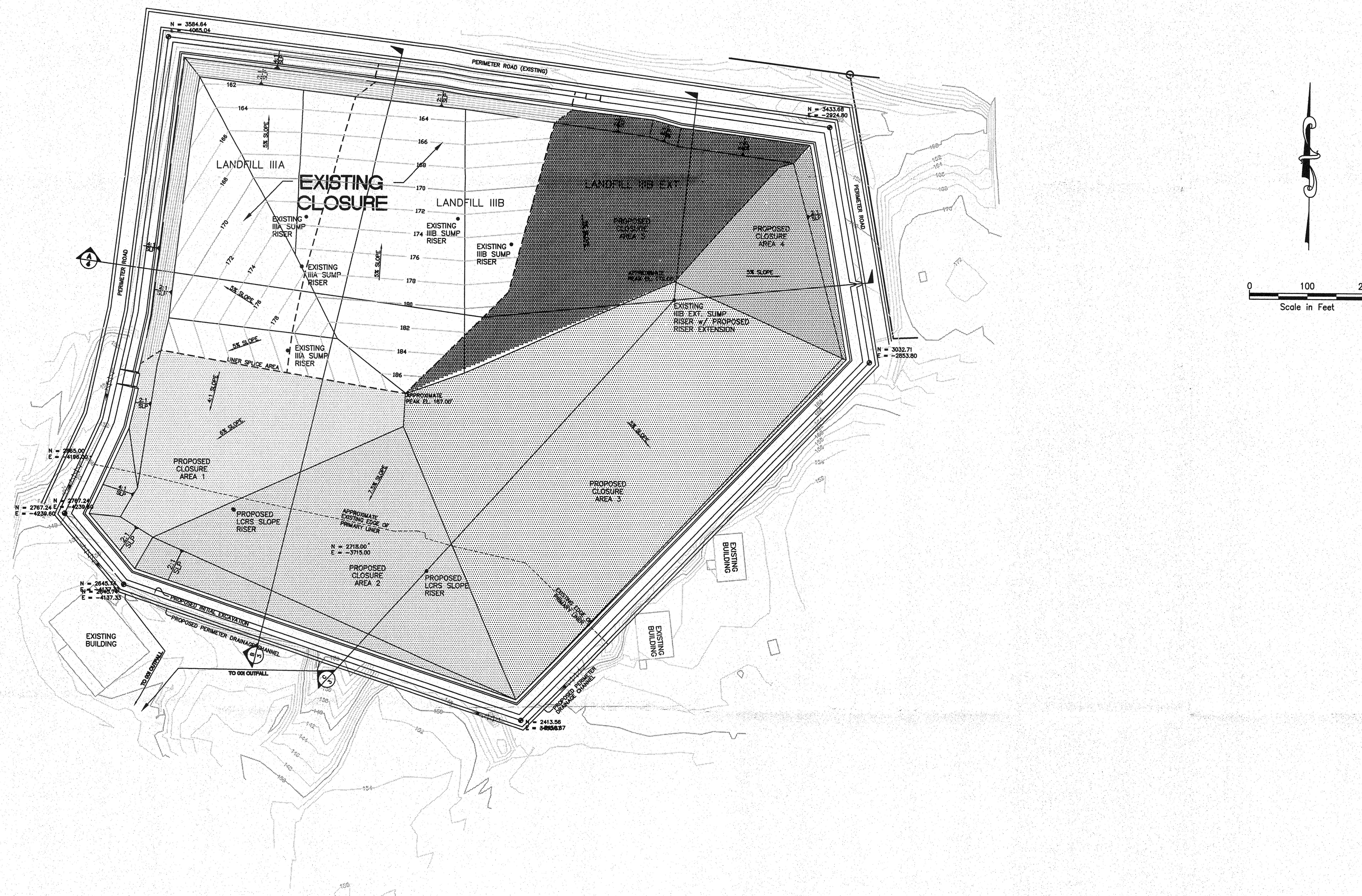
HOUSTON, TEXAS 77060
281-820-7600 281-820-7618 fax

FIGURE 1

EXISTING LANDFILL CONDITIONS
PINEWOOD LANDFILL SECTION III
PINEWOOD, SOUTH CAROLINA

SCALE	DWG. NO.
AS NOTED	3225-01



NOTES:
1. EXISTING CONTOURS ON THIS MAP WERE SURVEYED BY JAY S. JOSHI OF CONSTRUCTION SUPPORT SERVICES IN SEPTEMBER OF 2000.
2. THIS IS A CONCEPTUAL DRAWING AND NOT ISSUED FOR ACTUAL CONSTRUCTION.
3. LANDFILL CELLS IIIA & IIIB WERE PREVIOUSLY CLOSED BASED ON APPROVED CLOSURE PLAN.

LEGEND
- CELL DIVIDER LINE
- 2FT EXISTING CONTOURS
- 10FT EXISTING CONTOURS
- DRAINAGE FLOW DIRECTION

	BY	DATE
DRAWN	ELH	6-28-02
CHECKED	FK	6-28-02
APPROVED	FK	6-28-02
APPROVED		
REVISION	2	6-28-02

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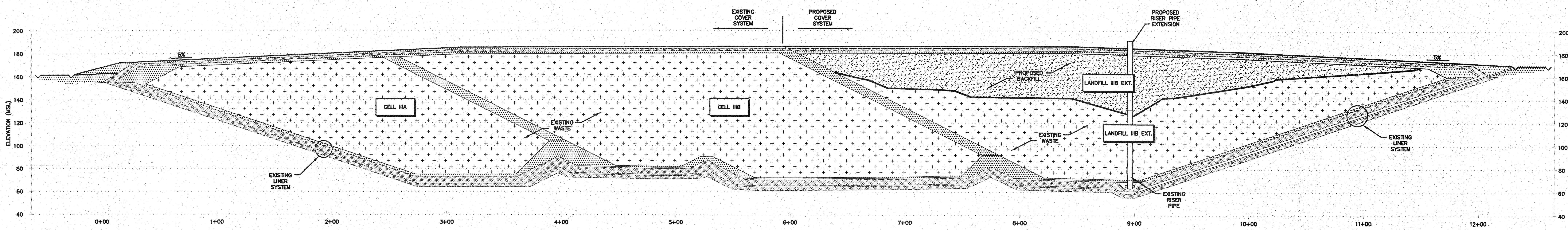
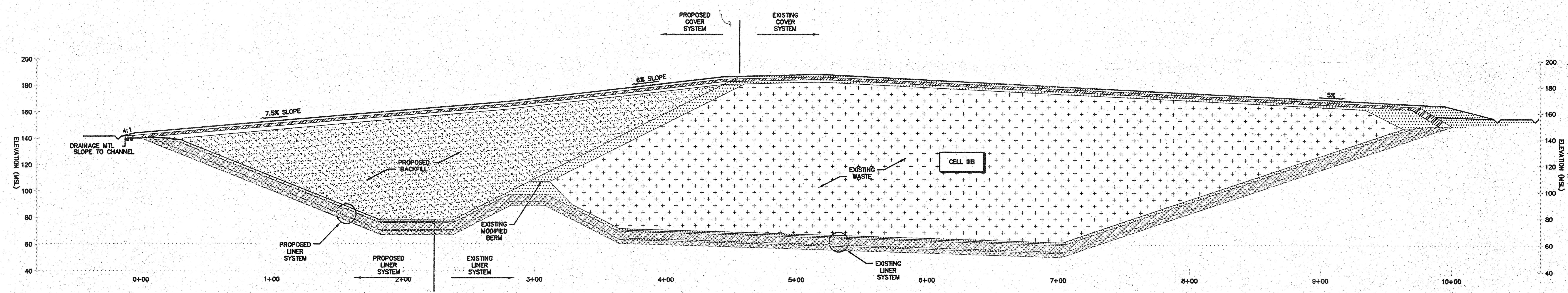
FIGURE 2

PROPOSED CONCEPTUAL CLOSURE PLAN
PINEWOOD LANDFILL SECTION III
PINEWOOD, SOUTH CAROLINA

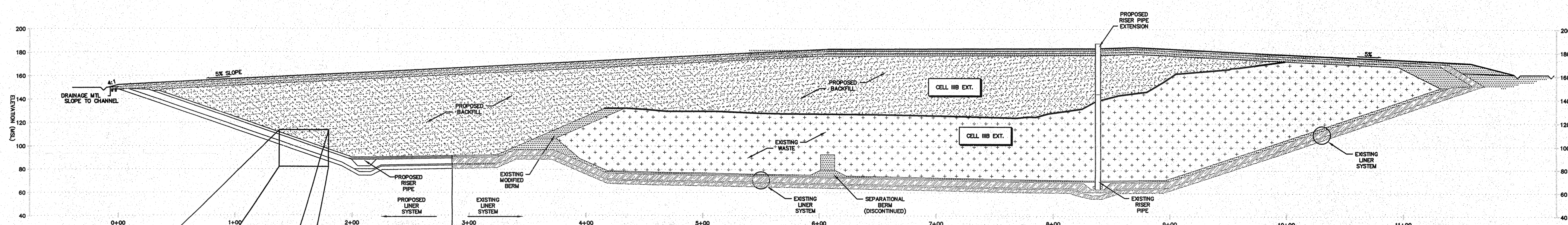
SCALE: AS NOTED
DWG. NO. 3225-02-REV2



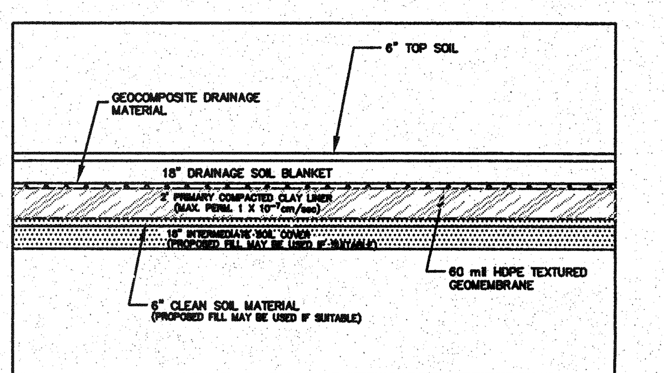
CROSS-SECTION A/3
(SCALES) - VERT: 1" = 50'
HORIZ: 1" = 50'



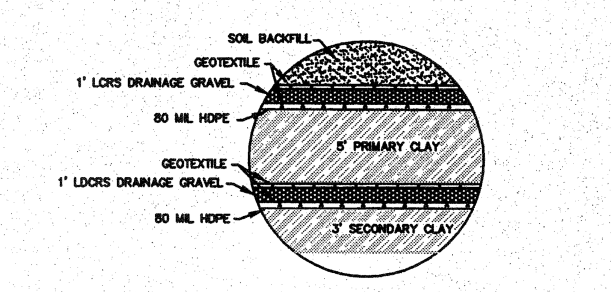
CROSS-SECTION B/3
(SCALES) - VERT: 1" = 50'
HORIZ: 1" = 50'



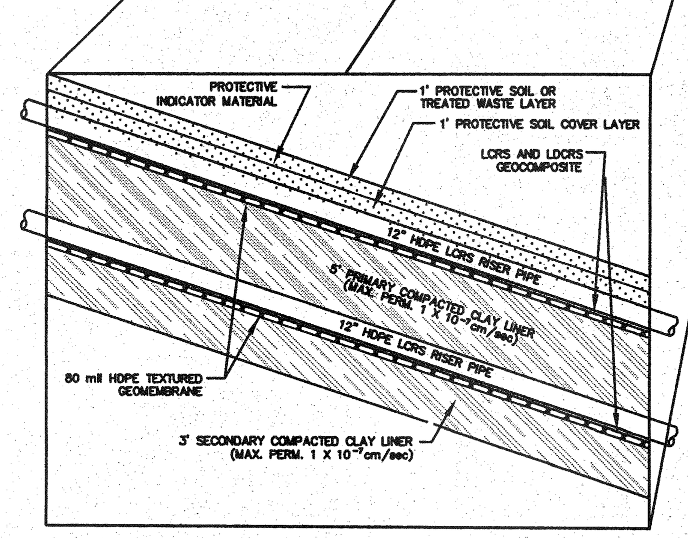
CROSS-SECTION C/3
(SCALES) - VERT: 1" = 50'
HORIZ: 1" = 50'



TYPICAL TOPLINER SYSTEM DETAIL
SCALE: 1" = 10'



TYPICAL BASELINER SYSTEM DETAIL
SCALE: 1" = 10'



TYPICAL SIDE SLOPE LINER DETAIL
SCALE: N.T.S.

LEGEND

EXISTING WASTE

PROPOSED BACKFILL

	BY	DATE
DRAWN	ELH	2-21-02
CHECKED	FK	2-21-02
APPROVED	FK	2-21-02
APPROVED		
REVISION	1	5-10-02

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HOUSTON, TEXAS 77060
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FIGURE 3

PROPOSED CROSS-SECTIONS
PINEWOOD LANDFILL SECTION III
PINEWOOD, SOUTH CAROLINA

SCALE	DWG. NO.
1" = 50'	3225-03-REV1