# BOULDER CREEK EAST PIT EXPANSION

## Aggregate Resource Assessment Technical Summary Provincial Pit Number # 2210

Ministry of Transportation and Infrastructure
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MCSL File: 2331-20126-00 Task 2013

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# 1 INTRODUCTION

McElhanney Consulting Services Ltd. (MCSL) is pleased to submit this technical summary report detailing the aggregate resource assessment conducted at Boulder Creek East Pit for Ministry of Transportation and Infrastructure (MoTI). The purpose of the assessment was to conduct a test pit program in the existing mined pit and in areas of potential interest within the gravel reserve boundary to determine the potential aggregate resource volume, quality and suitability. This report compiles data from the current field assessment conducted in November 2016 with data previously collected by McElhanney in 2013 (McElhanney Project No. 2331-20100-00 Task 2004).

# 2 LOCATION AND LEGAL LAND DESCRIPTION

**Pit Name:** Boulder Creek East

**Provincial Pit Number:** # 2210

**Location:** The portion of Boulder Creek East Pit assessed was on the north side of Highway 16, approximately 36 km north of Smithers, BC (Figure 1).

**Legal Land Description:** The site is currently a Section 16 Map Reserve (LF#0354452) held by the British Columbia Ministry of Transportation and Infrastructure. The legal description of the Map Reserve is "that part of District Lot 1230, Cassiar District, containing 16.2 hectares, more or less". The layout of the Map Reserve boundary is shown in the Pit Plan (Figure 2).

# 3 2013 ASSESSMENT

A test pitting program was conducted by MCSL on February 12, 2013, primarily within the existing pit area of the Boulder Creek East Pit. The site was snow covered (approximately 0.6 m deep) at the time of the assessment. Nine test pits were excavated in the existing mined pit area to depths ranging from 4.0 m to 6.0 m depth with an Hitachi EX200LC. The test pits were logged and sampled by MCSL.

The methods, data, laboratory results, and recommendations from the 2013 assessment can be reviewed in McElhanney's *Boulder East Pit – Aggregate Resource Assessment, Technical Summary, Provincial Pit 2210* dated February 18, 2013 (McElhanney Project No. 2331-20100-00 Task 2003).

# 4 2016 ASSESSMENT

A test pitting program was conducted by MCSL on November 16 and 17, 2016, primarily covering the undeveloped portion within the reserve boundary. A total of nineteen (19) test pits were excavated within the MoTI reserve boundary at the locations shown on Figure 2 to depths ranging from 2.5 m to 5.0 m depth using an Hitachi 200 series tracked excavator. The test pits were logged and sampled by MCSL. A Test Pit Summary Log is included in Appendix A. Soils were described according to the MoTI Unified Soil Classification (USC) Legend attached in Appendix A.

Samples of granular soils were taken during advancement of the test pits in 2016 and a list of the samples collected were sent to MoTI for review and samples were selected for further laboratory testing based on discussions between MoTI and MCSL. The following laboratory tests were performed:

- Wash Sieve Analysis (ASTM C136 and C117) on 9 samples
- Sand Equivalent Value (ASTM D2419) on 3 samples
- Micro Deval on Coarse Aggregates (ASTM D6928-03) on 3 samples
- Relative Density and Absorption of Coarse and Fine Aggregate (ASTM C127 and C128) on 3 samples

Laboratory results for the individual samples tested are summarized in the Tables in the following sections and the appended Test Pit Summary Logs. Detailed laboratory reports can be provided upon request. Note that sieve analyses were conducted on material passing the 75 mm screen only. The percentage and size of oversize material was visually estimated in the field and are listed in the Test Pit Summary Log.

Test Pit locations and prominent features such as natural embankments, slope breaks, depressions and/or draws, roads and other manmade features were mapped using a Global Positioning System (GPS) unit (Model Trimble GeoXH). The GPS data was differentially post-processed by MCSL. A list of the processed test pit UTM coordinates, NAD 83 datum, is provided on the Pit Plan (Figure 2). Figure 2 also shows the test pit locations and prominent features.

Photographs were taken at each test pit location. Select photographs are shown in the attached Photo Sheets 1 and 2.

For the purpose of this project, granular material was defined as any soil with less than 15% fines (particles with a diameter < 0.075 mm) by mass. If granular material was encountered, the test pit was advanced to the full reach of the excavator unless significant sloughing prevented advancement of the test pit.

# 5 MATERIAL GRADATIONS

Based on the results of the test pit assessments in both 2013 and 2016, four (4) areas (Areas A, B, C, and D) have been defined within the existing MoTI reserve boundary and are shown on the Pit Development Plan (Figure 3). Other portions of the reserve where test pits were excavated but areas are not delineated on Figure 3, were not considered suitable for aggregate development.

Areas A, B, C, and D were defined based on the gradations and the thickness of overburden. Areas defined varied significantly in the quantity of oversize materials and the percentage of fines. Area C appears to be the optimum area for mining and producing aggregate products.

Table 1 shows the gradation test results for Areas A, B, C, and D as a percentage by mass of the fines, sand and gravel components. The MoTI soil classification for each of the laboratory tested samples from Areas A through D are also listed.

***Table 1. Laboratory Gradations for Areas A, B, C, and D***

| Test Pit | Depth (m) | | Fines* (%) | Sand* (%) | Gravel (%) | | MoTI Soil Classification |
|---|---|---|---|---|---|---|---|
| | From | To | | | Fine* (4.75-25mm) | Coarse* (25-75mm) | |
| **Area A** | | | | | | | |
| TP13-03 (Sa 3) | 0.05 | 5.2 | 1.8 | 39.2 | 31.6 | 27.4 | GP |
| TP13-06 (Sa 6) | 0.05 | 6.0 | 1.4 | 40.5 | 22.8 | 35.3 | GP |
| TP13-07 (Sa 7) | 0.05 | 6.0 | 3.4 | 34.5 | 26.4 | 35.7 | GP |
| TP13-09 (Sa 9) | 0.0 | 6.0 | 1.2 | 32.4 | 30.2 | 36.2 | GW |
| ***Average of Area A*** | | | ***2.0*** | ***36.7*** | ***27.8*** | ***33.7*** | **-** |
| **Area B** | | | | | | | |
| TP13-01 (Sa 1) | 1.4 | 3.8 | 4.7 | 33.9 | 25.7 | 35.7 | GW |
| **Area C** | | | | | | | |
| TP16-03 (Sa 4) | 1.0 | 5.0 | 2.9 | 35.5 | 29.8 | 31.8 | GP |
| TP16-04 (Sa 5) | 1.5 | 5.0 | 2.2 | 33.3 | 31.3 | 33.2 | GW |
| TP16-05 (Sa 6) | 1.0 | 4.5 | 3.3 | 32.7 | 29.8 | 34.2 | GW |
| TP16-06 (Sa 7) | 1.0 | 4.5 | 2.6 | 39.5 | 32.2 | 25.7 | GW |
| TP16-07 (Sa 9) | 1.5 | 4.5 | 2.9 | 31.5 | 32.6 | 33.0 | GP |
| TP16-10 (Sa 14) | 1.0 | 4.5 | 2.0 | 31.9 | 28.9 | 37.2 | GW |

| Test Pit | Depth (m) | | Fines* (%) | Sand* (%) | Gravel (%) | | MoTI Soil Classification |
|---|---|---|---|---|---|---|---|
| | From | To | | | Fine* (4.75-25mm) | Coarse* (25-75mm) | |
| TP16-12 (Sa 16) | 1.0 | 5.0 | 5.0 | 43.1 | 27.3 | 24.6 | GP-GM |
| TP16-13 (Sa 17) | 1.2 | 5.0 | 2.8 | 40.3 | 22.6 | 34.3 | GP |
| ***Average of Area C*** | | | ***3.0*** | ***36.0*** | ***29.3*** | ***31.8*** | **-** |
| **Area D** | | | | | | | |
| TP16-19 (Sa 24) | 1.5 | 4.0 | 5.7 | 65.5 | 19.8 | 9.0 | SP-SM |

* Values are rounded to the nearest decimal number so may not add exactly to 100%.
** Minus values indicate the test pit was completed at a pit face. Positive values are the pit face, and negative values are below the toe of slope. Zero value is the toe of slope.

A summary of the gradations corrected to include the estimated oversize are provided in Table 2.

***Table 2. Summary of Gradations Including Oversize Material for Areas A through D***

| Test Pit | Fines* (%) | Sand* (%) | Gravel* (%) | | Small Boulders (75 to 300 mm) | Large Boulders (>300 mm) | MoTI Soil Classification |
|---|---|---|---|---|---|---|---|
| | | | Fine (4.75-25mm) | Coarse (25-75mm) | | | |
| **Area A** | | | | | | | |
| TP13-03 (Sa 3) | 1.7 | 38.0 | 30.7 | 26.6 | 3 | 0 | GP |
| TP13-06 (Sa 6) | 0.8 | 22.3 | 12.5 | 19.4 | 45 | 0 | GW |
| TP13-07 (Sa 7) | 1.4 | 13.8 | 10.6 | 14.3 | 50 | 10 | GP |
| TP13-09 (Sa 9) | 0.7 | 19.4 | 18.1 | 21.7 | 40 | 0 | GW |
| ***Average Area A*** | ***1.1*** | ***23.4*** | ***18.0*** | ***20.5*** | ***34.5*** | ***2.5*** | |
| **Area B** | | | | | | | |
| TP13-01 (Sa 1) | 3.2 | 23.1 | 17.5 | 24.3 | 32 | 0 | GP |
| **Area C** | | | | | | | |
| TP16-03 (Sa 4) | 2.6 | 31.6 | 26.5 | 28.3 | 11 | 0 | GP |
| TP16-04 (Sa 5) | 1.8 | 27.6 | 26.0 | 27.6 | 17 | 0 | GW |
| TP16-05 (Sa 6) | 2.6 | 25.3 | 23.1 | 26.5 | 20 | 3 | GW |
| TP16-06 (Sa 7) | 2.2 | 33.6 | 27.4 | 21.8 | 10 | 5 | GP |
| TP16-07 (Sa 9) | 2.5 | 27.1 | 28.0 | 28.4 | 13 | 1 | GW |
| TP16-10 | 1.3 | 20.7 | 18.8 | 24.2 | 32 | 3 | GW |

| Test Pit | Fines* (%) | Sand* (%) | Gravel* (%) | | Small Boulders (75 to 300 mm) | Large Boulders (>300 mm) | MoTI Soil Classification |
|---|---|---|---|---|---|---|---|
| | | | Fine (4.75-25mm) | Coarse (25-75mm) | | | |
| (Sa 14) | | | | | | | |
| TP16-12 (Sa 16) | 4.2 | 35.8 | 22.7 | 20.4 | 15 | 2 | GP |
| TP16-13 (Sa 17) | 2.2 | 32.2 | 18.1 | 27.4 | 20 | 5 | GP |
| ***Average Area C*** | ***2.4*** | ***29.2*** | ***23.8*** | ***25.6*** | ***17*** | ***2*** | **-** |
| **Area D** | | | | | | | |
| TP16-19 (Sa 24) | 5.4 | 62.2 | 18.8 | 8.6 | 5 | 0 | SP-SM |

* Values are rounded to the nearest decimal so may not add exactly to 100%.

# 6 MATERIAL DURABILITY

Table 3 shows the results of the durability tests as well as the specifications as required in the MoTI 2016 Standard Specifications for Highway Construction. Durability testing was completed on samples from Areas A, B, and C only.

***Table 3. Durability Test Results for Areas A, B, and C***

| Test Pit | Durability Test | | | |
|---|---|---|---|---|
| | Micro-Deval (Coarse) | Sand Equivalent | Absorption (Coarse/Fine) | Bulk Relative Density (Coarse/Fine) |
| **Area A** | | | | |
| TP13-06, Sa 6 | - | - | 1.5% / 1.9% | 2.61 / 2.60 |
| TP13-07, Sa 7 | 9% | 41 | - | - |
| TP13-09, Sa 9 | - | - | 1.9% / 2.6% | 2.55 / 2.58 |
| **Area B** | | | | |
| TP13-01, Sa 1 | 15% | 42 | - | - |
| **Area C** | | | | |
| TP16-03, Sa 3 | 12% | 63 | - | - |
| TP16-04, Sa 5 | - | - | 1.8% / 4.4% | 2.57 / 2.38 |
| TP16-06, Sa 7 | 9% | 76 | - | - |
| TP16-10, Sa 14 | - | - | 2.1% / 4.2% | 2.57 / 2.39 |
| TP16-12, Sa 16 | 11% | 44 | - | - |
| TP16-13, Sa 17 | - | - | 2.2% / 4.1% | 2.54 / 2.41 |
| **BC MoT Specifications[1]** | | | | |
| Micro Deval | ≤30% for select granular subbase (coarse) and bridge end fill aggregates<br>≤25% for surfacing and base course aggregates<br>≤20% for Class 2 pavement asphalt mix aggregates<br>≤18% for Class 1 pavement asphalt mix aggregates | | | |
| Sand Equivalent | ≥20 for subbase, bridge end fill and surfacing aggregates<br>≥40 for fine asphalt mix and base course aggregates | | | |
| Absorption | ≤ 2% for coarse paving aggregates<br>≤ 1% for coarse aggregates in graded aggregate seal products<br>≤ 1.5% for fine aggregates in graded aggregate seal products | | | |
| Relative Density | ~2.65 for all aggregate products | | | |

Micro-Deval and Sand Equivalent tests in Areas A, B, and C met specifications for **all** aggregates listed above.

The absorption for coarse aggregates in Areas A and C were at or marginally above the maximum requirement of 2% (on average) for coarse paving aggregates; however, absorption values did **not** meet the maximum specification of 1% for coarse graded aggregate seal. The fine aggregate absorption for samples in all areas did not pass the absorption specification of ≤ 1.5% for fine aggregates in graded aggregate seal products.

The specific gravity of the coarse aggregates was between 2.54 and 2.61.

[1] Ministry of Transportation, 2012 Standard Specifications for Highway Construction, Adopted November 1, 2011

# 7 MATERIAL SUITABILITY

Based on the assessment results, the material in Areas A, B, C, and D is likely to be suitable for the following purposes (Table 4):

***Table 4. Material Suitability***

| Area | Pit Run | Crush | Comments |
|---|---|---|---|
| Area A | Bridge End Fill (BEF) Select Granular Subbase (SGSB) | Base Course and Asphalt Paving Products | Screening of oversize required for pit run products |
| Area B | Bridge End Fill (BEF) Select Granular Subbase (SGSB) | Base Course and Asphalt Paving Products | Screening of oversize required for pit run products |
| Area C | Bridge End Fill (BEF) Select Granular Subbase (SGSB) | Base Course and Asphalt Paving Products | Screening of oversize required for pit run products |
| Area D | None | None | May be used as blending source of higher fines or sand if required for other areas |

The durability measured indicates the resource is generally suitable for production of SGSB, surfacing and base course aggregates, bridge end fills, and Class 1 and 2 pavement aggregates. Due to the absorption values of fine and coarse aggregates not meeting specifications, the source is not considered suitable for fine or course graded aggregate seal products. Material was marginally acceptable for coarse graded aggregate seal.

The proportion of oversize material varied between the different areas (typically ranged between 6% to 45% in the 2016 test pit program). Including this material in the crushing process may improve the durability of the crushed products.

# 8 VOLUME ESTIMATES

The volume estimates are provided in Table 5 and are based on the measured depths encountered during the subsurface test pit assessment. The potential volumes of granular material were calculated by averaging the total thickness of granular materials encountered. All of the test pits in Areas A through D were terminated in gravel; therefore, the volume of available gravel could potentially be higher than calculated. However, the water table was encountered in Area A in TP 13-02, 03, 05, and 08 at approximately 4.2 to 5.7 m depth and in Area C at TP16-17 at 2.2 m depth. A working surface of 0.5 m above the water table was considered when calculating the potential aggregate volumes in Area A and C. Note that

the water table could vary considerably during the year and therefore considerably less volume of aggregate may be available if water table levels were to rise (for example, during spring freshet) – additional assessment would be required to monitor seasonal water table variation at this site.

Note the height of the existing pit faces, and the topography suggests that a significantly more volume of aggregates may be available below the depth of the test pits and further deeper site assessment (drilling) would be required to confirm additional volumes.

***Table 5. Volume Estimates***

| Area | Surface Area ($m^2$) | Thickness/ Volume | Topsoil | Overburden | Gravel |
|---|---|---|---|---|---|
| Area A | 13,800 | Average Layer Thickness (m) | 0.04 | 0.0 | 5.2 |
| | | **Volume ($m^3$)** | **600** | **0** | **71,800** |
| Area B | 4,750 | Average Layer Thickness (m) | 0.2 | 0.6 | 4.2 |
| | | **Volume ($m^3$)** | **1000** | **2,900** | **20,000** |
| Area C | 66,140 | Average Layer Thickness (m) | 0.3 | 0.1 | 4.1 |
| | | **Volume ($m^3$)** | **19,800** | **6,600** | **271,200** |
| Area D | 2,900 | Average Layer Thickness (m) | 0.2 | 0 | 4.9 |
| | | **Volume ($m^3$)** | **600** | **0** | **14,2000** |

Note: Volumes rounded to the nearest hundred.

# 9 PIT DEVELOPMENT NOTES

- All pit development must be carried out in accordance with the Health, Safety, and reclamation Code for Mines in British Columbia, BC Ministry of Energy and Mines (2017), the Standard Specifications for Highway Construction, BC Ministry of Transportation and Infrastructure (2016, or later edition) and the Aggregate Operators Best Management Practices Handbook for BC.
- The pit is currently accessed from Highway 16 and the access is considered suitable.
- The average thickness of the topsoil and overburden varied and will require stripping and placing in the desginated stockpile areas. Areas were delineated on the pit development plan. Topsoil should be stockpiled separately from mineral soil overburden.
- All trees, vegetation and overburden are to be removed within 2 m of the top of the pit face. Logging, clearing and grubbing will be required to mine most of Area C and part of Area D.
- Topsoil, overburden and aggregate cannot be removed within 5 m of the reserve boundary.
- Development of Area C can commence from the existing pit faces of the gravel reserve. Begin mining Area C using the existing pit floor for crushing and stockpiling aggregates, relocating as required throughout development in each direction.

- Areas A and B will be most efficiently mined to their maximum extents following at least partial development of Area C. Once the working pit faces were extended to the north and west into Area C, the expanded pit floor can be used for crushing and stockpiling aggregates from Areas A and B.
- Area D can be mined if a higher-fines source (5-10%) or sand is required for blending, with new pit faces starting from the west and working to the east.
- The contractor must ensure that all materials passing through 375 mm x 450 mm slotted openings shall be used in the production of the crushed aggregates.
- No dumping of debris or petroleum products will be permitted and the site must be left in a clean and safe condition.
- At the completion of the pit development overations, but prior to the depletion of the pit, the sides of the pit faces, waste piles and overburden stockpiles must be trimmed to a 1.5H :1V slope. Active pit faces must be reshaped with native granular materials.
- Upon depletion of the pit, all disturbed areas must be reclaimed. The minimum reclamation procedure should include re-sloping of the pit-faces and waste piles to a 2H:1V slope, contouring the area for appropriate drainage, spreading of the overburden followed by topsoil and seeding.

# 10 CLOSURE

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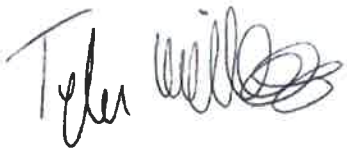
Respectfully submitted,

**McElhanney Consulting Services Ltd.**

Reviewed By:



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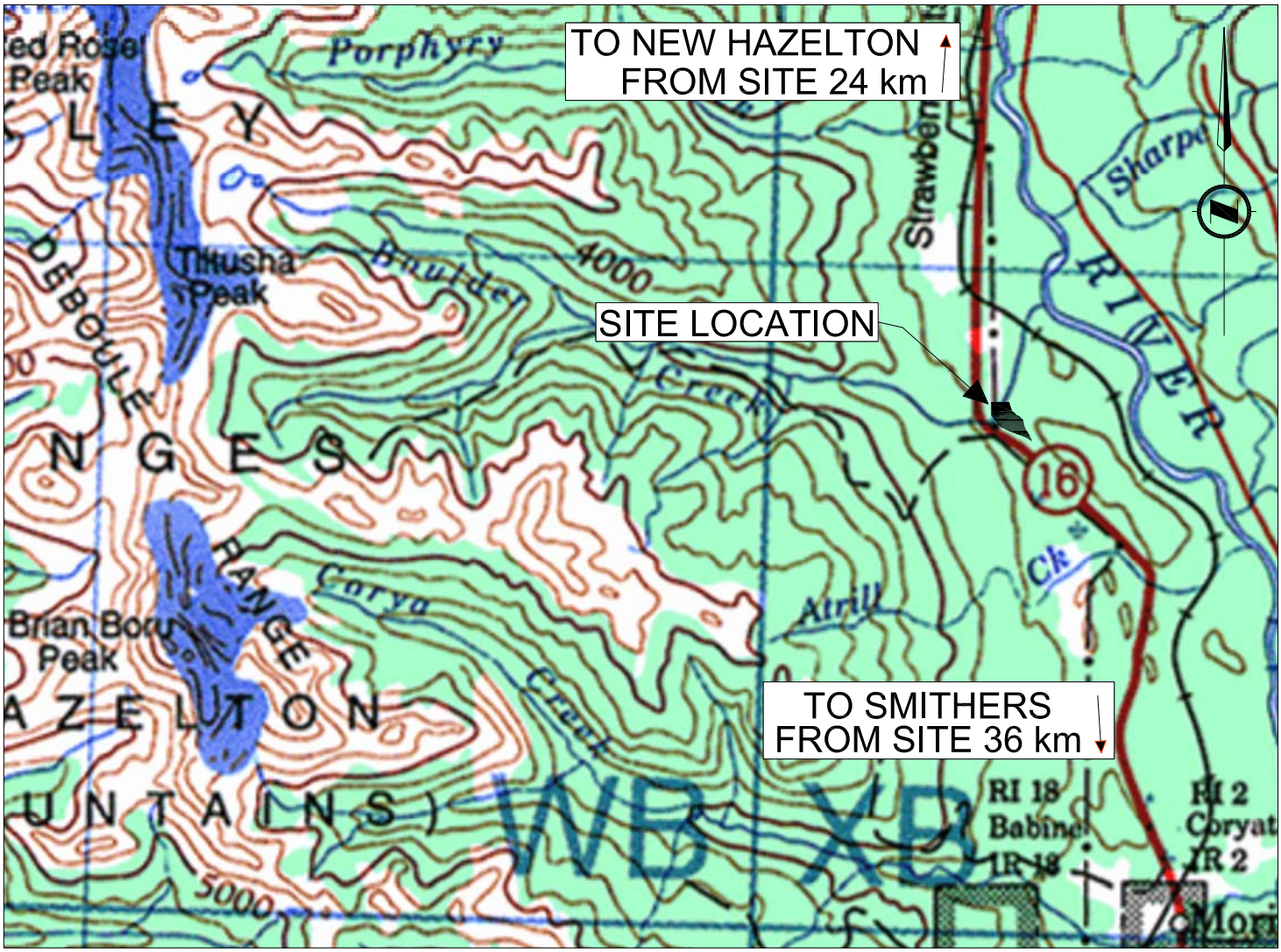
# DRAWINGS

Figure 1: Location Plan

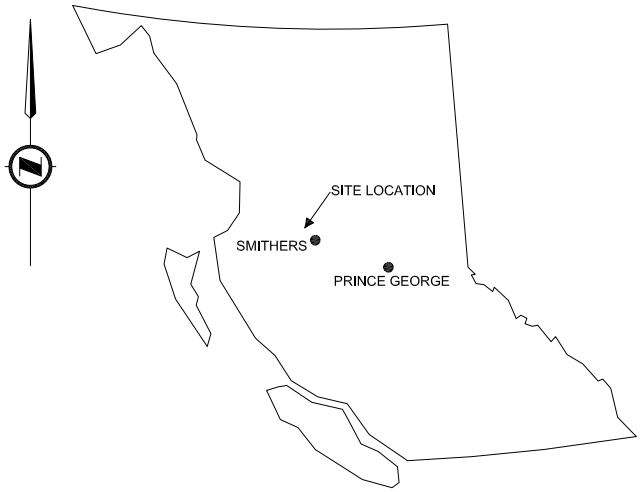
Figure 2: Pit Plan

Figure 3: Pit Development Plan




LOCATION PLAN: NTS MAPSHEET 93M014
SCALE: 1:100000

GOOGLE EARTH IMAGE:
SCALE: 1:20000, DATED 2013.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| | |
|---|---|
| Date: | JAN 2017 |
| Checked: | ED |
| Surveyed: | – |
| Designed: | – |
| Drawn: | AJK |

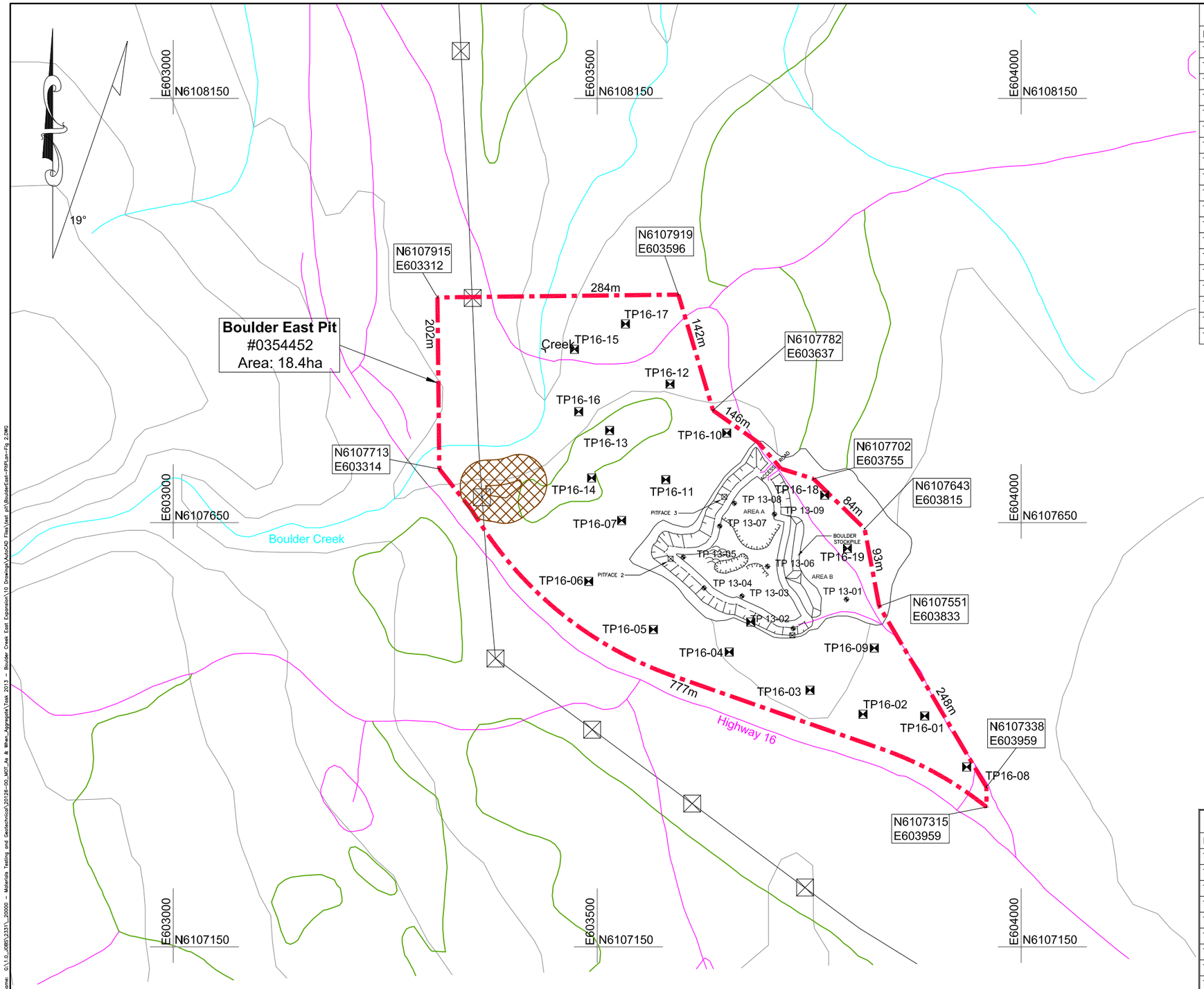
BULKLEY STIKINE DISTRICT

FIGURE 1
BOULDER EAST PIT
LOCATION PLAN

Client Project No.
Client Drawing No.
MCSL Project No. 2331–20126–13
Drawing No. FIG 1
Sheet 1 of 3
Revision –

Plotted Full Size on 8.5 x 11 Sheet

Destroy all prints bearing previous number




| TEST PITS 2016 | | |
|---|---|---|
| DESC | NORTHING | EASTING |
| TP16-01 | 6107422 | 603886 |
| TP16-02 | 6107424 | 603813 |
| TP16-03 | 6107453 | 603751 |
| TP16-04 | 6107497 | 603656 |
| TP16-05 | 6107524 | 603566 |
| TP16-06 | 6107581 | 603490 |
| TP16-07 | 6107653 | 603529 |
| TP16-08 | 6107362 | 603936 |
| TP16-09 | 6107502 | 603827 |
| TP16-10 | 6107756 | 603653 |
| TP16-11 | 6107701 | 603581 |
| TP16-12 | 6107813 | 603586 |
| TP16-13 | 6107759 | 603515 |
| TP16-14 | 6107703 | 603493 |
| TP16-15 | 6107854 | 603473 |
| TP16-16 | 6107781 | 603478 |
| TP16-17 | 6107884 | 603533 |
| TP16-18 | 6107682 | 603768 |
| TP16-19 | 6107620 | 603795 |

## PIT LEGEND

- NATURAL EMBANKMENT
- PIT FACE
- SYMB TEST PIT
- TEST HOLE
- PAVED ROAD
- GRAVEL ROAD
- TRAIL
- TREELINE
- DISTRICT LOT LINE
- SYMB Mon. MONUMENT
- SYMB IRON PIN
- SYMB POWER POLE
- OVERBURDEN STOCKPILE
- DEVELOPMENT DIRECTION
- FUTURE AGGREGATE POTENTIAL
- WELL
- STAND PIPE PIEZOMETER OR WELL
- SWAMP
- CREEK
- BUILDING (symbolic)
- FENCE
- SYMB SIGN POST
- SYMB UTILITY POLE
- GRAVEL RESERVE BOUNDARY
- 800m Contour Line (100m interval)
- Contour Line (20m interval)
- PITFACE OBSERVATIONS
- SYMB GPS COORDINATE (UTM NAD 83)
- CS CRUSHER SETUP
- STOCKPILE
- UNEVEN TERRAIN
- AOA (NO DISTURBANCE ZONE)
- PROPOSED NEW AGGREGATE SOURCE

**T.R.I.M. NOTES:**

1. 20m CONTOUR INTERVALS
2. BASE MAPDERIVED FROM T.R.I.M. DIGITAL MAP DATA:
   –MAP NO: 93M014
   –DATUM: NAD 83, UTM ZONE 09

**LEGAL NOTE**

1. DISTRICT LOT LINES ARE DERIVED FROM DIGITAL CROWN CADASTRAL REFERENCE MAPPING SUPPLIED BY CROWN LAND REGISTRY, VICTORIA

**DRAWING NOTE:**

1. SOME TESTPITS AND/OR TESTHOLES MAY NOT BE REPRESERNTATIVE OF CURRENT CONDITIONS DUE TO DEVELOPMENT AND EXCAVATING DONE AFTER TESTING WAS CONDUCTED.

**DATA NOTES:**

1. TEST PITS SURVEYED WITH A SINGLE FREQUENCY TRIMBLE GEOXH AND POST PROCESSED. PRECISION IS A FUNCTION OF SATELLITES DISTRIBUTION AND DISTANCE TO THE POST PROCESSING BASE.
2. PLAN FEATURES PARTLY SURVEYED WITH TRIMBLE GEOXH GPS AND ALSO TAKEN FROM AVAILABLE DIGITAL MAPS.

| TEST PITS 2013 | | |
|---|---|---|
| DESC | NORTHING | EASTING |
| TP13-01 | 6107559 | 603794 |
| TP13-02 | 6107525 | 603731 |
| TP13-03 | 6107563 | 603671 |
| TP13-04 | 6107575 | 603628 |
| TP13-05 | 6107609 | 603602 |
| TP13-06 | 6107598 | 603701 |
| TP13-07 | 6107646 | 603645 |
| TP13-08 | 6107673 | 603662 |
| TP13-09 | 6107660 | 603709 |

SCALE: 0m 25 50 75 100 — 1 : 5000

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| Rev | Date | REVISIONS | Signature |
|---|---|---|---|
| | | | |

NEGATIVE NO. _____
CAD FILE NO. _____

BRITISH COLUMBIA
Ministry of Transportation and Infrastructure
Geotechnical & Materials Engineering

SENIOR DESIGNER _____ DATE _____

DESIGNED ED DATE JAN 2017
QUALITY CONTROL - DATE -
DRAWN AJK DATE JAN 2017

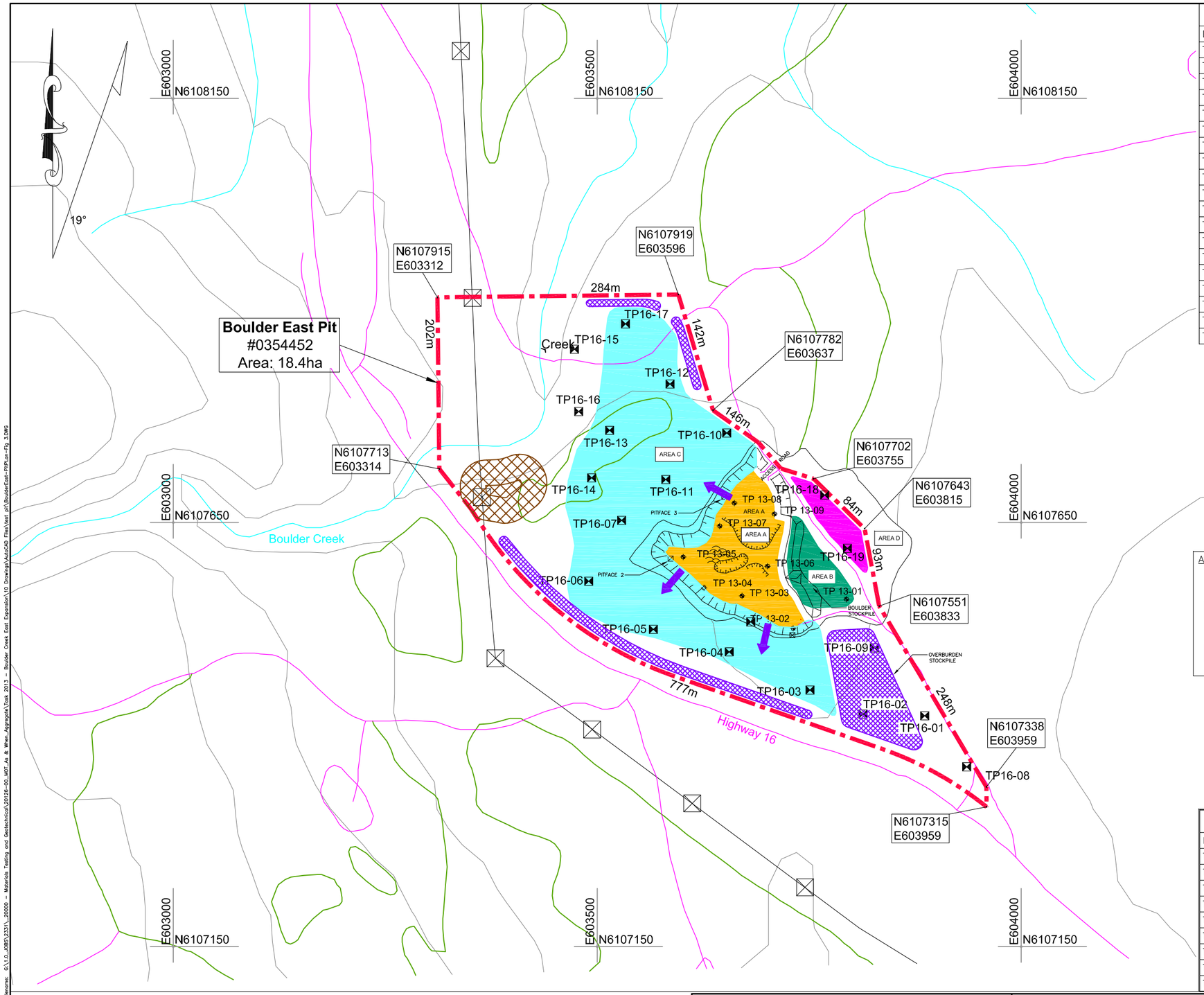
BULKLEY STIKINE HIGHWAY DISTRICT
BOULDER EAST PIT
FIGURE 2
PIT PLAN

| FILE No. | PROJECT No. | REG. | DRAWING No. |
|---|---|---|---|
| TASK 2013 | 2331-20126-0 | | 20126-2-013 - |

CANCEL PRINTS BEARING PREVIOUS LETTER

H-3308

Filename: G:\1.0_JOBS\2331_20000 - Materials Testing and Geotechnical\20126-00_MOT_Ja & Wren_Aggregate\Task 2013 - Boulder Creek East Expansion\10 Drawings\AutoCAD Files\test.plt\BoulderEast-PitPlan-Fig 2.DWG
March 23, 2017 , 09:59:47




## TEST PITS 2016

| DESC | NORTHING | EASTING |
|---|---|---|
| TP16-01 | 6107422 | 603886 |
| TP16-02 | 6107424 | 603813 |
| TP16-03 | 6107453 | 603751 |
| TP16-04 | 6107497 | 603656 |
| TP16-05 | 6107524 | 603566 |
| TP16-06 | 6107581 | 603490 |
| TP16-07 | 6107653 | 603529 |
| TP16-08 | 6107362 | 603936 |
| TP16-09 | 6107502 | 603827 |
| TP16-10 | 6107756 | 603653 |
| TP16-11 | 6107701 | 603581 |
| TP16-12 | 6107813 | 603586 |
| TP16-13 | 6107759 | 603515 |
| TP16-14 | 6107703 | 603493 |
| TP16-15 | 6107854 | 603473 |
| TP16-16 | 6107781 | 603478 |
| TP16-17 | 6107884 | 603533 |
| TP16-18 | 6107682 | 603768 |
| TP16-19 | 6107620 | 603795 |

## PIT LEGEND

- NATURAL EMBANKMENT
- PIT FACE
- SYMB TEST PIT
- TEST HOLE
- PAVED ROAD
- GRAVEL ROAD
- TRAIL
- TREELINE
- DISTRICT LOT LINE
- SYMB Mon. MONUMENT
- SYMB IRON PIN
- SYMB POWER POLE
- OVERBURDEN STOCKPILE
- DEVELOPMENT DIRECTION
- FUTURE AGGREGATE POTENTIAL
- WELL
- STAND PIPE PIEZOMETER OR WELL
- SWAMP
- CREEK
- BUILDING (symbolic)
- FENCE
- SYMB SIGN POST
- SYMB UTILITY POLE
- GRAVEL RESERVE BOUNDARY
- 800m Contour Line (100m interval)
- Contour Line (20m interval)
- PITFACE OBSERVATIONS
- SYMB GPS COORDINATE (UTM NAD 83)
- CS CRUSHER SETUP
- STOCKPILE
- UNEVEN TERRAIN
- AOA (NO DISTURBANCE ZONE)
- PROPOSED NEW AGGREGATE SOURCE

AREAS OUTLINED BY McELHANNEY

| | |
|---|---|
| A | AREA: 13800 m² |
| B | AREA: 4750 m² |
| C | AREA: 66140 m² |
| D | AREA: 2900 m² |

## TEST PITS 2013

| DESC | NORTHING | EASTING |
|---|---|---|
| TP13-01 | 6107559 | 603794 |
| TP13-02 | 6107525 | 603731 |
| TP13-03 | 6107563 | 603671 |
| TP13-04 | 6107575 | 603628 |
| TP13-05 | 6107609 | 603602 |
| TP13-06 | 6107598 | 603701 |
| TP13-07 | 6107646 | 603645 |
| TP13-08 | 6107673 | 603662 |
| TP13-09 | 6107660 | 603709 |

**T.R.I.M. NOTES:**

1. 20m CONTOUR INTERVALS
2. BASE MAPDERIVED FROM T.R.I.M. DIGITAL MAP DATA:
   –MAP NO: 93M014
   –DATUM: NAD 83, UTM ZONE 09

**LEGAL NOTE**

1. DISTRICT LOT LINES ARE DERIVED FROM DIGITAL CROWN CADASTRAL REFERENCE MAPPING SUPPLIED BY CROWN LAND REGISTRY, VICTORIA

**DRAWING NOTE:**

1. SOME TESTPITS AND/OR TESTHOLES MAY NOT BE REPRESERNTATIVE OF CURRENT CONDITIONS DUE TO DEVELOPMENT AND EXCAVATING DONE AFTER TESTING WAS CONDUCTED.

**PIT DEVELOPMENT NOTES:**

1. ALL PIT DEVELOPMENT MUST BE CARRIED OUT IN ACCORDANCE WITH THE HEALTH, SAFETY, AND RECLAMATION CODE FOR MINES IN BC (2008, OR LATER EDITION),THE STANDARDS SPECIFICATIONS FOR HIGHWAY CONSTRUCTION, BC MINISTRY OF TRANSPORTATION AND INFRASTRUCTURE (2012, OR LATER EDITION) AND THE AGGREGATE OPERATORS BEST MANAGEMENT PRACTICES HANDBOOK FOR BC.
2. PIT DEVELOPMENT MUST NOT TAKE PLACE WITHIN 5 m FROM THE EDGE OF THE RESERVE BOUNDARY.
3. NO DUMPING OF DEBRIS OR PETROLEUM PRODUCTS WILL BE PERMITTED AND THE SITE MUST BE LEFT IN A CLEAN AND SAFE CONDITION.
4. THE AVERAGE THICKNESS OF THE TOPSOIL AND OVERBURDEN VARIED AND WILL REQUIRE STRIPPING AND PLACING IN THE DESIGNATED STOCKPILE AREAS. AREAS ARE DELINEATED ON THE PIT DEVELOPMENT PLAN. TOPSOIL SHOULD BE STOCK PILED SEPARATELY FROM MINERAL SOIL OVERBURDEN.
5. ALL TREES, VEGETATION AND OVERBURDEN ARE TO BE REMOVED WITHIN 2 m OF THE TOP OF THE PIT FACE. LOGGING, CLEARING AND GRUBBING WILL BE REQUIRED TO MINE MOST OF AREA C AND PART OF AREA D.
6. DEVELOPMENT OF AREA C CAN COMMENCE FROM WHEREVER PRACTICAL ON THE EXISTING PIT FACES OF THE GRAVEL RESERVE. BEGIN MINING AREA C USING THE EXISTING PIT FLOOR FOR CRUSHING AND STOCKPILING AGGREGATES, RELOCATING AS REQUIRED THROUGHOUT DEVELOPMENT IN EACH DIRECTION.
7. AREAS A & B WILL BE MOST EFFICIENTLY MINED TO THERE MAXIMUM EXTENTS FOLLOWING AT LEAST PARTIAL DEVELOPMENT OF AREA C. ONCE THE WORKING PIT FACES WERE EXTENDED TO THE NORTH AND WEST INTO AREA C, THE EXPANDED PIT FLOOR CAN BE USED FOR CRUSHING AND STOCKPILING AGGREGATES FROM AREAS A & B.
8. AREA D CAN BE MINED IF A HIGHER–FINES SOURCE (5–10%) IS REQUIRED FOR BLENDING, WITH NEW PIT FACES STARTING FROM THE WEST AND WORKING TO THE EAST.
9. THE CONTRACTOR MUST ENSURE THAT ALL MATERIALS PASSING THROUGH 375 mm X 450 mm SLOTTED OPENINGS SHALL BE USED IN THE PRODUCTION OF THE CRUSHED AGGREGATES.
10. WHEN THE CONTRACTOR DISCONTINUES OPERATIONS IN THE PIT, ALL WORKING FACES AND STOCKPILES MUST BE TRIMMED TO 1.5H:1V SLOPES. WORKING PIT FACES MUST BE SHAPED WITH NATIVE GRANULAR MATERIAL. ALL OTHER PERMANENT SLOPES MUST BE RE–SLOPED TO NO STEEPER THAN 2H:1V.

SCALE: 0m 25 50 75 100 — 1 : 5000

NEGATIVE NO. ____
CAD FILE NO. ____

| Rev | Date | REVISIONS | Signature |
|---|---|---|---|
| | | | |

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BRITISH COLUMBIA
Ministry of Transportation and Infrastructure
Geotechnical & Materials Engineering

SENIOR DESIGNER ____ DATE ____
DESIGNED ED DATE JAN 2017
QUALITY CONTROL - DATE -
DRAWN AJK DATE JAN2017

BULKLEY STIKINE HIGHWAY DISTRICT
BOULDER EAST PIT
FIGURE 3
PIT PLAN

| FILE No. | PROJECT No. | REG. | DRAWING No. |
|---|---|---|---|
| TASK 2013 | 2331-20126-0 | | 20126-3-013 - |

CANCEL PRINTS BEARING PREVIOUS LETTER

H-3308

# PHOTOGRAPHS

Photo Sheet 1

Photo Sheet 2

**PHOTOGRAPH NO. 1:** View of pit access road at southeast corner of existing pit near TP16-19.

**PHOTOGRAPH NO. 2:** TP16-07 showing SW-SM to 1.2 m depth overlying GP soil typical for Area C.

**PHOTOGRAPH NO. 3:** Water table encountered at approximately 2.2 meters depth in TP16-17.


**PHOTOGRAPH NO. 4:** TP16-04 showing well-graded gravel with approximately 17% oversize material up to 300 mm diameter.

**PHOTOGRAPH NO. 5:** TP16-18 showing GP-GM soil typical for Area D.

**PHOTOGRAPH NO. 6:** TP16-19 showing GP-GM soils typical for Area D.

| | | | |
|---|---|---|---|
| McElhanney<br>**McElhanney Consulting Services Ltd.** | PREPARED BY: Tyler Wilkes, EIT | **BC Ministry of Transportation and Infrastructure** | PHOTOS TAKEN: November 16 and 17, 2016 |
| | DATE PREPARED: November, 2017 | **Boulder Creek East Pit**<br>**Provincial Pit No. 2210**<br>**Site Photographs** | MCSL PROJECT No: 2331-20126-00 T2013 |
| | | | **PHOTO SHEET 1 OF 2** |

**PHOTOGRAPH NO. 1:** TP16-14 in Area C.

**PHOTOGRAPH NO. 2:** TP16-14 in Area C.

**PHOTOGRAPH NO. 3:** TP16-12 in Area C

**PHOTOGRAPH NO. 4:** TP16-12 in Area C.

**PHOTOGRAPH NO. 5:** TP16-17 in Area C.

**PHOTOGRAPH NO. 6:** TP16-13 in Area C.

| | | | |
|---|---|---|---|
| McElhanney<br>**McElhanney Consulting Services Ltd.** | PREPARED BY: Tennille Lewis | **BC Ministry of Transportation and Infrastructure** | PHOTOS TAKEN: November 16 and 17, 2017 |
| | DATE PREPARED: November, 2017 | **Boulder Creek East Pit**<br>**Provincial Pit No.2210**<br>**Site Photographs** | MCSL PROJECT No: 2331-20126-00 T2013 |
| | | | **PHOTO SHEET 2 OF 2** |

# APPENDIX A

Test Pit Summary Logs
MoT Unified Soils Classification Legend
Charts 1 to 10

# TEST PIT SUMMARY

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PROJECT #:** | 2331-20126-00 T2013 | | | | | | | | | | | | | | **EXCAVATOR:** | Hitachi 200 | | | | | | | | | | |
| **DESCRIPTION:** | Boulder Creek Pit East | | | | | | | | | | | | | | **DATE:** | November 16, 2016 | | | | | | | | | | |
| | | **DEPTH (m)** | | | **FIELD VISUAL IDENTIFICATION** | | | | | | | | | | **LABORATORY TEST RESULTS** | | | | | | | | | | | |
| | | | | | | | | | **ADDITIONAL OVERSIZE** | | | | | | | | | **GRAVEL** | | | | | | | | | |
| **TEST PIT NUMBER** | **SAMPLE NUMBER** | **From** | **To** | **LAYER THICKNESS (m)** | **Soil Classification** | **Fines < 0.075 mm (%)** | **Sand < 4.75 mm (%)** | **Gravel <75 mm (%)** | **75 - 150 mm (%)** | **150-300 mm (%)** | **> 300 mm (%)** | **Max Size (mm)** | **Water Table (m)** | **Sand Size (F,M,C)** | **Soil Classification** | **Fines < 0.075 mm (%)** | **Sand < 4.75 mm (%)** | **< 25 mm (%)** | **25 - 75 mm (%)** | **Sand Equivalent** | **Micro-Deval % coarse/ % fines** | **Degrade** | **$MgSO_4$ %coarse / % fines** | **Bulk Relative Density % coarse / % fines** | **Absorption % coarse / % fines** | **Comments** |
| TP16-01 | | 0.0 | 0.2 | 0.2 | TS | | | | | | | | | | | | | | | | | | | | | | Organics, rootlets |
| | 1 | 0.2 | 3.0 | 2.8 | GM1 | 20 | 40 | 40 | 2 | - | - | 100 | | M | | | | | | | | | | | | | grey/brown, moist |
| | 2 | 3.0 | 4.5 | 1.5 | GM2 | 25 | 20 | 55 | 5 | 15 | - | 250 | | M | | | | | | | | | | | | | grey, moist |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-02 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | | organics, rootlets |
| | 3 | 0.3 | 2.0 | 1.7 | GM1 | 15 | 30 | 55 | | | | 50 | 1 | M/C | | | | | | | | | | | | | brown, wet, sloughing |
| | | 2.0 | 4.0 | 2.0 | GM1 | 20 | 25 | 55 | 5 | | | 100 | | M/C | | | | | | | | | | | | | grey/brown, wet, sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-03 | | 0.0 | 0.2 | 0.2 | TS | | | | | | | | | | | | | | | | | | | | | | organics |
| | | 0.2 | 1.0 | 0.8 | GP-GM | 12 | 45 | 43 | | | | 100 | | M | | | | | | | | | | | | | brown/grey, moist |
| | 4 | 1.0 | 3.5 | 2.5 | GW-GM | 7 | 33 | 60 | 5 | 2 | | 200 | | C | GP | 2.9 | 35.5 | 29.8 | 31.8 | 63.1 | 11.8 | | | | | | brown/grey, moist |
| | | 3.5 | 5.0 | 1.5 | GW-GM | 5 | 30 | 65 | 10 | 5 | | 300 | | C | | | | | | | | | | | | | brown/grey, moist |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-04 | | 0.0 | 0.4 | 0.4 | TS | | | | | | | | | | | | | | | | | | | | | | rootlets |
| | | 0.4 | 1.5 | 1.1 | GW-GM | 7 | 40 | 53 | 5 | 5 | | 250 | | M/C | | | | | | | | | | | | | roots to 2.0 m, brown, moist |
| | 5 | 1.5 | 5.0 | 3.5 | GW | 4 | 36 | 60 | 10 | 5 | 2 | 300 | | M | GW | 2.2 | 33.3 | 31.3 | 33.2 | | | | | 2.57/2.38 | 1.8/4.4 | | grey/brown, moist |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-05 | | 0.0 | 0.2 | 0.2 | TS | | | | | | | | | | | | | | | | | | | | | | roots/organics |
| | | 0.2 | 1.0 | 0.8 | SW | 3 | 57 | 40 | 2 | | | 100 | | M | | | | | | | | | | | | | grey/brown, small roots |
| | 6 | 1.0 | 3.0 | 2.0 | GP | 4 | 36 | 60 | 10 | 5 | | 300 | | M | GW | 3.3 | 32.7 | 29.8 | 34.2 | | | | | | | | grey/brown, moist |
| | | 3.0 | 4.5 | 1.5 | GP-GM | 5 | 30 | 65 | 15 | 10 | 5 | 500 | | M | | | | | | | | | | | | | grey/brown, lots of oversize |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-06 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | | roots/organics |
| | | 0.3 | 1.0 | 0.7 | SW-SM | 6 | 54 | 40 | 5 | 2 | | 250 | | M/F | | | | | | | | | | | | | grey/brown, sloughing |
| | 7 | 1.0 | 4.5 | 3.5 | GW-GM | 5 | 35 | 60 | 5 | 5 | 5 | 500 | | M | GW | 2.6 | 39.5 | 32.2 | 25.7 | 75.5 | 9.2 | | | | | | grey/brown, moist, sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-07 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | | rootlets, organics |
| | 8 | 0.3 | 1.5 | 1.2 | SW-SM | 7 | 50 | 43 | 2 | | | 120 | | M | | | | | | | | | | | | | grey/brown, moist |
| | 9 | 1.5 | 3.5 | 2.0 | GW | 4 | 35 | 61 | 5 | 5 | | 200 | | M | GP | 2.9 | 31.5 | 32.6 | 33 | | | | | | | | grey/brown, moist, sloughing |
| | | 3.5 | 4.5 | 1.0 | GW | 3 | 35 | 62 | 10 | 5 | 2 | 400 | | M | | | | | | | | | | | | | grey/brown, moist, sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-08 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | | |
| | | 0.3 | 1.0 | 0.7 | SM | 12 | 38 | 50 | 2 | | | 100 | | F | | | | | | | | | | | | | Grey, moist |
| | 10 | 1.0 | 4.0 | 3.0 | GC2 | 30 | 20 | 50 | 5 | | | 150 | | F | | | | | | | | | | | | | grey, moist |

Note: Soil classifications are based on Ministry of Transportation and Infrastructure Unified Soil Classification System

McElhanney

## TEST PIT SUMMARY

| PROJECT #: | 2331-20126-00 T2013 | EXCAVATOR: | Hitachi 200 |
|---|---|---|---|
| DESCRIPTION: | Boulder Creek Pit East | DATE: | November 16, 2016 |

| TEST PIT NUMBER | SAMPLE NUMBER | DEPTH (m) | | LAYER THICKNESS (m) | FIELD VISUAL IDENTIFICATION | | | | | | | | | | LABORATORY TEST RESULTS | | | | | | | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | From | To | | Soil Classification | Fines < 0.075 mm (%) | Sand < 4.75 mm (%) | Gravel <75 mm (%) | ADDITIONAL OVERSIZE | | | | Water Table (m) | Sand Size (F,M,C) | Soil Classification | Fines < 0.075 mm (%) | Sand < 4.75 mm (%) | GRAVEL | | Sand Equivalent | Micro-Deval % coarse/ % fines | Degrade | $MgSO_4$ %coarse / % fines | Bulk Relative Density % coarse / % fines | Absorption % coarse / % fines | |
| | | | | | | | | | 75 - 150 mm (%) | 150-300 mm (%) | > 300 mm (%) | Max Size (mm) | | | | | | < 25 mm (%) | 25 - 75 mm (%) | | | | | | | | |
| TP16-09 | | 0.0 | 0.2 | 0.2 | TS | | | | | | | | | | | | | | | | | | | | | | organics, rootlets |
| | | 0.2 | 1.0 | 0.8 | SM1 | 15 | 45 | 40 | | | | | | F | | | | | | | | | | | | | brown, moist |
| | 11 | 1.0 | 2.0 | 1.0 | GP-GM | 7 | 38 | 55 | 2 | | | 100 | 2 | M | | | | | | | | | | | | | wet, brown, sloughing |
| | 12 | 2.0 | 3.0 | 1.0 | CL | 40 | 35 | 25 | | | | | | M | | | | | | | | | | | | | grey, wet |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-10 | | 0.0 | 0.2 | 0.2 | TS | | | | | | | | | | | | | | | | | | | | | | organic, roots |
| | 13 | 0.2 | 1.0 | 0.8 | SW-SM | 5 | 45 | 50 | 2 | | | | | M | | | | | | | | | | | | | brown/grey, moist |
| | 14 | 1.0 | 2.5 | 1.5 | GP-GM | 5 | 35 | 60 | 20 | 5 | | 200 | | M | GW | 2.0 | 31.9 | 28.9 | 37.2 | | | | | 2.57/2.39 | 2.1/4.2 | grey/brown, moist, sloughing |
| | | 2.5 | 4.5 | 2.0 | GP-GM | 5 | 35 | 60 | 30 | 10 | 5 | 400 | | M | | | | | | | | | | | | grey/brown, moist, sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-11 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | | organics, roots, brown |
| | | 0.3 | 1.0 | 0.7 | GP-GM | 5 | 45 | 50 | 2 | | | 150 | | M | | | | | | | | | | | | | brown/grey, moist |
| | 15 | 1.0 | 2.5 | 1.5 | GP-GM | 5 | 30 | 65 | 5 | 5 | | 300 | | M | | | | | | | | | | | | | minor moisture, grey/brown, sloughing |
| | | 2.5 | 4.0 | 1.5 | GP-GM | 5 | 30 | 65 | 10 | 5 | 2 | 500 | | M | | | | | | | | | | | | | minor moisture, grey/brown, sloughing |

Note: Soil classifications are based on Ministry of Transportation and Infrastructure Unified Soil Classification System

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# TEST PIT SUMMARY

| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PROJECT #:** | 2331-20126-00 T2013 | | | | | | | | | | | | | **EXCAVATOR:** | Hitachi 200 | | | | | | | | | | | | |
| **DESCRIPTION:** | Boulder Creek Pit East | | | | | | | | | | | | | **DATE:** | November 17, 2016 | | | | | | | | | | | | |
| | | **DEPTH (m)** | | | **FIELD VISUAL IDENTIFICATION** | | | | | | | | | | **LABORATORY TEST RESULTS** | | | | | | | | | | | | |
| | | | | | | | | | **ADDITIONAL OVERSIZE** | | | | | | | | | **GRAVEL** | | | | | | | | | | |
| **TEST PIT NUMBER** | **SAMPLE NUMBER** | **From** | **To** | **LAYER THICKNESS (m)** | **Soil Classification** | **Fines < 0.075 mm (%)** | **Sand < 4.75 mm (%)** | **Gravel <75 mm (%)** | **75 - 150 mm (%)** | **150-300 mm (%)** | **> 300 mm (%)** | **Max Size (mm)** | **Water Table (m)** | **Sand Size (F,M,C)** | **Soil Classification** | **Fines < 0.075 mm (%)** | **Sand < 4.75 mm (%)** | **< 25 mm (%)** | **25 - 75 mm (%)** | **Sand Equivalent** | **Micro-Deval % coarse/ % fines** | **Degrade** | **$MgSO_4$ %coarse / % fines** | **Bulk Relative Density % coarse / % fines** | **Absorption % coarse / % fines** | **Comments** |
| TP16-12 | | 0.0 | 0.4 | 0.4 | TS | | | | | | | | | | | | | | | | | | | | | small roots |
| | | 0.4 | 1.0 | 0.6 | GP-GC | 7 | 33 | 60 | 5 | | | 125 | | M | | | | | | | | | | | | brown, moist, minor sloughing |
| | 16 | 1.0 | 5.0 | 4.0 | GW-GM | 5 | 38 | 57 | 10 | 5 | 2 | 400 | | M | GP-GM | 5.0 | 43.0 | 27.3 | 24.6 | 44.4 | 11.0 | | | | | brown, moist, minor sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-13 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | roots, brown |
| | | 0.3 | 1.2 | 0.9 | GP-GM | 7 | 38 | 55 | 5 | | | 100 | | M/C | | | | | | | | | | | | roots to 1.0 m, brown/grey |
| | 17 | 1.2 | 2.5 | 1.3 | GP-GM | 5 | 35 | 60 | 5 | 5 | | 200 | | M/C | GP | 2.8 | 40.3 | 22.6 | 34.3 | | | | | 2.54/2.41 | 2.2/4.1 | brown/grey, moist, sloughing |
| | | 2.5 | 5.0 | 2.5 | GP-GM | 5 | 30 | 65 | 10 | 10 | 5 | 375 | | M/C | | | | | | | | | | | | brown/grey, moist, sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-14 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | roots, brown |
| | | 0.3 | 1.0 | 0.7 | GP-GM | 5 | 40 | 55 | 2 | | | 100 | | M/C | | | | | | | | | | | | brown/grey, moist |
| | 18 | 1.0 | 5.0 | 4.0 | GP-GM | 5 | 30 | 65 | 6 | 3 | 1 | 350 | | M/C | | | | | | | | | | | | brown/grey, moist, sloughing |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-15 | | 0.0 | 0.4 | 0.4 | TS | | | | | | | | | | | | | | | | | | | | | roots |
| | | 0.4 | 1.0 | 0.6 | GP-GM | 8 | 32 | 60 | 10 | 5 | 3 | 400 | | M | | | | | | | | | | | | brown/grey, moist |
| | 19 | 1.0 | 5.0 | 4.0 | ML | 40 | 30 | 30 | 2 | | | 75 | | F/M | | | | | | | | | | | | grey, firm |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-16 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | roots |
| | | 0.3 | 2.5 | 2.2 | SM2 | 20 | 50 | 30 | 20 | 10 | 10 | 700 | | M | | | | | | | | | | | | brown/grey, moist, water seepage @2 m |
| | 20 | 2.5 | 3.5 | 1.0 | SC3 | 30 | 55 | 15 | 5 | | | 100 | | M | | | | | | | | | | | | brown, low plastic |
| | | 3.5 | 5.0 | 1.5 | SM3 | 30 | 45 | 25 | 5 | | | 125 | | F/M | | | | | | | | | | | | no plasticity, grey, sandy |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-17 | | 0.0 | 0.2 | 0.2 | TS | | | | | | | | | | | | | | | | | | | | | roots, brown, organics |
| | 21 | 0.2 | 1.5 | 1.3 | GP | 4 | 51 | 45 | 2 | | | 100 | 2.2 | M | | | | | | | | | | | | rootlets to 1.0 m, moist, brown |
| | | 1.5 | 2.5 | 1.0 | GP-GM | 6 | 24 | 70 | 5 | | | 500 | | C | | | | | | | | | | | | brown, moist |
| | | | | | | | | | | | | | | | | | | | | | | | | | | brown, moist |
| TP16-18 | 22 | 0.0 | 1.0 | 1.0 | GP-GM | 7 | 33 | 60 | 2 | | | 125 | | M/C | | | | | | | | | | | | |
| | 23 | 1.0 | 3.0 | 2.0 | GP-GM | 10 | 40 | 50 | 2 | | | 125 | | M | | | | | | | | | | | | |
| | | 3.0 | 5.0 | 2.0 | GP-GM | 10 | 45 | 45 | 5 | 1 | | 250 | | M | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| TP16-19 | | 0.0 | 0.3 | 0.3 | TS | | | | | | | | | | | | | | | | | | | | | Small rootlets, minor topsoil |
| | | 0.3 | 1.0 | 0.7 | GW-GM | 7 | 38 | 55 | 5 | | | 100 | | M | | | | | | | | | | | | grey/brown, moist |
| | | 1.0 | 1.5 | 0.5 | GP-GM | 7 | 33 | 60 | 30 | 5 | | 200 | | M | | | | | | | | | | | | grey/brown, moist |
| | 24 | 1.5 | 4.0 | 2.5 | GP-GM | 8 | 42 | 50 | 5 | | | 150 | | C | SP-SM | 5.7 | 65.5 | 19.8 | 9.0 | | | | | | | grey/brown, moist |
| | | 4.0 | 5.0 | 1.0 | GP-GM | 5 | 35 | 60 | 8 | 2 | | 200 | | C | | | | | | | | | | | | grey/brown, moist |

Note: Soil classifications are based on Ministry of Transportation and Infrastructure Unified Soil Classification System

McElhanney

# MATERIALS CLASSIFICATION LEGEND

| MAJOR DIVISIONS | | SYMBOL | SOIL TYPE |
|---|---|---|---|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | GW | WELL GRADED GRAVELS OR GRAVEL–SAND MIXTURES, < 5% FINES |
| | | GP | POORLY–GRADED GRAVELS OR GRAVEL–SAND MIXTURES, < 5% FINES |
| | | GM* | SILTY GRAVELS, GRAVEL–SAND–SILT MIXTURES |
| | | GC* | CLAYEY GRAVELS, GRAVEL–SAND–CLAY MIXTURES |
| | SAND AND SANDY SOILS | SW | WELL–GRADED SANDS OR GRAVELLY SANDS, < 5% FINES |
| | | SP | POORLY–GRADED SANDS OR GRAVELLY SANDS, < 5% FINES |
| | | SM* | SILTY SANDS<br>SAND–SILT MIXTURES |
| | | SC* | CLAYEY SANDS<br>SAND–CLAY MIXTURES |
| FINE GRAINED SOILS | SILTS AND CLAYS $w_L$ <50 | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY |
| | | CL | INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS |
| | | OL | ORGANIC SILTS AND ORGANIC SILT–CLAYS OF LOW PLASTICITY |
| | SILTS AND CLAYS $w_L$ >50 | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, PLASTIC SILTS |
| | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| ORGANIC SOILS | | Pt | PEAT AND OTHER HIGHLY ORGANIC SOILS |
| TOPSOIL | | TS | TOPSOIL WITH ROOTS, ETC. |
| COBBLES | | SB | ROCK FRAGMENTS AND COBBLES, PARTICLE SIZE 75mm TO 300mm |
| LARGE BOULDERS | | LB | BOULDERS, PARTICLE SIZE OVER 300mm |
| BEDROCK | | BR | BEDROCK |

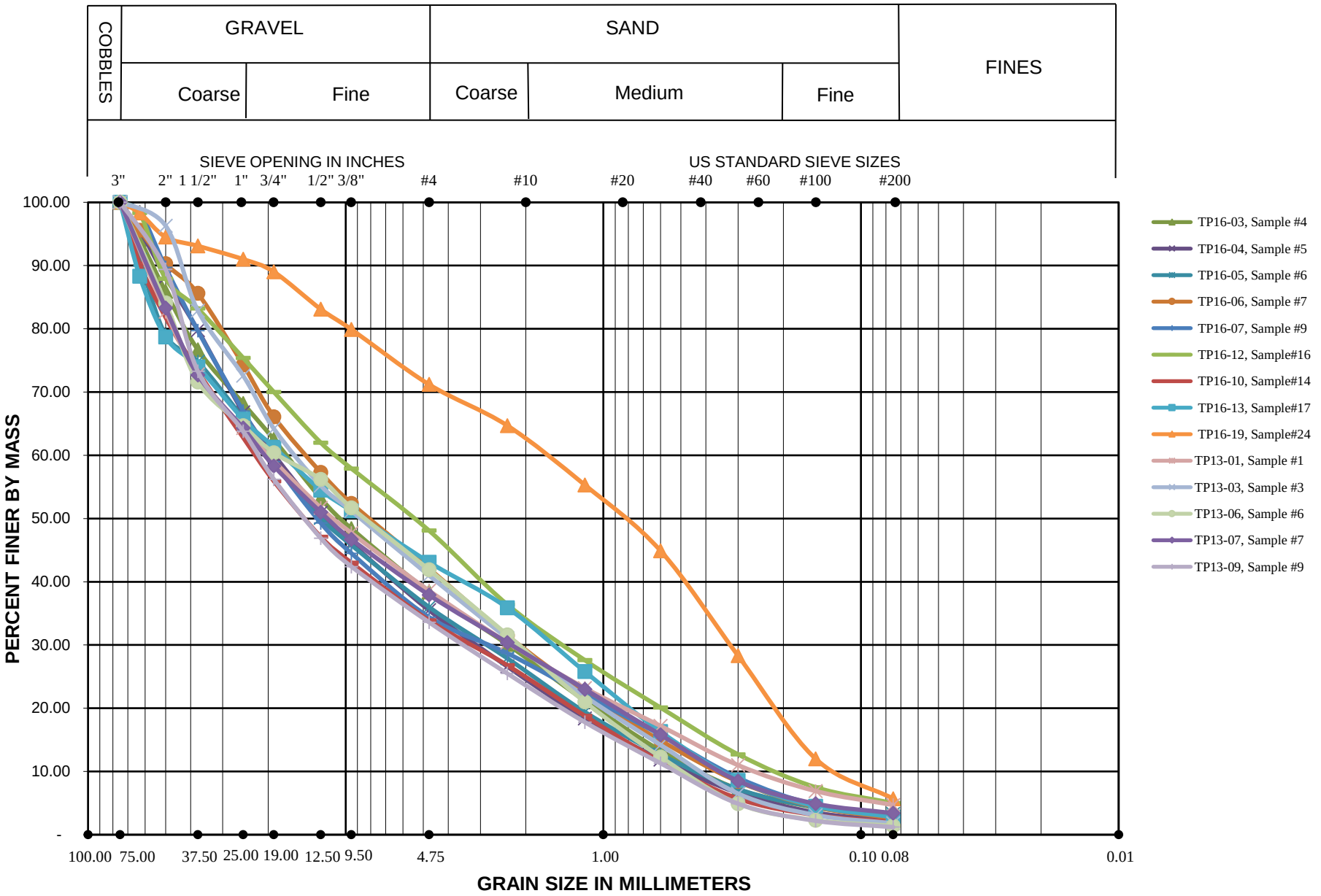
FOR SOILS HAVING 5 – 12% PASSING .075 SIEVE, USE DUAL SYMBOL

*GM1; GC1; SM1; SC1; 12 – 20%
GM2; GC2; SM2; SC2; 20 – 30%
GM3; GC3; SM3; SC3; 30 – 40%
GM4; GC4; SM4; SC4; 40 – 50%

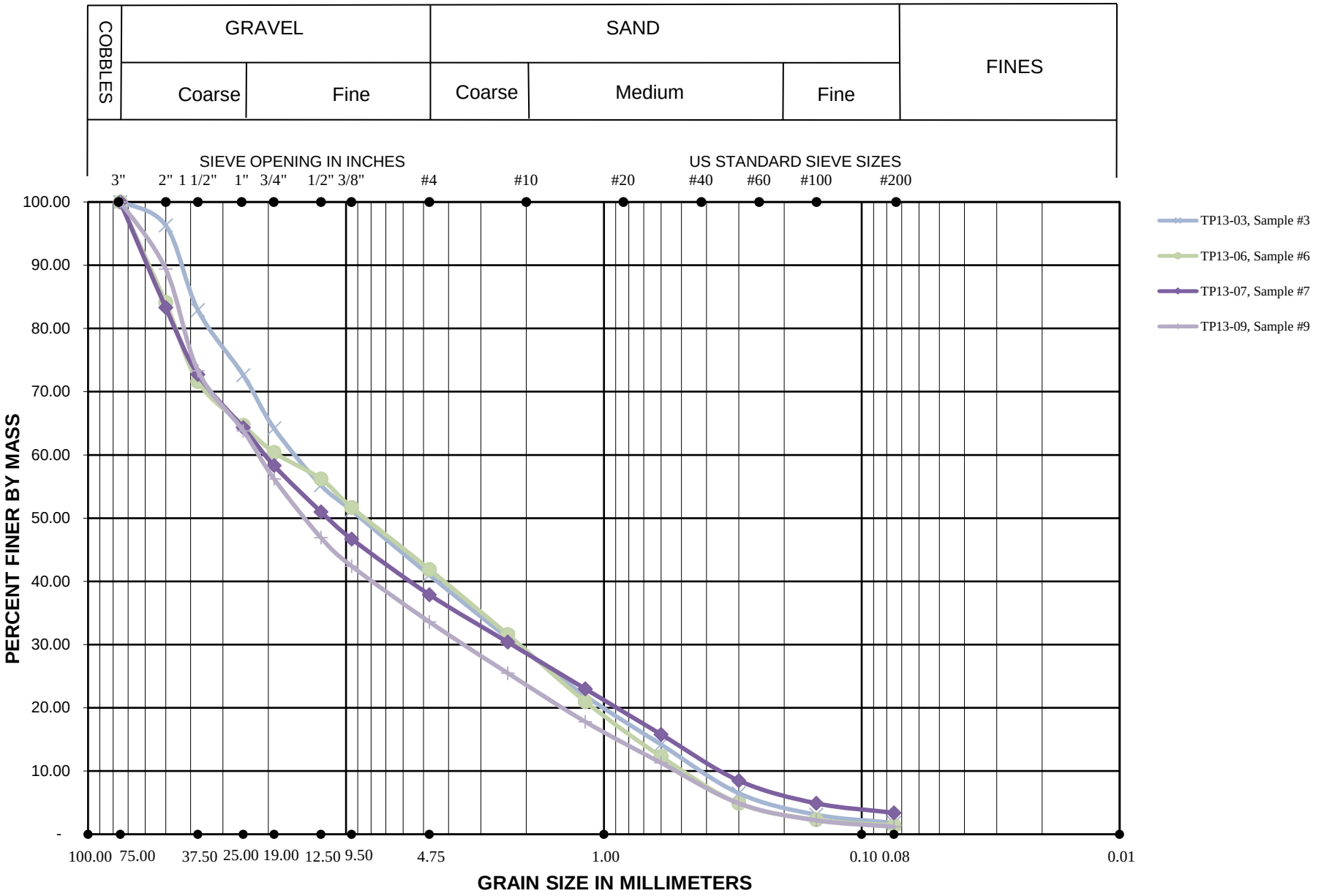
} PASSING .075mm SIEVE

REV. 90–04–26

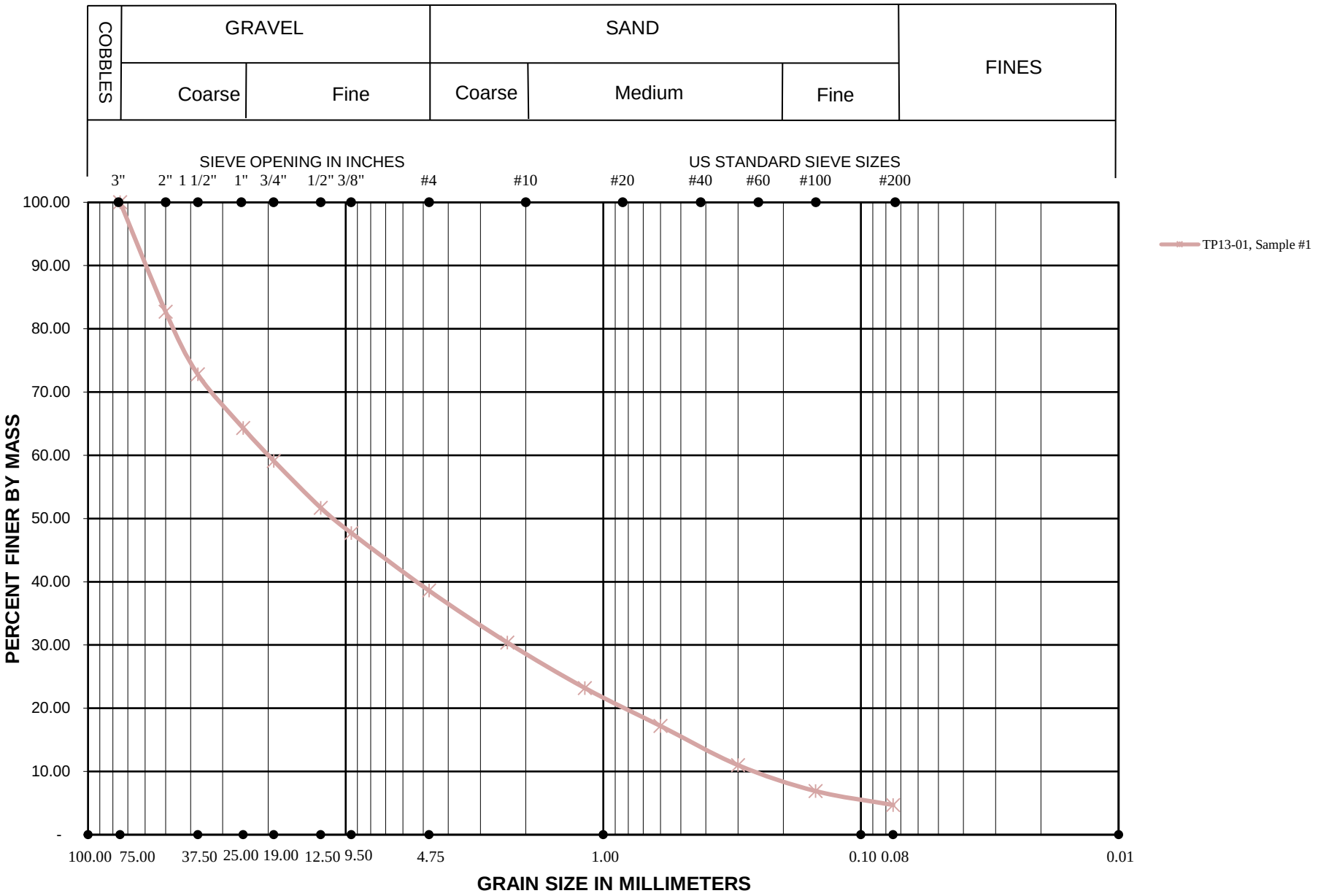
# BOULDER CREEK EAST PIT
## CHART 1 - GRADATION CURVES - ALL AREAS
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION REMOVED (<75mm)



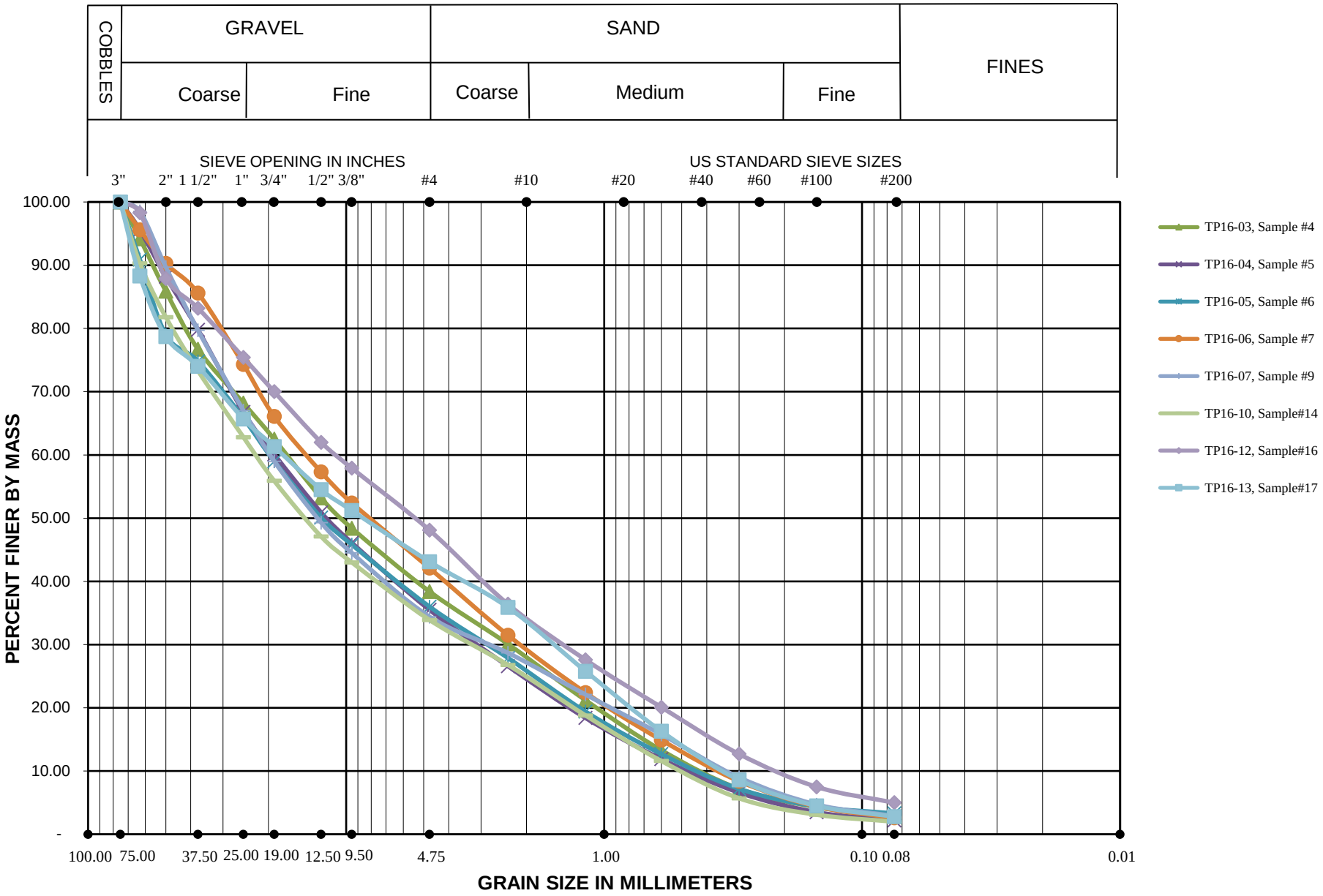
# BOULDER CREEK EAST PIT
## CHART 2 - GRADATION CURVES - AREA A
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION REMOVED (<75mm)



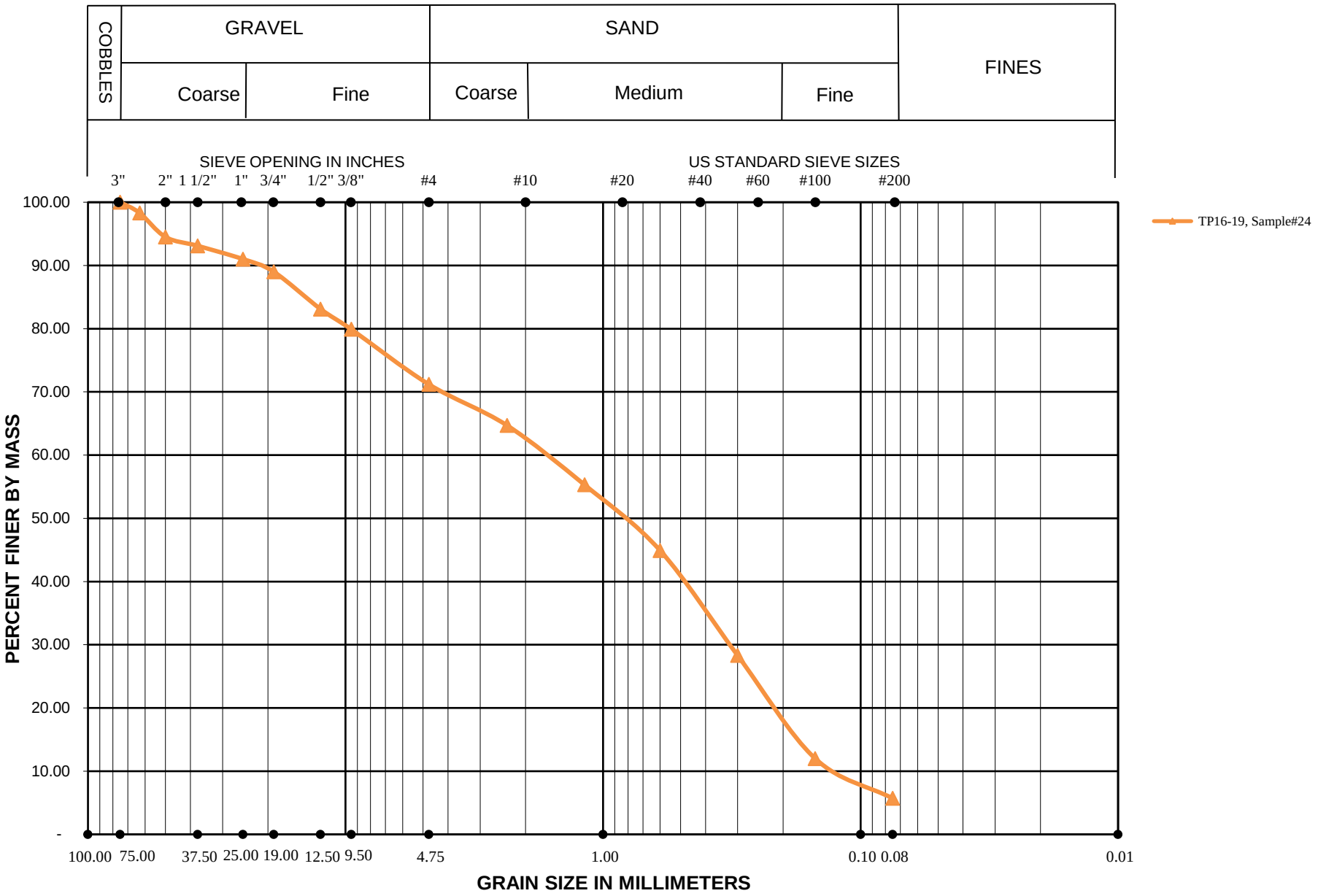
# BOULDER CREEK EAST PIT
## CHART 3 - GRADATION CURVES - AREA B
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION REMOVED (<75mm)



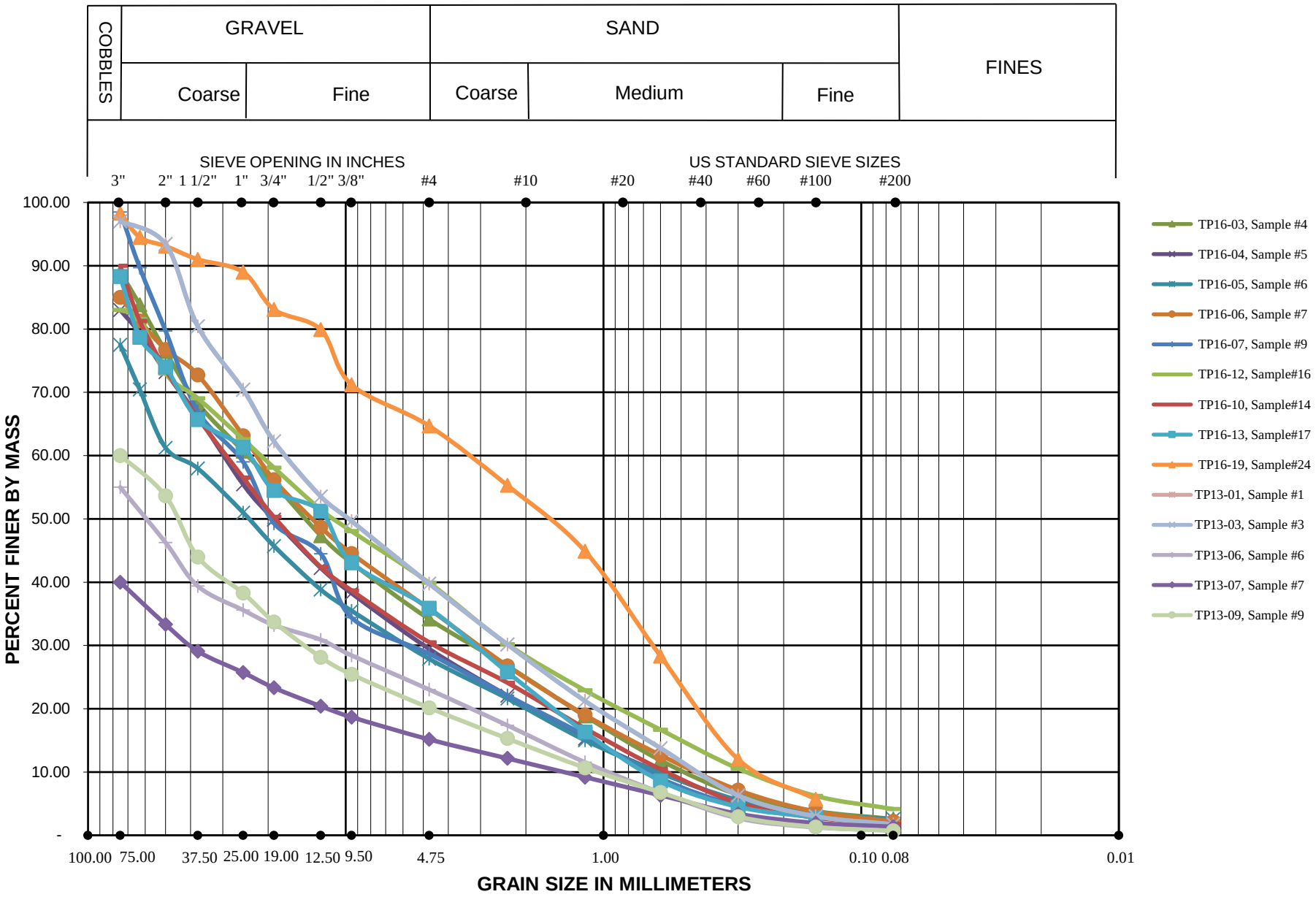
# BOULDER CREEK EAST PIT
## CHART 4 - GRADATION CURVES - AREA C
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION REMOVED (<75mm)



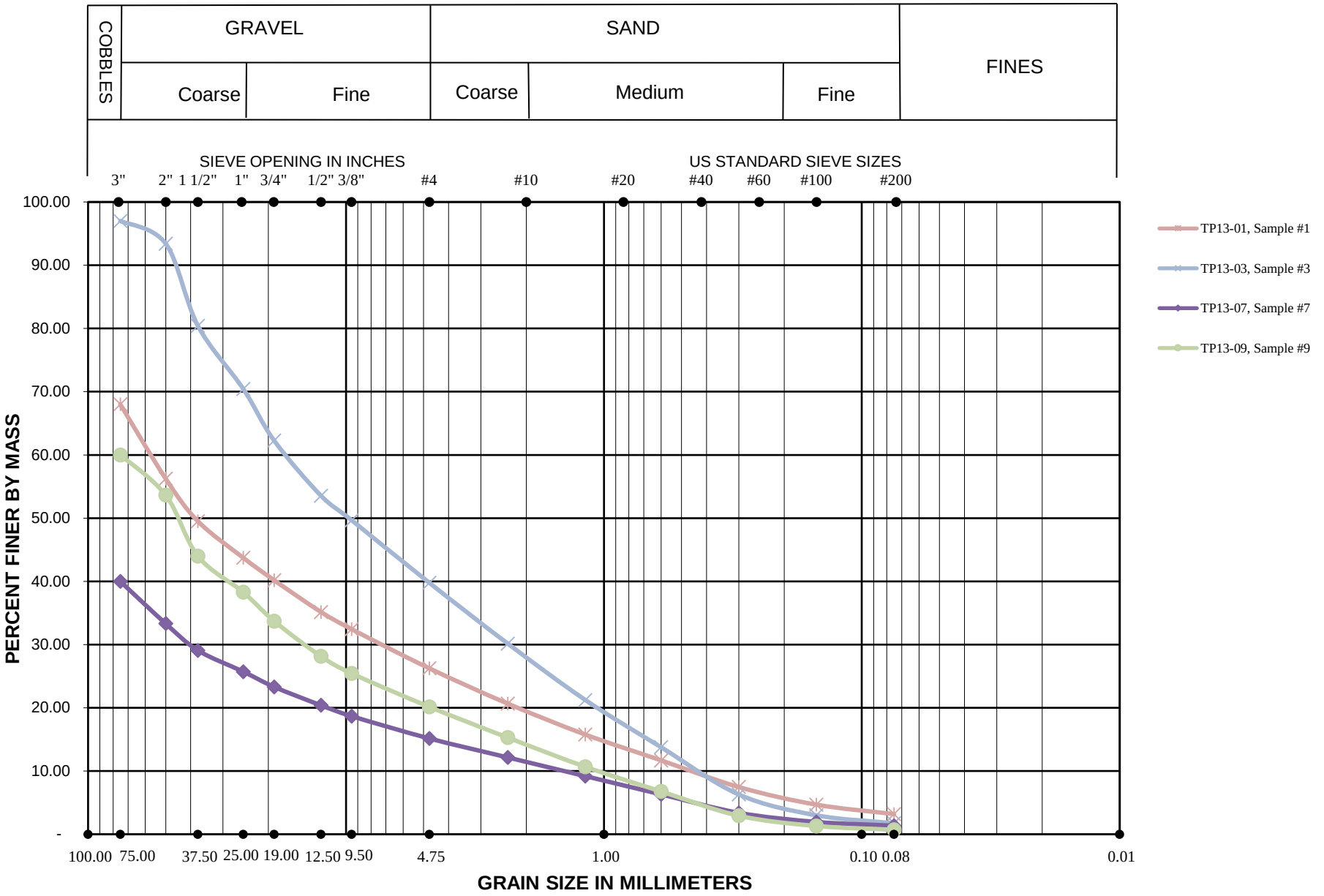
# BOULDER CREEK EAST PIT
## CHART 5 - GRADATION CURVES - AREA D
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION REMOVED (<75mm)



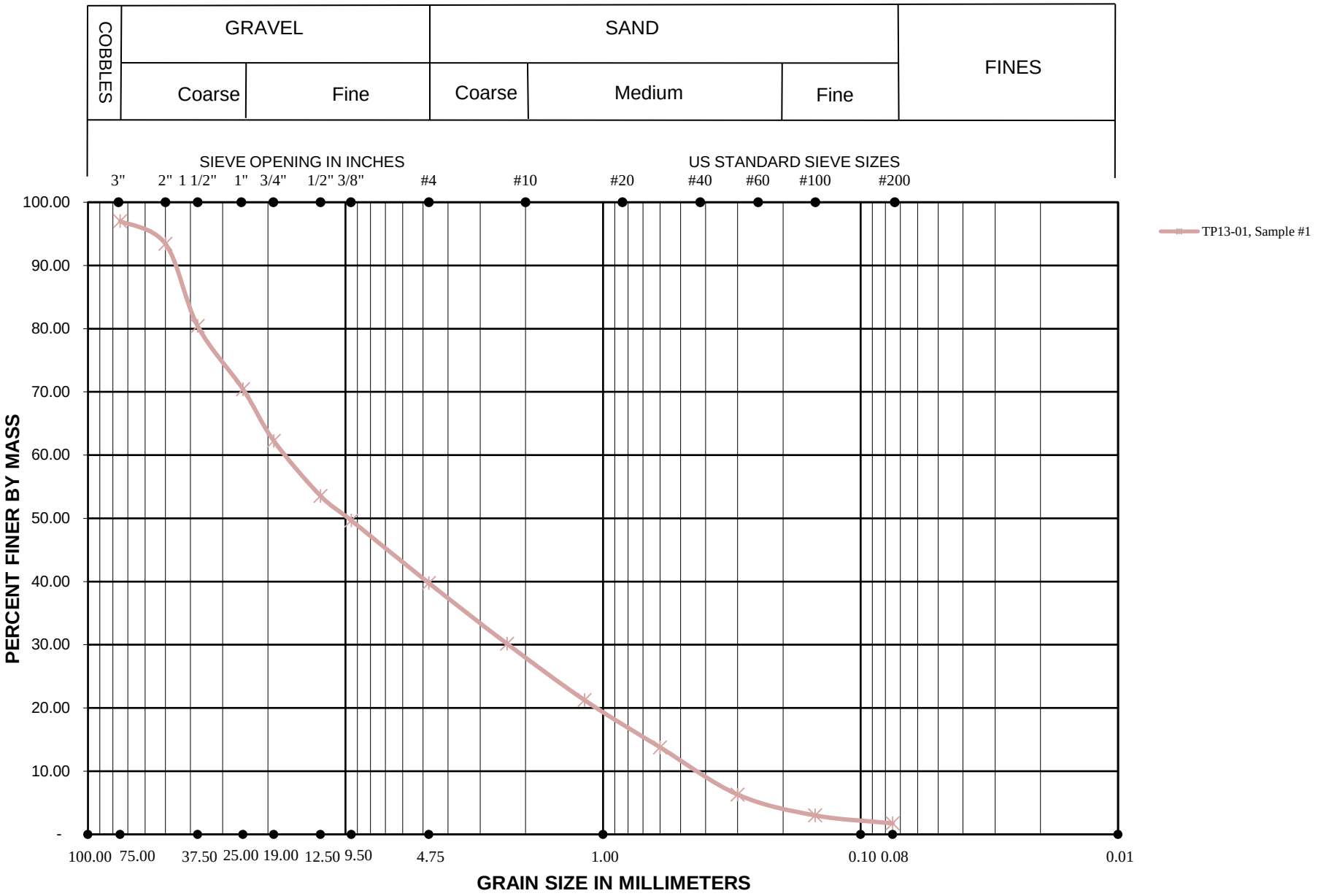
# BOULDER CREEK EAST PIT
## CHART 6 - GRADATION CURVES - ALL AREAS
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION INCLUDED (>75mm)



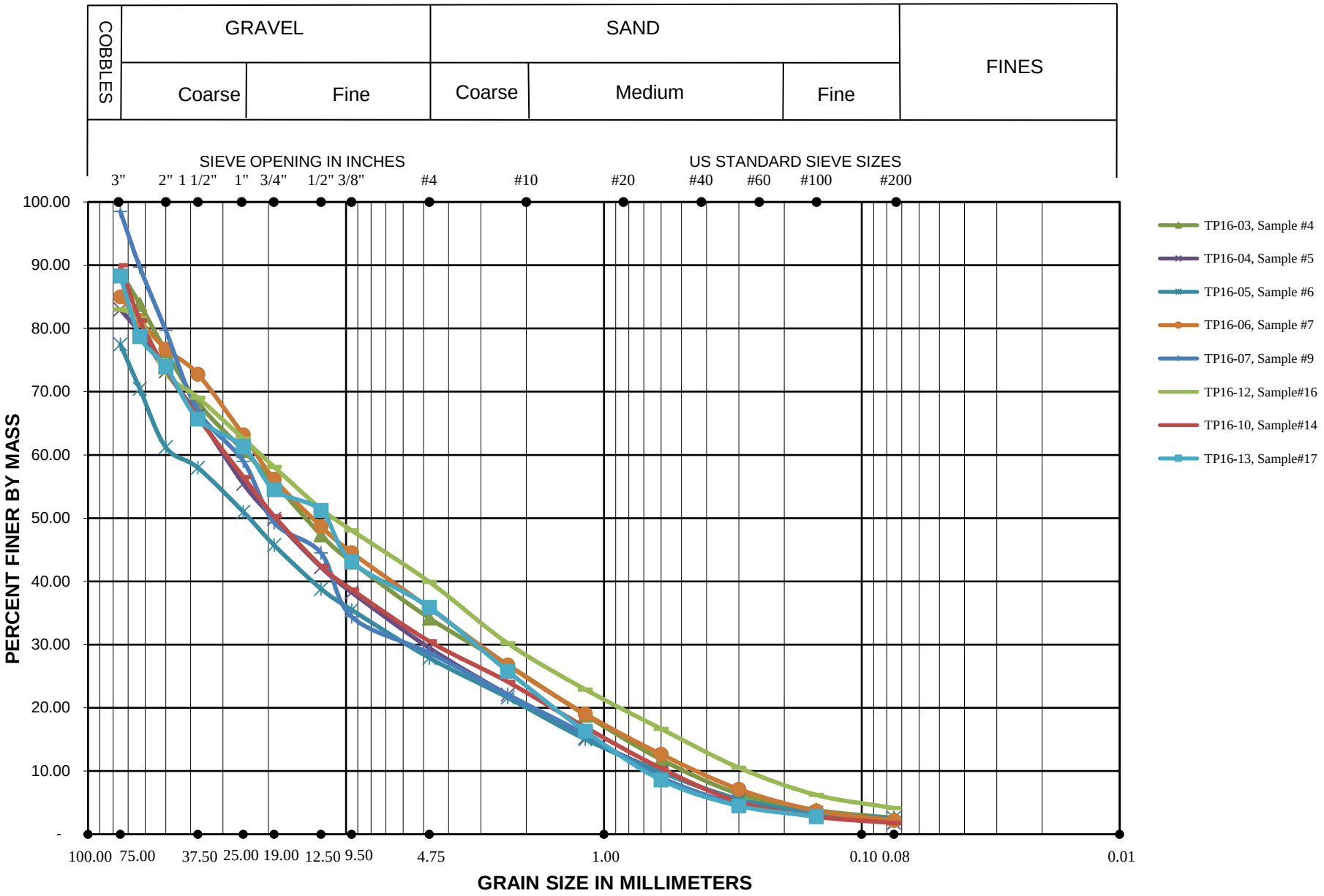
# BOULDER CREEK EAST PIT
## CHART 7 - GRADATION CURVES - AREA A
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION INCLUDED (>75mm)



# BOULDER CREEK EAST PIT
## CHART 8 - GRADATION CURVES - AREA B
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION INCLUDED (>75mm)



# BOULDER CREEK EAST PIT
## CHART 9 - GRADATION CURVES - AREA C
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION INCLUDED (>75mm)



# BOULDER CREEK EAST PIT
## CHART 10 - GRADATION CURVES - AREA D
## LABORATORY SIEVE REPORTS, OVERSIZE PORTION INCLUDED (>75mm)