



UNITED STATES  
NUCLEAR REGULATORY COMMISSION

REGION IV

611 RYAN PLAZA DRIVE, SUITE 400  
ARLINGTON, TEXAS 76011-8064

October 19, 1994

Rio Algom Mining Corporation  
ATTN: Bill Ferdinand, Manager  
Radiation Safety, Licensing  
and Regulatory Affairs  
6305 Waterford Blvd., Suite 325  
Oklahoma City, Oklahoma 73118

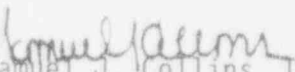
SUBJECT: RESPONSE TO NOTICE OF VIOLATION (REPORT 40-8084/94-01)

Thank you for your letter dated September 9, 1994, in response to our letter and Notice of Violation dated July 21, 1994. In your response, you disagree with the violation and request that the NRC rescind it. We discussed your response to the violation during a telephone conversation held on October 4, 1994, between Mr. Bill Ferdinand of your organization and Mr. Charles Cain and other members of the NRC staff from Region IV and the Office of Nuclear Materials Safety and Safeguards (NMSS).

Based on our review of your response and our telephone conversation, the NRC has determined that the violation should not be withdrawn. During the telephone conversation, your representative agreed to provide the NRC with another response addressing the violation and your corrective actions to prevent a recurrence. The response should address our specific concern that in the future, other than routine damage to your tailings empoundments be immediately reported to the NRC. Your representative committed to provide such a response and to explore with NMSS the possibility of amending your license to clarify the reporting requirement specified in License Condition 24. Please provide your response to this letter within 30 days so that we can continue our review.

Please note that the material provided in your September 9, 1994 letter in response to Unresolved Item 40-8084/9401-02 is under review by NMSS. This item will be addressed by separate correspondence in the future. Should you have any questions regarding this inspection, we will be pleased to discuss them with you.

Sincerely,

  
Samuel J. Collins, Director  
Division of Radiation Safety  
and Safeguards

Docket: 40-8084  
License: SUA-1119

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PDR ADOCK 04008084  
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Rio Algom Mining Corporation

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cc:  
Rio Algom Mining Corp.  
Lisbon Operations  
ATTN: Frank Fossey, RSO  
La Sal Route  
Moab, Utah 84532

Utah Radiation Control Program Director

W. Sinclair, State of Utah



bcc:

DMB - Original (IE-07)

LJCallan, RA

SJCcollins, D/DRSS

RAScarano, DD/DRSS

JJHolonich, NMSS/DWM/H (MS 7 J9)(TWFN)

Charlotte E. Abrams, Project Manager, NMSS/DWM/H (MS 7 J9)(TWFN)

DWeiss, OC/LFDCB (MS T-9E10)(TWFN)

GLShear, RIII/DRSS

CLCain, C/FCDB/DRSS

DBSpitzberg, FCDB/DRSS w/copy of licensee's letter dated 9/9/94

GMVasquez, FCDB/DRSS

MLMcLean, FCDB/DRSS


RJEvans, FCDB/DRSS

LCCarson, FCDB/DRSS

MIS System

FCDB Files (Hodges) w/copy of licensee's letter dated 9/9/94

RIV Material License Files (2) w/copy of licensee's letter dated 9/9/94



RIV:FCDB <i>DRSS</i>	C:FCDB <i>for</i>	DD:DRSS	D:DRSS	
DBSpitzberg:nh	CLCain <i>for</i>	RAScarano	SJCcollins	
10/17/94	10/13/94	1 / 94	10/14/94	

bcc:

DMB - Original (IE-07) *///*

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*Jm*

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DBSpitzberg:nh	CLCain	RAScarano	SJCcollins	
10/17/94	10/13/94	1/94	9/14/94	

# Rio Algom Mining Corp.

September 9, 1994

Certified Mail

Return Receipt Requested Z 147 271 334

U.S. Nuclear Regulatory Commission

Attn: Document Control Desk

Washington D.C. 20555

Re: Reply To A Notice of Violation  
Letter Dated July 21, 1994  
License SUA-1119, Docket No. 40-8084



To Whom It May Concern:

Rio Algom Mining Corp. has concluded its review of the Notice of Violation letter from NRC's report dated July 21, 1994, resulting from an inspection of the Lisbon facility on June 28, 1994. This response is submitted at this time pursuant to an extension of time granted by Mr. Charles Cain, Chief, Fuel Cycle and Decommissioning Branch on August 16, 1994.

Rio Algom responses are in regards to NRC's Notice of Violation (40-8084/94-01) contained within its July 21 report. Rio Algom respectfully disagrees with the issued Notice of Violation (NOV) and requests that the NOV be rescinded for the reason stated in the response. The violation alleges that Rio Algom failed to make a timely notification regarding damage to its evaporation cell on the Upper Tailings Impoundment. Rio Algom believes that its actions and notification on this issue were timely and in accordance with its license condition and applicable regulations. The attached responses details Rio Algom's belief in this matter.

Also contained within this response is Rio Algom's submittal of additional information regarding the unresolved item (40-8084/9401-02) concerning the Proctor values used in the construction of the radon cover system at the facility. Should you have questions regarding this submittal, please contact me at (405) 842-1773.

Sincerely,

Bill Ferdinand, Manager  
Radiation Safety, Licensing &  
Regulatory Compliance

xc: F. Fossey - RAMC (Lisbon)  
M. Freeman - RAMC (Oklahoma City)  
NRC Director, Division of Safety and Safeguards - (Arlington, Texas)  
file

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94-1905

IE-07

RIO ALGOM MINING CORP.  
Responses To NRC Inspection Violation  
Letter Dated July 21, 1994

I. Notice of Violation

"License Condition 24 requires, in part, that the license immediately notify the NRC, Uranium Recovery Field office, by telephone and telegraph, of any failure to the tailings dam or tailings discharge and return system which results in a release of radioactive material and/or of any unusual condition which, if not corrected, could lead to such a failure.

Contrary to this condition, immediate notification was not made to the NRC on March 28, 1994, when the licensee noted significant damage to the interior embankment of the upper evaporation pond which had occurred during a heavy storm. The embankment damage was an unusual condition sufficient to impair the integrity of the clay pond liner. A report of this damage was not made to the NRC until April 20, 1994, after the licensee noticed actual migration of contaminated solutions through the embankment."

Rio Algom's Responses To Notice of Violation

I. The Reason For the Violation, If Admitted

Rio Algom believed it complied with the requirements of license condition No. 24. and the regulation at 10 CFR §40.60(b)(2)(iii) for notification to NRC. Contrarily, the NOV states that Rio Algom violated condition #24 as it did not immediately report the embankment damage as an unusual event which was sufficient to impair the integrity of the clay pond liner. NRC states in its inspection report that Rio Algom should have

initially notified the Commission pursuant to the language in license condition #24 on March 28, 1994.

Rio Algom however, believes it was in compliance with condition #24 as the first indication that the clay liner's integrity may have been compromised in such a manner to sufficiently impair the integrity of the clay pond liner was on April 20, the date which Rio Algom notified NRC, not the March 28 date.

The March 28 date referred to in NRC's inspection report is the date when facility personnel first noted the additional wind wave notching of the upper tailings evaporation cell. This additional notching accentuated the existing wind wave notching on the face of the in-slopes which is inherent in all naturally lined embankments. The additional notching was primarily the result of a storm that occurred on Friday, March 25.

In this regards, Rio Algom is unsure of report's statement on page 6 which appears to indicate there was no prior wind wave notching on the in-slope of the embankment. The report states:

*"The licensee representatives stated that the damage occurred as a result of the heavy storm which occurred on March 25, 1994, and that prior to this time no such damage had been observed."*  
[Emphasis Added]

This is not correct as prior to the March 25 storm, the in-slope of the evaporation cell contained some notching due to previous wind wave action that is inherent in all naturally lined impoundments.

The examination of the additional wind wave notching by facility personnel on March 28 provided no physical evidence that the clay liner beneath the "silt" layer had been compromised by the notching action. This conclusion was based on visual examination of the notching by facility personnel. At the time of inspection on March 28, only silt material was visually apparent to the inspector as the solution level within the evaporation



**RIO ALGOM MINING CORP.**  
**Responses To NRC Inspection Violation**  
**Letter Dated July 21, 1994**

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cell was 6693.14 feet MSL, which near this evaporation cell's freeboard limit of 6694.0 feet MSL.

Thus, on March 28, when facility personnel first notice some additional notching above the water line, it was not possible to visually confirm that the clay liner system may have been compromised without first draining the evaporation cell. Further, since there was no other evidence which would suggest the loss of the evaporation cells integrity, Rio Algom had no reason to believe that a condition existed which would lead to a leak of the evaporation cell liner thereby necessitating notification to NRC.

This is demonstrated in Plot 1 which is enclosed in Appendix A. Plot 1 shows the general as-built conditions of the in-slope of the upper tailings evaporation cell and the solution level in evaporation cell on March 28. Because the visual inspection combined with the fact that there was no other evidence suggesting that the integrity was questioned, Rio Algom did not believe that license condition #24 was applicable as there was not an indication of any failure or any likely failure of the evaporation pond liner system.

Rather, the first indication of any unusual event was on April 20 when Rio Algom initiated work to repair and dress the upper evaporation cell. It was observed by facility personnel that in one area of the embankment, the surface area deflected upon heavy equipment movement. It was at this time that facility personnel first suspected there might be a compromise in the evaporation pond liner system. Once again, as was the situation on March 28, the inspection on April 20 could not identify any visual evidence that the clay layer covered by the silt material may have been compromised. The solution level on April 20 was slightly higher than on March 28 with an elevation of 6693.24 feet MSL. This level is also depicted on Plot 1.

Due to the deflection observation by facility personnel, and the inability to determine through visual means the exact extent of notching, several small core holes were cut into various portions of the berm on April 20 to better ascertain the berm condition. Initially,

two core holes were placed on the in-slope of the evaporation cell. Both of these core holes indicated the earthen material beneath the clay liner on the in-slope of the evaporation cell was moist. Two other core holes were placed in the middle of the berm and on the out-slope of the evaporation pond embankment. The core hole in the middle of the embankment indicated the underlying material was moist while the core hole placed on the outslope of the evaporation cell was dry. These tests were the first actual information facility personnel had that indicated the integrity of the evaporation cell liner may have been compromised. Based on this information, Rio Algom then notified NRC officials on April 20. Prior to April 20, Rio Algom did not have information to suggest a condition sufficient to compromise the integrity of the evaporation cell liner system had occurred.

Subsequent to Rio Algom's telephone notification on April 20, the solution level within the upper evaporation cell was lowered by transferring the solutions to the lower tailings evaporation cell. It was only during this transfer of solutions from the upper to the lower tailings evaporation cell that the nature of the wind wave action was fully determined.

Prior to the removal of the solutions from the evaporation cell, the extent of damage could not be seen by visual inspections. At the time of NRC's inspection on June 28 the solution level had been drawn down to 6690.33 feet MSL, well below the elevation where the extent of the notching damaged could be visually seen. This level is also shown on Plot 1.

Rio Algom believes that its actions were consistent and in compliance with license condition #24 and 10 CFR §40.60(b)(2)(iii) based on the information available to facility personnel on March 28 and April 20, and combined with the lack of any other indication that would suggest a possible compromise the evaporation cell system liner.

It should also be noted that there was no release of radioactive active material from the evaporation cell or through the embankment as stated in the NOV, or to the stability of the evaporation cell. All solutions were maintained within the embankment and as field



testing indicated the earthen material was moist only along the in-slope areas and in a few places in the middle section of the embankment. There was no visual indication of solutions reaching the outslope and none of the field tests indicated that the solutions had yet migrated to the out-slope areas of the embankment.

In making an examination and a subsequently drawing a conclusion regarding damage to the liner after the solutions have been removed, as was the situation during the NRC inspection of June 28, ignores the actual field conditions present during the time period when facility personnel were inspecting the evaporation cell. Without the benefit of the solutions being removed from the evaporation cell, facility personnel had to utilize the information and conditions known to them at the time. This fact combined with knowledge that there were no other indications that suggested a condition sufficient to compromise the evaporation cell liner integrity, indicated to facility personnel that there was not a situation requiring reporting under license condition #24. Based on the information available at the time, Rio Algom believes that it acted in compliance and in good faith with its reporting of the event on April 20 and respectfully requests that NRC withdraw the issuance of this violation.

## 2. The Corrective Steps Which Have Been Taken and The Results Achieved:

Although Rio Algom respectfully submits that it was in compliance license condition #24 and 10 CFR §40.60(b)(2)(iii) and believes that the issuance of the NOV is inappropriate and should be rescinded, concurrent with notification to NRC on April 20, Rio Algom immediately proceeded to initiate repairs on the upper tailings evaporation cell.

The corrective actions implemented to repair the upper evaporation cell included the removal of the solutions from upper evaporation cell by siphoning the fluids to the lower tailings evaporation cell. Siphoning continues to remove solutions from the upper tailings evaporation cell to the lower tailings evaporation cell.



Since the April 20 notification, construction on top and along the out-slope portions of the original berm to reinforce and strengthen the berm have been completed. The re-construction of the berm and outslope utilized previous construction parameters approved by NRC to construct the lower tailings evaporation cell dated February 24, 1993, included conducting a compaction test a minimum of every 500 yard<sup>3</sup> with the material passing 95% standard Proctor. Other construction specifications utilized during the construction included using  $\pm 2\%$  optimum moisture and performing; (1) a five point proctor every 5,000 yards<sup>3</sup>; (2) a one point proctor every 2,500 yards<sup>3</sup>; (3) an Atterberg Limit Test once per day when a minimum of 150 yards<sup>3</sup> is placed and; (4) a soil gradation each 1,000 yards<sup>3</sup>.

The re-constructed outslopes of the upper tailings evaporation cell have maintained their approved 2:1 grade and width of the berm. The elevation of the berm remains at 6696 ft (msl).

Subsequent to Rio Algom's April 20 notification, on May 16, NRC representative Mr. Ted Johnson and Daniel Rom visited the facility to review the situation and inspect the corrective measures being implemented by Rio Algom. It was concluded based on discussions with the NRC personnel, the measures being implemented by Rio Algom were appropriate.

An additional assessment was conducted also by Mr. Ken Klebba, P.E., an outside consultant from EarthFax Engineering. Mr. Klebba visited the site on May 2 and concluded there was no stability or potential failure problems associated with the embankments and that Rio Algom's corrective measures were acceptable. Mr. Klebba's assessment was forwarded to NRC as part of the facility's Annual Tailings Technical Evaluation Report.

Rio Algom is presently waiting for the in-slope portions of the evaporation cell to sufficiently dry to safely allow and support equipment use.

3. The Corrective Steps Which Will be Taken to Avoid Further Violations:

Rio Algom believes that it was in compliance with the regulatory requirements as previously stated in the discussion above.

4. The Date When Full Compliance Will Be Achieved:

Rio Algom was in compliance with the applicable requirements on April 20, 1994.

**RIO ALGOM MINING CORP.**  
**Responses To Unresolved Item (40-8084/9401-02)**  
**Letter Dated July 21, 1994**

The following responses address NRC's question regarding whether the appropriate Proctor values were used utilized in the construction of the tailings cover and the two evaporation ponds.

In responding to this item, it is first important to address the history of the operation, the reclamation plan and its subsequent implementation to lay the framework for the construction of the radon cover and its appropriate Proctor values.

The mill facility which initiated operations in May 1972, operated continuously until October 1988, when the mill facility was placed on stand-by due to exhaustion of available ore reserves. Within this time frame, Rio Algom submitted its original reclamation plan to the NRC on December 31, 1985. The final reclamation plan was officially approved by NRC on September 29, 1993.

During this period between when the reclamation plan was submitted and finally approved, and with the NRC knowledge and concurrence, Rio Algom proceeded with stabilizing the surface of the upper tailings impoundment (May 1989). After the surface was stabilized by the addition of an average 1.4 feet of fill, the construction of the clay layer as proposed in the reclamation plan was initiated in April 1990.

During the construction of the cover material layers for the upper tailings impoundment and evaporation cell which were performed in unison with each other, Rio Algom's geotechnical consultants EarthFax Engineering, Salt Lake City, continuously inspected and directed the construction of the cover system to ensure that it proceeded pursuant to the proposed QA/QC specifications. This included compaction testing and utilization of the appropriate Proctor values.

EarthFax, to assure the clay layer was being conservatively constructed for both the upper tailings impoundment and later the upper evaporation cell, initially developed a maximum dry

density control value for field compaction by averaging the first 3 compaction density results from Garco Testing Laboratories, an soil testing lab in Salt Lake City. These maximum dry densities as reported by Garco were 113.1, 116.9, and 117.6 pcf for an average of 115.9 pcf. As such, EarthFax selected 116 pcf as the initial maximum dry density control value used in the construction of the clay layer. These laboratory compaction testing results are enclosed in Appendix B.

To adjust and keep correct this selected control value for determining successful passing of the 95 % of standard Proctor density, EarthFax employed a cumulative average methodology for the compaction tests to assure the compaction values used in the construction of the cover continued to be acceptable.

Thus, in April 1990, when the construction of the clay cover layer commenced on the upper tailings impoundment, the 95 % standard Proctor value from the maximum dry density of 116 pcf was used as the control value to determine the compaction acceptability. As construction continued, additional Proctor curves indicated that the maximum dry density was lower than that selected by EarthFax. Proctor results completed after the start of construction indicated the maximum dry densities were typically from 106 to 111 pcf. Rather than prematurely lowering the 116 pcf maximum dry density control value, EarthFax continued to use this higher dry density value to assure acceptable compaction results which exceeded 95 % of standard Proctor. This hesitancy to reduce the compaction control value resulted in actual field compaction being higher than would have been the case if the subsequent lower dry density test values were used to establish 95 % of standard Proctor.

This conservatism continued as Earthfax only slowly lowered the acceptable Proctor values through time in response to sample results which indicated lower compaction values of the cover materials were appropriate. As previously mentioned, EarthFax utilized a cumulative average cross-check to assure the overall consistency of the program and to justify the lowering the maximum dry density control value from which the 95 % Proctor value was selected. This is shown in Table 1. The compaction test results in this table are attached in Appendix B.

TABLE 1  
COMPACTION DENSITY COMPARISONS - CLAY MATERIAL (pcf)

Test Date <sup>(1)</sup>	Maximum Dry Density Control Value	Compaction Test Dry Density	Cumulative Average Density	Rolling Average Density
06-Mar-89	116.0	113.1	113.1	113.1
06-Mar-89	116.0	116.9	115.0	115.0
06-Mar-89	116.0	117.6	115.9	115.9
20-Nov-89	116.0	110.4	114.5	114.5
20-Nov-89	116.0	111.3	113.9	113.9
24-Apr-90	116.0	106.5	112.6	112.6
30-Apr-90	116.0	105.7	111.6	111.6
16-May-90	114.0	106.1	111.1	111.0
01-Jun-90	114.0	109.8	110.8	110.5
24-May-90	114.0	106.9	110.4	109.3
07-Jun-90	114.0	110.5	110.4	108.4
13-Jun-90	114.0	110.9	110.5	108.5
22-Jun-90	112.0	109.0	110.4	108.2
08-Jun-90	112.0	108.7	110.1	108.5
14-Jun-90	112.0	115.4	110.6	109.7
22-Jun-90	112.0	114.4	110.8	110.7
21-Jun-90	112.0	113.9	110.9	111.2
20-Jun-90	112.0	107.3	110.7	111.3
27-Jun-90	112.0	114.3	110.9	111.7
11-Jul-90	112.0	106.6	110.8	111.2
26-Jul-90	112.0	108.9	110.8	111.2
01-Aug-90	112.0	107.9	110.6	111.1
08-Aug-90	112.0	107.3	110.5	110.1
14-Aug-90	111.2	108.4	110.4	109.3
21-Aug-90	111.2	112.0	110.5	109.1
06-Sep-90	111.2	107.2	110.3	109.1
09-Sep-90	111.2	115.2	110.4	109.2
18-Sep-90	111.2	112.0	110.5	109.9
25-Sep-90	111.2	105.5	110.3	109.4
09-Oct-90	111.2	106.7	110.2	109.3
Average	112.9	110.2	111.3	110.8

(1) Presented in the chronological order that EarthFax received back from lab.



As shown in Table 1, the column labelled as "Maximum Dry Density Control Value", contains the maximum dry densities EarthFax employed to determine if compaction result passed the 95 % Proctor values. The column labelled as "Compaction Test Dry Density" contains the results from the Proctor Curve tests performed on the material during the construction as part of the QA/QC program. As demonstrated in this table, EarthFax continued its conservatism throughout the construction of the upper tailings impoundment and upper evaporation cell as the "Maximum Dry Density Control Value" were almost always consistently higher than the "Compaction Test Dry Density" results, thus assuring the overall conservatism of the construction.

The values in the column labelled as "Cumulative Average Density" contains the cumulative average employed by EarthFax to assure that its selected control values in the "Maximum Dry Density Control Value" column were acceptable and within the envelope of confidence.

The overall results of EarthFax's methodology indicated that the average maximum dry density control value (112.9 pcf) is 2.7 pcf higher than the average compaction test Proctor curve value (110.2 pcf) as found in the "Compaction Test Dry Density" column. As clearly shown, the clay cover system that was constructed were conservative and resulted in actual compaction densities that would have greatly exceeded 95% of standard Proctor had the lower compaction Proctor test results been used for the control values.

For comparison purposes, also shown in Table 1 is another column entitled "Rolling Average Density". This column represents the average of the previous eight (8) maximum dry density values. This methodology was subsequently developed after a NRC inspection at the Lisbon facility on July 30-31, 1990.<sup>(1)</sup> During the inspection, the NRC inspector reviewed the maximum dry density for establishing the adequacy of the field compaction and noted that maximum dry densities selected by EarthFax were higher than the routine Proctor curve test

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<sup>(1)</sup> U.S. Nuclear Regulatory Commission, "Inspection Report 40-8084/90-01", August 13, 1990.

results. Although the maximum dry densities used by the Lisbon facility were conservative, the inspector indicated the lower maximum dry densities were more realistic values.<sup>(2)</sup>

Based on the recommendation and observations of the inspector, the rolling average methodology was set up and used to determine the maximum dry density control values for the lower tailings impoundment and evaporation cell. This system was subsequently reviewed and found to be acceptable by NRC. NRC stated in a follow-up inspection report:

*"The licensee is currently controlling the fill density and moisture based on the average of the previous eight test results for each material type. After reviewing the available laboratory compaction and classification data, it was determined that this method of determining the control values is acceptable due to the homogeneity of the material."* <sup>(3)</sup> [Emphasis Added]

Thus, for comparison purposes as this method was found to be acceptable by NRC, the "Rolling Average Density" column is presented and reconfirms that the selected maximum dry density control values used at the facility are appropriate, conservative and verifies that the cover material was compacted above the 95% Proctor density values. The overall average for the "Maximum Dry Density Control Value" was 112.9 pcf in comparison to the "Rolling Average Density" that was lower with a value of 110.8 pcf.

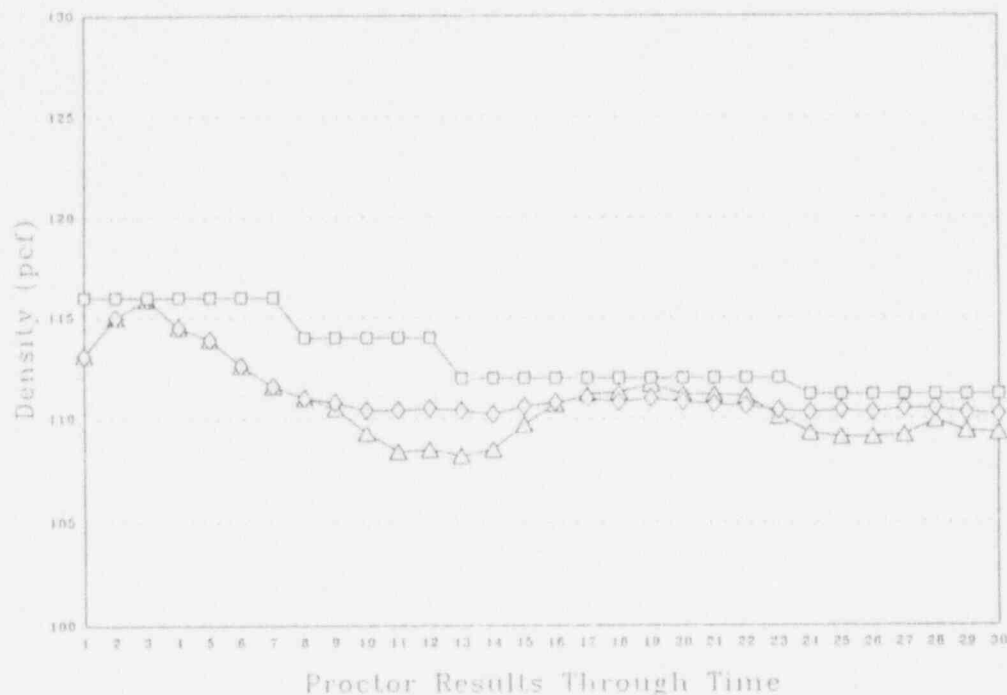
Presented as Figure 1, is a graph which shows each of the various densities and their relationship to the maximum dry density control value used during the construction of the clay cover layer on the upper tailings impoundment and evaporation cell. As demonstrated in the graph, the utilized control values did not result in the emplaced clay materials being compacted below the minimum density values.

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<sup>(2)</sup> Id. at 1, page 8

<sup>(3)</sup> U.S. Nuclear Regulatory Commission, "Inspection Report No. 40-8084/92-01", Page 6.

FIGURE 1  
COMPACTION DENSITY COMPARISON - CLAY



□ Used Max. Density ◇ Cum. Average Density △ Rolling Ave. Density

EarthFax employed the same methodology in regards to the silt material placed over the clay cover on the upper tailings impoundment and evaporation cell. The maximum dry density control value initially selected by EarthFax in March 1990 prior to placement of the silt material was 114.0 pcf. This maximum dry density control value was selected for conservatism by EarthFax based on the average of four (4) borrow area samples results from Garco Testing Laboratories and Dames & Moore. The average of these four samples was 113.1 pcf. Due to the spread in the data results which ranged from 108.7 to 121.3 pcf, to be conservative EarthFax chose to increase the initial control value from 113.1 to 114.0 pcf. These tests are attached in Appendix C.

As shown in Table 2, EarthFax modified the maximum dry density control value to 113.3 pcf in mid-July 1990 after it received two (2) additional compaction test results to better reflect the silt compaction density. The compaction results from this table are also enclosed in Appendix C.

TABLE 2  
COMPACTION DENSITY COMPARISONS - SILT MATERIAL (pcf)

Test Date	Maximum Dry Density Control Value	Compaction Density Test Result	Cumulative Average Density <sup>(1)</sup>	Cumulative Average Density <sup>(2)</sup>	Rolling Average Density
26-Oct-86	114.0	121.3	121.3	121.3	121.3
06-Mar-90	114.0	108.7	115.0	108.7	108.7
06-Mar-90	114.0	110.5	113.5	109.6	109.6
06-Mar-90	114.0	111.9	113.1	110.4	110.4
11-Jul-90	113.3	112.0	112.9	110.8	110.8
19-Jul-90	113.3	114.8	113.2	111.6	111.6
05-Sep-90	113.3	117.1	113.8	112.5	112.5
14-Sep-90	113.3	116.0	114.0	113.0	113.0
20-Sep-90	113.3	115.0	114.1	113.3	113.3
24-Sep-90	113.3	112.9	114.0	113.2	113.8
02-May-91	114.0	115.0	114.1	113.4	114.3
14-May-91	114.0	117.0	114.4	113.7	115.0
21-May-91	114.0	112.0	114.2	113.6	115.0
29-May-91	114.0	118.3	114.5	113.9	115.4
04-Jun-91	114.0	117.5	114.7	114.2	115.5
11-Jun-91	114.0	109.8	114.4	113.9	114.7
13-Jun-91	114.0	111.5	114.2	113.7	114.2
18-Jun-91	114.0	115.5	114.3	113.8	114.6
20-Jun-91	114.0	118.3	114.5	114.1	115.0
25-Jun-91	114.0	117.9	114.6	114.3	115.1
30-Jun-91	114.0	115.0	114.7	114.3	115.5
10-Jul-91	114.0	119.8	114.9	114.6	115.6
16-Jul-91	114.0	118.0	115.0	114.7	115.7
22-Jul-91	114.0	118.5	115.2	114.9	116.8
Averages	113.8	114.9	114.5	113.1	113.7

(1) Cumulative Average with 10/26/86 compaction result.

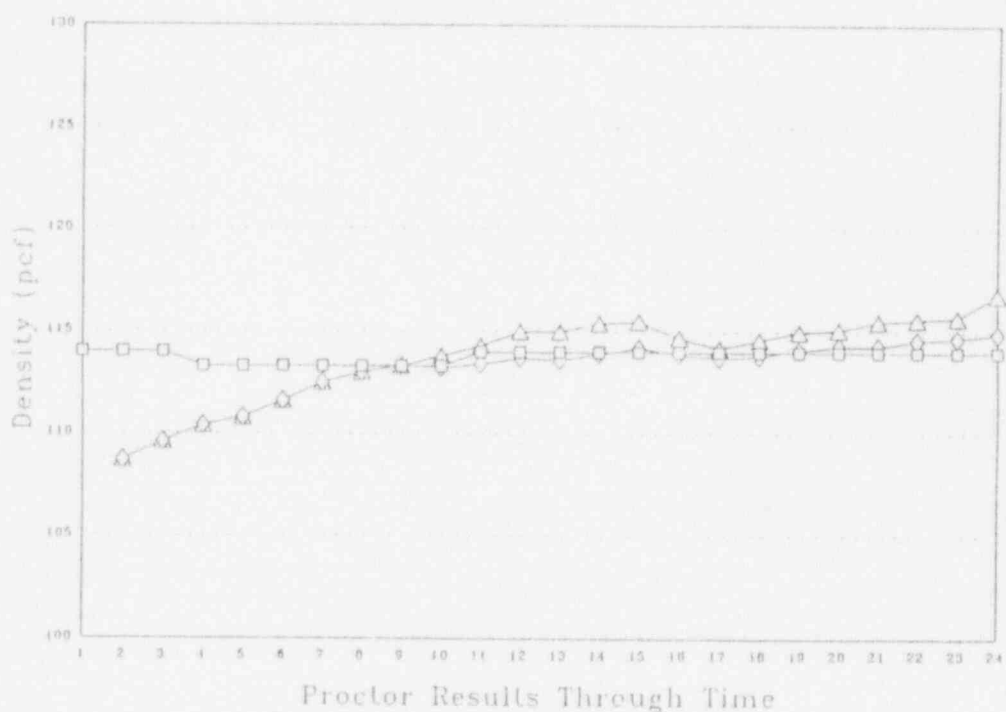
(2) Cumulative Average without 10/26/86 compaction result.

In May 1991, based on the average of the Proctor tests, EarthFax increased the maximum dry density control value to 114.0 pcf. This maximum dry density control value was kept for the remainder of the silt placement on the upper tailings impoundment and evaporation cell as the cumulative average used by EarthFax continued to indicate that the maximum dry density of

114.0 pcf was accurately reflecting the overall compaction composition and variability of the silt material.

This is shown in Table 2 as the cumulative average density values monitored by EarthFax closely match the use maximum dry density control values throughout the construction period on the upper tailings impoundment and evaporation cell. As with most soils, there is a naturally variability of densities, even when the soil is relatively homogeneous. EarthFax used the cumulative methodology to assure that compaction was consistent especially when the Proctor values indicated the dry density may vary both below and above the maximum dry density control value. This is also seen in the closeness of the graphed lines as presented in Figure 2. As indicated, the "Maximum Dry Density Control Value" plot closely approximates the "Cumulative Average Density" plot.

FIGURE 2  
COMPACTION DENSITY COMPARISON - SILT



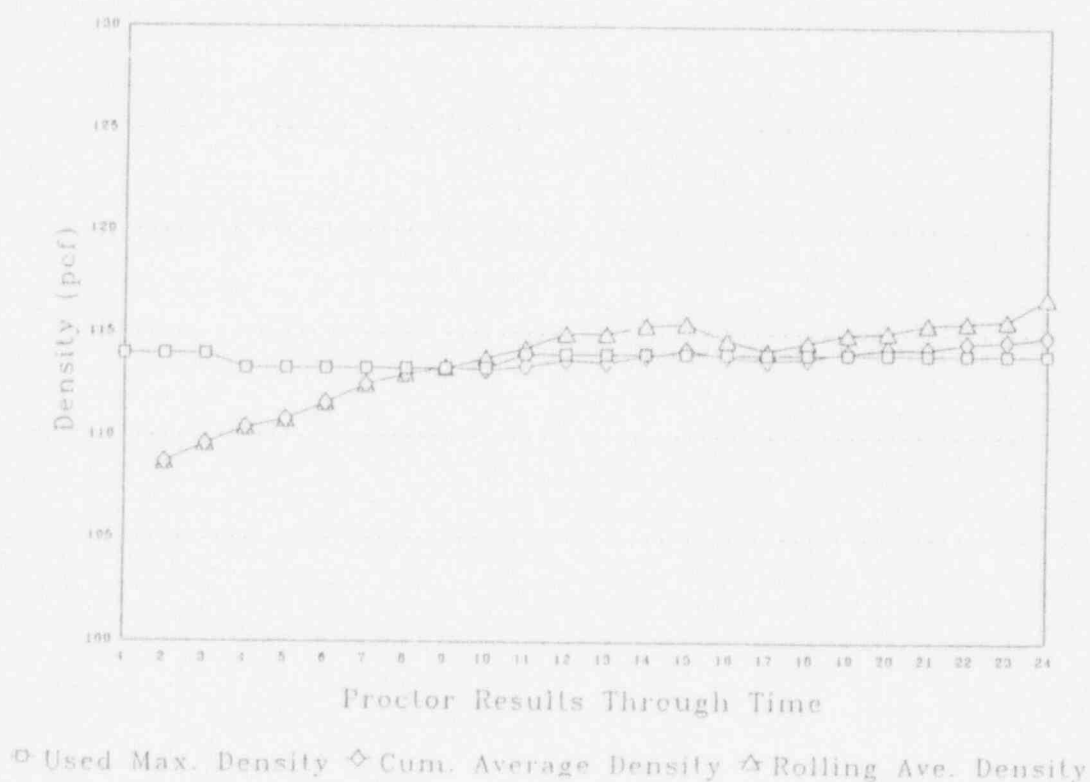
◻ Used Max. Density ◊ Cum. Average Density △ Rolling Ave. Density



114.0 pcf was accurately reflecting the overall compaction composition and variability of the silt material.

This is shown in Table 2 as the cumulative average density values monitored by EarthFax closely match the use maximum dry density control values throughout the construction period on the upper tailings impoundment and evaporation cell. As with most soils, there is a naturally variability of densities, even when the soil is relatively homogeneous. EarthFax used the cumulative methodology to assure that compaction was consistent especially when the Proctor values indicated the dry density may vary both below and above the maximum dry density control value. This is also seen in the closeness of the graphed lines as presented in Figure 2. As indicated, the "Maximum Dry Density Control Value" plot closely approximates the "Cumulative Average Density" plot.

FIGURE 2  
COMPACTION DENSITY COMPARISON - SILT



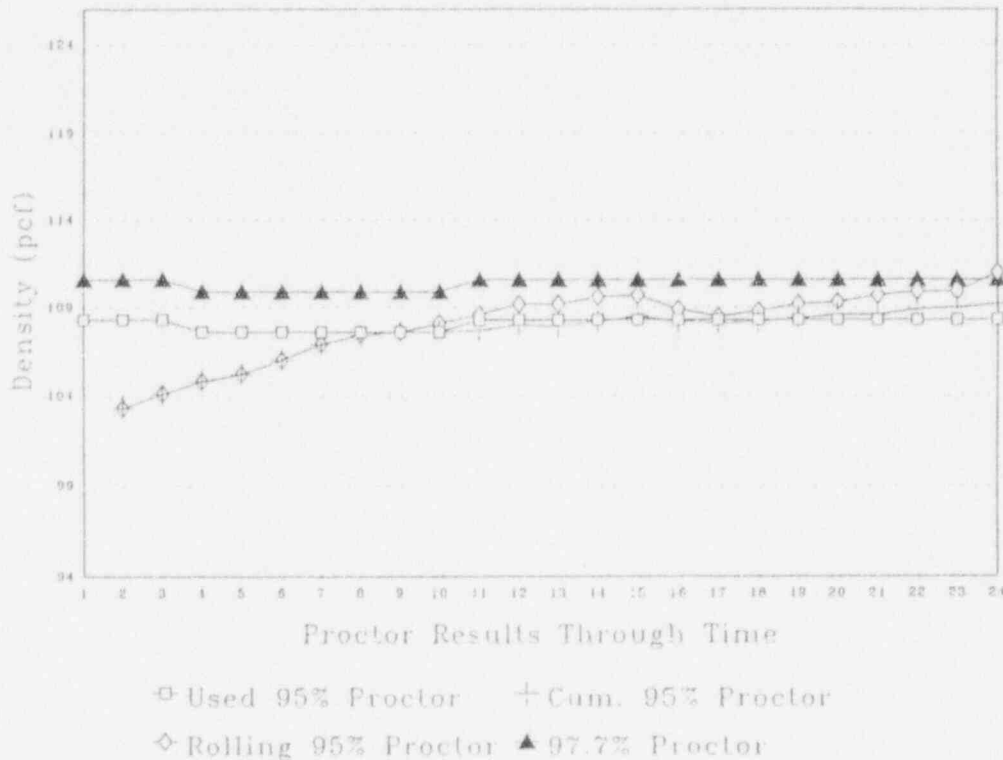
Although the compaction test results indicated variability both below and above the maximum dry density control value as is typical with all soils, EarthFax continued to use the designated maximum dry density control value as the conditioning and mixing of the soils in the borrow area blended the material to the appropriate control value of near 114.0 pcf. This was verified by EarthFax with the use of its cumulative average density that indicated the maximum compaction density was near 114.0 pcf.

Another factor which confirms the emplaced material was sufficiently compacted is the recognition that the actual compaction density results for the silt material far exceeded 95% of standard Proctor. A review of the 312 passing compaction test on the silt material for the upper tailings impoundment and evaporation cell indicates the average compaction density was 97.9% of standard Proctor. This higher compaction density assures that the silt material would meet the minimum compaction standard of 95% of standard Proctor.

This is confirmed by examining Figure 3. This figure compares the 95% standard Proctor density values with the average 97.9% Proctor density value from the maximum dry density control values used by EarthFax. As shown throughout the construction for the upper tailings cover and evaporation cell, the 97.9% average compaction for the silt cover material exceeds both the maximum dry density control values and the cumulative average density used by EarthFax.

Also contained on Figure 3 for comparison purposes, is a plot of the "Rolling Average Density" values. Even when using this NRC approved methodology for determining maximum density compaction control values, the average compaction densities of 97.9% of standard Proctor for the emplaced material reaffirms the appropriateness of the cover system and that the materials sufficiently meet minimum compaction densities.

FIGURE 3  
95% VS 97.7% PROCTOR COMPARISON - SILT



In regards to the lower tailings cover and its evaporation cell, at NRC's recommendation and subsequent approval, Rio Algom employed a "Rolling Average Density" methodology to select the maximum dry density control value for field determination of acceptable compaction. The basic premise of this methodology is to provide a realistic maximum dry density compaction value that is representative of the type of material being placed while taking into account the inherent variability of all soils that are relatively generally homogeneous.

Another important aspect of this methodology used during material construction was that if the field engineer noted a significant change in the soil material, he would begin another rolling average to assure the density was representative of the material characteristics.

At the commencement of placing clay cover on the lower tailings impoundment the maximum dry density control value used for determining acceptable field compaction was 111.2 pcf. This control value was selected to begin the construction program on the lower tailings area as it had been demonstrated during the construction of the upper tailings clay cover to be a conservative value thus continuing to assure that compaction densities would meet 95% standard Proctor.

Presented in Table 3 are the results of the "Rolling Average" methodology. The compaction data in the table are in Appendix D. As demonstrated in this table, throughout the construction of the clay cover on the lower tailings impoundment after the initial selection of the maximum dry density control value, the control value utilized was the same or a little higher than the average rolling average. This assured the soil emplaced had a compaction that met or exceeded 95% of standard Proctor.

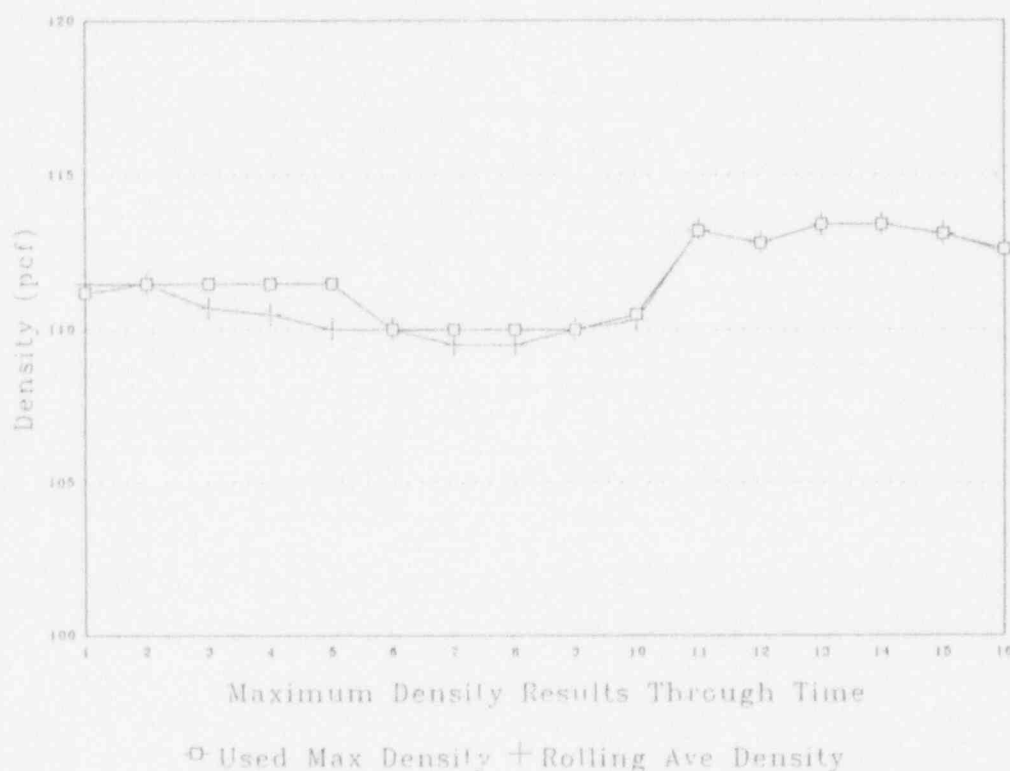
TABLE 3  
COMPACTION DENSITY COMPARISONS - CLAY MATERIAL (pcf)

Rolling Average Set Number	Maximum Dry Density Control Value	Rolling Average Density	Density Results Used To Obtain Rolling Average							
1	111.2	111.5	110.0	112.5	111.0	113.7	112.5	115.3	107.0	110.1
2	111.5	111.5	110.0	112.5	111.0	113.7	112.5	115.3	107.0	110.1
3	111.5	110.7	106.2	111.0	108.5	113.2	112.8	110.0	112.5	111.0
4	111.5	110.5	109.5	106.2	111.0	108.5	113.2	112.8	110.0	112.5
5	111.5	110.0	109.1	109.5	106.2	111.0	108.5	113.2	112.8	110.0
6	110.0	110.0	109.5	109.1	109.5	106.2	111.0	108.5	113.2	112.8
7	110.0	109.5	108.8	109.5	109.1	109.5	106.2	111.0	108.5	113.5
8	110.0	109.5	113.5	108.8	109.5	109.1	109.5	106.2	111.0	108.5
9	110.0	110.0	112.5	113.5	108.8	109.5	109.1	109.5	106.2	111.0
10	110.5	110.3	113.5	112.5	113.5	108.8	109.5	109.1	109.5	106.2
11	113.2	113.2 <sup>(1)</sup>	113.5	112.5	113.5					
12	112.8	112.8	111.5	113.5	112.5	113.5				
13	113.4	113.4	116.2	111.5	113.5	112.5	113.5			
14	113.4	113.4	113.0	116.2	111.5	113.5	112.5	113.5		
15	113.1	113.1	111.8	113.0	116.2	111.5	113.5	112.5		
16	112.6	112.5	109.3	111.8	113.0	116.2	111.5	113.5	112.5	

(1) Field engineer noted change in the material warranted the initiation of a new rolling average.

This table has been plotted and is shown as Figure 4. As seen, the maximum dry density control value selected allows the cover material to be placed and compacted to account for the inherent variability of the soil while incorporating the necessary controls to assure the material is compacted to density that is at least 95% of Standard Proctor.

FIGURE 4  
COMPACTION DENSITY COMPARISON - CLAY



Additionally, actual compaction results re-confirm that the emplaced material were sufficiently compacted. A review of the 496 passing compaction test on the clay material for the lower tailings cover system indicates the average compaction density was 97.8% of standard Proctor. This higher compaction density assures this clay material meets and exceeds the minimum compaction values.

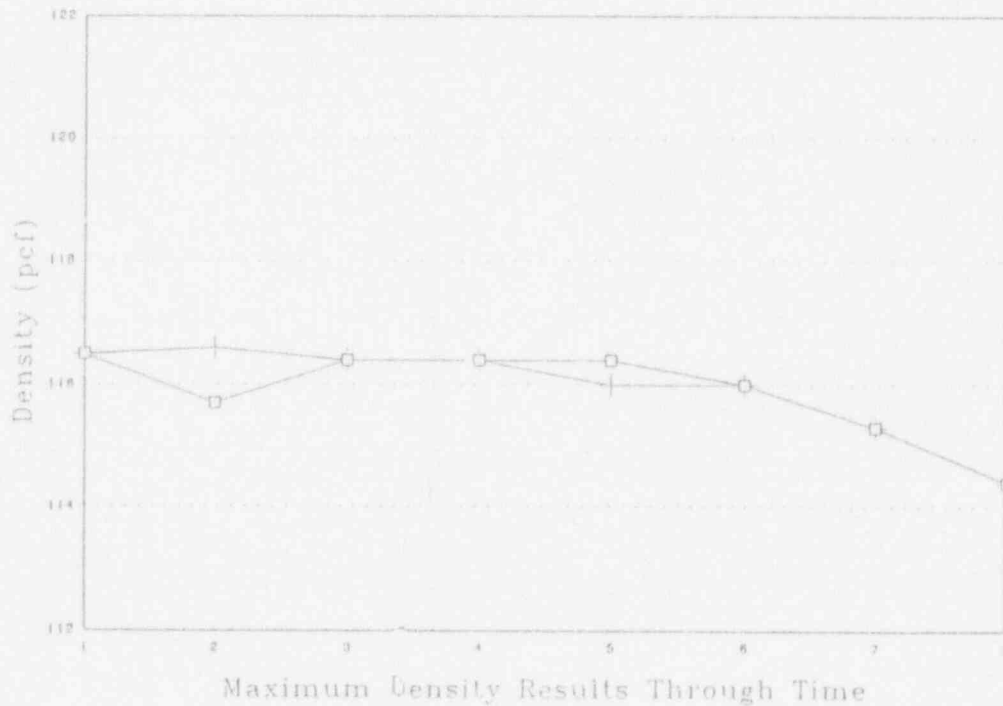


The silt material also utilized the "Rolling Average" methodology. The results of this methodology are presented in Table 4 and enclosed in Appendix E. For easy comparison, the table is graphed as Figure 5.

TABLE 4  
COMPACTION DENSITY COMPARISONS - SILT MATERIAL (pcf)

Rolling Average Set Number	Maximum Dry Density Control Value	Rolling Average Density	Density Results Used To Obtain Rolling Average							
1	116.5	116.5	115.8	116.2	118.6	115.4				
2	116.5	116.6	117.0	115.8	116.2	118.6	115.4			
3	116.4	116.4	115.5	117.0	115.8	116.2	118.6	115.4		
4	116.4	116.4	116.2	115.5	117.0	115.8	116.2	118.6	115.4	
5	116.0	116.0	113.0	116.2	115.5	117.0	115.8	116.2	118.6	115.4
6	115.3	115.3	110.2	113.0	116.2	115.5	117.0	115.8	116.2	118.6
7	114.4	114.4	111.5	110.2	113.0	116.2	115.5	117.0	115.8	116.2

FIGURE 5  
COMPACTION DENSITY COMPARISON - SILT



□ Used Max Density + Rolling Ave Density

A review of the passing compaction tests on the silt material for the lower tailings cover indicates the average compaction density was 98.7% of standard Proctor. This higher compaction average re-confirms that the minimum required compaction values have been attained.

The lower tailings evaporation cell which was built after the construction of the lower tailings cover, also used the rolling average method to determine the maximum dry density control values. The clay material on the evaporation cell utilized a maximum dry density control value of 111.0 pcf throughout its placement. Its determination is shown in Table 5. The density results noted in the table are enclosed in Appendix F. This value was used throughout the clay's placement because of the small quantity of clay did not necessitate additional Proctor tests.

TABLE 5  
COMPACTION DENSITY COMPARISONS - CLAY MATERIAL  
LOWER EVAPORATION CELL (pcf)

Rolling Average Set Number	Maximum Dry Density Control Value	Rolling Average Density	Density Results Used To Obtain Rolling Average							
1	111.0	111.0	112.0	111.0	111.8	112.9	111.6	112.0	109.3	107.5

As indicated by the density values, the rolling average methodology results in control values which are representative and provide the necessary control to assure that compaction meets at least 95% standard Proctor while also accounting for the natural variability that is inherently found in all relatively homogeneous soils.

A review of the passing compaction tests on the clay material for the lower tailings evaporation cell indicates the average compaction density was 98.7% of standard Proctor. This higher compaction value again re-confirms that compaction results exceeds the overall required compaction values.

The silt material placed upon the clay on the evaporation cell also used the rolling averages and the maximum dry density control values as shown on Table 6. These values are also contained in Appendix F.

TABLE 6  
COMPACTION DENSITY COMPARISONS - SILT MATERIAL  
LOWER EVAPORATION CELL (pcf)

Rolling Average Set Number	Maximum Dry Density Control Value	Rolling Average Density	Density Results Used To Obtain Rolling Average							
1	115.3	115.3	123.0	111.5	110.2	113.0	116.2	115.5	117.0	115.8
2	115.6	115.6	118.1	123.0	111.5	110.2	113.0	116.2	115.5	117.0
3	115.5	115.5	116.7	118.1	123.0	111.5	110.2	113.0	116.2	115.5
4	115.8	115.8	117.5	116.7	118.1	123.0	111.5	110.2	113.0	116.2
5	115.3	115.3	112.4	117.5	116.7	118.1	123.0	111.5	110.2	113.0
6	115.7	115.7	115.9	112.4	117.5	116.7	118.1	123.0	111.5	110.2
7	116.3	116.3	115.4	115.9	112.4	117.5	116.7	118.1	123.0	111.5
8	116.5	116.5	113.0	115.4	115.9	112.4	117.5	116.7	118.1	123.0
9	115.8	115.8	117.2	113.0	115.4	115.9	112.4	117.5	116.7	118.1
10	115.9	115.9	119.2	117.2	113.0	115.4	115.9	112.4	117.5	116.7
11	116.1	116.1	118.4	119.2	117.2	113.0	115.4	115.9	112.4	117.5
12	115.5	115.5	112.5	118.4	119.2	117.2	113.0	115.4	115.9	112.4
13	116.6	116.6	121.5	112.5	118.4	119.2	117.2	113.0	115.4	115.9
14	116.8	116.8	116.8	121.5	112.5	118.4	119.2	117.2	113.0	115.4
15	116.8	116.8	116.1	116.8	121.5	112.5	118.4	119.2	117.2	113.0
16	118.0	118.0	122.0	116.1	116.8	121.5	112.5	118.4	119.2	117.2
17	117.8	117.8	116.1	122.0	116.1	116.8	121.5	112.5	118.4	119.2
18	117.6	117.6	117.0	116.1	122.0	116.1	116.8	121.5	112.5	118.4
19	117.4	117.4	116.8	117.0	116.1	122.0	116.1	116.8	121.5	112.5

The average compaction result achieved on the placement of the silt material relating to the lower tailings evaporation cell was 96.7% of standard Proctor.

In conclusion, as clearly demonstrated for each of the cover materials on both the upper and lower tailings cover and evaporation cells, the compaction results and the methodologies employed at the facility allowed the emplaced cover materials to be sufficiently compacted to overall meet and exceed the 95% standard Proctor densities.

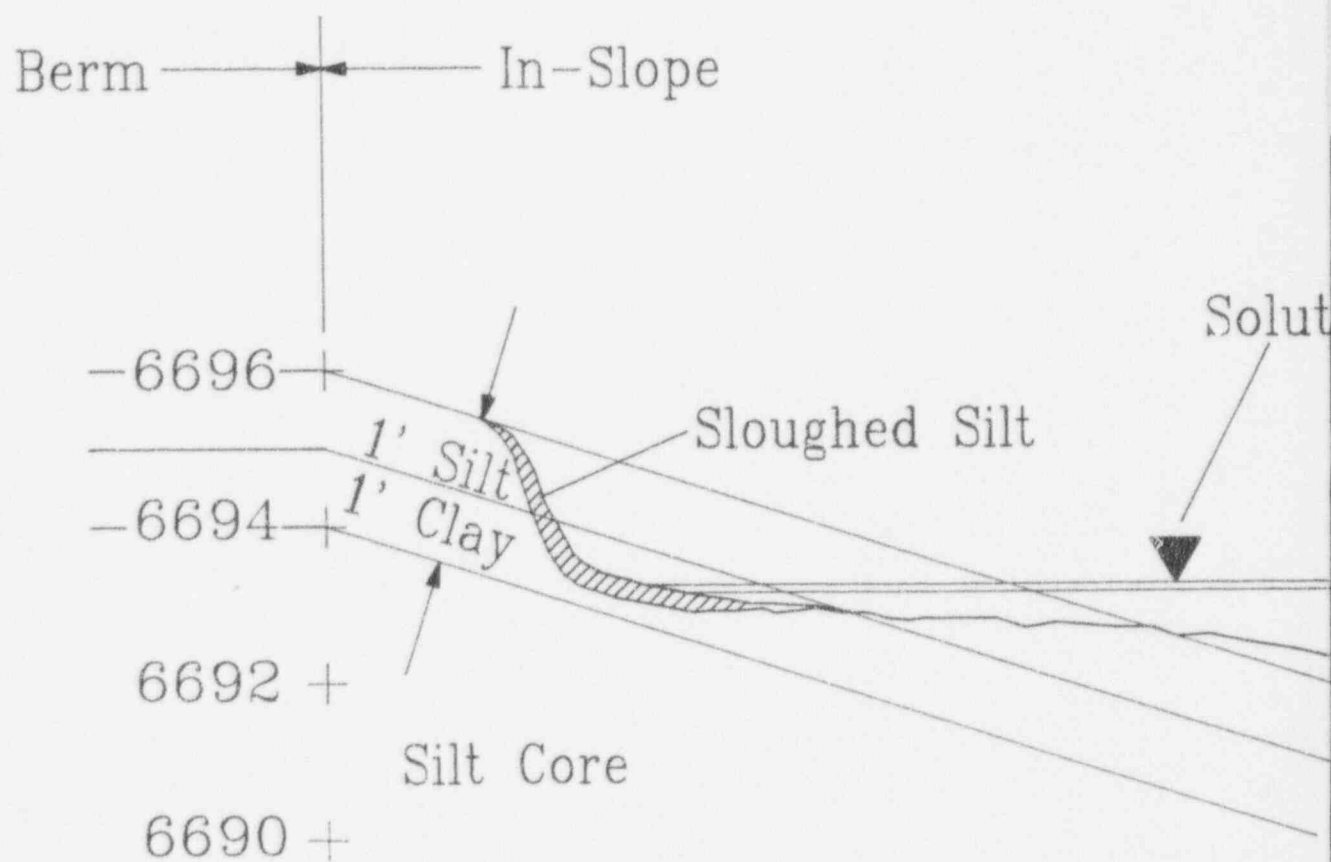
## APPENDIX A

### PLOT 1

# PLOT 1

## UPPER TAILINGS EVALUATION IN-SLOPE & SOLUTION

(Scale - .8" = 1'0")





# PORATION CELL TION LEVELS

ion Level 4/20/94 (6693.24')

Solution Level 3/28/94 (6693.14')

Solution Level 6/28/94 (6690.33')

ANSTEC  
APERTURE  
CARD

Also Available On  
Aperture Card

9410250003-01

## **APPENDIX B**

**UPPER TAILINGS COVER AND EVAPORATION POND**

**CLAY COMPACTION TESTS**



# GARCO TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355  
22-Mar-89

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett

Project: Rio Algom  
Material: Soil Stone, Gray,  
Sample had to be crushed  
from soil stone  
CL  
Source: SS-40-B, BA-4,  
10' - 12'  
Test: T-99 Proctor  
Date: 3/06/89

Lab#: 23174

Maximum Compaction 113.1 p.c.f.  
Optimum Moisture: 14.6 %

ATTERBERG LIMIT  
Lab #23175

Liquid Limit	= 43.6
Plastic Limit	= 24.4
Plastic Index	= 19.2

Sincerely,

Tom McNamee  
Lab Manager

National Voluntary  
Laboratory Accreditation  
Program



Member ASTM, ACI, AGC

United States Department  
of Commerce Accredited



# **GARCO** TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

22-Mar-89

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett

Project: Rio Algom  
Material: Gray Soil Stone  
Sample had to be crushed  
from Soil Stone  
CL  
Source: SS-36-C, BA-2,  
8'-12'  
Test: T-99 Proctor  
Date: 3/06/89

Lab#: 23150

Maximum Compaction 116.9 p.c.f.  
Optimum Moisture: 12.3 %

ATTERBERG LIMIT  
Lab #23151

Liquid Limit	= 42.4
Plastic Limit	= 20.3
Plastic Index	= 22.1

Sincerely,

Tom McNamee  
Lab Manager

National Voluntary  
Laboratory Accreditation  
Program



Member: ASTM, ACI, AGC

United States Department  
of Commerce Accredited



# GARCO TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

22-Mar-89

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett

Project: Rio Algom  
Material: Medium Gray, Clayey Fines  
Poorly Graded  
CH

Source: SS-37-B, BA-2, 9'

Test: T-99 Proctor  
Date: 3/06/89

Lab#: 23158

Maximum Compaction 117.6 p.c.f.  
Optimum Moisture: 7.8 %

## ATTERBERG LIMIT

Lab #23159

Liquid Limit	= 51.8
Plastic Limit	= 19.5
Plastic Index	= 32.3

Sincerely,

Tom McNamee  
Lab Manager

National Voluntary  
Laboratory Accreditation  
Program



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# GARCO TESTING LABORATORIES

532 West 2560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

5071 So Arville  
Las Vegas, Nevada 89118  
Phone (702) 364-8031

November 22, 1989

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett Brooks

Project: Rio Algom  
Material: Grey Clayey Fines,  
Poorly Graded  
Source: Pit 45 DEPTH 6-8.5'  
Test: T-99 Proctor  
Date: 11-20-89

Lab #28387

Maximum Compaction = 110.4 p.c.f.

Optimum Moisture = 15.8%

MEDIUM PLASTICITY CLAY.  
SUITABLE FOR USE AS  
CLAY LAYER.

Atterbert Limit  
Lab #28386

RKB

Liquid Limit = 47.8  
Plastic Limit = 21.7  
Plastic Index = 26.1

IN ACCORDANCE WITH THE RECLAMATION  
OVER DESIGN (APPENDIX L),

$$\begin{aligned} SL &= 5.5 - PI + 0.745(LL) \\ &= 5.5 - 26.1 + 0.745(47.8) \\ &= 15.0 \end{aligned}$$

RKB

Sincerely,

Doug Watson  
General Manager

National Voluntary  
Laboratory Accreditation  
Program



United States Department  
of Commerce Accredited

Member ASTM, ACI, AGC



# GARCO TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

5071 So. Arville  
Las Vegas, Nevada 89118  
Phone (702) 364-8031

November 22, 1989

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett Brooks

Project: Rio Algom  
Material: Tan & Grey Clayey Fines  
Poorly Graded  
Source: Pit ~~45~~ SS-46 DEPTH 2.5'-6'  
Test: T-99 Proctor  
Date: 11-20-89

Lab #28389

Maximum Compaction = 111.3 p.c.f.

Optimum Moisture = 15.0%

## Atterbert Limit

Lab #28388

Liquid Limit = 35.4

Plastic Limit = 18.2

Plastic Index = 17.2

IN ACCORDANCE WITH THE RECLAMATION COVER  
DESIGN (APPENDIX L),

$$\begin{aligned} SL &= 5.5 - PI + 0.745(LL) \\ &= 5.5 - 17.2 + 0.745(35.4) \\ &= 14.7 \end{aligned}$$

RKB

Sincerely,

Doug Watson  
General Manager

National Voluntary  
Laboratory Accreditation  
Program



United States Department  
of Commerce Accredited

Member ASTM, ACI, AGC

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: RHETT BROOKS Date: APRIL 24, 1990  
 Soil Description: GRAY CLAY NODULES MIXED w/ GRAY-BROWN SILTY CLAY  
w/ SOME FINE SAND

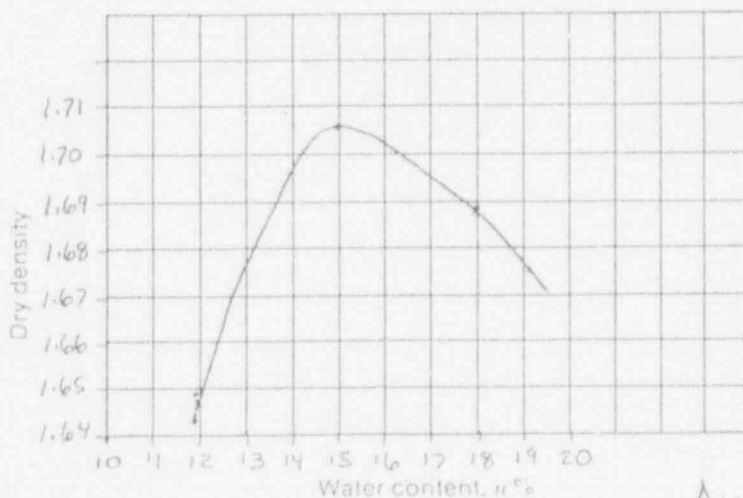
## Water Content Determination

CLAY TEST #1

Trial Number	1	2	3	4	5	6
Cup Number	43	4	45	29	47	11
Tare Weight, g ( $W_c$ )	11.32	11.09	11.40	11.49	11.29	11.02
Tare + Wet Soil, g ( $W_1$ )	71.83	54.27	55.08	86.57	59.56	
Tare + Dry Soil, g ( $W_2$ )	65.40	49.69	49.37	75.12	51.83	
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	54.08	38.60	37.97	63.63	40.54	
Wt of Water, g ( $w = W_1 - W_2$ )	6.43	4.58	5.71	11.45	7.73	
Water Content, % ( $w\% = (w/W_d)100$ )	11.9	11.9	15.0	18.0	19.1	

## Density Determination

Weight of Mold, g ( $W_p$ )	2046					
Mold + Wet Soil, g ( $W_3$ )	3782	3788	3898 <sup>(7)</sup>	3927	3952	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1736	1742	1852	1881	1906	
Volume of mold, cm <sup>3</sup> (V)	944					
Wet Density, g/cm <sup>3</sup> ( $W_v/V = D_w$ )	1.839	1.845	1.962	1.993	2.019	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.643	1.649	1.706	1.689	1.695	



Liquid Limit = 42.2  
 Plastic Limit = 22.1  
 Plastic Index = 20.1  
 Shrinkage Limit = 16.1  
 Soil Class = CL

Optimum Moisture = 15.0 %  
 Maximum Dry Density = 106.5 pcf

AVERAGES  
13.4 %  
112.6 pcf



EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Axtell Date: Apr. 30, 1990  
 Soil Description: Gray Silty Clay, w/some FINE SAND  
 Sample Location: Clay Layer No. 2 Between North Bank + stakes No 11 + 12 (1-11 + 1-12).

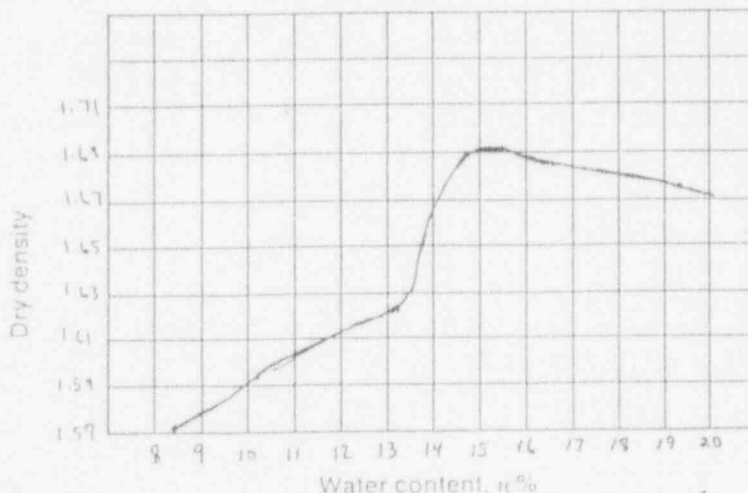
## Water Content Determination

CLAY TEST #2

Trial Number	1	2	3	4	5	6
Cup Number	24	25	30	35	31	
Tare Weight, g ( $W_c$ )	11.74	11.47	11.30	11.38	11.18	
Tare + Wet Soil, g ( $W_1$ )	75.50	65.17	49.94	42.96	45.48	
Tare + Dry Soil, g ( $W_2$ )	70.33	60.17	45.44	38.71	39.92	
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	58.59	48.7	34.14	27.33	28.74	
Wt of Water, g ( $w = W_1 - W_2$ )	4.97	5.0	4.5	4.25	5.56	
Water Content, % ( $w\% = (w/W_d)100$ )	8.483	10.267	13.181	15.551	19.346	

## Density Determination

Weight of Mold, g ( $W_p$ )	2042					
Mold + Wet Soil, g ( $W_3$ )	3653	3702	3775	3887	3929	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1611	1660	1733	1845	1887	
Volume of mold, $\text{cm}^3$ ( $V$ )	944					
Wet Density, $\text{g}/\text{cm}^3$ ( $W_v/V$ ) = $D_w$	1.707	1.758	1.836	1.954	1.999	
Dry Density, $\text{g}/\text{cm}^3$ ( $D_w/(1 + w\%/100)$ )	1.574	1.594	1.622	1.691	1.675	



Liquid Limit = 45.0  
 Plastic Limit = 24.63  
 Plastic Index = 20.367  
 Shrinkage Limit = 17.863  
 Soil Class. = CL

Optimum Moisture = 15.551 %  
 Maximum Dry Density = 1.691 pcf

AVERAGES  
13.6%  
111.6 pcf



EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry D. Axtell Date: 5-16-90  
 Soil Description: Gray silty clay with finesand  
 Sample Location: Random Locations in Drainage #5 clay layer #3

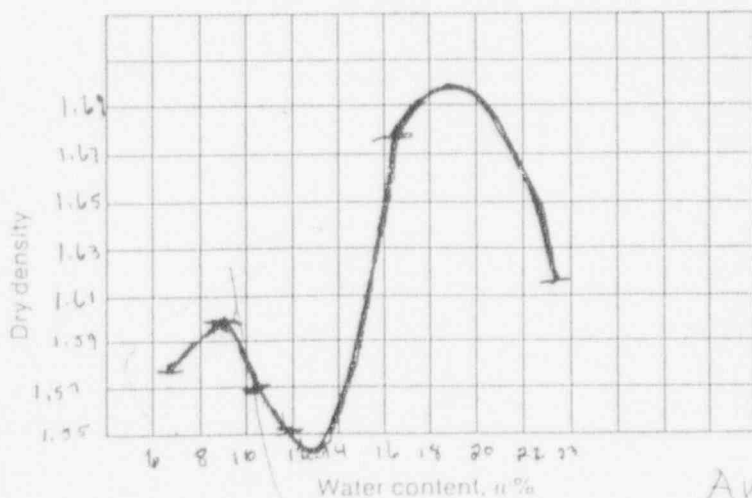
## Water Content Determination

CLAY TEST #3

Trial Number	1	2	3	4	5	6
Cup Number	30	32	35	43	34	38
Tare Weight, g ( $W_c$ )	11.31	11.33	11.39	11.34	11.52	11.78
Tare + Wet Soil, g ( $W_1$ )	79.01	81.08	78.94	71.52	72.94	75.84
Tare + Dry Soil, g ( $W_2$ )	74.76	75.27	72.64	65.11	64.16	63.94
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	63.45	63.94	61.25	53.77	52.64	52.16
Wt of Water, g ( $w = W_1 - W_2$ )	4.25	5.81	6.30	6.41	8.78	11.90
Water Content, % ( $w\% = (w/W_d)100$ )	6.70	9.09	10.29	11.92	16.68	22.81

## Density Determination

Weight of Mold, g ( $W_p$ )	8043					
Mold + Wet Soil, g ( $W_3$ )	3638	3690	3678	3685	3890	3923
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1595	1647	1635	1642	1847	1880
Volume of mold, $\text{cm}^3$ ( $V$ )	944					
Wet Density, $\text{g}/\text{cm}^3$ ( $W_v/V$ ) = $\rho_w$	1.69	1.74	1.73	1.74	1.96	1.99
Dry Density, $\text{g}/\text{cm}^3$ ( $\rho_w/(1 + w\%/100)$ )	1.58	1.60	1.57	1.55	1.68	1.62



Liquid Limit = 46.76  
 Plastic Limit = 22.53  
 Plastic Index = 24.23  
 Shrinkage Limit = 15.30  
 Soil Class. = CL

Optimum Moisture = 19.0 %  
 Maximum Dry Density = 1.61 pcf

AVERAGES  
14.3 %  
111.1 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Grab test

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: Bob Pattison & Larry Axtell  
 Soil Description: Gray silty clay  
 Sample Location: West Bank of clay stockpile

Project No.: C01-06  
 Sample No.:   
 Date: 6-1-90

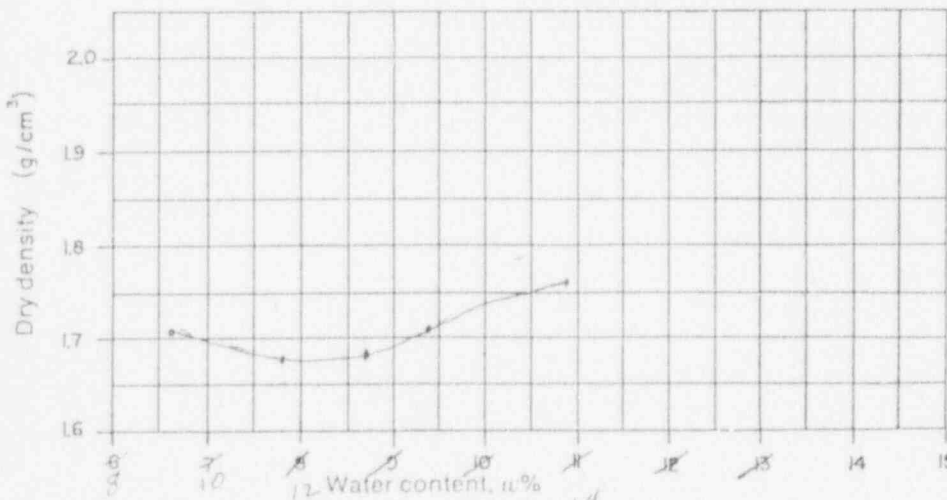
## Water Content Determination

CLAY TEST # 5

Trial Number	1	2	3	4	5	6
Cup Number	39	36	35	26	30	
Tare Weight, g ( $W_c$ )	11.56	11.48	11.36	11.78	11.29	
Tare + Wet Soil, g ( $W_1$ )	72.17	66.98	63.12	59.92	74.65	
Tare + Dry Soil, g ( $W_2$ )	67.06	61.24	57.01	53.66	65.02	
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	55.50	49.80	45.65	41.88	53.73	
Wt of Water, g ( $w = W_1 - W_2$ )	5.11	5.70	6.11	6.26	9.63	
Water Content, % ( $w\% = (w/W_d)100$ )	9.21	11.45	13.38	14.95	17.92	

## Density Determination

Weight of Mold, g ( $W_p$ )	2046	2046	2046	2046	2046	
Mold + Wet Soil, g ( $W_3$ )	3814	3809	3843	3901	3996	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1768	1763	1797	1855	1950	
Volume of mold, $\text{cm}^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $\text{g}/\text{cm}^3$ ( $D_v = W_v/V$ )	1.87	1.87	1.90	1.97	2.07	
Dry Density, $\text{g}/\text{cm}^3$ ( $D_w = (1 + w\%/100)$ )	1.71	1.68	1.68	1.71	1.76	



Optimum Moisture = 14.3 %  
 Maximum Dry Density = 1.76  $\text{g}/\text{cm}^3$

AVERAGES: 110.8 pcf @ 14.3% MOISTURE.

POOR CURVE. Dry  
 DENSITY USED.

NO ATTERBERG  
 LIMIT TEST WAS  
 CONDUCTED  
 Liquid Limit = \_\_\_\_\_  
 Plastic Limit = \_\_\_\_\_  
 Plastic Index = \_\_\_\_\_  
 Shrinkage Limit = \_\_\_\_\_  
 Soil Class. = \_\_\_\_\_

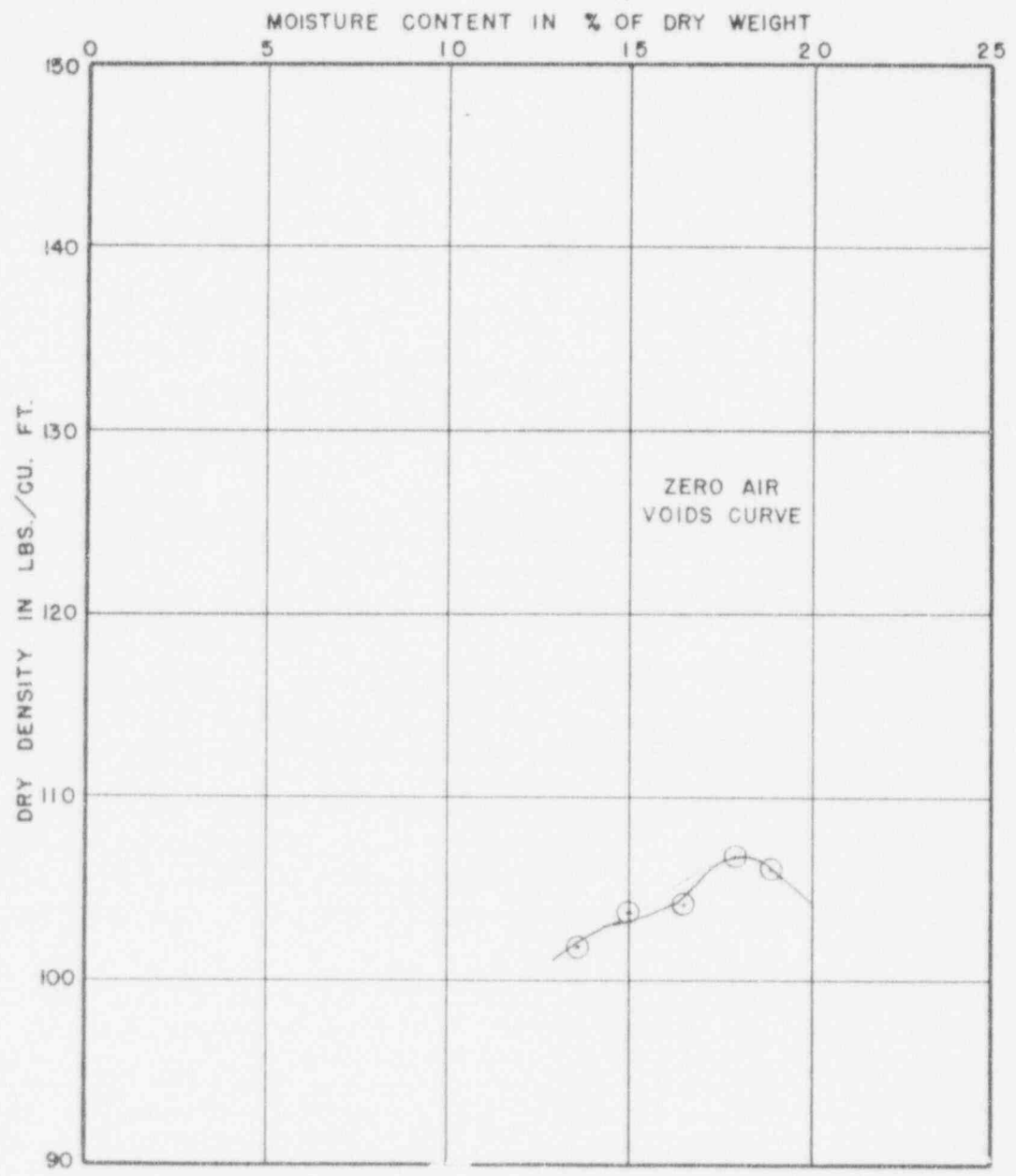


EarthFax

FILE 5060  
 DRAWN BY EEL DATE 6/7/90  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 REVISION 2 BY \_\_\_\_\_ DATE \_\_\_\_\_  
 REVISION 1 BY \_\_\_\_\_ DATE \_\_\_\_\_

SAMPLE NO. TP WEST DEPTH \_\_\_\_\_ ELEVATION \_\_\_\_\_  
 SOIL GRAY CLAY TR F1 SA SHALE FRAG'S  
 LOCATION Rio ALGOM REWORKED SPL  
 OPTIMUM MOISTURE CONTENT 17.8  
 MAXIMUM DRY DENSITY 106.9  
 METHOD OF COMPACTION D698 W MODIFICATION

SAMPLED 5/24/90



# COMPACTION TEST DATA



Dames & Moore

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

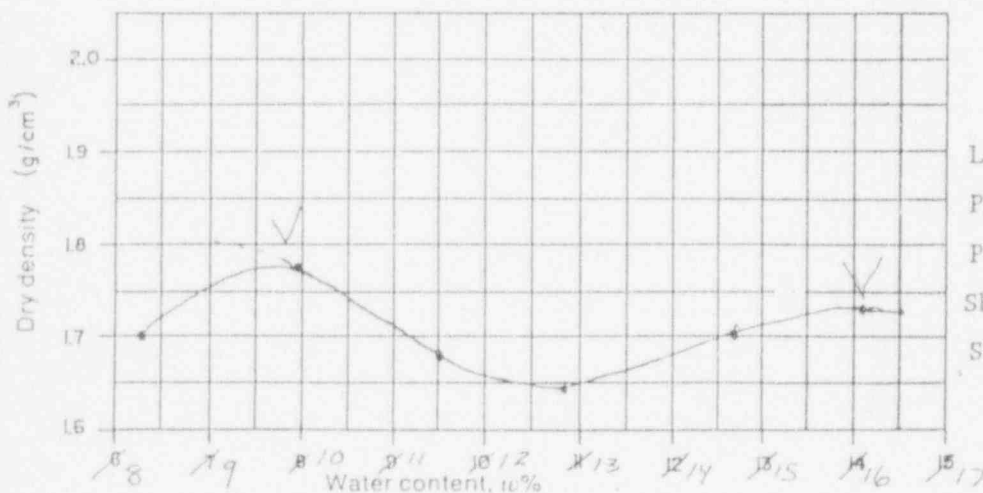
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Hattell Date: 6-7-90  
 Soil Description: Gray Silty clay w/ fine sand  
 Sample Location: Lane #3 Between stakes 3-10 & 3-13 Clay List #3  
 Water Content Determination CLAY TEST #5 150 ml 200 ml 250 300 350

Trial Number	1	2	3	4	5	6	
Cup Number	43	38	25	29	47	43	31
Tare Weight, g ( $W_c$ )	11.37	11.78	11.52	11.54	11.35	11.37	11.21
Tare + Wet Soil, g ( $W_1$ )	86.60	79.75	80.95	69.26	73.46	68.25	64.90
Tare + Dry Soil, g ( $W_2$ )	79.78	72.74	73.09	61.88	64.86	63.90	57.30
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	68.41	60.96	61.57	50.34	53.51	52.53	46.09
Wt of Water, g ( $w = W_1 - W_2$ )	6.82	7.01	7.86	7.38	8.60	4.35	7.60
Water Content, % ( $w\% = (w/W_d)100$ )	9.97	11.50	12.77	14.66	16.07	8.28	16.49

## Density Determination

MANY VOIDS ON SIDES OF  
 (SAMPLE, POSSIBLE INVALID DATA POINT)

Weight of Mold, g ( $W_p$ )	2046	2046	2046	2046	2046	2046	2046
Mold + Wet Soil, g ( $W_3$ )	3884	3815	3794	3888	3941	3784	3946
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1838	1769	1748	1842	1895	1738	1900
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	944	944
Wet Density, $g/cm^3$ ( $D_v = W_v/V$ )	1.947	1.874	1.852	1.951	2.007	1.841	2.013
Dry Density, $g/cm^3$ ( $D_w = (1 + w\%/100)$ )	1.771	1.681	1.642	1.702	1.730	1.700	1.728



Liquid Limit - 38.0  
 Plastic Limit - 18.5  
 Plastic Index - 19.5  
 Shrinkage Limit - 13.6  
 Soil Class. - CL

Optimum Moisture - ? % USING SECOND PEAK, OMC ~ 16%  
 Maximum Dry Density - 110.5 pcf (MAXIMUM @ FIRST PEAK)

AVERAGES: 110.4 pcf @ 14.8% MOISTURE



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

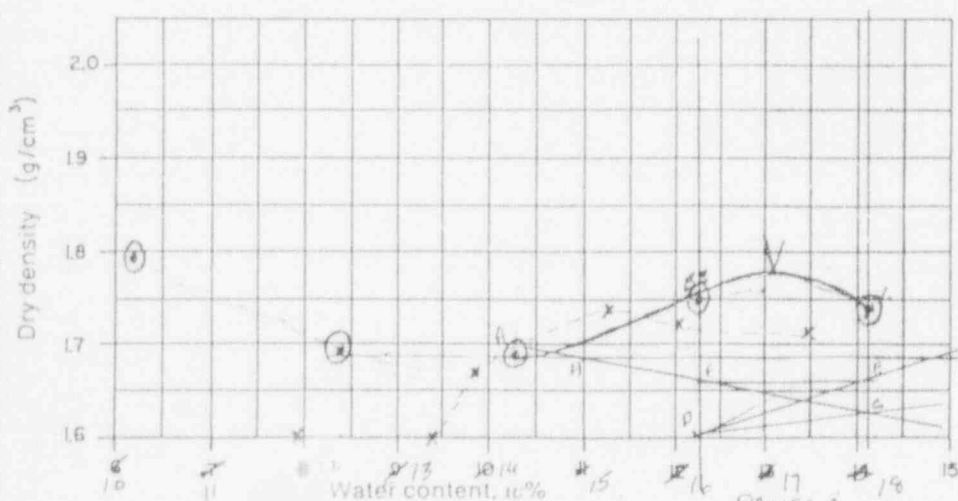
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Axtell Date: 6-13-90  
 Soil Description: Gray Silty Clay w/ Fine sand  
 Sample Location: Lane #4, Clay Lift #2 Between stakes 4-3 + 4-6

Water Content CLAY TEST #7  
 Determination G.P. Sample 1, 2, 3, 4, 5, 6 3800 3800 3780 3200 water content at start  
H<sub>2</sub>O 416.0 → 0 65 130 195 260

Trial Number	1	2	3	4	5	6
Cup Number	41	38	57	39	36	47
Tare Weight, g ( $W_c$ )	11.34	11.75	11.69	11.58	11.51	11.37
Tare + Wet Soil, g ( $W_1$ )	85.86	79.41	76.15	92.93	96.72	97.99
Tare + Dry Soil, g ( $W_2$ )	78.99	71.93	68.05	81.59	83.65	90.03
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	67.65	60.18	56.36	70.01	72.14	78.66
Wt of Water, g ( $w = W_1 - W_2$ )	6.87	7.48	8.10	11.34	13.07	7.96
Water Content, % ( $w\% = (w/W_d)100$ )	10.16	12.43	14.37	16.20	18.12	10.12

## Density Determination

Weight of Mold, g ( $W_p$ )	2046	2046	2046	2046	2046	
Mold + Wet Soil, g ( $W_3$ )	3901	3835	3863	3965	3995	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1855	1789	1817	1919	1949	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.97	1.90	1.92	2.03	2.06	
Dry Density, g/cm <sup>3</sup> ( $D_w = (1 + w\%/100)$ )	1.79	1.69	1.68	1.75	1.74	



--- DAMES & MOORE  
 (109.0% & 15.2%)

Liquid Limit - 42.0  
 Plastic Limit - 19.9  
 Plastic Index - 22.1  
 Shrinkage Limit - 14.0  
 Soil Class. - CL

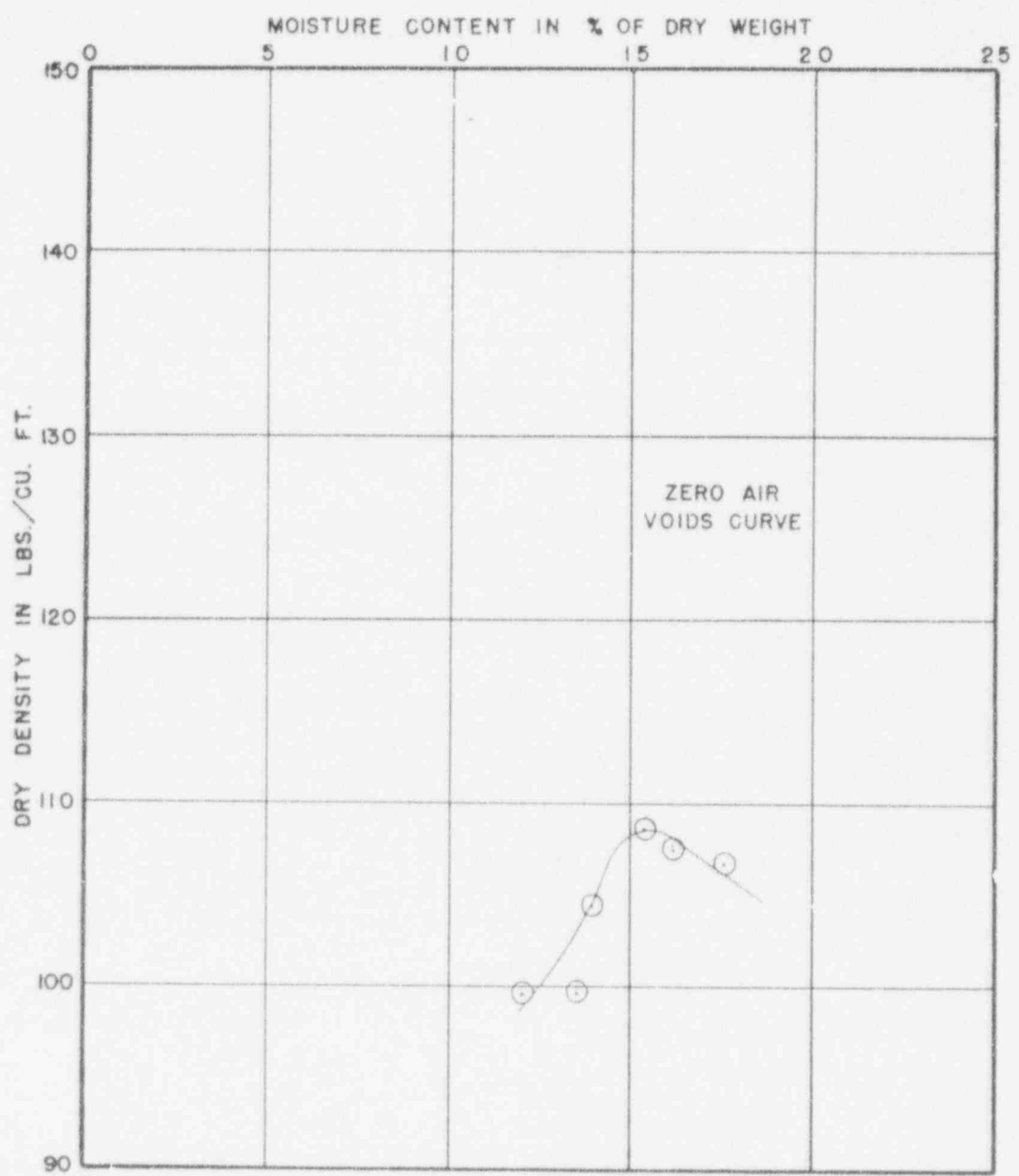
Optimum Moisture - 17.1 % DAMES & MOORE GARCO  
 Maximum Dry Density - 110.9 pcf 109.0 108.7 CUMULATIVE AVERAGE  
15.0% 110.1 pcf

DUPLICATE SAMPLES SUBMITTED TO DAMES & MOORE  
 AND GARCO (SEE THE FOLLOWING DATA SHEETS).



FILE 5461-025-5060  
 DRAWN BY ESL DATE 6/2/80  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_  
 REVISION 1 BY \_\_\_\_\_ DATE \_\_\_\_\_  
 REVISION 2 BY \_\_\_\_\_ DATE \_\_\_\_\_

LANE #4  
 SAMPLE NO. \_\_\_\_\_ DEPTH \_\_\_\_\_ ELEVATION \_\_\_\_\_  
 SOIL BR-GRAY SI. CLAY  
 LOCATION MOAB UTAH  
 OPTIMUM MOISTURE CONTENT \_\_\_\_\_ 15.2  
 MAXIMUM DRY DENSITY \_\_\_\_\_ 109  
 METHOD OF COMPACTION D698 WITH ALTERATION



DUPLICATE SAMPLES TESTED BY RIO ALGOM  
 (110.9 pcf @ 17.1%) AND GARCOL (%)

### COMPACTION TEST DATA

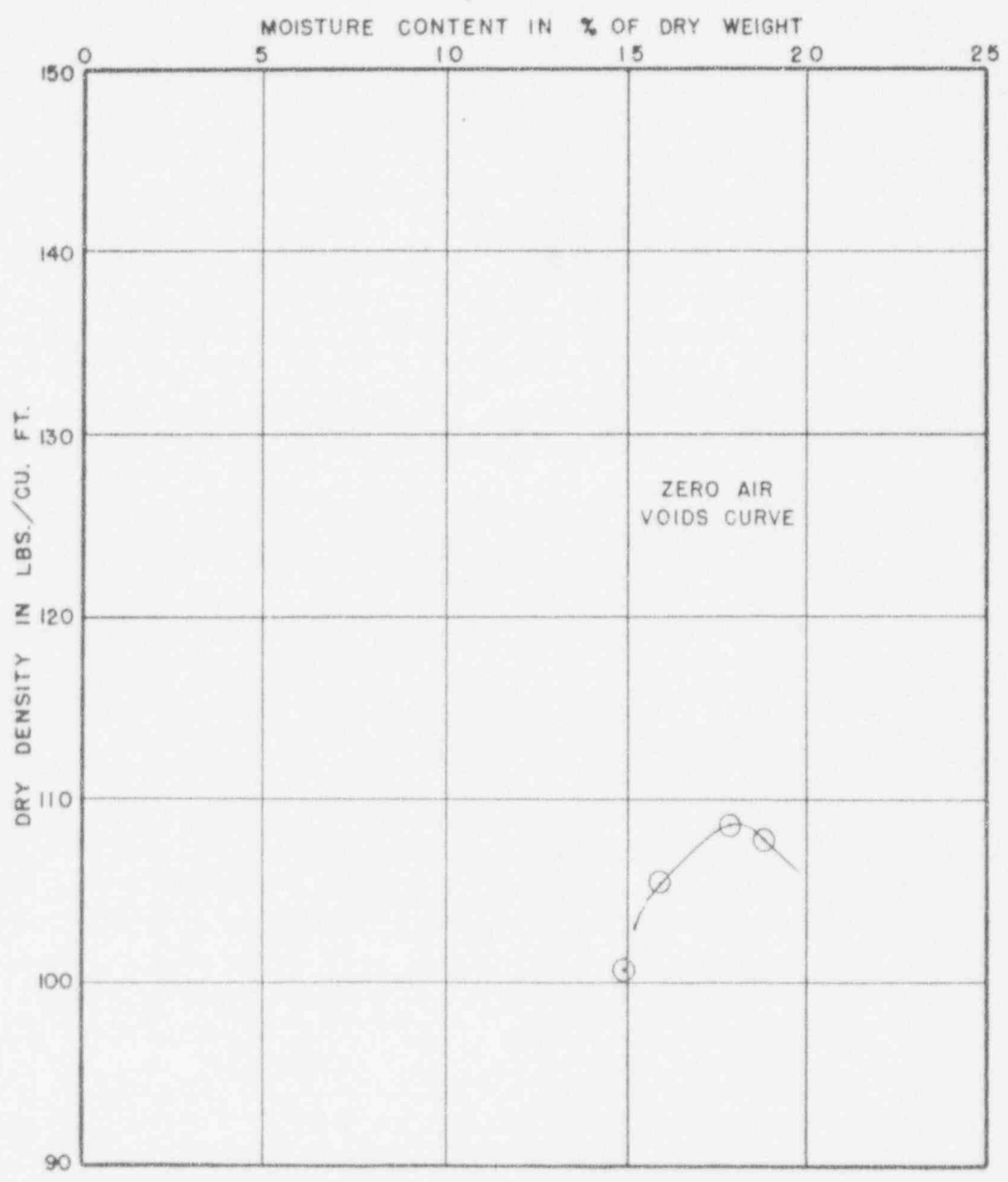
LIQUID LIMIT = 42.0  
 PLASTIC LIMIT = 19.9  
 PLASTIC INDEX = 22.1

Dames & Moore

FILE 5060  
 REVISION 1  
 BY \_\_\_\_\_ DATE \_\_\_\_\_  
 REVISION 2  
 BY REL DATE 6/8/90  
 CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SAMPLE NO. STOCK PILE DEPTH \_\_\_\_\_ ELEVATION \_\_\_\_\_  
 SOIL GRAY SILTY CLAY SHALE FRAGS REWORKED  
 LOCATION RIO ALGON  
 OPTIMUM MOISTURE CONTENT \_\_\_\_\_ 17.8 %  
 MAXIMUM DRY DENSITY \_\_\_\_\_ 108.7 pcf  
 METHOD OF COMPACTION ASTM D698 W MODIFICATION

SAMPLED 5/24/90



THIS DATA WAS USED IN THE DATA SET. CLAY TEST #4  
 COMPACTION TEST DATA

Dames & Moore



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

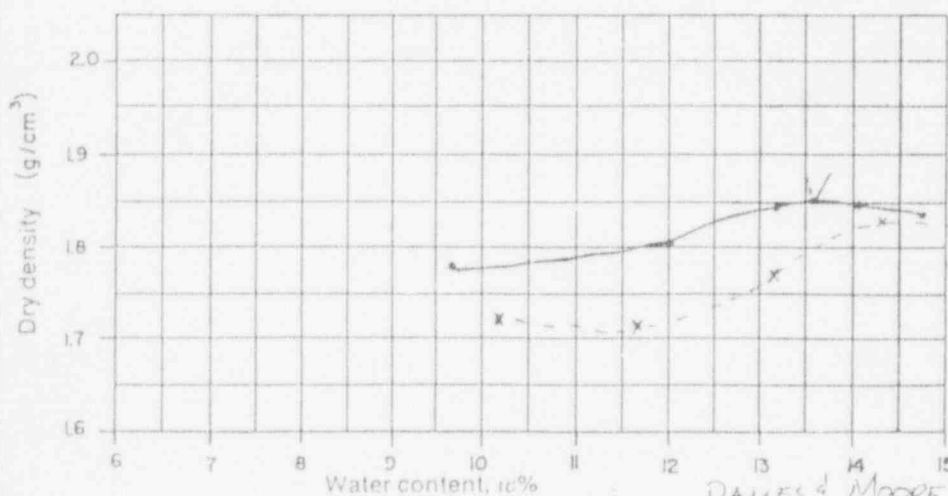
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Axtell Date: 6-14-90  
 Soil Description: Gray silty clay w/ fine sand  
 Sample Location: Borrow Area #2 CLAY TEST #8

## Water Content Determination

	3200 65	3100 130	3200 160	3200 200	3200 230	water content at start
Trial Number	1	2	3	4	5	6
Cup Number	42	32	28	45	44	25
Tare Weight, g ( $W_c$ )	11.65	11.34	11.50	11.44	11.56	11.53
Tare + Wet Soil, g ( $W_1$ )	78.92	83.38	80.28	77.59	95.00	95.93
Tare + Dry Soil, g ( $W_2$ )	72.98	75.65	72.26	69.45	84.29	89.72
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	61.33	64.31	60.76	58.01	72.73	78.19
Wt of Water, g ( $w = W_1 - W_2$ )	5.94	7.73	9.02	8.14	10.71	6.21
Water Content, % ( $w\% = (w/W_d)100$ )	9.69	12.02	13.20	14.03	14.73	7.94

## Density Determination

Weight of Mold, g ( $W_p$ )	2046					
Mold + Wet Soil, g ( $W_3$ )	3887	3952	4020	4035	4036	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1841	1906	1974	1989	1990	
Volume of mold, $cm^3$ ( $V$ )	944					
Wet Density, $g/cm^3$ ( $D_v = W_v/V$ )	1.950	2.019	2.091	2.107	2.108	
Dry Density, $g/cm^3$ ( $D_w = (1 + w\%/100)D_v$ )	1.778	1.802	1.847	1.848	1.837	

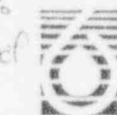


--- = DAMES & MOORE  
 (114.4 pcf @ 14.7%)

Liquid Limit - 34.0  
 Plastic Limit - 16.5  
 Plastic Index - 17.5  
 Shrinkage Limit - 12.7  
 Soil Class. - CL

Optimum Moisture - 13.6 %      DAMES & MOORE 14.3      GARCO 11.4      CUMULATIVE AVERAGE 14.7 %  
 Maximum Dry Density - 115.4 pcf      DAMES & MOORE 114.4      GARCO 113.9      CUMULATIVE AVERAGE 110.9 pcf

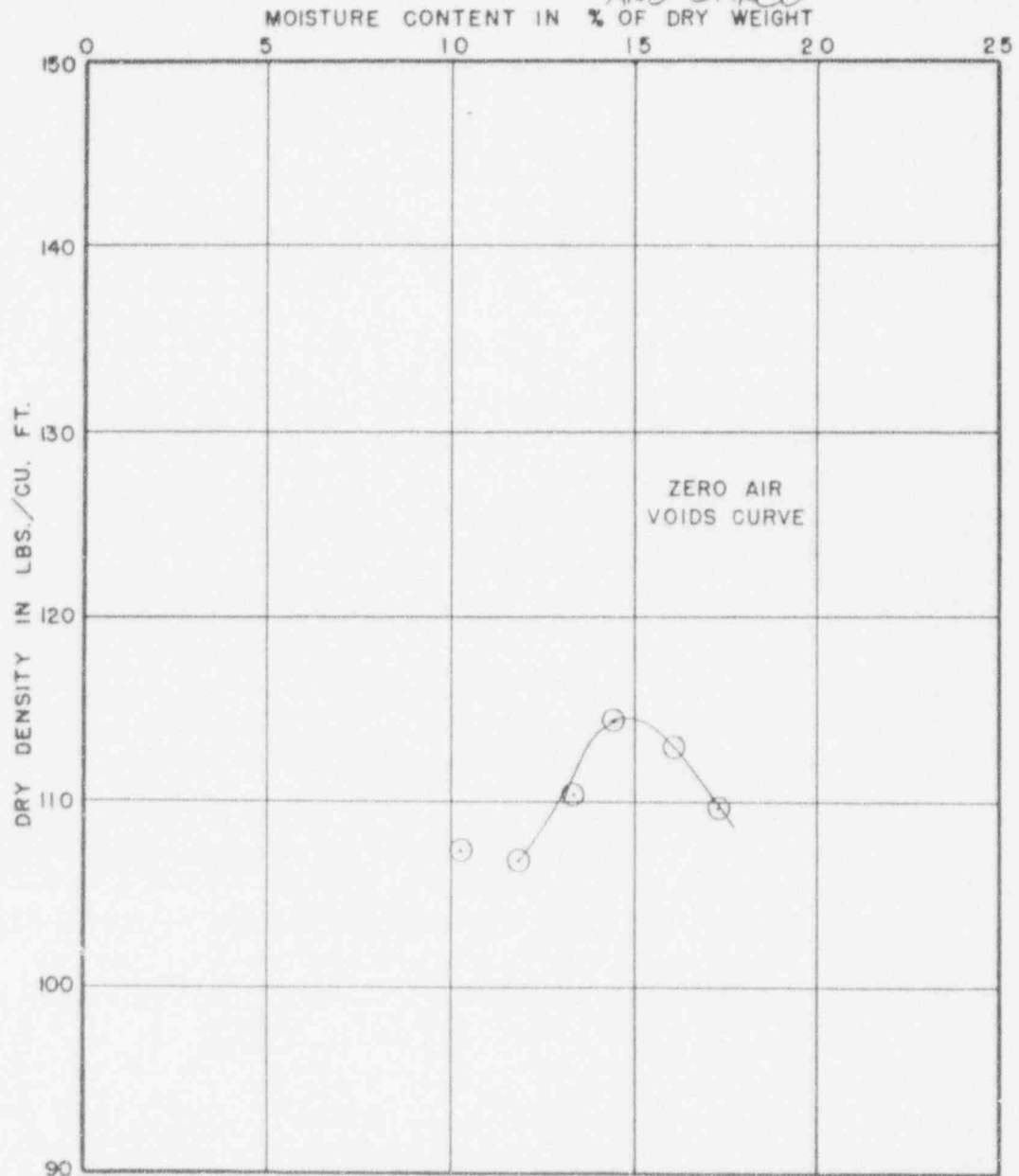
DUPLICATE SAMPLES SUBMITTED TO GARCO AND  
 DAMES & MOORE (SEE THE FOLLOWING DATA SHEETS)



EarthFax

SAMPLE NO. BORRAN #2 DEPTH \_\_\_\_\_ ELEVATION \_\_\_\_\_  
 SOIL BROWN-GRAY SILT CLAY  
 LOCATION MOAB UTAH  
 OPTIMUM MOISTURE CONTENT \_\_\_\_\_ 14.3  
 MAXIMUM DRY DENSITY \_\_\_\_\_ 114.4  
 METHOD OF COMPACTION D698 WITH ALTERATION

*SPLIT SAMPLE w/ Rio Algom 6/14/90  
 AND GARCO*



DUPLICATE SAMPLES TESTED BY RIO ALGOM  
 (115.4 pcf @ 13.6%) AND GARCO (113.9 pcf @ 11.4%).

### COMPACTION TEST DATA

LIQUID LIMIT = 34.0  
 PLASTIC LIMIT = 16.5  
 PLASTIC INDEX = 17.5

Dames & Moore

PLATE

DRAWN BY Ed DATE 6/22/90

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

REVISION 2

BY \_\_\_\_\_ DATE \_\_\_\_\_

REVISION 1

BY \_\_\_\_\_ DATE \_\_\_\_\_

FILE 5461-025-5060



# GARCO TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4464

5826 South 1900 West  
Roy, Utah 84067  
Phone 776 5355

5071 So. Arville  
Las Vegas, Nevada 89118  
Phone (702) 364-8031

June 28, 1990

Earth Fax Engineering  
7324 S. 1300 E., Ste 100  
Midvale, Utah 84047

Attn:

Project: Rio Algom  
Material: Grey Clay  
Source: Borrow #2  
Test: T-99-C Proctor  
Date: 6-21-90

Lab #31209

Maximum Compaction = 113.9 p.c.f.

Optimum Moisture = 11.4%

LIQUID LIMIT = 34.0

PLASTIC LIMIT = 16.5

PLASTIC INDEX = 17.5

→ FROM 6/14/90  
DUPLICATE SAMPLES TESTED  
By RIO ALGOM AND DAMES &  
MOORE.

RIO ALGOM = 115.4 pcf @ 13.6 %  
DAMES & MOORE = 114.4 pcf @ 14.3 %

Sincerely,

Doug Watson  
General Manager

National Voluntary  
Laboratory Accreditation  
Program



United States Department  
of Commerce Accredited

Member: ASTM, ACl, AGC

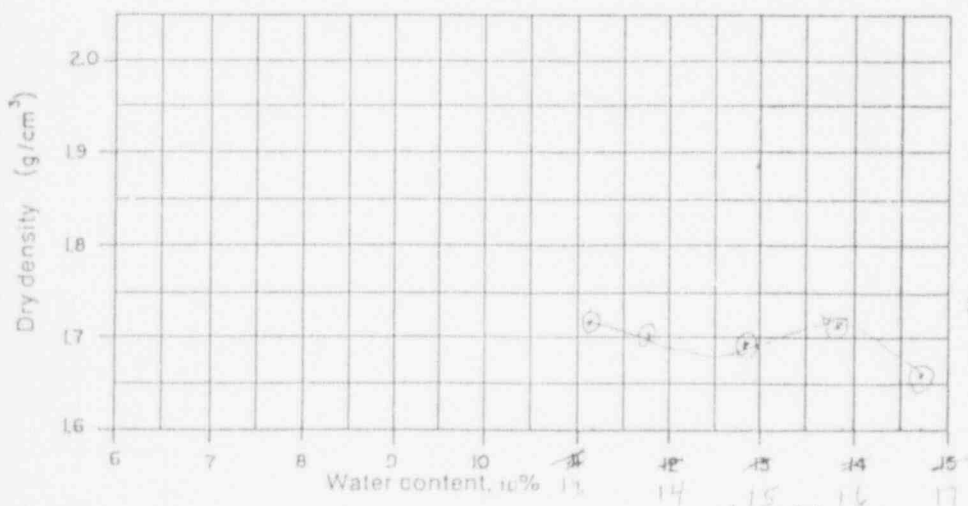
## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Axtell Date: 6-20-90  
 Soil Description: Gray silty clay w/ some sand  
 Sample Location: Layer #4 clay lift #1 between stakes 4-13 & 4-16  
CLAY TEST #9  
 Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	28	55	32	39	28	47
Tare Weight, g ( $W_c$ )	11.52	11.42	11.35	11.60	11.50	11.34
Tare + Wet Soil, g ( $W_1$ )	80.76	91.03	83.45	91.46	83.92	81.40
Tare + Dry Soil, g ( $W_2$ )	72.64	81.79	74.71	81.11	73.89	71.39
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	61.12	70.30	63.36	69.51	62.38	60.05
Wt of Water, g ( $w = W_1 - W_2$ )	8.12	9.24	8.74	10.35	9.94	10.01
Water Content, % ( $w\% = (w/W_d)100$ )	13.28	13.09	13.79	14.89	15.93	16.67
		(13.28)	(14.03)	(15.06)	(16.09)	(17.15)

## Density Determination

Weight of Mold, g ( $W_p$ )		2046	2046	2046	2046	2046
Mold + Wet Soil, g ( $W_3$ )		3875	3865	3882	3920	3882
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )		1829	1819	1836	1874	1836
Volume of mold, $cm^3$ ( $V$ )		944	944	944	944	944
Wet Density, $g/cm^3$ ( $D_v = W_v/V$ )		1.94	1.93	1.94	1.99	1.94
Dry Density, $g/cm^3$ ( $D_w = (1 + w\%/100)$ )		1.72	1.70	1.69	1.72	1.66



Optimum Moisture = 15.7 %  
 Maximum Dry Density = 107.3 pcf

AVERAGES  
14.8%  
110.7 pcf

Liquid Limit = 40.0  
 Plastic Limit = 17.7  
 Plastic Index = 22.3  
 Shrinkage Limit = 12.2  
 Soil Class. = CL

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

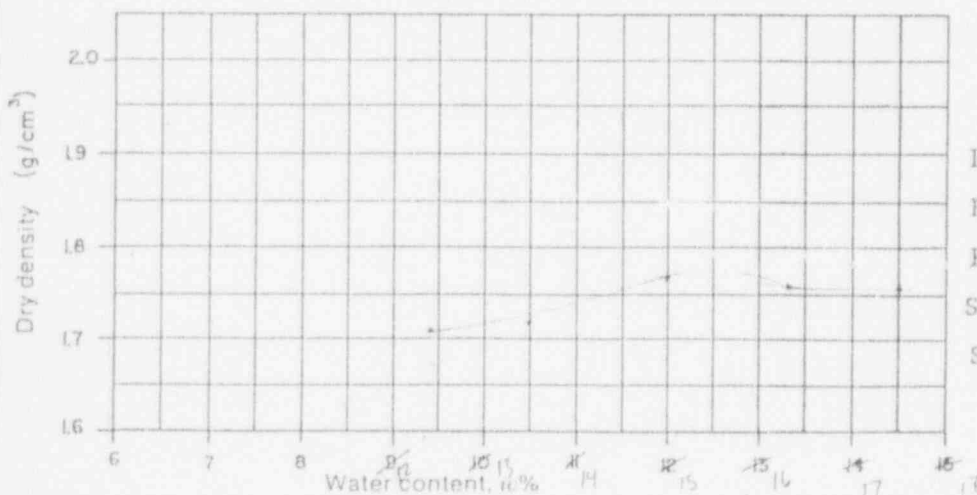
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry D. Axtell Date: 6-27-90  
 Soil Description: Gray S.Lty clay w/ some sand  
 Sample Location: Lane #5 Clay Lift #1 Between stakes 5-7 + 5-10  
CLAY TEST # 10

## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	43	39	44	45	41	43
Tare Weight, g ( $W_c$ )	11.39	11.59	11.58	11.45	11.35	11.38
Tare + Wet Soil, g ( $W_1$ )	122.12	78.66	86.29	79.08	81.76	97.37
Tare + Dry Soil, g ( $W_2$ )	84.1	71.25	77.43	70.25	71.91	84.56
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	72.71	59.66	65.85	58.80	60.56	73.18
Wt of Water, g ( $w = W_1 - W_2$ )	6.01	7.41	8.86	8.83	9.85	12.19
Water Content, % ( $w\% = (w/W_d)100$ )	7.2	12.4	13.5	15.0	16.3	17.5

## Density Determination

Weight of Mold, g ( $W_p$ )	2042	2042	2042	2042	2042	
Mold + Wet Soil, g ( $W_3$ )	3855	3887	3959	3974	3998	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1513	1845	1917	1932	1956	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ ( $D_v = W_v/V$ )	1.92	1.95	2.03	2.05	2.07	
Dry Density, $g/cm^3$ ( $D_w = (1 + w\%/100)$ )	1.71	1.72	1.77	1.76	1.76	



Liquid Limit = 38.5  
 Plastic Limit = 18.51  
 Plastic Index = 19.99  
 Shrinkage Limit = 13.52  
 Soil Class. = CL

Optimum Moisture = 15.5 %  
 Maximum Dry Density = 114.3 pcf

AVERAGES  
14.8 %  
110.9 pcf



# GARCO TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Rex, Utah 84067  
Phone 776-5355

5071 So. Arville  
Las Vegas, Nevada 89118  
Phone (702) 364-8031

July 11, 1990

Earth Fax Engineering  
7324 South 1300 East, Ste 100  
Midvale, Utah 84047

Attn: Rhett Brooks

Project: Rio Algom  
Material: Grey Clay, Poorly Graded  
Source: Lane #2 Clay Lift #4  
4-3 4-8  
Test: T-99 Proctor  
Date: 6-21-90 - 6-13

Lab #31210

Maximum Compaction = 106.6 p.c.f.

Optimum Moisture = 16.0%

Sincerely,

Doug Watson  
General Manager

National Voluntary  
Laboratory Accreditation  
Program



Member: ASTM, ACI, AGC

United States Department  
of Commerce Accredited



# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

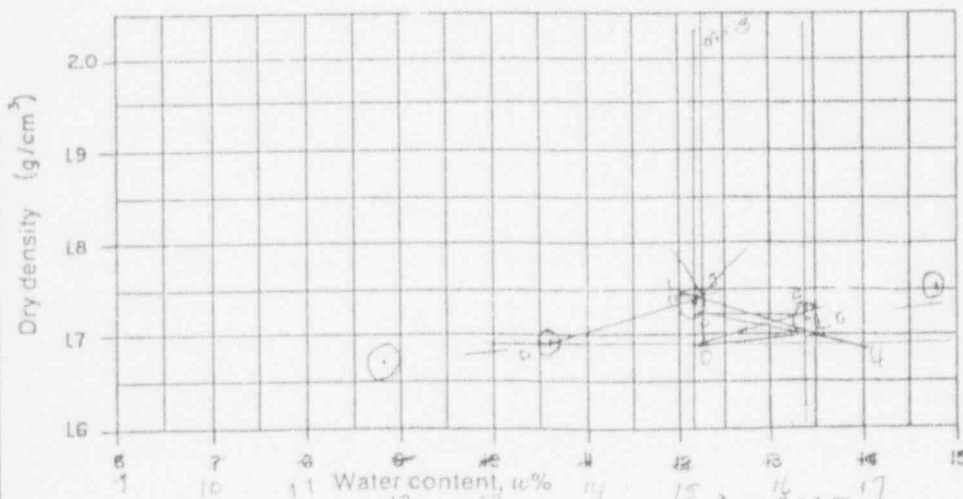
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Hxtell Date: 7-26-90  
 Soil Description: Gray silty clay w/ some sand  
 Sample Location: Lower #1 clay lift 4' between stakes 1-12  
CLAY TEST #11 H<sub>2</sub>O added

## Water Content Determination

	100	150	190	230	270	H <sub>2</sub> O added
Trial Number	1	2	3	4	5	6
Cup Number	39	25	38	42	37	25
Tare Weight, g (W <sub>c</sub> )	11.20	11.58	11.82	11.67	11.47	11.52
Tare + Wet Soil, g (W <sub>1</sub> )	90.33	92.91	82.49	100.07	98.17	99.26
Tare + Dry Soil, g (W <sub>2</sub> )	81.98	83.02	73.16	87.57	85.04	92.33
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	70.38	71.49	61.34	75.90	73.57	80.83
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	8.35	9.69	9.33	12.50	13.12	16.91
Water Content, % (w% = (w/W <sub>d</sub> )100)	11.86	13.55	15.21	16.47	17.85	20.55
	11.58	13.55	14.15	15.26	16.33	

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040
Mold + Wet Soil, g (W <sub>3</sub> )	3801	3856	3935	3931	3992
Wt Wet Soil, g (W <sub>v</sub> = W <sub>3</sub> - W <sub>p</sub> )	1761	1816	1895	1891	1952
Volume of mold, cm <sup>3</sup> (V)	922	922	922	922	922
Wet Density, g/cm <sup>3</sup> (D <sub>v</sub> = W <sub>v</sub> /V)	1.910	1.924	2.007	2.003	2.068
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.667	1.694	1.742	1.720	1.755
	1.702	1.758	1.758	1.758	1.778



Optimum Moisture = 15.25 %  
 Maximum Dry Density = 1.742 = 108.9 pcf

Liquid Limit = 38.0  
 Plastic Limit = 19.05  
 Plastic Index = 18.95  
 Shrinkage Limit = 14.19  
 Soil Class. = CL

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

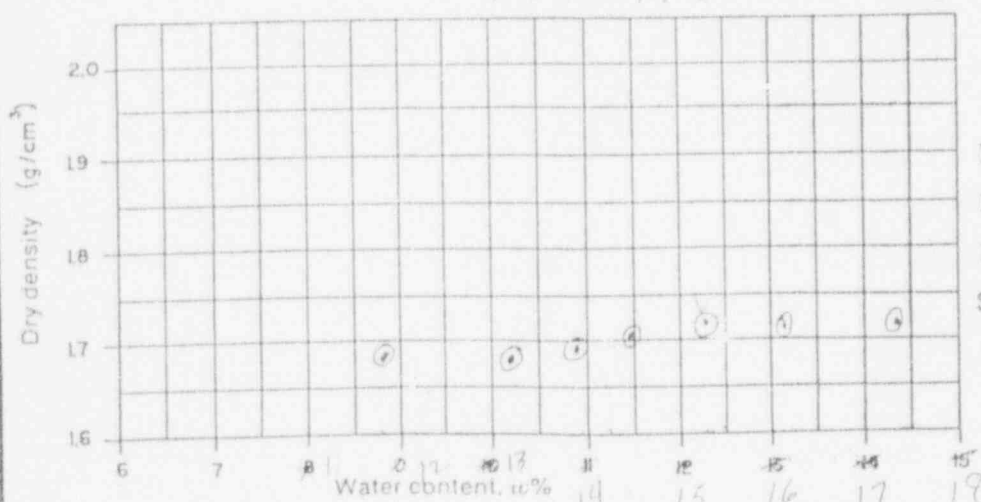
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry D. Axtell Date: 8-1-90  
 Soil Description: Gray Silty clay w/some sand  
 Sample Location: Lane #7, Clay Lift #4 Between Stake 7+2 + 0.0m  
CLAY TEST #12 H<sub>2</sub>O Added H<sub>2</sub>O @ start

## Water Content Determination

	70	110	150	200	240	H <sub>2</sub> O @ start
Trial Number	1	2	3	4	5	6
Cup Number	28	45	26	25	35	37
Tare Weight, g (W <sub>c</sub> )	11.54	11.46	11.80	11.54	11.03	11.47
Tare + Wet Soil, g (W <sub>1</sub> )	85.15	87.63	93.64	87.00	88.94	97.05
Tare + Dry Soil, g (W <sub>2</sub> )	77.99	78.74	83.29	76.53	77.43	89.31
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	66.45	67.28	71.49	64.99	66.40	77.84
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	7.75	8.89	10.35	10.47	11.51	7.74
Water Content, % (w% = (w/W <sub>d</sub> )100)	11.77	13.21	14.48	16.11	17.44	9.94

## Density Determination

	12.04	13.22	14.38	15.78	16.89	17.90
Weight of Mold, g (W <sub>p</sub> )	2041	2041	2041	2041	2041	
Mold + Wet Soil, g (W <sub>3</sub> )	3813	3834	3880	3922	3955	
Wt Wet Soil, g (W <sub>v</sub> = W <sub>3</sub> - W <sub>p</sub> )	1772	1793	1839	1881	1914	
Volume of mold, cm <sup>3</sup> (V)	100	100	100	100	100	
Wet Density, g/cm <sup>3</sup> (D <sub>v</sub> = W <sub>v</sub> /V)	1.772	1.793	1.839	1.881	1.914	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> = D <sub>v</sub> /(1 + w%/100))	1.679	1.697	1.707	1.716	1.727	



Optimum Moisture = 15.3 %  
 Maximum Dry Density = 1.727 g/cm<sup>3</sup> 107.9 pcf

Liquid Limit = 38.0  
 Plastic Limit = 19.24  
 Plastic Index = 18.76  
 Shrinkage Limit = 14.38  
 Soil Class. = CL

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: \_\_\_\_\_  
 Soil Description: \_\_\_\_\_  
 Sample Location: \_\_\_\_\_

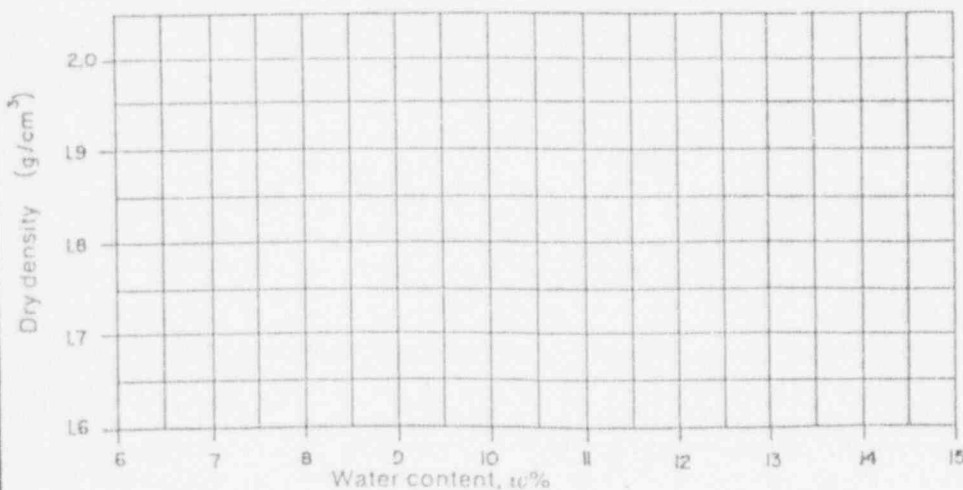
Project No.: C01-06  
 Sample No.: \_\_\_\_\_  
 Date: \_\_\_\_\_

## Water Content Determination

Trial Number	<del>6</del>	<del>7</del>	3	4	5	6
Cup Number	25	38				
Tare Weight, g ( $W_c$ )	11.55	11.83				
Tare + Wet Soil, g ( $W_1$ )	78.71	77.10				
Tare + Dry Soil, g ( $W_2$ )	70.49	68.10				
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	58.94	56.27				
Wt of Water, g ( $w = W_1 - W_2$ )	8.22	8.70	4			
Water Content, % ( $w\% = (w/W_d)100$ )	13.95	15.38				

## Density Determination

Weight of Mold, g ( $W_p$ )	2041	2041				
Mold + Wet Soil, g ( $W_3$ )	3865	3925				
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1824	1884				
Volume of mold, $\text{cm}^3$ ( $V$ )	950	944				
Wet Density, $\text{g}/\text{cm}^3$ ( $D_v = W_v/V$ )	1.922	1.996				
Dry Density, $\text{g}/\text{cm}^3$ ( $D_w = (1 + w\%/100)$ )	1.645	1.750				



Liquid Limit - \_\_\_\_\_  
 Plastic Limit - \_\_\_\_\_  
 Plastic Index - \_\_\_\_\_  
 Shrinkage Limit - \_\_\_\_\_  
 Soil Class. - \_\_\_\_\_

Optimum Moisture - \_\_\_\_\_ %  
 Maximum Dry Density - \_\_\_\_\_ pcf

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Aytell Date: 8-8-90  
 Soil Description: Gray silty clay w/ some sand  
 Sample Location: East End of Borrow Pit #2  
CLAY TEST #13 H<sub>2</sub>O ADDED

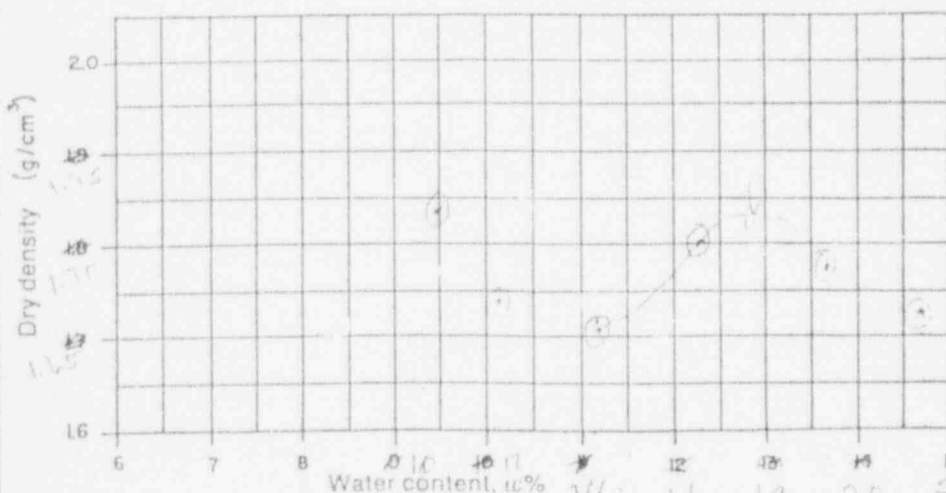
## Water Content Determination

	40	100	170	240	300	0
Trial Number	1	2	3	4	5	6
Cup Number	45	25	28	38	43	37
Tare Weight, g ( $W_c$ )	11.48	11.55	11.55	11.83	11.39	11.48
Tare + Wet Soil, g ( $W_1$ )	80.75	78.49	76.12	91.01	96.83	87.89
Tare + Dry Soil, g ( $W_2$ )	73.27	70.11	66.87	78.15	81.73	80.31
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	61.79	58.56	55.32	66.32	70.34	68.83
Wt of Water, g ( $w = W_1 - W_2$ )	7.48	9.93	9.25	12.86	15.10	7.58
Water Content, % ( $w\% = (w/W_d)100$ )	12.106	14.310	16.720	19.391	21.467	11.013

## Density Determination

Weight of Mold, g ( $W_p$ )	2042	2092	2042	2042	2042	2042
Mold + Wet Soil, g ( $W_3$ )	3814	3827	3914	3941	3948	3844
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1772	1735	1872	1909	1906	1802
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	944
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.877	1.841	1.983	2.012	2.019	1.919
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.674	1.654	1.699	1.685	1.667	1.720

Average 1.674 1.659 1.710 1.706 1.690 1.721

Optimum Moisture = 11.7 %Maximum Dry Density = 1.72 = 107.3 pcf

AVERAGES

15.0 %

110.5 pcf

Liquid Limit = 40.50Plastic Limit = 51.61Plastic Index = 18.49Shrinkage Limit = 16.08Soil Class. = CL

EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

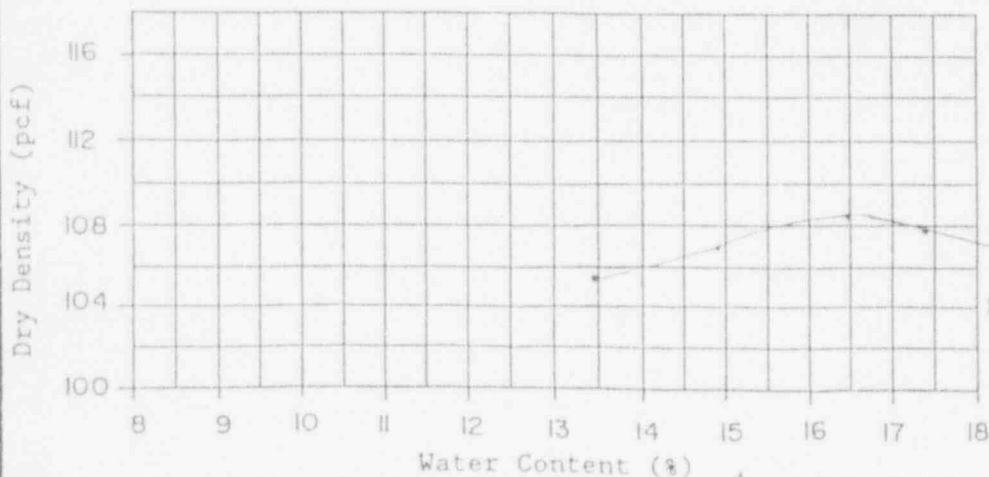
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY D. AXTELL Date: 8-14-90  
 Soil Description: GRAY SILTY CLAY w/SOME SAND  
 Sample Location: CLAY PIT #2, EAST END  
CLAY TEST #14

## Water Content Determination

Trial Number	H <sub>2</sub> O ADDED					H <sub>2</sub> O
	110	145	180	215	250	
Cup Number	1	2	3	4	5	6
Tare Weight, g (W <sub>c</sub> )	43	35	25	38	45	32
Tare + Wet Soil, g (W <sub>1</sub> )	11.40	11.41	11.57	11.85	11.48	11.37
Tare + Dry Soil, g (W <sub>2</sub> )	78.62	85.29	77.00	80.23	101.65	100.64
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	70.63	75.73	67.75	70.09	87.59	92.62
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	59.23	64.29	56.18	58.24	76.11	81.75
Water Content, % (w% = (w/W <sub>d</sub> )100)	7.99	9.56	9.25	10.14	14.06	14.06
	13.49	14.87	16.46	17.41	18.47	9.79

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3854	3903	3947	3952	3943	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1814	1863	1907	1912	1903	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.92	1.97	2.02	2.03	2.02	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.69	1.71	1.73	1.73	1.71	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	105.6	107.0	108.2	107.9	106.4	



Liquid Limit - 43.0  
 Plastic Limit - 20.49  
 Plastic Index - 22.51  
 Shrinkage Limit - 14.28  
 Soil Class. - CL

Optimum Moisture - 16.1 %  
 Maximum Dry Density - 108.4 pcf

AVERAGES  
15.1 %  
110.4 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Pavl Patterson Date: 8-21-90  
 Soil Description: Gray silty clay w/ some sand.  
 Sample Location: Pit #2 East end

CLAY TEST #15

H<sub>2</sub>O Acid

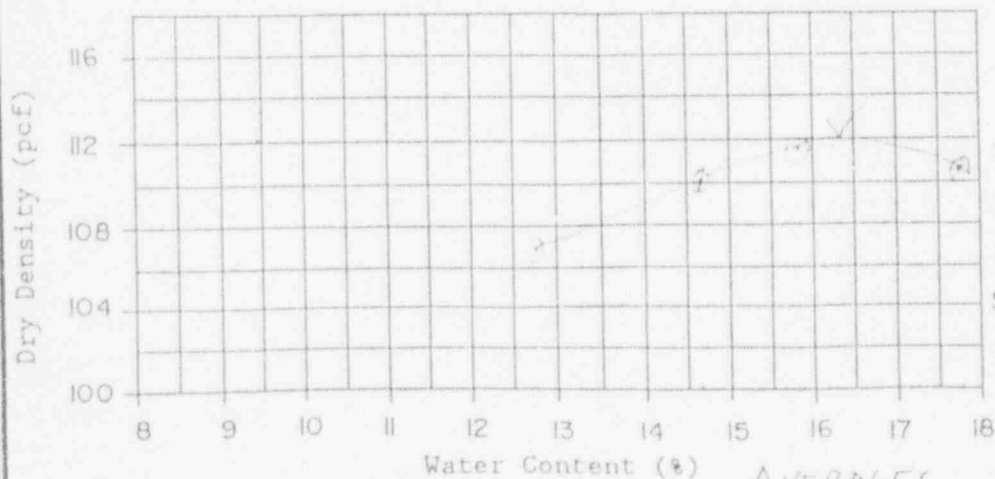
## Water Content Determination

	150	190	225	260	H <sub>2</sub> O
Trial Number	1	2	3	4	5
Cup Number	45	36	44	35	57
Tare Weight, g (W <sub>c</sub> )	11.48	11.53	11.62	11.45	11.76
Tare + Wet Soil, g (W <sub>1</sub> )	87.89	79.02	89.00	89.72	87.28
Tare + Dry Soil, g (W <sub>2</sub> )	79.28	70.42	78.39	77.91	81.93
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	67.80	58.89	66.77	66.46	70.17
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	8.61	8.60	10.61	11.81	5.35
Water Content, % (w% = (w/W <sub>d</sub> )100)	12.70	14.60	15.89	17.77	7.62

Project #15 → 12.70 13.97 15.06 16.53

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040		
Mold + Wet Soil, g (W <sub>3</sub> )	3874	3947	3998	4012		
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1834	1907	1958	1972		
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944		
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.943	2.020	2.074	2.089		
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.724	1.762	1.790	1.774		
Dry Density, pcf (62.4 × g/cm <sup>3</sup> )	107.2	110.0	111.7	110.7		



Liquid Limit - 40.0  
 Plastic Limit - 18.86  
 Plastic Index - 21.12  
 Shrinkage Limit - 15.48  
 Soil Class. - CL

Optimum Moisture - 16.30 %Maximum Dry Density - 112.0 pcf

AVERAGES

15.1%

110.5 pcf



EarthFax



# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

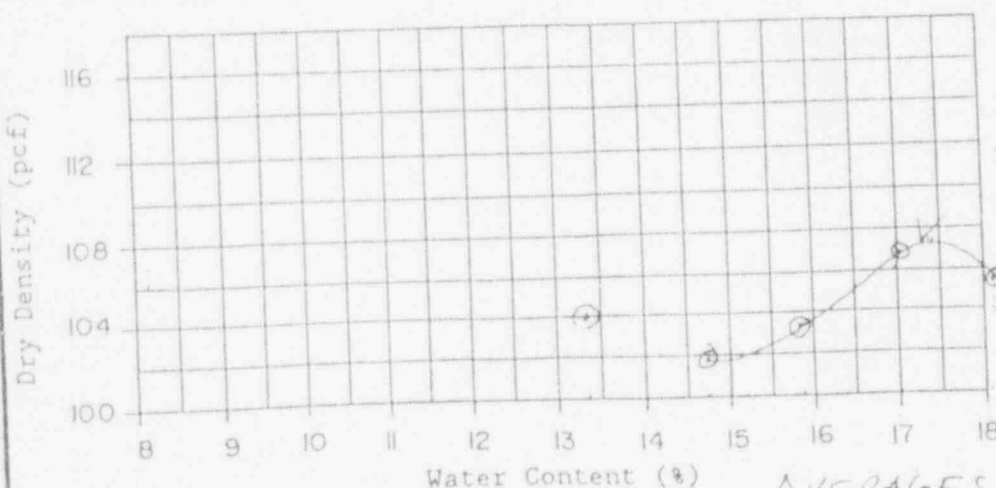
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AXTELL Date: 9-6-90  
 Soil Description: Gray, silty clay w/ some sand  
 Sample Location: Borrow pit #2 North End Clay Layer

## Water Content Determination

	0 - 40		75	110	145	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	57	41	45	35	27	28
Tare Weight, g (W <sub>c</sub> )	11.80	11.39	11.52	11.49	11.52	11.56
Tare + Wet Soil, g (W <sub>1</sub> )	68.10	69.98	80.26	74.20	69.42	86.97
Tare + Dry Soil, g (W <sub>2</sub> )	61.46	62.47	70.84	65.06	60.51	77.85
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	49.66	51.08	59.32	53.57	48.99	66.29
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.64	7.51	9.42	9.14	8.91	9.12
Water Content, % (w% = (w/W <sub>d</sub> )100)	13.37	14.70	15.88	17.06	18.19	13.76

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3823	3805	3848	3925	3919	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1783	1765	1808	1885	1879	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.89	1.87	1.92	2.00	1.99	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.67	1.63	1.66	1.71	1.68	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	104.03	101.73	103.39	106.61	105.06	



Liquid Limit - 49.50  
 Plastic Limit - 22.10  
 Plastic Index - 27.40  
 Shrinkage Limit - 14.14  
 Soil Class. - CL

Optimum Moisture - 17.25 %  
 Maximum Dry Density - 107.5 pcf

AVERAGES  
15.2 %  
110.5 pcf

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

AND EVAPORATION POND #1

Client: Rio Algom Mining Corp. Project No.: COL-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: Larry Hxtell Date: 9-12-90  
 Soil Description: Gray silty clay w/ some sand  
 Sample Location: Borrow pit #2 North East End

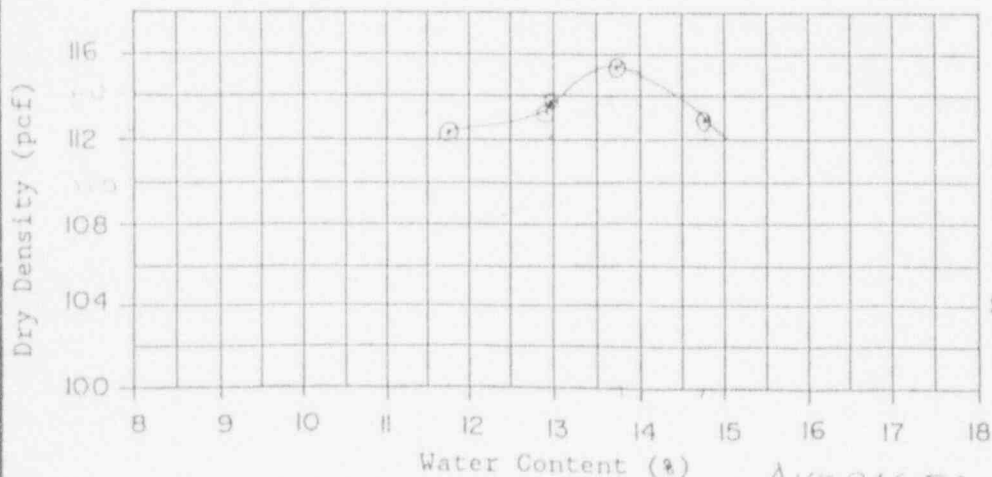
CLAY TEST #18 H<sub>2</sub>O Added

## Water Content Determination

	165	200	215	235	270	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	47	41	57	39	44	46
Tare Weight, g (W <sub>c</sub> )	11.38	11.38	11.80	11.66	11.65	11.46
Tare + Wet Soil, g (W <sub>1</sub> )	70.59	74.77	80.89	87.38	85.52	101.98
Tare + Dry Soil, g (W <sub>2</sub> )	64.47	67.51	72.96	78.25	76.03	96.57
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	53.09	56.13	61.16	66.59	64.38	85.11
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.12	7.26	7.93	9.13	9.49	5.41
Water Content, % (w% = (w/W <sub>d</sub> )100)	11.53	12.93	12.97	13.71	14.74	6.36

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3934	3979	3985	4025	4005	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1894	1939	1945	1985	1965	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	2.01	2.05	2.06	2.10	2.08	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.80	1.82	1.82	1.85	1.81	
Dry Density, pcf (62.4 × g/cm <sup>3</sup> )	112.32	113.27	113.79	115.24	113.12	



Liquid Limit - 32.0  
 Plastic Limit - 17.1  
 Plastic Index - 14.9  
 Shrinkage Limit - 13.87  
 Soil Class. - CL

Optimum Moisture - 13.7 %  
 Maximum Dry Density - 115.2 pcf

AVERAGES

15.2 %  
 110.4 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

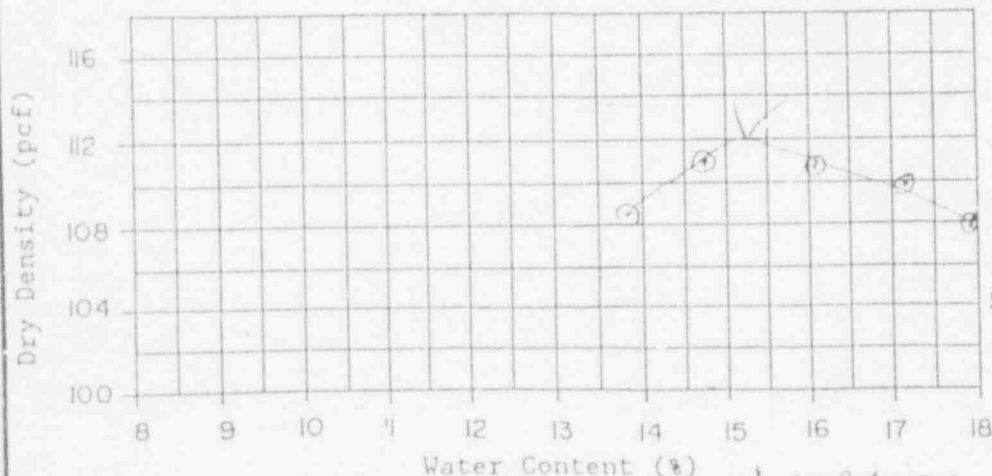
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.: 9-18-90  
 Tested by: Larry Axtell Date: 9-18-90  
 Soil Description: Gray silty clay w/ some sand  
 Sample Location: Borrow pit #2, North End, Clay layer  
CLAY TEST #19 H<sub>2</sub>O Added (mL)

## Water Content Determination

	100	135	170	205	240	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	41	26	43	35	39	28
Tare Weight, g (W <sub>c</sub> )	11.37	11.82	11.48	11.49	11.66	11.58
Tare + Wet Soil, g (W <sub>1</sub> )	71.35	75.48	81.35	92.79	87.32	96.24
Tare + Dry Soil, g (W <sub>2</sub> )	64.07	67.27	71.67	80.92	75.82	88.52
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	52.70	55.45	60.19	69.43	64.16	76.94
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	7.28	8.21	9.68	11.87	11.50	7.82
Water Content, % (w% = (w/W <sub>d</sub> )100)	13.81	14.81	16.08	17.10	17.92	10.16

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3920	3970	3995	3984	3967	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1880	1930	1955	1944	1927	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.99	2.04	2.07	2.06	2.04	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.75	1.78	1.78	1.76	1.73	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	109.2	111.07	111.07	109.82	107.95	



Liquid Limit - 38.0  
 Plastic Limit - 22.47  
 Plastic Index - 15.53  
 Shrinkage Limit - 17.61  
 Soil Class. - CL

Optimum Moisture - 15.25 %

Maximum Dry Density - 112 pcf

AVERAGES

15.2%

110.5 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Bio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 9-25-90  
 Soil Description: Gray Silty Clay of some sand  
 Sample Location: Borrow pit #2, North End, Clay Layer  
CLAY TEST #20

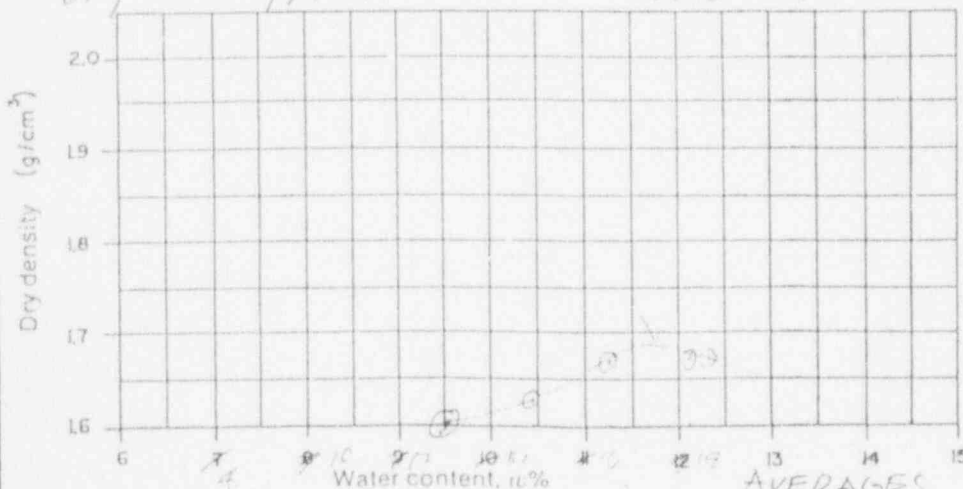
## Water Content Determination

	75	120	160	200	240	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	59	46	32	47	39	28
Tare Weight, g ( $W_c$ )	11.74	11.46	11.29	11.37	11.66	11.58
Tare + Wet Soil, g ( $W_1$ )	77.13	80.12	75.15	86.65	82.66	76.13
Tare + Dry Soil, g ( $W_2$ )	78.36	71.24	74.11	75.00	71.49	87.99
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	66.62	59.78	62.82	63.63	59.83	76.41
Wt of Water, g ( $w = W_1 - W_2$ )	9.77	8.94	10.51	11.56	11.17	8.14
Water Content, % ( $w\% = (w/W_d)100$ )	13.02	14.95	16.54	18.14	18.67	10.65

## Density Determination

Weight of Mold, g ( $W_p$ )	2011	2040	2041	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3745	3805	3869	3892	3905	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1734	1765	1828	1852	1865	
Volume of mold, cm <sup>3</sup> ( $V$ )	941	941	941	941	941	
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.84	1.87	1.94	1.96	1.98	
Dry Density, g/cm <sup>3</sup> ( $D_w = (100/(100 + w\%))D_v$ )	1.66	1.67	1.66	1.66	1.67	

Dry Density, pcf: 99.8, 101.7, 103.6, 103.6, 104.2



Liquid Limit - 44.00  
 Plastic Limit - 22.01  
 Plastic Index - 21.99  
 Shrinkage Limit - 15.53  
 Soil Class. - CL

Optimum Moisture - 11.5 %  
 Maximum Dry Density - 1.69 g/cm<sup>3</sup> = 105.5 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

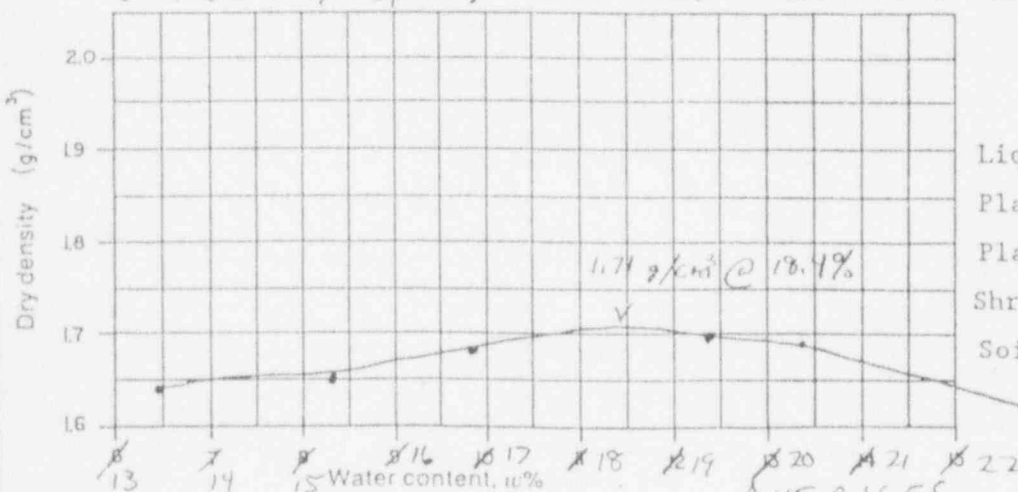
Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: RHETT BROOKS  
 Soil Description: GRAY SANDY CLAY  
 Sample Location: EMBANKMENT  
 Water Content Determination CLAY TEST # 21

Project No.: C01-06  
 Sample No.:   
 Date: 10/9/90

Trial Number	1	2	3	4	5	6
Cup Number	32	47	37	39	57	28
Tare Weight, g ( $W_c$ )	11.40	11.38	11.52	11.68	11.81	11.59
Tare + Wet Soil, g ( $W_1$ )	74.30	66.27	71.61	75.50	82.61	84.42
Tare + Dry Soil, g ( $W_2$ )	66.83	58.99	62.97	65.12	70.67	70.58
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	55.43	47.61	51.45	53.44	58.86	58.99
Wt of Water, g ( $w = W_1 - W_2$ )	7.47	7.28	8.64	10.38	11.94	13.84
Water Content, % ( $w\% = (w/W_d)100$ )	13.48	15.29	16.79	19.42	20.29	23.46

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	2040
Mold + Wet Soil, g ( $W_3$ )	3798	3837	3900	3955	3959	3914
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1758	1797	1860	1915	1919	1874
Volume of mold, $\text{cm}^3$ ( $V$ )	944					
Wet Density, $\text{g}/\text{cm}^3$ ( $D_v = W_v/V$ )	1.862	1.904	1.970	2.029	2.033	1.985
Dry Density, $\text{g}/\text{cm}^3$ ( $D_w/(1 + w\%/100)$ )	1.641	1.651	1.687	1.699	1.690	1.608
DRY DENSITY (pcf)	102.4	103.0	105.3	106.0	105.5	100.3



Liquid Limit - 41.4  
 Plastic Limit - 23.0  
 Plastic Index - 18.4  
 Shrinkage Limit - 17.2  
 Soil Class. - CL

Optimum Moisture - 18.4 %

Maximum Dry Density - 106.7 pcf

AVERAGES  
15.4%  
110.2 pcf



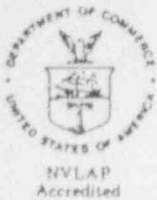
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## **APPENDIX C**

**UPPER TAILINGS COVER AND EVAPORATION POND**

**SILT COMPACTION TESTS**





# **GARCO** TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

22-Mar-89

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett

Project: Rio Algom  
Material: Reddish Brown (-4)  
Clayey Silt, Poorly Graded  
CL-ML  
Source: SS-38, BA-2, 2-5.5'  
Test: T-99 Proctor  
Date: 3/06/89

Lab#: 23162

Maximum Compaction 108.7 p.c.f.  
Optimum Moisture: 14.8 %

## ATTERBERG LIMIT Lab #23162

Liquid Limit	= 25.6
Plastic Limit	= 20
Plastic Index	= 4.4

Sincerely,

Tom McNamee  
Lab Manager

National Voluntary  
Laboratory Accreditation  
Program



Member: ASTM, ACI, AGC

United States Department  
of Commerce Accredited



# GARCO TESTING LABORATORIES

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Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

22-Mar-89

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett

Project: Rio Algom  
Material: Brown (-2") Clay  
Inclusions, Poorly Graded  
CL-ML  
Source: SS-37-A, BA-2, 5'-6'  
C-01-06  
Test: T-99 Proctor  
Date: 3/06/89

Lab#: 23154

Maximum Compaction 110.5 p.c.f.  
Optimum Moisture: 15.2 %

## ATTERBERG LIMIT

Lab #23154

Liquid Limit	= 28.8
Plastic Limit	= 22.5
Plastic Index	= 6.3

Sincerely,

Tom McNamee  
Lab Manager

National Voluntary  
Laboratory Accreditation  
Program



Member: ASTM, ACI, AGC

United States Department  
of Commerce Accredited



# GARCO TESTING LABORATORIES

532 West 3560 South  
Salt Lake City, Utah 84115  
Phone 266-4498

5826 South 1900 West  
Roy, Utah 84067  
Phone 776-5355

22-Mar-89

Earth Fax Engineering  
7324 South 1300 East  
Midvale, Utah 84047

Attn: Rhett

Project: Rio Algom  
Material: Reddish Brown (-4)  
Clayey Silt, Poorly Graded  
CL  
Source: SS-36-A, BA-2, ~~5-8~~ 3'-4'  
Test: T-99-C Proctor  
Date: 3/06/89

Lab#: 23142

Maximum Compaction 111.9 p.c.f.  
Optimum Moisture: 10.8 %

## ATTERBERG LIMIT Lab #23143

Liquid Limit	= 28.2
Plastic Limit	= 19.5
Plastic Index	= 8.7

Sincerely,

Tom McNamee  
Lab Manager

National Voluntary  
Laboratory Accreditation  
Program



Member: ASTM, ACI, AGC

United States Department  
of Commerce Accredited

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: Larry H. H. H.  
 Soil Description: CL - Non-plastic Silt

Project No.: C01-06  
 Sample No.:             
 Date: 7-11-90

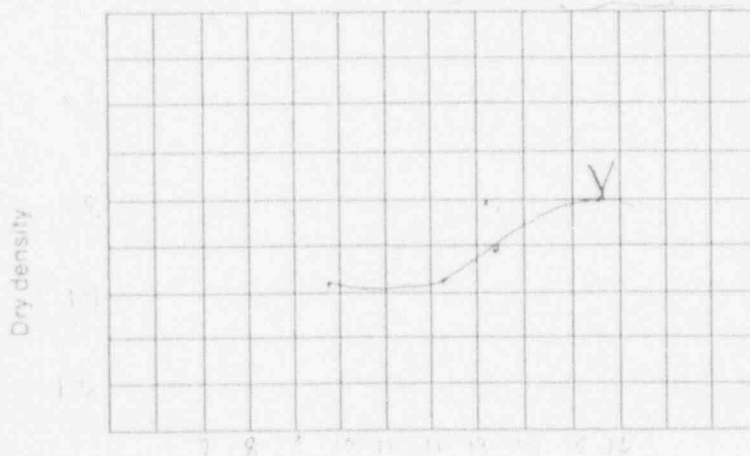
## SILT TEST #1

### Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	38	32	41	31	28	35
Tare Weight, g ( $W_c$ )	11.80	11.24	11.16	11.21	11.52	11.41
Tare + Wet Soil, g ( $W_1$ )	89.10	87.92	89.45	87.20	86.42	91.54
Tare + Dry Soil, g ( $W_2$ )	82.28	75.58	79.94	84.40	76.37	81.19
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	70.48	64.34	68.78	73.19	64.85	70.18
Wt of Water, g ( $w = W_1 - W_2$ )	6.62	12.34	9.21	4.81	10.07	1.22
Water Content, % ( $w\% = (w/W_d)100$ )	9.75	12.78	13.43	6.57	15.57	1.77

### Density Determination

Weight of Mold, g ( $W_p$ )	2042	2042	2042	2042	2042	
Mold + Wet Soil, g ( $W_3$ )	3815	3815	3910	3961	4000	
Wt Wet Soil, g ( $W_s = W_3 - W_p$ )	1773	1773	1868	1919	1958	
Volume of mold, $cm^3$ ( $V$ )	9.47	9.47	9.47	9.47	9.47	
Wet Density, $g/cm^3$ ( $W_s/V$ )	1.872	1.872	1.983	2.026	2.068	
Dry Density, $g/cm^3$ ( $w/(1 + w\%/100)$ )	1.709	1.713	1.745	1.797	1.795	



Liquid Limit = 50.5  
 Plastic Limit = 16.46  
 Plastic Index = 13.54  
 Shrinkage Limit = 14.7  
 Soil Class = CL

Optimum Moisture = 15.5 %  
 Maximum Dry Density = 112.0 pcf

AVERAGES w/ PRECONSTRUCTION DATA  
13.4 %  
112.9 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

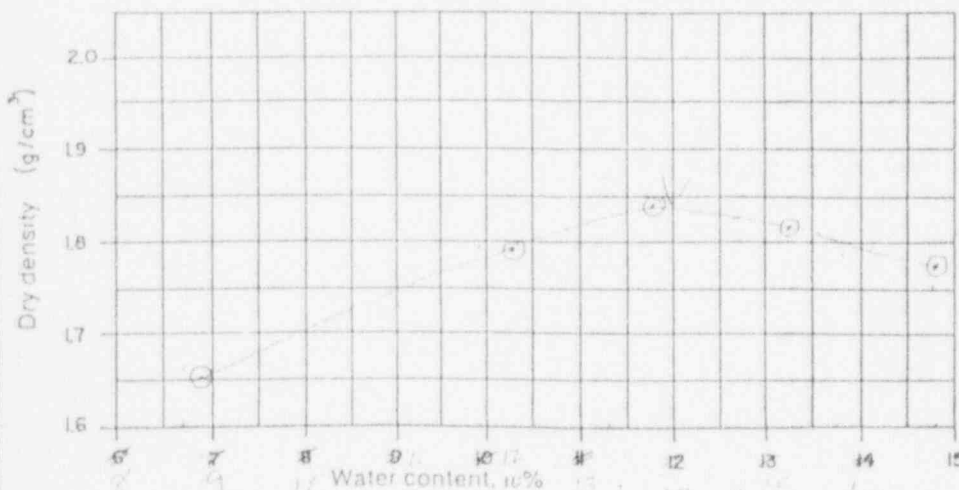
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: H. H. H. Date: 7-10-02  
 Soil Description: Reddish Brown SILT  
 Sample Location: SILT TEST #2

## Water Content Determination

	125	170	215	260	0	H <sub>2</sub> O
Trial Number	21	32	43	54	61	6
Cup Number	35	25	39	38	27	37
Tare Weight, g ( $W_c$ )	11.32	11.52	11.60	11.81	11.47	11.47
Tare + Wet Soil, g ( $W_1$ )	91.69	100.54	91.41	125.56	88.05	124.52
Tare + Dry Soil, g ( $W_2$ )	82.86	89.72	80.80	109.23	81.81	97.69
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	71.44	78.20	69.20	97.42	70.34	86.22
Wt of Water, g ( $w = W_1 - W_2$ )	8.81	10.82	10.61	16.33	6.24	7.10
Water Content, % ( $w\% = (w/W_d)100$ )	12.33	13.84	15.33	16.74	8.87	8.23
	11.99	12.27	12.53	15.13	8.63	

## Density Determination

Weight of Mold, g ( $W_p$ )	2043	2043	2043	2043	2043	
Mold + Wet Soil, g ( $W_3$ )	3945	4021	4026	3949	3740	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1902	1978	1983	1904	1697	
Volume of mold, cm <sup>3</sup> ( $V$ )	9.96	9.96	9.96	9.96	9.96	
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.91	1.98	1.99	1.91	1.70	
Dry Density, g/cm <sup>3</sup> ( $D_w = D_v/(1 + w\%/100)$ )	1.789	1.845	1.821	1.773	1.653	



Optimum Moisture - 14.0 %  
 Maximum Dry Density - 1.84 - 114.8 pcf

AVERAGES  
13.5 %  
113.2 pcf

Liquid Limit - 28.0  
 Plastic Limit - 16.83  
 Plastic Index - 11.17  
 Shrinkage Limit - 14.67  
 Soil Class. - CL



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AYTELL Date: 9-5-90  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #2, North End Silt Layer

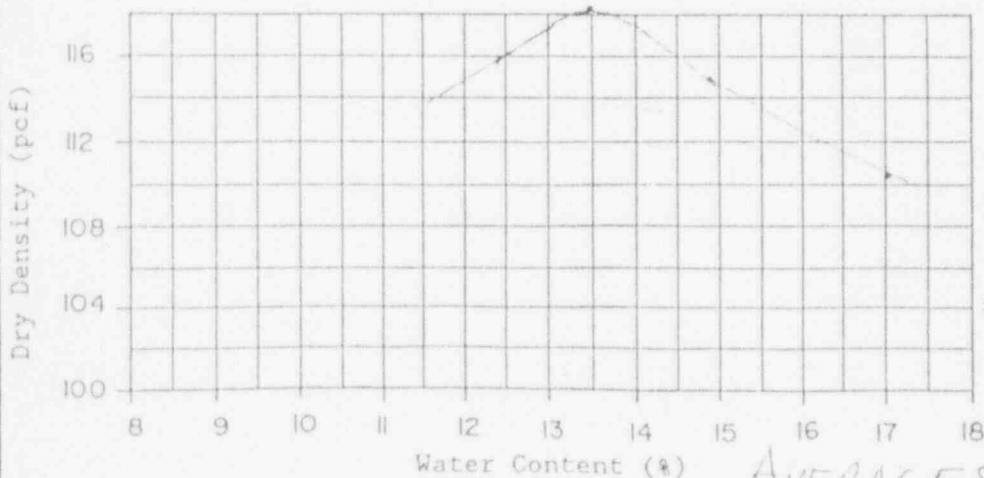
## Water Content Determination

SILT TEST #3 H<sub>2</sub>O Added

	75	115	155	195	235	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	32	28	31	46	26	26
Tare Weight, g (W <sub>c</sub> )	11.38	11.56	11.23	11.45	11.82	11.83
Tare + Wet Soil, g (W <sub>1</sub> )	77.15	92.78	102.14	101.47	S	79.66
Tare + Dry Soil, g (W <sub>2</sub> )	69.88	83.12	90.45	88.36	1A	73.058
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	58.50	71.56	79.22	76.91	M	61.75
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	7.27	9.66	11.71	13.11	P	6.08
Water Content, % (w% = (w/W <sub>d</sub> )100)	12.43	13.50	14.78	17.05	L	9.85

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	+	
Mold + Wet Soil, g (W <sub>3</sub> )	4011	4050	4025	3973	W	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1971	2010	1985	1933	E	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	+	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	2.09	2.13	2.10	2.05	S	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.86	1.88	1.84	1.75	P	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	115.9	117.1	114.9	109.2	N	



Liquid Limit - 22.50  
 Plastic Limit - 14.05  
 Plastic Index - 8.45  
 Shrinkage Limit - 13.58  
 Soil Class. - CL

Optimum Moisture - 13.5 % AVERAGES  
 Maximum Dry Density - 117.1 pcf 13.5 %  
113.8 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

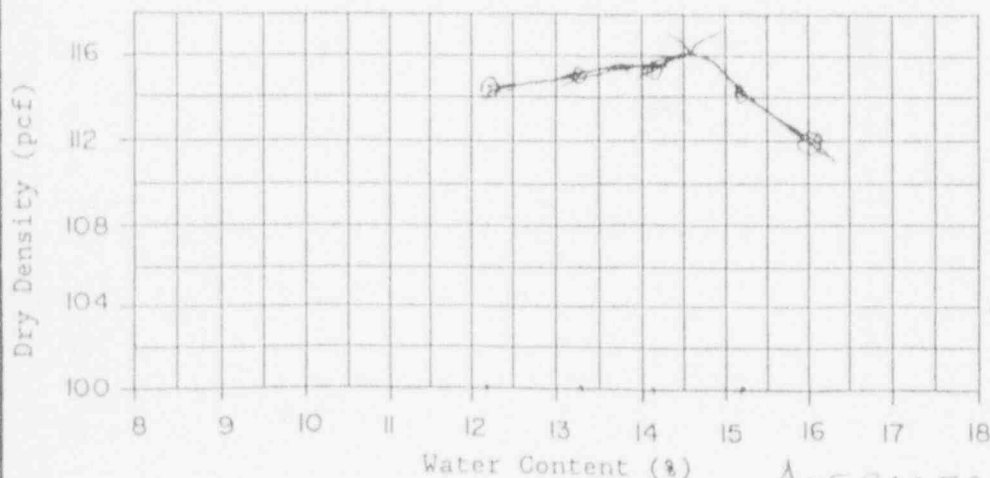
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AXTELL Date: 9-14-93  
 Soil Description: Reddish Brown Silty  
 Sample Location: North Pit #2 Silty Layer

SILT TEST #4 H<sub>2</sub>O added

	250	280	310	340	370	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	57	47	41	44	39	37
Tare Weight, g (W <sub>c</sub> )	11.78	11.39	11.38	11.65	11.66	11.51
Tare + Wet Soil, g (W <sub>1</sub> )	83.56	87.51	86.52	106.89	95.58	91.83
Tare + Dry Soil, g (W <sub>2</sub> )	75.77	78.57	77.22	94.32	83.95	88.64
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	63.99	67.18	65.84	82.67	72.29	77.13
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	7.79	8.94	9.30	12.57	11.63	3.14
Water Content, % (w% = (w/W <sub>d</sub> )100)	12.17	13.31	14.13	15.21	16.09	4.1

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3984	4014	4035	4030	4002	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1944	1974	1995	1990	1962	
Volume of mold, cm <sup>3</sup> (V)	944	928	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	2.06	2.09	2.11	2.11	2.08	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.84	1.84	1.85	1.83	1.79	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	114.82	115.10	115.36	114.28	116.80	



Liquid Limit - 36.00  
 Plastic Limit - 17.46  
 Plastic Index - 18.54  
 Shrinkage Limit - 15.24  
 Soil Class. - CL

Optimum Moisture - 14.55 %

Maximum Dry Density - 116 pcf

AVERAGES

13.6%

114.0 pcf



EarthFax

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AYTELL Date: 9-20-90  
 Soil Description: Reddish Brown SILT  
 Sample Location: Borrow Area #2, North End, Silt Layer

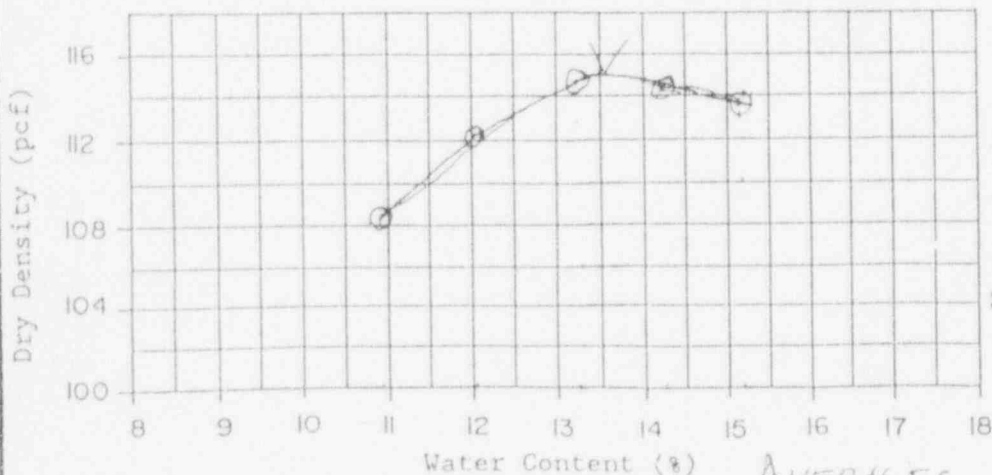
SILT TEST #5

## Water Content Determination

	75	110	145	180	215	
Trial Number	1	2	3	4	5	6
Cup Number	26	43	41	39	35	57
Tare Weight, g ( $W_c$ )	11.82	11.48	11.37	11.66	11.50	11.79
Tare + Wet Soil, g ( $W_1$ )	73.61	84.51	84.30	84.99	104.39	75.92
Tare + Dry Soil, g ( $W_2$ )	67.52	76.65	75.78	75.86	92.16	70.75
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	55.70	65.17	64.41	64.20	80.66	58.96
Wt of Water, g ( $w = W_1 - W_2$ )	6.09	7.86	8.52	9.13	12.23	5.17
Water Content, % ( $w\% = (w/W_d)100$ )	10.93	12.06	13.23	14.22	15.16	8.77

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3865	3944	4000	4011	4020	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1825	1904	1960	1971	1980	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ ( $D_w = W_w/V$ )	1.93	2.02	2.08	2.09	2.10	
Dry Density, $g/cm^3$ ( $D_d = (100/(100 + w\%))D_w$ )	1.74	1.80	1.84	1.83	1.82	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	108.57	112.48	114.63	114.18	113.79	



Liquid Limit - 25.0  
 Plastic Limit - Spilled  
 Plastic Index - Simple  
 Shrinkage Limit -  
 Soil Class. -

Optimum Moisture - 13.55 % AVERAGES 13.6 %  
 Maximum Dry Density - 115.0 pcf 114.1 pcf



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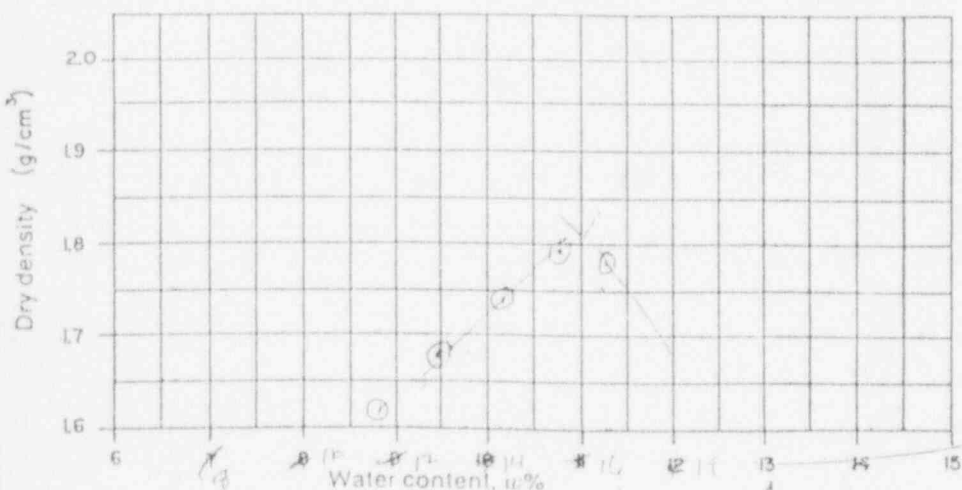
## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 9-24-90  
 Soil Description: Reddish Brown Silt  
 Sample Location: Borrow pit #2, north end, Silt Layer  
SILT TEST #6  
 Water Content Determination

	135	170	205	245	300	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	43	41	28	26	35	28
Tare Weight, g ( $W_c$ )	11.48	11.38	11.58	11.82	11.50	11.58
Tare + Wet Soil, g ( $W_1$ )	74.92	79.47	85.40	84.91	90.48	72.99
Tare + Dry Soil, g ( $W_2$ )	66.26	71.66	76.26	75.18	79.24	86.30
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	56.78	60.28	64.68	63.36	67.74	74.72
Wt of Water, g ( $w = W_1 - W_2$ )	6.66	7.81	9.14	9.73	11.24	6.69
Water Content, % ( $w\% = (w/W_d)100$ )	11.73	12.96	14.13	15.36	16.59	8.95

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3751	3835	3914	3992	4005	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1711	1795	1874	1952	1965	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.81	1.90	1.99	2.07	2.08	
Dry Density, g/cm <sup>3</sup> ( $D_w = (1 + w\%/100)$ )	1.62	1.72	1.74	1.79	1.78	



Optimum Moisture - 16.0 %  
 Maximum Dry Density - 1.79 g/cm³

AVERAGES  
13.9%  
1.74 g/cm³

Liquid Limit - 28.00  
 Plastic Limit - 17.32  
 Plastic Index - 10.68  
 Shrinkage Limit - 15.16  
 Soil Class. - CL



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AXTELL Date: 5-2-91  
 Soil Description: Reddish Brown Silt  
 Sample Location: Silt Storage Area

SILT TEST #7

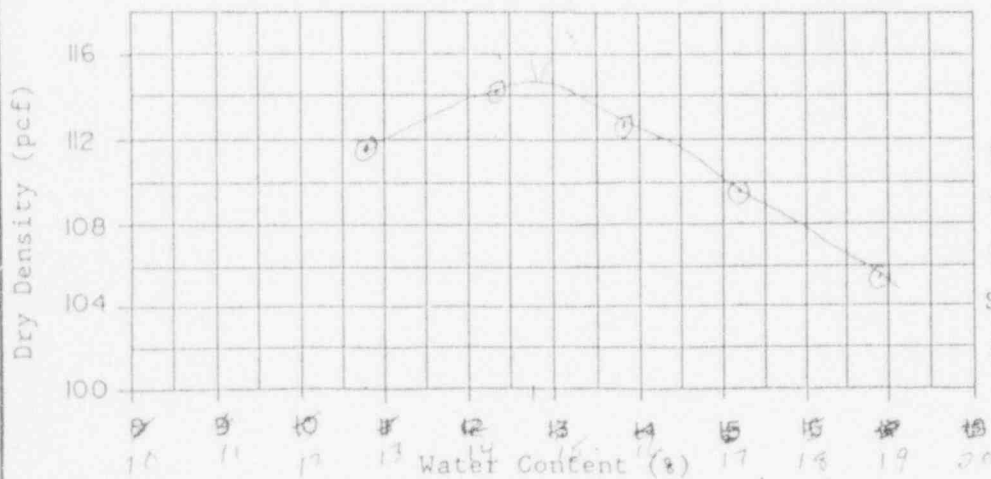
H2O 11.4% 13.1% 14.3% 15.5% 16.9%

## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	42	45	29	57	43	57
Tare Weight, g ( $W_c$ )	11.78	11.51	11.53	11.82	11.46	11.82
Tare + Wet Soil, g ( $W_1$ )	94.64	94.22	99.62	102.99	96.94	85.03
Tare + Dry Soil, g ( $W_2$ )	85.26	83.86	87.62	89.61	83.39	83.62
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	73.48	72.35	76.09	77.79	71.93	71.80
Wt of Water, g ( $w = W_1 - W_2$ )	9.38	10.36	12.00	13.37	13.60	1.41
Water Content, % ( $w = (w/W_d)100$ )	12.77	14.32	15.77	17.19	18.91	2.0

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3945	4012	4014	3981	3941	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1905	1972	1974	1941	1901	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ ( $D_w = W_w/V$ )	2.02	2.09	2.09	2.06	2.01	
Dry Density, $g/cm^3$ ( $D_w/(1 + w\%/100)$ )	1.79	1.83	1.81	1.76	1.69	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	111.8	114.1	112.7	109.7	105.5	



Liquid Limit - 26.00  
 Plastic Limit - 16.97  
 Plastic Index - 9.03  
 Shrinkage Limit - 15.35  
 Soil Class. - CL

Optimum Moisture - 14.75 %  
 Maximum Dry Density - 115.0 pcf

AVERAGES

13.9%  
 114.1 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: LARRY Axtell  
 Soil Description: Reddish Brown silt  
 Sample Location: BORROW AREA #4

Project No.: C01-06  
 Sample No.:   
 Date: 5-14-91

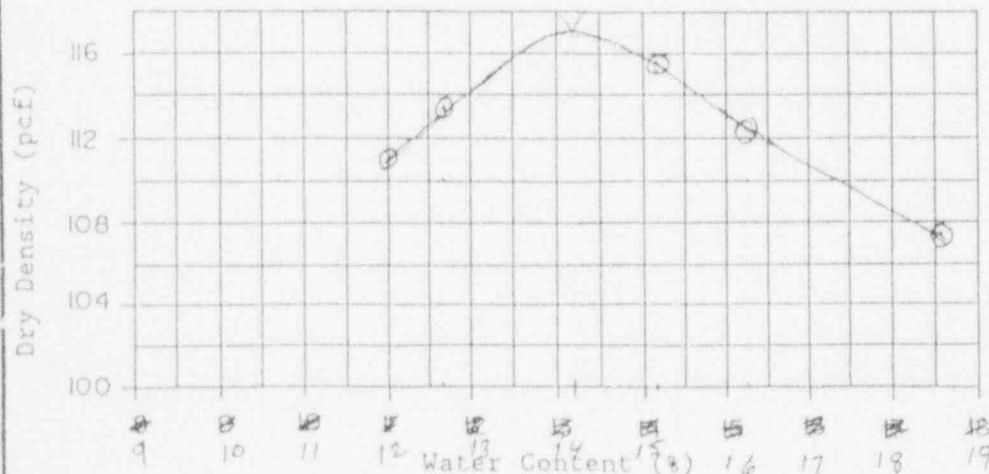
SILT TEST #8

## Water Content Determination

	100	150	200	250	300	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	41	39	45	43	42	42
Tare Weight, g (W <sub>c</sub> )	11.39	11.69	11.48	11.44	11.77	11.78
Tare + Wet Soil, g (W <sub>1</sub> )	87.83	91.29	87.32	91.29	99.84	85.96
Tare + Dry Soil, g (W <sub>2</sub> )	79.60	82.37	77.37	80.12	86.04	80.59
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	68.21	70.68	65.89	68.68	74.27	68.81
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	8.23	8.92	9.95	11.17	13.80	5.37
Water Content, % (w% = (w/W <sub>d</sub> )100)	12.07	12.62	15.10	16.26	18.58	7.8
	10.9	12.5	14.1	15.6	17.2	

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3931	3974	4047	4018	3964	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1893	1934	2007	1978	1924	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	2.00	2.05	2.13	2.10	2.04	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.78	1.82	1.85	1.80	1.72	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	111.4	113.6	115.5	112.4	107.4	



Liquid Limit - 27.00  
 Plastic Limit - 16.90  
 Plastic Index - 10.10  
 Shrinkage Limit - 15.01  
 Soil Class. - CL

Optimum Moisture - 14.20 %  
 Maximum Dry Density - 117.0 pcf

AVERAGES  
14.0 %  
114.4 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: LARRY Axtell  
 Soil Description: Reddish gray silt  
 Sample Location: #4 Borrow pit

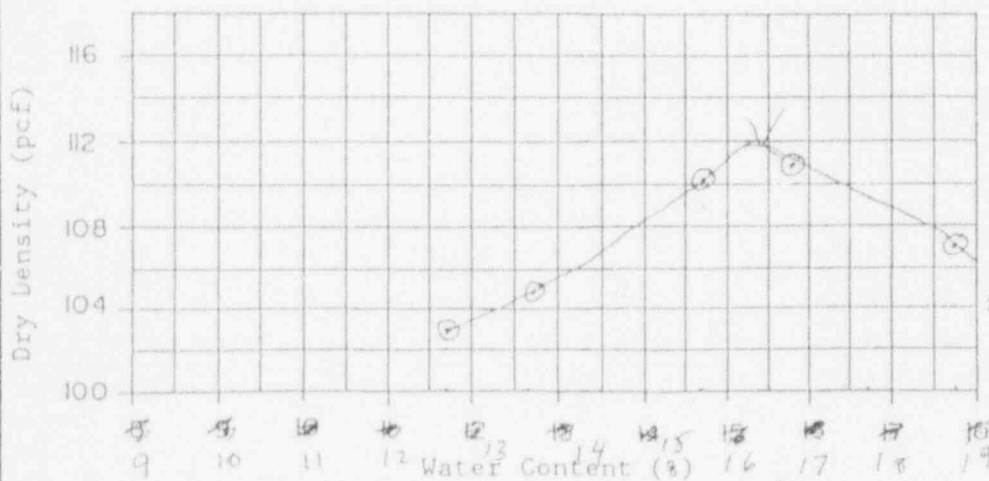
Project No.: C01-06  
 Sample No.: \_\_\_\_\_  
 Date: 5-21-91

SILT TEST #9  
 Water Content Determination

Trial Number	H <sub>2</sub> O ADDED					
	0	50	100	150	200	H <sub>2</sub> O
Cup Number	1	2	3	4	5	6
Tare Weight, g (W <sub>c</sub> )	42	41	39	43	45	45
Tare + Wet Soil, g (W <sub>1</sub> )	11.78	11.40	11.69	11.44	11.48	11.48
Tare + Dry Soil, g (W <sub>2</sub> )	68.70	78.24	77.24	84.46	94.36	85.71
Tare + Dry Soil, g (W <sub>2</sub> )	62.30	70.23	68.35	73.93	81.30	76.98
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	50.52	58.83	56.66	62.49	69.82	65.50
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.40	8.01	8.89	10.53	13.06	8.73
Water Content, % (w% = (w/W <sub>d</sub> )100)	12.67	13.62	15.69	16.85	18.71	13.3
	13.3	14.8	16.3	17.8		

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3792	3842	3966	4001	3969	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1752	1802	1926	1961	1929	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.86	1.91	2.04	2.08	2.04	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.65	1.68	1.76	1.78	1.72	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	103.61	104.90	110.03	111.08	107.23	



Liquid Limit - 28.00  
 Plastic Limit - 18.52  
 Plastic Index - 9.48  
 Shrinkage Limit - 16.36  
 Soil Class. - CL

Optimum Moisture - 16.25 %  
 Maximum Dry Density - 112.0 pcf

AVERAGES  
14.1 %  
114.2 pcf



EarthFax



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY WATKINS Date: 5-29-91  
 Soil Description: Reddish gray silt  
 Sample Location: Borrow pit #4

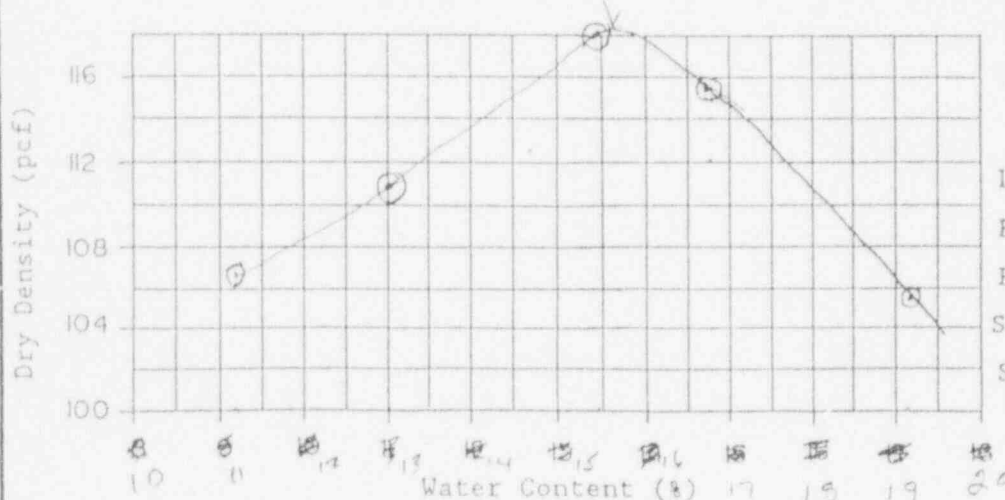
SILT TEST #10 H<sub>2</sub>O ADDED

## Water Content Determination

	50	100	150	200	250	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	42	39	45	57	41	39
Tare Weight, g (W <sub>c</sub> )	11.77	11.70	11.48	11.81	11.40	11.70
Tare + Wet Soil, g (W <sub>1</sub> )	81.29	89.33	97.50	102.91	101.94	74.45
Tare + Dry Soil, g (W <sub>2</sub> )	74.32	80.39	85.98	89.88	87.36	68.46
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	62.55	68.69	74.50	78.07	75.96	56.76
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.97	8.94	11.52	13.03	14.58	5.99
Water Content, % (w% = (w/W <sub>d</sub> )100)	11.14	13.01	15.46	16.69	19.19	10.6
	12.1	13.6	15.0	16.4	17.8	

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3836	3939	4032	4012	3949	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1796	1899	1992	1972	1909	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.90	2.01	2.11	2.09	2.02	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.71	1.78	1.89	1.85	1.69	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	106.7	110.98	118.06	115.38	105.75	



Liquid Limit - 27.00  
 Plastic Limit - 16.69  
 Plastic Index - 11.31  
 Shrinkage Limit - 14.53  
 Soil Class. - CL

Optimum Moisture - 15.10 %  
 Maximum Dry Density - 118.25 pcf

AVERAGES  
14.2 %  
114.5 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

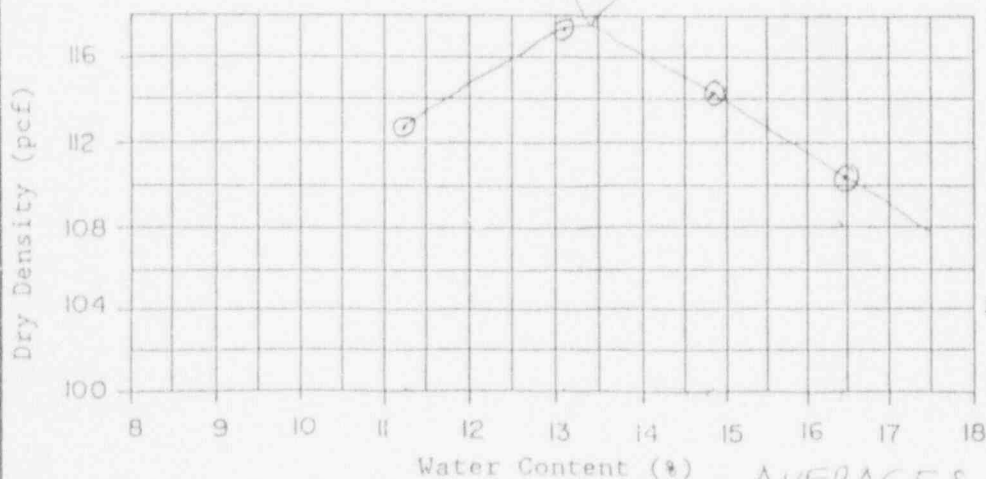
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AxteLL Date: 6-4-91  
 Soil Description: Reddish Browns. Lt  
 Sample Location: #4 Borrow pit

SILT TEST # 11  
 Water Content Determination

	H <sub>2</sub> O Added (mL)					H <sub>2</sub> O %
Trial Number	1	2	3	4	5	6
Cup Number	45	41	57	43	42	42
Tare Weight, g (W <sub>c</sub> )	11.47	11.40	11.80	11.43	11.77	11.27
Tare + Wet Soil, g (W <sub>1</sub> )	96.52	102.80	100.28	118.12	+	85.79
Tare + Dry Soil, g (W <sub>2</sub> )	87.91	92.22	88.84	103.05	⊙	81.02
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	76.44	80.82	77.04	91.62		69.25
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	8.61	10.58	11.44	15.07	W	4.77
Water Content, % (w% = (w/W <sub>d</sub> )100)	11.26	13.09	14.85	16.45	W	6.89

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3939	4052	4020	3980	+	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1899	2012	1980	1940	+	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	2.01	2.13	2.10	2.06		
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.81	1.88	1.83	1.77		
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	112.73	117.53	114.10	110.39		



Liquid Limit = 23.50  
 Plastic Limit = 12.86  
 Plastic Index = 10.64  
 Shrinkage Limit = 11.92  
 Soil Class. = CL

Optimum Moisture = 13.40 %

Maximum Dry Density = 117.50 pcf

AVERAGES

14.2 %

114.7 pcf



EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 6-11-91  
 Soil Description: Reddish gray silt  
 Sample Location: Borrow area #4 - Middle

SILT TEST # 12

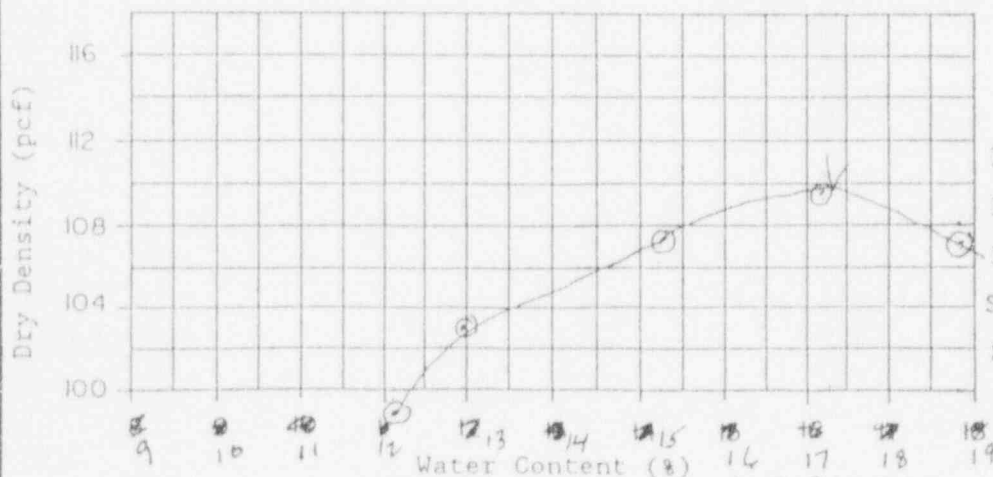
H<sub>2</sub>O Added - mL

## Water Content Determination

	0	50	100	150	200	H <sub>2</sub> O	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6	7
Cup Number	41	42	43	57	39	57	57
Tare Weight, g (W <sub>c</sub> )	11.40	11.78	11.43	11.79	11.70	11.79	11.80
Tare + Wet Soil, g (W <sub>1</sub> )	74.94	76.10	83.16	95.14	94.97	90.61	83.18
Tare + Dry Soil, g (W <sub>2</sub> )	68.09	68.74	73.69	82.91	81.75	80.16	75.94
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	56.69	56.96	62.26	71.12	70.05	68.37	64.14
Wt of Water, g (W = W <sub>1</sub> - W <sub>2</sub> )	6.85	7.36	9.47	12.23	13.22	10.45	7.24
Water Content, % (w% = (W/W <sub>d</sub> )100)	12.08	12.92	15.21	17.20	18.87	15.28	11.29
	11.29	12.85	14.42	15.98	17.54		

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3692	3793	3908	3982	3968	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1652	1753	1868	1942	1928	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	904	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.75	1.86	1.98	2.06	2.04	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.56	1.65	1.72	1.76	1.72	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	97.34	102.78	107.24	109.68	107.09	



Liquid Limit - 30.50  
 Plastic Limit - 26.20  
 Plastic Index - 4.30  
 Shrinkage Limit - 19.27  
 Soil Class. - CL

Optimum Moisture - 17.30 %  
 Maximum Dry Density - 109.75 pcf

AVERAGES

14.4%

114.4 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

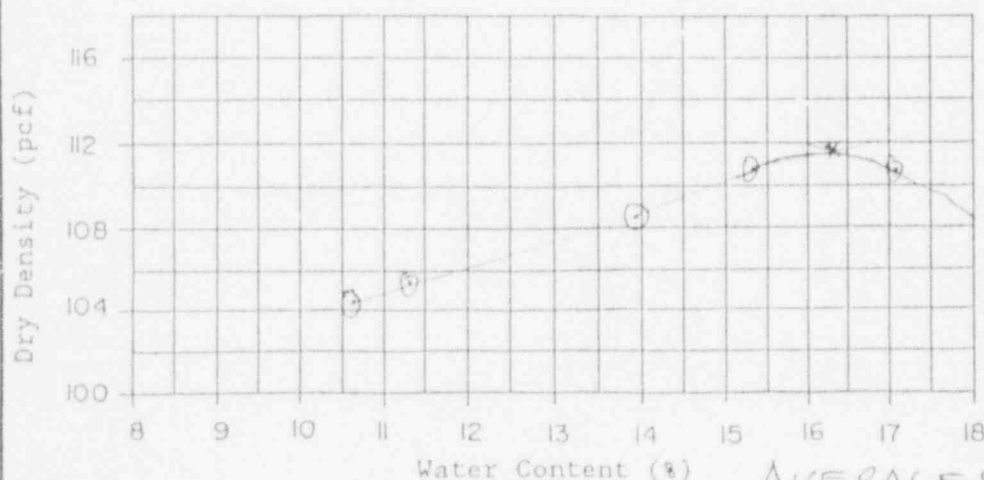
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AXTELL Date: 6-13-91  
 Soil Description: Reddish gray silt  
 Sample Location: Law #5, L#6 Between Stokes 5-1 & 5-3  
SILT TEST # 13

## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	42	39	43	45	41	45
Tare Weight, g ( $W_c$ )	11.77	11.69	11.42	11.48	11.40	11.47
Tare + Wet Soil, g ( $W_1$ )	26.11	80.84	82.99	87.30	83.91	95.63
Tare + Dry Soil, g ( $W_2$ )	78.92	73.79	74.27	77.21	73.35	89.16
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	67.15	62.10	62.85	65.73	61.95	77.69
Wt of Water, g ( $w = W_1 - W_2$ )	7.19	7.05	8.72	10.09	10.56	6.47
Water Content, % ( $w\% = (w/W_d)100$ )	10.71	11.35	13.87	15.35	17.05	8.33

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3788	3816	3905	3978	4004	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1748	1776	1865	1938	1964	
Volume of mold, $\text{cm}^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $\text{g}/\text{cm}^3$ ( $D_w = W_w/V$ )	1.85	1.88	1.98	2.05	2.08	
Dry Density, $\text{g}/\text{cm}^3$ ( $D_d = W_d/(1 + w\%/100)$ )	1.67	1.69	1.74	1.78	1.73	
Dry Density, pcf ( $62.4 \times \text{g}/\text{cm}^3$ )	104.21	105.35	108.50	110.90	110.89	



Liquid Limit - 33.50  
 Plastic Limit - 17.55  
 Plastic Index - 15.95  
 Shrinkage Limit - 12.91  
 Soil Class. - CL

Optimum Moisture - 16.3 %  
 Maximum Dry Density - 111.5 pcf

## AVERAGES

14.5 %  
114.2 pcf

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: LARRY HATCO  
 Soil Description: Reddish gray silt  
 Sample Location: #4 Borrow area

Project No.: C01-06  
 Sample No.:   
 Date: 6-18-91

SILT TEST #14

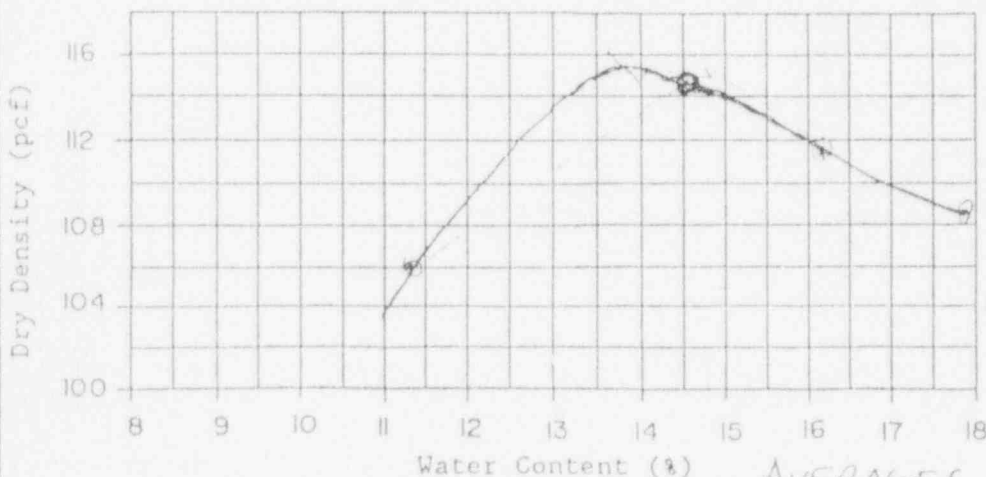
14.0 ACC-D ML

## Water Content Determination

	150	200	250	300	350	H2O
Trial Number	1	2	3	4	5	6
Cup Number	26	29	39	41	45	42
Tare Weight, g ( $W_c$ )	11.84	11.53	11.70	11.40	11.48	11.77
Tare + Wet Soil, g ( $W_1$ )	84.63	86.93	102.91	90.18	Tare wet	98.39
Tare + Dry Soil, g ( $W_2$ )	77.22	77.39	90.21	78.27		93.03
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	65.38	65.86	78.51	66.87		81.26
Wt of Water, g ( $w = W_1 - W_2$ )	7.41	15.54	12.70	11.91		5.36
Water Content, % ( $w\% = (w/W_d)100$ )	11.33	14.49	16.18	17.81		6.60

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3825	4021	4000	3971	X	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1785	1981	1960	1931	X	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ ( $D_w = W_w/V$ )	1.89	2.10	2.07	2.05		
Dry Density, $g/cm^3$ ( $D_w/(1 + w\%/100)$ )	1.70	1.83	1.79	1.74		
Dry Density, pcf ( $62.4 \times g/cm^3$ )	106.0	114.4	111.5	108.4		



Liquid Limit - 27.0  
 Plastic Limit - 17.0  
 Plastic Index - 10.0  
 Shrinkage Limit - 15.1  
 Soil Class. - CL

Optimum Moisture - 13.8 %  
 Maximum Dry Density - 115.5 pcf

AVERAGES

14.4 %  
 114.3 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Upper Tailings Cover System  
 Tested by: Paul Pattison  
 Soil Description: Reddish gray silt  
 Sample Location: #4 Borrow area

Project No.: C01-06  
 Sample No.:           
 Date: 6-20-91 ✓

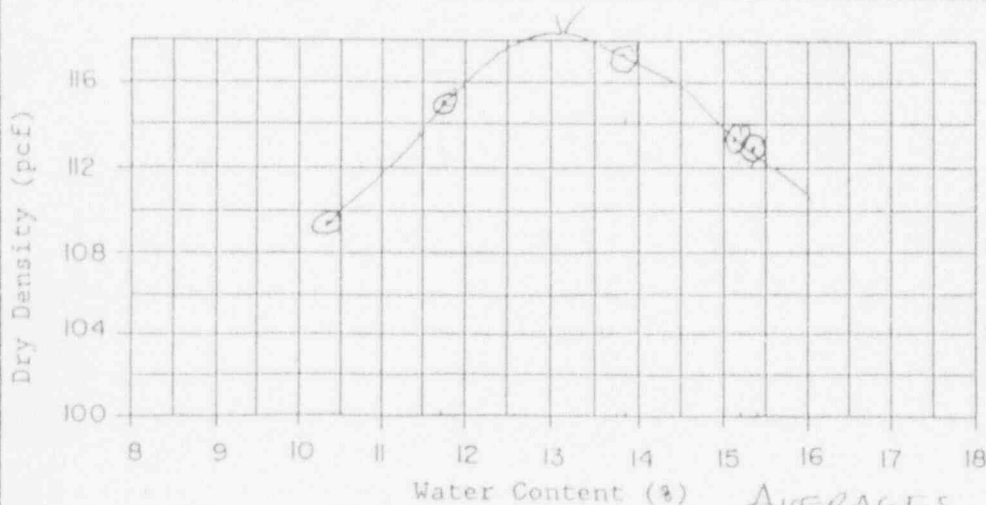
SILT TEST # 2015 L04

## Water Content Determination

	200	250	300	350	400	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	26	36	42	43	45	42
Tare Weight, g ( $W_c$ )	11.81	11.57	11.79	11.43	11.47	11.77
Tare + Wet Soil, g ( $W_1$ )	78.98	82.07	87.35	96.59	88.39	94.89
Tare + Dry Soil, g ( $W_2$ )	72.65	78.25	78.15	85.22	78.23	91.27
Wt. Dry Soil, g ( $W_d = W_2 - W_c$ )	60.84	66.67	66.36	73.79	66.76	79.50
Wt of Water, g ( $w = W_1 - W_2$ )	6.33	7.82	9.20	11.37	10.16	3.60
Water Content, % ( $w\% = (w/W_d)100$ )	10.40	11.73	13.86	15.41	15.22	4.53

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3870	3984	4063	4009	4013	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1830	1944	2023	1969	1973	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.94	2.06	2.14	2.09	2.09	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.76	1.84	1.88	1.81	1.81	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	109.65	115.05	117.28	113.0	113.19	



Liquid Limit 24.0  
 Plastic Limit 18.1  
 Plastic Index 5.94  
 Shrinkage Limit 17.0  
 Soil Class. CL-ML

Optimum Moisture 13.25 %

Maximum Dry Density 118.25 pcf

AVERAGES

14.4%

114.5 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

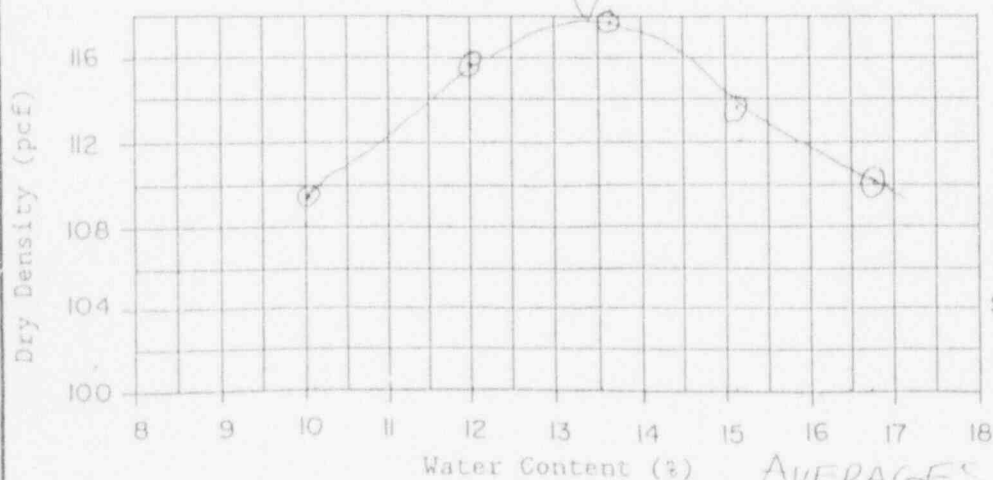
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 6-25-91  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #4  
SILT TEST #16 H<sub>2</sub>O Added (ml)

## Water Content Determination

	150	200	250	300	350	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	45	43	36	42	26	43
Tare Weight, g (W <sub>c</sub> )	11.47	11.43	11.57	11.77	11.82	11.43
Tare + Wet Soil, g (W <sub>1</sub> )	78.45	87.80	88.18	105.78	96.57	81.32
Tare + Dry Soil, g (W <sub>2</sub> )	72.32	79.62	79.04	93.41	84.42	77.43
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	60.85	68.19	67.47	81.64	72.60	66.00
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.13	8.18	9.14	12.37	12.15	3.89
Water Content, % (w% = (w/W <sub>d</sub> )100)	10.07	12.00	13.55	15.15	16.74	5.89
	Projected 10.52	12.14	13.11	15.27	16.83	

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3860	4000	4060	4026	3986	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1820	1960	2020	1986	1946	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.93	2.08	2.14	2.10	2.06	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.75	1.86	1.88	1.82	1.76	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	109.41	115.89	117.60	113.80	110.11	



Liquid Limit - 24.50  
 Plastic Limit - 18.22  
 Plastic Index - 6.28  
 Shrinkage Limit - 17.01  
 Soil Class. - CL-ML

Optimum Moisture - 13.40 % AVERAGES 14.3 %  
 Maximum Dry Density - 117.90 pcf 114.7 pcf

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

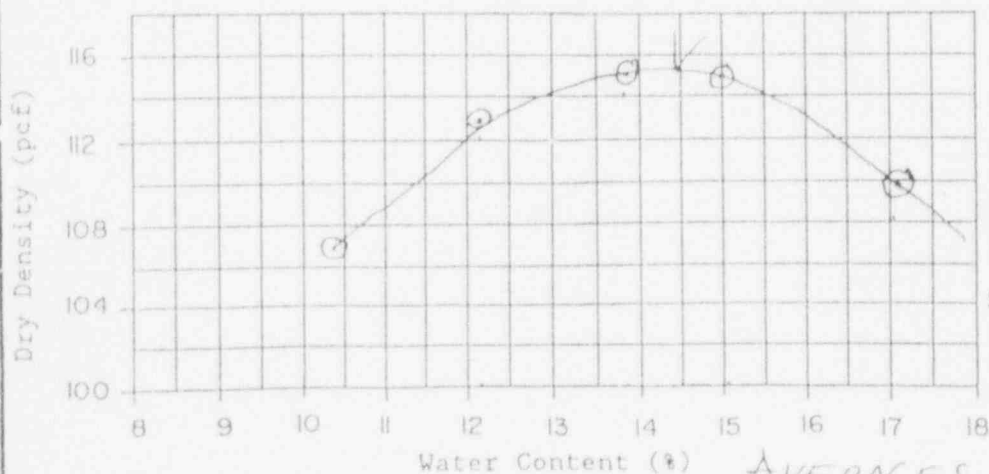
Client: Rio Tinto Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 6-30-91  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #4 North West End  
SILT TEST #17 H<sub>2</sub>O Added (PAL)

## Water Content Determination

	100	150	200	250	300	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	36	42	45	43	26	36
Tare Weight, g (W <sub>c</sub> )	11.57	11.77	11.47	11.43	11.83	11.58
Tare + Wet Soil, g (W <sub>1</sub> )	83.85	83.09	95.99	89.43	108.81	88.40
Tare + Dry Soil, g (W <sub>2</sub> )	77.13	75.35	85.68	79.23	94.67	82.07
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	65.56	63.58	74.21	67.80	82.84	71.49
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.82	7.74	10.31	10.20	14.14	5.33
Water Content, % (w% = (w/W <sub>d</sub> )100)	10.40	12.17	13.89	15.04	17.07	7.5

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3820	3958	4020	4042	3982	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1780	1918	1980	2002	1942	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.89	2.03	2.10	2.12	2.06	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.71	1.81	1.84	1.84	1.76	
Dry Density, pcf (62.4 × g/cm <sup>3</sup> )	106.83	112.93	115.06	114.99	109.80	



Liquid Limit - 27.50  
 Plastic Limit - 17.19  
 Plastic Index - 10.31  
 Shrinkage Limit - 15.17  
 Soil Class. - CL

Optimum Moisture - 14.45 % AVERAGES 14.3%  
 Maximum Dry Density - 115.00 pcf 114.7 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

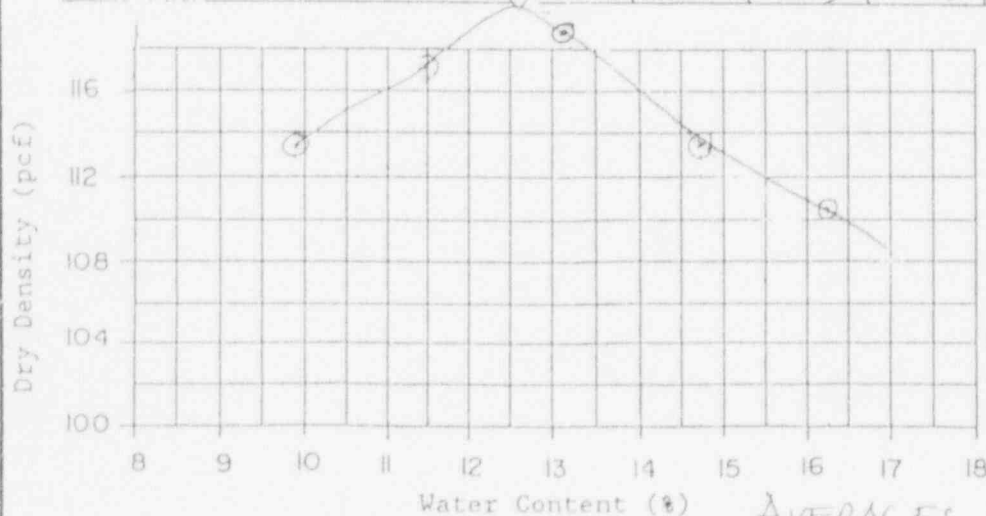
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 7-10-91  
 Soil Description: Redish Brown silt  
 Sample Location: Borrow pit #4 North side  
SILT TEST #18  $H_2O$  ADDED in mL

## Water Content Determination

	50	100	150	200	250	1420
Trial Number	1	2	3	4	5	6
Cup Number	26	45	43	42	36	42
Tare Weight, g ( $W_c$ )	11.84	11.49	11.44	11.78	11.59	11.79
Tare + Wet Soil, g ( $W_1$ )	88.65	95.09	101.16	104.96	105.82	83.69
Tare + Dry Soil, g ( $W_2$ )	81.70	86.45	90.73	93.05	92.69	78.16
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	69.86	74.96	79.29	81.27	81.10	66.37
Wt of Water, g ( $W_w = W_1 - W_2$ )	6.95	8.64	10.43	11.91	13.13	5.53
Water Content, % ( $w = (W_w/W_d)100$ )	9.9	11.5	13.2	14.7	16.2	8.3
	Projected	9.8	11.3	12.8	14.2	15.5

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3925	4024	4068	4013	3982	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1885	1984	2028	1973	1942	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ ( $D_w = W_w/V$ )	2.00	2.10	2.15	2.09	2.06	
Dry Density, $g/cm^3$ ( $D_d = (1 + w/100)D_w$ )	1.82	1.88	1.90	1.82	1.77	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	113.6	117.3	118.6	113.6	110.4	



Liquid Limit - 23.5  
 Plastic Limit - 18.5  
 Plastic Index - 5.0  
 Shrinkage Limit - 17.6  
 Soil Class. - CL-ML

Optimum Moisture - 12.70 % AVERAGES 14.3 %  
 Maximum Dry Density - 119.75 pcf 114.9 pcf

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

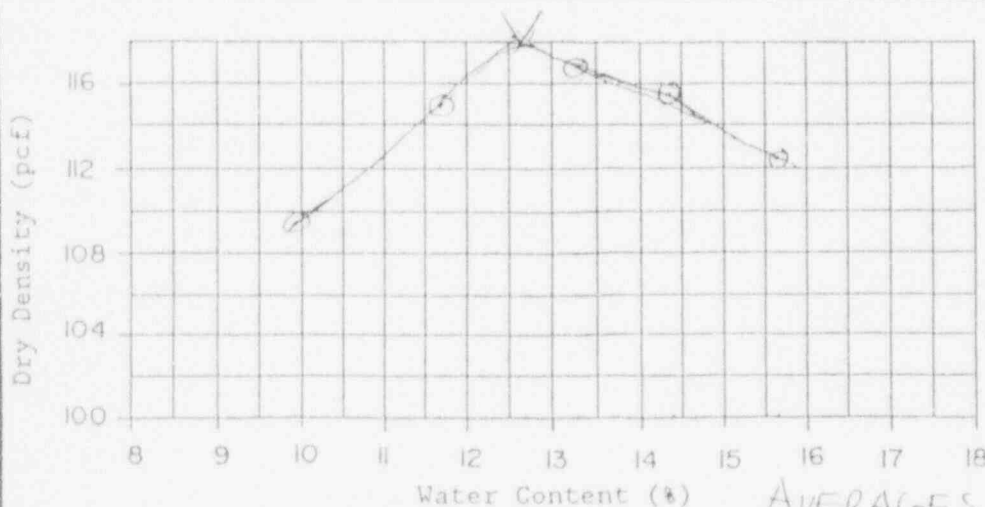
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY Axtell Date: 7-16-91  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #4 M. 226  
SILT TEST # 19 H<sub>2</sub>O ADDED (ML)

## Water Content Determination

	100	140	180	220	260	H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	26	36	43	42	45	43
Tare Weight, g (W <sub>c</sub> )	11.85	11.59	11.45	11.29	11.49	11.44
Tare + Wet Soil, g (W <sub>1</sub> )	84.43	90.58	105.59	104.01	106.75	92.60
Tare + Dry Soil, g (W <sub>2</sub> )	77.87	82.39	94.57	92.39	93.88	86.97
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	66.02	70.80	83.12	80.60	82.39	75.53
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	6.56	8.19	11.02	11.62	12.87	5.63
Water Content, % (w% = (w/W <sub>d</sub> )100)	9.9	11.6	13.3	14.4	15.6	7.5
	Project 2	10.5	11.7	12.8	13.9	15.0

## Density Determination

Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3866	3986	4041	4037	4005	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1826	1946	2001	1997	1965	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> (D <sub>w</sub> = W <sub>w</sub> /V)	1.93	2.06	2.12	2.12	2.08	
Dry Density, g/cm <sup>3</sup> (D <sub>w</sub> /(1 + w%/100))	1.76	1.85	1.87	1.85	1.80	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	109.6	115.2	116.8	115.6	112.3	



Liquid Limit - 24.5  
 Plastic Limit - 17.7  
 Plastic Index - 6.8  
 Shrinkage Limit - 16.5  
 Soil Class. - CL-ML

Optimum Moisture - 12.6 % AVERAGES 14.2 %  
 Maximum Dry Density - 118.0 pcf 115.0



EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

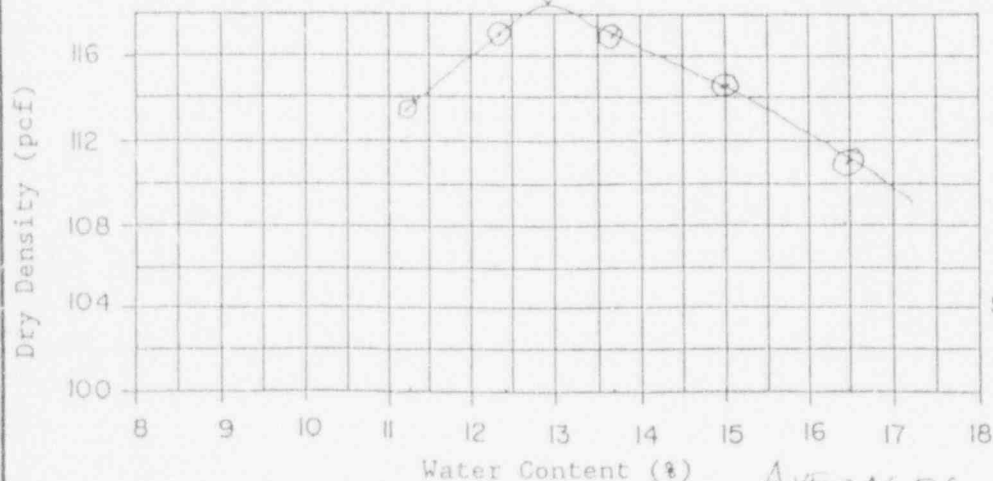
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Upper Tailings Cover System Sample No.:  
 Tested by: LARRY AXTELL Date: 7-22-91  
 Soil Description: Reddish Brown Silt  
 Sample Location: Borrow pit #4, North West End  
SILT TEST #20

## Water Content Determination

	140	180	220	260	300	
Trial Number	1	2	3	4	5	6
Cup Number	45	42	43	26	36	43
Tare Weight, g ( $W_c$ )	11.49	11.79	11.45	11.87	11.59	11.46
Tare + Wet Soil, g ( $W_1$ )	81.11	84.17	86.32	104.23	106.14	86.96
Tare + Dry Soil, g ( $W_2$ )	74.07	76.16	77.34	92.20	92.77	82.29
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	62.58	64.37	65.89	80.33	81.18	70.83
Wt of Water, g ( $W_w = W_1 - W_2$ )	7.04	8.01	8.98	12.03	13.37	4.67
Water Content, % ( $w\% = (W_w/W_d)100$ )	11.2	12.4	13.6	15.0	16.5	6.6
	10.8	11.9	13.0	14.1	15.2	

## Density Determination

Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3944	4035	4053	4028	3993	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1904	1995	2013	1988	1953	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ ( $D_w = W_w/V$ )	2.02	2.11	2.13	2.11	2.07	
Dry Density, $g/cm^3$ ( $D_d = (1 + w\%/100) D_w$ )	1.82	1.88	1.88	1.83	1.78	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	113.4	117.1	117.0	114.5	110.9	



Liquid Limit - 23.5  
 Plastic Limit - 17.4  
 Plastic Index - 6.1  
 Shrinkage Limit - 16.5  
 Soil Class. - CL-ML

Optimum Moisture - 12.4 %  
 Maximum Dry Density - 118.5 pcf

AVERAGES  
14.1 %  
115.2 pcf



EarthFax

## **APPENDIX D**

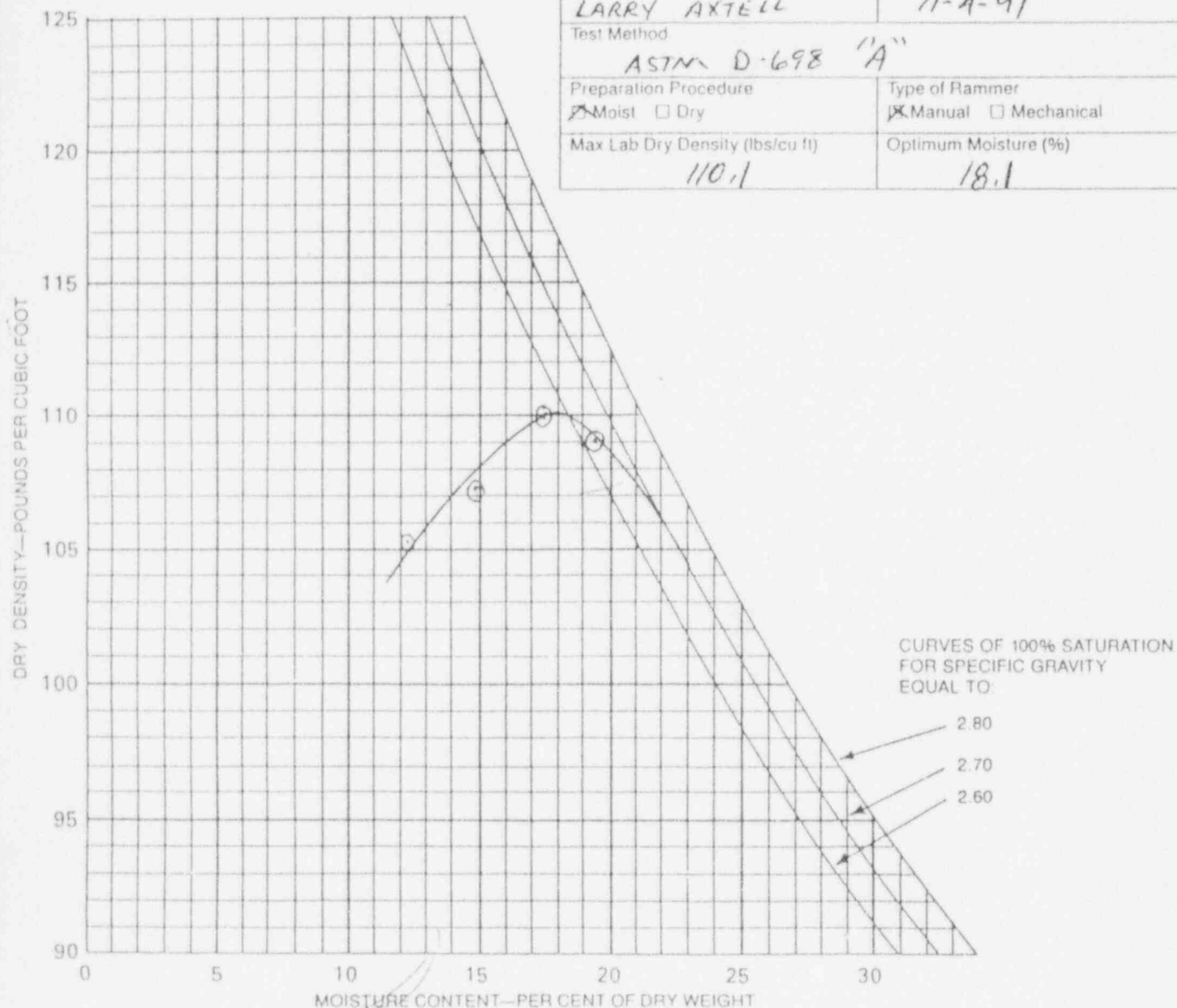
### **LOWER TAILINGS COVER CLAY COMPACTION TESTS**





## MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project	Report Date	Report No.	PTL Order No.
LISBON VALLEY			
Client	Client Order No.	Page of	Lab No.
RIO ALGOM MINING CORP.			706-570
	Source of Sample	#1 PROCTOR	
	Soil Description	BORROW PIT #2 NW END	
	Sample Submitted By	GRAY CLAY	
	LARRY AXTELL	Date Sample Received	
		11-4-91	
	Test Method	ASTM D-698 'A'	
	Preparation Procedure	Type of Rammer	
	<input checked="" type="checkbox"/> Moist <input type="checkbox"/> Dry	<input checked="" type="checkbox"/> Manual <input type="checkbox"/> Mechanical	
	Max Lab Dry Density (lbs/cu ft)	Optimum Moisture (%)	
	110.1	18.1	



Distribution/Remarks

Submitted By:

Manager

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray Clay  
 Sample Location: Borrow Area #2, N.W. side

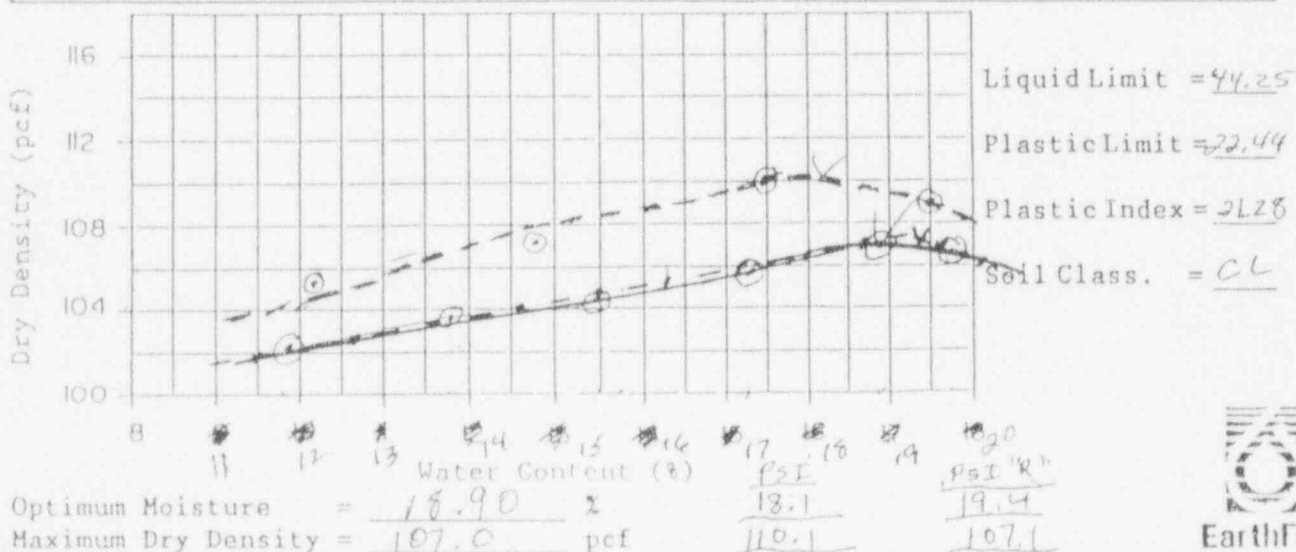
Project No.: C01-06  
 Date: 11-4-91  
 Tested by: LARRY Axtell

Water Content Determination 125 175 225 275 325 H<sub>2</sub>O 375

Trial Number	1	2	3	4	5	6	7
Cup Number	29	42	57	41	35	26	27
Tare Weight, g (W <sub>c</sub> )	11.53	11.81	11.83	11.41	11.50	11.88	11.53
Tare + Wet Soil, g (W <sub>1</sub> )	85.72	88.68	85.43	88.63	83.62	102.20	89.25
Tare + Dry Soil, g (W <sub>2</sub> )	77.89	79.40	75.57	77.27	72.15	95.93	76.42
Wt Dry Soil, g (W <sub>d</sub> =W <sub>2</sub> -W <sub>c</sub> )	66.36	67.59	63.74	65.86	60.65	84.05	64.89
Wt of Water, g (w=W <sub>1</sub> -W <sub>2</sub> )	7.83	9.28	9.66	11.36	11.47	6.27	12.83
Water Content, (w%=w/W <sub>d</sub> )	11.80	13.73	15.47	17.25	18.91	7.46	19.77
	11.46	12.97	14.44	15.86	17.23		18.57

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2042	2042
Mold + Wet Soil, g (W <sub>3</sub> )	3765	3826	3859	3919	3967	3977
Wt Wet Soil, g (W <sub>w</sub> =W <sub>3</sub> -W <sub>p</sub> )	1725	1786	1819	1879	1927	1937
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	944
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> =W <sub>w</sub> /V	1.83	1.89	1.93	1.99	2.04	2.05
Dry Density, g/cm <sup>3</sup> D <sub>w</sub> /(1 + w%/100)	1.64	1.66	1.67	1.70	1.72	1.71
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	102.14	103.70	104.30	105.91	107.05	106.80



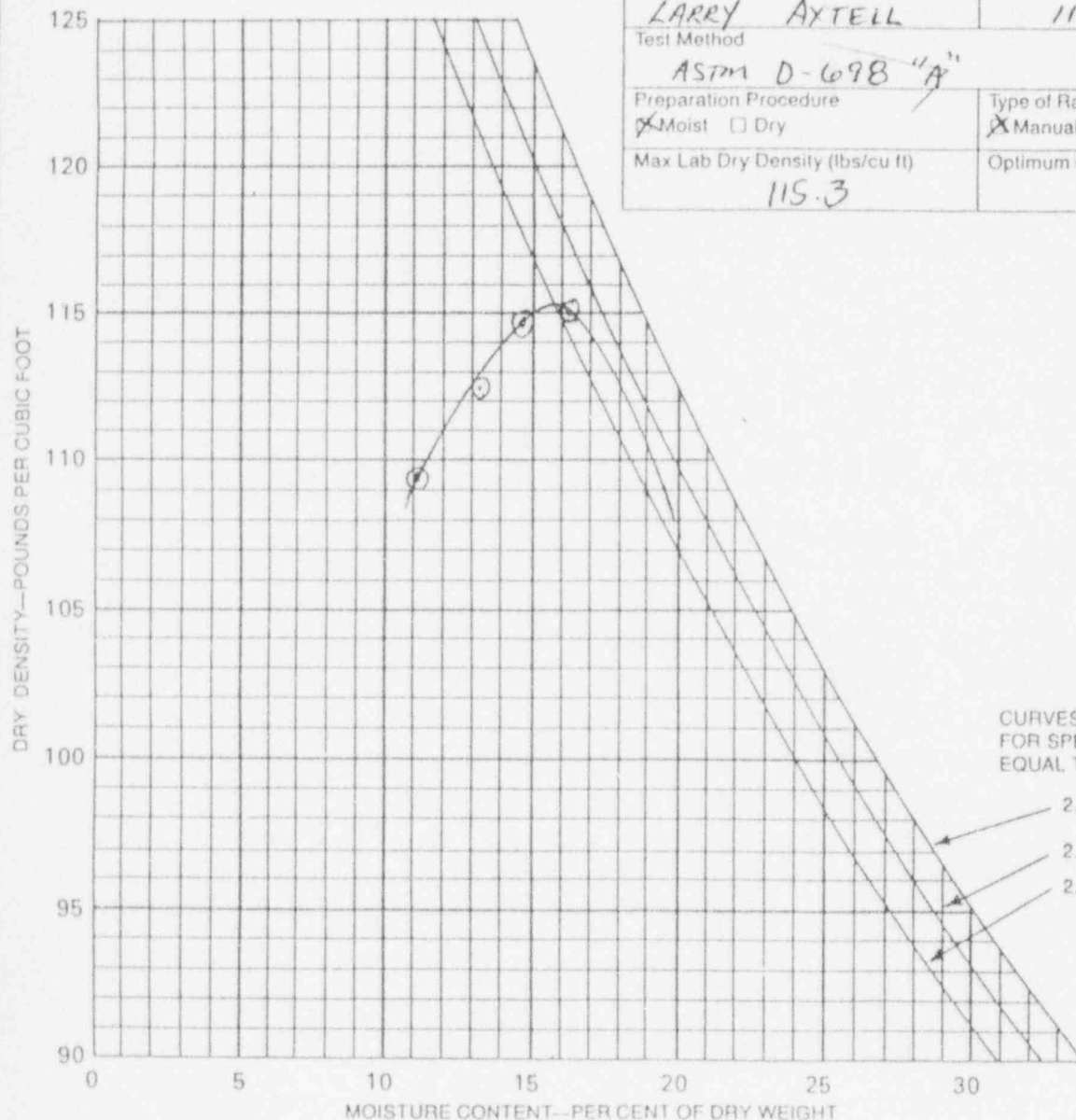
PSI ---

PSI Curves using R.D. Numbers - - - -



## MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project	Report Date	Report No.	PTL Order No.
LISBON VALLEY			
Client	Client Order No.	Page of	Lab No.
RIO ALGOM MINING CORP			706-570
	Source of Sample	#2 PROCTOR	
	Soil Description	BORROW PIT #2 (NE END)	
	Soil Description	GRAY CLAY	
	Sample Submitted By	Date Sample Received	
	LARRY AXTELL	11-9-91	
	Test Method	ASTM D-698 "A"	
	Preparation Procedure	Type of Rammer	
	<input checked="" type="checkbox"/> Moist <input type="checkbox"/> Dry	<input checked="" type="checkbox"/> Manual <input type="checkbox"/> Mechanical	
	Max Lab Dry Density (lbs/cu ft)	Optimum Moisture (%)	
	115.3	15.8	



Distribution/Remarks

Submitted By:

Manager

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 11-4-91  
 Soil Description: Gray Clay Tested by: Larry Axtell  
 Sample Location: #2 Borrow Area N.E. Side

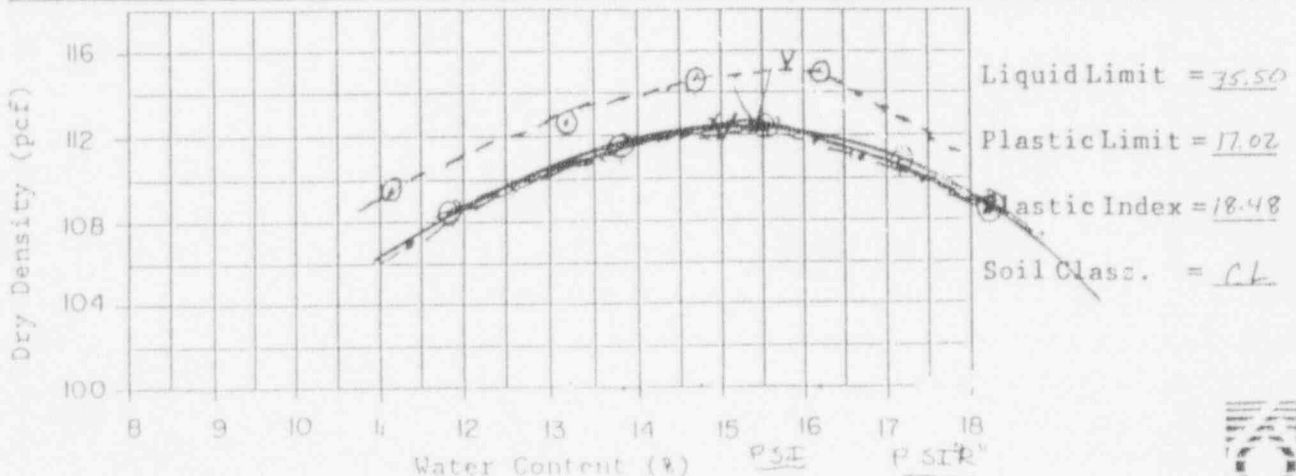
Water Content Determination 200 250 300 350 400  
H<sub>2</sub>O Added in mL

Trial Number	1	2	3	4	5	6
Cup Number	46	26	43	36	45	36
Tare Weight, g ( $W_c$ )	11.48	11.88	11.47	11.61	11.51	11.61
Tare + Wet Soil, g ( $W_1$ )	90.43	86.98	89.31	105.04	101.03	98.15
Tare + Dry Soil, g ( $W_2$ )	82.10	77.86	78.85	91.37	87.17	93.90
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	70.62	65.98	67.38	79.76	75.66	82.29
Wt of Water, g ( $w = W_1 - W_2$ )	8.33	9.12	10.46	13.67	13.86	4.25
Water Content, ( $w\% = w/W_d$ )	11.80	13.82	15.52	17.14	18.32	5.16

11.41 12.85 14.25 15.61 16.92

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3867	3968	4001	4002	3986	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1827	1928	1961	1962	1946	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> $D_w = W_w/V$	1.94	2.04	2.08	2.08	2.06	
Dry Density, g/cm <sup>3</sup> $D_w/(1 + w\%/100)$	1.74	1.79	1.80	1.78	1.74	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	108.59	111.70	112.31	110.87	108.58	
	108.28	111.84	112.35	110.80	108.64	



Optimum Moisture = 15.45 %  
 Maximum Dry Density = 112.50 pcf



PSI---

PSI "R" - - - -



## MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project	Report Date	Report No.	PTL Order No.
LISBON VALLEY			
	Client Order No.	Page of	Lab No.
			706-570

Client	Source of Sample
RIO ALGOM MINING CORP.	#3 PROCTOR BORROW PIT #2 SOUTH SIDE

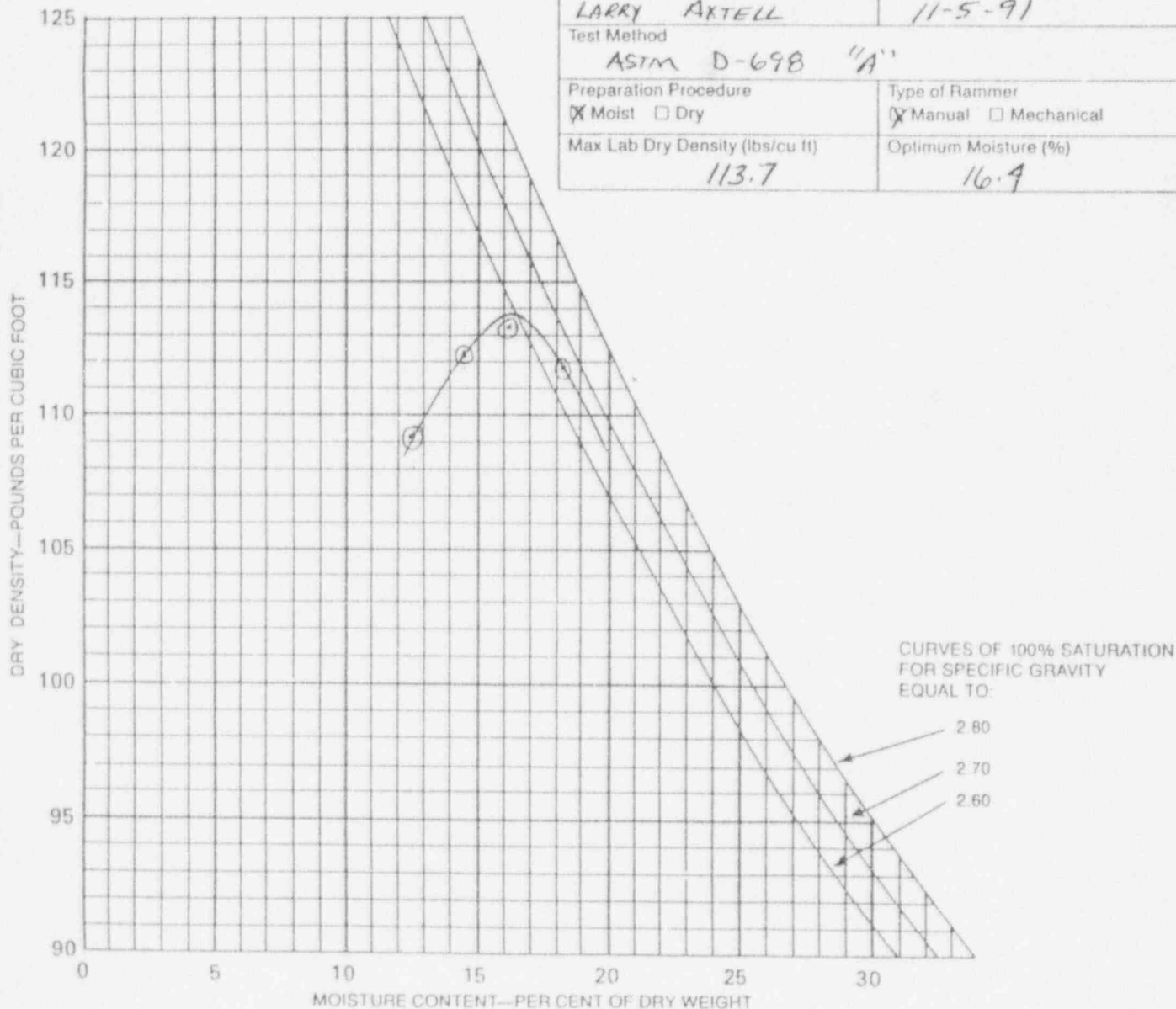
Soil Description
GRAY CLAY

Sample Submitted By	Date Sample Received
LARRY AXTELL	11-5-91

Test Method
ASTM D-698 "A"

Preparation Procedure	Type of Rammer
<input checked="" type="checkbox"/> Moist <input type="checkbox"/> Dry	<input checked="" type="checkbox"/> Manual <input type="checkbox"/> Mechanical

Max Lab Dry Density (lbs/cu ft)	Optimum Moisture (%)
113.7	16.4



Distribution/Remarks	Submitted By
	Manager



# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray Clay  
 Sample Location: #2 Borrow area, South side

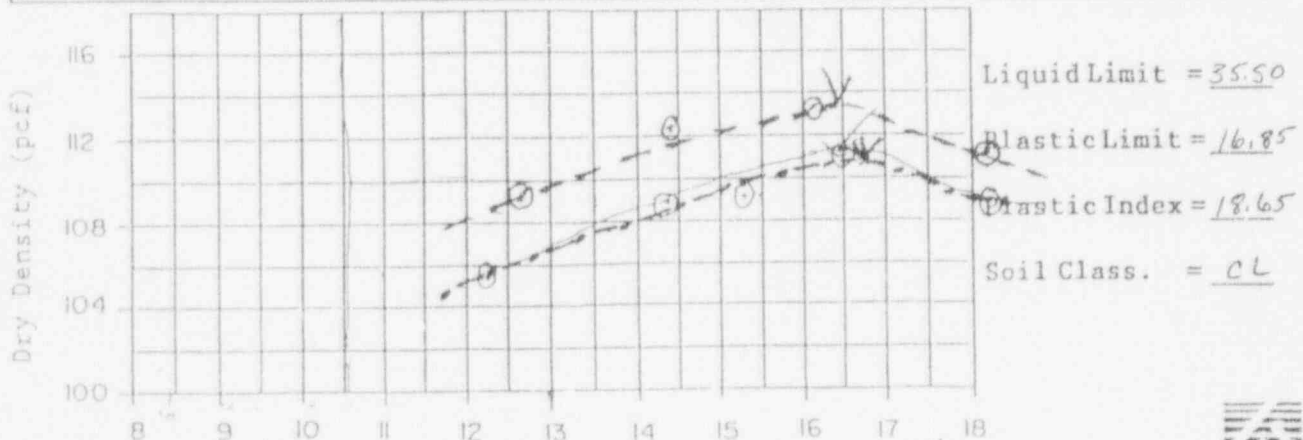
Project No.: C01-06  
 Date: 11-5-91  
 Tested by: LARRY Axtell

Water Content Determination 100 140 175 210 250

Trial Number	1	2	3	4	5	6
Cup Number	57	36	45	35	26	36
Tare Weight, g ( $W_c$ )	11.83	11.61	11.51	11.50	11.88	11.62
Tare + Wet Soil, g ( $W_1$ )	65.24	91.39	90.02	91.71	106.43	102.85
Tare + Dry Soil, g ( $W_2$ )	59.42	81.39	79.61	80.32	91.75	95.58
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	47.59	69.78	68.10	68.82	79.87	83.96
Wt of Water, g ( $w = W_1 - W_2$ )	5.82	10.00	10.41	11.39	14.68	7.27
Water Content, ( $w\% = w/W_d$ )	12.23	14.33	15.29	16.55	18.38	8.66
	11.88	13.12	14.17	15.20	16.35	

Density Determination

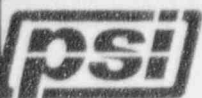
Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3832	3905	3958	3997	3996	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1792	1865	1918	1957	1956	
Volume of mold, $cm^3$ ( $V$ )	944	944	944	944	944	
Wet Density, $g/cm^3$ $D_w = W_w/V$	1.90	1.98	2.03	2.07	2.07	
Dry Density, $g/cm^3$ $D_w/(1 + w\%/100)$	1.69	1.73	1.76	1.78	1.75	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	105.64	108.07	109.87	110.83	109.11	



Optimum Moisture = 11.0 %  
 Maximum Dry Density = 111.0 pcf

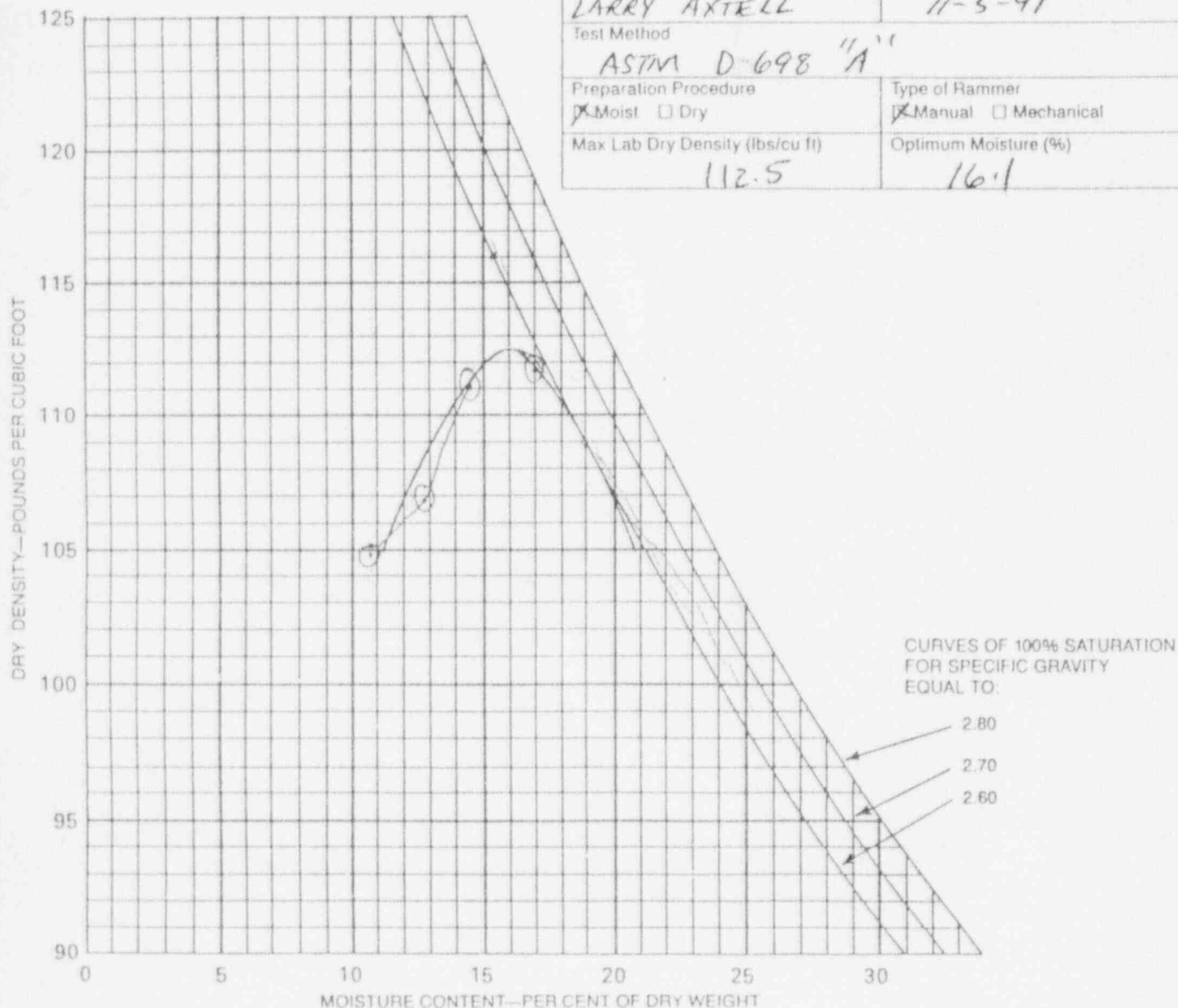
PSI - - - -  
 PSI<sup>+</sup>R - - - -





## MOISTURE DENSITY RELATIONSHIP TEST REPORT

Project	Report Date	Report No.	PTL Order No.
LISBON VALLEY			
Client	Client Order No.	Page of 1	Lab No. 706-570
REG ALGOM MINING CORP.	Source of Sample	#4 PROCTOR	
	BORROW PIT #4 SOUTH END		
	Soil Description	GRAY-BLACK CLAY	
	Sample Submitted By	Date Sample Received	
	LARRY AXTELL	11-5-91	
	Test Method	ASTM D-698 "A"	
	Preparation Procedure	Type of Rammer	
	<input checked="" type="checkbox"/> Moist <input type="checkbox"/> Dry	<input checked="" type="checkbox"/> Manual <input type="checkbox"/> Mechanical	
	Max Lab Dry Density (lbs/cu ft)	Optimum Moisture (%)	
	112.5	16.1	



Distribution/Remarks

Submitted By:

Manager

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray Black Clay  
 Sample Location: #4 Borrow Area, South Side

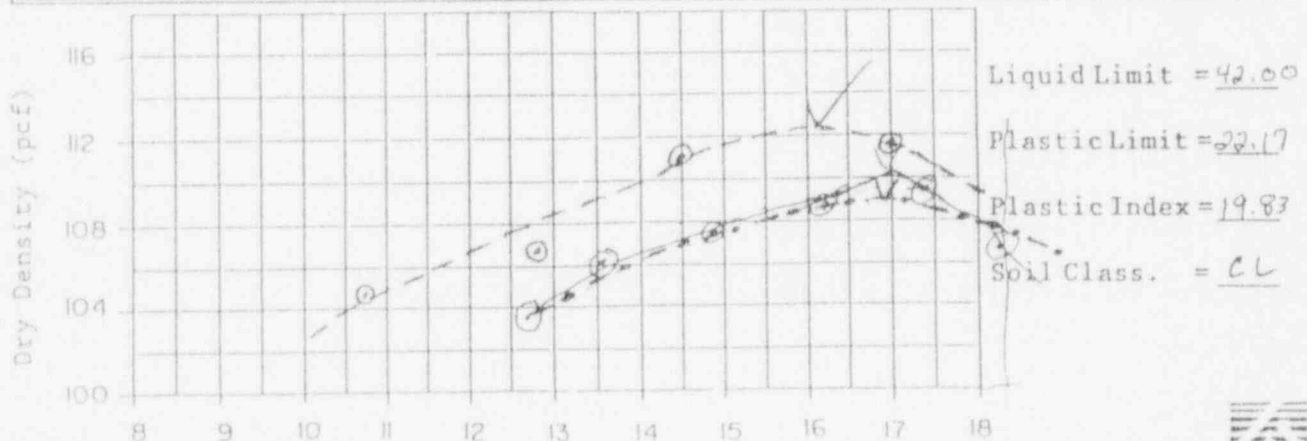
Project No.: C01-06  
 Date: 11-5-91  
 Tested by: LARRY AXTELL

Water Content Determination 125 160 195 230 265 H<sub>2</sub>O 300

Trial Number	1	2	3	4	5	6	7
Cup Number	29	42	32	43	46	43	41
Tare Weight, g ( $W_c$ )	11.53	11.81	11.44	11.47	11.47	11.47	11.41
Tare + Wet Soil, g ( $W_1$ )	82.21	87.30	79.72	87.48	89.08	100.32	88.20
Tare + Dry Soil, g ( $W_2$ )	74.54	78.29	70.86	76.88	77.54	93.73	76.21
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	63.01	66.48	59.42	65.41	66.07	82.26	64.80
Wt of Water, g ( $w = W_1 - W_2$ )	7.67	9.01	8.86	10.60	11.54	6.59	11.99
Water Content, (%) ( $w\% = w/W_d$ )	12.17	13.55	14.91	16.21	17.47	8.01	18.50
	12.01	13.07	14.11	15.13	16.13		17.10

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	2040
Mold + Wet Soil, g ( $W_3$ )	3793	3865	3908	3948	3985	3953
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1753	1825	1868	1908	1945	1913
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	944
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.86	1.93	1.98	2.02	2.06	2.03
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w\%/100)$ )	1.66	1.70	1.72	1.74	1.75	1.71
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	103.47	106.06	107.52	108.58	109.20	106.70



Optimum Moisture = 17.0 %  
 Maximum Dry Density = 110.0 pcf

PSI = 16.1 %  
 PSI-A = 16.9 %

PSI = 112.5 pcf  
 PSI-A = 108.9 pcf



EarthFax

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: Borrow pit #2

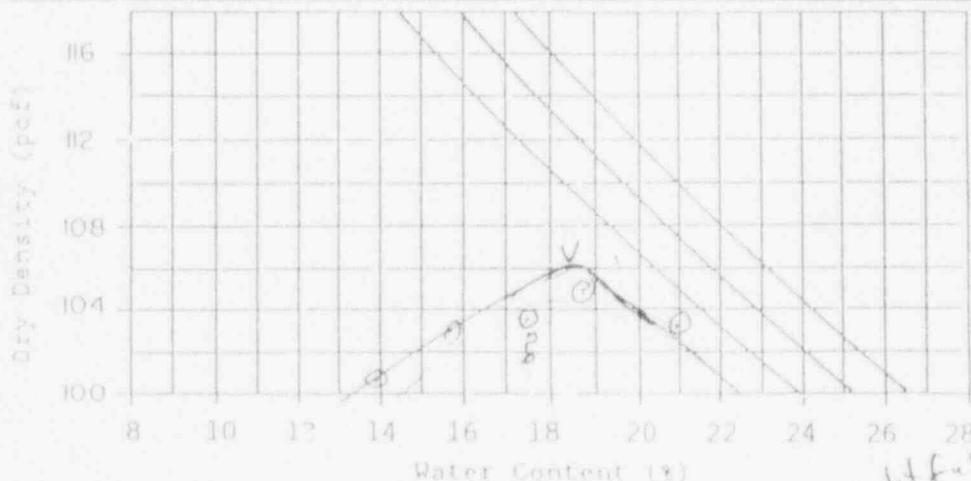
Project No.: C01-06  
 Date: 1-9-92  
 Tested by: Axtell

Water Content Determination H<sub>2</sub>O Added (ml) Orig H<sub>2</sub>O  
 125 175 225 275 325

Trial Number	1	2	3	4	5	6
Cup Number	1	2	3	4	5	2
Tare Weight, g (W <sub>c</sub> )	32.95	33.33	33.00	33.25	33.25	33.33
Tare + Wet Soil, g (W <sub>1</sub> )	380.25	349.73	363.41	378.48	360.85	353.09
Tare + Dry Soil, g (W <sub>2</sub> )	338.02	346.73	314.52	323.81	304.08	324.93
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	305.07	273.40	281.52	290.56	270.83	291.60
Wt of Water, g (w = W <sub>1</sub> - W <sub>2</sub> )	42.23	43.00	48.89	54.67	56.77	28.16
Water Content, (w% = w/W <sub>d</sub> )	13.8	15.7	17.4	18.8	21.0	9.7

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2037	2037	2037	2037	2037	
Mold + Wet Soil, g (W <sub>3</sub> )	3761	3837	3880	3924	3936	
Wt Wet Soil, g (W <sub>w</sub> = W <sub>3</sub> - W <sub>p</sub> )	1724	1800	1843	1887	1899	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> = W <sub>w</sub> /V	1.83	1.91	1.95	2.00	2.01	
Dry Density, g/cm <sup>3</sup> D <sub>w</sub> /(1 + w%/100)	1.61	1.65	1.66	1.68	1.66	
Dry Density, pcf (62.4 × g/cm <sup>3</sup> )	100.5	103.0	103.6	104.8	103.6	



Liquid Limit = 46  
 Plastic Limit = 19.5  
 Plastic Index = 26.5  
 Soil Class. = CL

Optimum Moisture = 18.2 %  
 Maximum Dry Density = 106.2 pcf

*Doubtful Info*



# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

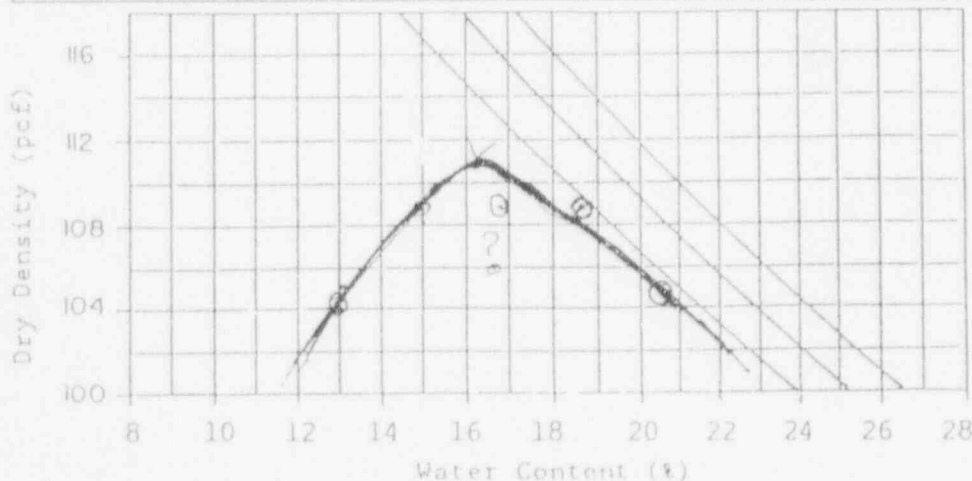
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 12-31-91  
 Soil Description: Gray clay Tested by: Axtell  
 Sample Location: Borrow pit #2 North side

Water Content Determination 90 140 190 240 290 Dry H<sub>2</sub>O

Trial Number	1	2	3	4	5	6
Cup Number	1	2	3	4	5	1
Tare Weight, g ( $W_c$ )	32.95	33.32	32.89	33.23	33.25	32.94
Tare + Wet Soil, g ( $W_1$ )	337.51	337.42	338.46	337.95	357.44	367.20
Tare + Dry Soil, g ( $W_2$ )	302.37	297.64	294.62	332.60	302.12	336.81
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	269.42	264.32	261.64	299.37	268.87	303.87
Wt of Water, g ( $w = W_1 - W_2$ )	35.14	39.78	43.84	55.35	55.32	30.39
Water Content, ( $w\% = w/W_d$ )	13.0	15.0	16.8	18.5	20.6	10.00

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3822	3925	3960	3985	3959	
Wt Wet Soil, g ( $W_u = W_3 - W_p$ )	1782	1885	1920	1945	1919	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> $D_u = W_u/V$	1.89	2.00	2.03	2.06	2.03	
Dry Density, g/cm <sup>3</sup> $D_w/(1 + w\%/100)$	1.67	1.74	1.74	1.74	1.68	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	104.2	108.6	108.6	108.6	104.8	



Liquid Limit = 38.5

Plastic Limit = 17.2

Plastic Index = 21.3

Soil Class. = CL

Optimum Moisture = 16.3 %

Maximum Dry Density = 111.8 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: Borrow pit #2 (middle)

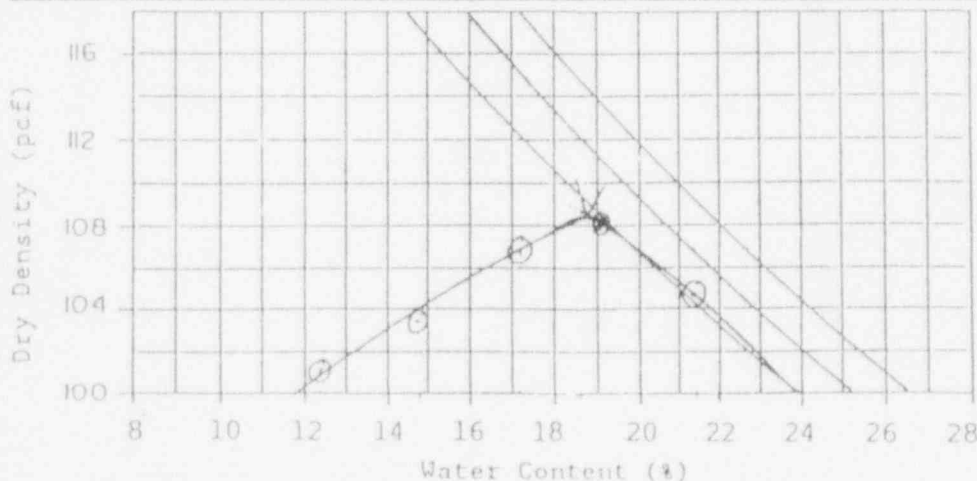
Project No.: C01-06  
 Date: 12-10-91  
 Tested by: LARRY AXTELL

Water Content Determination 160 110 160 210 260 ORIG H<sub>2</sub>O

Trial Number	1	2	3	4	5	6
Cup Number	45	36	42	44	35	—
Tare Weight, g ( $W_c$ )	11.52	11.61	11.80	11.64	11.55	648
Tare + Wet Soil, g ( $W_1$ )	98.08	90.07	99.00	97.61	115.14	1313
Tare + Dry Soil, g ( $W_2$ )	88.60	79.95	86.18	83.80	96.91	1249
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	77.08	68.34	74.38	72.16	85.36	601
Wt of Water, g ( $w = W_1 - W_2$ )	9.48	10.12	12.82	13.81	18.23	64
Water Content, ( $w\% = w/W_d$ )	12.3	14.8	17.2	19.1	21.4	10.6

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3756	3841	3924	3980	3962	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1716	1801	1884	1940	1922	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> $D_w = W_w/V$	1.82	1.91	2.00	2.06	2.04	
Dry Density, g/cm <sup>3</sup> $D_d = (1 + w\%/100)$	1.62	1.66	1.71	1.73	1.68	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	101.1	103.4	106.7	108.0	104.8	

Liquid Limit = 44.5Plastic Limit = 18.0Plastic Index = 26.5Soil Class. = CL

Optimum Moisture = 18.6 %  
 Maximum Dry Density = 108.5 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

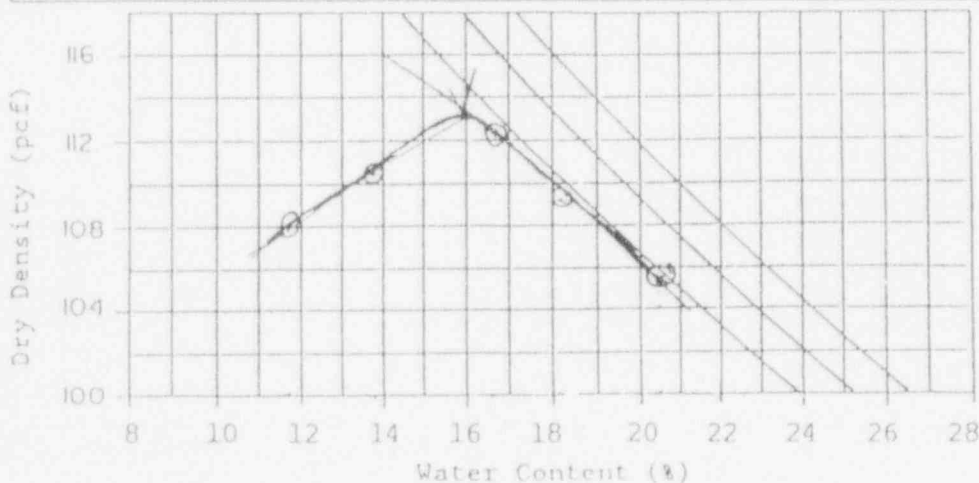
Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: Borrow pit #2 East End

Project No.: C01-06  
 Date: 12-3-91  
 Tested by: AT&T

Water Content Determination	H <sub>2</sub> O ADDED (mL)					ORIG H <sub>2</sub> O
	200	250	300	350	400	
Trial Number	1	2	3	4	5	6
Cup Number	35	57	41	36	42	—
Tare Weight, g (W <sub>c</sub> )	11.54	11.80	11.41	11.61	11.80	16.47
Tare + Wet Soil, g (W <sub>1</sub> )	96.25	91.60	94.82	103.66	100.43	1657
Tare + Dry Soil, g (W <sub>2</sub> )	87.36	81.91	83.28	89.52	85.38	1610
Wt Dry Soil, g (W <sub>d</sub> =W <sub>2</sub> -W <sub>c</sub> )	75.82	70.11	71.87	77.91	73.58	963
Wt of Water, g (W=W <sub>1</sub> -W <sub>2</sub> )	8.89	9.69	11.54	14.14	15.05	47
Water Content, (w <sub>L</sub> =W/W <sub>d</sub> )	11.73	13.82	16.06	18.15	20.45	4.9

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3859	3944	4013	3998	3963	
Wt Wet Soil, g (W <sub>w</sub> =W <sub>3</sub> -W <sub>p</sub> )	1819	1904	1973	1958	1923	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> =W <sub>w</sub> /V	1.93	2.02	2.09	2.07	2.04	
Dry Density, g/cm <sup>3</sup> D <sub>w</sub> /(1 + w <sub>L</sub> /100)	1.73	1.77	1.80	1.75	1.69	
Dry Density, pcf (62.4 × g/cm <sup>3</sup> )	108.0	110.4	112.3	109.2	105.5	



Optimum Moisture = 16.0 %  
 Maximum Dry Density = 113.2 pcf

Liquid Limit = 36.0

Plastic Limit = 17.4

Plastic Index = 18.6

Soil Class. = CL





## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray Clay  
 Sample Location: #2 Borrow pit, North side

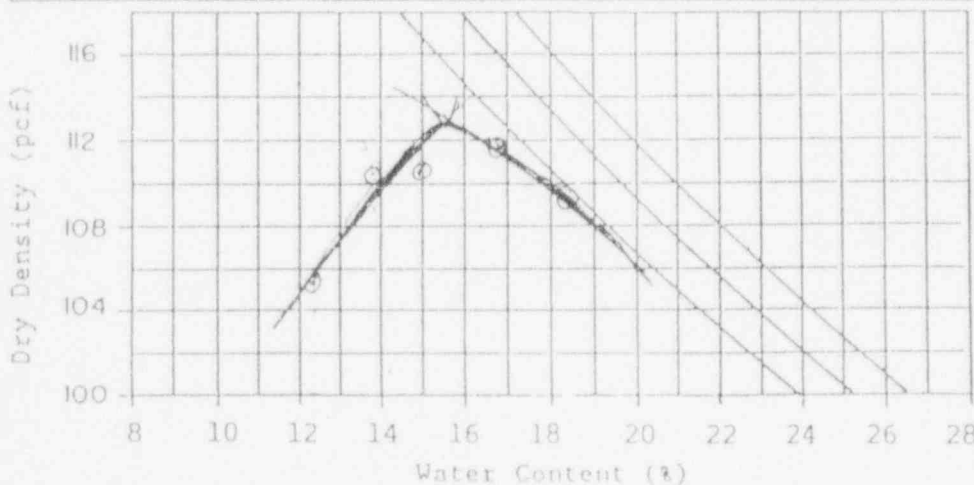
Project No.: C01-06  
 Date: 11-26-91  
 Tested by: LARRY Axtell

## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	37	26	36	45	27	—
Tare Weight, g ( $W_c$ )	11.54	11.88	11.61	11.51	11.53	650
Tare + Wet Soil, g ( $W_1$ )	94.66	94.58	100.68	95.90	100.79	1538
Tare + Dry Soil, g ( $W_2$ )	85.59	84.52	89.07	83.78	86.92	1469
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	74.05	72.64	77.46	72.27	75.39	819
Wt of Water, g ( $w = W_1 - W_2$ )	9.07	10.06	11.61	12.12	13.87	69
Water Content, (%) ( $w\% = w/W_d$ )	12.2	13.8	15.0	16.8	18.4	8.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3835	3940	3955	4015	4000	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1795	1900	1915	1975	1960	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.90	2.01	2.03	2.09	2.08	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.69	1.77	1.77	1.79	1.78	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	105.5	110.4	110.4	111.7	109.8	

Liquid Limit = 36.0Plastic Limit = 16.3Plastic Index = 19.7Soil Class. = CL

Optimum Moisture = 15.5 %  
 Maximum Dry Density = 112.9 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

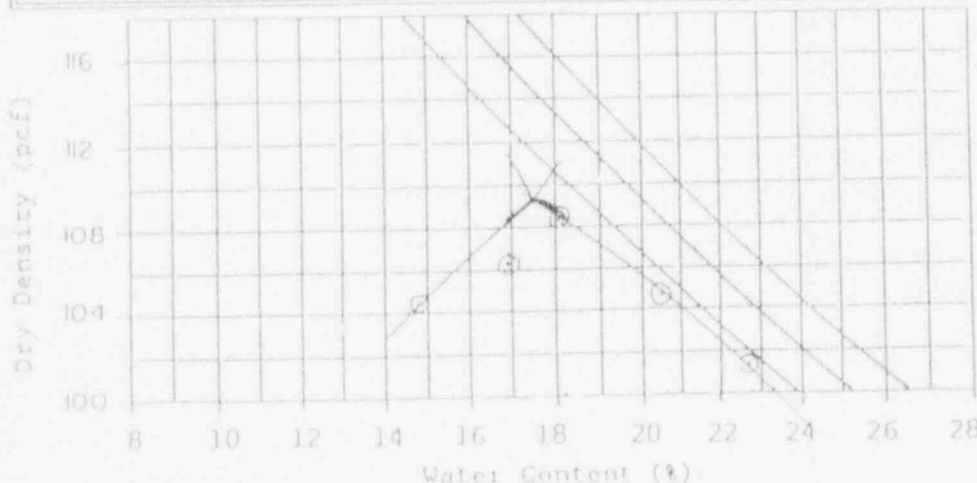
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 1-30-92  
 Soil Description: Gray clay Tested by: AX-ell  
 Sample Location: Borrow pit #4 West side  
H2O added (ml)

Water Content Determination 100 150 200 250 300 OR: 0 H2O

Trial Number	1	2	3	4	5	6
Cup Number	10	5	4	7	9	10
Tare Weight, g ( $W_c$ )	32.89	33.27	33.29	33.29	33.76	32.90
Tare + Wet Soil, g ( $W_1$ )	346.80	355.22	350.36	372.57	376.53	348.04
Tare + Dry Soil, g ( $W_2$ )	306.40	308.62	300.12	314.73	312.97	318.53
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	273.51	275.35	276.83	281.44	279.21	285.63
Wt of Water, g ( $w = W_1 - W_2$ )	40.40	46.60	50.24	57.84	63.56	29.51
Water Content, (%) ( $w = w/W_d$ )	14.8	16.9	18.1	20.6	22.8	10.3
	14.0	15.9	17.7	19.6	21.4	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3855	3920	3970	3958	3922	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1817	1882	1932	1920	1884	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.92	1.99	2.05	2.03	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w/100)$ )	1.67	1.70	1.74	1.68	1.63	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	104.2	106.1	108.6	104.8	101.7	



Optimum Moisture = 17.5 %  
 Maximum Dry Density = 109.5 pcf

Liquid Limit = \_\_\_\_\_  
 Plastic Limit = \_\_\_\_\_  
 Plastic Index = \_\_\_\_\_  
 Soil Class. = \_\_\_\_\_

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

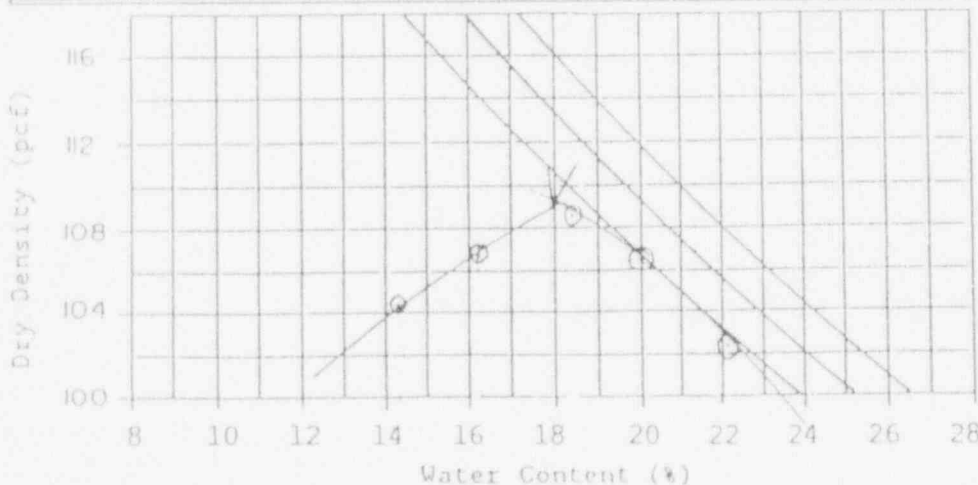
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 3-16-92  
 Soil Description: Gray Clay Tested by: LARRY AXTELL  
 Sample Location: Borrow pit #2 - East End  
1/20 ADD'D (ml)

## Water Content Determination

	165	215	245	315	365	ORIG H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	11	9	10	5	4	10
Tare Weight, g ( $W_c$ )	32.72	33.79	32.92	33.30	33.28	32.92
Tare + Wet Soil, g ( $W_1$ )	334.72	355.82	375.36	361.26	366.36	387.74
Tare + Dry Soil, g ( $W_2$ )	297.16	311.01	322.26	306.69	306.18	362.42
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	264.44	277.22	289.34	273.39	272.90	329.50
Wt of Water, g ( $w = W_1 - W_2$ )	3756	44.81	53.10	54.57	60.18	25.32
Water Content, (%) ( $w\% = w/W_d$ )	14.2	16.2	18.4	20.0	22.1	7.7
	13.8	15.7	17.5	19.4	21.2	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3845	3920	3981	3974	3922	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1807	1882	1943	1936	1884	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.91	1.99	2.06	2.05	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w\%/100)$ )	1.67	1.71	1.74	1.71	1.64	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	104.2	106.7	108.6	106.7	102.3	



Liquid Limit = 44.0

Plastic Limit = 17.7

Plastic Index = 26.3

Soil Class. = CL

Optimum Moisture = 18.1 %  
 Maximum Dry Density = 109.1 pcf



# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 3-23-92  
 Soil Description: Gray Clay Tested by: AXTEL  
 Sample Location: Borrow pit #0, East End + Borrow pit #4, West End  
H<sub>2</sub>O Added (WL) ORIG. H<sub>2</sub>O

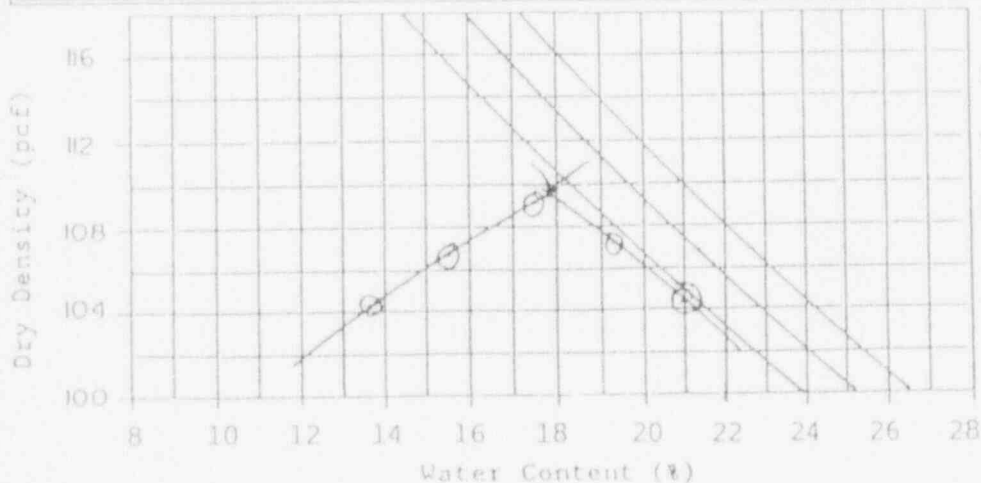
## Water Content Determination

	50	100	150	200	250	
Trial Number	1	2	3	4	5	6
Cup Number	1	7	5	11	4	4
Tare Weight, g ( $W_c$ )	32.98	33.31	33.30	32.71	33.30	33.29
Tare + Wet Soil, g ( $W_1$ )	342.41	352.08	371.92	370.09	393.51	363.59
Tare + Dry Soil, g ( $W_2$ )	305.47	309.80	321.82	316.10	330.94	329.76
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	272.49	276.49	288.52	283.39	297.64	296.47
Wt of Water, g ( $w = W_1 - W_2$ )	36.94	42.28	50.10	53.99	62.57	33.83
Water Content, (%) ( $w\% = w/W_d$ )	13.6	15.3	17.4	19.1	21.0	11.4

Est.  $H_2O$  = 13.3 15.1 17.0 18.8 20.7

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	2039	2039	2039	2039	
Mold + Wet Soil, g ( $W_3$ )	3836	3900	3979	3973	3944	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1797	1861	1937	1934	1905	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.90	1.97	2.05	2.05	2.02	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w\%/100)$ )	1.67	1.71	1.75	1.72	1.67	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	104.2	106.7	109.2	107.3	104.2	



Liquid Limit = 44.0  
 Plastic Limit = 17.9  
 Plastic Index = 26.1  
 Soil Class. = CL

Optimum Moisture = 17.8 %  
 Maximum Dry Density = 109.5 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: Borrow pit #2

Project No.: C01-06  
 Date: 5-5-92  
 Tested by: Axtell

East End  
H<sub>2</sub>O added (ML)

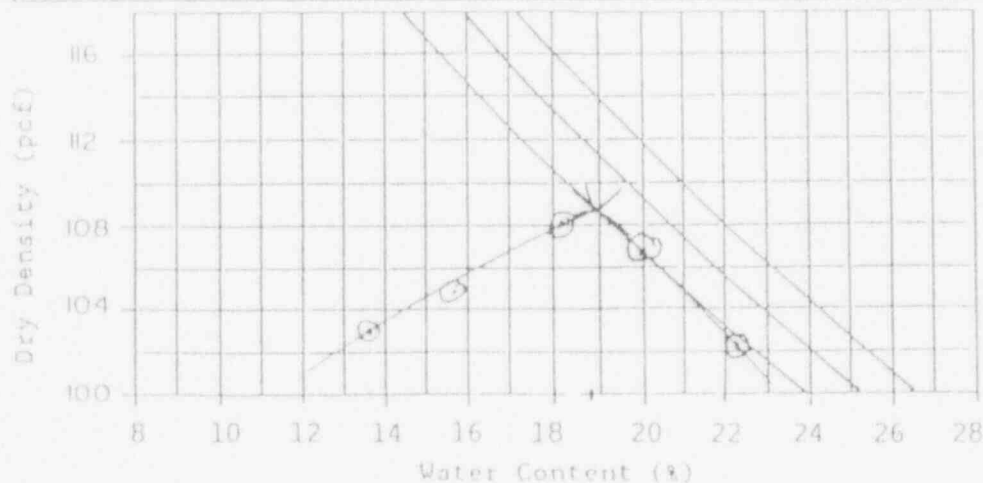
OR 19 H<sub>2</sub>O

## Water Content Determination

	150	210	265	315	365	
Trial Number	1	2	3	4	5	6
Cup Number	9	12	11	4	1	4
Tare Weight, g ( $W_c$ )	33.84	33.32	32.71	33.32	33.01	33.32
Tare + Wet Soil, g ( $W_1$ )	330.16	384.05	357.17	362.72	378.69	358.18
Tare + Dry Soil, g ( $W_2$ )	294.73	336.26	308.03	307.76	315.73	335.33
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	260.89	302.94	275.32	274.44	282.72	302.01
Wt of Water, g ( $w = W_1 - W_2$ )	35.43	47.79	49.74	54.96	62.96	22.85
Water Content, ( $w\% = w/W_d$ )	13.6	15.8	18.1	20.0	22.3	7.6

## Density Determination

	13.1	15.3	17.4	19.2	21.1	
Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	2039	2039	2039	2039	
Mold + Wet Soil, g ( $W_3$ )	3809	3880	3965	3970	3930	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1770	1841	1926	1931	1891	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.88	1.95	2.04	2.05	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w\%/100) \times D_w$ )	1.65	1.68	1.73	1.71	1.64	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	103.0	104.8	108.0	106.7	102.3	



Liquid Limit = 44.0

Plastic Limit = 16.8

Plastic Index = 27.2

Soil Class. = CL

Optimum Moisture = 18.8 %  
 Maximum Dry Density = 108.8 pcf

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

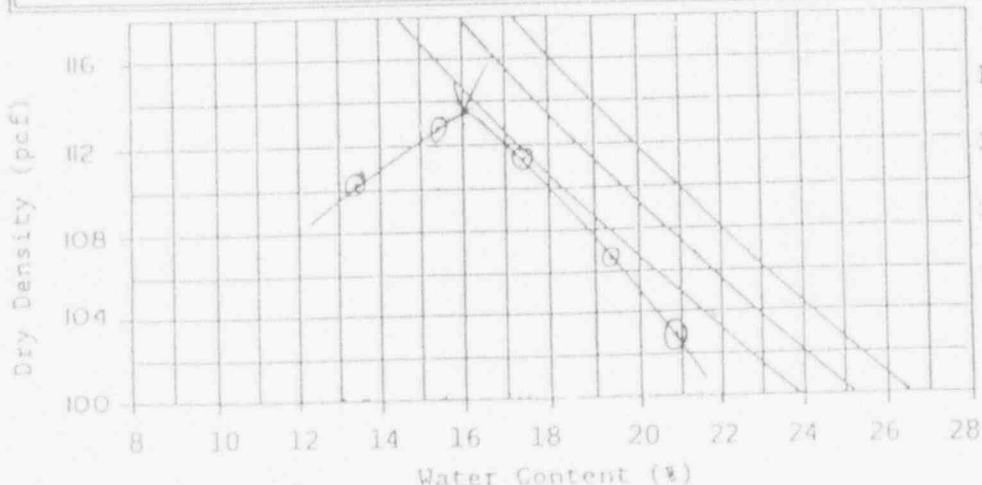
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 5-12-92  
 Soil Description: Gray Clay Tested by: Ar+ell  
 Sample Location: Borrow pit #4 West side  
H<sub>2</sub>O ADDED (ml) ORIG. H<sub>2</sub>O

## Water Content Determination

	0	50	100	150	200	
Trial Number	1	2	3	4	5	6
Cup Number	9	6	4	11	1	6
Tare Weight, g ( $W_c$ )	33.82	33.70	33.33	32.71	33.03	33.70
Tare + Wet Soil, g ( $W_1$ )	374.46	372.38	395.65	397.72	396.04	321.61
Tare + Dry Soil, g ( $W_2$ )	334.44	327.44	336.87	343.90	333.31	287.36
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	300.62	293.74	303.49	310.99	300.28	253.66
Wt of Water, g ( $w = W_1 - W_2$ )	40.02	44.94	58.78	54.02	62.73	34.25
Water Content, ( $w\% = w/W_d$ )	13.3	15.3	19.4	17.4	20.9	13.5

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	2039	2039	2039	2039	
Mold + Wet Soil, g ( $W_3$ )	3927	4009	3965	4019	3925	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1888	1970	1926	1980	1886	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	2.00	2.09	2.04	2.10	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.77	1.81	1.71	1.79	1.65	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	110.4	112.9	106.7	111.7	103.0	



Liquid Limit = 36.5

Plastic Limit = 16.2

Plastic Index = 20.3

Soil Class. = CL

Optimum Moisture = 16.0 %  
 Maximum Dry Density = 113.5 pcf





# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

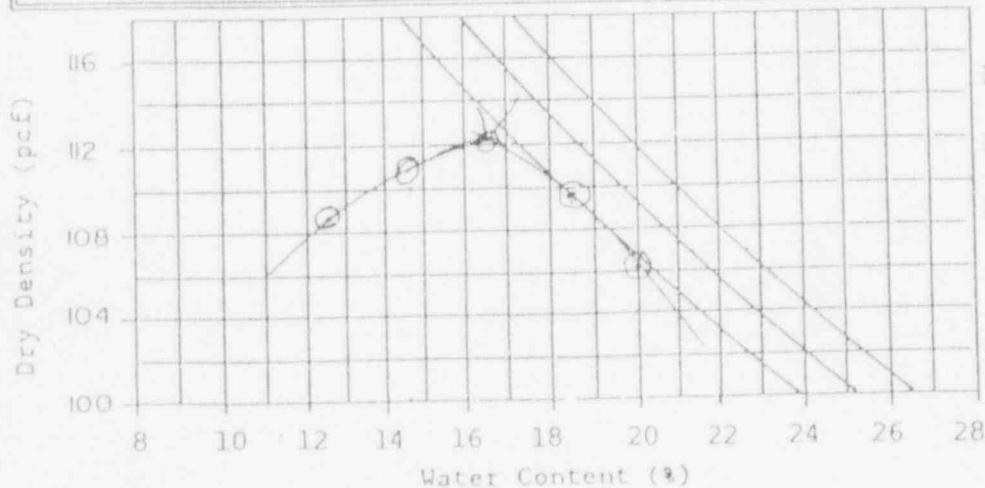
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 5-18-92  
 Soil Description: Gray clay Tested by: Atch  
 Sample Location: Borrow pit #2, East End  
 H<sub>2</sub>O ADDED (ML)                      ORIG. H<sub>2</sub>O                     

## Water Content Determination

	0	40	90	140	190	
Trial Number	1	2	3	4	5	6
Cup Number	9	1	4	11	6	4
Tare Weight, g (W <sub>c</sub> )	33.88	33.12	33.37	32.75	33.74	33.36
Tare + Wet Soil, g (W <sub>1</sub> )	376.28	357.29	380.09	345.03	373.42	346.68
Tare + Dry Soil, g (W <sub>2</sub> )	338.23	316.05	331.04	296.34	316.25	311.86
Wt Dry Soil, g (W <sub>d</sub> = W <sub>2</sub> - W <sub>c</sub> )	304.35	282.93	297.67	263.59	282.51	278.50
Wt of Water, g (W = W <sub>1</sub> - W <sub>2</sub> )	38.05	41.24	49.05	48.69	56.67	34.82
Water Content, (w% = W/W <sub>d</sub> )	12.5	14.6	16.5	18.5	20.0	12.5
Est. H <sub>2</sub> O %	12.5	14.0	15.8	17.7	19.5	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g (W <sub>3</sub> )	3890	3963	4024	4003	3965	
Wt Wet Soil, g (W <sub>v</sub> = W <sub>3</sub> - W <sub>p</sub> )	1852	1925	1986	1965	1927	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> = W <sub>v</sub> /V	1.96	2.04	2.10	2.08	2.04	
Dry Density, g/cm <sup>3</sup> D <sub>w</sub> /(1 + w%/100)	1.74	1.78	1.80	1.76	1.70	
Dry Density, pcf (62.4 × g/cm <sup>3</sup> )	108.6	111.1	112.3	109.8	106.1	



Liquid Limit =             
 Plastic Limit =             
 Plastic Index =             
 Soil Class. =           

Optimum Moisture = 16.5 %  
 Maximum Dry Density = 112.5 pcf



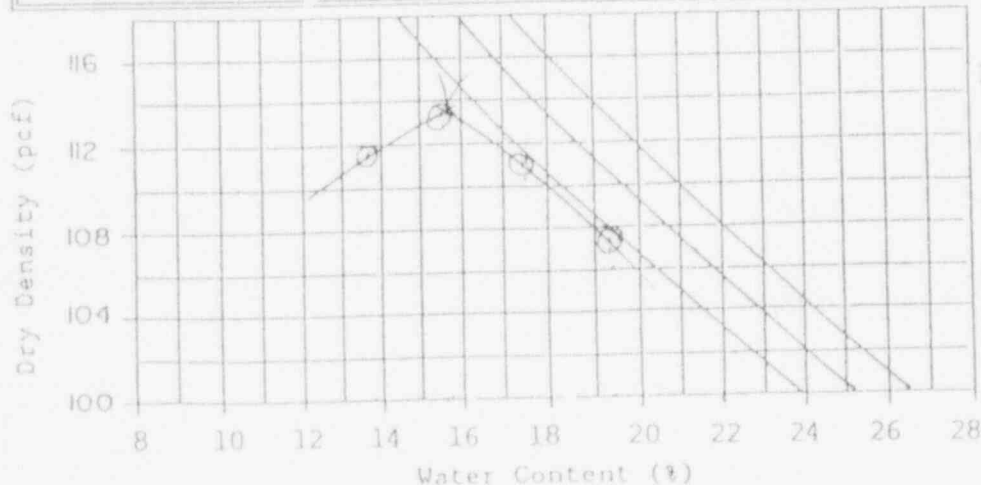
# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 6-17-92  
 Soil Description: Gray Clay Tested by: AX+U  
 Sample Location: #4 Pit South End  
H<sub>2</sub>O Added (mL) 0.0 0.9

Water Content Determination						
	75	125	180	235	290	
Trial Number	1	2	3	4	5	6
Cup Number	1	7	12	15	14	4
Tare Weight, g ( $W_c$ )	33.12	33.32	33.33	33.05	32.63	34.40
Tare + Wet Soil, g ( $W_1$ )	382.36	385.74	387.65	392.81	+	379.56
Tare + Dry Soil, g ( $W_2$ )	340.03	338.32	334.66	334.73	+	346.92
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	306.91	305.00	301.33	301.68	+	312.52
Wt of Water, g ( $w = W_1 - W_2$ )	42.33	47.42	52.99	58.08	+	32.64
Water Content, ( $w\% = w/W_d$ )	13.8	15.5	17.6	19.3	20.9	10.4
	13.2	15.0	17.1	19.1	21.1	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3965	4026	4010	3976	+	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1925	1986	1970	1936	+	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	+	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	2.04	2.10	2.09	2.05	+	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w\%/100)$ )	1.79	1.82	1.78	1.72	+	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	111.7	113.6	111.1	107.3	+	



Optimum Moisture = 15.5 %  
 Maximum Dry Density = 113.6 pcf

Liquid Limit = \_\_\_\_\_  
 Plastic Limit = \_\_\_\_\_  
 Plastic Index = \_\_\_\_\_  
 Soil Class. = \_\_\_\_\_



# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: \_\_\_\_\_

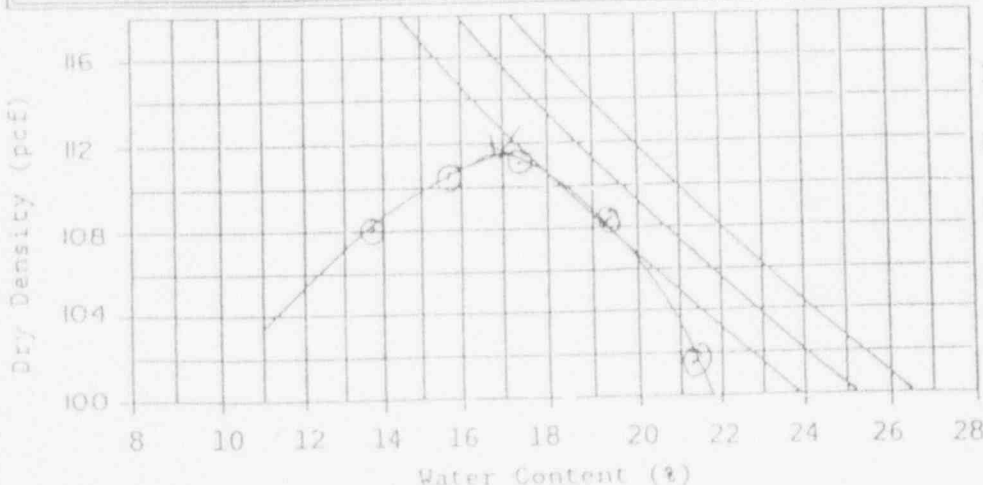
Project No.: C01-06  
 Date: 6-30-92  
 Tested by: Ant+cs

Water Content Determination H<sub>2</sub>O Added (ml) OR:  $\frac{W_1}{W_2}$   
150 200 250 300 350

Trial Number	1	2	3	4	5	6
Cup Number	14	1	6	10	2	14
Tare Weight, g ( $W_c$ )	32.62	33.18	33.76	32.92	33.37	32.63
Tare + Wet Soil, g ( $W_1$ )	347.42	377.14	373.82	334.41	369.04	362.45
Tare + Dry Soil, g ( $W_2$ )	309.55	330.73	323.32	285.64	310.27	339.81
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	276.93	297.55	289.56	252.72	276.90	307.18
Wt of Water, g ( $W = W_1 - W_2$ )	37.87	46.41	50.50	48.77	58.77	22.64
Water Content, (%) ( $w = W/W_d$ )	13.7	15.6	17.4	19.3	21.2	7.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3921	3972	4017	3995	3906	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	861	1932	1977	1955	1866	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.99	2.05	2.09	2.07	1.98	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100)D_w$ )	1.73	1.77	1.78	1.74	1.63	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	108.0	110.4	111.1	108.6	101.7	



Optimum Moisture = 16.9 %  
 Maximum Dry Density = 111.5 pcf

Liquid Limit = \_\_\_\_\_  
 Plastic Limit = \_\_\_\_\_  
 Plastic Index = \_\_\_\_\_  
 Soil Class. = \_\_\_\_\_

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698) *Est DMC - 15.0*

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 8-3-92  
 Soil Description: Gray clay Tested by: Atkell  
 Sample Location: Pit # 4, West End

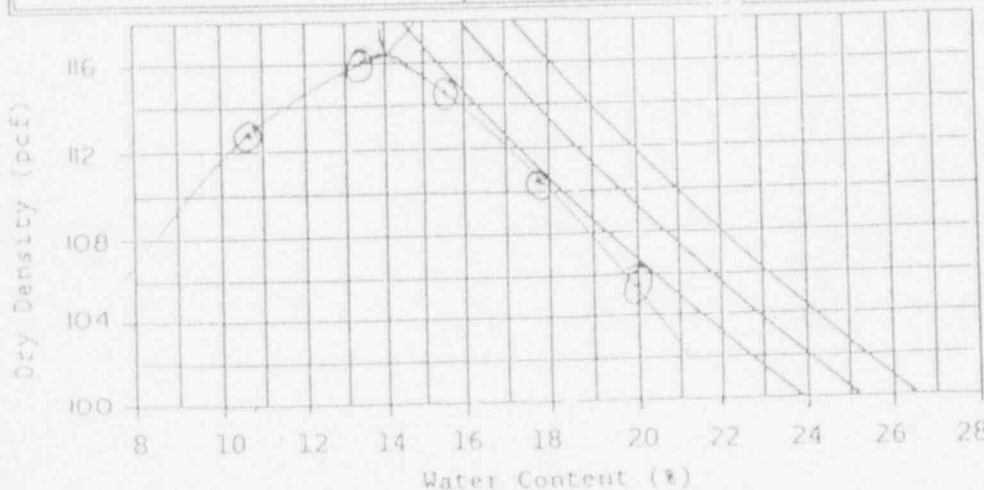
Water Content Determination *H<sub>2</sub>O Added (mL)* *CRIG H<sub>2</sub>O*  
 60 120 170 230 280

Trial Number	1	2	3	4	5	6
Cup Number	2	10	6	12	11	10
Tare Weight, g ( $W_c$ )	33.39	32.94	33.81	33.39	32.80	32.95
Tare + Wet Soil, g ( $W_1$ )	308.40	319.09	346.20	391.32	337.91	310.46
Tare + Dry Soil, g ( $W_2$ )	281.84	285.49	321.52	337.23	287.16	288.67
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	248.45	252.55	287.71	303.84	254.36	255.72
Wt of Water, g ( $w = W_1 - W_2$ )	26.56	33.60	44.68	54.09	50.75	21.79
Water Content, (%) ( $w = w/W_d$ )	10.7	13.3	15.5	17.8	20.0	8.5

*Est* 10.7 12.4 14.8 17.0 18.9

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2042	2042	2042	2042	2042	
Mold + Wet Soil, g ( $W_3$ )	3930	4038	4055	4004	3955	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1888	1996	2013	1962	1913	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	2.00	2.11	2.13	2.08	2.03	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w/100)$ )	1.81	1.86	1.84	1.77	1.69	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	112.9	116.1	114.8	110.4	105.5	



Liquid Limit = 31.0  
 Plastic Limit = 16.2  
 Plastic Index = 14.8  
 Soil Class. = CL

Optimum Moisture = 14.1 %  
 Maximum Dry Density = 116.2 pcf



EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: Clay stockpile on top of pit

Project No.: C01-06  
 Date: 8-13-92  
 Tested by: Wattell

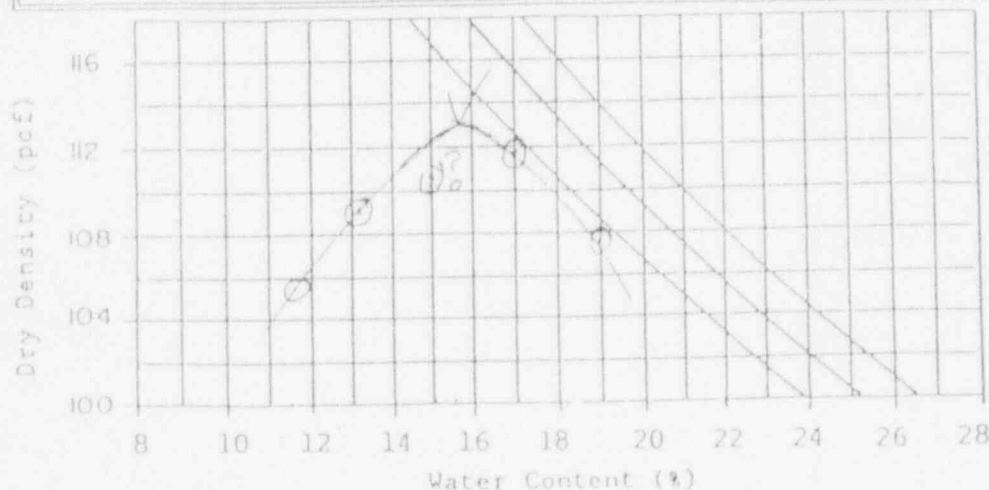
## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	14	12	7	10	2	10
Tare Weight, g ( $W_c$ )	32.66	33.37	33.36	32.96	33.39	32.95
Tare + Wet Soil, g ( $W_1$ )	242.82	322.06	324.67	350.86	342.80	393.88
Tare + Dry Soil, g ( $W_2$ )	239.19	289.66	286.67	304.71	293.50	371.14
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	206.53	255.29	253.31	271.75	260.11	338.19
Wt of Water, g ( $w = W_1 - W_2$ )	23.63	33.40	38.00	46.15	49.30	22.74
Water Content, (%) ( $w\% = w/W_d$ )	11.4	13.1	15.0	17.0	19.0	6.7

Est - 11.3 13.2 15.0 16.4 18.9

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3811	3906	3966	4012	3975	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1771	1866	1926	1972	1935	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.88	1.98	2.04	2.09	2.05	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.69	1.75	1.77	1.79	1.72	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	105.5	109.2	110.4	111.7	107.3	

Liquid Limit = 35.5Plastic Limit = 18.1Plastic Index = 17.4Soil Class. = CL

Optimum Moisture = 15.6 %  
 Maximum Dry Density = 113.0 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698) 257 0101

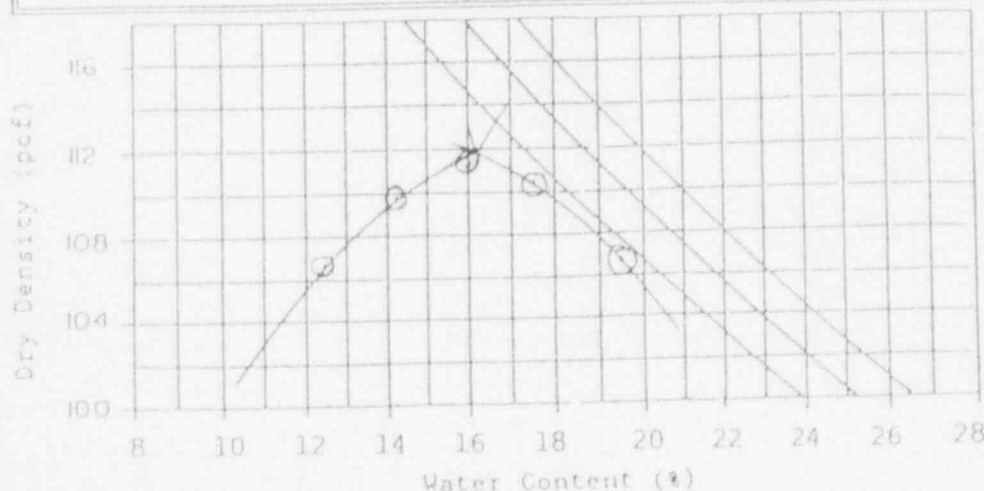
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 8-17-92  
 Soil Description: Gray Clay Tested by: AXC  
 Sample Location: Clay Stockpile Area P. 4 #4  
 H<sub>2</sub>O 7.10-2 10.5 0.85-2

Water Content Determination 200 250 300 350 400

Trial Number	1	2	3	4	5	6
Cup Number	12	6	14	7	2	14
Tare Weight, g ( $W_c$ )	33.37	33.82	32.66	33.36	33.39	32.65
Tare + Wet Soil, g ( $W_1$ )	328.02	326.43	346.92	326.59	338.15	327.16
Tare + Dry Soil, g ( $W_2$ )	295.40	290.38	303.62	282.67	288.56	360.95
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	262.03	256.56	270.96	249.31	254.97	328.30
Wt of Water, g ( $w = W_1 - W_2$ )	32.62	36.05	43.30	43.92	49.79	16.21
Water Content, (%) ( $w = w/W_d$ )	12.4	14.1	16.0	17.6	19.5	4.9
	12.3	14.2	16.0	17.4	19.7	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	2039	2039	2039	2039	
Mold + Wet Soil, g ( $W_3$ )	3850	3933	3986	3998	3965	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1811	1894	1947	1959	1926	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.92	2.01	2.06	2.08	2.04	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.71	1.76	1.78	1.77	1.71	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	106.7	109.8	111.1	110.4	106.7	



Liquid Limit = 36.0

Plastic Limit = 16.0

Plastic Index = 20.0

Soil Class. = CL

Optimum Moisture = 16.2 %  
 Maximum Dry Density = 111.8 pcf





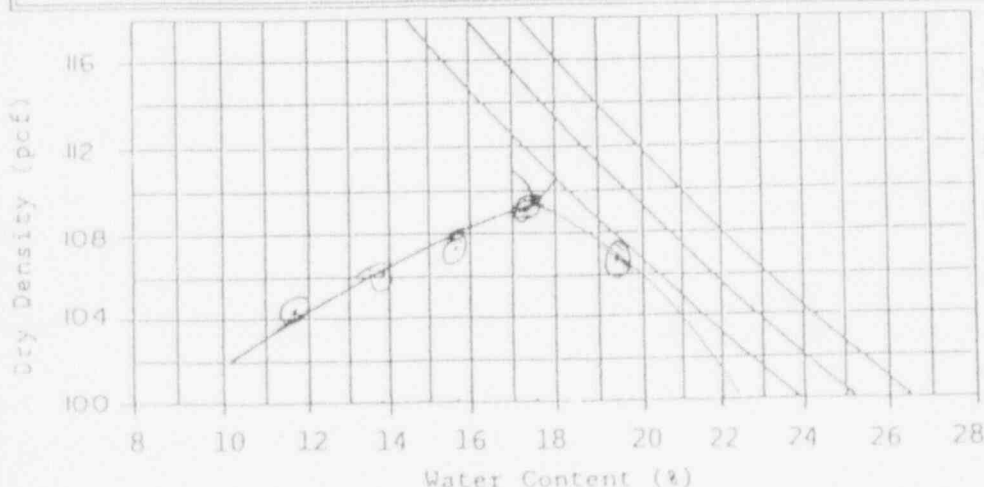
## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 8-21-92  
 Soil Description: Gray clay Tested by: AXT  
 Sample Location: Clay stockpile from pit #4 H<sub>2</sub>O added ORIG H<sub>2</sub>O

Water Content Determination	100	160	210	260	320	
Trial Number	1	2	3	4	5	6
Cup Number	2	14	6	9	12	7
Tare Weight, g ( $W_c$ )	33.39	32.68	33.83	33.87	33.38	33.35
Tare + Wet Soil, g ( $W_1$ )	324.15	333.46	368.78	324.76	349.76	358.23
Tare + Dry Soil, g ( $W_2$ )	293.93	296.80	323.37	281.62	298.60	334.77
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	260.54	264.12	289.54	247.75	265.22	301.42
Wt of Water, g ( $w = W_1 - W_2$ )	30.22	36.66	45.41	43.14	51.16	23.46
Water Content, ( $w\% = w/W_d$ )	11.6	13.9	15.7	17.4	19.3	7.8

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3795	3873	3914	3982	3964	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1757	1835	1876	1944	1926	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> $D_v = W_v/V$	1.86	1.94	1.99	2.06	2.04	
Dry Density, g/cm <sup>3</sup> $D_w/(1 + w\%/100)$	1.67	1.70	1.72	1.75	1.71	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	104.2	106.1	107.3	109.2	106.7	



Optimum Moisture = 17.5 %  
 Maximum Dry Density = 109.3 pcf

Liquid Limit = 36.0Plastic Limit = 15.7Plastic Index = 20.3Soil Class. = CL

## **APPENDIX E**

**LOWER TAILINGS COVER**

**SILT COMPACTION TESTS**

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #4

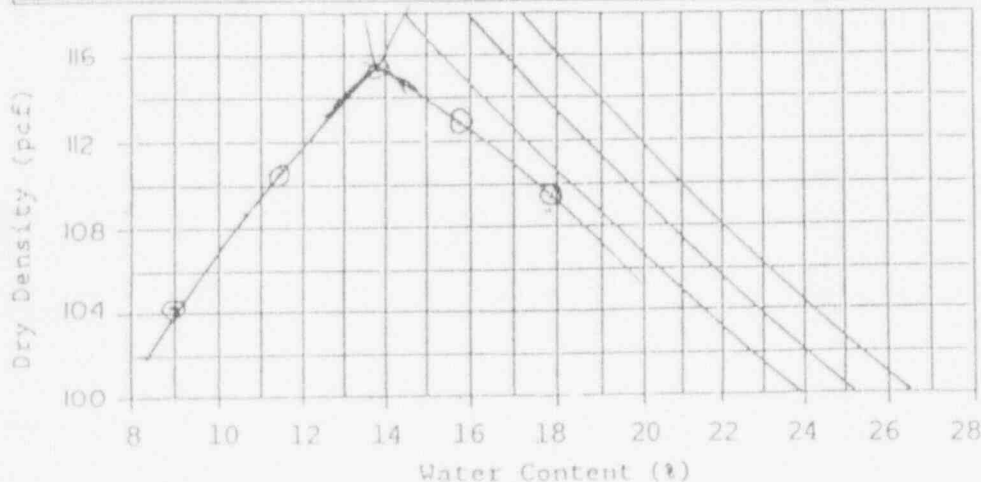
Project No.: C01-06  
 Date: 12-10-91  
 Tested by: LARRY AXTELL

## Water Content Determination

	40	90	140	190	240	68.6 H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	57	27	39	43	28	—
Tare Weight, g ( $W_c$ )	11.80	11.54	11.71	11.47	11.62	654
Tare + Wet Soil, g ( $W_1$ )	91.18	92.76	100.55	108.90	122.85	1156
Tare + Dry Soil, g ( $W_2$ )	84.61	84.44	89.72	95.63	105.98	1115
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	72.81	72.90	78.01	84.16	94.36	461
Wt of Water, g ( $w = W_1 - W_2$ )	6.57	8.32	10.83	13.27	16.87	41
Water Content, (%) ( $w\% = w/W_d$ )	9.0	11.4	13.9	15.8	17.9	8.9

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3762	3901	4034	4022	3992	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1922	1861	1994	1982	1952	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.82	1.97	2.11	2.10	2.07	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.67	1.77	1.85	1.81	1.76	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	104.2	110.4	115.4	112.9	109.8	

Liquid Limit = 27.5Plastic Limit = 16.7Plastic Index = 10.8Soil Class. = CL

Optimum Moisture = 13.9 %  
 Maximum Dry Density = 115.4 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

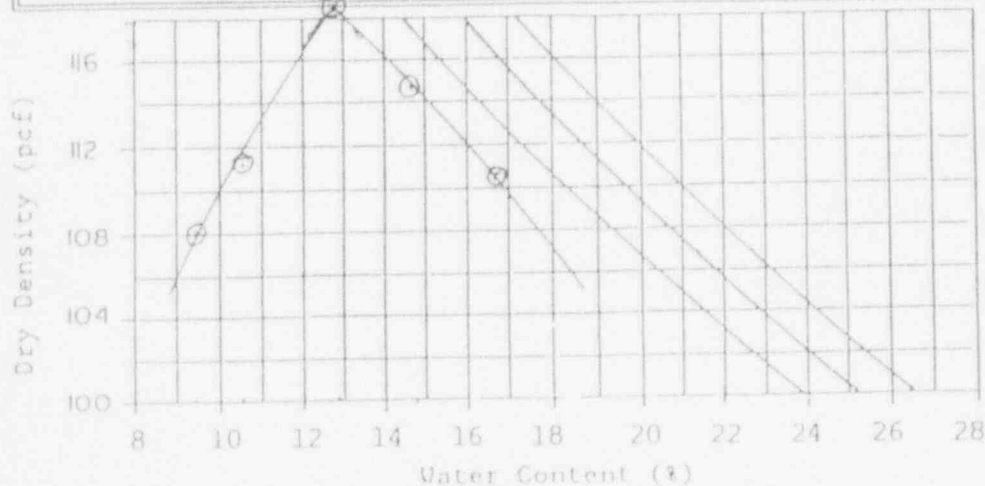
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 1-9-92  
 Soil Description: Radish Brown Silt Tested by: Hxtell  
 Sample Location: Dorow Pit #4 South East side

Water Content Determination 160 210 260 310 360

Trial Number	1	2	3	4	5	6
Cup Number	6	7	8	9	10	4
Tare Weight, g ( $W_c$ )	33.68	33.28	33.04	33.74	32.88	33.24
Tare + Wet Soil, g ( $W_1$ )	368.52	395.75	379.07	395.93	380.79	363.49
Tare + Dry Soil, g ( $W_2$ )	339.66	360.94	339.42	349.36	330.93	352.14
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	305.98	327.66	306.38	315.62	298.05	318.90
Wt of Water, g ( $w = W_1 - W_2$ )	28.84	34.81	39.65	46.57	49.86	11.35
Water Content, (%) ( $w = w/W_d$ )	9.4	10.6	12.9	14.8	16.7	3.6

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3827	3900	4060	4030	3996	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1787	1860	2020	1990	1956	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.89	1.97	2.14	2.11	2.07	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w/100)$ )	1.73	1.78	1.90	1.84	1.77	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	108.0	111.1	118.6	114.8	110.4	



Liquid Limit = 25.0

Plastic Limit = 15.3

Plastic Index = 9.7

Soil Class. = CL

Optimum Moisture = 12.9 %  
 Maximum Dry Density = 118.6 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

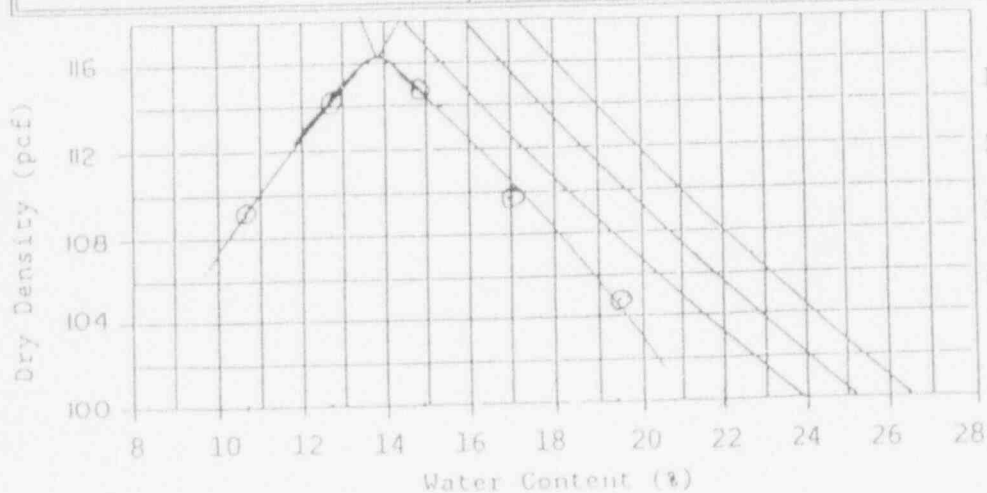
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 1-29-92  
 Soil Description: Redish Brown silt Tested by: LARRY MATELL  
 Sample Location: Borrow pit #4 South East side

Water Content Determination

	40	110	160	210	260	ORIG H <sub>2</sub> O
Trial Number	1	2	3	4	5	6
Cup Number	8	6	3	2	1	5
Tare Weight, g (W <sub>c</sub> )	33.05	33.70	33.03	33.37	32.98	33.29
Tare + Wet Soil, g (W <sub>1</sub> )	351.84	373.27	392.39	374.38	386.36	313.90
Tare + Dry Soil, g (W <sub>2</sub> )	321.08	335.11	345.79	324.81	329.27	294.12
Wt Dry Soil, g (W <sub>d</sub> =W <sub>2</sub> -W <sub>c</sub> )	288.03	301.41	312.76	291.44	296.29	260.83
Wt of Water, g (w=W <sub>1</sub> -W <sub>2</sub> )	30.76	38.16	46.60	49.57	57.09	19.78
Water Content, (w <sub>L</sub> =w/W <sub>d</sub> )	10.7	12.7	14.9	17.0	19.3	7.6
	9.8	11.7	13.5	15.4	17.2	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g (W <sub>3</sub> )	3869	3985	4029	3986	3940	
Wt Wet Soil, g (W <sub>w</sub> =W <sub>3</sub> -W <sub>p</sub> )	1831	1947	1991	1948	1902	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> =W <sub>w</sub> /V	1.94	2.06	2.11	2.06	2.01	
Dry Density, g/cm <sup>3</sup> D <sub>w</sub> /(1 + w <sub>L</sub> /100)	1.75	1.83	1.84	1.76	1.68	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	109.2	114.2	114.8	109.8	104.8	



Liquid Limit = \_\_\_\_\_

Plastic Limit = \_\_\_\_\_

Plastic Index = \_\_\_\_\_

Soil Class. = \_\_\_\_\_

Optimum Moisture = 13.8 %  
 Maximum Dry Density = 116.2 pcf



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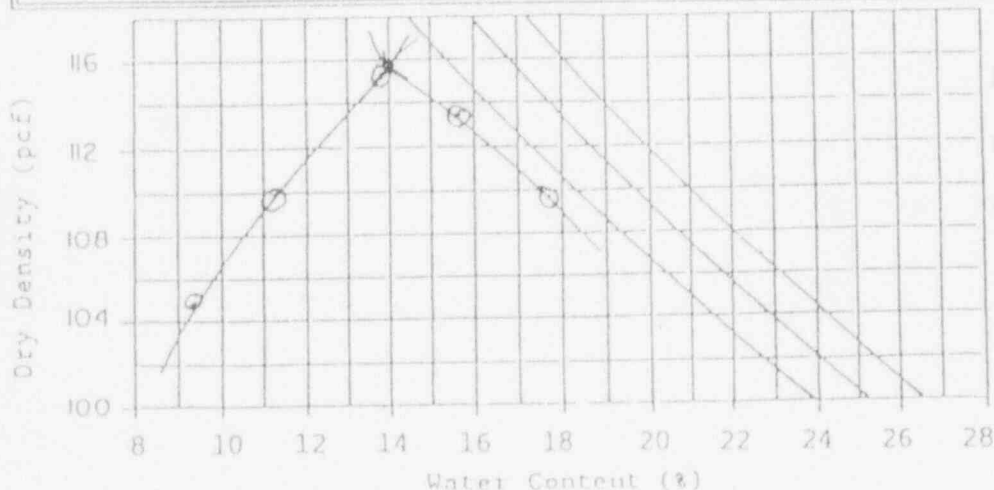
# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 2-25-92  
 Soil Description: Reddish Brown Silt Tested by: LARRY AXTELL  
 Sample Location: #4 Borrow Area East End H<sub>2</sub>O Added (ml) OR 19.1 H<sub>2</sub>O

Water Content Determination	100	150	200	250	300	
Trial Number	1	2	3	4	5	6
Cup Number	5	9	10	7	1	4
Tare Weight, g (W <sub>c</sub> )	33.27	33.80	32.90	33.29	32.96	33.28
Tare + Wet Soil, g (W <sub>1</sub> )	328.47	385.58	360.81	377.97	375.21	364.34
Tare + Dry Soil, g (W <sub>2</sub> )	303.73	350.48	321.63	331.28	324.00	345.20
Wt Dry Soil, g (W <sub>d</sub> =W <sub>2</sub> -W <sub>c</sub> )	270.46	316.68	288.13	297.99	291.04	311.92
Wt of Water, g (w=W <sub>1</sub> -W <sub>2</sub> )	24.74	35.10	39.78	46.69	51.21	19.14
Water Content, (w <sub>L</sub> =w/W <sub>d</sub> )	9.1	11.1	13.8	15.7	17.6	6.1

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3768	3894	4035	4028	3997	
Wt Wet Soil, g (W <sub>w</sub> =W <sub>3</sub> -W <sub>p</sub> )	1728	1854	1995	1988	1957	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> =W <sub>w</sub> /V	1.83	1.96	2.11	2.11	2.07	
Dry Density, g/cm <sup>3</sup> D <sub>d</sub> /(1 + w <sub>L</sub> /100)	1.68	1.76	1.85	1.82	1.76	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	104.8	109.8	115.4	113.6	109.8	



Liquid Limit = 26.0

Plastic Limit = 15.8

Plastic Index = 10.2

Soil Class. = CL

Optimum Moisture = 14.0 %  
 Maximum Dry Density = 115.8 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown Silt  
 Sample Location: Borrow pit #10, East side

Project No.: C01-06  
 Date: 8-4-92  
 Tested by: AK

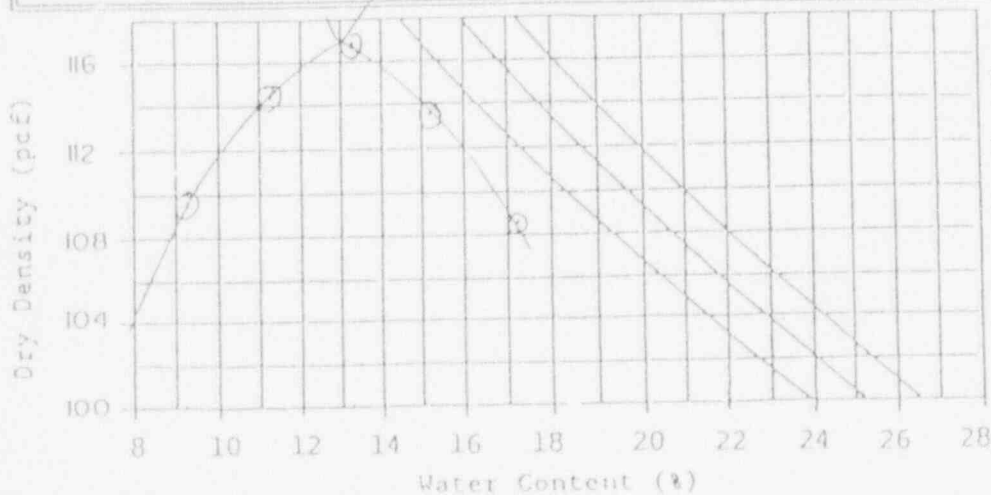
## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	11	12	2	6	10	11
Tare Weight, g ( $W_c$ )	32.80	33.37	33.40	33.82	32.95	32.82
Tare + Wet Soil, g ( $W_1$ )	329.14	328.06	379.01	342.38	365.53	351.19
Tare + Dry Soil, g ( $W_2$ )	304.47	298.26	338.77	301.89	317.07	340.57
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	271.67	264.89	305.37	268.07	284.12	307.75
Wt of Water, g ( $w = W_1 - W_2$ )	24.67	29.80	40.24	40.49	48.46	10.62
Water Content, (%) ( $w = w/W_d$ )	9.1	11.2	13.2	15.1	17.1	3.5

Est - 9.1 11.3 13.1 15.0 16.8

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3852	3963	4042	4021	3961	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1814	1925	2004	1983	1923	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.92	2.04	2.12	2.10	2.04	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w/100)$ )	1.76	1.83	1.87	1.82	1.74	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	109.8	114.2	116.7	113.6	108.6	

Liquid Limit = 22.5Plastic Limit = 17.0Plastic Index = 5.5Soil Class. = CL-ML

Optimum Moisture = 13.0 %  
 Maximum Dry Density = 117.0 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 9987)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 8-5-92  
 Soil Description: Redish Brown silt Tested by: AXL  
 Sample Location: Borrow pit #10, west side of 56 H<sub>2</sub>O

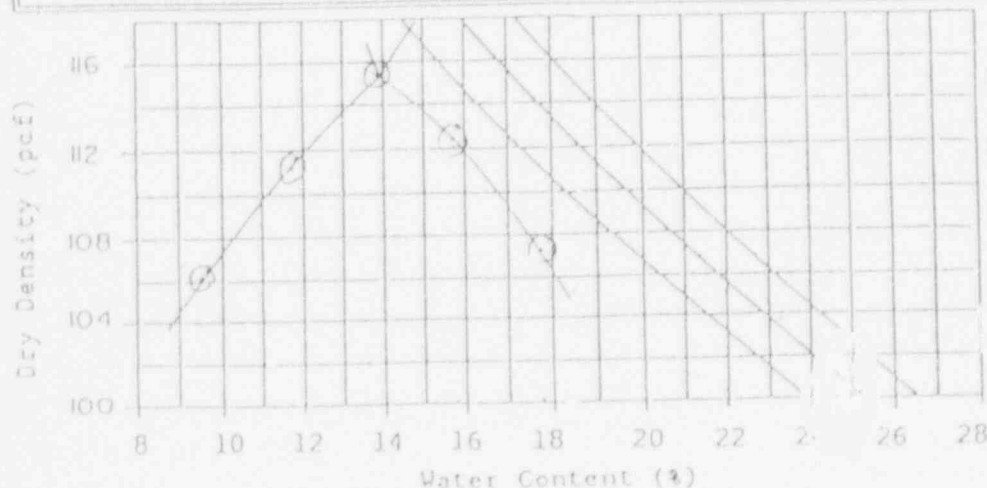
## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	7	14	9	15	4	2
Tare Weight, g ( $W_c$ )	333.7	326.7	338.8	331.2	334.6	334.0
Tare + Wet Soil, g ( $W_1$ )	302.24	342.55	348.22	335.91	320.88	326.46
Tare + Dry Soil, g ( $W_2$ )	279.02	310.06	309.83	294.51	328.66	300.79
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	245.65	277.39	275.95	266.39	295.20	267.39
Wt of Water, g ( $w = W_1 - W_2$ )	23.22	32.49	38.39	41.40	52.22	25.67
Water Content, ( $w\% = w/W_d$ )	9.5	11.7	13.9	15.8	17.7	9.6

Est - 9.6 11.6 13.7 15.7 17.7

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3793	3912	4031	4007	3956	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1755	1874	1993	1969	1918	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.86	1.99	2.11	2.09	2.03	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w\%/100)$ )	1.70	1.78	1.85	1.80	1.72	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	106.1	111.1	115.4	112.3	107.3	



Liquid Limit = 24.5

Plastic Limit = 17.0

Plastic Index = 7.5

Soil Class. = CL

Optimum Moisture = 13.9 %  
 Maximum Dry Density = 115.5 pcf



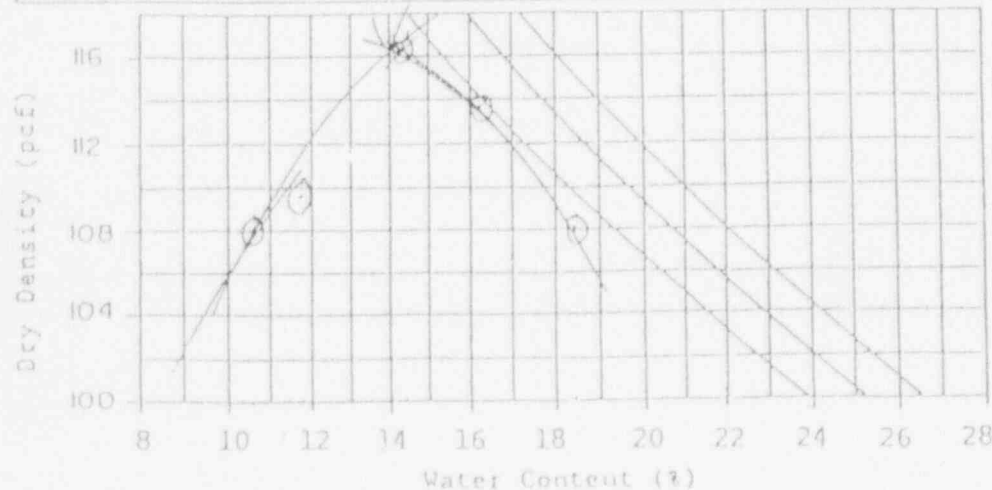
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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698) EST. OMR-121

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 9-23-92  
 Soil Description: Reddish Brown Silty Tested by: AK+ell  
 Sample Location: Borrow pit #10, East side  
H<sub>2</sub>O Added (ml) ORIS H<sub>2</sub>O

Water Content Determination	0	35	85	135	185	
Trial Number	1	2	3	4	5	6
Cup Number	2	11	9	14	10	10
Tare Weight, g ( $W_c$ )	33.39	32.83	33.88	32.67	32.96	32.96
Tare + Wet Soil, g ( $W_1$ )	341.58	335.00	337.08	371.97	343.32	338.56
Tare + Dry Soil, g ( $W_2$ )	311.80	303.19	299.18	324.86	312.03	309.53
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	278.41	270.36	265.30	292.19	279.07	276.57
Wt of Water, g ( $w = W_1 - W_2$ )	29.78	31.81	37.90	47.11	51.29	29.03
Water Content, (%) ( $w = w/W_d$ )	10.7	11.8	14.3	16.1	18.4	10.5

Density Determination	1	2	3	4	5	6
Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3841	3902	4048	4033	3978	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1801	1862	2008	1993	1938	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.91	1.97	2.13	2.11	2.05	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	1.73	1.76	1.86	1.82	1.73	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	108.0	109.8	116.1	113.6	108.0	



Liquid Limit = 27.0

Plastic Limit = 15.1

Plastic Index = 11.9

Soil Class. = CL

Optimum Moisture = 14.0 %  
 Maximum Dry Density = 116.2 pcf



# STANDARD PROCTOR COMPACTION TEST (ASTM D 6907)

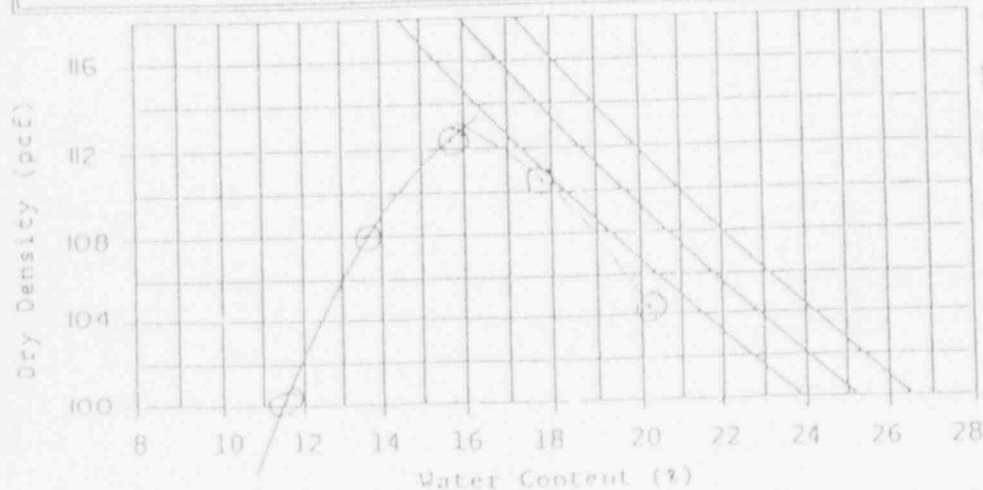
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 7/30/12  
 Soil Description: Red & Brown Silt Tested by: M...  
 Sample Location: Bottom of #10 East side

Water Content Determination

	20	70	120	170	220	
Trial Number	1	2	3	4	5	6
Cup Number	6	2	14	11	9	9
Tare Weight, g ( $W_c$ )	33.89	33.39	32.69	32.83	33.86	33.88
Tare + Wet Soil, g ( $W_1$ )	310.58	294.20	261.99	265.70	341.15	339.33
Tare + Dry Soil, g ( $W_2$ )	282.14	262.71	230.71	230.52	299.64	309.57
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	248.25	229.32	198.02	197.69	265.78	275.61
Wt of Water, g ( $W = W_1 - W_2$ )	28.44	31.49	31.28	35.18	51.51	29.84
Water Content, (%) ( $w = W/W_d$ )	11.5	13.7	15.8	17.8	20.1	10.8

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3742	3846	4013	4002	3942	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1702	1806	1973	1962	1902	
Volume of mold, cm <sup>3</sup> (V)	1000	1000	1000	1000	1000	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.70	1.81	1.97	1.96	1.90	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.61	1.66	1.70	1.77	1.72	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	100.5	104.1	112.3	110.4	107.2	



Liquid Limit = 33.0

Plastic Limit = 16.1

Plastic Index = 16.9

Soil Class. = CL

Optimum Moisture = 16.2 %  
 Maximum Dry Density = 113.0 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown S-L  
 Sample Location: Borven p. + #10

Project No.: C01-06  
 Date: 10-6-92  
 Tested by: Wax + LLC

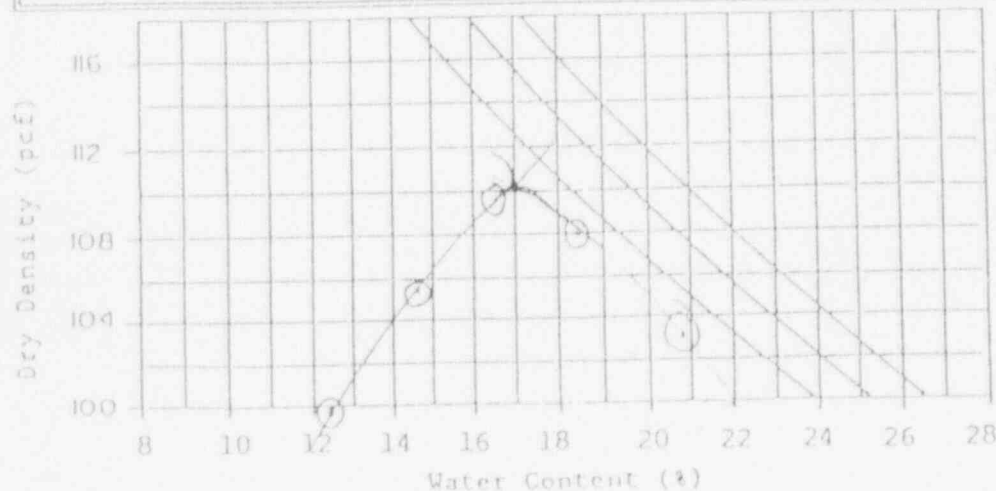
## Water Content Determination

	110	160	210	260	310	
Trial Number	1	2	3	4	5	6
Cup Number	2	14	11	9	6	6
Tare Weight, g ( $W_c$ )	33.39	32.69	32.82	33.88	33.86	33.85
Tare + Wet Soil, g ( $W_1$ )	253.75	326.86	365.31	365.68	370.94	311.34
Tare + Dry Soil, g ( $W_2$ )	229.10	289.48	318.20	314.07	312.21	290.73
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	195.71	256.79	285.38	280.19	278.35	256.88
Wt of Water, g ( $w = W_1 - W_2$ )	24.65	37.38	47.11	51.61	58.73	20.61
Water Content, (%) ( $w = w/W_d$ )	12.4	14.6	16.5	18.4	20.9	8.0

Est  $\rightarrow$  12.4 14.4 16.4 18.4 20.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3739	3868	3971	3977	3929	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1699	1828	1931	1937	1889	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	940	994	940	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.80	1.94	2.05	2.05	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.60	1.69	1.76	1.73	1.65	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	99.8	105.5	109.8	106.0	103.0	

Liquid Limit = 36.5Plastic Limit = 18.7Plastic Index = 17.8Soil Class. = CL

Optimum Moisture = 17.0 %  
 Maximum Dry Density = 110.2 pcf





Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #10

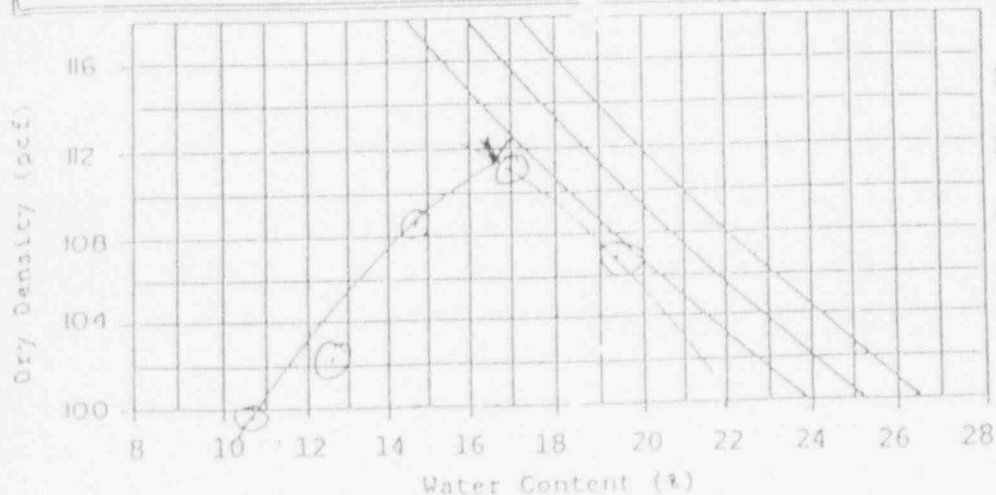
Project No.: C01-06  
 Date: 10-13-92  
 Tested by: AXCELL

## Water Content Determination

	75	125	175	225	275	300
Trial Number	1	2	3	4	5	6
Cup Number	7	6	9	11	2	6
Tare Weight, g ( $W_c$ )	33.37	33.97	33.90	32.81	33.39	33.86
Tare + Wet Soil, g ( $W_1$ )	301.95	275.76	371.47	331.10	288.79	358.55
Tare + Dry Soil, g ( $W_2$ )	276.05	248.93	328.15	287.81	247.59	335.93
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	242.68	215.06	294.25	255.00	214.20	302.07
Wt of Water, g ( $w = W_1 - W_2$ )	25.90	26.83	43.32	43.29	41.20	22.62
Water Content, (%) ( $w = w/W_d$ )	10.7	12.5	14.7	17.0	19.2	7.5

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3695	3773	3930	4008	3962	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1655	1733	1890	1968	1922	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.75	1.84	2.00	2.08	2.04	
Dry Density, g/cm <sup>3</sup> ( $D_w = D_v / (1 + w/100)$ )	1.58	1.64	1.74	1.78	1.71	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	98.6	102.3	108.6	111.1	106.7	



Optimum Moisture = 16.5 %  
 Maximum Dry Density = 111.5 pcf

Liquid Limit = 30.0Plastic Limit = 2Plastic Index = Soil Class. = 

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## **APPENDIX F**

**LOWER TAILINGS EVAPORATION CELL**

**CLAY AND SILT COMPACTION TESTS**

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Fol 001 102

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Gray clay  
 Sample Location: Clay stockpile from pit #4

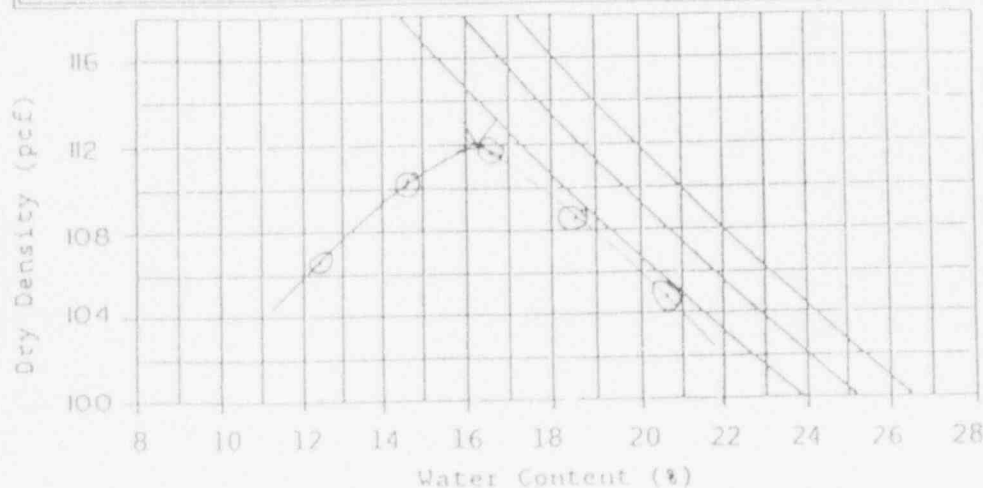
Project No.: C01-06  
 Date: 7-10-01  
 Tested by: J. X. Lee

## Water Content Determination

	50	100	150	200	250	
Trial Number	1	2	3	4	5	6
Cup Number	12	11	9	6	10	12
Tare Weight, g ( $W_c$ )	333.8	32.82	33.87	33.83	32.5	33.39
Tare + Wet Soil, g ( $W_1$ )	341.63	312.40	346.23	332.45	334.74	367.09
Tare + Dry Soil, g ( $W_2$ )	307.58	276.56	301.47	286.45	282.91	335.76
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	274.20	243.74	267.60	251.62	250.41	302.37
Wt of Water, g ( $w = W_1 - W_2$ )	34.05	35.84	44.76	47.00	51.83	31.82
Water Content, (%) ( $w = w/W_d$ )	12.4	14.7	16.7	18.7	20.7	10.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2041	2041	2041	2041	2041	
Mold + Wet Soil, g ( $W_3$ )	3852	3954	4011	3995	3962	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1811	1913	1970	1954	1921	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.92	2.03	2.09	2.07	2.03	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.71	1.77	1.79	1.74	1.68	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	107.7	110.4	111.7	108.6	105.3	

Liquid Limit = 37.5Plastic Limit = 17.2Plastic Index = 19.8Soil Class. = CL

Optimum Moisture = 16.3 %  
 Maximum Dry Density = 112.0 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: Clay  
 Sample Location: Clay Stockpile

Project No.: C01-06  
 Date: 5-21-93  
 Tested by: AXCEL  
 Sample #: 1

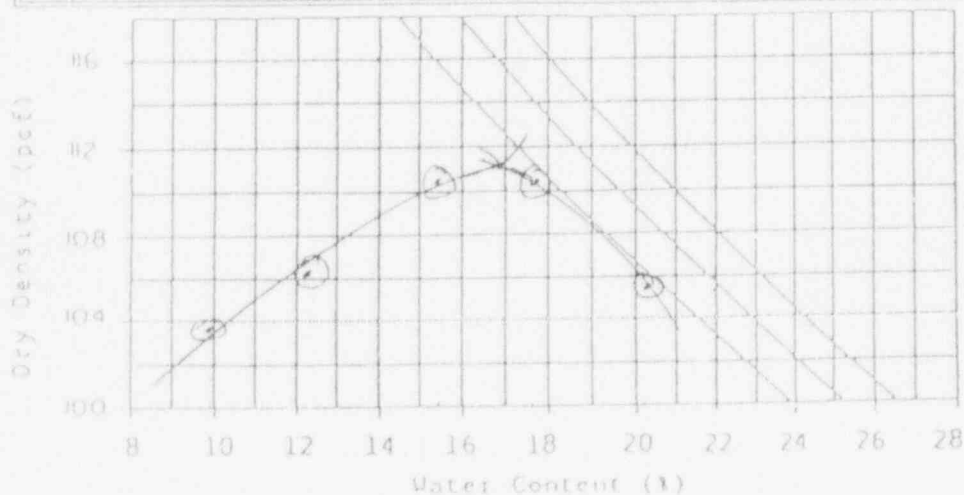
Water Content Determination 25 75 125 175 225

Trial Number	1	2	3	4	5	6
Cup Number	10	15	13	3	7	11
Tare Weight, g ( $W_c$ )	32.97	33.10	33.05	33.04	33.34	32.77
Tare + Wet Soil, g ( $W_1$ )	260.19	254.37	255.70	315.14	301.52	259.12
Tare + Dry Soil, g ( $W_2$ )	239.84	230.35	226.20	273.13	256.50	236.21
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	206.87	197.25	193.15	240.09	223.16	203.44
Wt of Water, g ( $w = W_1 - W_2$ )	20.35	24.02	29.50	42.28	45.02	22.91
Water Content, (%) ( $w = w/W_d$ )	9.8	12.2	15.3	17.6	20.2	11.3

12.2 14.3 16.3 18.3 20.3

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3760	3843	3965	4007	3953	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1721	1804	1926	1968	1914	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.82	1.91	2.04	2.08	2.03	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	1.66	1.70	1.77	1.77	1.69	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	103.6	106.1	110.4	110.4	105.5	



Liquid Limit = 39.5  
 Plastic Limit = 17.32  
 Plastic Index = 21.18  
 Soil Class. = CL

Optimum Moisture = 16.9 %  
 Maximum Dry Density = 111.0 pcf



Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-21-93  
 Soil Description: Clay Tested by: A. Hall  
 Sample Location: Clay Stockpile Sample #: 3

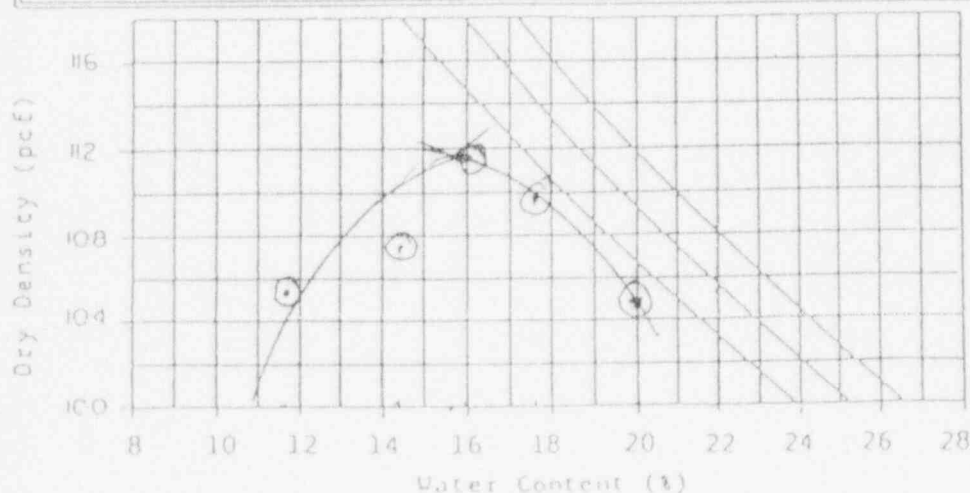
Water Content Determination 100 150 200 250 300

Trial Number	1	2	3	4	5	6
Cup Number	<u>6</u>	<u>15</u>	<u>14</u>	<u>10</u>	<u>3</u>	<u>9</u>
Tare Weight, g ( $W_c$ )	<u>33.04</u>	<u>33.10</u>	<u>32.68</u>	<u>32.97</u>	<u>33.04</u>	<u>33.83</u>
Tare + Wet Soil, g ( $W_1$ )	<u>291.38</u>	<u>246.47</u>	<u>286.18</u>	<u>307.72</u>	<u>259.53</u>	<u>334.29</u>
Tare + Dry Soil, g ( $W_2$ )	<u>264.99</u>	<u>220.83</u>	<u>251.27</u>	<u>266.56</u>	<u>214.31</u>	<u>312.12</u>
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	<u>231.90</u>	<u>187.73</u>	<u>218.59</u>	<u>233.59</u>	<u>181.27</u>	<u>278.29</u>
Wt of Water, g ( $w = W_1 - W_2$ )	<u>26.89</u>	<u>25.64</u>	<u>34.91</u>	<u>41.16</u>	<u>36.22</u>	<u>22.17</u>
Water Content, (%) ( $w = w/W_d$ )	<u>11.6</u>	<u>14.3</u>	<u>16.0</u>	<u>17.6</u>	<u>20.0</u>	<u>8.0</u>

12.0 14.0 16.0 18.0 20.0

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	<u>2039</u>					
Mold + Wet Soil, g ( $W_3$ )	<u>3820</u>	<u>3898</u>	<u>4007</u>	<u>3992</u>	<u>3939</u>	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	<u>1781</u>	<u>1859</u>	<u>1968</u>	<u>1953</u>	<u>1900</u>	
Volume of mold, cm <sup>3</sup> ( $V$ )	<u>944</u>					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	<u>1.89</u>	<u>1.97</u>	<u>2.08</u>	<u>2.07</u>	<u>2.01</u>	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	<u>1.69</u>	<u>1.72</u>	<u>1.79</u>	<u>1.76</u>	<u>1.68</u>	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	<u>105.5</u>	<u>107.3</u>	<u>111.7</u>	<u>109.8</u>	<u>104.8</u>	

Liquid Limit = 38.00Plastic Limit = 17.97Plastic Index = 20.03Soil Class = CL

Optimum Moisture = 15.7 %  
 Maximum Dry Density = 111.8 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: Clay  
 Sample Location: Clay Stockpile

Project No.: C01-06  
 Date: 5-21-93  
 Tested by: AKA

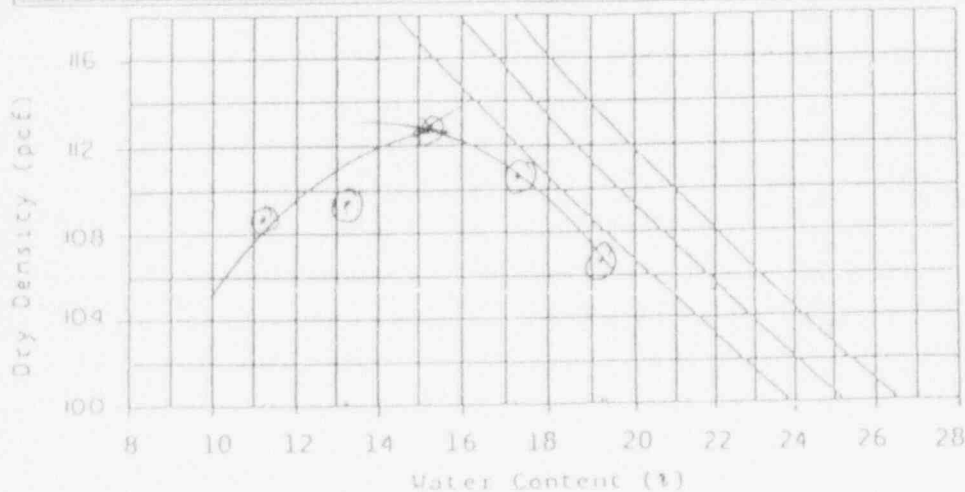
Water Content Determination 50 100 150 200 250

Trial Number	1	2	3	4	5	6
Cup Number	2	9	5	12	6	1
Tare Weight, g ( $W_c$ )	33.38	33.82	33.36	33.38	33.84	33.18
Tare + Wet Soil, g ( $W_1$ )	237.02	286.64	234.87	229.53	295.38	285.10
Tare + Dry Soil, g ( $W_2$ )	216.75	257.27	210.06	200.69	253.44	244.23
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	183.37	223.45	176.72	167.31	219.60	211.05
Wt of Water, g ( $w = W_1 - W_2$ )	20.27	29.37	26.79	28.84	41.94	20.87
Water Content, (%) ( $w = w/W_d$ )	11.1	13.1	15.2	17.2	19.1	9.0

11.0 13.0 15.0 17.0 19.0

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3865	3910	4007	4002	3961	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1826	1871	1968	1963	1922	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.93	1.98	2.08	2.08	2.04	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w/(1 + w/100)$ )	1.74	1.75	1.81	1.77	1.71	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	108.6	109.2	112.9	110.4	106.7	



Liquid Limit = 39.00  
 Plastic Limit = 16.90  
 Plastic Index = 22.10  
 Soil Class = CL

Optimum Moisture = 15.2 %  
 Maximum Dry Density = 112.9 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

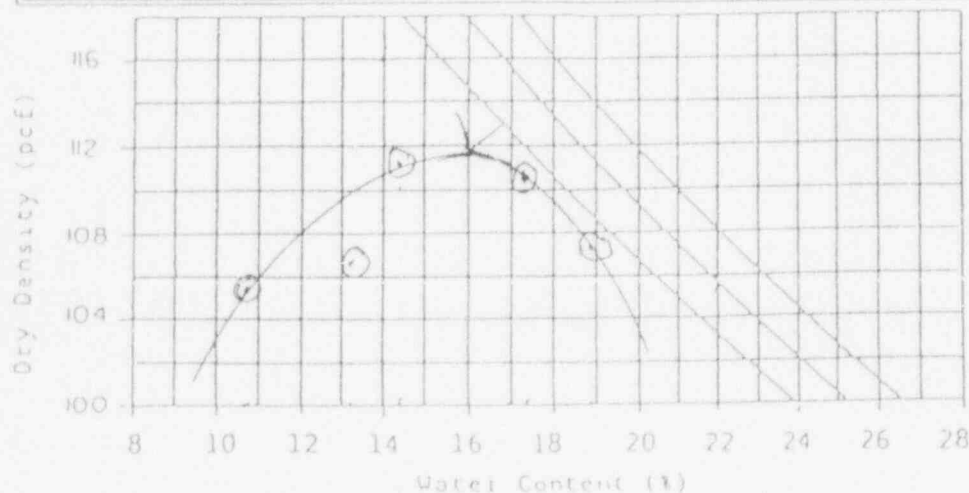
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-21-93  
 Soil Description: Clay Tested by: Atxccc  
 Sample Location: Clay stock pile Sample # 4

Water Content Determination 50 100 150 200 250

Trial Number	1	2	3	4	5	6
Cup Number	11	13	7	1	4	12
Tare Weight, g ( $W_c$ )	32.83	33.06	33.24	33.23	33.50	33.37
Tare + Wet Soil, g ( $W_1$ )	270.67	254.49	227.48	236.38	300.54	326.58
Tare + Dry Soil, g ( $W_2$ )	247.59	230.61	201.95	206.59	258.18	302.63
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	214.76	197.55	177.61	173.36	224.68	269.26
Wt of Water, g ( $w = W_1 - W_2$ )	23.08	25.88	25.53	29.79	42.36	23.95
Water Content, (%) ( $w = w/W_d$ )	10.7	13.1	14.4	17.2	18.9	8.9
	10.9	12.9	14.5	16.9	18.9	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3901	3864	3969	4001	3973	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1762	1825	1930	1962	1934	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.87	1.93	2.04	2.08	2.05	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	1.69	1.71	1.78	1.77	1.72	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	105.5	106.7	111.1	110.4	107.3	



Liquid Limit = 40.00  
 Plastic Limit = 18.12  
 Plastic Index = 21.88  
 Soil Class = CL

Optimum Moisture = 16.0 %  
 Maximum Dry Density = 111.6 pcf





Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 6-2-93  
 Soil Description: CLay Tested by: AKT cell  
 Sample Location: SAMPLE 5 CLay 5th Pile

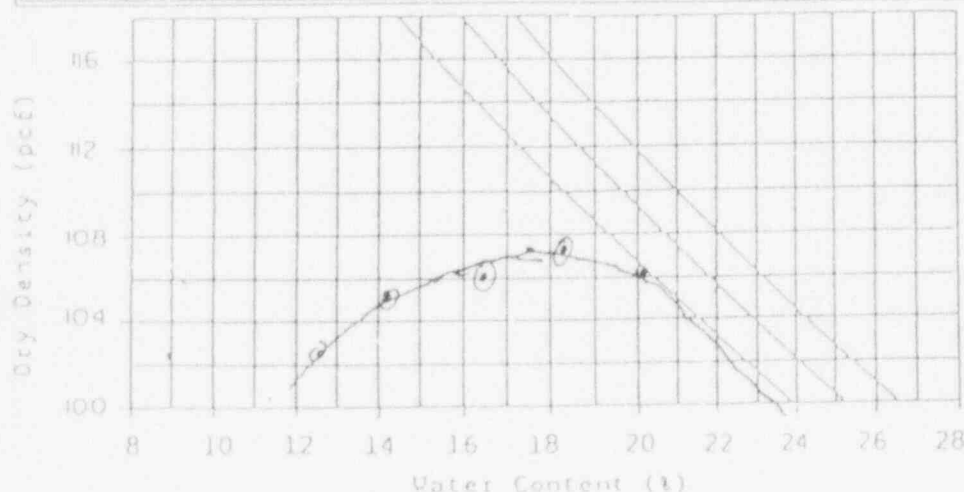
Water Content Determination 200 250 300 350 400

Trial Number	1	2	3	4	5	6
Cup Number	10	1	15	3	2	106
Tare Weight, g ( $W_c$ )	32.98	33.22	33.10	33.05	33.39	106.0
Tare + Wet Soil, g ( $W_1$ )	260.77	231.00	259.83	230.22	275.49	354.0
Tare + Dry Soil, g ( $W_2$ )	235.07	206.95	219.79	199.51	234.74	343.69
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	202.09	173.73	186.69	166.46	201.35	237.69
Wt of Water, g ( $w = W_1 - W_2$ )	25.7	24.05	31.04	30.71	40.75	10.31
Water Content, (%) ( $w = w/W_d$ )	12.7	13.8	16.6	18.5	20.2	4.3

12.3 14.3 16.3 18.3 20.3

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3797	3835	3909	3968	3955	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1758	1799	1870	1929	1916	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.862	1.906	1.981	2.043	2.030	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.652	1.675	1.699	1.724	1.689	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	103.1	104.5	106.0	107.6	105.3	



Liquid Limit = 39.90

Plastic Limit = 17.54

Plastic Index = 22.36

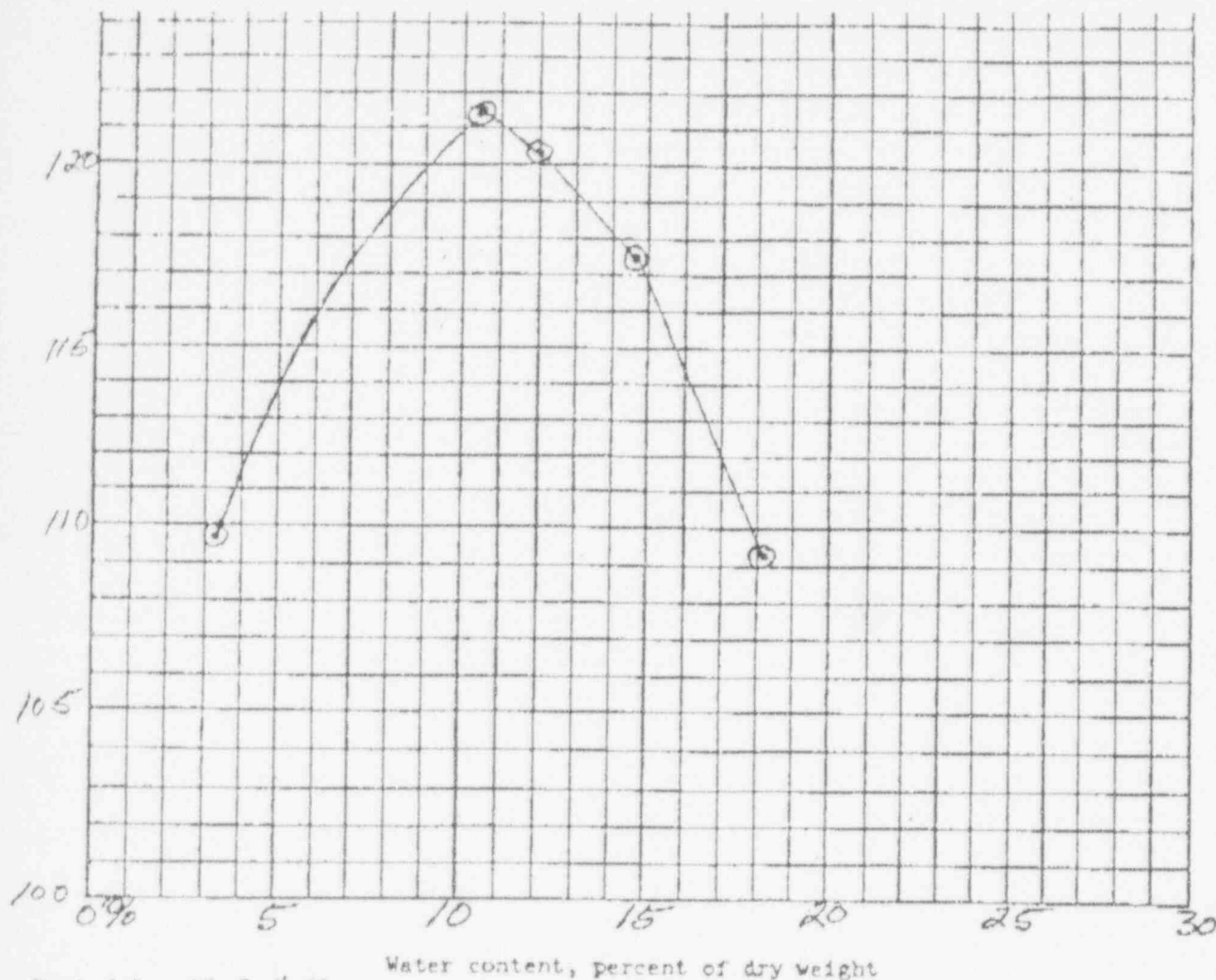
Soil Class. = CL

Optimum Moisture = 17.5 %  
 Maximum Dry Density = 107.5 pcf



Earthfax

dry density, lb/cu ft



Composite SS, 3, 4, 5,  
13, 24

compaction test

56 blows per each of 5 layers, with 10 lb rammer and  
18 inch drop. 6.0 inch diameter mold

Sample No.	Elev or Depth	Classification	Q	LL	PL	% > No. 4	% > 3/4 in.

Sample No.			
atural water content, percent			
climax water content, percent			
x dry density, lb/cu ft			

Remarks	Project	
	Area	
	Boring No.	Date
	COMPACTION TEST REPORT	

## STANDARD PROCTOR COMPACTION TEST (ASTM D 698) Est. 01-11-8

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #10

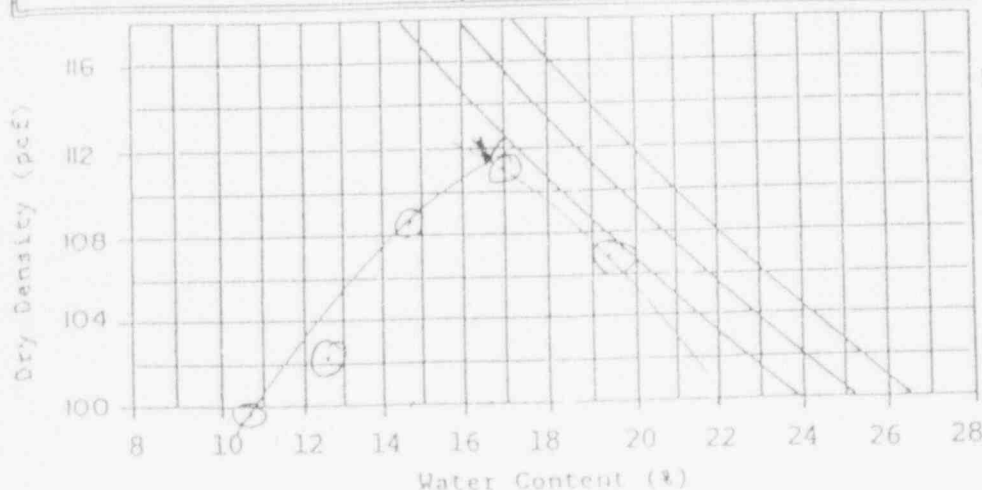
Project No.: C01-06  
 Date: 10-13-92  
 Tested by: Axtell

## Water Content Determination

	H <sub>2</sub> O ADDED (mL)					
	75	125	175	225	275	ORIG
Trial Number	1	2	3	4	5	6
Cup Number	7	6	9	11	2	6
Tare Weight, g ( $W_c$ )	33.37	33.97	33.90	32.91	33.39	33.86
Tare + Wet Soil, g ( $W_1$ )	301.95	275.76	371.47	331.10	288.79	358.55
Tare + Dry Soil, g ( $W_2$ )	276.05	249.93	329.15	297.81	247.59	335.93
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	242.68	215.06	294.25	255.00	214.20	302.07
Wt of Water, g ( $w = W_1 - W_2$ )	25.90	26.83	43.32	43.29	41.20	22.62
Water Content, ( $w\% = w/W_d$ )	10.7	12.5	14.7	17.0	19.2	7.5

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3695	3773	3930	4008	3962	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1655	1733	1890	1968	1922	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> $D_w = W_w/V$	1.75	1.84	2.00	2.08	2.04	
Dry Density, g/cm <sup>3</sup> $D_d = (1 + w\%/100)$	1.58	1.64	1.74	1.78	1.71	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	98.6	102.3	108.6	111.1	106.7	



Liquid Limit = 30.0

Plastic Limit = 2.0

Plastic Index = 28.0

Soil Class. = CL

Optimum Moisture = 16.4 %  
 Maximum Dry Density = 111.5 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown Silt  
 Sample Location: Borvan p. #10

Project No.: C01-06  
 Date: 10-6-92  
 Tested by: AX + LLC

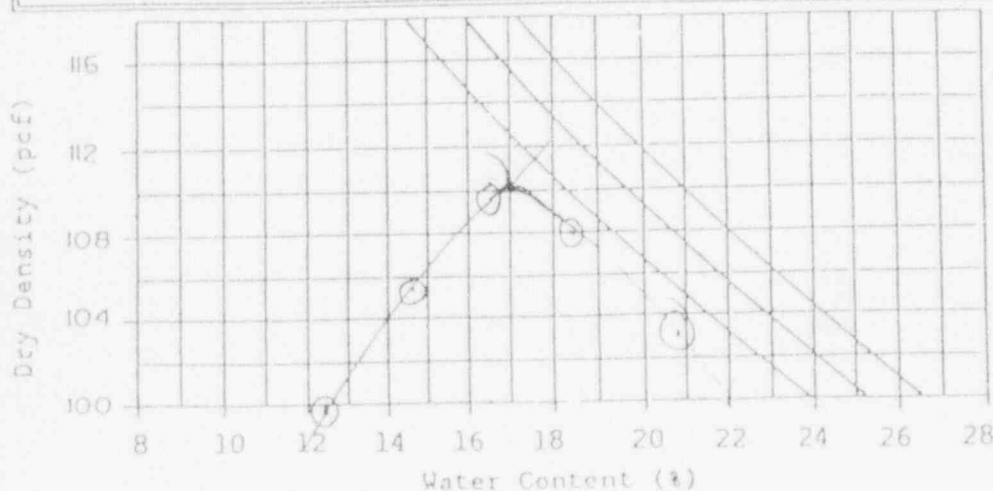
## Water Content Determination

	110	160	210	260	310	
Trial Number	1	2	3	4	5	6
Cup Number	2	14	11	9	6	6
Tare Weight, g ( $W_c$ )	33.39	32.69	32.82	33.88	33.86	33.85
Tare + Wet Soil, g ( $W_1$ )	253.75	326.86	365.31	365.68	370.44	311.34
Tare + Dry Soil, g ( $W_2$ )	229.10	289.48	318.20	314.07	312.21	290.73
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	195.71	256.79	285.38	280.19	278.35	256.88
Wt of Water, g ( $w = W_1 - W_2$ )	24.65	37.38	47.11	51.61	58.23	20.61
Water Content, (%) ( $w = w/W_d$ )	12.4	14.6	16.5	18.4	20.9	8.0

Est  $\rightarrow$  12.4 14.4 16.4 18.4 20.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3739	3868	3971	3977	3929	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1699	1828	1931	1937	1889	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.80	1.94	2.05	2.05	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w/100)$ )	1.60	1.69	1.76	1.73	1.65	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	99.8	105.5	109.8	108.0	103.0	

Liquid Limit = 36.5Plastic Limit = 18.7Plastic Index = 17.8Soil Class. = CL

Optimum Moisture = 17.0 %  
 Maximum Dry Density = 109.8 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 7-20-12  
 Soil Description: Red - Brown Silty Tested by: A. ...  
 Sample Location: Between p. + W. E. East side

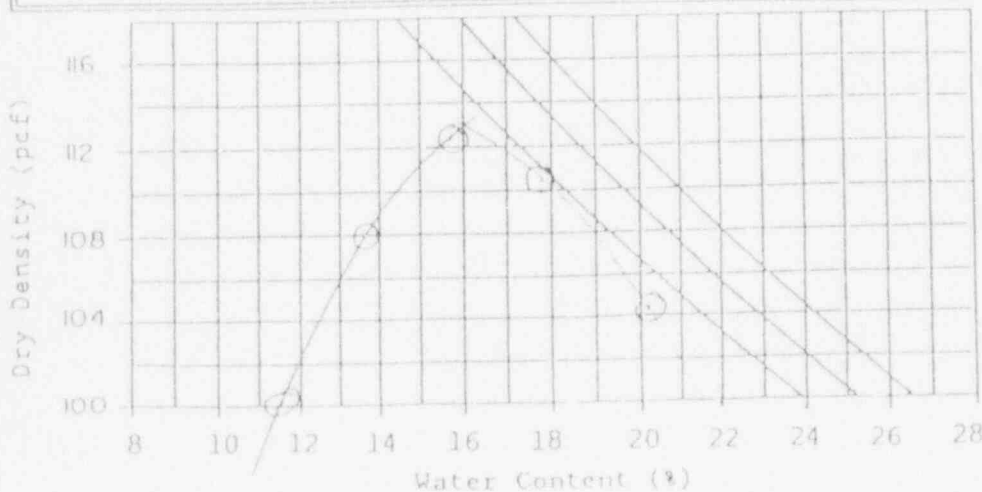
## Water Content Determination

	20	70	120	170	220	
Trial Number	1	2	3	4	5	6
Cup Number	6	2	14	11	9	9
Tare Weight, g ( $W_c$ )	33.89	33.39	32.69	32.83	33.86	33.88
Tare + Wet Soil, g ( $W_1$ )	310.58	294.20	261.99	265.70	341.15	339.33
Tare + Dry Soil, g ( $W_2$ )	282.14	262.71	230.71	230.52	299.64	209.93
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	248.25	229.32	198.02	197.69	265.78	275.61
Wt of Water, g ( $w = W_1 - W_2$ )	28.44	31.49	31.28	35.18	51.51	29.84
Water Content, ( $w\% = w/W_d$ )	11.5	13.7	15.8	17.8	20.1	10.8

Calc.  $w \rightarrow$  11.6 13.6 15.6 17.6 19.6

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3742	3896	4013	4002	3942	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1702	1856	1973	1962	1902	
Volume of mold, cm <sup>3</sup> ( $V$ )	1000	1000	1000	1000	1000	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.702	1.856	1.973	1.962	1.902	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w\%/100)$ )	1.61	1.73	1.80	1.77	1.67	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	100.5	107.1	112.3	110.4	104.2	

Liquid Limit = 33.0Plastic Limit = 16.1Plastic Index = 16.9Soil Class. = CL

Optimum Moisture = 16.0 %  
 Maximum Dry Density = 113.0 pcf



Earthfax



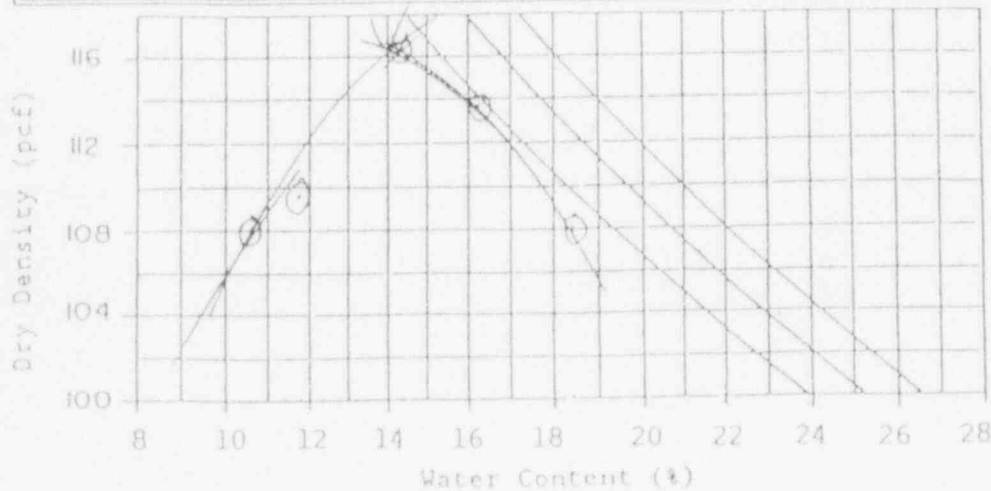
# STANDARD PROCTOR COMPACTION TEST (ASTM D 698) Est. OMC, - 15.1

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 9-23-92  
 Soil Description: Reddish Brown silt Tested by: AK+ELL  
 Sample Location: Borrow pit #10, East side  
H<sub>2</sub>O Added (ml) Orig H<sub>2</sub>O

Water Content Determination						
	0	35	85	135	185	
Trial Number	1	2	3	4	5	6
Cup Number	2	11	9	14	10	10
Tare Weight, g ( $W_c$ )	33.39	32.83	33.88	32.67	32.96	32.96
Tare + Wet Soil, g ( $W_1$ )	341.58	335.00	337.08	371.97	363.32	338.54
Tare + Dry Soil, g ( $W_2$ )	311.80	303.19	299.18	324.86	312.03	309.53
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	278.41	270.36	265.30	292.19	279.07	276.57
Wt of Water, g ( $W = W_1 - W_2$ )	29.78	31.81	37.90	47.11	51.29	29.03
Water Content, ( $w\% = W/W_d$ )	10.7	11.8	14.3	16.1	18.4	10.5

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3841	3902	4048	4033	3978	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1801	1862	2008	1993	1938	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.91	1.97	2.13	2.11	2.05	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + w\%/100)$ )	1.73	1.76	1.86	1.82	1.73	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	108.0	109.8	116.1	113.6	108.0	



Liquid Limit = 27.0

Plastic Limit = 15.1

Plastic Index = 11.9

Soil Class. = CL

Optimum Moisture = 14.0 %  
 Maximum Dry Density = 114.2 pcf





# STANDARD PROCTOR COMPACTION TEST (ASTM D 698) Est 04-208

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 8-5-92  
 Soil Description: Reddish Brown silt Tested by: AXCEL  
 Sample Location: Borrow pit #10, west side H<sub>2</sub>O ADD. (%) 0.16 ORIG H<sub>2</sub>O

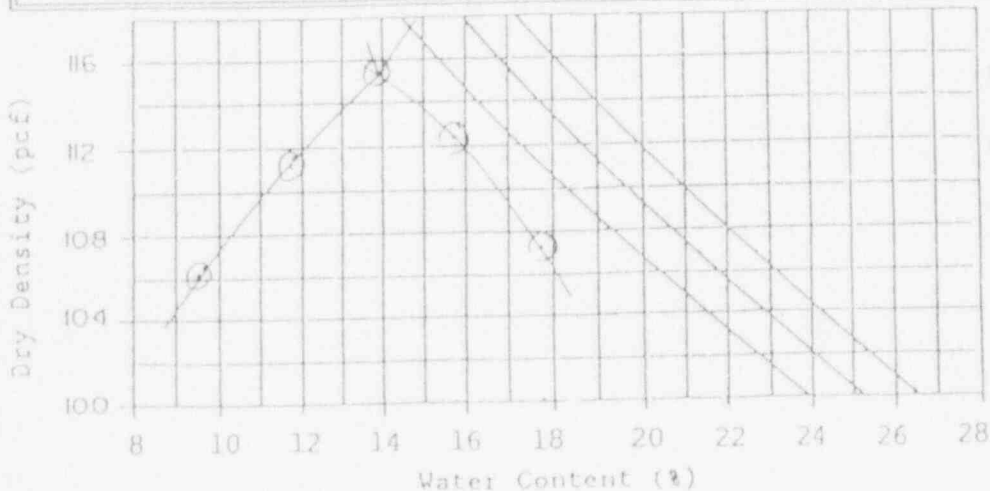
## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	7	14	9	15	4	2
Tare Weight, g ( $W_c$ )	333.7	32.67	33.88	33.12	33.46	33.40
Tare + Wet Soil, g ( $W_1$ )	302.24	342.55	348.22	335.91	322.88	326.46
Tare + Dry Soil, g ( $W_2$ )	279.02	310.06	309.83	294.51	328.66	300.79
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	245.65	277.39	275.95	261.39	295.20	267.39
Wt of Water, g ( $w = W_1 - W_2$ )	23.22	32.49	38.39	41.40	52.22	25.67
Water Content, (%) ( $wL = w/W_d$ )	9.5	11.7	13.9	15.8	17.7	9.6

Est = 9.6 11.6 13.7 15.7 17.7

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3793	3912	4031	4007	3956	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1755	1874	1993	1969	1918	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.86	1.99	2.11	2.09	2.03	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + wL/100)$ )	1.70	1.78	1.85	1.80	1.72	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	106.1	111.1	115.4	112.3	107.3	



Liquid Limit = 24.5

Plastic Limit = 17.0

Plastic Index = 7.5

Soil Class. = CL

Optimum Moisture = 13.9 %  
 Maximum Dry Density = 115.4 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

E-101-01-1-1-3

Client: Rio Algom Mining Corp.  
 Site Location: Lower Tailings Cover System  
 Soil Description: Reddish Brown silt  
 Sample Location: Borrow pit #10, East side

Project No.: C01-06  
 Date: 8-4-92  
 Tested by: AK-101

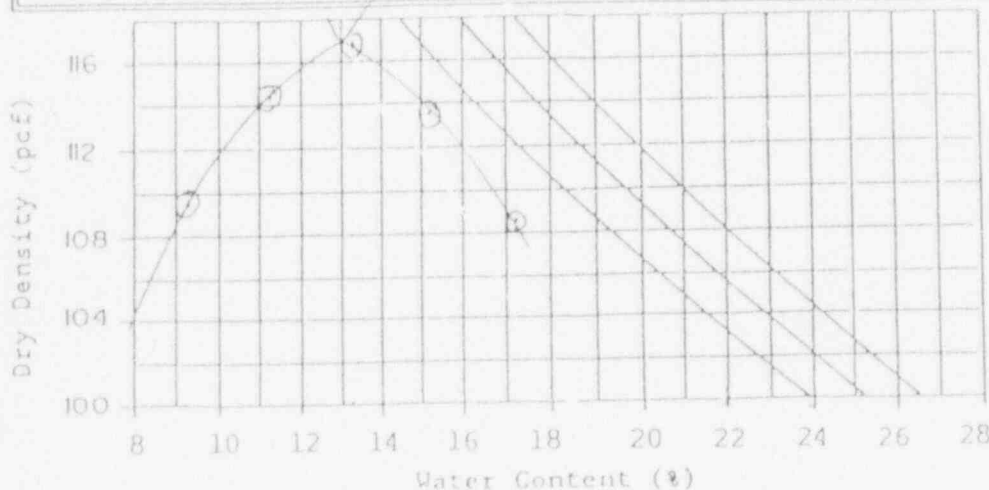
## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	11	12	2	6	10	11
Tare Weight, g ( $W_c$ )	32.80	33.37	33.40	33.82	32.95	32.82
Tare + Wet Soil, g ( $W_1$ )	329.14	328.06	329.01	342.38	365.53	351.19
Tare + Dry Soil, g ( $W_2$ )	304.47	298.26	338.77	301.89	317.07	340.57
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	271.67	264.89	305.37	268.07	284.12	307.75
Wt of Water, g ( $w = W_1 - W_2$ )	24.67	29.80	40.24	40.49	48.46	10.62
Water Content, (%) ( $wL = w/W_d$ )	9.1	11.2	13.2	15.1	17.1	3.5

Est - 9.1 11.3 13.1 15.0 16.8

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2038	2038	2038	2038	2038	
Mold + Wet Soil, g ( $W_3$ )	3852	3963	4042	4021	3961	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1814	1925	2004	1983	1923	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.92	2.04	2.12	2.10	2.04	
Dry Density, g/cm <sup>3</sup> ( $D_w/(1 + wL/100)$ )	1.76	1.83	1.87	1.82	1.74	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	109.8	114.2	116.7	113.6	108.6	

Liquid Limit = 22.5Plastic Limit = 17.0Plastic Index = 5.5Soil Class. = CL-ML

Optimum Moisture = 13.0 %  
 Maximum Dry Density = 117.0 pcf



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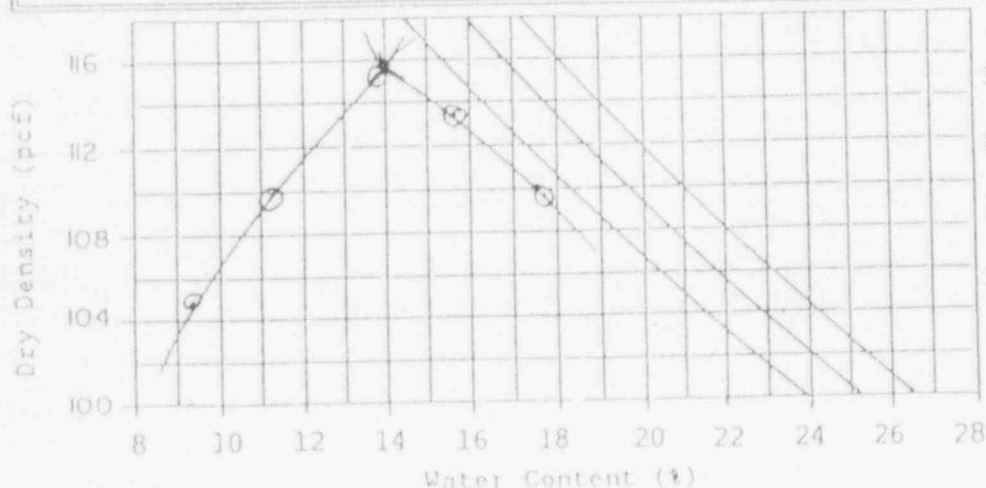
# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: Lower Tailings Cover System Date: 2-25-92  
 Soil Description: Reddish Brown Silt Tested by: LARRY AXTELL  
 Sample Location: #4 Borrow area East End H<sub>2</sub>O Added (w) ORIG. H<sub>2</sub>O

Water Content Determination	100	150	200	250	300	
Trial Number	1	2	3	4	5	6
Cup Number	5	9	10	7	1	4
Tare Weight, g (W <sub>c</sub> )	33.27	33.80	32.90	33.29	32.96	33.28
Tare + Wet Soil, g (W <sub>1</sub> )	328.47	385.58	360.81	377.97	375.21	364.34
Tare + Dry Soil, g (W <sub>2</sub> )	303.73	350.48	321.63	331.28	324.00	345.20
Wt Dry Soil, g (W <sub>d</sub> =W <sub>2</sub> -W <sub>c</sub> )	270.46	316.68	288.73	297.99	291.04	311.92
Wt of Water, g (w=W <sub>1</sub> -W <sub>2</sub> )	24.74	35.10	39.78	46.69	51.21	19.14
Water Content, (w <sub>%</sub> =w/W <sub>d</sub> )	9.1	11.1	13.8	15.7	17.6	6.1

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g (W <sub>3</sub> )	3768	3894	4035	4028	3997	
Wt Wet Soil, g (W <sub>w</sub> =W <sub>3</sub> -W <sub>p</sub> )	1728	1854	1995	1988	1957	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> =W <sub>w</sub> /V	1.83	1.96	2.11	2.11	2.07	
Dry Density, g/cm <sup>3</sup> D <sub>w</sub> /(1 + w <sub>%</sub> /100)	1.68	1.76	1.85	1.82	1.76	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	104.8	109.8	115.4	113.6	109.8	



Optimum Moisture = 14.0 %  
 Maximum Dry Density = 115.4 pcf



EarthFax

Client: Rio Algom Mining Corp.

Project No.: C01-06

Site Location: No. 2 Evap. Pond

Date: 10-29-92

Soil Description: Reddish Brown clay

Tested by: AXT-LL

Sample Location: Borrow pit #10 East

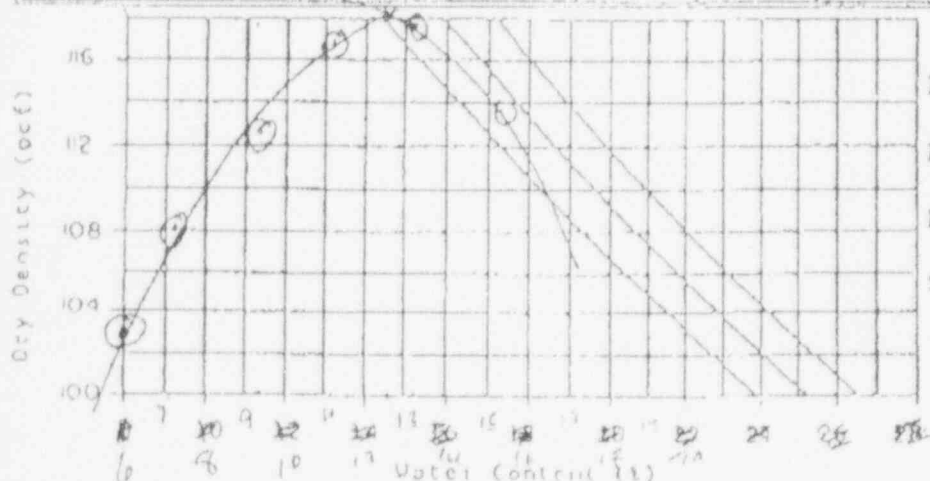
Water Content Determination (O) 30 80 130 180

Trial Number	1	2	3	4	5	6
Cup Number	5	11	12	14	9	14
Tare Weight, g ( $W_c$ )	33.33	32.79	33.39	32.68	33.89	32.68
Tare + Wet Soil, g ( $W_1$ )	273.58	291.16	333.54	347.88	347.27	341.26
Tare + Dry Soil, g ( $W_2$ )	260.02	273.94	308.22	316.35	310.77	324.02
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	226.69	241.15	274.83	283.67	276.90	291.34
Wt of Water, g ( $w = W_1 - W_2$ )	13.56	17.22	25.32	31.53	36.50	17.24
Water Content, (%) ( $w = w/W_d$ )	6.0	7.1	9.2	11.1	13.2	8.6

9.8 11.8 13.8 15.8

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2042	2042	2042	2042	2042	2042
Mold + Wet Soil, g ( $W_3$ )	3697	3793	3903	4008	4063	4007
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1655	1751	1861	1966	2021	1965
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	944
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.75	1.85	1.97	2.08	2.14	2.08
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	1.65	1.73	1.80	1.87	1.89	1.81
Dry Density, pcf ( $62.4 \times g/cm^3$ )	103.0	108.0	112.3	116.7	117.9	112.9



Liquid Limit = 20.0

Plastic Limit = 12.8

Plastic Index = 7.2

Soil Class = CL



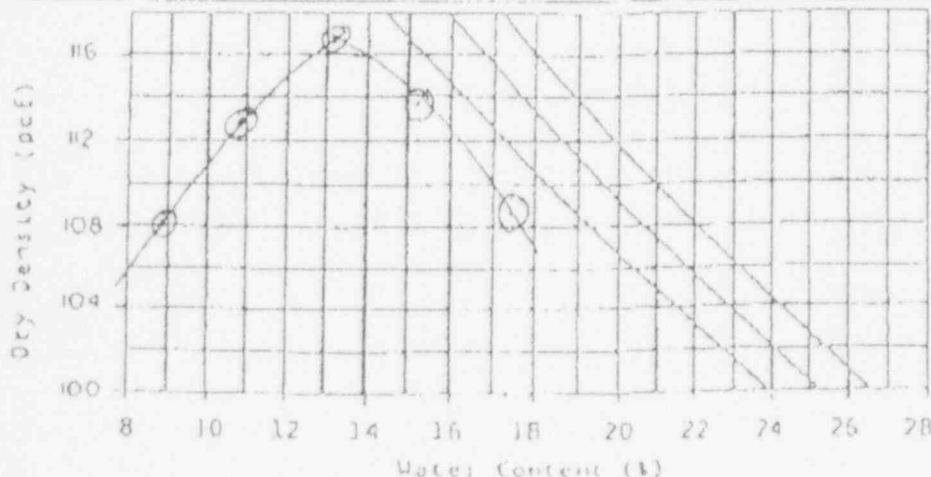
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 11-12-92  
 Soil Description: Reddish Brown Silty Tested by: Larry Axell  
 Sample Location: Borrow pit #10 mid dle H<sub>2</sub>O added (2%) ORIG H<sub>2</sub>O

Water Content Determination

	45	135	185	235	285	
Trial Number	1	2	3	4	5	6
Cup Number	6	2	5	9	12	9
Tare Weight, g ( $W_c$ )	33.88	33.40	33.34	33.87	33.39	33.87
Tare + Wet Soil, g ( $W_1$ )	317.73	342.17	375.10	343.93	345.85	353.86
Tare + Dry Soil, g ( $W_2$ )	294.58	311.70	335.53	303.21	299.88	336.40
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	260.70	278.30	302.19	269.34	266.49	302.53
Wt of Water, g ( $w = W_1 - W_2$ )	23.15	30.47	39.57	40.72	45.97	17.46
Water Content, (%) ( $w = w/W_d$ )	8.9	10.9	13.1	15.1	17.3	5.8
	9.7	11.2	13.2	15.2	17.7	

Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3816	3934	4038	4018	3967	
Wt Wet Soil, g ( $W_s = W_3 - W_p$ )	1776	1894	1998	1978	1927	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_s/V$ )	1.88	2.01	2.12	2.10	2.04	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	1.73	1.81	1.87	1.82	1.74	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	108.0	112.9	116.7	113.6	108.6	



Liquid Limit = 23.0  
 Plastic Limit = 16.3  
 Plastic Index = 6.7  
 Soil Class = CL-ML

Optimum Moisture = 13.1 %  
 Maximum Dry Density = 116.7 pcf





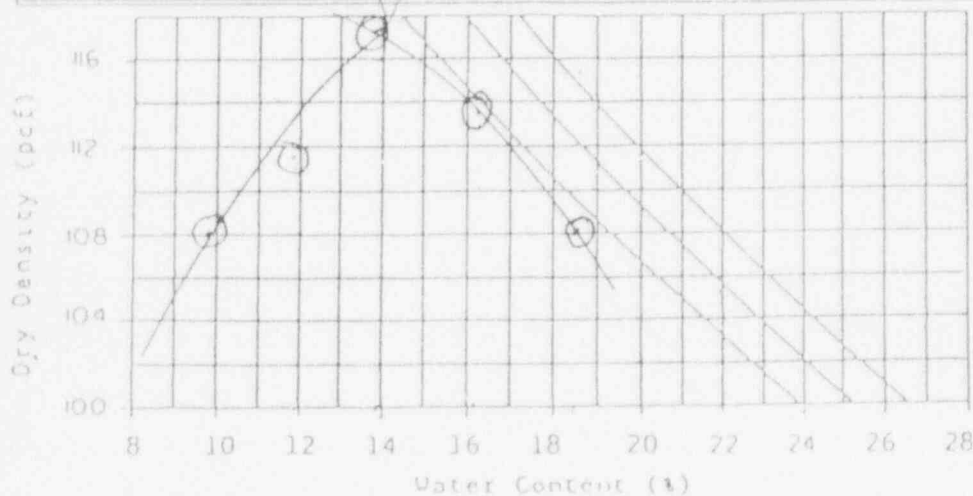
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 11-19-92  
 Soil Description: Reddish Brown silt Tested by: W. J. Ellis  
 Sample Location: Borrow pit #10 Middle East  
H<sub>2</sub>O added (ml) orig

## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	13	9	12	6	7	6
Tare Weight, g ( $W_c$ )	33.05	33.89	33.39	33.87	33.37	33.85
Tare + Wet Soil, g ( $W_1$ )	325.75	293.89	294.41	340.95	353.80	353.96
Tare + Dry Soil, g ( $W_2$ )	299.54	266.22	262.49	298.48	304.20	332.94
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	266.49	232.34	229.10	264.61	270.83	299.09
Wt of Water, g ( $w = W_1 - W_2$ )	26.21	27.67	31.92	42.47	49.60	21.02
Water Content, (%) ( $w\% = w/W_d$ )	9.8	11.9	13.9	16.1	18.3	7.0
	10.0	12.0	14.0	16.0	18.0	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2040	2040	2040	2040	2040	
Mold + Wet Soil, g ( $W_3$ )	3832	3932	4061	4035	3971	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1792	1892	2021	1995	1931	
Volume of mold, cm <sup>3</sup> (V)	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.90	2.00	2.14	2.11	2.05	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w\%/100) D_w$ )	1.73	1.79	1.88	1.82	1.73	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	108.0	111.7	117.3	113.6	108.0	

Liquid Limit = 26.5Plastic Limit = 16.3Plastic Index = 10.2Soil Class = CLOptimum Moisture = 11.75 %Maximum Dry Density = 117.3 pcf

EarthFax



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

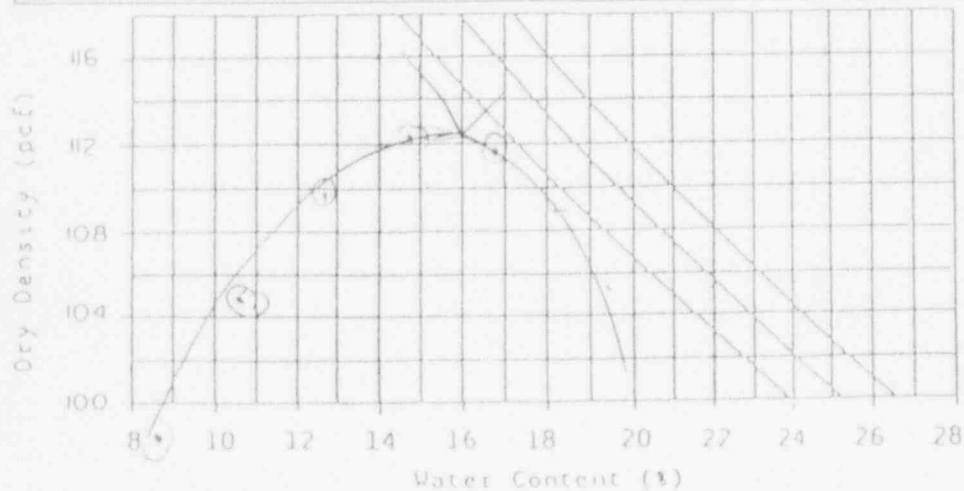
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-17-93  
 Soil Description: \_\_\_\_\_ Tested by: AXELL  
 Sample Location: #93-11-1 Borrow pit #11

ORIG. H<sub>2</sub>O

Water Content Determination	0	50	100	150	200	
Trial Number	1	2	3	4	5	6
Cup Number	12	15	1	4	11	13
Tare Weight, g (W <sub>c</sub> )	33.35	33.09	33.16	33.50	32.79	33.06
Tare + Wet Soil, g (W <sub>1</sub> )	314.36	272.26	285.04	288.40	301.50	298.65
Tare + Dry Soil, g (W <sub>2</sub> )	291.91	249.23	256.61	255.49	263.08	277.12
Wt Dry Soil, g (W <sub>d</sub> =W <sub>2</sub> -W <sub>c</sub> )	258.56	216.14	223.45	221.99	230.29	244.06
Wt of Water, g (w=W <sub>1</sub> -W <sub>2</sub> )	22.45	23.03	28.43	32.91	38.42	21.53
Water Content, (wZ=w/W <sub>d</sub> )	8.7	10.7	12.7	14.8	16.7	8.8
	8.8	10.8	12.8	14.8	16.8	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g (W <sub>p</sub> )	2039					
Mold + Wet Soil, g (W <sub>3</sub> )	3654	3796	3916	3994	4015	
Wt Wet Soil, g (W <sub>w</sub> =W <sub>3</sub> -W <sub>p</sub> )	1615	1757	1877	1957	1976	
Volume of mold, cm <sup>3</sup> (V)	944					
Wet Density, g/cm <sup>3</sup> D <sub>w</sub> =W <sub>w</sub> /V	1.71	1.86	1.99	2.07	2.09	
Dry Density, g/cm <sup>3</sup> D <sub>d</sub> /(1 + wZ/100)	1.57	1.68	1.76	1.82	1.79	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	98.0	104.8	109.8	112.3	111.7	

Liquid Limit = 28.0Plastic Limit = 18.4Plastic Index = 9.6Soil Class = CLOptimum Moisture = 10.8 %Maximum Dry Density = 112.4 pcf

EarthFax

# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

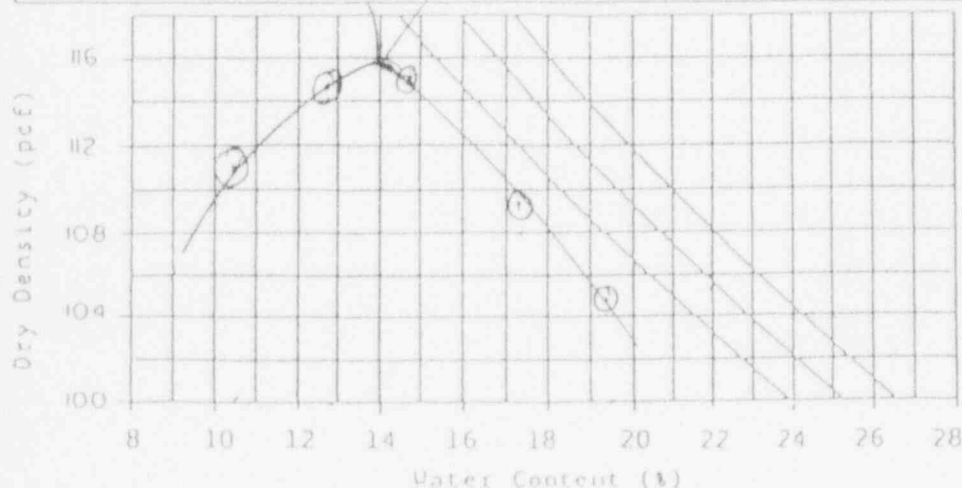
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-17-93  
 Soil Description:  Tested by: Axtell  
 Sample Location: 93-11-2 Borrow pit #11

## Water Content Determination

	0	50	100	150	200	
Trial Number	1	2	3	4	5	6
Cup Number	4	1	12	15	11	12
Tare Weight, g ( $W_c$ )	33.50	33.18	33.37	33.09	32.78	33.36
Tare + Wet Soil, g ( $W_1$ )	593.55	648.01	659.38	640.89	662.44	661.25
Tare + Dry Soil, g ( $W_2$ )	258.88	223.16	230.21	295.72	225.12	236.87
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	225.38	190.48	196.84	262.63	192.34	203.51
Wt of Water, g ( $w = W_1 - W_2$ )	23.37	24.35	29.17	45.17	37.32	24.38
Water Content, (%) ( $w = w/W_d$ )	10.4	12.8	14.8	17.2	19.4	12.0
	12.0	14.0	16.0	18.0	20.0	

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	2039	2039	2039	2039	
Mold + Wet Soil, g ( $W_3$ )	3920	3989	4034	3977	3931	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1851	1950	1995	1938	1892	
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944	944	
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.96	2.07	2.11	2.05	2.00	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100)D_v$ )	1.78	1.84	1.84	1.75	1.68	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	111.1	114.8	114.8	109.2	104.8	



Liquid Limit = 25.5

Plastic Limit = 17.8

Plastic Index = 7.7

Soil Class. = CL

Optimum Moisture = 13.9 %  
 Maximum Dry Density = 115.4 pcf



Client: Rio Algom Mining Corp. Project No.: COL-06  
 Site Location: No. 2 Evap. Pond Date: 5-17-93  
 Soil Description:  Tested by: AXI  
 Sample Location: 93-11-3 Borrow pit #11

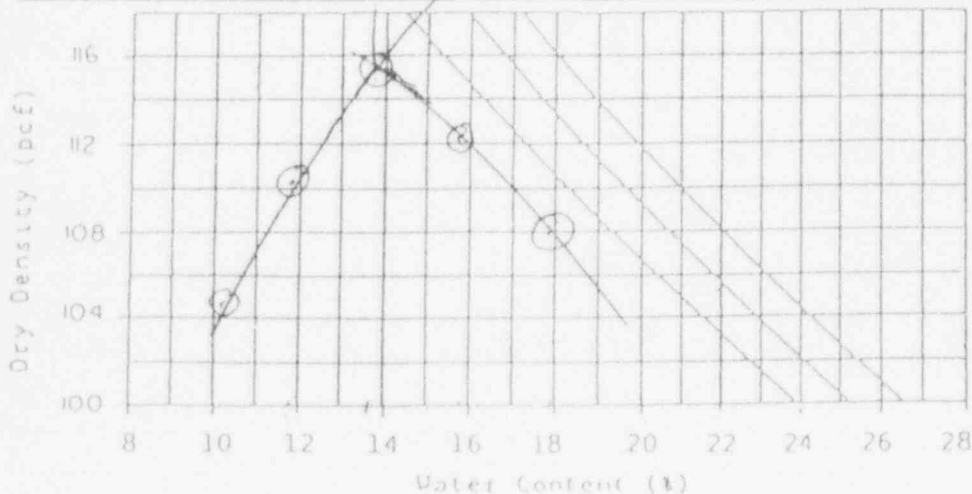
## Water Content Determination 50 100 150 200 250

Trial Number	1	2	3	4	5	6
Cup Number	6	7	3	2	5	11
Tare Weight, g ( $W_c$ )	33.86	33.33	33.03	33.37	33.34	32.78
Tare + Wet Soil, g ( $W_1$ )	254.71	329.38	503.01	266.93	271.62	255.66
Tare + Dry Soil, g ( $W_2$ )	234.54	298.08	270.22	230.76	243.89	238.72
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	200.68	264.75	237.19	197.39	210.55	205.94
Wt of Water, g ( $w = W_1 - W_2$ )	201.7	31.30	32.79	31.17	37.73	16.94
Water Content, ( $wL = w/W_d$ )	10.1	11.8	13.8	15.8	17.9	8.2

10.2 12.2 14.2 16.2 18.2

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3783	3904	4017	4010	3961	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1744	1865	1978	1971	1922	
Volume of mold, $cm^3$ ( $V$ )	944					
Wet Density, $g/cm^3$ $D_v = W_v/V$	1.85	1.98	2.10	2.09	2.04	
Dry Density, $g/cm^3$ $D_d/(1 + wL/100)$	1.68	1.77	1.85	1.80	1.73	
Dry Density, pcf (62.4 x $g/cm^3$ )	104.8	110.4	115.4	112.3	108.0	



Liquid Limit = 25.5  
 Plastic Limit = 15.5  
 Plastic Index = 10.0  
 Soil Class = CL

Optimum Moisture = 13.7 %  
 Maximum Dry Density = 115.4 pcf



EarthFax

## STANDARD PROCTOR COMPACTION TEST (ASTM D 690)

Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-17-93  
 Soil Description: \_\_\_\_\_ Tested by: AKC  
 Sample Location: 93-11-4 Cuttings Pit #11

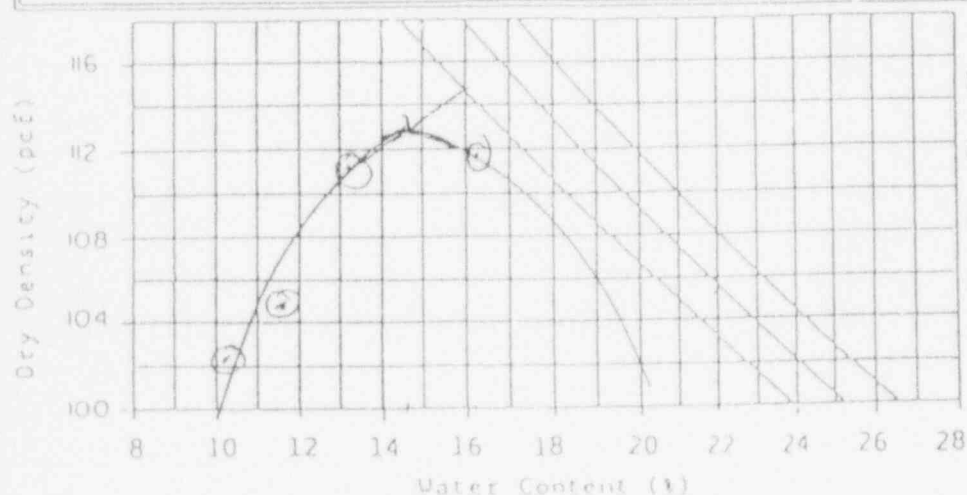
## Water Content Determination

Trial Number	1	2	3	4	5	6
Cup Number	13	14	10	12		15
Tare Weight, g ( $W_c$ )	53.08	32.67	32.96	33.38		33.09
Tare + Wet Soil, g ( $W_1$ )	301.46	269.15	258.28	312.39		276.02
Tare + Dry Soil, g ( $W_2$ )	276.51	244.53	232.15	273.77		253.31
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	243.73	211.86	199.19	240.39		220.22
Wt of Water, g ( $w = W_1 - W_2$ )	24.65	24.62	26.13	38.62		22.71
Water Content, (%) ( $w = w/W_d$ )	10.1	11.6	13.1	16.1		10.3

10.3 12.3 14.3 16.3 18.3

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	2039	2029	2039		
Mold + Wet Soil, g ( $W_3$ )	3750	3816	3936	4002		
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1711	1777	1897	1963		
Volume of mold, cm <sup>3</sup> ( $V$ )	944	944	944	944		
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.81	1.88	2.01	2.08		
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.64	1.68	1.78	1.79		
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	102.3	104.9	111.1	111.7		

Liquid Limit = 26.5Plastic Limit = 16.5Plastic Index = 10.0Soil Class. = CL

Optimum Moisture = 14.6 %  
 Maximum Dry Density = 113.0 pcf





# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: Silt  
 Sample Location: 93-11-5 Borrow pit #11

Project No.: C01-06  
 Date: 5-20-93  
 Tested by: Axiell

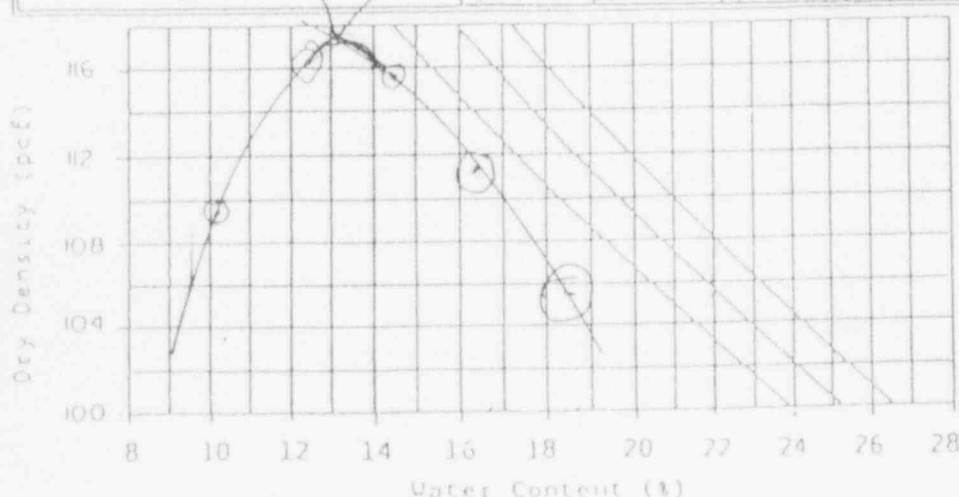
Water Content Determination 60 110 160 210 260

Trial Number	1	2	3	4	5	6
Cup Number	1	15	4	9	8	8
Tare Weight, g ( $W_c$ )	33.20	33.10	33.51	33.82	33.07	33.10
Tare + Wet Soil, g ( $W_1$ )	328.11	309.34	261.69	277.45	296.46	254.74
Tare + Dry Soil, g ( $W_2$ )	301.03	276.90	232.91	242.93	255.23	239.37
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	267.83	243.80	199.40	209.11	222.16	206.23
Wt of Water, g ( $w = W_1 - W_2$ )	27.08	32.44	61.78	67.52	41.23	15.41
Water Content, (%) ( $w = w/W_d$ )	10.1	12.4	14.4	16.5	18.6	7.5

9.9 11.9 13.9 15.9 17.9

Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3861	4016	4038	3993	3940	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1822	1977	1999	1954	1901	
Volume of mold, cm <sup>3</sup> (V)	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.93	2.09	2.12	2.07	2.01	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.75	1.86	1.85	1.78	1.69	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	109.2	116.1	115.4	111.1	105.5	



Liquid Limit = 21.00

Plastic Limit = 17.85

Plastic Index = 3.15

Soil Class. = ML

Optimum Moisture = 13.1 %

Maximum Dry Density = 117.2 pcf



Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: S-LT  
 Sample Location: 93-11-6 #11 P. +

Project No.: C01-06  
 Date: 5-21-93  
 Tested by: Axtach

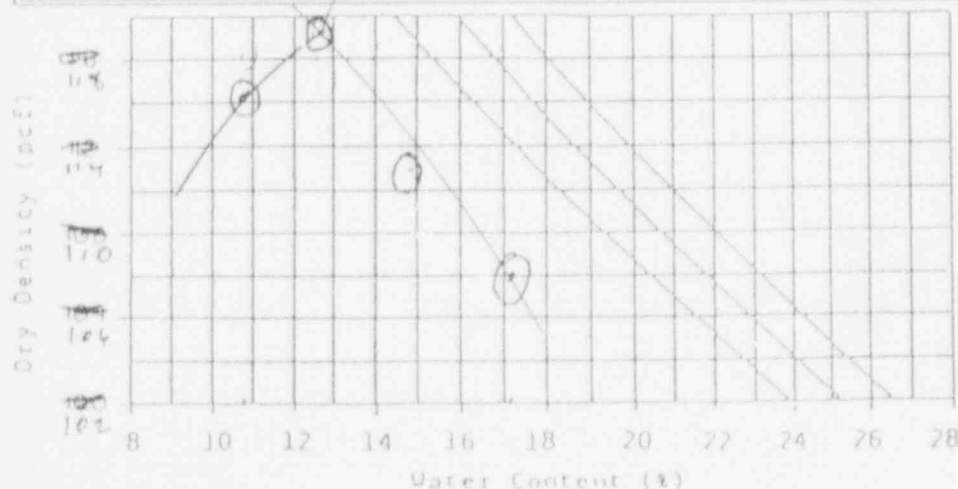
## Water Content Determination 100 150 200 250 300

Trial Number	1	2	3	4	5	6
Cup Number	13	11	6	3	7	4
Tare Weight, g ( $W_c$ )	33.06	32.80	33.81	33.03	33.32	33.50
Tare + Wet Soil, g ( $W_1$ )	384.67	322.53	293.48	201.00	+	256.71
Tare + Dry Soil, g ( $W_2$ )	350.35	289.77	258.82	176.51	W	243.22
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	317.29	256.97	225.01	143.48	e	209.72
Wt of Water, g ( $w = W_1 - W_2$ )	34.32	32.76	33.66	24.49	+	13.49
Water Content, (%) ( $w = w/W_d$ )	10.8	12.7	14.9	17.1		6.4

10.4 12.4 14.4 16.4 14.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039				+	
Mold + Wet Soil, g ( $W_3$ )	3987	4069	4005	3948	0	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1948	2030	1964	1909	F	
Volume of mold, cm <sup>3</sup> (V)	944				0	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	2.06	2.15	2.08	2.02	U	
Dry Density, g/cm <sup>3</sup> ( $D_d = (1 + w/100) D_w$ )	1.86	1.91	1.81	1.73	U	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	116.1	119.2	112.9	108.0		



Liquid Limit = 21.50

Plastic Limit = 19.25

Plastic Index = 2.25

Soil Class. = ML

Optimum Moisture = 12.7 %

Maximum Dry Density = 119.2 pcf





Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-21-93  
 Soil Description: Silt Tested by: ATC  
 Sample Location: 93-11-7 #11 Pit

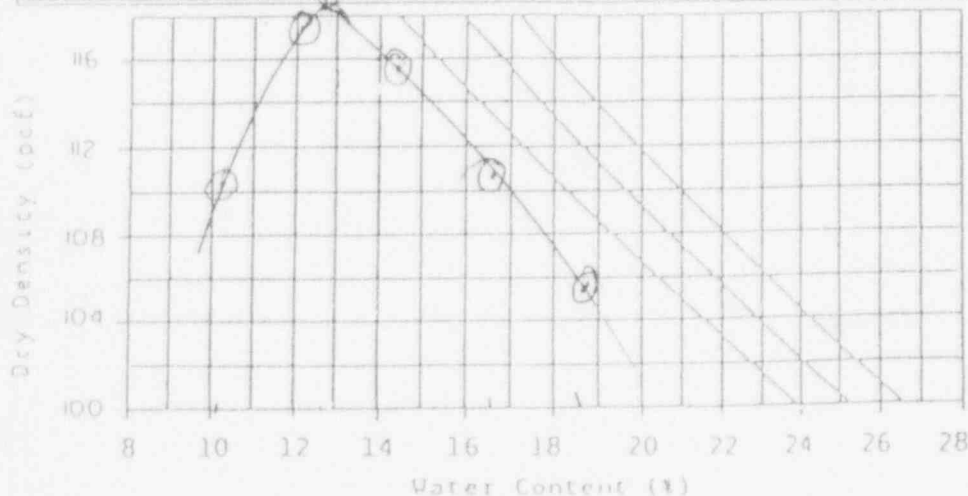
Water Content Determination 25 75 125 175 225

Trial Number	1	2	3	4	5	6
Cup Number	7	2	12	5	14	15
Tare Weight, g ( $W_c$ )	33.34	33.36	33.38	33.36	32.68	33.10
Tare + Wet Soil, g ( $W_1$ )	318.17	315.62	306.69	341.25	296.28	265.91
Tare + Dry Soil, g ( $W_2$ )	291.93	285.05	272.30	297.41	254.78	246.35
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	258.59	251.69	238.92	264.05	222.10	213.25
Wt of Water, g ( $w = W_1 - W_2$ )	26.24	30.57	34.39	43.84	41.50	19.56
Water Content, (%) ( $w = w/W_d$ )	10.1	12.1	14.4	16.6	18.7	9.2

10.2 12.2 14.2 16.2 18.2

Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3877	4035	4036	3988	3935	
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1838	1996	1997	1949	1896	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.95	2.11	2.12	2.06	2.01	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_v / (1 + w/100)$ )	1.77	1.88	1.85	1.77	1.69	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	110.4	117.3	115.4	110.4	105.5	



Liquid Limit = 23.00

Plastic Limit = 17.56

Plastic Index = 5.44

Soil Class. = CL-ML

Optimum Moisture = 12.2 %  
 Maximum Dry Density = 118.4 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

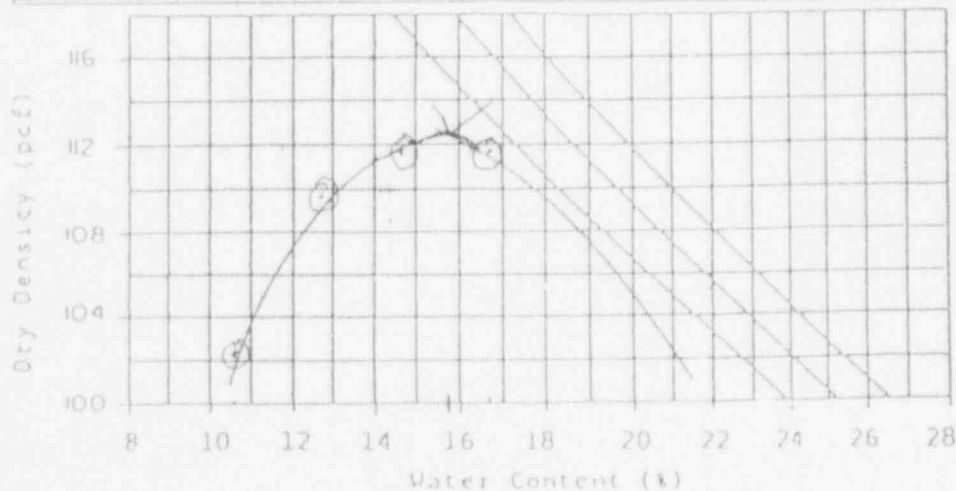
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-25-93  
 Soil Description: Silt Tested by: Axtell  
 Sample Location: 93-11-8 P. 4 #11

Water Content Determination 0 50 100 150 200

Trial Number	1	2	3	4	5	6
Cup Number	4	10	6	14		10
Tare Weight, g ( $W_c$ )	33.51	32.97	33.85	32.68		32.97
Tare + Wet Soil, g ( $W_1$ )	270.23	323.71	263.60	270.56		275.34
Tare + Dry Soil, g ( $W_2$ )	247.62	290.86	234.20	236.64		252.95
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	214.11	257.89	200.35	203.96		219.98
Wt of Water, g ( $w = W_1 - W_2$ )	22.61	32.85	29.40	33.92		25.39
Water Content, (%) ( $w\% = w/W_d$ )	10.6	12.7	14.7	16.6		11.5

Density Determination 11.5 12.5 13.5 17.5 17.5

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3745	3904	3977	4011		
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1706	1865	1938	1972		
Volume of mold, cm <sup>3</sup> (V)	944					
Wet Density, g/cm <sup>3</sup> ( $D_v = W_v/V$ )	1.81	1.98	2.05	2.09		
Dry Density, g/cm <sup>3</sup> $D_d/(1 + w\%/100)$	1.64	1.76	1.79	1.79		
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	102.3	109.8	111.7	111.7		

Liquid Limit = 26.00Plastic Limit = 15.0Plastic Index = 11.0Soil Class = Ch

Optimum Moisture = 14.7 %  
 Maximum Dry Density = 112.5 pcf



Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-25-93  
 Soil Description: Silt Tested by: Axtell  
 Sample Location: 93-11-9 Pit #11

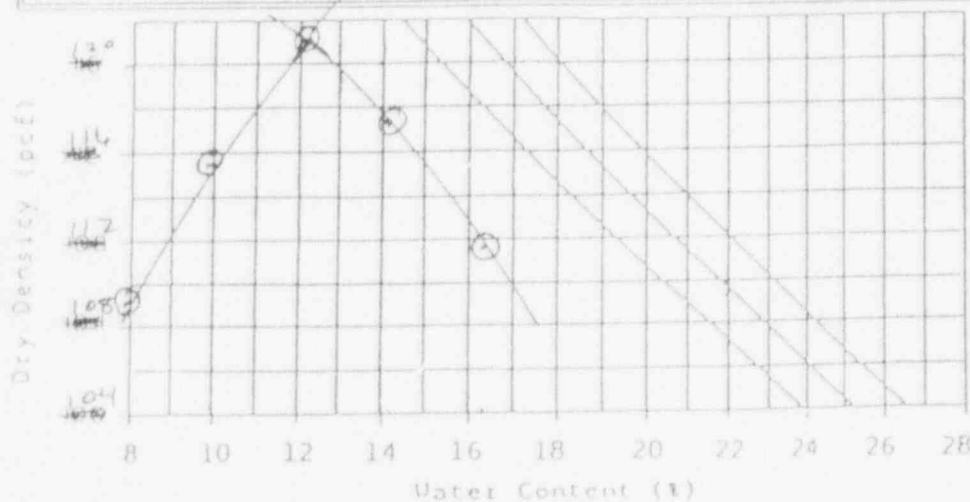
Water Content Determination 75 125 175 225 275

Trial Number	1	2	3	4	5	6
Cup Number	15	3	9	8	1	9
Tare Weight, g ( $W_c$ )	33.10	33.04	33.85	33.07	33.19	33.83
Tare + Wet Soil, g ( $W_1$ )	301.65	259.97	283.96	317.90	294.26	309.36
Tare + Dry Soil, g ( $W_2$ )	291.98	239.51	257.00	282.66	257.89	296.45
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	248.88	206.47	223.15	249.59	224.70	262.62
Wt of Water, g ( $w = W_1 - W_2$ )	196.7	20.46	26.94	35.24	36.34	12.91
Water Content, (%) ( $w = w/W_d$ )	7.9	9.9	12.1	14.1	16.2	4.9

7.9 9.9 11.9 13.9 15.9

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039	—	—	—	—	—
Mold + Wet Soil, g ( $W_3$ )	3823	3959	4092	4055	3999	—
Wt Wet Soil, g ( $W_v = W_3 - W_p$ )	1784	1920	2053	2014	1960	—
Volume of mold, cm <sup>3</sup> ( $V$ )	944	—	—	—	—	—
Wet Density, g/cm <sup>3</sup> ( $D_w = W_v/V$ )	1.89	2.03	2.17	2.14	2.08	—
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.75	1.85	1.94	1.86	1.79	—
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	109.2	115.4	121.1	117.3	111.7	—

Liquid Limit = 22.50Plastic Limit = 16.95Plastic Index = 5.55Soil Class. = CL-ML

Optimum Moisture = 12.1 %  
 Maximum Dry Density = 121.1 pcf



## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: CL-ML  
 Sample Location: 0 50 100 150 200

Project No.: C01-06  
 Date: 5-26-73  
 Tested by: 123456

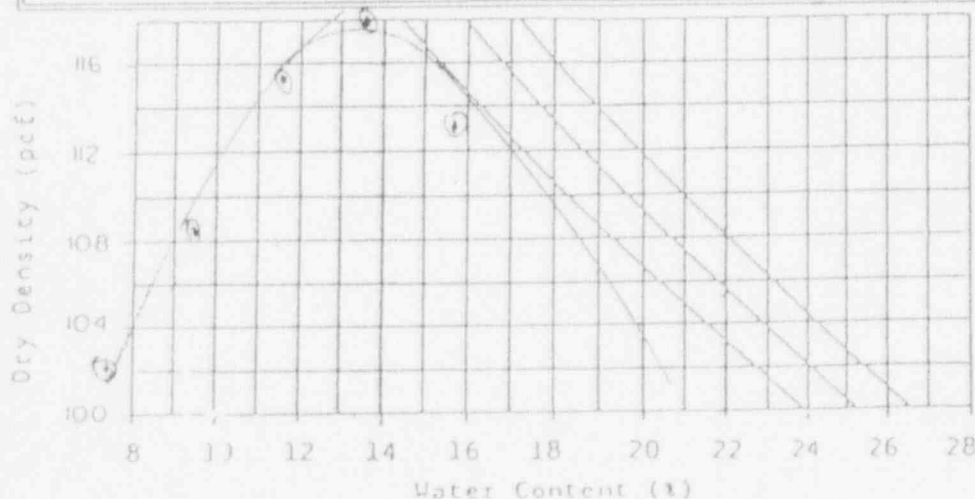
Water Content Determination 0 50 100 150 200

Trial Number	1	2	3	4	5	6
Cup Number	84 33.52	41 22.84	45 33.37	47 33.36	46 33.88	10
Tare Weight, g ( $W_c$ )	33.52	32.94	33.37	33.36	33.88	32.96
Tare + Wet Soil, g ( $W_1$ )	251.88	269.87	276.60	256.92	261.41	270.21
Tare + Dry Soil, g ( $W_2$ )	236.48	249.30	251.54	230.23	230.65	249.81
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	202.96	216.36	218.17	196.87	196.77	216.85
Wt of Water, g ( $w = W_1 - W_2$ )	15.4	20.57	25.06	26.69	30.76	20.40
Water Content, (%) ( $w = w/W_d$ )	7.6	9.5	11.5	13.4	15.4	9.4

4.4 11.4 13.4 15.4 17.4

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3700	3835	3957	4054	4014	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1661	1796	1918	2015	1975	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.76	1.90	2.03	2.13	2.09	
Dry Density, g/cm <sup>3</sup> $D_d/(1 + w/100)$	1.64	1.74	1.82	1.84	1.81	
Dry Density, pcf (62.4 x g/cm <sup>3</sup> )	102.1	108.3	113.6	117.0	128.2	

Liquid Limit = 24.00Plastic Limit = 17.75Plastic Index = 6.25Soil Class. = CL-ML

Optimum Moisture = 13.5 %  
 Maximum Dry Density = 118.8 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 6902)

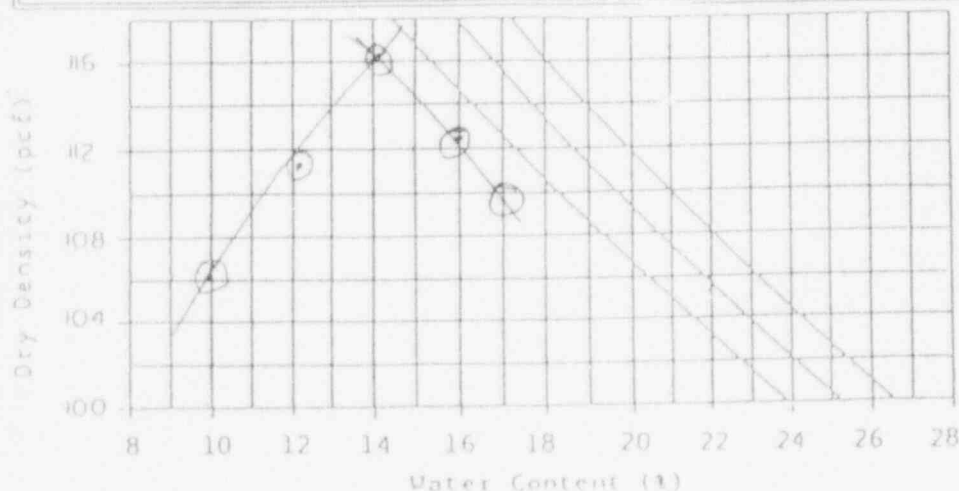
Client: Rio Algom Mining Corp. Project No.: C01-06  
 Site Location: No. 2 Evap. Pond Date: 5-26-93  
 Soil Description: Silt Tested by: A  
 Sample Location: 93-11-12 A. 4 H/C

Water Content Determination 50 100 150 200 250 ✓

Trial Number	1	2	3	4	5	6
Cup Number	5	12	1	4	2	2
Tare Weight, g ( $W_c$ )	33.36	33.39	33.22	33.54	33.36	33.35
Tare + Wet Soil, g ( $W_1$ )	290.24	292.59	255.87	251.82	288.59	239.64
Tare + Dry Soil, g ( $W_2$ )	267.18	264.57	228.36	221.82	251.56	222.03
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	233.82	231.18	195.14	188.31	218.20	188.68
Wt of Water, g ( $w = W_1 - W_2$ )	23.06	28.02	27.51	30.00	37.01	17.61
Water Content, ( $wL = w/W_d$ )	9.9	12.1	14.1	15.9	17.0	9.3

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3800	3930	4041	4016	3979	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1761	1891	2002	1977	1940	
Volume of mold, $cm^3$ ( $V$ )	944					
Wet Density, $g/cm^3$ $D_w = W_w/V$	1.87	2.00	2.12	2.09	2.06	
Dry Density, $g/cm^3$ $D_d/(1 + wL/100)$	1.70	1.78	1.86	1.80	1.76	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	106.1	111.1	116.1	112.3	109.8	

Liquid Limit = 26.00Plastic Limit = 17.38Plastic Index = 8.62Soil Class. = CLOptimum Moisture = 14.1 %Maximum Dry Density = 116.1 pcf

Earthfax



Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: Silt  
 Sample Location: 93-11-11

Project No.: C01-06  
 Date: 5-26-93  
 Tested by: Axtell  
Pit # 11

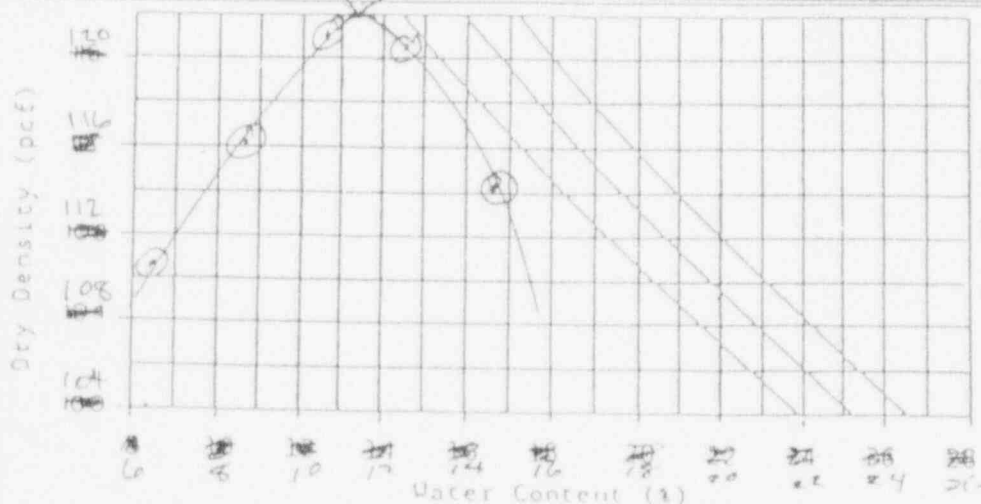
Water Content Determination 90 140 190 240 290 ✓

Trial Number	1	2	3	4	5	6
Cup Number	14	6	9	8	11	5
Tare Weight, g ( $W_c$ )	32.69	33.84	33.85	33.09	32.81	33.40
Tare + Wet Soil, g ( $W_1$ )	283.71	251.05	256.51	262.83	296.86	285.15
Tare + Dry Soil, g ( $W_2$ )	264.66	233.94	235.44	237.23	263.89	272.67
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	235.97	200.08	201.59	204.14	230.48	239.27
Wt of Water, g ( $w = W_1 - W_2$ )	15.15	17.11	21.07	25.60	33.57	12.48
Water Content, (%) ( $w = w/W_d$ )	6.4	8.6	10.5	12.5	14.6	5.2

8.8 10.8 12.8 14.4 16.8

### Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3813	3944	4062	4092	4024	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1774	1905	2023	2053	1985	
Volume of mold, $cm^3$ ( $V$ )	944					
Wet Density, $g/cm^3$ ( $D_w = W_w/V$ )	1.88	2.02	2.14	2.17	2.10	
Dry Density, $g/cm^3$ $D_d/(1 + w/100)$	1.77	1.86	1.94	1.93	1.83	
Dry Density, pcf ( $62.4 \times g/cm^3$ )	110.4	116.1	121.1	120.4	114.2	



Liquid Limit = 18.83  
 Plastic Limit = 16.92  
 Plastic Index = 1.91  
 Soil Class. = ML

Optimum Moisture = 11.4 %  
 Maximum Dry Density = 122.0 pcf





## STANDARD PROCTOR COMPACTION TEST (ASTM D 1557)

Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: Silt  
 Sample Location: 93-11-15

Project No.: C01-06  
 Date: 9-26-93  
 Tested by: Axtell  
P.T. #11

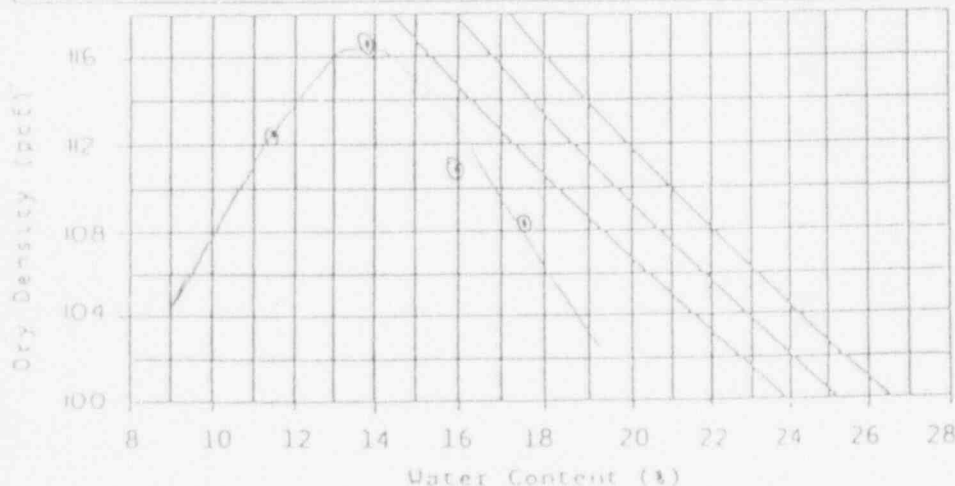
Water Content Determination 40 90 140 190 240 ✓

Trial Number	1	2	3	4	5	6
Cup Number	14	12	9	8	1	11
Tare Weight, g ( $W_c$ )	32.66	33.39	33.86	33.08	33.22	32.80
Tare + Wet Soil, g ( $W_1$ )	283.64	226.45	323.80	299.14	✓	269.40
Tare + Dry Soil, g ( $W_2$ )	257.92	202.99	283.89	259.27	0	257.24
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	225.26	169.6	250.03	226.19	U	224.44
Wt of Water, g ( $w = W_1 - W_2$ )	25.72	23.46	39.91	39.97	21	12.16
Water Content, (%) ( $w = w/W_d$ )	11.4	13.9	16.0	17.6	✓	5.4

7.0 9.0 11.0 13.0 15.0

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039				✓	
Mold + Wet Soil, g ( $W_3$ )	3922	4040	3987	3966	6	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1883	2001	1948	1927		
Volume of mold, cm <sup>3</sup> (V)	944				C	
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.99	2.12	2.04	2.04	2	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + w/100)$ )	1.79	1.86	1.78	1.73	9	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	111.5	116.3	110.8	108.2	4	



Liquid Limit = 23.50

Plastic Limit = 18.34

Plastic Index = 5.16

Soil Class. = CLML

Optimum Moisture = 13.3 %  
 Maximum Dry Density = 116.3 pcf



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# STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description:   
 Sample Location: 14

Project No.: C01-06  
 Date:   
 Tested by:

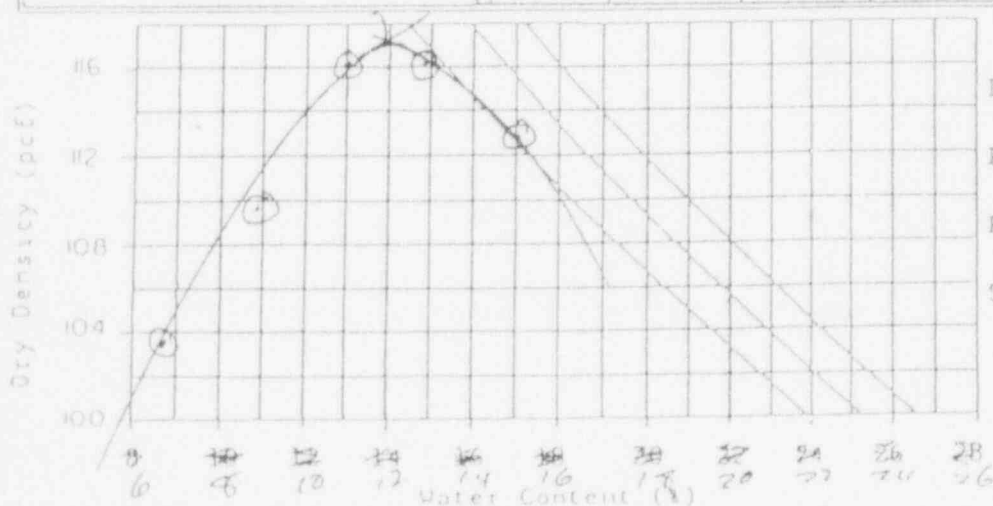
Water Content Determination 100 150 200 250 300

Trial Number	1	2	3	4	5	6
Cup Number	11	1	4	12	8	14
Tare Weight, g ( $W_c$ )	32.85	33.22	33.50	33.37	33.09	32.68
Tare + Wet Soil, g ( $W_1$ )	251.76	205.63	240.83	337.60	260.81	260.04
Tare + Dry Soil, g ( $W_2$ )	238.03	191.70	220.24	302.91	231.16	254.80
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	205.18	158.48	186.76	269.54	198.07	222.12
Wt of Water, g ( $w = W_1 - W_2$ )	13.73	13.93	54.07	34.69	29.65	11.54
Water Content, (%) ( $wI = w/W_d$ )	6.7	8.8	11.0	12.9	15.0	5.2

9.2 11.2 13.2 15.2 17.2

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3712	3848	3988	4022	4001	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1673	1809	1949	1983	1962	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.77	1.92	2.06	2.10	2.08	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + wI/100)$ )	1.66	1.76	1.86	1.86	1.81	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	103.6	109.8	116.1	116.1	112.9	



Liquid Limit = 25.2

Plastic Limit = 13.0

Plastic Index = 12.2

Soil Class = CL

Optimum Moisture = 12.0 %  
 Maximum Dry Density = 117.0 pcf



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## STANDARD PROCTOR COMPACTION TEST (ASTM D 698)

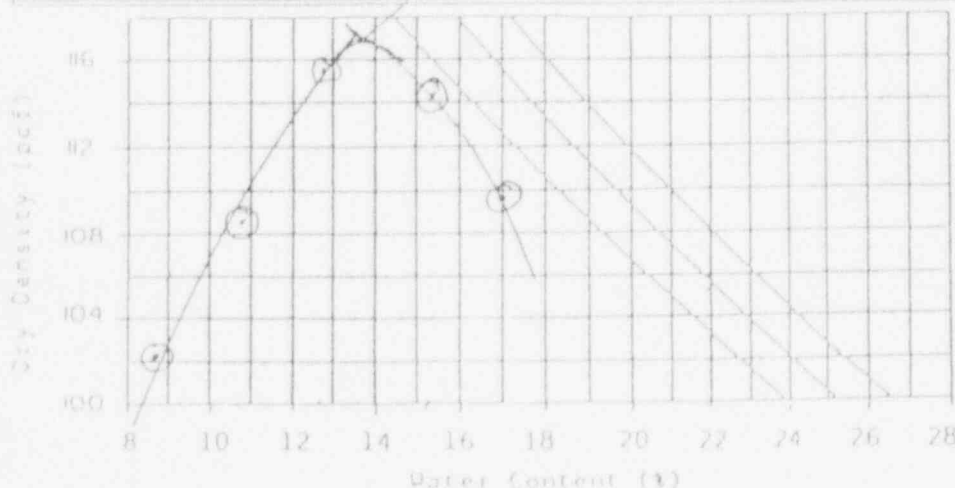
Client: Rio Algom Mining Corp.  
 Site Location: No. 2 Evap. Pond  
 Soil Description: 3-6  
 Sample Location: 42-11-13

Project No.: C01-06  
 Date: 5-26-97  
 Tested by: P. H. H.

Water Content Determination	0	50	100	150	200	
Trial Number	1	2	3	4	5	6
Cup Number	9	6	2	5	14	12
Tare Weight, g ( $W_c$ )	33.85	33.86	33.38	33.36	32.68	33.38
Tare + Wet Soil, g ( $W_1$ )	269.79	277.13	311.16	282.23	284.42	212.70
Tare + Dry Soil, g ( $W_2$ )	251.04	253.62	280.03	249.45	247.80	197.93
Wt Dry Soil, g ( $W_d = W_2 - W_c$ )	217.19	219.76	246.65	216.09	215.12	164.55
Wt of Water, g ( $w = W_1 - W_2$ )	18.75	23.51	31.13	32.78	36.62	14.77
Water Content, (%) ( $wL = w/W_d$ )	8.6	10.7	12.6	15.2	17.0	9.0

## Density Determination

Trial Number	1	2	3	4	5	6
Weight of Mold, g ( $W_p$ )	2039					
Mold + Wet Soil, g ( $W_3$ )	3721	3863	3998	4037	3987	
Wt Wet Soil, g ( $W_w = W_3 - W_p$ )	1682	1824	1957	1998	1948	
Volume of mold, cm <sup>3</sup> ( $V$ )	944					
Wet Density, g/cm <sup>3</sup> ( $D_w = W_w/V$ )	1.78	1.93	2.08	2.12	2.06	
Dry Density, g/cm <sup>3</sup> ( $D_d = D_w / (1 + wL/100)$ )	1.64	1.74	1.85	1.84	1.76	
Dry Density, pcf ( $62.4 \times \text{g/cm}^3$ )	102.3	108.6	115.4	114.8	109.8	



Liquid Limit = 23.07  
 Plastic Limit = 14.32  
 Plastic Index = 8.68  
 Soil Class = CL

Optimum Moisture = 13.6 %  
 Maximum Dry Density = 116.8 pcf



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