HYDRO-CONSULT ENGINEERING

**CALCULATION FORM**

| | | | | |
|---|---|---|---|---|
| **Job:** | **Jhimruk khola** | **Date:** | **2/15/2023** | **Page** |
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** |
| | | **Drg no:** | | **Chkd. By:** |
| | | | | **Recommended By:** |
| | | | | **Approved By:** |

| Return period (T-year) | Minimum Daily flows, $m^3/s$ | | | |
|---|---|---|---|---|
| | 1-day | 7-day | 15-day | 30-day |
| 2 | 1.17 | 1.61 | 1.96 | 2.24 |
| 5 | 2.80 | 3.24 | 2.89 | 3.20 |
| 10 | 4.97 | 5.15 | 3.74 | 4.05 |
| 20 | 8.63 | 8.04 | 4.79 | 5.07 |
| 50 | 17.61 | 14.29 | 6.60 | 6.79 |
| 100 | 30.05 | 22.00 | 8.38 | 8.44 |

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**Job:** Jhimruk khola | **Date:** | **Page**

**Subject:** Low flow analysis at Jhimruk | **Job No:** | **Calc. By:**

**Drg no:** | **Chkd. By:**

**Recommended By:**

**Approved By:**

| Years | Min 1-day | Min 7-day | Min 15-day | Min 30-day |
|---|---|---|---|---|
| 61/62 | 1.60 | 1.76 | 1.78 | 1.98 |
| 62/63 | 1.57 | 1.71 | 1.86 | 2.04 |
| 63/64 | 2.00 | 2.14 | 2.26 | 2.48 |
| 64/65 | 1.23 | 1.82 | 2.04 | 2.61 |
| 65/66 | 1.10 | 1.41 | 1.52 | 1.55 |
| 66/67 | 1.40 | 1.54 | 1.60 | 1.75 |
| 67/68 | 1.56 | 1.72 | 1.91 | 1.93 |
| 68/69 | 1.62 | 1.83 | 1.90 | 2.18 |
| 69/70 | 6.01 | 6.14 | 6.14 | 6.14 |
| 70/71 | | | | |
| 71/72 | 2.62 | 2.83 | 2.87 | 2.87 |
| 72/73 | 1.33 | 1.38 | 1.57 | 1.82 |
| 73/74 | 2.26 | 2.48 | 2.63 | 2.84 |
| 74/75 | 1.39 | 1.96 | 2.10 | 2.34 |
| 75/76 | 0.24 | 1.63 | 2.19 | 2.55 |
| 76/77 | 1.29 | 1.93 | 2.25 | 2.75 |
| 77/78 | 0.68 | 1.60 | 1.62 | 1.72 |
| 78/79 | 0.34 | 0.34 | 1.39 | 2.71 |

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| **Job:** | **Jhimruk khola** | **Date:** | 2/15/2023 | **Page** | |
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** | |
| | | **Drg no:** | | **Chkd. By:** | |
| | | | | **Recommended By:** | |
| | | | | **Approved By:** | |

| **1. Calculation of 1-day low flow** | | | | | | |
|---|---|---|---|---|---|---|
| **1- Day minimum series** | **Q ascending** | **Rank** | **P=m/(n+1)** | **1/(1-P)** | **ln(ln(1/(1-P))** | **ln(Q)** |
| 1.60 | 6.01 | 1 | 0.06 | 1.059 | -2.86 | 1.79 |
| 1.57 | 2.62 | 2 | 0.11 | 1.125 | -2.14 | 0.96 |
| 2.00 | 2.26 | 3 | 0.17 | 1.200 | -1.70 | 0.81 |
| 1.23 | 2.00 | 4 | 0.22 | 1.286 | -1.38 | 0.69 |
| 1.10 | 1.62 | 5 | 0.28 | 1.385 | -1.12 | 0.48 |
| 1.40 | 1.60 | 6 | 0.33 | 1.500 | -0.90 | 0.47 |
| 1.56 | 1.57 | 7 | 0.39 | 1.636 | -0.71 | 0.45 |
| 1.62 | 1.56 | 8 | 0.44 | 1.800 | -0.53 | 0.44 |
| 6.01 | 1.40 | 9 | 0.50 | 2.000 | -0.37 | 0.34 |
| | 1.39 | 10 | 0.56 | 2.250 | -0.21 | 0.33 |
| 2.62 | 1.33 | 11 | 0.61 | 2.571 | -0.06 | 0.29 |
| 1.33 | 1.29 | 12 | 0.67 | 3.000 | 0.09 | 0.25 |
| 2.26 | 1.23 | 13 | 0.72 | 3.600 | 0.25 | 0.21 |
| 1.39 | 1.10 | 14 | 0.78 | 4.500 | 0.41 | 0.10 |
| 0.24 | 0.68 | 15 | 0.83 | 6.000 | 0.58 | -0.38 |
| 1.29 | 0.34 | 16 | 0.89 | 9.000 | 0.79 | -1.08 |
| 0.68 | 0.24 | 17 | 0.94 | 18.000 | 1.06 | -1.45 |
| 0.34 | | | | | | |

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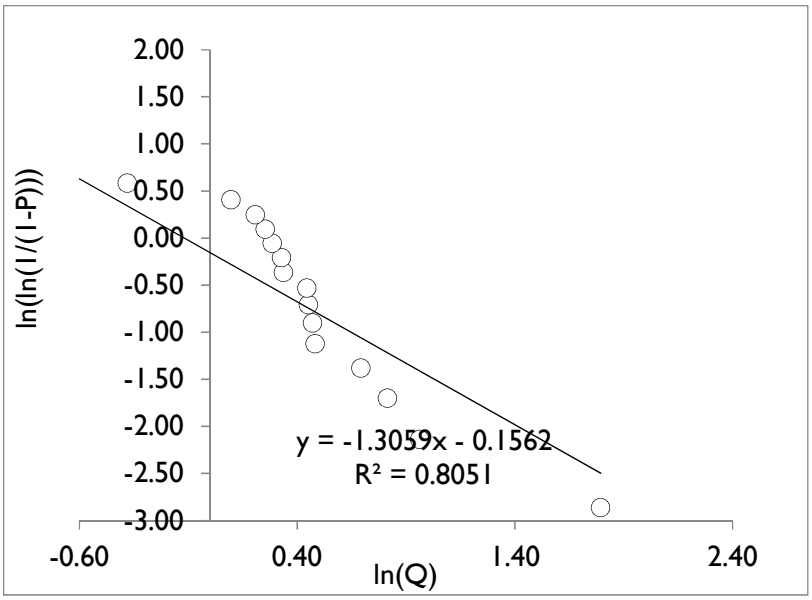
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** | |
| | | **Drg no:** | | **Chkd. By:** | |
| | | | | **Recommended By:** | |
| | | | | **Approved By:** | |




Equation from plot: y=

y=-1.3059x-0.1562 x

| | | |
|---|---|---|
| a = | -1.3059162 | -1.3059162 |
| b= | -0.1562147 | -0.1562147 |

Beta (or Shape Parameter) : a -1.31

Alpha (or Characteristic Lif Exp(-b/Beta) 0.89

| Return period (years) T | Reliability, R | Low flow ($m^3/s$) |
|---|---|---|
| **2** | **0.5** | **1.17** |

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| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** |
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| | | | | **Recommended By:** |
| | | | | **Approved By:** |

| | | |
|---|---|---|
| **5** | **0.8** | **2.80** |
| **10** | **0.9** | **4.97** |
| **20** | **0.95** | **8.63** |
| **50** | **0.98** | **17.61** |
| **100** | **0.99** | **30.05** |

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**CALCULATION FORM**

**Job:** Jhimruk khola
**Subject:** Low flow analysis at Jhimruk

**Date:** 2/15/2023 **Page**
**Job No:** 932045 **Calc. By:**
**Drg no:** **Chkd. By:**
**Recommended By:**
**Approved By:**

**1. Calculation of 7-day low flow**

| 7- Day minimum series | Q ascending | Rank | P=m/(n+1) | 1/(1-P) | (ln(1/(1-P) | ln(Q) |
|---|---|---|---|---|---|---|
| 1.76 | 6.14 | 1 | 0.06 | 1.059 | -2.86 | 1.82 |
| 1.71 | 2.83 | 2 | 0.11 | 1.125 | -2.14 | 1.04 |
| 2.14 | 2.48 | 3 | 0.17 | 1.200 | -1.70 | 0.91 |
| 1.82 | 2.14 | 4 | 0.22 | 1.286 | -1.38 | 0.76 |
| 1.41 | 1.96 | 5 | 0.28 | 1.385 | -1.12 | 0.67 |
| 1.54 | 1.93 | 6 | 0.33 | 1.500 | -0.90 | 0.66 |
| 1.72 | 1.83 | 7 | 0.39 | 1.636 | -0.71 | 0.60 |
| 1.83 | 1.82 | 8 | 0.44 | 1.800 | -0.53 | 0.60 |
| 6.14 | 1.76 | 9 | 0.50 | 2.000 | -0.37 | 0.57 |
| | 1.72 | 10 | 0.56 | 2.250 | -0.21 | 0.54 |
| 2.83 | 1.71 | 11 | 0.61 | 2.571 | -0.06 | 0.54 |
| 1.38 | 1.63 | 12 | 0.67 | 3.000 | 0.09 | 0.49 |
| 2.48 | 1.60 | 13 | 0.72 | 3.600 | 0.25 | 0.47 |
| 1.96 | 1.54 | 14 | 0.78 | 4.500 | 0.41 | 0.43 |
| 1.63 | 1.41 | 15 | 0.83 | 6.000 | 0.58 | 0.34 |
| 1.93 | 1.38 | 16 | 0.89 | 9.000 | 0.79 | 0.32 |
| 1.60 | 0.34 | 17 | 0.94 | 18.000 | 1.06 | -1.08 |
| 0.34 | | | | | | |

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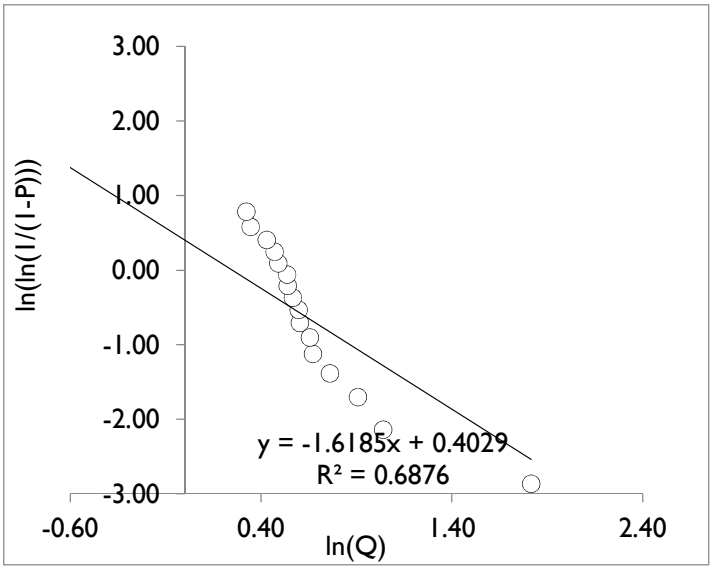
| **Job:** | **Jhimruk khola** | **Date:** | **2/15/2023** | **Page** |
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | **932045** | **Calc. By:** |
| | | **Drg no:** | | **Chkd. By:** |
| | | | | **Recommended By:** |
| | | | | **Approved By:** |




y=

Equation from plot: y=-1.6185x0.4029 x

| | | |
|---|---|---|
| a = | -1.6185 | |
| b= | 0.4029 | |
| R2 | 0.6876357 | |
| Beta (or Shape Parameter) = | a | -1.62 |
| Alpha (or Characteristic Life) = | Exp(-b/Beta) | 1.28 |

| Return period (years) T | Reliability, R | Low flow ($m^3/s$) |
|---|---|---|
| **2** | **0.5** | **1.61** |
| **5** | **0.8** | **3.24** |
| **10** | **0.9** | **5.15** |

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|---|---|---|---|---|
| **Job:** | **Jhimruk khola** | **Date:** | **2/15/2023** | **Page** |
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | **932045** | **Calc. By:** |
| | | **Drg no:** | | **Chkd. By:** |
| | | | | **Recommended By:** |
| | | | | **Approved By:** |

| | | |
|---|---|---|
| **20** | **0.95** | **8.04** |
| **50** | **0.98** | **14.29** |
| **100** | **0.99** | **22.00** |

HYDRO-CONSULT ENGINEERING

**CALCULATION FORM**

**Job:** Jhimruk khola **Date:** 2/15/2023 **Page**

**Subject:** Low flow analysis at Jhimruk **Job No:** **Calc. By:**

**Drg no:** **Chkd. By:**

**Recommended By:**

**Approved By:**

| 1. Calculation of 15-day low flow | | | | | | |
|---|---|---|---|---|---|---|
| 15- Day minimum series | Q ascending | Rank | P=m/(n+1) | 1/(1-P) | n(ln(1/(1-P)) | ln(Q) |
| 1.78 | 6.14 | 1 | 0.06 | 1.059 | -2.86 | 1.82 |
| 1.86 | 2.87 | 2 | 0.11 | 1.125 | -2.14 | 1.05 |
| 2.26 | 2.63 | 3 | 0.17 | 1.200 | -1.70 | 0.97 |
| 2.04 | 2.26 | 4 | 0.22 | 1.286 | -1.38 | 0.81 |
| 1.52 | 2.25 | 5 | 0.28 | 1.385 | -1.12 | 0.81 |
| 1.60 | 2.19 | 6 | 0.33 | 1.500 | -0.90 | 0.78 |
| 1.91 | 2.10 | 7 | 0.39 | 1.636 | -0.71 | 0.74 |
| 1.90 | 2.04 | 8 | 0.44 | 1.800 | -0.53 | 0.71 |
| 6.14 | 1.91 | 9 | 0.50 | 2.000 | -0.37 | 0.65 |
| | 1.90 | 10 | 0.56 | 2.250 | -0.21 | 0.64 |
| 2.87 | 1.86 | 11 | 0.61 | 2.571 | -0.06 | 0.62 |
| 1.57 | 1.78 | 12 | 0.67 | 3.000 | 0.09 | 0.57 |
| 2.63 | 1.62 | 13 | 0.72 | 3.600 | 0.25 | 0.48 |
| 2.10 | 1.60 | 14 | 0.78 | 4.500 | 0.41 | 0.47 |
| 2.19 | 1.57 | 15 | 0.83 | 6.000 | 0.58 | 0.45 |
| 2.25 | 1.52 | 16 | 0.89 | 9.000 | 0.79 | 0.42 |
| 1.62 | 1.39 | 17 | 0.94 | 18.000 | 1.06 | 0.33 |
| 1.39 | | | | | | |

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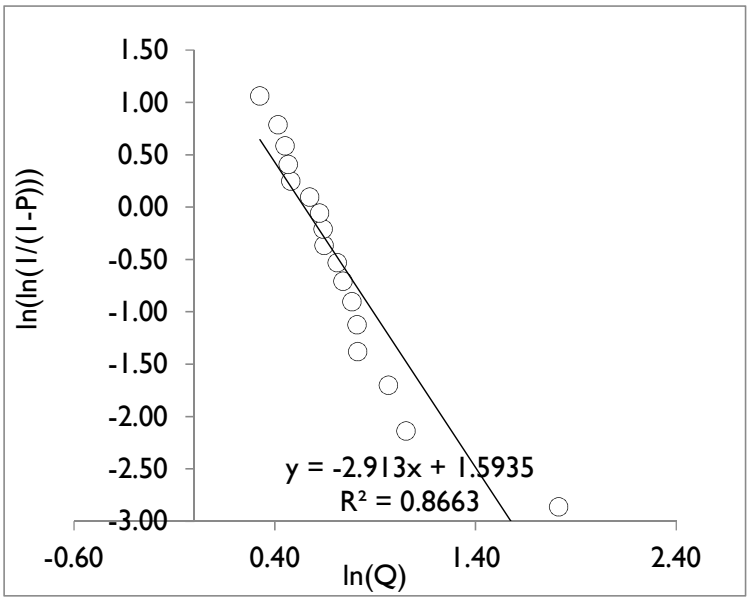
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** |
| | | **Drg no:** | | **Chkd. By:** |
| | | | | **Recommended By:** |
| | | | | **Approved By:** |




y=

Equation from plot: y=-2.913x1.5935 x

| | |
|---|---|
| a = | -2.913 |
| b= | 1.5935 |
| R2 | 0.8662624 |

Beta (or Shape Parameter) = a -2.91

Alpha (or Characteristic Life) = Exp(-b/Beta) 1.73

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**Drg no:** **Chkd. By:**

**Recommended By:**

**Approved By:**

| Return period (years) T | Reliability, R | Low flow ($m^3/s$) |
|---|---|---|
| 2 | 0.5 | 1.96 |
| 5 | 0.8 | 2.89 |
| 10 | 0.9 | 3.74 |
| 20 | 0.95 | 4.79 |
| 50 | 0.98 | 6.60 |
| 100 | 0.99 | 8.38 |

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| **Job:** | **Jhimruk khola** | **Date:** | 2/15/2023 | **Page** | |
| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** | |
| | | **Drg no:** | | **Chkd. By:** | |
| | | | | **Recommended By:** | |
| | | | | **Approved By:** | |

| **1. Calculation of 30-day low flow** | | | | | | |
|---|---|---|---|---|---|---|
| **30- Day minimum series** | **Q ascending** | **Rank** | **P=m/(n+1)** | **1/(1-P)** | **n(ln(1/(1-P))** | **ln(Q)** |
| 1.98 | 6.14 | 1 | 0.06 | 1.059 | -2.86 | 1.82 |
| 2.04 | 2.87 | 2 | 0.11 | 1.125 | -2.14 | 1.05 |
| 2.48 | 2.84 | 3 | 0.17 | 1.200 | -1.70 | 1.04 |
| 2.61 | 2.75 | 4 | 0.22 | 1.286 | -1.38 | 1.01 |
| 1.55 | 2.71 | 5 | 0.28 | 1.385 | -1.12 | 1.00 |
| 1.75 | 2.61 | 6 | 0.33 | 1.500 | -0.90 | 0.96 |
| 1.93 | 2.55 | 7 | 0.39 | 1.636 | -0.71 | 0.93 |
| 2.18 | 2.48 | 8 | 0.44 | 1.800 | -0.53 | 0.91 |
| 6.14 | 2.34 | 9 | 0.50 | 2.000 | -0.37 | 0.85 |
| | 2.18 | 10 | 0.56 | 2.250 | -0.21 | 0.78 |
| 2.87 | 2.04 | 11 | 0.61 | 2.571 | -0.06 | 0.71 |
| 1.82 | 1.98 | 12 | 0.67 | 3.000 | 0.09 | 0.68 |
| 2.84 | 1.93 | 13 | 0.72 | 3.600 | 0.25 | 0.66 |
| 2.34 | 1.82 | 14 | 0.78 | 4.500 | 0.41 | 0.60 |
| 2.55 | 1.75 | 15 | 0.83 | 6.000 | 0.58 | 0.56 |
| 2.75 | 1.72 | 16 | 0.89 | 9.000 | 0.79 | 0.55 |
| 1.72 | 1.55 | 17 | 0.94 | 18.000 | 1.06 | 0.44 |
| 2.71 | | | | | | |

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| **Subject:** | **Low flow analysis at Jhimruk** | **Job No:** | | **Calc. By:** |
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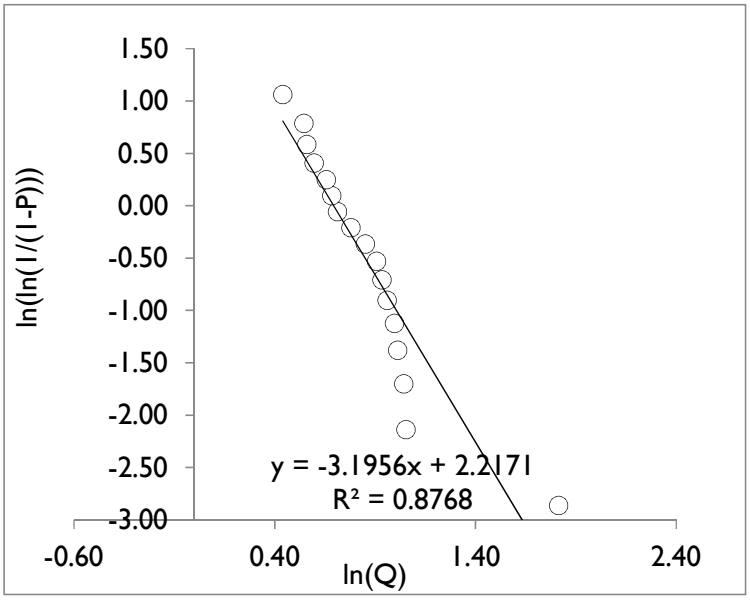
| | | | | **Recommended By:** |
| | | | | **Approved By:** |




Equation from plot: y=-3.1956x2.2171

| | |
|---|---|
| a = | -3.1956 |
| b= | 2.2171 |
| R2 | 0.8768362 |

Beta (or Shape Parameter) = a -3.20

Alpha (or Characteristic Life) = Exp(-b/Beta) 2.00

| **Return period (years) T** | **Reliability, R** | **Low flow ($m^3/s$)** |
|---|---|---|

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| | | | | **Recommended By:** |
| | | | | **Approved By:** |

| | | |
|---|---|---|
| **2** | **0.5** | **2.24** |
| **5** | **0.8** | **3.20** |
| **10** | **0.9** | **4.05** |
| **20** | **0.95** | **5.07** |
| **50** | **0.98** | **6.79** |
| **100** | **0.99** | **8.44** |