Prepared By:

GM BluePlan ENGINEERING

Caframo Limited

Stormwater Management Report

GMBP File: 214154-1

February, 2015

Caframo®

GUELPH | OWEN SOUND | LISTOWEL | KITCHENER | EXETER | HAMILTON | GTA
1260-2ND AVE. E., UNIT 1, OWEN SOUND ON N4K 2J3 P: 519-376-1805
WWW.GMBLUEPLAN.CA

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STORMWATER MANAGEMENT REPORT

CAFRAMO LIMITED

FEBRUARY, 2015

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1. INTRODUCTION AND BACKGROUND

Caframo Limited, is a privately owned company which manufactures specialty fans and heaters for marine or residential use as well as laboratory stirrers and mixing impellers and accessories. The company office and manufacturing facility is located just east of Wiarton at 501273 Grey Road 1, in the Township of Georgian Bluffs, as shown on Figure 1.

For the purposes of this report, Grey Road 1 is assumed to run in an east-west direction, meaning Grey Road 1 is to the South and Colpoy's Bay is to the North. As such, the property is adjacent to undeveloped lands to the east, residential lands and Grey Road 1 to the south, residential lands to the west and Colpoy's Bay to the north.

Caframo Limited is planning on constructing a proposed building expansion to the warehouse building and a future expansion to the office and manufacturing building. Additional site improvements are proposed to increase parking areas, to construct an on-site Class IV sewage system and to improve drainage through the site.

GM BluePlan has prepared this report to address stormwater management requirements following the proposed and future site and building improvements and to address stormwater quality treatment for runoff from the site, prior to discharging to Colpoy's Bay.

2. PROPOSED SITE IMPROVEMENTS

2.1 Proposed Buildings

It is proposed to construct a future expansion to extend the office and manufacturing building farther to the west as shown on Figure No. 2. This will result in further blocking overland flow as it drains northerly toward Colpoy's Bay. In addition, an existing storm sewer outlets within the footprint of the proposed addition. As such, the existing storm sewer will need to be redirected to a new stormwater outlet.

It is also proposed to construct a dome structure and future addition to the dome structure on the south side of the existing Warehouse Building, with a small building connecting the existing warehouse and proposed dome structure. The proposed dome structure is located in an area with an existing drainage ditch which directs runoff around the existing Warehouse building toward Colpoy's Bay.

2.2 Proposed Site Improvements

With construction of the proposed building additions, additional parking spaces and improved access lanes through the site are required. It is proposed to construct a new parking area on the south side of the future office and manufacturing addition, along with a new accessible entrance. A new storm sewer system will be constructed in this area to provide a drainage outlet for the proposed parking lot and the existing storm sewer system and trench drain.

An existing parking area on the south side of the testing facility is proposed to be expanded to increase the available parking area. This parking area is proposed to remain gravel.

3. STORMWATER MANAGEMENT CRITERIA

As discussed with staff from the Grey Sauble Conservation Authority during the initial project start-up meeting, given that the stormwater outlet for runoff from the subject property is Colpoy's Bay, there are no stormwater quantity requirements for runoff discharging from the site. However, it needs to be demonstrated that runoff from the subject property and upstream lands can be conveyed through the property and around the existing, proposed and future buildings to outlet to Colpoy's Bay.

Stormwater quality treatment for runoff from the subject property is to be provided to an Enhanced Level (80% TSS Removal).

4. STORMWATER DRAINAGE PATTERNS

The entire subject property slopes downward from Grey Road 1 toward Colpoy's Bay. As such, all runoff from the subject property, as well as the residential lands to the south, and the north half of the Grey Road 1 right-of-way, drains northerly to Colpoy's Bay through the subject property.

There are four main stormwater outlets which convey runoff around the existing, proposed and future buildings, each of which is shown on Figure No. 2, along with the upstream drainage area for each outlet and imperviousness of the catchment. MIDUSS modelling was completed to determine the peak flow rates during a 5 and 100 year design storm event, and the MIDUSS modelling and input information is provided in Appendix A.

4.1 Stormwater Outlet 1 – Proposed Ditch to the South and West Of Warehouse Building

With the proposed construction of a dome structure on the south side of the Warehouse Building, it is proposed to construct a drainage ditch around the new dome structure, to intercept and convey flows which drain overland from the southerly upstream lands, as well as from the proposed gravel parking lot to the south of the testing facility building, and the rooftops of the dome structures as well as the existing warehouse building.

It should be noted that an existing concrete box culvert conveys some runoff flows in a defined channel under the paved driveway located just south of the proposed dome structure, while some flows would flow overland across the driveway. The defined channel will be intercepted by the proposed drainage ditch and runoff will be directed around the building.

It is also proposed to construct several shallow clear stone check dams in the drainage ditch to provide additional stormwater quality treatment along the grassed ditch. At the downstream limit of the proposed ditch,

runoff is expected to spread out into a more sheetflow pattern as it drains through the existing treed area prior to reaching Colpoy's Bay.

Stormwater Quantity Control

As shown on Figure 2, the area draining to the drainage ditch is 2.517 hectares in size, with an imperviousness of 18%. As per the appended MIDUSS modelling, the expected 5 year peak runoff rate draining to the ditch is 0.082 m^3/s and the 100 year peak flow rate is 0.188 m^3/s.

The proposed drainage ditch has a minimum slope of 1%, with 3:1 side slopes. To convey the 100 year peak flow rate, the flow depth in the ditch would be less than 0.3 metres deep. As the proposed ditch is generally designed with a depth of 0.5 metres in the area around the proposed dome structure and a minimum depth of 0.3 metres further downstream, the ditch is designed with sufficient capacity to convey a 100 year design storm event.

Stormwater Quality Treatment

Runoff draining to Stormwater Outlet 1 is from mostly treed or rooftop areas. The one exception is the gravel parking area to the south of the Testing Facility. Runoff from the parking area is to be gravel finished and runoff is to be via surface sheetflow, the minimal amount of oils which could wash off vehicles in this area would drain into the gravel surface and would be broken down.

Several rock check dams are proposed along the downstream ditch as it extends around the proposed dome structure building. The rock check dams and grassed ditch allow sediment to settle out of suspension. Further polishing would be provided by the treed area downstream of the proposed swale, prior to reaching Colpoy's Bay.

Given that a majority of the drainage area for Outlet 1 consists of treed or rooftop areas, the length of the grassed drainage ditches, the rock flow check dams and the further polishing by the treed area prior to reaching Colpoy's Bay, the stormwater quality level for runoff from Catchment 1 is expected to be in excess of an Enhanced Level of treatment.

4.2 Stormwater Outlet 2 – Proposed Parking Area Storm Sewer System

With the proposed parking lot to be constructed on the south side of the office and manufacturing building addition, it is proposed to place several catchbasins and a storm sewer system to capture and direct runoff around the building addition, outletting in an existing treed area and draining to Colpoy's Bay. The existing trench drain and catchbasin to the south of the existing main entrance will connect into the proposed storm sewer system as well.

The storm sewer system is proposed to outlet to a treed area located to the northwest of the proposed office building addition and north of the proposed sewage system. At the outlet, it is proposed to install an earth berm/clear stone berm to provide additional water quality treatment and to slow flow and allow it to spread out as it is directed through the existing treed area.

Stormwater Quantity Control

As shown on Figure 2, the overall area draining to the storm sewer system is 0.375 hectares in size with and imperviousness of 100%. The storm sewers have been designed with sufficient capacity to convey a 100 year design storm event, as per the storm sewer design sheet provided in Appendix B. The storm sewers were overdesigned given the potential for the existing trench drain to spill toward the catchbasin near the existing main entrance and be directed to Stormwater Outlet 3. An emergency overflow route is provided to allow runoff

to spill from catchbasin to catchbasin through the proposed parking lot, however, the potential would still exist for runoff to spill from the trench drain to Stormwater Outlet 3 during storm events in excess of a 100 year design storm event.

Stormwater Quality Treatment

Runoff draining to Stormwater Outlet 2 is from rooftop and asphalt parking and driving areas. As such, water quality treatment is required for runoff from this area. Initial water quality treatment is provided by the proposed goss traps or Snout traps to be installed in each of the proposed catchbasins in the proposed parking lot. The goss traps or Snout traps serve to capture trash and oils that may runoff from the parking lot area.

At the stormwater outlet, it is proposed to construct an earth berm to block flow in a northerly direction, and to direct runoff in a westerly direction through a clear stone berm with geotextile filter cloth. The stone berm is meant to slow flow through the facility to encourage sediment to settle out, and to provide treatment during minor storm events by directing runoff through the clear stone and geotextile fabric prior to reaching the outlet.

On the downstream side of the clear stone berm, further polishing will be provided as runoff is expected to flow northerly in sheet flow fashion through the existing treed area toward Colpoy's Bay.

With the initial water quality treatment provided by goss traps in each of the catchbasins, and further treatment provided by the clear stone berm with geotextile filter cloth and final polishing by the existing treed area, it is expected that runoff draining to Stormwater Outlet 2 will be treated to an Enhanced Level of water quality treatment prior to draining to Colpoy's Bay.

4.3 Stormwater Outlet 3 – Existing Storm Sewer Under Existing Office Building

As there are no changes to increase the runoff flows to the existing single catchbasin and 300 mm diameter storm sewer which conveys flow under the existing building, there are no proposed changes to the existing drainage system. While it is certainly not ideal to have the storm sewer drain under a building, it is my understanding that since the trench drain was installed just south of the existing catchbasin, there have been no drainage issues with regard to this outlet and the Owner proposes no changes at this time.

Stormwater Quantity Control

As shown on Figure 2, the area draining to the catchbasin is 0.055 hectares in size, with an imperviousness of 95%. As per the appended MIDUSS modelling, the expected 5 year peak runoff rate to the catchbasin is 0.010 m^3/s and the 100 year peak flow rate is 0.016 m^3/s. The existing storm sewer has sufficient capacity to convey the peak flow rate under the building during a 100 year design storm event.

It should be noted that the invert of the outlet pipe is located at an elevation of 177.71, which is below the 100 year flood elevation in Colpoy's Bay of 177.90. However, the slope in the pipe provides sufficient relief that backwater effects are not expected to be an issue.

Stormwater Quality Treatment

As there are no changes within the drainage area of Stormwater Outlet 3, there are no proposed stormwater quality improvements proposed in this area.

4.4 Stormwater Outlet 4 – Existing Storm Sewer East of Office Building

An existing natural ditch conveys runoff flows from the treed area south of the existing office building to a catchbasin located at the southeast corner of the office building. In addition, runoff from the asphalt parking and driving areas and loading dock drain to the single catchbasin with a 200 mm diameter outlet pipe which outlets to the northeast of the office building.

There are minimal changes to the area draining to Stormwater Outlet 4. A small area which is currently grassed is expected to be paved, which may slightly increase the runoff to this outlet. However, with the minor changes, and with no existing drainage issues in this area, there are no changes proposed to the existing storm sewer system at this time.

Stormwater Quantity Control

As shown on Figure 2, the area draining to the drainage ditch is 0.685 hectares in size, with an imperviousness of 40%. As per the appended MIDUSS modelling, the expected 5 year peak runoff rate to the catchbasin is 0.048 m^3/s and the 100 year peak flow rate is 0.087 m^3/s.

The existing 200 mm diameter culvert has a capacity of 0.043 m^3/s, which is slightly less than the peak runoff flow rate during a 5 year design storm event. During storm events in excess of the culvert capacity, runoff is expected to spill overland along the east side of the office/manufacturing building towards Colpoy's Bay, the same as it currently does under existing conditions.

Stormwater Quality Treatment

As there are minimal changes within the drainage area of Stormwater Outlet 4, there are no proposed stormwater quality improvements proposed in this area. Similar to existing conditions, stormwater quality treatment would be provided by the treed area to the northeast of the existing office and manufacturing building prior to runoff reaching Colpoy's Bay.

5. SUMMARY

The proposed site improvements include building expansions, a proposed sewage system, parking lot expansions and drainage improvements. All runoff from the subject property, as well as the residential lands to the south, and the north half of the Grey Road 1 right-of-way, drains northerly to Colpoy's Bay through the subject property. There are four (4) main stormwater outlets which direct runoff around the existing, proposed and future buildings on the site. The proposed and future site improvements result in changes in the drainage patterns in 2 of the 4 drainage outlets.

The following summarizes our drainage analysis:

- The ditch proposed to be constructed to convey runoff around the proposed Dome Structure to Stormwater Outlet 1 has been sized to convey a 100 year peak runoff flow while providing an Enhanced Level of water quality treatment prior to draining to Colpoy's Bay.

- The storm sewer system proposed for the new parking area south of the future office building addition is designed to convey a 100 year design storm event to Stormwater Outlet 2, and to provide an Enhanced Level of water quality treatment prior to draining to Colpoy's Bay.

- The existing storm sewer which drains runoff under the existing building to Stormwater Outlet 3 is proposed to remain unchanged.

- The existing storm sewer which drains runoff around the east side of the existing office and manufacturing building to Stormwater Outlet 4, is proposed to remain unchanged.

As such, we feel the stormwater management design is satisfactory to accommodate the proposed development.

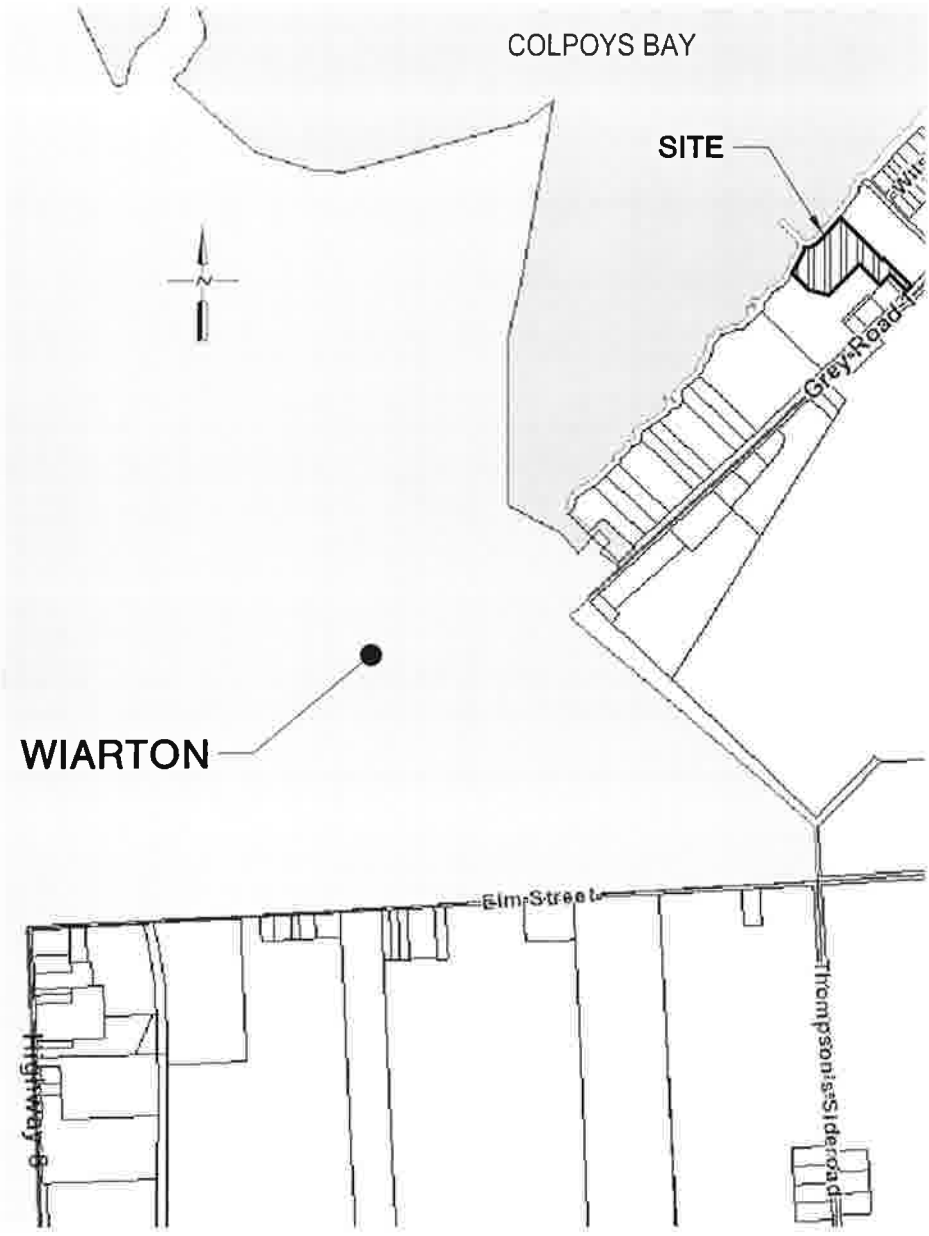
All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED
Per:

Ian E. Eriksen, P.Eng.
IEE/dr

FIGURES

214154-1
501273 Grey Road 1
Township of
Georgian Bluffs



NOT TO SCALE
FEBRUARY 2015

SITE LOCATION PLAN

PROPOSED ADDITIONS
CAFRAMO LIMITED

Figure No. 1

BluePlan
ENGINEERING

214154-1
501273 Grey Road 1
Township of Georgian Bluffs

STORMWATER OUTLET 4

STORMWATER OUTLET 3

STORMWATER OUTLET 2

STORMWATER OUTLET 1

400	
0.685	40%

300	
0.055	95%

200	
0.375	100%

500	
1.032	5%

100	
2.517	18%

AREA OF EXISTING TREES

AREA OF EXISTING TREES

PROPOSED GRAVEL PARKING AREA

PROPOSED DOME STRUCTURE

FUTURE ADDITION

LOT 18

LOT 17

LOT 16

LOT 15

LOT 14

LOT 13

ALLOWANCE

ROAD

ALLEY

ORIGINAL ROAD ALLOWANCE

PART 4, PLAN 16R-9455

PART 3, PLAN 16R-9455

PART PLAN 16R-9455

PART PLAN 16R-2740

REGISTERED PLAN

CONSTRUCTION NORTH

LEGEND

- DRAINAGE BOUNDARY
- 200 / 1.55 / 15% — CATCHMENT NUMBER; IMPERVIOUS PERCENTAGE; DRAINAGE AREA (ha)
- GENERAL DRAINAGE DIRECTION

15 0 10 20 40

1:1000 (m)

SCALE = 1:1,000

FEBRUARY 2015

POST DEVELOPMENT DRAINAGE AREA PLAN

PROPOSED ADDITIONS CAFRAMO LIMITED

Figure No. 2

BluePlan ENGINEERING

FILE:C:\Civil 3D Projects\214154-1 SP-K.dwg LAYOUT:Drainage Areas
LAST SAVED BY: Kboers, 2/5/2015 10:58:45 AM PLOTTED BY: Ken Boers - GM BluePlan 2/5/2015 10:59:08 AM

APPENDIX A:
MIDUSS MODELLING AND RAINFALL CHICAGO PARAMETERS

Chicago Storm Parameters

Environment Canada - Wiarton Rainfall Station
IDF Curve Data from Environment Canada – 1973 to 2007 (33 Years of Data)

5 Year
A = 864.20
B = 9.417
C = 0.7941
R = 0.375

100 Year
A = 2198.13
B = 16.618
C = 0.8566
R = 0.375

```
"               MIDUSS Output ------------------------------------------------>"
"               MIDUSS version                              Version 2.25  rev. 473"
"               MIDUSS created                          Sunday, February 07, 2010"
"          10   Units used:                                                ie METRIC"
"               Job folder:          C:\Users\IEriksen\Ians Documents\MIDUSS\"
"                                                                          214154-1"
"               Output filename:    214154-1 Post-Development 5yr Feb 2015.out"
"               Licensee name:                                                  "
"               Company                                        Gamsby and Mannerow"
"               Date & Time last used:                  2/5/2015 at 1:22:00 PM"
" 31          TIME PARAMETERS"
"      10.000   Time Step"
"     360.000   Max. Storm length"
"    2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     864.200   Coefficient A"
"       9.417   Constant B"
"       0.794   Exponent C"
"       0.375   Fraction R"
"     360.000   Duration"
"       1.000   Time step multiplier"
"            Maximum intensity            80.822    mm/hr"
"            Total depth                  47.413    mm"
"           6   005hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Catchment 1"
"      18.000   % Impervious"
"       2.517   Total Area"
"     100.000   Flow length"
"       8.000   Overland Slope"
"       2.064   Pervious Area"
"     100.000   Pervious length"
"       8.000   Pervious slope"
"       0.453   Impervious Area"
"     100.000   Impervious length"
"       8.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      71.000   Pervious SCS Curve No."
"       0.205   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      10.375   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      99.000   Impervious SCS Curve No."
"       0.929   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.257   Impervious Initial abstraction"
"                   0.082     0.000     0.000     0.000 c.m/sec"
"            Catchment 100          Pervious   Impervious Total Area "
"            Surface Area           2.064      0.453      2.517      hectare"
"            Time of concentration  39.345     3.305      21.379     minutes"
"            Time to Centroid       246.275    169.733    208.119    minutes"
"            Rainfall depth         47.413     47.413     47.413     mm"
"            Rainfall volume        978.58     214.81     1193.39    c.m"
"            Rainfall losses        37.683     3.354      31.504     mm"
"            Runoff depth           9.730      44.059     15.909     mm"
"            Runoff volume          200.82     199.61     400.43     c.m"
"            Runoff coefficient     0.205      0.929      0.336      "
"            Maximum flow           0.030      0.079      0.082      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
```

```
"            4   Add Runoff "
"                    0.082     0.082     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.082     0.082     0.082     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                  0.082    c.m/sec"
"             Hydrograph volume           400.433    c.m"
"                    0.082     0.082     0.082     0.082"
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"            2   Start - New Tributary"
"                    0.082     0.000     0.082     0.082"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Catchment 2"
"      100.000   % Impervious"
"        0.375   Total Area"
"       30.000   Flow length"
"        3.000   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        3.000   Pervious slope"
"        0.375   Impervious Area"
"       30.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.000   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.915   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.069     0.000     0.082     0.082 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.375      0.375      hectare"
"             Time of concentration  25.642     2.154      2.154      minutes"
"             Time to Centroid       229.709    168.026    168.026    minutes"
"             Rainfall depth         47.413     47.413     47.413     mm"
"             Rainfall volume        0.00       177.80     177.80     c.m"
"             Rainfall losses        37.709     4.025      4.025      mm"
"             Runoff depth           9.705      43.388     43.388     mm"
"             Runoff volume          0.00       162.70     162.70     c.m"
"             Runoff coefficient     0.000      0.915      0.915      "
"             Maximum flow           0.000      0.069      0.069      c.m/sec"
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"            4   Add Runoff "
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"            8   Copy to Outflow"
"                    0.069     0.069     0.069     0.082"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                  0.151    c.m/sec"
```

```
"            Hydrograph volume          563.137    c.m"
"                  0.069     0.069     0.069     0.151"
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"           2   Start - New Tributary"
"                  0.069     0.000     0.069     0.151"
" 33         CATCHMENT 300"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         300   Catchment 3"
"      95.000   % Impervious"
"       0.055   Total Area"
"      15.000   Flow length"
"       3.000   Overland Slope"
"       0.003   Pervious Area"
"      15.000   Pervious length"
"       3.000   Pervious slope"
"       0.052   Impervious Area"
"      15.000   Impervious length"
"       3.000   Impervious slope"
"       0.250   Pervious Manning 'n'"
"      71.000   Pervious SCS Curve No."
"       0.205   Pervious Runoff coefficient"
"       0.100   Pervious Ia/S coefficient"
"      10.375   Pervious Initial abstraction"
"       0.015   Impervious Manning 'n'"
"      99.000   Impervious SCS Curve No."
"       0.889   Impervious Runoff coefficient"
"       0.100   Impervious Ia/S coefficient"
"       0.257   Impervious Initial abstraction"
"                  0.010     0.000     0.069     0.151 c.m/sec"
"            Catchment 300          Pervious   Impervious Total Area "
"            Surface Area           0.003      0.052      0.055      hectare"
"            Time of concentration  16.918     1.421      1.607      minutes"
"            Time to Centroid       218.992    167.520    168.137    minutes"
"            Rainfall depth         47.413     47.413     47.413     mm"
"            Rainfall volume        1.30       24.77      26.08      c.m"
"            Rainfall losses        37.693     5.256      6.877      mm"
"            Runoff depth           9.720      42.158     40.536     mm"
"            Runoff volume          0.27       22.03      22.29      c.m"
"            Runoff coefficient     0.205      0.889      0.855      "
"            Maximum flow           0.000      0.010      0.010      c.m/sec"
" 40         HYDROGRAPH Add Runoff "
"           4   Add Runoff "
"                  0.010     0.010     0.069     0.151"
" 40         HYDROGRAPH Copy to Outflow"
"           8   Copy to Outflow"
"                  0.010     0.010     0.010     0.151"
" 40         HYDROGRAPH   Combine    1"
"           6   Combine "
"           1   Node #"
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"            Maximum flow                0.161    c.m/sec"
"            Hydrograph volume          585.432    c.m"
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"           1   Equal length"
"           1   SCS method"
"         400   Catchment 4"
```

```
"       40.000   % Impervious"
"        0.685   Total Area"
"       80.000   Flow length"
"        5.000   Overland Slope"
"        0.411   Pervious Area"
"       80.000   Pervious length"
"        5.000   Pervious slope"
"        0.274   Impervious Area"
"       80.000   Impervious length"
"        5.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.205   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.929   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.048     0.000     0.010     0.161 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.411      0.274      0.685      hectare"
"             Time of concentration  39.626     3.328      12.361     minutes"
"             Time to Centroid       246.612    169.771    188.894    minutes"
"             Rainfall depth         47.413     47.413     47.413     mm"
"             Rainfall volume        194.87     129.91     324.78     c.m"
"             Rainfall losses        37.681     3.349      23.948     mm"
"             Runoff depth           9.733      44.064     23.465     mm"
"             Runoff volume          40.00      120.74     160.74     c.m"
"             Runoff coefficient     0.205      0.929      0.495      "
"             Maximum flow           0.006      0.048      0.048      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.048     0.048     0.010     0.161"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.048     0.048     0.048     0.161"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                 0.209    c.m/sec"
"             Hydrograph volume          746.169    c.m"
"                    0.048     0.048     0.048     0.209"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.048     0.000     0.048     0.209"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          500   Catchment 5"
"        5.000   % Impervious"
"        1.032   Total Area"
"       40.000   Flow length"
"        1.000   Overland Slope"
"        0.980   Pervious Area"
"       40.000   Pervious length"
"        1.000   Pervious slope"
"        0.052   Impervious Area"
"       40.000   Impervious length"
"        1.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.205   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.931   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                  0.015     0.000     0.048     0.209 c.m/sec"
"             Catchment 500          Pervious   Impervious Total Area "
"             Surface Area           0.980      0.052      1.032      hectare"
"             Time of concentration  42.370     3.559      34.892     minutes"
"             Time to Centroid       249.946    170.204    234.582    minutes"
"             Rainfall depth         47.413     47.413     47.413     mm"
"             Rainfall volume        464.84     24.47      489.31     c.m"
"             Rainfall losses        37.682     3.288      35.963     mm"
"             Runoff depth           9.731      44.125     11.451     mm"
"             Runoff volume          95.40      22.77      118.17     c.m"
"             Runoff coefficient     0.205      0.931      0.242      "
"             Maximum flow           0.014      0.009      0.015      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                  0.015     0.015     0.048     0.209"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                  0.015     0.015     0.015     0.209"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                0.219    c.m/sec"
"             Hydrograph volume           864.341  c.m"
"                  0.015     0.015     0.015     0.219"
" 38          START/RE-START TOTALS 500"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                    4.664    hectare"
"             Total Impervious area                   1.206    hectare"
"             Total % impervious                     25.856"
" 19          EXIT"
```

```
"               MIDUSS Output ------------------------------------------->"
"               MIDUSS version                              Version 2.25  rev. 473"
"               MIDUSS created                          Sunday, February 07, 2010"
"          10   Units used:                                            ie METRIC"
"               Job folder:          C:\Users\IEriksen\Ians Documents\MIDUSS\"
"                                                                       214154-1"
"               Output filename:  214154-1 Post-Development 100yr Feb 2015.out"
"               Licensee name:                                                 ."
"               Company                                        Gamsby and Mannerow"
"               Date & Time last used:                    2/5/2015 at 1:18:57 PM"
" 31          TIME PARAMETERS"
"       10.000   Time Step"
"      360.000   Max. Storm length"
"     2400.000   Max. Hydrograph"
" 32          STORM Chicago storm"
"           1   Chicago storm"
"     2198.130   Coefficient A"
"       16.618   Constant B"
"        0.857   Exponent C"
"        0.375   Fraction R"
"      360.000   Duration"
"        1.000   Time step multiplier"
"             Maximum intensity           130.253    mm/hr"
"             Total depth                  81.782    mm"
"           6   100hyd   Hydrograph extension used in this file"
" 33          CATCHMENT 100"
"           1   Triangular SCS"
"           1   Equal length"
"           1   SCS method"
"         100   Catchment 1"
"       18.000   % Impervious"
"        2.517   Total Area"
"      100.000   Flow length"
"        8.000   Overland Slope"
"        2.064   Pervious Area"
"      100.000   Pervious length"
"        8.000   Pervious slope"
"        0.453   Impervious Area"
"      100.000   Impervious length"
"        8.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.355   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.949   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.188     0.000     0.000     0.000 c.m/sec"
"             Catchment 100          Pervious   Impervious Total Area "
"             Surface Area           2.064      0.453      2.517      hectare"
"             Time of concentration  23.573     2.719      15.853     minutes"
"             Time to Centroid       216.214    165.447    197.421    minutes"
"             Rainfall depth         81.782     81.782     81.782     mm"
"             Rainfall volume        1687.93    370.52     2058.45    c.m"
"             Rainfall losses        52.787     4.144      44.032     mm"
"             Runoff depth           28.995     77.638     37.750     mm"
"             Runoff volume          598.43     351.75     950.18     c.m"
"             Runoff coefficient     0.355      0.949      0.462      "
"             Maximum flow           0.132      0.136      0.188      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
```

```
"            4   Add Runoff "
"                    0.188     0.188     0.000     0.000"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.188     0.188     0.188     0.000"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                  0.188    c.m/sec"
"             Hydrograph volume           950.177    c.m"
"                    0.188     0.188     0.188     0.188"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.188     0.000     0.188     0.188"
" 33          CATCHMENT 200"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          200   Catchment 2"
"      100.000   % Impervious"
"        0.375   Total Area"
"       30.000   Flow length"
"        3.000   Overland Slope"
"        0.000   Pervious Area"
"       30.000   Pervious length"
"        3.000   Pervious slope"
"        0.375   Impervious Area"
"       30.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.000   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.925   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.116     0.000     0.188     0.188 c.m/sec"
"             Catchment 200          Pervious   Impervious Total Area "
"             Surface Area           0.000      0.375      0.375      hectare"
"             Time of concentration  15.363     1.772      1.772      minutes"
"             Time to Centroid       205.792    164.037    164.036    minutes"
"             Rainfall depth         81.782     81.782     81.782     mm"
"             Rainfall volume        0.00       306.68     306.68     c.m"
"             Rainfall losses        52.761     6.097      6.097      mm"
"             Runoff depth           29.020     75.685     75.685     mm"
"             Runoff volume          0.00       283.82     283.82     c.m"
"             Runoff coefficient     0.000      0.925      0.925      "
"             Maximum flow           0.000      0.116      0.116      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.116     0.116     0.188     0.188"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.116     0.116     0.116     0.188"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                  0.277    c.m/sec"
```

```
"             Hydrograph volume          1233.997    c.m"
"                    0.116     0.116     0.116     0.277"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.116     0.000     0.116     0.277"
" 33          CATCHMENT 300"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          300   Catchment 3"
"       95.000   % Impervious"
"        0.055   Total Area"
"       15.000   Flow length"
"        3.000   Overland Slope"
"        0.003   Pervious Area"
"       15.000   Pervious length"
"        3.000   Pervious slope"
"        0.052   Impervious Area"
"       15.000   Impervious length"
"        3.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.354   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.889   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.016     0.000     0.116     0.277 c.m/sec"
"             Catchment 300          Pervious   Impervious Total Area "
"             Surface Area           0.003      0.052      0.055      hectare"
"             Time of concentration  10.136     1.169      1.353      minutes"
"             Time to Centroid       199.067    164.009    164.729    minutes"
"             Rainfall depth         81.782     81.782     81.782     mm"
"             Rainfall volume        2.25       42.73      44.98      c.m"
"             Rainfall losses        52.826     9.093      11.280     mm"
"             Runoff depth           28.956     72.689     70.502     mm"
"             Runoff volume          0.80       37.98      38.78      c.m"
"             Runoff coefficient     0.354      0.889      0.862      "
"             Maximum flow           0.000      0.016      0.016      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.016     0.016     0.116     0.277"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.016     0.016     0.016     0.277"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                 0.294    c.m/sec"
"             Hydrograph volume          1272.772    c.m"
"                    0.016     0.016     0.016     0.294"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.016     0.000     0.016     0.294"
" 33          CATCHMENT 400"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          400   Catchment 4"
```

```
"       40.000   % Impervious"
"        0.685   Total Area"
"       80.000   Flow length"
"        5.000   Overland Slope"
"        0.411   Pervious Area"
"       80.000   Pervious length"
"        5.000   Pervious slope"
"        0.274   Impervious Area"
"       80.000   Impervious length"
"        5.000   Impervious slope"
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.355   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.949   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.087     0.000     0.016     0.294 c.m/sec"
"             Catchment 400          Pervious   Impervious Total Area "
"             Surface Area           0.411      0.274      0.685      hectare"
"             Time of concentration  23.741     2.738      10.279     minutes"
"             Time to Centroid       216.424    165.468    183.764    minutes"
"             Rainfall depth         81.782     81.782     81.782     mm"
"             Rainfall volume        336.12     224.08     560.21     c.m"
"             Rainfall losses        52.782     4.130      33.321     mm"
"             Runoff depth           29.000     77.652     48.461     mm"
"             Runoff volume          119.19     212.77     331.96     c.m"
"             Runoff coefficient     0.355      0.949      0.593      "
"             Maximum flow           0.026      0.082      0.087      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.087     0.087     0.016     0.294"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.087     0.087     0.087     0.294"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                  0.381    c.m/sec"
"             Hydrograph volume          1604.728    c.m"
"                    0.087     0.087     0.087     0.381"
" 40          HYDROGRAPH Start - New Tributary"
"            2   Start - New Tributary"
"                    0.087     0.000     0.087     0.381"
" 33          CATCHMENT 500"
"            1   Triangular SCS"
"            1   Equal length"
"            1   SCS method"
"          500   Catchment 5"
"        5.000   % Impervious"
"        1.032   Total Area"
"       40.000   Flow length"
"        1.000   Overland Slope"
"        0.980   Pervious Area"
"       40.000   Pervious length"
"        1.000   Pervious slope"
"        0.052   Impervious Area"
"       40.000   Impervious length"
"        1.000   Impervious slope"
```

```
"        0.250   Pervious Manning 'n'"
"       71.000   Pervious SCS Curve No."
"        0.355   Pervious Runoff coefficient"
"        0.100   Pervious Ia/S coefficient"
"       10.375   Pervious Initial abstraction"
"        0.015   Impervious Manning 'n'"
"       99.000   Impervious SCS Curve No."
"        0.951   Impervious Runoff coefficient"
"        0.100   Impervious Ia/S coefficient"
"        0.257   Impervious Initial abstraction"
"                    0.066     0.000     0.087     0.381 c.m/sec"
"             Catchment 500           Pervious   Impervious Total Area "
"             Surface Area            0.980      0.052      1.032      hectare"
"             Time of concentration   25.385     2.928      22.609     minutes"
"             Time to Centroid        218.541    165.679    212.007    minutes"
"             Rainfall depth          81.782     81.782     81.782     mm"
"             Rainfall volume         801.79     42.20      843.99     c.m"
"             Rainfall losses         52.758     4.011      50.320     mm"
"             Runoff depth            29.024     77.771     31.462     mm"
"             Runoff volume           284.55     40.13      324.68     c.m"
"             Runoff coefficient      0.355      0.951      0.385      "
"             Maximum flow            0.061      0.015      0.066      c.m/sec"
" 40          HYDROGRAPH Add Runoff "
"            4   Add Runoff "
"                    0.066     0.066     0.087     0.381"
" 40          HYDROGRAPH Copy to Outflow"
"            8   Copy to Outflow"
"                    0.066     0.066     0.066     0.381"
" 40          HYDROGRAPH   Combine    1"
"            6   Combine "
"            1   Node #"
"                Flow from catch 1"
"             Maximum flow                  0.407    c.m/sec"
"             Hydrograph volume          1929.411    c.m"
"                    0.066     0.066     0.066     0.407"
" 38          START/RE-START TOTALS 500"
"            3   Runoff Totals on EXIT"
"             Total Catchment area                      4.664    hectare"
"             Total Impervious area                     1.206    hectare"
"             Total % impervious                       25.856"
" 19          EXIT"
```

APPENDIX B:
STORM SEWER DESIGN SHEET

Design Storm	A	B
2 yr	19.2	-0.672
5 yr	**25.6**	**-0.666**
10 yr	29.8	-0.664
25 yr	35.1	-0.662
50 yr	39.0	-0.660
100 yr	**42.9**	**-0.659**

Where Q = 2.78 AIC and I = A x TcB (where Tc in hours)
Q = peak flow in litres per second (L/s)
A = area in hectares (ha)
I = rainfall intensity in millimetres per hour (mm/h)
C = runoff coefficient
A, B = design storm coefficients
Tc = time of concentration in minutes (MIN. 10.0 minutes)

ESTIMATED DESIGN FLOWS

STORM SEWER DESIGN SHEET

Wiarton IDF

DESIGN:	PROJECT:	SHEET NO.
Ian Eriksen GM BluePlan	Caframo Limited	1 of 1
DATE: Feb-5 2015	**Project No:** 214154-1	

LOCATION			AREA (ha)		Individual 2.78 AC	Cumulative 2.78 AC	Time of Concentration Tc (minutes)	Rainfall Intensity I (mm/h)	Peak Flow Q (L/s)	SEWER DATA							
5yr Design Flow	FROM	TO	C = 0.30	C = 0.90						Type of Pipe	Roughness Coefficient (n)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Full Flow Velocity (m/s)	Time of Flow (minutes)
	CB-1	CB-2	0.000	0.055	0.14	0.14	10.00	84	12	HDPE	0.013	250	0.70	26.0	50	1.01	0.43
	CB-2	CB-4	0.000	0.067	0.17	0.31	10.43	82	25	HDPE	0.013	250	3.00	15.0	103	2.10	0.12
	Ex CB	CB-3	0.000	0.122	0.31	0.31	10.00	84	26	HDPE	0.013	250	4.00	8.0	119	2.42	0.06
	CB-3	CB-4	0.000	0.035	0.09	0.39	10.06	84	33	HDPE	0.013	250	1.00	27.0	59	1.21	0.37
	CB-4	CB-5	0.000	0.052	0.13	0.83	10.43	82	68	HDPE	0.013	300	1.50	21.0	118	1.68	0.21
	CB-5	Outlet	0.000	0.044	0.11	0.94	10.64	81	76	HDPE	0.013	375	1.00	22.0	175	1.59	0.23

LOCATION			AREA (ha)		Individual 2.78 AC	Cumulative 2.78 AC	Time of Concentration Tc (minutes)	Rainfall Intensity I (mm/h)	Peak Flow Q (L/s)	SEWER DATA							
100yr Design Flow	FROM	TO	C = 0.30	C = 0.90						Type of Pipe	Roughness Coefficient (n)	Diameter (mm)	Slope (%)	Length (m)	Capacity (L/s)	Full Flow Velocity (m/s)	Time of Flow (minutes)
	CB-1	CB-2	0.000	0.055	0.14	0.14	10.00	140	19	HDPE	0.013	250	0.70	26.0	50	1.01	0.43
	CB-2	CB-4	0.000	0.067	0.17	0.31	10.43	136	41	HDPE	0.013	250	3.00	15.0	103	2.10	0.12
	Ex CB	CB-3	0.000	0.122	0.31	0.31	10.00	140	43	HDPE	0.013	250	4.00	8.0	119	2.42	0.06
	CB-3	CB-4	0.000	0.035	0.09	0.39	10.06	139	55	HDPE	0.013	250	1.00	27.0	59	1.21	0.37
	CB-4	CB-5	0.000	0.052	0.13	0.83	10.43	136	113	HDPE	0.013	300	1.50	21.0	118	1.68	0.21
	CB-5	Outlet	0.000	0.044	0.11	0.94	10.64	134	126	HDPE	0.013	375	1.00	22.0	175	1.59	0.23