

# **MEMORIAL DE INSTALAÇÕES HIDROSSANITÁRIAS**

## **PRÉDIO DO MINISTÉRIO PÚBLICO DO CEARÁ**

## **MEMORIAL DESCRITIVO – PROJETO HIDROSSANITÁRIO**

NOME DO EMPREENDIMENTO: Edifício do Ministério Público do Ceará

ENDEREÇO: Av. Gen. Afonso Albuquerque Lima, 130, Fortaleza., Bairro: Cambéba

Nome do Projetista: Antonio Leonardo Medina Andrade – Engenheiro Civil – CREA n. 061451389-8 e Arquiteto – CAU n. A74406-9

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## **1.0 Listagem de Pranchas**

- UMPRAUM-MPCE-EX-HIS-01-Isometrica Geral-R00
- UMPRAUM-MPCE-EX-HIS-02-Pav. Superior AF Geral-R00
- UMPRAUM-MPCE-EX-HIS-03-Pav. Superior AF Setor 01-R00
- UMPRAUM-MPCE-EX-HIS-04-Pav. Superior AF Setor 02-R00
- UMPRAUM-MPCE-EX-HIS-05-Pav. Superior AF Setor 03-R00
- UMPRAUM-MPCE-EX-HIS-06-Pav. Superior AF Setor 04-R00
- UMPRAUM-MPCE-EX-HIS-07-Pav. Inferior AF Geral e Setor 01-R00
- UMPRAUM-MPCE-EX-HIS-08-Pav. Inferior AF Setor 02-R00
- UMPRAUM-MPCE-EX-HIS-09-Pav. Superior Esgoto Geral-R00
- UMPRAUM-MPCE-EX-HIS-10-Pav. Superior Esgoto Setor 01-R00
- UMPRAUM-MPCE-EX-HIS-11-Pav. Superior Esgoto Setor 02-R00
- UMPRAUM-MPCE-EX-HIS-12-Pav. Superior Esgoto Setor 03-R00
- UMPRAUM-MPCE-EX-HIS-13-Pav. Superior Esgoto Setor 04-R00
- UMPRAUM-MPCE-EX-HIS-14-Pav. Inferior Esgoto Geral e Setor 01-R00
- UMPRAUM-MPCE-EX-HIS-15-Pav. Inferior Esgoto Setor 02-R00
- UMPRAUM-MPCE-EX-HIS-16-Pav. Coberta-R00
- UMPRAUM-MPCE-EX-HIS-17-Planta Baixa de Drenagem Superior e Inferior-R00
- UMPRAUM-MPCE-EX-HIS-18-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-19-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-20-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-21-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-22-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-23-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-24-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-25-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-26-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-27-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-28-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-29-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-30-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-31-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-32-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-33-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-34-Detalhamento-R00
- UMPRAUM-MPCE-EX-HIS-35-Detalhamento-R00

## **2.0 Resumo do Memorial**

Memorial destinado a dissertar acerca das decisões de projeto adotadas para o sistema de instalações hidrossanitárias prediais da **reforma** do antigo edifício do Tribunal de Contas do Estado do Ceará (TCM) para uso Ministério Público do Ceará (MPCE), situado no complexo do Cambéba no Ceará, endereço Av. Gen. Afonso Albuquerque Lima, 130, Cambéba, Fortaleza.

O abastecimento de água fria é dado pela ligação com a concessionária (CAGECE) e o esgotamento sanitário, é feito por uma ligação à Estação de Tratamento de Esgoto (E.T.E.) dentro do complexo.

## **3.0 Dimensionamento de Consumo Predial**

### *3.1 Dados Gerais*

Pavimentos Habitados = 2 (Pav. Inferior + Pav. Superior)

População Total = (1 pessoa / 7 m<sup>2</sup>) \* 7.294 m<sup>2</sup> = 1.042 pessoas

Consumo Predial = 1.042 pessoas x 50 litros por dia = 52.100 litros por dia

### *3.2 Reservatório Superior*

Demanda Teórica Suprimento de AF = 52.100 x 2 dias x 0,40 = 41.680 L

Reserva R.T.I. = 12.000 L

TOTAL = 53.680 L

**Capacidade da Caixa D'água Existente:**

Número de células = 2

Volume para Consumo Predial por célula = 24.000 L

Volume total para Consumo Predial = 48.000 L

Volume Reserva R.T.I. por célula = 6.000 L

Volume total para R.T.I. = 12.000 L

TOTAL = 60.000 L

**Conclusão:**

A Caixa d'água existente **atende** as demandas.

### *3.3 Reservatório Inferior*

Demanda Teórica Suprimento de AF =  $52.100 \times 2 \text{ dias} \times 0,60 = 62.520 \text{ L}$

Capacidade da Cisterna Existente: 60.000 L

Volume Caixa d'água existente – Volume Demanda =  $48.000 \text{ L} - 41.680 \text{ L} = 6.320 \text{ L}$

Demanda Real Cisterna:  $62.520 \text{ L} - 6.320 \text{ L} = 56.200 \text{ L}$

**Conclusão:**

A Cisterna existente **atende** as demandas.

### **4.0 Dimensionamento do Alimentador Predial**

Material = PVC

$52.100 \text{ L} \times 1,0 \text{ m/s} = 52.100 \text{ L}$

$Q = 52.100 / 86.400 = 0,6030 \text{ L/s}$

Ábaco de Fair-Whipple-Hsiao >> 27mm

Bitola do Alimentador Predial Existente: 32 mm

O Alimentador Predial Existente **atende** a demanda.

### **5.0 Dimensionamento de Bombas**

A caixa d'água, cisterna e tubulação de alimentação existentes não serão modificadas, pois atendem as demandas da edificação.

Detalhe das Bombas de Recalque Existentes:

Marca: Dancor

Modelo: CAM-W10

Vazão Máxima =  $8.4 \text{ m}^3 / \text{h}$

H(man) = 26 m.c.a.

Potência = 1.5 CV

São utilizadas duas bombas de recalque em regime de funcionamento alternado.

## 6.0 Cálculo das Pressões

### 6.1 AF Coluna 01

| Trecho   | Soma do Peso | Vazao Estimada (l/s) | Diametro Nominal (mm) | Velocidade (m/s) | Perda de Carga Unitaria (kPa/m) | Diferença de Cota (m) | Pressao Disponivel (kPa) | Comprimento da Tubulacao real (m) | Comprimento da Tubulacao Equivalente (m) | Perda de Carga da Tubulacao (kPa) | Perda de Carga Total (kPa) | Pressao Disponivel Residual (kPa) | Pressao requerida no ponto de utilizacao (kPa) |
|----------|--------------|----------------------|-----------------------|------------------|---------------------------------|-----------------------|--------------------------|-----------------------------------|------------------------------------------|-----------------------------------|----------------------------|-----------------------------------|------------------------------------------------|
| 1 -- 2   | 21.3         | 1.38                 | 60                    | 0.62             | 0.1                             | -3.23                 | 117.74                   | 27.67                             | 57.27                                    | 5.48                              | 5.48                       | 112.26                            | 5                                              |
| 2 -- 3   | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 136.26                   | 3.03                              | 9.13                                     | 2.83                              | 2.83                       | 133.44                            | 5                                              |
| 3 -- 4   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 137.28                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 135.17                            | 5                                              |
| 3 -- 5   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 133.44                   | 2.21                              | 6.01                                     | 3.17                              | 3.17                       | 130.27                            | 10                                             |
| 2 -- 6   | 20.7         | 1.36                 | 60                    | 0.61             | 0.09                            | 0                     | 112.26                   | 12.42                             | 13.22                                    | 1.23                              | 1.23                       | 111.03                            | 5                                              |
| 6 -- 7   | 16.5         | 1.22                 | 60                    | 0.54             | 0.08                            | 0                     | 111.03                   | 2.34                              | 2.34                                     | 0.18                              | 0.18                       | 110.85                            | 5                                              |
| 7 -- 8   | 16.5         | 1.22                 | 60                    | 0.54             | 0.08                            | 1.7                   | 127.85                   | 6.17                              | 11.17                                    | 0.85                              | 0.85                       | 127                               | 5                                              |
| 8 -- 9   | 13.8         | 1.11                 | 60                    | 0.5              | 0.07                            | 0                     | 127                      | 0.5                               | 0.5                                      | 0.03                              | 0.03                       | 126.97                            | 5                                              |
| 9 -- 10  | 13.2         | 1.09                 | 60                    | 0.49             | 0.06                            | 0                     | 126.97                   | 1.2                               | 1.2                                      | 0.08                              | 0.08                       | 126.89                            | 5                                              |
| 10 -- 11 | 2.1          | 0.43                 | 25                    | 1.19             | 0.93                            | 2.4                   | 150.89                   | 8.81                              | 18.21                                    | 16.89                             | 16.89                      | 134                               | 5                                              |
| 11 -- 12 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 134                      | 0.05                              | 2.45                                     | 1.29                              | 1.29                       | 132.71                            | 10                                             |
| 11 -- 13 | 1.8          | 0.4                  | 25                    | 1.1              | 0.81                            | 0                     | 134                      | 0.72                              | 1.52                                     | 1.23                              | 1.23                       | 132.77                            | 5                                              |
| 13 -- 14 | 1.5          | 0.37                 | 25                    | 1                | 0.69                            | 0                     | 132.77                   | 0.72                              | 1.52                                     | 1.05                              | 1.05                       | 131.72                            | 5                                              |
| 14 -- 15 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 131.72                   | 3.19                              | 5.49                                     | 3.12                              | 3.12                       | 128.59                            | 5                                              |
| 15 -- 16 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 128.59                   | 0.69                              | 1.49                                     | 0.85                              | 0.85                       | 127.75                            | 5                                              |
| 16 -- 17 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 127.75                   | 0.59                              | 1.39                                     | 0.79                              | 0.79                       | 126.96                            | 5                                              |
| 17 -- 18 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 126.96                   | 2.01                              | 4.31                                     | 2.45                              | 2.45                       | 124.51                            | 5                                              |
| 18 -- 19 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 124.51                   | 1.03                              | 1.83                                     | 0.81                              | 0.81                       | 123.7                             | 5                                              |
| 19 -- 20 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 127.54                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 125.43                            | 5                                              |
| 19 -- 21 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 123.7                    | 1.01                              | 1.81                                     | 0.56                              | 0.56                       | 123.14                            | 5                                              |
| 21 -- 22 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 127.14                   | 1.41                              | 4.91                                     | 2.59                              | 2.59                       | 124.55                            | 5                                              |
| 21 -- 23 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 126.98                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 124.87                            | 5                                              |
| 18 -- 24 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 128.36                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 126.24                            | 5                                              |
| 17 -- 28 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.02                  | 127.11                   | 1.93                              | 7.93                                     | 4.18                              | 4.18                       | 122.93                            | 10                                             |
| 13 -- 29 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 132.77                   | 0.05                              | 2.45                                     | 1.29                              | 1.29                       | 131.48                            | 10                                             |
| 10 -- 30 | 11.1         | 1                    | 40                    | 1.03             | 0.39                            | 0                     | 126.89                   | 3.58                              | 3.58                                     | 1.4                               | 1.4                        | 125.49                            | 5                                              |
| 30 -- 31 | 11.1         | 1                    | 40                    | 1.03             | 0.39                            | 1.7                   | 142.49                   | 3.08                              | 16.58                                    | 6.49                              | 6.49                       | 136                               | 5                                              |
| 31 -- 32 | 8.4          | 0.87                 | 40                    | 0.89             | 0.31                            | 0                     | 136                      | 6.14                              | 8.34                                     | 2.56                              | 2.56                       | 133.44                            | 5                                              |
| 32 -- 33 | 1.5          | 0.37                 | 32                    | 0.61             | 0.21                            | 0                     | 133.44                   | 18.12                             | 22.72                                    | 4.73                              | 4.73                       | 128.71                            | 5                                              |
| 33 -- 34 | 0.3          | 0.16                 | 25                    | 0.45             | 0.17                            | 2.4                   | 152.71                   | 3.7                               | 11.8                                     | 1.99                              | 1.99                       | 150.72                            | 5                                              |
| 34 -- 35 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | -0.7                  | 143.72                   | 1.24                              | 5.04                                     | 2.65                              | 2.65                       | 141.06                            | 10                                             |
| 33 -- 36 | 1.2          | 0.33                 | 32                    | 0.54             | 0.17                            | 0                     | 128.71                   | 0.59                              | 2.09                                     | 0.36                              | 0.36                       | 128.35                            | 5                                              |
| 36 -- 37 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 152.35                   | 3.74                              | 10.74                                    | 3.33                              | 3.33                       | 149.02                            | 5                                              |
| 37 -- 38 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 153.02                   | 1.79                              | 5.29                                     | 2.79                              | 2.79                       | 150.24                            | 5                                              |
| 37 -- 39 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 149.02                   | 0.02                              | 2.42                                     | 1.28                              | 1.28                       | 147.75                            | 10                                             |
| 36 -- 40 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 152.35                   | 5.2                               | 16.8                                     | 5.21                              | 5.21                       | 147.15                            | 5                                              |
| 40 -- 41 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 147.15                   | 0.04                              | 2.44                                     | 1.29                              | 1.29                       | 145.86                            | 10                                             |
| 40 -- 42 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 151.15                   | 2.08                              | 5.58                                     | 2.94                              | 2.94                       | 148.21                            | 5                                              |

|          |     |      |    |      |      |      |        |       |       |       |       |        |    |
|----------|-----|------|----|------|------|------|--------|-------|-------|-------|-------|--------|----|
| 32 -- 43 | 6.9 | 0.79 | 32 | 1.3  | 0.79 | 0    | 133.44 | 15.45 | 20.15 | 15.96 | 15.96 | 117.48 | 5  |
| 43 -- 44 | 1.5 | 0.37 | 32 | 0.61 | 0.21 | 0    | 117.48 | 17.09 | 18.59 | 3.87  | 3.87  | 113.61 | 5  |
| 44 -- 45 | 1.2 | 0.33 | 32 | 0.54 | 0.17 | 0    | 113.61 | 0.24  | 1.74  | 0.3   | 0.3   | 113.31 | 5  |
| 45 -- 46 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4  | 137.31 | 5.18  | 12.18 | 3.78  | 3.78  | 133.54 | 5  |
| 46 -- 47 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 133.54 | 1.4   | 3.7   | 1.95  | 1.95  | 131.59 | 10 |
| 46 -- 48 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 137.38 | 0.4   | 4     | 2.11  | 2.11  | 135.27 | 5  |
| 45 -- 49 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4  | 137.31 | 3.14  | 11.24 | 3.48  | 3.48  | 133.83 | 5  |
| 49 -- 50 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 137.83 | 2.05  | 5.55  | 2.93  | 2.93  | 134.9  | 5  |
| 49 -- 51 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 133.83 | 0.02  | 2.42  | 1.27  | 1.27  | 132.55 | 10 |
| 44 -- 52 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 2.4  | 137.61 | 3.15  | 11.25 | 1.9   | 1.9   | 135.71 | 5  |
| 52 -- 53 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | -0.7 | 128.71 | 1.13  | 4.63  | 2.44  | 2.44  | 126.27 | 10 |
| 43 -- 54 | 5.4 | 0.7  | 32 | 1.15 | 0.64 | 0    | 117.48 | 2.17  | 3.67  | 2.35  | 2.35  | 115.14 | 5  |
| 54 -- 55 | 2.1 | 0.43 | 25 | 1.19 | 0.93 | 2.4  | 139.14 | 4.32  | 13.42 | 12.45 | 12.45 | 126.69 | 5  |
| 55 -- 56 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 130.53 | 0.43  | 4.03  | 2.12  | 2.12  | 128.41 | 5  |
| 55 -- 57 | 1.8 | 0.4  | 25 | 1.1  | 0.81 | 0    | 126.69 | 1.1   | 1.9   | 1.54  | 1.54  | 125.15 | 5  |
| 57 -- 58 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 128.99 | 0.43  | 4.03  | 2.12  | 2.12  | 126.87 | 5  |
| 57 -- 59 | 1.5 | 0.37 | 25 | 1    | 0.69 | 0    | 125.15 | 1.11  | 1.91  | 1.32  | 1.32  | 123.83 | 5  |
| 59 -- 60 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0    | 123.83 | 1.06  | 1.86  | 1.06  | 1.06  | 122.77 | 5  |
| 60 -- 61 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 122.77 | 2.44  | 4.74  | 2.09  | 2.09  | 120.68 | 5  |
| 61 -- 62 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 120.68 | 0.69  | 1.49  | 0.66  | 0.66  | 120.02 | 5  |
| 62 -- 63 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 120.02 | 3.01  | 5.31  | 2.35  | 2.35  | 117.67 | 5  |
| 63 -- 64 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 117.67 | 0.02  | 2.42  | 1.28  | 1.28  | 116.39 | 10 |
| 63 -- 65 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 117.67 | 0.85  | 1.65  | 0.51  | 0.51  | 117.16 | 5  |
| 65 -- 66 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 117.16 | 0.02  | 2.42  | 1.28  | 1.28  | 115.88 | 10 |
| 65 -- 67 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 117.16 | 0.87  | 3.17  | 1.67  | 1.67  | 115.49 | 10 |
| 62 -- 70 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.42 | 124.17 | 1.65  | 7.65  | 4.03  | 4.03  | 120.14 | 5  |
| 59 -- 71 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 127.67 | 0.43  | 4.03  | 2.12  | 2.12  | 125.55 | 5  |
| 54 -- 72 | 3.3 | 0.54 | 32 | 0.9  | 0.42 | 0    | 115.14 | 0.99  | 2.49  | 1.03  | 1.03  | 114.1  | 5  |
| 72 -- 73 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4  | 138.1  | 6.45  | 16.05 | 4.97  | 4.97  | 133.13 | 5  |
| 73 -- 74 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 136.97 | 0.4   | 4     | 2.11  | 2.11  | 134.87 | 5  |
| 73 -- 75 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 133.13 | 2.22  | 6.02  | 3.17  | 3.17  | 129.96 | 10 |
| 72 -- 76 | 2.7 | 0.49 | 25 | 1.35 | 1.16 | 2.4  | 138.1  | 7.58  | 15.58 | 18    | 18    | 120.1  | 5  |
| 76 -- 77 | 2.4 | 0.46 | 25 | 1.27 | 1.04 | 0    | 120.1  | 0.94  | 1.74  | 1.81  | 1.81  | 118.29 | 5  |
| 77 -- 78 | 2.1 | 0.43 | 25 | 1.19 | 0.93 | 0    | 118.29 | 0.93  | 1.73  | 1.61  | 1.61  | 116.68 | 5  |
| 78 -- 79 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 120.53 | 0.4   | 4     | 2.11  | 2.11  | 118.42 | 5  |
| 78 -- 80 | 1.8 | 0.4  | 25 | 1.1  | 0.81 | 0    | 116.68 | 0.93  | 1.73  | 1.4   | 1.4   | 115.28 | 5  |
| 80 -- 81 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 119.12 | 0.4   | 4     | 2.11  | 2.11  | 117.01 | 5  |
| 80 -- 82 | 1.5 | 0.37 | 25 | 1    | 0.69 | 0    | 115.28 | 0.92  | 1.72  | 1.19  | 1.19  | 114.09 | 5  |
| 82 -- 83 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 117.93 | 0.4   | 4     | 2.11  | 2.11  | 115.82 | 5  |
| 82 -- 84 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0    | 114.09 | 0.95  | 1.75  | 0.99  | 0.99  | 113.09 | 5  |
| 84 -- 85 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 116.94 | 0.4   | 4     | 2.11  | 2.11  | 114.83 | 5  |
| 84 -- 86 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 113.09 | 4.16  | 7.96  | 3.52  | 3.52  | 109.58 | 5  |
| 86 -- 87 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 109.58 | 0.85  | 1.65  | 0.51  | 0.51  | 109.06 | 5  |
| 87 -- 88 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 109.06 | 0.87  | 3.17  | 1.67  | 1.67  | 107.39 | 10 |
| 87 -- 89 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 109.06 | 0.02  | 2.42  | 1.28  | 1.28  | 107.79 | 10 |
| 86 -- 90 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 109.58 | 0.02  | 2.42  | 1.28  | 1.28  | 108.3  | 10 |
| 77 -- 91 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 122.13 | 0.4   | 4     | 2.11  | 2.11  | 120.02 | 5  |

|            |     |      |    |      |      |      |        |       |       |       |       |        |    |
|------------|-----|------|----|------|------|------|--------|-------|-------|-------|-------|--------|----|
| 76 -- 92   | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 123.94 | 0.4   | 4     | 2.11  | 2.11  | 121.83 | 5  |
| 31 -- 93   | 2.7 | 0.49 | 40 | 0.51 | 0.11 | 0    | 136    | 7.5   | 9     | 1.02  | 1.02  | 134.98 | 5  |
| 93 -- 94   | 1.8 | 0.4  | 32 | 0.66 | 0.24 | 0    | 134.98 | 18.47 | 19.97 | 4.88  | 4.88  | 130.1  | 5  |
| 94 -- 95   | 1.2 | 0.33 | 32 | 0.54 | 0.17 | 0    | 130.1  | 0.66  | 2.16  | 0.37  | 0.37  | 129.73 | 5  |
| 95 -- 96   | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4  | 153.73 | 5.22  | 12.22 | 3.79  | 3.79  | 149.94 | 5  |
| 96 -- 97   | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 153.79 | 0.41  | 4.01  | 2.11  | 2.11  | 151.67 | 5  |
| 96 -- 98   | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 149.94 | 1.4   | 3.7   | 1.95  | 1.95  | 147.99 | 10 |
| 95 -- 99   | 0.6 | 0.23 | 20 | 1.02 | 0.97 | 2.4  | 153.73 | 3.39  | 11.19 | 10.81 | 10.81 | 142.92 | 5  |
| 99 -- 100  | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 146.92 | 1.79  | 4.99  | 2.63  | 2.63  | 144.29 | 5  |
| 99 -- 101  | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 142.92 | 0.02  | 2.42  | 1.28  | 1.28  | 141.64 | 10 |
| 94 -- 102  | 0.6 | 0.23 | 32 | 0.38 | 0.09 | 0    | 130.1  | 0.75  | 5.35  | 0.5   | 0.5   | 129.6  | 5  |
| 102 -- 103 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 2.4  | 153.6  | 2.56  | 6.96  | 1.18  | 1.18  | 152.42 | 5  |
| 103 -- 104 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 152.42 | 0.72  | 3.12  | 1.64  | 1.64  | 150.78 | 10 |
| 103 -- 105 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 1.71 | 169.57 | 3.99  | 9.79  | 1.65  | 1.65  | 167.91 | 5  |
| 105 -- 106 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | -0.7 | 160.91 | 1.33  | 4.83  | 2.55  | 2.55  | 158.37 | 10 |
| 93 -- 107  | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 134.98 | 25.05 | 29.75 | 13.15 | 13.15 | 121.83 | 5  |
| 107 -- 108 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 2.4  | 145.83 | 3.78  | 9.88  | 1.67  | 1.67  | 144.16 | 5  |
| 108 -- 109 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | -0.7 | 137.16 | 1.28  | 4.78  | 2.52  | 2.52  | 134.65 | 10 |
| 107 -- 110 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4  | 145.83 | 4.33  | 9.73  | 3.02  | 3.02  | 142.82 | 5  |
| 110 -- 111 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 142.82 | 0.02  | 2.42  | 1.28  | 1.28  | 141.54 | 10 |
| 110 -- 112 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 146.82 | 1.78  | 5.28  | 2.78  | 2.78  | 144.03 | 5  |
| 9 -- 113   | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4  | 150.97 | 6.37  | 12.57 | 3.9   | 3.9   | 147.07 | 5  |
| 113 -- 114 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 151.07 | 1.98  | 6.98  | 3.68  | 3.68  | 147.39 | 5  |
| 113 -- 115 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 147.07 | 0.01  | 2.41  | 1.27  | 1.27  | 145.8  | 10 |
| 8 -- 116   | 2.7 | 0.49 | 25 | 1.35 | 1.16 | 2.4  | 151    | 10.67 | 17.07 | 19.73 | 19.73 | 131.27 | 5  |
| 116 -- 117 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 131.27 | 0.24  | 1.14  | 0.5   | 0.5   | 130.77 | 5  |
| 117 -- 118 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 130.77 | 0.72  | 1.52  | 0.47  | 0.47  | 130.3  | 5  |
| 118 -- 119 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 130.3  | 0.05  | 2.45  | 1.29  | 1.29  | 129.01 | 10 |
| 118 -- 120 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 130.3  | 0.77  | 3.07  | 1.62  | 1.62  | 128.68 | 10 |
| 117 -- 121 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 130.77 | 0.05  | 2.45  | 1.29  | 1.29  | 129.48 | 10 |
| 116 -- 122 | 1.8 | 0.4  | 25 | 1.1  | 0.81 | 0    | 131.27 | 5.25  | 9.15  | 7.41  | 7.41  | 123.86 | 5  |
| 122 -- 123 | 1.5 | 0.37 | 25 | 1    | 0.69 | 0    | 123.86 | 0.91  | 1.71  | 1.18  | 1.18  | 122.67 | 5  |
| 123 -- 124 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 126.52 | 0.4   | 4     | 2.11  | 2.11  | 124.41 | 5  |
| 123 -- 125 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0    | 122.67 | 0.89  | 1.69  | 0.96  | 0.96  | 121.71 | 5  |
| 125 -- 126 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 125.56 | 0.4   | 4     | 2.11  | 2.11  | 123.45 | 5  |
| 125 -- 127 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 121.71 | 0.89  | 1.69  | 0.75  | 0.75  | 120.96 | 5  |
| 127 -- 128 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 120.96 | 0.89  | 1.69  | 0.52  | 0.52  | 120.44 | 5  |
| 128 -- 129 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 124.44 | 1.3   | 4.8   | 2.53  | 2.53  | 121.91 | 5  |
| 128 -- 130 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 124.28 | 0.4   | 4     | 2.11  | 2.11  | 122.18 | 5  |
| 127 -- 131 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 124.81 | 0.4   | 4     | 2.11  | 2.11  | 122.7  | 5  |
| 122 -- 132 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 127.7  | 0.4   | 4     | 2.11  | 2.11  | 125.6  | 5  |
| 6 -- 133   | 4.2 | 0.61 | 32 | 1.01 | 0.51 | 0    | 111.03 | 5.53  | 7.03  | 3.61  | 3.61  | 107.43 | 5  |
| 133 -- 134 | 3.6 | 0.57 | 32 | 0.94 | 0.45 | 0    | 107.43 | 1.88  | 3.38  | 1.51  | 1.51  | 105.91 | 5  |
| 134 -- 135 | 1.8 | 0.4  | 32 | 0.66 | 0.24 | 0    | 105.91 | 0.69  | 2.19  | 0.54  | 0.54  | 105.38 | 5  |
| 135 -- 136 | 1.2 | 0.33 | 20 | 1.45 | 1.77 | 2.4  | 129.38 | 7.41  | 13.11 | 23.23 | 23.23 | 106.14 | 5  |
| 136 -- 137 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 106.14 | 0.02  | 2.42  | 1.28  | 1.28  | 104.87 | 10 |
| 136 -- 138 | 0.9 | 0.28 | 20 | 1.25 | 1.38 | 0    | 106.14 | 0.95  | 1.75  | 2.41  | 2.41  | 103.73 | 5  |

|            |     |      |    |      |      |       |        |      |       |       |       |        |    |
|------------|-----|------|----|------|------|-------|--------|------|-------|-------|-------|--------|----|
| 138 -- 139 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 103.73 | 0.02 | 2.42  | 1.28  | 1.28  | 102.46 | 10 |
| 138 -- 140 | 0.6 | 0.23 | 20 | 1.02 | 0.97 | 0     | 103.73 | 2.78 | 4.78  | 4.62  | 4.62  | 99.11  | 5  |
| 140 -- 141 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4   | 103.11 | 2.19 | 5.39  | 2.84  | 2.84  | 100.27 | 5  |
| 140 -- 142 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.39  | 102.98 | 0.41 | 4.01  | 2.11  | 2.11  | 100.86 | 5  |
| 135 -- 143 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.4   | 129.38 | 7.15 | 15.25 | 4.72  | 4.72  | 124.65 | 5  |
| 143 -- 144 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 124.65 | 1.24 | 3.54  | 1.86  | 1.86  | 122.79 | 10 |
| 143 -- 145 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38  | 128.5  | 0.4  | 4     | 2.11  | 2.11  | 126.39 | 5  |
| 134 -- 146 | 1.8 | 0.4  | 25 | 1.1  | 0.81 | 2.4   | 129.91 | 6.38 | 16.18 | 13.12 | 13.12 | 116.8  | 5  |
| 146 -- 147 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 116.8  | 0.06 | 2.46  | 1.29  | 1.29  | 115.5  | 10 |
| 146 -- 148 | 1.5 | 0.37 | 25 | 1    | 0.69 | 0     | 116.8  | 0.78 | 1.58  | 1.09  | 1.09  | 115.71 | 5  |
| 148 -- 149 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0     | 115.71 | 0.77 | 1.57  | 0.89  | 0.89  | 114.82 | 5  |
| 149 -- 150 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 114.82 | 0.06 | 2.46  | 1.29  | 1.29  | 113.52 | 10 |
| 149 -- 151 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0     | 114.82 | 0.76 | 1.56  | 0.69  | 0.69  | 114.13 | 5  |
| 151 -- 152 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 114.13 | 0.06 | 2.46  | 1.29  | 1.29  | 112.83 | 10 |
| 151 -- 153 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0     | 114.13 | 2.45 | 4.75  | 1.47  | 1.47  | 112.66 | 5  |
| 153 -- 154 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38  | 116.5  | 0.41 | 4.01  | 2.11  | 2.11  | 114.39 | 5  |
| 153 -- 155 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 0     | 112.66 | 1.96 | 2.76  | 0.47  | 0.47  | 112.19 | 5  |
| 155 -- 156 | 0   | 0    | 25 | 0    | 0    | -0.62 | 105.95 | 2.98 | 8.28  | 0     | 0     | 105.95 | 5  |
| 156 -- 158 | 0   | 0    | 25 | 0    | 0    | 0     | 105.95 | 0.77 | 3.17  | 0     | 0     | 105.95 | 5  |
| 158 -- 160 | 0   | 0    | 25 | 0    | 0    | 0     | 105.95 | 0.78 | 3.18  | 0     | 0     | 105.95 | 5  |
| 160 -- 163 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4   | 109.95 | 1.22 | 4.72  | 2.49  | 2.49  | 107.46 | 5  |
| 148 -- 164 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 115.71 | 0.06 | 2.46  | 1.29  | 1.29  | 114.41 | 10 |
| 133 -- 165 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 1.9   | 126.43 | 4.54 | 12.64 | 3.92  | 3.92  | 122.51 | 5  |
| 165 -- 166 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 0     | 122.51 | 0.57 | 1.37  | 0.23  | 0.23  | 122.28 | 5  |
| 166 -- 167 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.3   | 125.28 | 1.29 | 6.29  | 3.32  | 3.32  | 121.96 | 10 |
| 165 -- 168 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.48  | 127.36 | 0.53 | 4.13  | 2.18  | 2.18  | 125.18 | 10 |

## 6.2 AF Coluna 02

| Trecho   | Soma do Peso | Vazao Estimada (l/s) | Diametro Nominal (mm) | Velocidade (m/s) | Perda de Carga Unitaria (kPa/m) | Diferenca de Cota (m) | Pressao Disponivel (kPa) | Comprimento da Tubulacao real (m) | Comprimento da Tubulacao Equivalente (m) | Perda de Carga da Tubulacao (kPa) | Perda de Carga Total (kPa) | Pressao Disponivel Residual (kPa) | Pressao requerida no ponto de utilizacao (kPa) |
|----------|--------------|----------------------|-----------------------|------------------|---------------------------------|-----------------------|--------------------------|-----------------------------------|------------------------------------------|-----------------------------------|----------------------------|-----------------------------------|------------------------------------------------|
| 1 -- 2   | 10.2         | 0.96                 | 60                    | 0.43             | 0.05                            | -3.23                 | 117.74                   | 69.72                             | 100.72                                   | 5.06                              | 5.06                       | 112.68                            | 5                                              |
| 2 -- 3   | 1.5          | 0.37                 | 60                    | 0.16             | 0.01                            | 0                     | 112.68                   | 5.94                              | 13.74                                    | 0.13                              | 0.13                       | 112.56                            | 5                                              |
| 3 -- 4   | 0.9          | 0.28                 | 60                    | 0.13             | 0.01                            | 0                     | 112.56                   | 4.52                              | 6.92                                     | 0.04                              | 0.04                       | 112.51                            | 5                                              |
| 4 -- 5   | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 136.51                   | 3.69                              | 16.69                                    | 5.17                              | 5.17                       | 131.34                            | 5                                              |
| 5 -- 6   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 135.34                   | 1.9                               | 5.4                                      | 2.84                              | 2.84                       | 132.5                             | 5                                              |
| 5 -- 7   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 131.34                   | 0.05                              | 2.45                                     | 1.29                              | 1.29                       | 130.05                            | 10                                             |
| 4 -- 8   | 0.3          | 0.16                 | 25                    | 0.45             | 0.17                            | 2.4                   | 136.51                   | 4.57                              | 15.87                                    | 2.68                              | 2.68                       | 133.83                            | 5                                              |
| 8 -- 9   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | -0.7                  | 126.83                   | 1.34                              | 5.14                                     | 2.71                              | 2.71                       | 124.13                            | 10                                             |
| 3 -- 10  | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 136.56                   | 4.03                              | 17.03                                    | 5.28                              | 5.28                       | 131.28                            | 5                                              |
| 10 -- 11 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 131.28                   | 0.05                              | 2.45                                     | 1.29                              | 1.29                       | 129.99                            | 10                                             |
| 10 -- 12 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 135.28                   | 1.32                              | 4.82                                     | 2.54                              | 2.54                       | 132.74                            | 5                                              |
| 2 -- 13  | 8.7          | 0.88                 | 60                    | 0.4              | 0.04                            | 0                     | 112.68                   | 36.53                             | 42.63                                    | 1.86                              | 1.86                       | 110.82                            | 5                                              |
| 13 -- 14 | 3.3          | 0.54                 | 50                    | 0.36             | 0.05                            | 0                     | 110.82                   | 15.82                             | 18.02                                    | 0.85                              | 0.85                       | 109.98                            | 5                                              |
| 14 -- 15 | 1.8          | 0.4                  | 40                    | 0.41             | 0.08                            | 0                     | 109.98                   | 2.04                              | 4.24                                     | 0.34                              | 0.34                       | 109.64                            | 5                                              |
| 15 -- 16 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 2.4                   | 133.64                   | 9.81                              | 24.81                                    | 14.1                              | 14.1                       | 119.54                            | 5                                              |
| 16 -- 17 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 119.54                   | 3.23                              | 5.63                                     | 1.75                              | 1.75                       | 117.79                            | 5                                              |
| 17 -- 18 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 117.79                   | 0.63                              | 2.93                                     | 1.54                              | 1.54                       | 116.25                            | 10                                             |
| 17 -- 19 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 117.79                   | 0.06                              | 2.46                                     | 1.29                              | 1.29                       | 116.5                             | 10                                             |
| 16 -- 20 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 119.54                   | 3.07                              | 5.47                                     | 1.7                               | 1.7                        | 117.84                            | 5                                              |
| 20 -- 21 | 0.3          | 0.16                 | 25                    | 0.45             | 0.17                            | 0                     | 117.84                   | 0.85                              | 1.65                                     | 0.28                              | 0.28                       | 117.56                            | 5                                              |
| 21 -- 22 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 121.41                   | 0.39                              | 3.99                                     | 2.1                               | 2.1                        | 119.31                            | 5                                              |
| 21 -- 24 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 121.56                   | 1.62                              | 6.32                                     | 3.33                              | 3.33                       | 118.24                            | 5                                              |
| 15 -- 25 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 133.64                   | 4.6                               | 18.1                                     | 5.61                              | 5.61                       | 128.03                            | 5                                              |
| 25 -- 26 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 128.03                   | 0                                 | 2.4                                      | 1.27                              | 1.27                       | 126.76                            | 10                                             |
| 25 -- 27 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 132.03                   | 3.33                              | 8.33                                     | 4.39                              | 4.39                       | 127.64                            | 5                                              |
| 14 -- 28 | 1.5          | 0.37                 | 25                    | 1                | 0.69                            | 2.4                   | 133.98                   | 4.16                              | 17.66                                    | 12.2                              | 12.2                       | 121.77                            | 5                                              |
| 28 -- 29 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 121.77                   | 0.02                              | 2.42                                     | 1.28                              | 1.28                       | 120.5                             | 10                                             |
| 28 -- 30 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 121.77                   | 0.57                              | 1.37                                     | 0.78                              | 0.78                       | 120.99                            | 5                                              |
| 30 -- 31 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 120.99                   | 0.02                              | 2.42                                     | 1.28                              | 1.28                       | 119.72                            | 10                                             |
| 30 -- 32 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 120.99                   | 2.8                               | 5.1                                      | 2.25                              | 2.25                       | 118.74                            | 5                                              |
| 32 -- 33 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 122.59                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 120.48                            | 5                                              |
| 32 -- 34 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 118.74                   | 0.84                              | 1.64                                     | 0.51                              | 0.51                       | 118.23                            | 5                                              |
| 34 -- 35 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 122.23                   | 1.25                              | 4.75                                     | 2.5                               | 2.5                        | 119.73                            | 5                                              |
| 34 -- 36 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 122.08                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 119.97                            | 5                                              |
| 13 -- 37 | 5.4          | 0.7                  | 40                    | 0.72             | 0.21                            | 0                     | 110.82                   | 10.59                             | 10.59                                    | 2.21                              | 2.21                       | 108.62                            | 5                                              |
| 37 -- 38 | 2.7          | 0.49                 | 40                    | 0.51             | 0.11                            | 0                     | 108.62                   | 0.06                              | 2.26                                     | 0.26                              | 0.26                       | 108.36                            | 5                                              |

|          |     |      |    |      |      |      |        |      |       |       |       |        |    |
|----------|-----|------|----|------|------|------|--------|------|-------|-------|-------|--------|----|
| 38 -- 39 | 2.1 | 0.43 | 25 | 1.19 | 0.93 | 2.4  | 132.36 | 6.57 | 15.17 | 14.06 | 14.06 | 118.3  | 5  |
| 39 -- 40 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 118.3  | 2.17 | 4.57  | 2.02  | 2.02  | 116.28 | 5  |
| 40 -- 41 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 116.28 | 0.86 | 1.66  | 0.51  | 0.51  | 115.76 | 5  |
| 41 -- 42 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 115.76 | 0.88 | 3.18  | 1.67  | 1.67  | 114.09 | 10 |
| 41 -- 43 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 115.76 | 0.02 | 2.42  | 1.28  | 1.28  | 114.49 | 10 |
| 40 -- 44 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 116.28 | 0.02 | 2.42  | 1.28  | 1.28  | 115    | 10 |
| 39 -- 45 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0    | 118.3  | 0.79 | 1.69  | 0.96  | 0.96  | 117.34 | 5  |
| 45 -- 47 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0.02 | 117.49 | 1.32 | 4.92  | 2.8   | 2.8   | 114.69 | 5  |
| 47 -- 48 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0    | 114.69 | 2.02 | 4.32  | 2.46  | 2.46  | 112.24 | 5  |
| 48 -- 49 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 116.08 | 0.4  | 4     | 2.11  | 2.11  | 113.98 | 5  |
| 48 -- 50 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 112.24 | 1.06 | 1.86  | 0.82  | 0.82  | 111.41 | 5  |
| 50 -- 51 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 111.41 | 1.11 | 1.91  | 0.59  | 0.59  | 110.82 | 5  |
| 51 -- 52 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 114.82 | 1.51 | 5.01  | 2.64  | 2.64  | 112.18 | 5  |
| 51 -- 53 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 114.67 | 0.4  | 4     | 2.11  | 2.11  | 112.56 | 5  |
| 50 -- 54 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 115.26 | 0.4  | 4     | 2.11  | 2.11  | 113.15 | 5  |
| 47 -- 56 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 2.42 | 138.85 | 5.3  | 15.3  | 4.74  | 4.74  | 134.11 | 5  |
| 56 -- 57 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 138.11 | 1.54 | 6.64  | 3.5   | 3.5   | 134.61 | 5  |
| 56 -- 58 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 134.11 | 0.42 | 2.82  | 1.48  | 1.48  | 132.62 | 10 |
| 37 -- 59 | 2.7 | 0.49 | 25 | 1.35 | 1.16 | 2.4  | 132.62 | 4.03 | 14.53 | 16.79 | 16.79 | 115.83 | 5  |
| 59 -- 60 | 1.8 | 0.4  | 25 | 1.1  | 0.81 | 0    | 115.83 | 3.22 | 5.62  | 4.56  | 4.56  | 111.27 | 5  |
| 60 -- 61 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 115.12 | 0.4  | 4     | 2.11  | 2.11  | 113.01 | 5  |
| 60 -- 62 | 1.5 | 0.37 | 25 | 1    | 0.69 | 0    | 111.27 | 0.95 | 1.75  | 1.21  | 1.21  | 110.06 | 5  |
| 62 -- 63 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0    | 110.06 | 0.93 | 1.73  | 0.98  | 0.98  | 109.08 | 5  |
| 63 -- 64 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 109.08 | 0.93 | 1.73  | 0.76  | 0.76  | 108.31 | 5  |
| 64 -- 65 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 112.16 | 0.4  | 4     | 2.11  | 2.11  | 110.05 | 5  |
| 64 -- 66 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 108.31 | 0.93 | 1.73  | 0.54  | 0.54  | 107.78 | 5  |
| 66 -- 67 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 111.62 | 0.4  | 4     | 2.11  | 2.11  | 109.52 | 5  |
| 66 -- 68 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4  | 111.78 | 1.35 | 4.85  | 2.56  | 2.56  | 109.22 | 5  |
| 63 -- 69 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 112.92 | 0.4  | 4     | 2.11  | 2.11  | 110.82 | 5  |
| 62 -- 70 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38 | 113.9  | 0.4  | 4     | 2.11  | 2.11  | 111.8  | 5  |
| 59 -- 71 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0    | 115.83 | 1.69 | 4.09  | 1.81  | 1.81  | 114.02 | 5  |
| 71 -- 72 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0    | 114.02 | 0.86 | 1.66  | 0.51  | 0.51  | 113.51 | 5  |
| 72 -- 73 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 113.51 | 0.02 | 2.42  | 1.28  | 1.28  | 112.23 | 10 |
| 72 -- 74 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 113.51 | 0.87 | 3.17  | 1.67  | 1.67  | 111.84 | 10 |
| 71 -- 75 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0    | 114.02 | 0.02 | 2.42  | 1.28  | 1.28  | 112.75 | 10 |

### 6.3 AF Coluna 03

| Trecho   | Soma do Peso | Vazao Estimada (l/s) | Diametro Nominal (mm) | Velocidade (m/s) | Perda de Carga Unitaria (kPa/m) | Diferenca de Cota (m) | Pressao Disponivel (kPa) | Comprimento da Tubulacao real (m) | Comprimento da Tubulacao Equivalente (m) | Perda de Carga da Tubulacao (kPa) | Perda de Carga Total (kPa) | Pressao Disponivel Residual (kPa) | Pressao requerida no ponto de utilizacao (kPa) |
|----------|--------------|----------------------|-----------------------|------------------|---------------------------------|-----------------------|--------------------------|-----------------------------------|------------------------------------------|-----------------------------------|----------------------------|-----------------------------------|------------------------------------------------|
| 1 -- 2   | 3.3          | 0.54                 | 32                    | 0.9              | 0.42                            | -3.23                 | 117.74                   | 62.07                             | 78.07                                    | 32.43                             | 32.43                      | 85.31                             | 5                                              |
| 2 -- 3   | 0            | 0                    | 25                    | 0                | 0                               | 2.4                   | 109.31                   | 3.21                              | 9.81                                     | 0                                 | 0                          | 109.31                            | 5                                              |
| 3 -- 4   | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 1.1                               | 3.5                                      | 0                                 | 0                          | 109.31                            | 5                                              |
| 4 -- 5   | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 0.86                              | 1.66                                     | 0                                 | 0                          | 109.31                            | 5                                              |
| 5 -- 6   | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 2.71                              | 5.01                                     | 0                                 | 0                          | 109.31                            | 5                                              |
| 6 -- 7   | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 0.7                               | 1.5                                      | 0                                 | 0                          | 109.31                            | 5                                              |
| 7 -- 8   | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 2.02                              | 4.32                                     | 0                                 | 0                          | 109.31                            | 5                                              |
| 8 -- 9   | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 1.06                              | 1.86                                     | 0                                 | 0                          | 109.31                            | 5                                              |
| 9 -- 10  | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 109.31                   | 1.11                              | 1.91                                     | 0                                 | 0                          | 109.31                            | 5                                              |
| 10 -- 11 | 3.3          | 0.54                 | 32                    | 0.9              | 0.42                            | 0                     | 109.31                   | 2.39                              | 4.69                                     | 1.95                              | 1.95                       | 107.36                            | 5                                              |
| 11 -- 12 | 2.7          | 0.49                 | 25                    | 1.35             | 1.16                            | 2.4                   | 131.36                   | 3.21                              | 9.81                                     | 11.33                             | 11.33                      | 120.03                            | 5                                              |
| 12 -- 13 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 120.03                   | 1.3                               | 3.7                                      | 1.63                              | 1.63                       | 118.4                             | 5                                              |
| 13 -- 14 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 118.4                    | 0.02                              | 2.42                                     | 1.28                              | 1.28                       | 117.12                            | 10                                             |
| 13 -- 15 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 118.4                    | 0.86                              | 1.66                                     | 0.51                              | 0.51                       | 117.88                            | 5                                              |
| 15 -- 16 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 117.88                   | 0.87                              | 3.17                                     | 1.67                              | 1.67                       | 116.21                            | 10                                             |
| 15 -- 17 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 117.88                   | 0.02                              | 2.42                                     | 1.28                              | 1.28                       | 116.61                            | 10                                             |
| 12 -- 18 | 1.8          | 0.4                  | 25                    | 1.1              | 0.81                            | 0                     | 120.03                   | 3.61                              | 6.01                                     | 4.87                              | 4.87                       | 115.16                            | 5                                              |
| 18 -- 19 | 1.5          | 0.37                 | 25                    | 1                | 0.69                            | 0                     | 115.16                   | 0.95                              | 1.75                                     | 1.21                              | 1.21                       | 113.94                            | 5                                              |
| 19 -- 20 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 117.79                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 115.68                            | 5                                              |
| 19 -- 21 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 113.94                   | 0.93                              | 1.73                                     | 0.98                              | 0.98                       | 112.96                            | 5                                              |
| 21 -- 22 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 112.96                   | 0.93                              | 1.73                                     | 0.76                              | 0.76                       | 112.2                             | 5                                              |
| 22 -- 23 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 116.05                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 113.93                            | 5                                              |
| 22 -- 24 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 112.2                    | 0.93                              | 1.73                                     | 0.54                              | 0.54                       | 111.66                            | 5                                              |
| 24 -- 25 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 115.66                   | 1.36                              | 4.86                                     | 2.56                              | 2.56                       | 113.1                             | 5                                              |
| 24 -- 26 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 115.51                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 113.4                             | 5                                              |
| 21 -- 27 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 116.81                   | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 114.7                             | 5                                              |
| 18 -- 28 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 119                      | 0.41                              | 4.01                                     | 2.11                              | 2.11                       | 116.89                            | 5                                              |
| 11 -- 29 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.4                   | 131.36                   | 7.92                              | 15.42                                    | 4.78                              | 4.78                       | 126.58                            | 5                                              |
| 29 -- 30 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 126.58                   | 0.5                               | 2.9                                      | 1.53                              | 1.53                       | 125.05                            | 10                                             |
| 29 -- 31 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 130.58                   | 1.54                              | 6.64                                     | 3.5                               | 3.5                        | 127.08                            | 5                                              |

#### 6.4 AF Coluna 04

| Trecho   | Soma do Peso | Vazao Estimada (l/s) | Diametro Nominal (mm) | Velocidade (m/s) | Perda de Carga Unitaria (kPa/m) | Diferenca de Cota (m) | Pressao Disponivel (kPa) | Comprimento da Tubulacao real (m) | Comprimento da Tubulacao Equivalente (m) | Perda de Carga da Tubulacao (kPa) | Perda de Carga Total (kPa) | Pressao Disponivel Residual (kPa) | Pressao requerida no ponto de utilizacao (kPa) |
|----------|--------------|----------------------|-----------------------|------------------|---------------------------------|-----------------------|--------------------------|-----------------------------------|------------------------------------------|-----------------------------------|----------------------------|-----------------------------------|------------------------------------------------|
| 1 -- 2   | 8.1          | 0.85                 | 60                    | 0.38             | 0.04                            | 0.57                  | 155.74                   | 91.81                             | 128.81                                   | 5.28                              | 5.28                       | 150.46                            | 5                                              |
| 2 -- 3   | 3.9          | 0.59                 | 50                    | 0.39             | 0.05                            | 0                     | 150.46                   | 1.8                               | 4.1                                      | 0.22                              | 0.22                       | 150.23                            | 5                                              |
| 3 -- 4   | 2.4          | 0.46                 | 50                    | 0.31             | 0.04                            | 0                     | 150.23                   | 1.69                              | 3.89                                     | 0.14                              | 0.14                       | 150.09                            | 5                                              |
| 4 -- 5   | 1.8          | 0.4                  | 50                    | 0.26             | 0.03                            | 0                     | 150.09                   | 3.24                              | 5.44                                     | 0.15                              | 0.15                       | 149.94                            | 5                                              |
| 5 -- 6   | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.6                   | 175.94                   | 4.77                              | 12.47                                    | 3.86                              | 3.86                       | 172.08                            | 5                                              |
| 6 -- 7   | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | -0.69                 | 165.23                   | 1.89                              | 6.49                                     | 2.01                              | 2.01                       | 163.21                            | 5                                              |
| 7 -- 8   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 163.21                   | 0.03                              | 2.43                                     | 1.28                              | 1.28                       | 161.93                            | 10                                             |
| 7 -- 9   | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 163.21                   | 0.53                              | 2.83                                     | 1.49                              | 1.49                       | 161.72                            | 10                                             |
| 5 -- 10  | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 2.6                   | 175.94                   | 4.39                              | 17.89                                    | 10.17                             | 10.17                      | 165.78                            | 5                                              |
| 10 -- 11 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 165.78                   | 0.03                              | 2.43                                     | 1.28                              | 1.28                       | 164.5                             | 10                                             |
| 10 -- 12 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 165.78                   | 0.59                              | 1.39                                     | 0.62                              | 0.62                       | 165.16                            | 5                                              |
| 12 -- 13 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 165.16                   | 3.81                              | 6.11                                     | 1.89                              | 1.89                       | 163.27                            | 5                                              |
| 13 -- 14 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 167.11                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 165.01                            | 5                                              |
| 13 -- 15 | 0.3          | 0.16                 | 25                    | 0.45             | 0.17                            | 0                     | 163.27                   | 0.87                              | 1.67                                     | 0.28                              | 0.28                       | 162.99                            | 5                                              |
| 15 -- 16 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 166.83                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 164.72                            | 5                                              |
| 15 -- 17 | 0            | 0                    | 25                    | 0                | 0                               | 0                     | 162.99                   | 0.62                              | 1.42                                     | 0                                 | 0                          | 162.99                            | 5                                              |
| 17 -- 20 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 162.99                   | 2.07                              | 6.77                                     | 3.57                              | 3.57                       | 159.42                            | 10                                             |
| 4 -- 21  | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 2.6                   | 176.09                   | 5.11                              | 18.81                                    | 5.83                              | 5.83                       | 170.26                            | 5                                              |
| 21 -- 22 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 170.26                   | 0.4                               | 2.8                                      | 1.48                              | 1.48                       | 168.79                            | 10                                             |
| 21 -- 23 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 174.26                   | 1.55                              | 6.65                                     | 3.51                              | 3.51                       | 170.76                            | 5                                              |
| 3 -- 24  | 1.5          | 0.37                 | 25                    | 1                | 0.69                            | 2.6                   | 176.23                   | 4.35                              | 17.85                                    | 12.33                             | 12.33                      | 163.9                             | 5                                              |
| 24 -- 25 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 163.9                    | 0.57                              | 1.37                                     | 0.78                              | 0.78                       | 163.12                            | 5                                              |
| 25 -- 26 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 163.12                   | 3.25                              | 5.55                                     | 2.45                              | 2.45                       | 160.67                            | 5                                              |
| 26 -- 27 | 0.6          | 0.23                 | 25                    | 0.63             | 0.31                            | 0                     | 160.67                   | 0.83                              | 1.63                                     | 0.5                               | 0.5                        | 160.16                            | 5                                              |
| 27 -- 28 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.4                   | 164.16                   | 1.26                              | 4.76                                     | 2.51                              | 2.51                       | 161.66                            | 5                                              |
| 27 -- 29 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 164.01                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 161.9                             | 5                                              |
| 26 -- 30 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0.38                  | 164.51                   | 0.4                               | 4                                        | 2.11                              | 2.11                       | 162.41                            | 5                                              |
| 25 -- 31 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 163.12                   | 0.04                              | 2.44                                     | 1.29                              | 1.29                       | 161.83                            | 10                                             |
| 24 -- 32 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 163.9                    | 0.04                              | 2.44                                     | 1.29                              | 1.29                       | 162.61                            | 10                                             |
| 2 -- 33  | 4.2          | 0.61                 | 50                    | 0.4              | 0.06                            | 0                     | 150.46                   | 5.08                              | 6.58                                     | 0.38                              | 0.38                       | 150.07                            | 5                                              |
| 33 -- 34 | 2.1          | 0.43                 | 25                    | 1.19             | 0.93                            | 2.6                   | 176.07                   | 3.79                              | 13.39                                    | 12.42                             | 12.42                      | 163.66                            | 5                                              |
| 34 -- 35 | 1.8          | 0.4                  | 25                    | 1.1              | 0.81                            | 0                     | 163.66                   | 0.95                              | 1.75                                     | 1.42                              | 1.42                       | 162.24                            | 5                                              |
| 35 -- 36 | 0.3          | 0.16                 | 20                    | 0.72             | 0.53                            | 0                     | 162.24                   | 0.04                              | 2.44                                     | 1.28                              | 1.28                       | 160.96                            | 10                                             |
| 35 -- 37 | 1.5          | 0.37                 | 25                    | 1                | 0.69                            | 0                     | 162.24                   | 0.57                              | 1.37                                     | 0.95                              | 0.95                       | 161.29                            | 5                                              |
| 37 -- 38 | 1.2          | 0.33                 | 25                    | 0.9              | 0.57                            | 0                     | 161.29                   | 0.58                              | 1.38                                     | 0.78                              | 0.78                       | 160.51                            | 5                                              |
| 38 -- 39 | 0.9          | 0.28                 | 25                    | 0.78             | 0.44                            | 0                     | 160.51                   | 0.46                              | 1.36                                     | 0.6                               | 0.6                        | 159.91                            | 5                                              |

|          |     |      |    |      |      |       |        |       |       |       |       |        |    |
|----------|-----|------|----|------|------|-------|--------|-------|-------|-------|-------|--------|----|
| 39 -- 40 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | -2.39 | 136.05 | 5.25  | 9.85  | 4.35  | 4.35  | 131.7  | 5  |
| 40 -- 41 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 2.4   | 155.7  | 3.67  | 6.07  | 2.68  | 2.68  | 153.02 | 5  |
| 41 -- 42 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0     | 153.02 | 0.53  | 1.43  | 0.44  | 0.44  | 152.58 | 5  |
| 42 -- 43 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4   | 156.58 | 1.34  | 4.84  | 2.55  | 2.55  | 154.02 | 5  |
| 42 -- 44 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38  | 156.42 | 0.41  | 4.01  | 2.11  | 2.11  | 154.31 | 5  |
| 41 -- 45 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4   | 157.02 | 0.82  | 4.42  | 2.33  | 2.33  | 154.69 | 5  |
| 40 -- 46 | 0   | 0    | 25 | 0    | 0    | 2.4   | 155.7  | 3.32  | 9.42  | 0     | 0     | 155.7  | 5  |
| 46 -- 49 | 0   | 0    | 25 | 0    | 0    | 0     | 155.7  | 2.55  | 7.25  | 0     | 0     | 155.7  | 5  |
| 49 -- 50 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | -3    | 125.7  | 4.04  | 8.44  | 4.45  | 4.45  | 121.25 | 10 |
| 37 -- 51 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 161.29 | 0.04  | 2.44  | 1.28  | 1.28  | 160.01 | 10 |
| 34 -- 52 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 163.66 | 0.04  | 2.44  | 1.28  | 1.28  | 162.37 | 10 |
| 33 -- 53 | 2.1 | 0.43 | 25 | 1.19 | 0.93 | 2.6   | 176.07 | 11.85 | 20.35 | 18.87 | 18.87 | 157.2  | 5  |
| 53 -- 54 | 1.8 | 0.4  | 25 | 1.1  | 0.81 | 0     | 157.2  | 0.93  | 1.73  | 1.41  | 1.41  | 155.8  | 5  |
| 54 -- 55 | 1.5 | 0.37 | 25 | 1    | 0.69 | 0     | 155.8  | 0.59  | 1.39  | 0.96  | 0.96  | 154.84 | 5  |
| 55 -- 56 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 154.84 | 0.04  | 2.44  | 1.29  | 1.29  | 153.56 | 10 |
| 55 -- 57 | 1.2 | 0.33 | 25 | 0.9  | 0.57 | 0     | 154.84 | 0.58  | 1.38  | 0.78  | 0.78  | 154.06 | 5  |
| 57 -- 58 | 0.9 | 0.28 | 25 | 0.78 | 0.44 | 0     | 154.06 | 0.38  | 1.18  | 0.52  | 0.52  | 153.54 | 5  |
| 58 -- 59 | 0.6 | 0.23 | 25 | 0.63 | 0.31 | 0     | 153.54 | 0.41  | 1.21  | 0.38  | 0.38  | 153.16 | 5  |
| 59 -- 60 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.38  | 157.01 | 0.41  | 4.01  | 2.12  | 2.12  | 154.89 | 5  |
| 59 -- 61 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4   | 157.16 | 1.38  | 4.88  | 2.57  | 2.57  | 154.59 | 5  |
| 58 -- 62 | 0.3 | 0.16 | 25 | 0.45 | 0.17 | 0     | 153.54 | 8.93  | 16.53 | 2.79  | 2.79  | 150.75 | 5  |
| 62 -- 63 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0.4   | 154.75 | 0.51  | 4.11  | 2.17  | 2.17  | 152.58 | 5  |
| 62 -- 64 | 0   | 0    | 25 | 0    | 0    | 0     | 150.75 | 0.55  | 1.35  | 0     | 0     | 150.75 | 5  |
| 64 -- 65 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | -2.98 | 120.9  | 4.06  | 10.06 | 5.3   | 5.3   | 115.6  | 10 |
| 54 -- 66 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 155.8  | 0.04  | 2.44  | 1.29  | 1.29  | 154.51 | 10 |
| 53 -- 67 | 0.3 | 0.16 | 20 | 0.72 | 0.53 | 0     | 157.2  | 0.04  | 2.44  | 1.29  | 1.29  | 155.92 | 10 |

## **7.0 Esgotamento Sanitário**

O projeto de esgotamento sanitário tem como objetivo, permitir o rápido escoamento de dejetos, acessibilidade de manutenção e vedação de gases.

O destino final do sistema de esgotamento sanitário deste projeto é a estação de tratamento de esgoto existente no complexo.

Os tubos de Queda, Gordura e Sabão terão diâmetro constante de 100 mm, tendo em vista que nenhum destes alcançou o valor máximo de Unidades Hunter de Contribuição estipulado em norma (500 U.H.C.) para a bitola de 100 mm.

### ***7.1 Dimensionamento dos Ramais (esgoto e descarga), coletores e sub-coletores***

Os ramais de descarga e de esgoto, bem como, os coletores prediais e sub coletores são dimensionados pela somatória de Unidades Hunter de Contribuição (U.H.C.) e seguindo as tabelas fixadas na NBR-8160:03, conforme abaixo:

**Tabela 1- Distância máxima de um desconector ao tubo ventilador**

| Diâmetro nominal do ramal de descarga<br><i>DN</i> | Distância máxima<br>m |
|----------------------------------------------------|-----------------------|
| 40                                                 | 1,00                  |
| 50                                                 | 1,20                  |
| 75                                                 | 1,80                  |
| 100                                                | 2,40                  |

**Tabela 2 - Dimensionamento de colunas e barriletes de ventilação**

| Diâmetro nominal do tubo de queda ou do ramal de esgoto<br><br>DN | Número de unidades de Hunter de contribuição | Diâmetro nominal mínimo do tubo de ventilação |    |     |     |     |     |     |     |
|-------------------------------------------------------------------|----------------------------------------------|-----------------------------------------------|----|-----|-----|-----|-----|-----|-----|
|                                                                   |                                              | 40                                            | 50 | 75  | 100 | 150 | 200 | 250 | 300 |
|                                                                   |                                              | Comprimento permitido<br>m                    |    |     |     |     |     |     |     |
| 40                                                                | 8                                            | 46                                            | -  | -   | -   | -   | -   | -   | -   |
| 40                                                                | 10                                           | 30                                            | -  | -   | -   | -   | -   | -   | -   |
| 50                                                                | 12                                           | 23                                            | 61 | -   | -   | -   | -   | -   | -   |
| 50                                                                | 20                                           | 15                                            | 46 | -   | -   | -   | -   | -   | -   |
| 75                                                                | 10                                           | 13                                            | 46 | 317 | -   | -   | -   | -   | -   |
| 75                                                                | 21                                           | 10                                            | 33 | 247 | -   | -   | -   | -   | -   |
| 75                                                                | 53                                           | 8                                             | 29 | 207 | -   | -   | -   | -   | -   |
| 75                                                                | 102                                          | 8                                             | 26 | 189 | -   | -   | -   | -   | -   |
| 100                                                               | 43                                           | -                                             | 11 | 76  | 299 | -   | -   | -   | -   |
| 100                                                               | 140                                          | -                                             | 8  | 61  | 229 | -   | -   | -   | -   |
| 100                                                               | 320                                          | -                                             | 7  | 52  | 195 | -   | -   | -   | -   |
| 100                                                               | 530                                          | -                                             | 6  | 46  | 177 | -   | -   | -   | -   |
| 150                                                               | 500                                          | -                                             | -  | 10  | 40  | 305 | -   | -   | -   |
| 150                                                               | 1 100                                        | -                                             | -  | 8   | 31  | 238 | -   | -   | -   |
| 150                                                               | 2 000                                        | -                                             | -  | 7   | 26  | 201 | -   | -   | -   |
| 150                                                               | 2 900                                        | -                                             | -  | 6   | 23  | 183 | -   | -   | -   |
| 200                                                               | 1 800                                        | -                                             | -  | -   | 10  | 73  | 286 | -   | -   |
| 200                                                               | 3 400                                        | -                                             | -  | -   | 7   | 57  | 219 | -   | -   |
| 200                                                               | 5 600                                        | -                                             | -  | -   | 6   | 49  | 186 | -   | -   |
| 200                                                               | 7 600                                        | -                                             | -  | -   | 5   | 43  | 171 | -   | -   |
| 250                                                               | 4 000                                        | -                                             | -  | -   | -   | 24  | 94  | 293 | -   |
| 250                                                               | 7 200                                        | -                                             | -  | -   | -   | 18  | 73  | 225 | -   |
| 250                                                               | 11 000                                       | -                                             | -  | -   | -   | 16  | 60  | 192 | -   |
| 250                                                               | 15 000                                       | -                                             | -  | -   | -   | 14  | 55  | 174 | -   |
| 300                                                               | 7 300                                        | -                                             | -  | -   | -   | 9   | 37  | 116 | 287 |
| 300                                                               | 13 000                                       | -                                             | -  | -   | -   | 7   | 29  | 90  | 219 |
| 300                                                               | 20 000                                       | -                                             | -  | -   | -   | 6   | 24  | 76  | 186 |
| 300                                                               | 26 000                                       | -                                             | -  | -   | -   | 5   | 22  | 70  | 152 |

**Tabela 3 - Unidades de Hunter de contribuição dos aparelhos sanitários e diâmetro nominal mínimo dos ramais de descarga**

| Aparelho sanitário         |                     | Número de unidades de Hunter de contribuição | Diâmetro nominal mínimo do ramal de descarga<br><i>DN</i> |
|----------------------------|---------------------|----------------------------------------------|-----------------------------------------------------------|
| Bacia sanitária            |                     | 6                                            | 100 <sup>1)</sup>                                         |
| Banheira de residência     |                     | 2                                            | 40                                                        |
| Bebedouro                  |                     | 0,5                                          | 40                                                        |
| Bidê                       |                     | 1                                            | 40                                                        |
| Chuveiro                   | De residência       | 2                                            | 40                                                        |
|                            | Coletivo            | 4                                            | 40                                                        |
| Lavatório                  | De residência       | 1                                            | 40                                                        |
|                            | De uso geral        | 2                                            | 40                                                        |
| Mictório                   | Válvula de descarga | 6                                            | 75                                                        |
|                            | Caixa de descarga   | 5                                            | 50                                                        |
|                            | Descarga automática | 2                                            | 40                                                        |
|                            | De calha            | 2 <sup>2)</sup>                              | 50                                                        |
| Pia de cozinha residencial |                     | 3                                            | 50                                                        |
| Pia de cozinha industrial  | Preparação          | 3                                            | 50                                                        |
|                            | Lavagem de painéis  | 4                                            | 50                                                        |
| Tanque de lavar roupas     |                     | 3                                            | 40                                                        |
| Máquina de lavar louças    |                     | 2                                            | 50 <sup>3)</sup>                                          |
| Máquina de lavar roupas    |                     | 3                                            | 50 <sup>3)</sup>                                          |

**Tabela 5 - Dimensionamento de ramais de esgoto**

| Diâmetro nominal mínimo do tubo<br><i>DN</i> | Número máximo de unidades de Hunter de contribuição<br>UHC |
|----------------------------------------------|------------------------------------------------------------|
| 40                                           | 3                                                          |
| 50                                           | 6                                                          |
| 75                                           | 20                                                         |
| 100                                          | 160                                                        |

**Tabela 7 - Dimensionamento de subcoletores e coletor predial**

| Diâmetro nominal do tubo<br><i>DN</i> | Número máximo de unidades de Hunter de contribuição em função das declividades mínimas % |       |        |        |
|---------------------------------------|------------------------------------------------------------------------------------------|-------|--------|--------|
|                                       | 0,5                                                                                      | 1     | 2      | 4      |
| 100                                   | -                                                                                        | 180   | 216    | 250    |
| 150                                   | -                                                                                        | 700   | 840    | 1 000  |
| 200                                   | 1 400                                                                                    | 1 600 | 1 920  | 2 300  |
| 250                                   | 2 500                                                                                    | 2 900 | 3 500  | 4 200  |
| 300                                   | 3 900                                                                                    | 4 600 | 5 600  | 6 700  |
| 400                                   | 7 000                                                                                    | 8 300 | 10 000 | 12 000 |

**Tabela 8 - Dimensionamento de ramais de ventilação**

| Grupo de aparelhos sem bacias sanitárias     |                                         | Grupo de aparelhos com bacias sanitárias     |                                         |
|----------------------------------------------|-----------------------------------------|----------------------------------------------|-----------------------------------------|
| Número de unidades de Hunter de contribuição | Diâmetro nominal do ramal de ventilação | Número de unidades de Hunter de contribuição | Diâmetro nominal do ramal de ventilação |
| Até 12                                       | 40                                      | Até 17                                       | 50                                      |
| 13 a 18                                      | 50                                      | 18 a 60                                      | 75                                      |
| 19 a 36                                      | 75                                      | -                                            | -                                       |

## **8.0 Materiais**

### *8.1 Tubos*

As tubulações de esgoto serão de PVC série normal.

### *8.2 Conexões*

Conexões de PVC série normal.

### *8.3 Caixas Sifonadas*

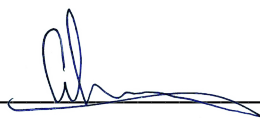
Caixas sifonadas em PVC com grelhas cromadas redondas.

#### 8.4 Sifão

Sifões dos banheiros de serviço serão de PVC e dos demais cômodos, serão metálicos com acabamento cromado.

#### 8.5 Caixas de Inspeção

3 Caixas serão confeccionadas *in loco* em alvenaria com fundo em concreto magro e visita em concreto armado nas dimensões padrão de 60 x 60 cm, sendo todo o resto das caixas de inspeção, gordura, sabão e areia existentes, bem como o caminhamento do esgoto para a E.T.E. existente, reaproveitados.



Leonardo Medina

Engenheiro Civil – CREA n. 061451389-8

Arquiteto – CAU n. A74406-9