Smokerise/Penstock Wash Stream Capacity and Stabilization

F25 CENE 476

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AGUA JACKS WATER MANAGEMENT

Project Background

Reduce flooding in Smokerise Neighborhood by improving Penstock Wash stormwater capacity.

Client: Chase McLeod
City of Flagstaff Stormwater Engineer

Technical Advisor: Owen Allen
Remal Consulting

Location: East Trails End Drive
Flagstaff, AZ

Figure 1: Project Vicinity Map

Figure 2: Project Location Map

Figure 3: Project Outfall

Project Scope – Tasks 1 & 2

Task 1: Due Diligence

- **1.1 Identify Existing Issues**
- **1.2 Records Review**
- **1.3 Research Existing Topo Data**

Task 2: Site Investigation

- **2.1 Document Existing Conditions**
- **2.2 Surveying**
- **2.3 Data Analysis**

Figure 4: Surveying Equipment

Project Scope – Tasks 3 & 4

Task 3: Hydrologic Analysis

- **3.1 Watershed Delineation**
- **3.2 Time of Concentration**
- **3.3 Design Storm Modeling**

Task 4: Hydraulic Analysis – Existing

- **4.1 Culvert Analysis**
- **4.2 Channel Analysis**
- **4.3 Deficiency Identification**

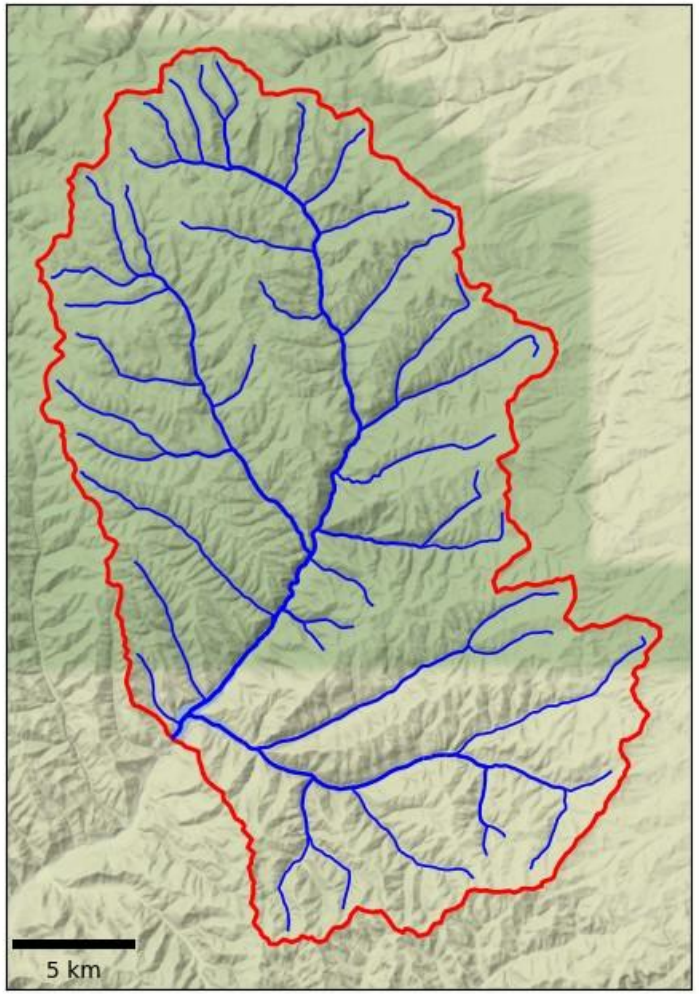


Figure 5: Example Delineated Watershed

Project Scope – Tasks 5 - 7

Task 5: Alternatives Developments & Screening

- **5.1 Identify Constraints and Criteria**
- **5.2 Develop Alternatives**
- **5.3 Select Best Alternative**

Task 6: Final Design

- **6.1 Final Hydraulic Design**
- **6.2 Plan Set Creation**
    - **Task 6.2.1 Cover Sheet/Existing Site Plan**
    - **Task 6.2.2 Proposed Site Plan**
    - **Task 6.2.3 Detailed Design Drawings**
- **6.3 Construction Cost Estimate**

Task 7: Impacts Analysis

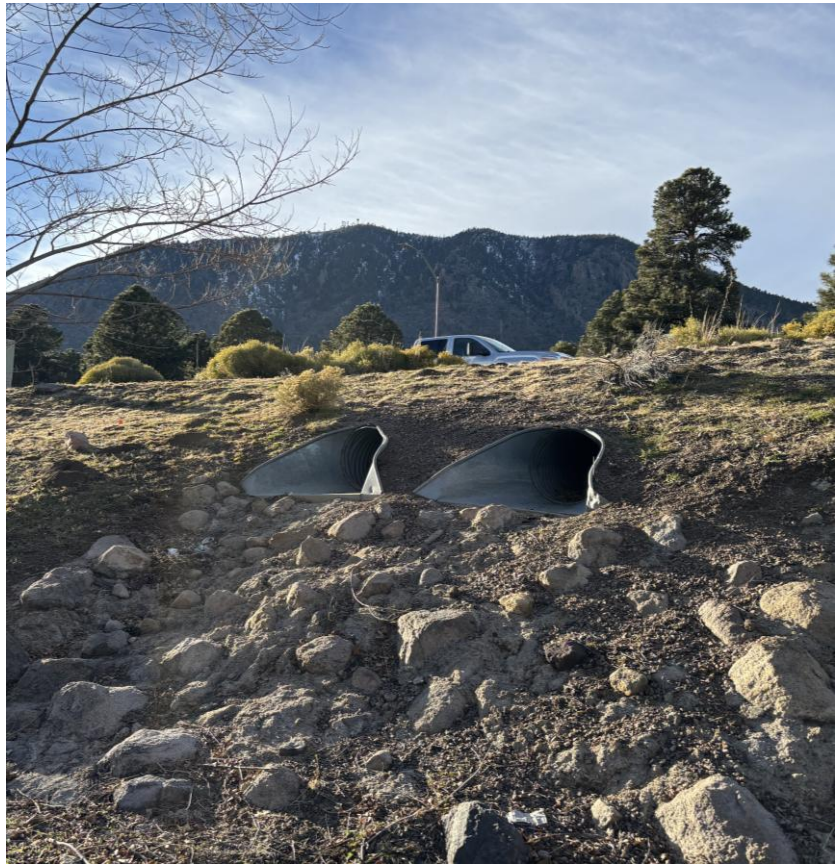


Figure 6: Culverts at Site

Project Scope – Tasks 8 & 9

Task 8: Deliverables

- **8.1 – 30% Deliverables**
  - **Tasks 1 & 2**
- **8.2 – 60% Deliverables**
  - **Tasks 4.1-4.3, 5.2, & 5.3**
- **8.3 – 90% Deliverables**
  - **Tasks 3-6 & 7**
- **8.4 – Final Deliverables**
  - **All Tasks**

Task 9: Project Management

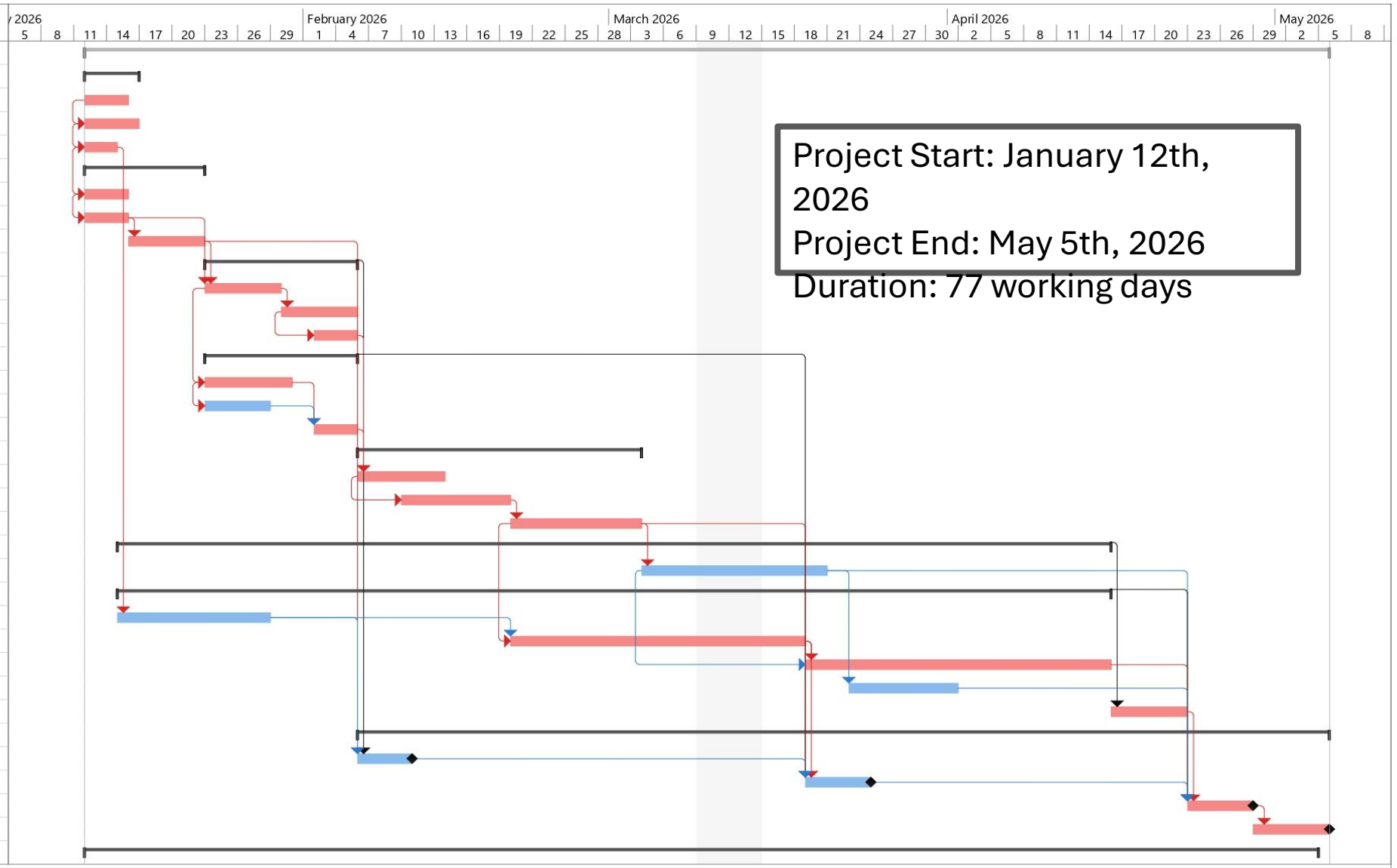
- **9.1 – Schedule Management**
- **9.2 – Resource & Budget Management**
- **9.3 – Meetings & Quality Assurance**

Figure 7: Site Image

Exclusions

- Geotechnical Investigation
  - No drilling, subsurface sampling, laboratory soil testing
- Land or Right-of-Way Acquisition
  - No property acquisition or easements.
- Community Outreach
  - No public engagement and community meetings
- Environmental Permitting
  - No preparation of NEPA documentation or Section 404 permit applications
- Construction-Ready review
  - No PE-stamped, construction-ready documents will be produced, student-design level.
- Construction Phase
  - No bidding, contractor coordination, and construction oversight
- FEMA paperwork
  - No preparation or submission of FEMA compliance paperwork

ID	Task Name
0	**Penstock Wash Project Schedule**
1	**Task 1: Due Diligence**
2	1.1 Identify Existing Issues
3	1.2 Records Review
4	1.3 Research Existing Topo
5	**Task 2: Site Investigation**
6	2.1 Document Existing Conditions
7	2.2 Surveying
8	2.3 Data Analysis and Mapping
9	**Task 3: Hydrologic Analysis**
10	3.1 Watershed Delineation
11	3.2 Time of Concentration (Tc) Analysis
12	3.3 Design Storm Modeling (HEC-HMS)
13	**Task 4: Hydraulic Analysis - Existing**
14	4.1 Culvert Analysis
15	4.2 Channel Analysis
16	4.3 Deficiency Identification
17	**Task 5: Alternatives Development**
18	5.1 Identify Constraints and Criteria
19	5.2 Develop Conceptual Alternatives
20	5.3 Select Best Alternative
21	**Task 6: Final Design**
22	6.1 Final Hydraulic Design
23	**6.2 Plan Set Creation**
24	6.2.1 Cover Sheet & Existing Site Plan
25	6.2.2 Proposed Site Plan
26	6.2.3 Detailed Design Drawings
27	6.3 Construction Cost Estimate (EOPC)
28	Task 7: Impacts Analysis
29	**Task 8: Deliverables**
30	8.1 30% Deliverable
31	8.2 60% Deliverable
32	8.3 90% Deliverable
33	8.4 Final Deliverable
34	**Task 9: Project Management**



Project Start: January 12th, 2026
Project End: May 5th, 2026
Duration: 77 working days

Staffing Plan

Task	PE	PrE	EIT	INT	Task Total
Task 1: Due Diligence (Total hrs)	0	9	18	30	57
Task 2: Site Investigation (Total hrs)	0	12	24	13	49
Task 3: Hydrologic Analysis (Total hrs)	7	17	25	9	58
Task 4: Hydraulic Analysis - Existing (Total hrs)	7	21	35	12	75
Task 5: Alternatives Development (Total hrs)	6	6	6	6	6
Task 6: Final Design (Total hrs)	15	28	45	15	103
Task 7: Impacts Analysis (Total hrs)	0	7	4	4	15
Task 8: Deliverables (Total hrs)	8	32	40	20	100
Task 9: Project Management (Total hrs)	20	44	20	20	104
Total hours	**63**	**185**	**231**	**132**	**611**

Table 1: Staffing Plan

Qualifications

- Principal Engineer: Civil/Environmental PE, 5-10 years
- Project Engineer: Civil/Environmental PE, 2-5 years
- Engineer-in-Training: Passed Civil/Environmental FE, 0-2 years
- Intern: Pursuing Civil/Environmental BS Degree

Cost of Engineering Services

Personnel	Hours	Billing Rate ($/hr)	Total
Principal Engineer (PE)	63	270	$17,010
Project Engineer (PrE)	185	186	$34,410
Engineer-in-Training (EIT)	231	138	$31,878
Intern (INT)	132	42	$5,544
Personnel Subtotal			**$88,842**
Equipment	**Days**	**$/day**	**Total**
Surveying	2	100	$200
Computer Lab	10	100	$1,000
Equipment Subtotal			**$1,200**
Project Total			**$90,042**

Table 2: Cost of Engineering Services by Category

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[7] Coconino Country Arizona, “Coconino Country Drainage Design Criteria Manual,” 2025. [Online]. Available: https://www.coconino.az.gov/DocumentCenter/View/67366/2025-Drainage-Design-Criteria-Manual. [Accessed 18 September 2025].

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