REQUEST for PROPOSAL #909

PROFESSIONAL, TECHNICAL AND EXPERT SERVICES

Clark County Washington

RELEASE DATE: WEDNESDAY, NOVEMBER 13, 2024
DUE DATE: WEDNESDAY, DECEMBER 11, 2024 by 1:30 pm

Request for Proposal for:

LOWER SUDS CREEK ENHANCEMENT SIXTY-PERCENT PROJECT DESIGN

SUBMIT:
One (1) Original
Three (3) Complete Copies

of the Proposal to:

Shipping Method of your Choice or Hand Delivery	**United States Postal Service**
Clark County ATTN: Office of Purchasing 1300 Franklin Street, 6th Floor, Suite 650 Vancouver WA 98660 564-397-2323	Clark County ATTN: Office of Purchasing PO Box 5000 Vancouver WA 98666-5000 564-397-2323

Office Hours: 8:00 am – 3:00 pm, Monday – Friday, except Legal Holidays.
No electronic submissions.

***Proposals must be delivered to the Purchasing office – No Exceptions**
***Proposals must be date and time stamped by Purchasing staff by 1:30 pm on due date.**
****Proposal shall be sealed and clearly marked on the package cover with RFP #, Title & Company Name**

Refer Questions to Project Manager:

Jeff Schnabel
Stormwater Infrastructure Manager, Clark County Public Works
Jeff.Schnabel@clark.wa.gov
564-397-4583

ADMINISTRATIVE REQUIREMENTS - Contractors shall comply with all management and administrative requirements established by Washington Administrative Code (WAC), the Revised Code of the State of Washington (RCW), and any subsequent amendments or modifications, as applicable to providers licensed in the State of Washington.

ALL proposals submitted become the property of Clark County. It is understood and agreed that the prospective Proposer claims no proprietary rights to the ideas and written materials contained in or attached to the proposal submitted. Clark County has the right to reject or accept proprietary information.

AUTHORSHIP - Applicants must identify any assistance provided by agencies or individuals outside the proposers own organization in preparing the proposal. No contingent fees for such assistance will be allowed to be paid under any contract resulting from this RFP.

CANCELLATION OF AWARD - Clark County reserves the right to immediately cancel an award if the contractual agreement has not been entered into by both parties or if new state regulations or policy make it necessary to change the program purpose or content, discontinue such programs, or impose funding reductions. In those cases where negotiation of contract activities are necessary, Clark County reserves the right to limit the period of negotiation to sixty (60) days after which time funds may be unencumbered.

CONFIDENTIALLY - Proposer shall comply with all applicable state and federal laws governing the confidentiality of information.

CONFLICT OF INTEREST - All proposals submitted must contain a statement disclosing or denying any interest, financial or otherwise, that any employee or official of Clark County or the appropriate Advisory Board may have in the proposing agency or proposed project.

CONSORTIUM OF AGENCIES - Any consortium of companies or agencies submitting a proposal must certify that each company or agency of the consortium can meet the requirements set forth in the RFP.

COST OF PROPOSAL & AWARD - The contract award will not be final until Clark County and the prospective contractor have executed a contractual agreement. The contractual agreement consists of the following parts: (a) the basic provisions and general terms and conditions, (b) the special terms and conditions, (c) the project description and goals (Statement of Work), and (d) the budget and payment terms. Clark County is not responsible for any costs incurred prior to the effective date of the contract. Clark County reserves the right to make an award without further negotiation of the proposal submitted. Therefore, the proposal should be submitted in final form from a budgetary, technical, and programmatic standpoint.

DISPUTES - Clark County encourages the use of informal resolution to address complaints or disputes arising over any actions in implementing the provisions of this RFP. Written complaints should be addressed to Clark County – Purchasing, P.O. Box 5000, Vancouver, Washington 98666-5000.

DIVERSITY IN EMPLOYMENT AND CONTRACTING REQUIREMENTS - It is the policy of Clark County to require equal opportunity in employment and services subject to eligibility standards that may be required for a specific program. Clark County is an equal opportunity employer and is committed to providing equal opportunity in employment and in access to the provision of all county services. Clark County's Equal Employment Opportunity Plan is available at http://www.clark.wa.gov/hr/documents.html. This commitment applies regardless of race, color, religion, creed, sex, marital status, national origin, disability, age, veteran status, on-the-job injury, or sexual orientation. Employment decisions are made without consideration of these or any other factors that are prohibited by law. In compliance with department of Labor Regulations implementing Section 504 of the rehabilitation Act of 1973, as amended, no qualified handicapped individual shall be discriminated against in admission or access to any program or activity. The prospective contractor must agree to provide equal opportunity in the administration of the contract, and its subcontracts or other agreements.

MUNICIPAL RESEARCH and SERVICE CENTER - Clark County (WA) contracts with the Municipal Research and Service Center (MRSC) to maintain our Consultant, Small Works and Vendor rosters. To be eligible to participate in this Clark County public solicitation and the resulting contract, your business must be registered with the MRSC Rosters. Failure to register may result in your proposal being marked nonresponsive. Be sure to select Clark County in your application. If you have questions about the registration process, contact the MRSC Rosters at 206-436-3798 or https://mrscrosters.org/businesses/business-membership/

INDEPENDENT PRICE DETERMINATION - The prospective contractor guarantees that, in connection with this proposal, the prices and/or cost data have been arrived at independently, without consultation, communication, or agreement for the purpose of restricting competition. This does not preclude or impede the formation of a consortium of companies and/or agencies for purposes of engaging in jointly sponsored proposals.

INTERLOCAL AGREEMENT - Clark County has made this RFP subject to Washington State statute RCW 39.34. Therefore, the proposer may, at the proposers option, extend identical prices and services to other public agencies wishing to participate in this RFP. Each public agency wishing to utilize this RFP will issue a purchase order (or contract) binding only their agency. Each contract is between the proposer and the individual agency with no liability to Clark County.

LIMITATION - This RFP does not commit Clark County to award a contract, to pay any costs incurred in the preparation of a response to this RFP, or to procure or contract for services or supplies.

LATE PROPOSALS - A proposal received after the date and time indicated above will not be accepted. No exceptions will be made.

ORAL PRESENTATIONS - An oral presentation may be required of those prospective contractors whose proposals are under consideration. Prospective contractors may be informed that an oral presentation is desired and will be notified of the date, time and location the oral presentation is to be conducted.

OTHER AUDIT/MONITORING REQUIREMENTS - In addition, auditing or monitoring for the following purposes will be conducted at the discretion of Clark County: Fund accountability; Contract compliance; and Program performance.

PRICE WARRANT - The proposer shall warrant that the costs quoted for services in response to the RFP are not in excess of those which would be charged any other individual or entity for the same services performed by the prospective contractor, in a similar socioeconomic, geographical region.

PROTESTS - Must be submitted to the Purchasing Department.

PUBLIC SAFETY - May require limiting access to public work sites, public facilities, and public offices, sometimes without advance notice. The successful Proposer's employees and agents shall carry sufficient identification to show by whom they are employed and display it upon request to security personnel. County project managers have discretion to require the successful Proposer's employees and agents to be escorted to and from any public office, facility or work site if national or local security appears to require it.

ACCEPTANCE or REJECTION OF PROPOSALS - Clark County reserves the right to accept or reject any or all proposals received as a result of this RFP, to negotiate with any or all prospective contractors on modifications to proposals, to waive formalities, to postpone award, or to cancel in part or in its entirety this RFP if it is in the best interest of Clark County to do so.

SUBCONTRACTING - No activities or services included as a part of this proposal may be subcontracted to another organization, firm, or individual without the approval of Clark County. Such intent to subcontract shall be clearly identified in the proposal. It is understood that the contractor is held responsible for the satisfactory accomplishment of the service or activities included in a subcontract.

VERBAL PROPOSALS - Verbal proposals will not be considered in making the award of any contract as a result of this RFP.

WORKERS COMPENSATION INSURANCE – The contractor shall comply with R.C.W. Title 51- with minimum coverage limits of $500,000 for each accident, or provide evidence that State law does not require such coverage.

FOR ALTERNATIVE FORMATS
Clark County ADA Office: V: 564-397-2322
ADA@clark.wa.gov

Request for Proposals
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Request for Proposal #909
Lower Suds Creek Enhancement Sixty-Percent Project Design

Part I Proposal Requirements

Section IA	**General Information**
1. Introduction	Clark County Public Works is seeking contracted project planning, engineering design, and permitting services to develop a sixty (60) percent engineering Design Report, design plans, and permit submittal package for the Lower Suds Creek Enhancement project. The project site is located on Clark County Public Works Parks Division land along the Salmon Creek Greenway at the confluence of Salmon Creek and the Suds Creek tributary. Clark County (WA) contracts with the Municipal Research and Service Center (MRSC) to maintain our Consultant, Small Works and Vendor Rosters. To be eligible to participate in this Clark County public solicitation and the resulting contract your business must be registered with the MRSC Rosters. Failure to register may result in your proposal being marked nonresponsive. Be sure to select Clark County in your application. If you have questions about the registration process, contact the MRSC Rosters at 206-436-3798 or https://mrscrosters.org/businesses/business-membership/ If your company contact details ***are not*** on the Plan Holder List at https://clark.wa.gov/internal-services/request-proposal-1 Attachment B, Letter of Interest must be submitted to participate in this RFP. Proposers shall respond to all sections to be considered. Clark County has made this Request for Proposal subject to Washington State statute RCW 39.34 Interlocal Cooperation Act. The proposer may opt to extend identical services and prices to qualified public agencies. Each contract is between the proposer and individual agency binding only their agency, with no liability to Clark County.
2. Background	A planning level cost estimate and conceptual design were developed in 2018. The planning level scope includes culvert and berm removal to facilitate fish passage and floodplain connection; channel complexity and aquatic habitat enhancement; improved wetland and riparian habitat complexity; native plantings, and trail re-alignment components.
3. Scope of Project	The successful proposer will enter into a Professional Services Contract with Clark County to provide the services and deliverables described below and in Section IB. The scope is expected to include: • Project management • Project planning and coordination • 30% preliminary engineering design • 60% engineering design and engineer's cost estimate • Permit submittals • Design report, including alternatives analysis Draft versions of designs, costs estimates, and Design Report will be provided to the county for review, and feedback will be incorporated in final deliverable versions. The Interfluve, Inc. report is included as an attachment to this RFP.

<table>
<tr><td>4. Project Funding</td><td>Qualifications based selection, do not submit pricing.

Funding will be provided by the Public Works Clean Water Division..</td></tr>
<tr><td>5. Title VI Statement</td><td><u>Title VI Statement</u>
Clark County, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d to 2000d-4) and the Regulations, hereby notifies all bidders that it will affirmatively ensure that any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full and fair opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, or national origin in consideration for an award.

El Condado de Clark, de acuerdo con las disposiciones del Título VI de la Ley de Derechos Civiles de 1964 (78 Stat. 252, 42 U.S.C. §§ 2000d a 2000d-4) y el Reglamento, por la presente notifica a todos los postores que se asegurará afirmativamente de que cualquier contrato celebrado de conformidad con este anuncio, las empresas comerciales desfavorecidas tendrán la oportunidad plena y justa de presentar ofertas en respuesta a esta invitación y no serán discriminadas por motivos de raza, color u origen nacional en consideración a un laudo.

La políza del condado de Clark es garantizar que ninguna persona por motivos de raza, color, origen nacional o sexo según lo dispuesto en el Title VI of the Civil Rights Act de 1964, según enmendada, sea excluida por participar en, ser negado los beneficios de, o ser discriminado por cualquier programa o actividad patrocinada por el condado. Para preguntas relacionadas con el programa de Title VI de Obras Públicas del condado de Clark, o para servicios de interpretación o traducción para personas que no hablan inglés. O para que los materiales estén disponibles en un formato alternativo, comuníquese con el coordinador del Title VI de Obras Públicas del condado de Clark por correo electrónico a CCPW-TitleVI@clark.wa.gov o por teléfono a 564-397-4944. Las personas con problemas de audición / habla pueden llamar a Washington Relay Center al 711.

For questions regarding Clark County Public Works' Title VI Program, or for interpretation or translation services for non-English speakers, or otherwise making materials available in an alternate format, contact Clark County Public Works' Title VI Coordinator via email at CCPW-TitleVI@clark.wa.gov or phone at 564-397-4944. Hearing/speech impaired may call the Washington Relay Center at 711.</td></tr>
<tr><td>6. Timeline for Selection</td><td>The following dates are the <u>intended</u> timeline:

<table>
<tr><td>Pre-submittal Meeting</td><td>November 20, 2024</td></tr>
<tr><td>Deadline for Questions and Answers</td><td>November 25, 2024</td></tr>
<tr><td>Final date for Addendum, if needed</td><td>November 27, 2024</td></tr>
<tr><td>Proposals Due</td><td>December 11, 2024</td></tr>
<tr><td>Proposal Review/Evaluation Period</td><td>December 12 - 20, 2024</td></tr>
<tr><td>Selection Committee Recommendation</td><td>January 3, 2025</td></tr>
<tr><td>Contract Negotiation/Execution</td><td>January 3 – February 28, 2025</td></tr>
<tr><td>Contract Intended to Begin</td><td>March 1, 2025</td></tr>
</table></td></tr>
</table>

7. Employment Verification	The Proposer, if awarded the Contract, shall register and enter into a Memorandum of Understanding (MOU) with the Department of Homeland Security E-Verify program before execution of the Contract. The Contractor shall ensure all Contractor employees and any sub-contractor(s) assigned to perform work under this Agreement are eligible to work in the United States. The Contractor shall provide verification of compliance upon County request. Failure by Contractor to comply with this subsection shall be considered a material breach. (Sole Proprietors must submit a letter stating such.)
Section IB	**Work Requirements**
1. Required Services	The project requires production of engineering plans and design reports stamped by a professional engineer licensed in the State of Washington. The contractor must identify, coordinate, provide meeting facilitation and build consensus among a team of project stakeholders.
2. County Performed Work	Clark County has a conceptual design created by Interfluve, Inc. in 2018. The county team includes the Public Works Clean Water Division Infrastructure manager, Public Works Parks Division managers, and Public Works Engineering and Construction Division design and permitting staff.
3. Deliverables & Schedule	The contractor will provide a schedule for completing the draft and final 30 percent and 60 percent plans. The project will produce a 30 percent and 60 percent design for the preferred option by June 30, 2026.
4. Place of Performance	Contract performance will take place primarily at the Proposer's facility. Meetings with county staff may take place in the County's facility, the Proposer's facility, or a third-party location. Site visits and field meetings are also anticipated and will take place at the project location.
5. Period of Performance	A contract awarded as a result of this RFP will be for sixteen (16) months and is intended to begin on March 1, 2025 and end June 30, 2026. The anticipated contract value is $175,000, including extensions. Final contract value will be determined by approved funding. Clark County reserves the right to extend the contract resulting from this RFP for a period of two (2) additional years, in one (1) year increments, with the same terms and conditions, with the exception of cost, by service of a written notice of its intention to do so prior to the contract termination date. Cost for additional option year(s) shall be reviewed prior to extension of the contract. The county also reserves the right to terminate the contract, with thirty (30) days written notice, at any time if the requirements of the contract are not being met satisfactorily, solely in the county's judgment.

6. Prevailing Wage Applicable to all public work as defined in RCW 39.04.010(4) Public Works Definition	Pursuant to Washington State RCW 39.12 PREVAILING WAGES ON PUBLIC WORKS all work identified in this project as a public work requires the contractor to pay Washington State prevailing wages and file all affidavits of intent to pay with the WA State Dept of Labor & Industries. Contractors shall meet the requirements for Prevailing Wage and public works requirements, per RCW 39.04.350 BIDDER RESPONSIBILITY CRITERIA – SWORN STATMENT – SUPPLEMENTAL CRITERIA. For this project select the Clark County rates that apply on the proposal closing date from either of these sites: **http://www.wsdot.wa.gov/Design/ProjectDev/WageRates/default.htm** **http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates** Before payment is made by the Local Agency of any sums due under this contract, the Local Agency must receive from the Contractor and each Subcontractor a copy of "Statement of Intent to Pay Prevailing Wages" (Form L & I Number 700-29) approved by the Washington State Department of Labor and Industries. A fee of $45.00 per each "Statement of Intent to Pay Prevailing Wages" and "Affidavit of Wages Paid" is required to accompany each form submitted to this Department of Labor and Industries. The Contractor is responsible for payment of these fees and shall make all applications directly to the Department of Labor and Industries. These fees shall be incidental to all the proposed items of this contract.
7. Debarred/Suspended	Federally or Washington State debarred or suspended suppliers may not participate in this Request for Proposal. All proposer's must fill out, sign and submit the "Certification Regarding Debarment, Suspension, and Other Responsibility Matters" form with their proposal to be eligible to participate.
8. Americans with Disabilities Act (ADA) Information	Clark County in accordance with Section 504 of the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA), commits to nondiscrimination on the basis of disability, in all of its programs and activities. This material can be made available in an alternate format by emailing ADA@clark.wa.gov or by calling 564-397-2322.
9. Public Disclosure	This procurement is subject to the Washington Public Records Act (the "Act"), chapter 42.56 RCW. Once in the County's possession, all of the RFP Submittals shall be considered public records and available for public records inspection and copying, unless exempt under the Act. If a Respondent or Proposer considers any portion of an RFP Submittal to be protected under the law, whether in electronic or hard copy form, the Respondent or Proposer shall clearly identify each such portion with the word "PROPRIETARY". The County will notify the Respondent or Proposer in writing of the request and allow the Respondent or Proposer ten (10) days to obtain a court order enjoining release of the record(s). If the Respondent or Proposer does not take such action within the ten (10) day period, the County will release the portions of the RFP Submittal deemed subject to disclosure. All Respondents and Proposers who provide RFP Submittals for this procurement accept the procedures described above and agree that the County shall not be responsible or liable in any way for any losses that the party may incur from the disclosure of records to a third party who requests them.

10. Insurance/Bond	**A. Waiver of Subrogation** All insurance coverage maintained or procured pursuant to this agreement shall be endorsed to waive subrogation against County, its elected or appointed officers, agents, officials, employees and volunteers or shall specifically allow Contractor or others providing insurance evidence in compliance with these specifications to waive their right of subrogation prior to a loss. Contractor hereby waives its own right of subrogation against County and shall require similar written express waivers and insurance clauses from each of its subcontractors. **B. Proof of Insurance** Proof of Insurance shall be provided prior to the starting of the contract performance. Proof will be on an ACORD Certificate(s) of Liability Insurance, which the Proposer shall provide to Clark County. Each certificate will show the coverage, deductible and policy period. Policies shall be endorsed to state that coverage will not be suspended, voided, canceled or reduced without a 30-day written notice by mail to the County. It is the Proposer's responsibility to provide evidence of continuing coverage during the overlap periods of the policy and the contract. **C. Worker's Compensation** As required by the industrial insurance laws of the State of Washington. **D. Automobile** If the Proposer or its employees use motor vehicles in conducting activities under this Contract, liability insurance covering bodily injury and property damage shall be provided by the Proposer through a commercial automobile insurance policy. The policy shall cover all owned and non-owned vehicles. Such insurance shall have minimum limits of $1,000,000 per occurrence, combined single limit for bodily injury liability and property damage liability with a $1,000,000 annual aggregate limit. If the Proposer does not use motor vehicles in conducting activities under this Contract, then written confirmation to that effect on Proposer letterhead shall be submitted by the Proposer. **E. Commercial General Liability (CGL) Insurance** Written under ISO Form CG0001 or its latest equivalent with minimum limits of $2,000,000 per occurrence and in the aggregate for each one-year policy period. Personal and Advertising Injury $1,000,000 and General Aggregate $1,000,000. This policy must renew annually. This coverage may be any combination of primary, umbrella or excess liability coverage affording total liability limits of not less than $1,000,000 per occurrence and in the aggregate. However, if other policies are added they must be a follow-form policy in language, renewal date, and have no more exclusions than the underlying coverage. Products and Completed Operations coverage shall be provided for a period of three years following Substantial Completion of the Work. The deductible will not be more than $50,000 unless prior arrangements are made with Clark County on a case-by-case basis; the criterion is the Contractor's liquidity and ability to pay from its own resources regardless of coverage status due to cancellation, reservation of rights, or other no-coverage-enforce reason. Coverage shall not contain any endorsement(s) excluding nor limiting Product/Completed Operations, Contractual Liability or Cross Liability. Clark County needs to be listed as additional insured. **F. Professional Liability (aka Errors and Omissions)** The Proposer shall obtain, at Proposer's expense, and keep in force during the term of this contract Professional Liability insurance policy to protect against legal liability arising out of contract activity. Such insurance shall provide a minimum of $1,000,000 per occurrence. The deductible will not be more than $25,000 unless prior arrangements are made with Clark County on a case-by-case basis; the criterion is the Proposer's liquidity and ability to pay from its own resources. It should be an "Occurrence Form" policy. If the policy is "Claims Made", then Extended Reporting Period Coverage (Tail coverage) shall be purchased for three (3) years after the end of the contract.

	G. <u>Umbrella Liability Coverage</u> Umbrella Coverage in the amount of $1,000,000 shall be provided and will apply over all liability policies without exception, including Commercial General Liability and Automobile Liability. **H. <u>Additional Insured</u>** Clark County, its officers, employees and agents, will be named on all policies of contractor and any subcontractors as an additional insured, with no restrictions or limitations concerning products and completed operations. This coverage shall be primary coverage and noncontributory to any coverage maintained by Clark County. The contractor shall provide Clark County with verification of insurance and endorsements required by this agreement. Clark County reserves the right to require complete, certified copies of all required insurance policies at any time. All insurance shall be obtained from an insurance company authorized to do business in the State of Washington. All policies must have a Best's Rating of A-VII or better.
11. Plan Holders List	All proposers are required to be listed on the plan holders list. ✓ Prior to submission of proposal, confirm your organization is on the Plan Holders List below: To view the Plan Holders List, click on the link below or copy and paste into your browser. Clark County RFP site: https://clark.wa.gov/internal-services/purchasing-overview • If your organization is NOT listed, submit Attachment B - Letter of Interest to ensure your inclusion. • Proposals received by Clark County by proposers not included on the Plan Holders List may be considered non-responsive.

Part II Proposal Preparation and Submittal

Section IIA	Pre-Submittal Meeting / Clarification
1. Pre-Submittal Meeting	A pre-submittal meeting will be held on Wednesday, November 20, 2024 at 1:00 pm, via Microsoft Teams. Attendees shall email Jeff Schnabel at jeff.schnabel@clark.wa.gov to request the meeting invite.
2. Proposal Clarification	Questions and Requests for Clarification regarding this Request for Proposal must be directed in writing, via email, to the person listed on the cover page. The deadline for submitting such questions/clarifications is November 25, 2024 by 5:00 pm. An addendum will be issued no later than November 27, 2024 to all recorded holders of the RFP if a substantive clarification is in order. The Questions & Answers/Clarifications are available for review at the link below. Each proposer is strongly encouraged to review this document prior to submitting their proposal. Clark County RFP site: **https://clark.wa.gov/internal-services/request-proposal-1**
Section IIB	**Proposal Submission**
1. Proposals Due	Sealed proposals must be received no later than the date, time and location specified on the cover of this document. **The outside of the envelope/package shall clearly identify:** **1. RFP Number and;** **2. TITLE and;** **3. Name and Address of the Proposer.** Responses received after submittal time will not be considered and will be returned to the Proposer - unopened. Proposals received with insufficient copies (as noted on the cover of this document) cannot be properly disseminated to the Review Committee and other reviewers for necessary action, therefore, may not be accepted.
2. Proposal	Proposals must be clear, succinct and not exceed 15 pages, excluding resumes, coversheet and debarment form. Proposer's who submit more than the pages indicated may not have the additional pages of the proposal read or considered. For purposes of review and in the interest of the County, the County encourages the use of submittal materials (i.e. paper, dividers, binders, brochures, etc.) that contain post-consumer recycled content and are readily recyclable. The County discourages the use of materials that cannot be readily recycled such as PVC (vinyl) binders, spiral bindings, and plastic or glossy covers or dividers. Alternative bindings such as

	reusable/recyclable binding posts, reusable binder clips or binder rings, and recyclable cardboard/paperboard binders are examples of preferable submittal materials. Proposers are encouraged to print/copy on both sides of a single sheet of paper wherever applicable; if sheets are printed on both sides, it is considered to be two pages. Color is acceptable, but content should not be lost by black-and-white printing or copying. All submittals will be evaluated on the completeness and quality of the content. Only those Proposers providing complete information as required will be considered for evaluation. The ability to follow these instructions demonstrates attention to detail. Additional support documents, such as sales brochures, should not be included with each copy unless otherwise specified.
Section IIC	**Proposal Content**
1. Cover Sheet	This form is to be used as your proposal Cover Sheet. See Cover Sheet - Attachment A
2. Project Team	Include the title and a short summary of each project team member expertise and capabilities, with the option to attach resumes for key team members.
3. Management Approach	Successful RFP proposers will include clear, logical methodologies and timelines for completing the scope of work. To achieve this, the project team should outline their approach including important technical considerations, and an idea of how to achieve key tasks and deliverables in the designated time frame
4. Respondent's Capabilities	Please describe your team's readiness to proceed on this scope of work including the expertise and capabilities of the application team, necessary partnerships, or subcontractors to successfully complete this work.
5. Project Approach and Understanding	Describe how you understand the project and your approach to completing the project.
6. Proposed Cost	Do not submit cost, it will not be considered for this RFP.

Part III Proposal Evaluation & Contract Award

<table>
<tr><th>Section IIIA</th><th>Proposal Review and Selection</th></tr>
<tr><td>1. Evaluation and Selection:</td><td>Proposals received in response to this RFP will be evaluated by a Review Committee. The Committee may require a presentation.</td></tr>
<tr><td>2. Evaluation Criteria Scoring</td><td>Each proposal received in response to the RFP will be objectively evaluated and rated according to a specified point system.

A one hundred (100) point system will be used, weighted against the following criteria:

<table>
<tr><td>Technical Merit This criterion evaluates the technical merit of the proposal, and the applicant's comprehensive understanding of planning, designing, and permitting in-stream enhancement projects. The proposal addresses stakeholder coordination, meetings, consensus-building, permit requirements and design considerations.</td><td>50</td></tr>
<tr><td>Project Team Capabilities This criterion evaluates readiness to proceed on the scope of work. This includes an evaluation of the expertise and capabilities of the consultant team. Work history, examples and references will be considered.</td><td>25</td></tr>
<tr><td>Quality of the Proposal Submittal A clear, concise proposal that addresses the RFP and demonstrates understanding of the requested work.</td><td>25</td></tr>
<tr><td>Total Points</td><td>100</td></tr>
</table>
</td></tr>
<tr><th>Section IIIB</th><th>Contract Award</th></tr>
<tr><td>1. Consultant Selection</td><td>The County will determine the most qualified proposer based on the evaluation criteria listed using predetermined weights, the attributes of the Proposers and the overall responsiveness of the Proposal. If the County does not reach a favorable agreement with the top Proposer, the County shall terminate negotiations and begin negotiations with the next qualified Proposer. If the County is unable to reach agreeable terms with either Proposer, they may opt to void the RFP and determine next steps.

Clark County reserves the right to accept or reject any or all proposals received, to negotiate with any or all prospective contractors on modifications to proposals, to waive formalities, to postpone award, or to cancel in part or in its entirety this RFP. Clark County reserves the right to award the contract based on the best interests of the County.</td></tr>
<tr><td>2. Contract Development</td><td>The proposal and all responses provided by the successful Proposer may become a part of the final contract.</td></tr>
<tr><td>3. Award Review</td><td>The public may view Request for Proposal documents by submitting a public records request at www.clark.wa.gov .</td></tr>
<tr><td>4. Orientation/Kick-off Meeting</td><td>A kick-off meeting will be scheduled shortly after the final contract is executed.</td></tr>
</table>

Request for Proposal #909
Lower Suds Creek Enhancement Sixty-Percent Project Design

Attachment A: COVER SHEET

General Information:

Legal Name of Proposing Firm	
Street Address	
City | State | Zip Code	
Contact Person | Title	
Phone	
Program Location (if different than above)	
Email Address	
Tax Identification Number	

ADDENDUM:

Proposer shall acknowledge receipt of Addenda by checking the appropriate box(es).

None ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐

NOTE: Failure to do so, shall render the proposer non-responsive and therefore be rejected.

I certify that to the best of my knowledge the information contained in this proposal is accurate and complete and that I have the legal authority to commit this agency to a contractual agreement. I realize the final funding for any service is based upon funding levels, and the approval of the Clark County Council and required approvals.

Authorized Signature of Proposing Firm

Date

Printed Name

Title

Request for Proposal #909
Lower Suds Creek Enhancement Sixty-Percent Project Design

Attachment B: LETTER OF INTEREST

Legal Name of Proposing Firm	
Street Address	
City | State | Zip Code	
Contact Person | Title	
Phone	
Program Location (if different than above)	
Email Address	

- All proposers are required to be included on the plan holders list.
- If your organization is NOT listed, submit the 'Letter of Interest" to ensure your inclusion.

Email Letter of Interest to*: Koni.Odell@clark.wa.gov and Priscilla.Mason@clark.wa.gov*

Clark County web link: https://clark.wa.gov/internal-services/request-proposal-1

This document will only be used to add a proposer to the plan holders list. Submitting this document does not commit proposer to provide services to Clark County, nor is it required to be submitted with proposal.

Proposals may be considered non-responsive if the Proposer is not listed on the plan holders list.

Request for Proposal #909
Lower Suds Creek Enhancement Sixty-Percent Project Design

Attachment C

Clark County, Washington

Certification Regarding
Debarment, Suspension and Other Responsibility Matters

The prospective participant certifies to the best of its knowledge and belief that it and its principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal, State or local department or agency;

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a government entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

I understand that a false statement on this certification may be grounds for rejection of this proposal or termination of the award. In addition, under 18 USC Sec. 1001, a false statement may result in a fine of up to $10,000 or imprisonment for up to 5 years, or both.

_____
Company Name

_____
Typed Name & Title of Authorized Representative

_____ _____
Signature of Authorized Representative Date

☐ I am unable to certify to the above statements. My explanation is attached.

TECHNICAL MEMORANDUM

To:	Clark County Public Works
From:	Inter-Fluve
Date:	December 20, 2018
Re:	Cougar and Suds Creeks – Clark County Reach Project Alternatives

Introduction

This memorandum is intended to facilitate project planning and prioritization in the Cougar and Suds Creek basins within the Salmon Creek watershed. Specifically, the memo describes potential treatments for stream channel, riparian, and floodplain stabilization and enhancement for reaches within Cougar and Suds Creeks. Appendix A provides Design sheets describing techniques employed within the 5 potential project areas. The provided information will allow evaluation of and comparison between the projects as part of Clark County's project evaluation process. Note that throughout this memorandum we refer to Cougar Canyon Creek by the common name, Cougar Creek.

Project Goal and Objectives

Cougar and Suds Creeks are important tributaries within the Salmon Creek basin, with respect to fish habitat and water quality. The creeks have and are currently experiencing urbanization-related channel incision that is threatening channel stability, contributing to severe erosion, and is compromising aquatic habitat and water quality.

The overall project goal is to identify projects that reduce sediment inputs to Salmon Creek, prevent property damage, and restore channel and floodplain conditions.

Identified primary project objectives include identifying projects that:

- Prevent bank failure where there is an imminent threat to property
- Identify solutions for severe erosion sites
- Address bank erosion caused by stormwater outfalls
- Identify risk to Clark Regional Waste District sewer infrastructure
- Reconnect floodplain with channel
- Control down cutting that disconnects floodplain or threatens bank stability
- Work on county land where possible

Site Assessment

The site assessment was conducted in August of 2018. The study reaches were walked and documented through photographs and geomorphic assessment forms. Reach breaks used for this project match those used for the 2008 Stormwater Needs Assessment Program (SNAP) report (Clark County Public Works, 2009), and those reaches covered for this project include reaches 4 – 14 on Cougar Creek and 1 – 10 on Suds Creek (Figure 1). Prior field assessment project locations identified by Clark County were assessed and alterations to physical and ecological processes and locations with at-risk infrastructure were identified.

The following table (Table 1) presents summaries of field observations for each reach, relative to the project goal and objectives stated above. In some cases, reach properties and needs were very similar and were thus combined in the table as noted.

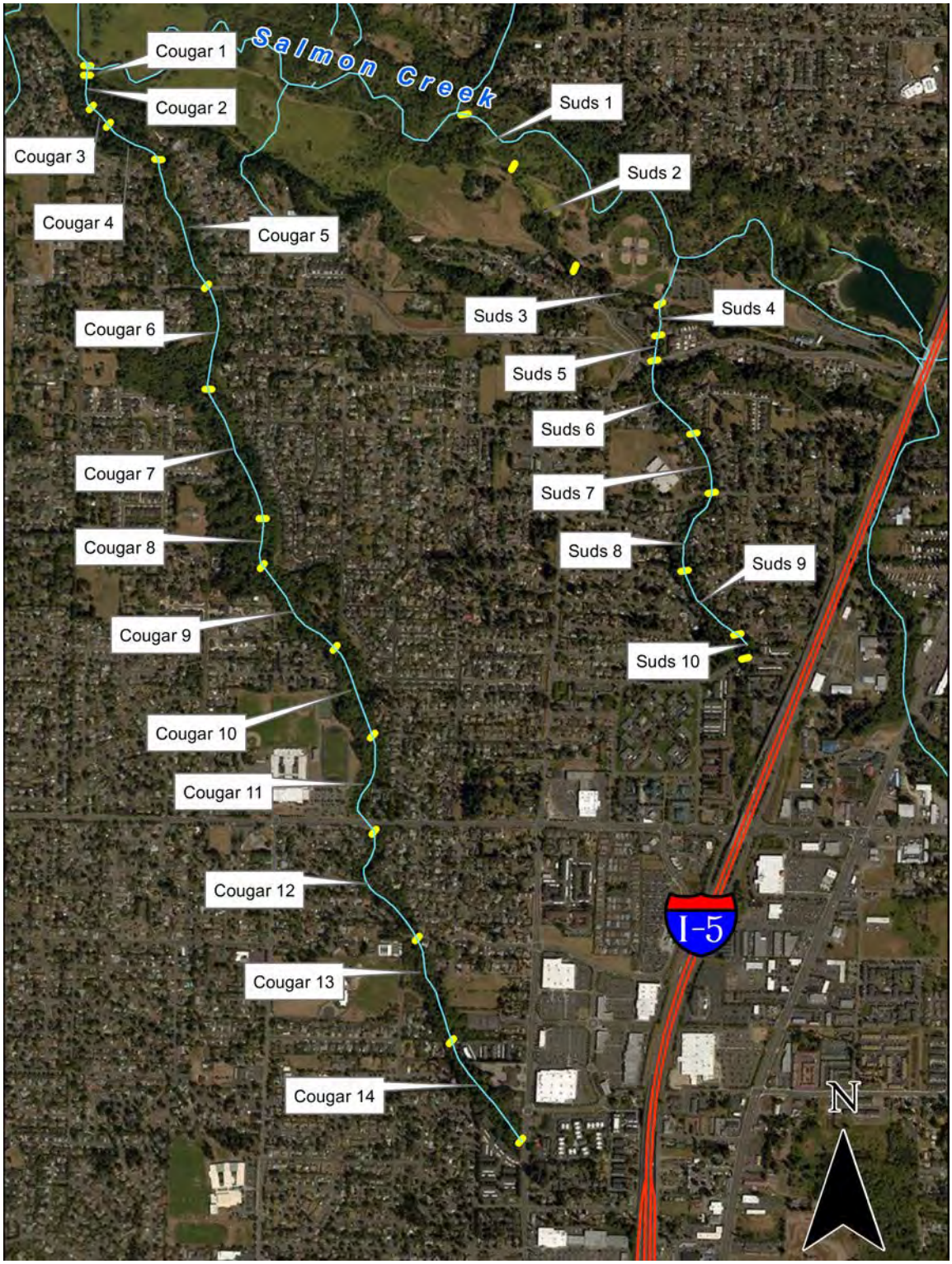

Figure 1. Project reach map. Reach break locations are approximate and shown as yellow lines. Note that Suds Creek no longer takes the route depicted across the Salmon Creek Floodplain.

Table 1. Summary reach observations from the site assessment.

COUGAR CREEK		
Reach	Notes	Opportunities/Needs
4	• Creek incised into sandstone and conglomerate bedrock associated with Troutdale formation • Banks above conglomerate are tall, vertical, and have cohesive and alluvial layers (associated with the Missoula Flood deposits) • Several falls present in reach, ranging in height from ~5-10 feet, are likely passage barriers • Section of creek is part of community park and has walking path adjacent to creek • Tributary drainages (potentially associated with stormwater outfalls) are downcutting and supplying sediment to creek • Downstream boundary is knickpoint in conglomerate; headcuts present in reach	Opportunities: • Slow progression of headcuts and further channel incision above conglomerate • Revegetate with native species to provide shade and organic matter inputs • Outfall/erosion protection for tributary inputs Needs: • Monitor progression of knickpoint at downstream end of reach
5	• Creek is relatively well connected to adjacent/available floodplain, likely a result of culvert in the reach. • Few pieces of large wood adding complexity to mostly fine-grained substrate (sands and silts) • Riparian vegetation consists of trees and shrubs; blackberry pervasive in spots • Culvert perched ~2 feet and likely passage barrier • Bank stability controlled by presence of hardpoints (i.e., riprap) and large trees • Upstream end of reach is culvert under NW 119th Street; passage barrier	Opportunities: • Slow progression of headcuts and further channel incision above conglomerate • Remove blackberry and revegetate banks and floodplain with native species to provide shade and organic matter inputs • Outfall/erosion protection for tributary inputs Needs: • Replace/remove culvert
6, 7, 8	• Creek incising below inset floodplain • Several failing outfalls and tributary inputs contributing fine sediments to the creek • Riparian community dominated by blackberry which appears to be contributing to channel incision and bank erosion • Limited large wood adding localized complexity to channel • Banks generally tall, bare, and consist of fine sediments	Opportunities: • Limit tributary input of fine sediment through outfall repair, erosion protection (e.g., rundowns), and wetland/deposition zones • Reconnect channel to inset floodplain to take advantage of available storage and reduce pervasive bank erosion • Remove blackberry and revegetate banks and floodplain with native

	• Bed sediments patchy and variable ranging from sands and silts in slackwater areas to cobbles in higher energy riffles • Limited mass wasting of channel banks, but present in places • Several small wetlands perched above channel on inset floodplain • Erosion threatening sewer infrastructure • Rill and gully erosion pervasive	species to provide shade and organic matter inputs <u>Needs:</u> • Provide erosion protection for sewer infrastructure • Evaluate, repair, and/or replace failing outfalls
9, 10, 11, 12	• Creek incising below inset floodplain • Several failing outfalls and tributary inputs contributing fine sediments to the creek • Riparian community dominated by blackberry which appears to be contributing to channel incision and bank erosion • Fish passage structure below culvert at upstream end of Reach 11 (NW 99th Street) full of trash and debris • Banks generally tall, bare, and consist of fine sediments • Bed sediments patchy and variable ranging from sands and silts in slackwater areas to cobbles in higher energy riffles • Bank erosion threatening sewer infrastructure • Rill and gully erosion pervasive	<u>Opportunities</u>: • Limit tributary input of fine sediment through outfall repair, erosion protection (e.g., rundowns), and wetland/deposition zones • Reconnect channel to inset floodplain to take advantage of available storage and reduce pervasive bank erosion • Remove blackberry and revegetate banks and floodplain with native species to provide shade and organic matter inputs <u>Needs:</u> • Provide erosion protection for sewer infrastructure • Evaluate, repair, and/or replace failing outfalls • Trash removal
13, 14	• Creek incising below inset floodplain • Several failing outfalls and tributary inputs contributing fine sediments to the creek • Riparian community dominated by blackberry which appears to be contributing to channel incision and bank erosion • Large unstable slope below stormwater detention pond; broken culvert directing flow towards the bank • Banks generally tall, bare, and consist of fine sediments	<u>Opportunities</u>: • Limit tributary input of fine sediment through outfall repair, erosion protection (e.g., rundowns), and wetland/deposition zones • Reconnect channel to inset floodplain to take advantage of available storage and reduce pervasive bank erosion • Remove blackberry and revegetate banks and floodplain with native species to provide shade and organic matter inputs

	• Bed sediments patchy and variable ranging from sands and silts in slackwater areas to cobbles in higher energy riffles • Steep eroding slope below fire station • Rill and gully erosion pervasive	• Remove or replace culvert <u>Needs:</u> • Provide erosion protection for sewer infrastructure • Evaluate, repair, and/or replace failing outfalls • Geotechnical evaluation of steep slopes below fire station
SUDS CREEK		
Reach	Notes	Opportunities, Needs
1	• Suds Creek routed through wetland channel and pond north of walking path • Channel choked with blackberry along path • Creek in perched CMP under walking path • Fish passage through culvert unlikely	<u>Opportunities</u>: • Realign trail around wetland ponds removing need for culvert • Remove blackberry and load channel with large wood to maintain and shade channel, and provide habitat complexity and cover <u>Needs:</u> • Replace CMP to provide passage – use multiple openings or remove entirely and reroute trail
2	• Creek channelized through forest on Salmon Creek floodplain and routed into pond • Channel connecting pond to culvert lacks structure and choked with vegetation • Banks generally vertical and actively eroding; fine-grained • Channel lack bedform complexity; substrate fines with infrequent accumulations of cobbles and gravels • Fine sediment deposition will be an issue as channel drops bedload traveling across relatively flat Salmon Creek floodplain • Upstream reach break at countersunk CMP	<u>Opportunities</u>: • Create/support complex wetland habitat at pond • Add large wood to increase complexity of channel above pond • Existing trails consist of paved and dirt options and provide options for rerouting existing trail adjacent to pond • Revegetate as appropriate to provide shade, support wetland complexity <u>Needs:</u> • Facilitate passage to and through culvert and downstream end of reach • Evaluate fish passage at upstream culvert

3	• Creek rerouted along margin of Salmon Creek floodplain and terrace toe • Creek passed through two countersunk culverts, each with relatively minor erosion adjacent to the culvert • Channel sediments range from fines to coarse gravels • Reach lacks pool habitat • Bend at upstream end has exposed jersey barrier • Access challenging because of thick riparian vegetation and mature trees	Opportunities: • Augment available habitat with selective large wood placement • Repair bend at upstream end with combination of rock treatment and bioengineered banks Needs: • Evaluate passage at culverts
4, 5	• Channel deeply entrenched, incising down through Missoula flood deposits to Salmon Creek floodplain • Channel bed supported by engineered boulder weirs and log weirs most of which have been undercut • At upper end, piping is eroding sediments from behind boulder wall on right bank • Boulder cascade from crossing at NE 117th Street is passage barrier • Challenging access because of the topography	Opportunities: • Limited options for enhancement because creek is highly entrenched and supported by large boulder drops • Boulder drops and log weirs may need replacement Needs: • Evaluate structural integrity of boulder wall
6	• Creek incising into inset floodplain as you move upstream from culvert • English Ivy and blackberry dominate riparian vegetation • Large headcut and failing slope associated with stormwater detention facility on un-named tributary • Creek eroding laterally into sewer infrastructure in places	Opportunities: • Stabilize invert and reconnect creek to inset floodplain • Remove ivy and blackberry and evegetate with native species Needs: • Drainage repairs to stormwater detention facility • Erosion protection for stormwater infrastructure • Headcut stabilization
7, 8	• Creek incising into inset floodplain • Banks vertical, actively eroding and composed of fine, cohesive sediments in some locations; loosely consolidated alluvium in other locations • English Ivy and blackberry dominate riparian vegetation	Opportunities: • Stabilize invert and reconnect creek to inset floodplain • Revegetate with native species Needs: • Trash removal

	• Outfalls eroding through inset floodplain, contributing fine sediment • Exposed sewer infrastructure in channel	• Outfall repair and energy dissipation • Erosion protection around sewer infrastructure
9	• Creek cutting through Missoula Flood deposits and closely coupled to valley wall • Boulder and cobble substrate with gravels and fines • English Ivy and blackberry dominate riparian vegetation • Sewer line exposed in bottom of creek • Un-named tributary and outfall appear to be causing large headcut and possibly threatening homes	Opportunities: • Stabilize invert to slow incision into sewer infrastructure • Cover and backfill exposed sewer line; provide grade control • Remove ivy and blackberry, and revegetate with native species • Extend outfall on un-named tributary and provide grade control Needs: • Trash removal • Outfall repair and energy dissipation • Erosion protection around sewer infrastructure • Geotechnical evaluation of steep, eroding slopes below homes on Suds Creek and un-named tributary
10	• Steep, short reach below NE 105th Street • Boulder and cobble dominated substrate • Riparian vegetation mostly blackberry	Opportunities: • Stabilize invert and reconnect creek to inset floodplain • Remove blackberry and revegetate with native species • Topography is an access challenge Needs: • None

SYNTHESIS OF FIELD OBSERVATIONS

In light of the observations made in the field and summarized above, bank erosion and downcutting in the reaches of Cougar and Suds Creeks above the Salmon Creek floodplain is the product of a geomorphic response to an altered hydrologic regime acting on readily erodible geology. Positive feedback loops, acting on the reach and site scales, exacerbate channel erosion. Flashier hydrographs flush bed substrate, initiating channel incision. Channel incision concentrates flows, increasing flow energy and initiating additional bed deformation. Invasive blackberry and ivy do little to bind soil together and out-compete native plants that might otherwise reduce overland and bank sediment loading. The invasive vegetation, the majority of

which is Himalayan blackberry, encourages additional bed incision by hanging over the channel banks and concentrating flows in the middle of the channel. However, the banks themselves remain bare and susceptible to erosion from fluvial entrainment and mass wasting as bank height exceeds critical bank height. Channel incision in some locations is limited by proximity to hard grade controls (e.g., culverts) and/or more erosion-resistant geology.

These positive feedback loops all contribute to fine sediment loading, bank instability, and reduced habitat quality. The process can be conceptualized with reference to the Channel Evolution Model (CEM) for incised channels described in Schumm et al. (1984). The CEM plots a course through stages of potential stream response following incision (Figure 2). In locations below dominant grade controls (e.g., culverts), Cougar and Suds Creeks are in Stages 2 and 3. Just upstream of many of the culverts, the creeks are aggrading and eroding laterally, as depicted in Stage 4. Catching the stream in its evolutionary trajectory before it gets to Stage 3 – where mass wasting of the banks becomes prevalent – is key to limiting further sediment loading.

The rates at which the streams progress through the stages varies throughout the project site, predominantly controlled by the channel's proximity to hard grade controls and the more erosion resistant geology of the Troutdale Formation. Observations of lower Cougar Creek made by the County suggest that Cougar Creek has changed very little below (or north of) NW119th where several knickpoints exist. We attribute this to the more erosion resistant substrate and bedrock (associated with the Troutdale Formation) present in the lower reaches (Clark County Public Works, 2009). In these locations, channel progression through the stages of channel evolution is likely to be slower in comparison to more responsive reaches. Moving upstream, channel substrate and bank composition transitions to cataclysmic flood deposits, and stream response potential generally increases.

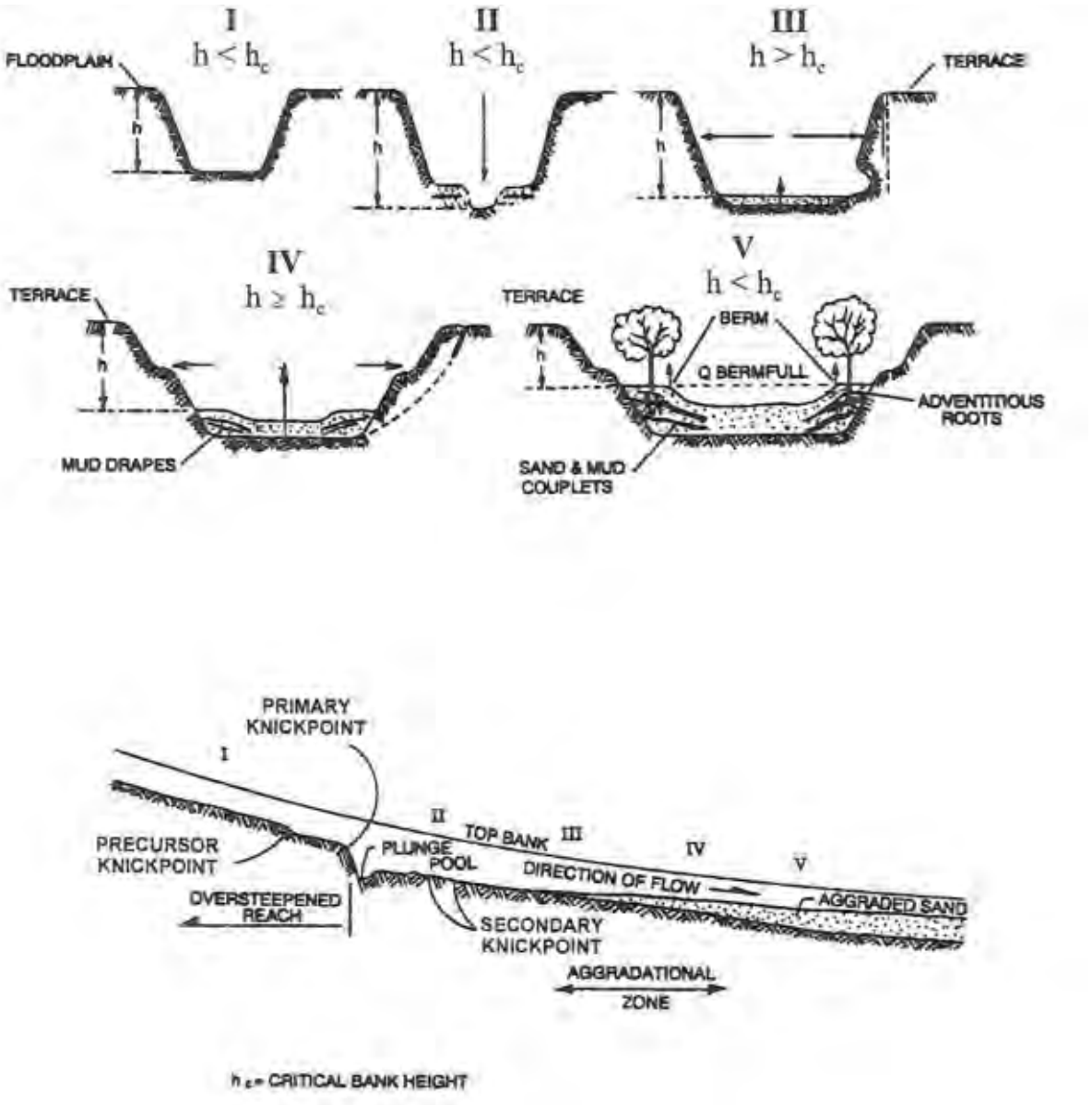

Figure 2. Incised Channel Evolution Sequence described in Schumm et al. (1984).

LIMITING FACTORS

Following the site assessment, the primary issues common to both creeks were identified. These were condensed into five physical and ecological limiting factors: 1) fine sediment loading, 2) altered hydrology, 3) habitat degradation, 4) infrastructure undermining, and 5) longitudinal and lateral disconnection. Although limiting factors have been consolidated into categories, the processes that contribute to the degraded condition are interrelated, hence symptoms of each limiting factor appear in more than one category.

Sediment Loading

- The existing invasive vegetation fails to provide suitable bank stability and roughness and thus is increasing bank erosion that contributes fine sediment to the channel.
- The existing channel banks and hillslopes are becoming undercut, contributing fine sediment, and are at risk of failure through mass wasting processes.
- Increasing urbanization and runoff from impermeable surfaces have altered stream hydrology and resulted in more frequent and higher magnitude flood peaks. This amplified runoff has led to higher rates of channel erosion within the study reaches and greater inputs of fine sediment into Salmon Creek.
- The existing geometry and altered hydrology of the study creeks have resulted in diminished channel complexity and a lack of sediment storage within the system.

Altered Hydrology

- Rapid suburban development over the last century has increased the area of impermeable surfaces, altering the timing and magnitude of flow artificially directed into the creeks.
- Stormwater infrastructure that contributes flow to the study creeks has expanded to accommodate needs, but improvements to increase storage may not have evolved at the same pace.
- Altered hydrology has increased channel entrenchment and channel simplification, leading to disconnection of the channel from the floodplain and less opportunity for energy dissipation, enhancing the erosive capability of the flow.

Habitat Degradation

- Floodplain disconnection resulting from channel entrenchment and incision has allowed invasive species to proliferate within the riparian zone and floodplain, out-competing native vegetation reliant on inundation.
- Channel simplification has occurred through scouring from high flows, as well as likely channel realignment from installation of waste water infrastructure.
- The lack of channel complexity has resulted in a lack of sediment storage within the system and degraded and/or absent aquatic habitat.

Infrastructure Undermining

- The existing wastewater infrastructure requires maintenance, and in some cases, immediate repairs to damage caused by channel incision and avulsions associated with altered hydrology.
- Undermining of, or damage to, wastewater infrastructure may create water quality issues if not addressed and mitigated.
- Wastewater structures act as impediments to flow and are adversely affecting natural channel processes associated with lateral and vertical channel dynamics.

Longitudinal and Lateral Disconnection

- Incision of the stream channel through much of the study area has resulted in widespread lateral disconnection between the channel and floodplain. This eliminates lateral exchanges that reduce stream energy, store sediments, and develop robust riparian ecosystems.
- The existing, artificial grade controls (e.g., culverts) and headcuts result in disruption to sediment continuity and a reduction of channel longitudinal connectivity for aquatic organisms.
- The migration of existing channel knickpoints (aka headcuts), if left unaddressed, may further threaten infrastructure and increase channel entrenchment, resulting in increased lateral disconnection.
- Lateral disconnection reduces large wood recruitment to the channel, which has led to channel simplification and a lack of in-channel storage of sediments.

Treatment Types

The treatments developed for this project are focused on interrupting the feedback loops that exacerbate channel incision before critical bank height is reached and widespread mass wasting is triggered. This is primarily accomplished by reducing stream energy through floodplain reconnection, as well as through revegetation with native plants that may be more successful at limiting rill and gully erosion.

Specifically, six treatment types have been identified to address the impairments and to achieve the primary objectives (refer to Appendix A). These treatment types include: 1) channel bed stabilization and grade control, 2) floodplain reconnection, 3) bank and infrastructure protection, 4) outfall repair, 5) habitat enhancement, and 6) native revegetation. These treatment types will be described in the following paragraphs. In the subsequent section, various combinations of these treatment types are discussed as potential treatment strategies.

TREATMENT TYPE 1 – CHANNEL BED STABILIZATION AND GRADE CONTROL

Priority Objective: This treatment type addresses channel entrenchment, damage to infrastructure, habitat degradation, and longitudinal disconnection. Invert stabilization at key locations of the study area will slow the upstream migration of headcuts, slow channel incision, and lateral and longitudinal connectivity.

Description: Currently, portions of the study reaches and adjacent valley bottom wetlands are at risk for further incision, mass wastage of the banks, and habitat loss (Figure 3). Opportunities exist throughout each sub-basin to prevent mass wasting of the banks and the associated sediment loading, by stabilizing the channel bed.

Figure 3: Existing headcuts on Cougar Creek

Carefully placed grade controls at key locations in the study area would emulate a geologic control and transition the change in grade through the headcut through a step or steep riffle. Several design options exist but each must place grade control across the entire valley bottom width to eliminate risk of avulsion or flanking. Grade controls can be constructed from rocks, logs and/or a combination of both and can be used to protect infrastructure, banks, and further channel incision. An example of a rock grade control designed and implemented to mimic a sequence of rock steps is shown in Figure 4.

Benefits: Grade control will stop the upstream migration of existing headcuts thereby preserving remaining valley bottom and channel connectivity, hydrology and associated wetland function. When designed in coordination with floodplain reconnection and revegetation (discussed separately below), they will also prevent the transition to widespread mass wasting of the channel banks associated with further incision. This treatment type will also address the risk of future channel and floodplain instability associated with further alteration of the hydrologic regime.

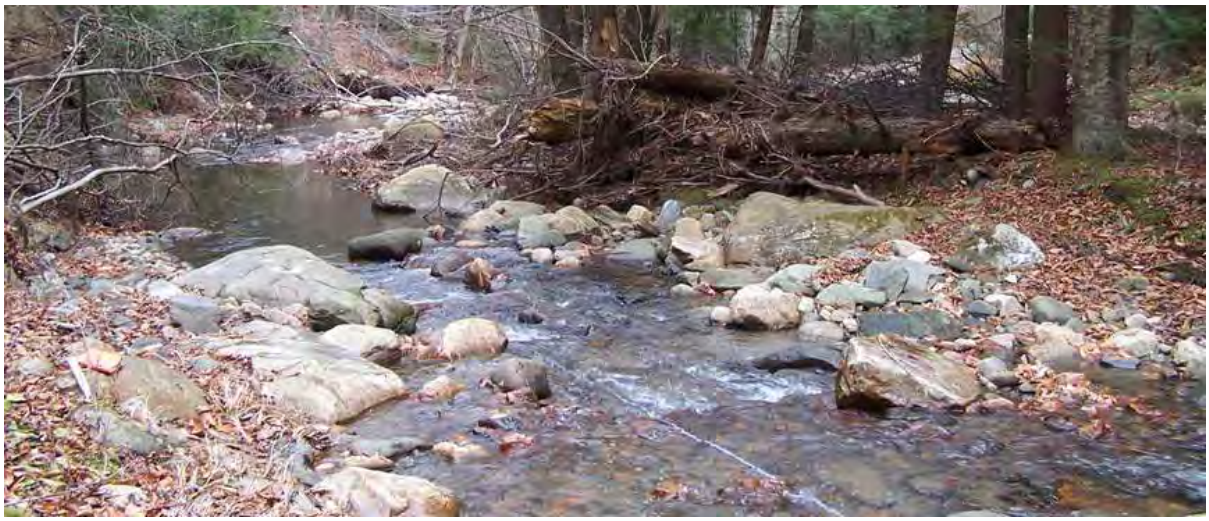

Figure 4: Series of rock steps installed for channel grade control | Tower Brook, Chesterfield, MA.

TREATMENT TYPE 2 – FLOODPLAIN RECONNECTION

Priority Objective: This treatment type addresses, either directly or indirectly, all of the limiting factors discussed above. Floodplain reconnection and placement of structural roughness elements slow flood velocities, provide stormwater retention and infiltration, encourage nutrient deposition, and enhances riparian health.

Description: The majority of the study reaches experience floodplain disconnection, in which annual and biennial flows fail to inundate the floodplain. Discharges that at one time flooded the valley, are now contained well within the channel. This floodplain disconnection is associated with elevated flow velocities and a lack of sediment storage within the channel, riparian and floodplain zones. Treatment for these reaches involves lowering existing floodplain elevations and increasing channel and floodplain roughness, to encourage flood flow dissipation and sediment storage.

Constructed flow detention and roughness structures would emulate a valley-spanning log structure (Figure 5). It would be designed to retain an approximate depth of water upstream of each structure, and would be spaced at appropriate intervals downstream to maximize flow dissipation and sediment storage within the reach.

Figure 5: Examples of floodplain and valley-spanning roughness features | Whipple Creek, WA.

Benefits: Valley-spanning log structures would have a variety of benefits that address existing issues. The attenuation of downstream peak flow discharges would slow incision upstream and enhance post-incision recovery. Stream energy would be reduced, which would also help to protect infrastructure. The increased floodplain inundation would benefit wetland plants, creating a stable, diverse riparian zone to dissipate flood flows well into the future. The deposition and retention of sediment and nutrients within the study reach, both in the channel and within the floodplain, would increase aquatic and terrestrial health and decrease nuisance sedimentation downstream (Figure 6).

Figure 6: Floodplain inundation and connectivity encouraging native riparian growth | Cemetery Creek, WA.

TREATMENT TYPE 3 – BANK AND INFRASTRUCTURE PROTECTION

Priority Objective: This treatment type addresses the fine sediment loading, infrastructure undermining, and habitat degradation limiting factors. Placement of structural elements and re-alignment of the channel would discourage mass-wasting, increase the lifespan of existing waste water infrastructure, protect private property, and increase channel and floodplain roughness. Figure 7 shows an example of exposed sewer infrastructure.

Figure 7: Channel avulsion and undercutting of existing waste water infrastructure along Cougar Creek.

Description: Throughout the study reaches, channel incision has led to over-steepened banks and slopes at risk of mass-failure. Failure of these slopes would have a significant impact on existing infrastructure and contribute to sediment loading issues. Stabilization of these banks, through channel realignment and placement of large wood and rock (Figure 8), would encourage appropriate channel development and alleviate pressure on existing infrastructure. This approach involves moving the channel away from the at-risk infrastructure in some locations, reducing the size of the bankfull channel, and construction of a floodplain surface. This increases the opportunity for floodplain inundation and decreases flood energy available for continued bank undermining.

Figure 8: Example large wood and soil lift bank stability treatment that also improves channel complexity | Kelley Creek, WA.

Benefits: This treatment type will encourage post-incision channel development, enhance floodplain connectivity, and protect existing infrastructure and property.

TREATMENT TYPE 4 – OUTFALL REPAIR

Priority Objective: This treatment type addresses the sediment loading and habitat degradation limiting factors. Repair, replacement, and/or the installation energy dissipators will reduce the erosion observed on the valley walls and streambanks.

Description: Many culverts and outfalls throughout the project site are plugged, flanked, lack energy dissipators, and/or are in various states of disrepair (Figure 9). They are exacerbating erosion on the valley walls and streambanks throughout the study area, and in some cases, threatening private property and infrastructure. Treatment begins with a systematic evaluation of each culvert and outfall to determine if they are functioning or not. If they appear to be functioning, with no evidence of gully erosion, evaluation can focus on the installation of rundowns or other BMPs that provide energy dissipation at the outfall. In many cases, gully erosion was observed around the outfalls, suggesting that they may be plugged, broken, and/or undersized. In these cases, the outfall needs to be evaluated for sizing and replacement. French drains around the outfalls may reduce the potential for the reestablishment of gully erosion.

Figure 9. Examples of outfalls that lack energy dissipators and are eroding through the bank (left) and a gully that has formed adjacent to an outfall indicating that the outfall is not functioning.

Benefits: Repair to many of the culverts and outfalls, including energy dissipators, will reduce sediment loading and slow the upward propagation of gullies through the study area.

TREATMENT TYPE 5 – HABITAT ENHANCEMENT

Priority Objective: This treatment type addresses habitat degradation and aquatic passage loss within the lower reaches of Suds Creek. These reaches are Tier 3 reaches in EDT, which is the highest tier in the Salmon Creek Basin.

Description: The lower reaches of Suds Creek, just upstream of the confluence with Salmon Creek, are currently lacking in structural elements that provide cover, shade, and habitat for aquatic species, and influence hydraulics such as to encourage deposition and gravel sorting. Placement of large wood would improve channel complexity, provide cover, encourage more natural sediment deposition patterns, and inundate the floodplain more frequently, connecting species with floodplain habitat during higher flows. Additionally, Suds Creek flows through a culvert that is perched at summer flows and winter low flows, and likely not passable by aquatic organisms. Proposed habitat enhancements include restoring connectivity by removing the lower culvert and re-routing the walking path around the ponds. Large wood would be placed to improve local habitat cover and complexity. Invasive plant species on floodplains and riparian areas would be removed to support and improve the food web for aquatic species and increase shading. The currently impounded area would be restored with native riparian vegetation. Given that this would likely entail some conversion of existing wetland, additional investigation would be required. Substrate, proposed grade, existing and proposed habitat

benefits should be evaluated to understand the impacts of reconfiguring this channel on the wetland.

Figure 10: Perched culvert (left) and lack of channel complexity (right) limiting aquatic passage and habitat within the lower reaches of Suds Creek.

Benefits: Removing the walking path and allowing Suds Creek to flow in a non-impounded channel would encourage Coho salmon populations to access this tributary to Salmon Creek for spawning, feeding and refuge, though spawning may be limited by water quality. Multiple species habitats should be supported with this action, and if necessary wetland hydrology could be supported and/or maintained with placed grade control.

Figure 6. Large wood complexes installed for habitat enhancement | Redtail Reach, WA.

TREATMENT TYPE 6 – NATIVE REVEGETATION

Priority Objective: This treatment type addresses fine sediment loading and habitat degradation through invasive species proliferation along Cougar and Suds Creeks.

Description: The planting of native species would occur in conjunction with invasive species removal. In general, native revegetation would be planned in conjunction with other treatment types, providing stability to recently excavated soil or constructed features. Recommended approaches include the following:

- In riparian corridors, plant conifers of sufficient size and provide follow-up maintenance to control for impacts of invasive species, beavers, and browse from deer. Planting fewer, but larger, conifers that can shade out the blackberries may be the best approach for long-term success.
- Restoration of saturated areas, with frequently inundated soils, involves removing invasive species and planting Oregon ash, alder, maple, and western red cedar. Depending on the hydrologic regime, willows may also be planted in these areas. Similar to the note above, allowing for several years of maintenance to remove invasive species will allow the native species to become established.
- Drier sites are often dominated by blackberries. Restoration in these areas can be accomplished by selectively removing patches of blackberries and planting trees of sufficient size (6-8 feet) to shade out the blackberries. Maintenance of the newly planted area, at least once or twice a year, will greatly increase the chances of successful establishment.
- Willow baffles may be utilized to help slow flow and facilitate sediment exchange between the bed and banks. Willow cuttings can be placed into groundwater perpendicular to flow and allowed to sprout in side channel or swale areas.
- In floodplain areas that are infrequently inundated and currently have an open deciduous canopy, alder, big leaf maple, and Douglas fir can be planted with western red cedar in shaded spots.
- Willows, cottonwood, dogwoods, spirea, pacific ninebark, and other quickly establishing species that rapidly propagate from cuttings can be planted directly on eroding streambanks.
- Plantings may require irrigation and mulching during at least the first summer after planting.
- Plantings should occur between Oct 1 and March 1.
- Use native and locally-adapted plant stock.

Benefits: This treatment type will slow bank and overbank erosion, increase future large woody material sources, provide shade, and enhance aquatic and riparian habitat complexity within the reach. A diverse community of native vegetation can increase bank stability with varying root depths and increases resiliency to further changes in hydrology. Additionally, a diverse plant community supports a more diverse food web, further supporting aquatic species.

Project Identification and Concept Development

In total, 14 projects were identified in the study area, organized based on the spatial proximity of issues and needs identified in the field, with consideration to property ownership (Figure 11). Of the 14, five were developed to the concept level. The remaining 9 are summarized in the table below (Table 2), organized by creek. Concept designs are presented in Appendix A. Project concepts were developed from field assessments, with reference to LiDAR (Corps, 2010), aerial imagery, and available GIS datasets. The specific locations, extents, configuration, and quantities of restoration features will vary and will depend on additional assessment and engineering analysis.

Figure 11: Site map showing the locations of all 14 potential project locations. Five of these were selected for conceptual design (circled in yellow).

Table 2. Project descriptions and primary components for identified projects.

COUGAR CREEK		
Project Number	**Project Description**	**Project Components**
1	Through Cougar Creek reaches 4 and 5, the channel is highly entrenched and has incised to bedrock at the lower end. Partway up, the creek passes through a perched culvert that limits aquatic organism passage. Above the culvert, the channel has aggraded with fine sediments. Riparian vegetation generally consists of invasive species (e.g., English Ivy and blackberry) and mature trees.	Opportunities exist to limit further bank erosion, reduce sediment loading, revegetate the riparian corridor, and improve aquatic organism passage. Primary project components include removal of the culvert, benching the banks to facilitate riparian plantings and reduce erosion, and revegetation. Challenges to project implementation include limited ability to work around mature trees and the need to close a portion of the park during construction.
3	(Refer to Concept Design in Appendix A)	
4	Project 4 on Cougar Creek is entirely located on private land in reaches 7, 8, and 9. The primary concerns include an entrenched channel, exposed sewer infrastructure, eroding outfalls and associated gully erosion, and trash debris in the channel.	Primary project components include slowing channel incision by spreading flows across the available floodplain. This will help to arrest erosion into the sewer infrastructure and reduce sediment loading. Floodplain reconnection can be facilitated by valley spanning jams or other grade controls, and floodplain grading. A systematic review and evaluation of outfalls within the project footprint can help determine how best to address tributary sediment inputs. Revegetation with native vegetation will improve habitat quality and reduce sediment loading.
5	Project 5 covers portions of reaches 10 and 11 and is located mostly on County land. Primary issues are similar to those present in Cougar Project 4 – laterally disconnected channel, bank and gully erosion, and invasive plants. Trash has collected in the fish ladder on the	Primary treatments include floodplain reconnection, tributary outfall repair, trash debris cleanup, and revegetation with native species. Clark County is working on a detention project on the Columbia River High School property.

	downstream side of the NW 99th Street crossing.	
6	(Refer to Concept Design in Appendix A)	
7	(Refer to Concept Design in Appendix A)	
8	Project 8 covers Reach 14 at the most upstream end of the study area. Here, the channel abuts the hillslope toe, and as a result, slope instabilities triggered by toe erosion appear to be present in the reach.	Toe erosion of the slopes can be slowed with the installation of grade control in the channel. Geotechnical evaluation of eroding slopes may be necessary where slope failure is threatening infrastructure.
SUDS CREEK		
Project Number	**Issues**	**Project Components**
1	(Refer to Concept Design in Appendix A)	
3	Suds 3 covers reaches 4 and 5 on Suds Creek. Here, the channel is steep and confined as the creek descends to meet the Salmon Creek floodplain. Rock and log grade control structures from a past project are present in the reach, along with a boulder wall revetment. Many of the grade control structures have been undermined and piping is exacerbating erosion behind the boulder wall.	The primary components of Project 3 include repair of the grade control structures and boulder wall. A geotechnical evaluation of the slope and boulder wall may be necessary.
4	Suds 4 is located in Reach 6 and is focused on slope instabilities in an un-named tributary that enters Suds Creek just above the NE 117th crossing. Gully erosion that appears to be associated with a stormwater detention facility is causing destabilization of the hillslope toe. A large headcut has formed in the channel at this location and overland erosion is being exacerbated by the presence of English Ivy.	Primary project components at this site include drainage improvements associated with the stormwater facility, re-grading of the failing hillslope slope, and grade control to slow the progression of the headcut. Revegetation with native plants will slow the supply of sediment to the creek.
5	Suds 5 is located in Reach 6 and involves many of the issues seen elsewhere – i.e. channel incision and associated bank	Similar in approach to Cougar projects 4 and 5, the overall strategy for this project is to reconnect the creek to available

	erosion is threatening sewer infrastructure and reducing water quality.	floodplain, protect the sewer infrastructure, address failing tributary outfalls, and revegetate with native plants. Although the project is located on County land, machine access is challenging because of the steep nature of the terrain.
6	Suds Creek through Reach 7 has incised and disconnected from the available floodplain. The channel is narrow, deep, and relatively homogenous. Riparian vegetation is dominated by blackberry. Gully erosion associated with stormwater and drainage outfalls is prevalent.	Suds 6 occupies a reach of stream with available floodplain that could be used to slow runoff, dissipate stream energy, and store sediment. Floodplain reconnection, outfall repair, and revegetation could all work together to address many of the limiting factors present in the reach. The project is mostly on private property.
7	Suds 7 is similar to projects 5 and 6 whereby channel incision is threatening stormwater infrastructure.	Treatments for Suds 7 would potentially be similar to those suggested for projects 5 and 6. Access to the site is challenging because of private property and the steep the topography.
8	(Refer to Concept Design in Appendix A)	

References

Clark County Public Works Clean Water Program. 2009. 2008 Stormwater Needs Assessment Program - Salmon Creek (RM 03.83)/Cougar Creek Subwatershed Needs Assessment Report.

Corps (U.S. Army Corps of Engineers). 2010. Columbia River LiDAR Project. Downloaded from Washington LiDAR Portal, at http://lidarportal.dnr.wa.gov/

Pollock, M.M., G. Lewallen, K. Woodruff, C.E. Jordan and J.M. Castro (Editors) 2015. The Beaver Restoration Guidebook: Working with Beaver to Restore Streams, Wetlands, and Floodplains. Version 1.0. United States Fish and Wildlife Service, Portland, Oregon. 189 pp. Online at: http://www.fws.gov/oregonfwo/ToolsForLandowners/RiverScience/Beaver.asp

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Appendix A – Design Sheets

Cougar 3

Reach: 6-7

Site Description

This project spans Reach 6 and most of Reach 7. Cougar Creek within this area is mainly narrow and incised with very little floodplain connection or lateral channel adjustment potential. Several eroding outfalls are present in the reach and are contributing to fine sediment loading. Invasive plants are exacerbating channel erosion issues. An erosion resistant clay layer is exposed in several areas in the banks and bed, and is likely providing grade control throughout the project area, although the competency of this material is unknown.

There are several locations where sewer manholes have been exposed and are now subject to hydraulic conditions of the main channel of Cougar Creek, posing a risk to water and habitat quality as well as the integrity of sewer infrastructure. These are locations of immediate need.

Exposed stormwater outlet within incised and straightened main channel (left) and an exposed manhole within the active channel of Cougar Creek (right) in the Cougar 3 project area.

Treatment Strategy

Recommended treatments:

- Use valley-spanning grade control structures to reconnect the channel to the floodplain. These structures will create depositional areas upstream of the structures, which could also be facilitated through localized re-grading of the floodplain. This will encourage floodplain inundation, which should be targeted at median winter flows.
- In coordination with the valley-spanning structures, channel realignments may be necessary in specific locations to redirect stream energy away from exposed sewer infrastructure. Buried and/or set-back wood structures and revetments can help ensure the long-term protection of sewer infrastructure.
- Beaver dam analogs, spanning the active channel width and located at flow concentration points, will help store sediments, reduce stream energy, promote infiltration, and reduce incision rates. These should be designed in coordination with the valley spanning structures.
- Address concentrated erosion at perched stormwater outfall locations along the channel margin throughout the project area. Provide energy dissipation at outfall points to reduce erosion and delivery of fine sediment to the channel. These dissipation structures would preferably mimic natural features such as large wood.
- Clean debris from the channel that has accumulated at culverts, stormwater outflows, and other locations. Debris includes pieces of riprap, garbage, tires, and concrete blocks.
- Remove invasive plant species and revegetate with native species appropriate for the site, following the guidelines detailed in the project report.
- Large wood placements in the main channel and in depositional areas will add roughness, store sediments, increase channel complexity, and encourage infiltration.

Phasing strategies/prioritization:

- Phasing the project components could involve prioritizing the failing outfalls and exposed sewer infrastructure to address immediate needs. However, without grade control, any revetments constructed to protect sewer infrastructure should be considered temporary.

Examples of Treatment Types (Upper photos courtesy Clark County, lower photo from Pollack et al., 2015)

Expected Benefits

The proposed project will reconnect the floodplain for energy dissipation, flow attenuation, and sediment storage. While the amount of available floodplain is not extensive, nearly all of it is undeveloped. Adjacent infrastructure is generally situated on top of the adjacent flood terrace, separated vertically from the floodplain. Revegetation with native species, designed in concert with the valley spanning structures, will be a critical component of the success of the design. Although no signs of migratory fish were observed during the site assessment, the project will increase the habitat quality and quantity through the project footprint. The project, as developed, is likely to address all of the limiting factors identified as part of the site assessment and can be used as a model for other reaches in the study area with similar characteristics.

Access and Landownership

The Project Area is located mostly on Clark County Parks land as well as a few private property parcels that extend into the riparian area along the north side of the downstream end of the project area. Machine access to the site may be facilitated through Cougar Creek Woods Community Park.

Data and Analysis Requirements

A topographic survey will be needed to support the design process including determination of feature placements, access, and final excavation volumes and extent. This involves the identification and assessment of sewer infrastructure and outfalls. Hydrologic and hydraulic analysis will be required for the design process to assess existing and proposed conditions hydraulics, determine the locations and impacts of the valley spanning structures, identify suitable sites for beaver dam analogs, and facilitate the design of infrastructure protection elements. The hydrologic benefits of the approach will need to be assessed. Public access and safety around constructed features will need to be determined and addressed. A wetland delineation will need to be carried out within the project areas to identify wetlands at the site and assess potential project impacts to regulated wetlands. Ordinary high water will need to be delineated to assess impacts to the waterbody and facilitate project permitting.

Cost Estimate

A planning-level cost estimate was developed for the project based on knowledge and experience on similar projects and review of WSDOT bid tabs. The concepts developed herein are preliminary, and thus the costs should be also be considered as preliminary planning-level costs. There is a high level of uncertainty in these estimates because of unknown earthwork quantities, material costs, impacts to regulatory flood elevations, and environmental compliance permitting. General assumptions associated with each line item are listed in the table below.

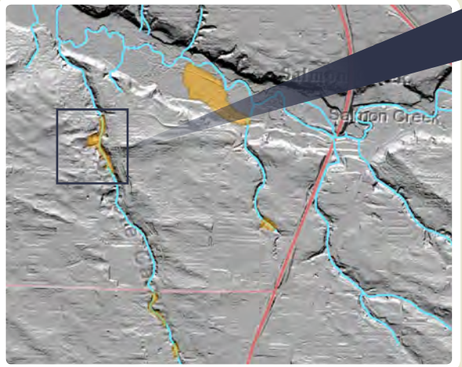
Cougar 3					
Treatment Action	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	**Notes and Assumptions**
Earthwork *(Channel work)*	7,800	CY	$6	$46,800	Assumes an average of 6' depth. Dig and pitch. No trucking. No import or export of material.
Imported Stream Gravel	648	CY	$40	$25,926	Backfill around jams. Furnished and installed.
Revegetation	3	AC	$10,000	$30,000	
Valley-spanning Large Wood Structures[1]	7	EA	$20,000	$140,000	
Large Wood Placements[1] *(Individual rootwads)*	25	EA	$1,000	$25,000	Large wood placed for roughness and habitat not included in valley spanning structures
Beaver Dam Analogs[1]	10	EA	$2,000	$19,000	Hand installed. Each consists of primary and secondary structure.
Outfall Repair[1]	5	EA	$27,500	$137,500	Assumes 5 outfalls need attention, actual number to be determined; Unit cost averaged from outfall repair costs developed in Cougar 6
Sewer Protection[1]	5	EA	$15,000	$75,000	Consists of minor channel realignments, wood, and rock placement; Assumes 5 locations
Subtotal				***$499,000***	
Mobilization (% of construction cost)	10%	LS		$49,900	
Environmental Site Controls (% of construction cost)	10%	LS		$49,900	
Design (% of construction cost)	20%	LS		$99,800	Includes survey, design, stakeholder engagement, permitting (wetlands and cultural). No LOMR/CLOMR
Construction Period Services	200	HR	$160	$32,000	Bid period assistance, layout staking, engineer oversight during construction (3 weeks oversight)
Contingency (% of construction cost)	20%	LS		$99,800	
Project Total				***$830,000***	

Notes:

1. *Several items listed (Outfall Repair, Sewer Protection, Valley-spanning Large Wood Structures, and Large Wood Placements) contain estimated quantities and are scalable depending upon the actual quantity required. For this planning-level cost estimate, we have included quantities that are based on a rapid field assessment, but will likely change as part of the design process.*

Cougar Creek: Project 3

Salmon Creek Watershed

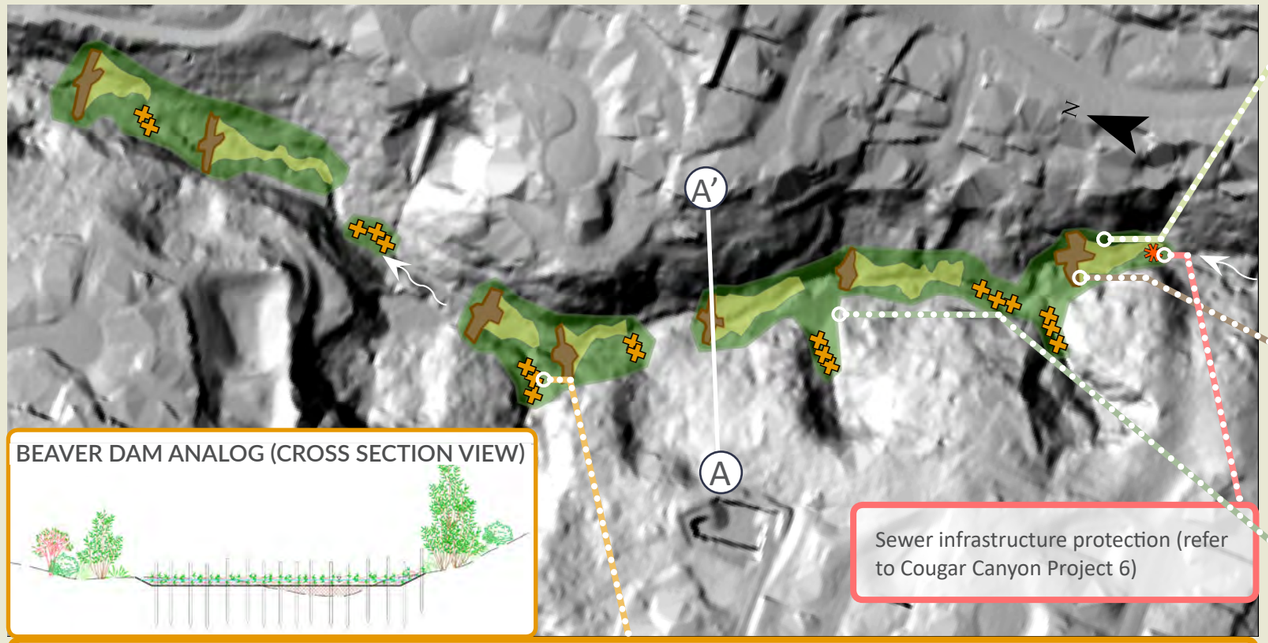


PROJECT DESCRIPTION

This project is within Reaches 6 and 7 of Cougar Creek. The existing channel is confined, straightened and disconnected from its floodplain; waste water infrastructure is at risk of failure and gully erosion is impacting hillslope stability. Sediment mobility is high with minimal gravel deposition, especially in areas with an exposed clay layer. This project reconnects the channel to avialable floodplain through the use of valley-spanning wood structures.

TREATMENT HIGHLIGHTS

- Increase floodplain connectivity through installation of valley spanning large wood structures
- Protect existing waste water infrastructure
- Mitigate bank erosion
- Improve and increase riparian and wetland habitat
- Improve water quality through a reduction of bank erosion, flood peak attenuation, and sediment storage.



BEAVER DAM ANALOG (CROSS SECTION VIEW)

BEAVER DAM ANALOGS

Beaver dam analogs could be used to slow channel erosion between the valley-spanning structures, and to slow tributary gully erosion. These structures, generally constructed with small wood, are relatively cheap options that slow the downstream transport of sediment (see photo at left).

WOODED DEPOSITION AREA

The area upstream of the valley-spanning wood structures would incorporate log placements and be planted with willows and alders to create conditions for sediment deposition and flow attenuation.

VALLEY-SPANNING LARGE WOOD

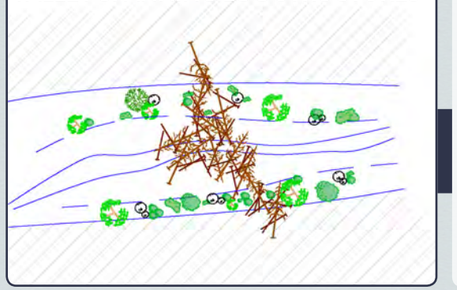
Large wood will be placed to slow floodwaters, stabilize banks and improve habitat complexity. These would also function to attenuate flood peaks, reduce stream energy, and store sediment. (see XS A-A').

NATIVE PLANTINGS

The existing vegetation, primarily non-native and invasive, would be replaced with native plantings. These plantings would provide soil stability and resilience to flooding. Established vegetation increases roughness, dissipating high flow energy.

EXISTING AND PROPOSED PROFILES

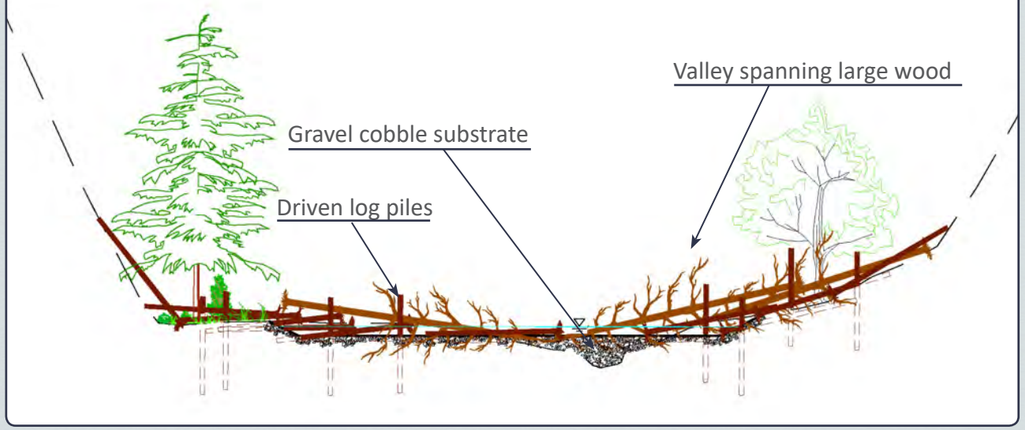
VALLEY SPANNING LOG STRUCTURES



Spacing of the structures would depend on a number of hydrologic and hydraulic factors (e.g, flood magnitude and frequency), but the structures would be designed to work together to attenuate peak flows.

As a result of the readily erodible sediments in the valley bottom, the structures would extend across the available width, creating deposition zones upstream of the structure. Native vegetation would be planted to stabilize the floodplain.

A VALLEY SPANNING LOG STRUCTURE (CROSS SECTION VIEW) A'



Cougar 6

Reach: 12

Site Description

This project site encompasses Reach 12 of Cougar Creek. Cougar Creek in this reach is incised and entrenched in a confined valley. However, there are areas where relatively low banks and some potentially connected floodplains occur. These appear to be areas associated with recent residential construction and are currently actively maintained, mowed, and planted with ornamental vegetation. The channel bed material consists of embedded cobbles and gravels with patches of fine gravel and sand. Bank erosion is prevalent and threatening sewer infrastructure. English Ivy and blackberry are pervasive on banks and in the riparian area.

Several locations of gully and hillslope erosion occur at points of storm water outfall and residential drainage. These features pose risks to water and habitat quality. Strategies developed for this reach are focused on low-capital improvements or repairs to the failing outfalls.

A manhole that is currently exposed in the main channel of Cougar Creek (left) and a stormwater runoff culvert lacking a rundown causing hillslope erosion (right) in Reach 12.

Treatment Strategy

Recommended treatments:

- This project is used to provide examples for low-capital strategies to address outfall erosion issues that can be used in multiple locations throughout Cougar and Suds Creeks. A systematic inventory of outfall locations and function would help prioritize the most important outfalls to address.
- Some culverts and outfalls may simply require maintenance while others may be in need of replacement. The need to upsize the outfall and culvert should be assessed.
- Erosion at outfall locations should be addressed with rundowns and energy dissipators. These can take many forms, the most common of which involves courses of riprap.
- Opportunities to provide detention with the use of wetlands and/or beaver dam analogs should be explored to take advantage of the multiple benefits these structures provide.

Phasing strategies/prioritization:

- Enhance detention at storm flow outfalls with wetlands to provide increased quality of riparian habitat as well as increased hydrologic and sediment retention for stormwater run-off.
- Where options such as floodplain reconnection are not feasible, address bank instability and erosive failure using natural treatments such as large wood.

Example of Treatment Type

Expected Benefits

The extent of the project's benefits will depend on the number of improvements to be made in the reach. From our observations, erosion associated with stormwater and drainage discharge points is extensive and treatment should reduce sediment loading and offer water quality improvements. The limiting factors addressed as part of this project include altered hydrology, sediment loading, and in some cases, infrastructure undermining.

Access and Landownership

This project is located entirely on private property, but the treatments can be applied to failing outfalls throughout the study area.

Data and Analysis Requirements

A systematic survey of outfalls in the reach and study area, that includes an evaluation of the cause of the issue (e.g., capacity, maintenance), will need to be performed. Those outfalls that only require maintenance and energy dissipation will only need labor and materials in order to complete improvements. As the issues become larger, engineering analysis may be required in order to implement an effective treatment. This may require survey, modeling, design, and associated permitting.

Cost Estimate

A planning-level cost estimate was developed for the project based on knowledge and experience on similar projects and review of the WSDOT bid tabs. The concepts developed herein are preliminary, and thus the costs should be also be considered as preliminary planning-level costs. There is a high level of uncertainty in these estimates because of an undefined problem extent, material costs, the potential need for engineering, and environmental compliance permitting. The level of effort needed for the repair of the culverts and outfalls depends on the nature of the problem. Those outfalls that simply need maintenance and energy dissipators will cost substantially less than those requiring a more detailed level of analysis. As such, a range of costs is provided. Additionally, County engineering staff may likely be able to perform the design work in house, which may yield cost savings and more accurate estimates. General assumptions associated with each line item are listed in the table below.

Cougar 6

High Cost Treatment Action	Qty	Unit	Unit Cost	Total Cost	Notes and Assumptions
Earthwork *(Excavation, Material Placement)*	30	CY	$6	$178	Assumes replacement of 30' of culvert requiring 50' excavation, backfill with filter material, and placement of rundown. No material export.
Revegetation	0.25	AC	$10,000	$2,500	
Stream Gravel Import	8	CY	$45	$360	Filter material at 50' length, 2' width and depth
Riprap Import	11	CY	$100	$1,100	Riprap Rundown 15' length, 2'depth, 10' width
Culvert (material cost)	30	LF	$40	$1,200	12 in. dia. Culvert; unit cost from WSDOT bid tabs. Assumes 1 culvert
Rundown and Filter (material cost)	40	CY	$100	$3,981	
Subtotal				***$9,000***	
Mobilization	1	LS	$10,000	$10,000	
Environmental Site Controls	1	LS	$1,000	$1,000	
Design (% of construction cost)	300%	LS		$27,000	Includes survey, design, permitting (wetlands and cultural). No LOMR/CLOMR
Construction Period Services	24	HR	$160	$3,840	
Contingency (% of construction cost)	25%	LS		$2,250	
High Cost Estimate (per outfall)				***$50,000***	

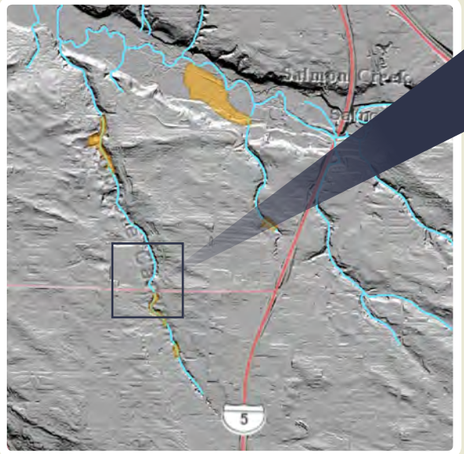
Low Cost Treatment Action	Qty	Unit	Unit Cost	Total Cost	Notes and Assumptions
Culvert Maintenance and Rundown installation	1	EA	$5,000	$5,000	Assumes mostly functional culvert in need of maintenance and small, localized rundown/energy dissipator. Treatment performed by maintenance staff
Low Cost Estimate (per outfall)				***$5,000***	

Cougar 6

Treatment Action	Qty	Unit	Unit Cost Range		Notes and Assumptions
Drainage Assessment and Repair	7	EA	$5,000	$50,000	Assumes 7 culverts and outfalls need attention; actual number to be determined
Project Cost Range			***$35,000***	***$350,000***	

Cougar Creek: Project 6

Salmon Creek Watershed



PROJECT DESCRIPTION

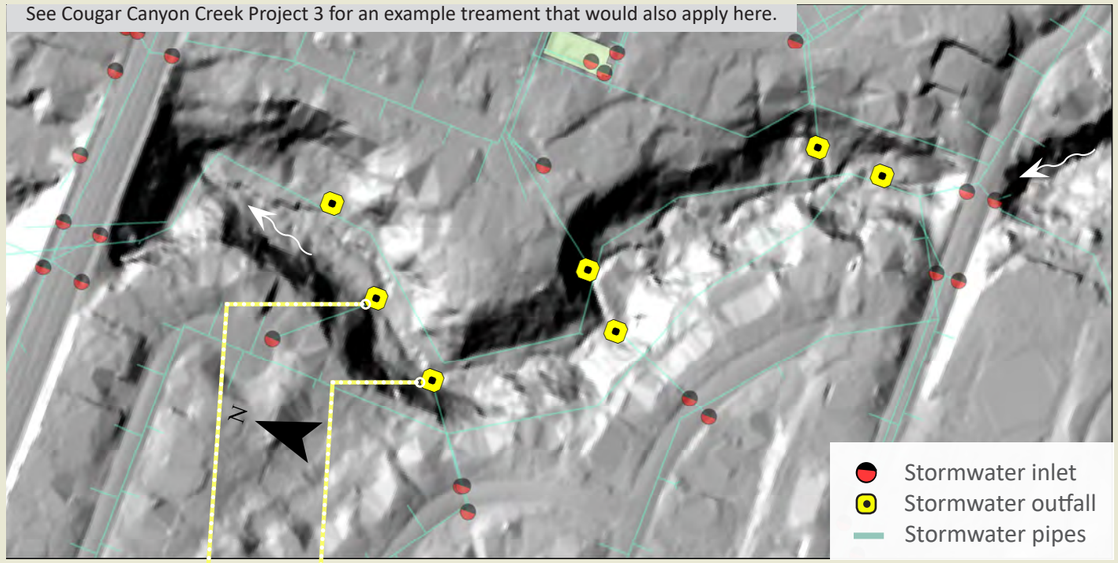
This project is within Reach 12 of Cougar Creek, and provides example low-cost treatments for outfall-caused erosion that can be used throughout the project area. Before appropriate treatments can be determined, a systematic evaluation of culvert/outfall condition and cause of impairment will need to be completed. Treatments can then be defined and may include repair, replacement, and the installation of energy dissipators.

A conceptual treatment strategy for the channel-associated issues present in the reach can be found by referring to the project Cougar 3.

TREATMENT HIGHLIGHTS

- Systematic evaluation of culvert/outfall performance
- Repair and/or replacement of individual culverts
- Provide energy dissipators at outfall locations

See Cougar Canyon Creek Project 3 for an example treament that would also apply here.



OUTFALL ENERGY DISSIPATION

Cobble- and boulder-sized material would be placed at the downstream side of the stormwater outfall, to dissipate energy and attenuate sediment.

Note: this technique would not be appropriate in areas where aquatic habitat and fish passage were a concern.

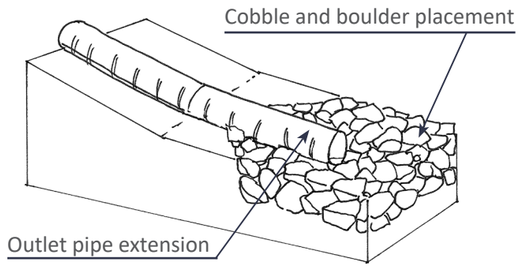
LOW COST TREATMENT

This project aims to address the existing issues surrounding erosion and outfall undermining with a low cost approach.

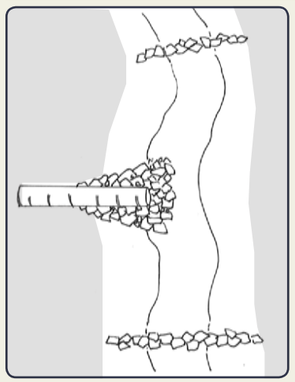
Waste water infrastructure such as exposed manholes are currently being undermined by channel bed and bank erosion.

The installation of large wood and fill material, as well as channel realignment, may alleviate future threats to structure stability.

OUTFALL ENERGY DISSIPATOR (ISOMETRIC VIEW)



OUTFALL ENERGY DISSIPATOR (PLAN VIEW)

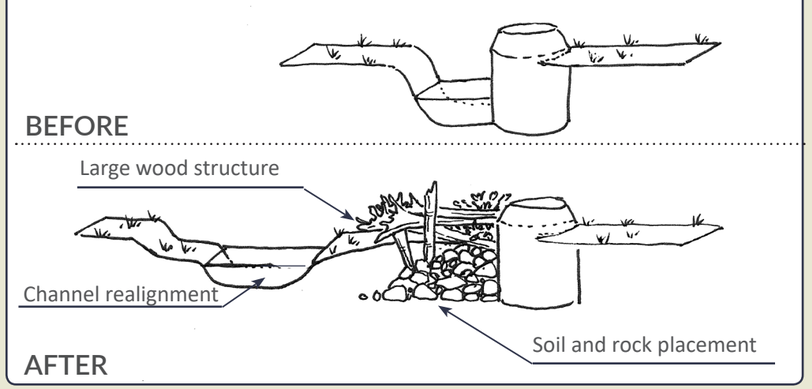


The exposed outfalls of stormwater pipes could be extended where feasible, to control slope and energy at outfall.

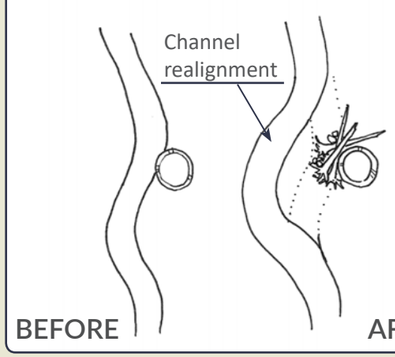
Placement of cobble-sized fill can further dissipate energy.

Headcut migration will be discouraged through valley spanning rock or wood check dams.

SEWER INFRASTRUCTURE PROTECTION (ISOMETRIC VIEW)



SEWER INFRASTRUCTURE PROTECTION (PLAN VIEW)



Cougar 7

Reach: 13

Site Description

This project site is located within Reach 13 of Cougar Creek. The Creek is incised and highly entrenched with little to no floodplain connectivity. The channel bed material is fine grained throughout, with clay found in the bed in many locations. Coarser material is embedded in the fine grain matrix. There is sediment input from fluvial inputs, bank erosion, and hillslope erosion. At the project location, the creek passes through a culvert under an access route that is no longer used.

Of primary concern in this project area is a culvert where significant hillslope erosion is occurring. The culvert is not functioning, and flow is coming out around the pipe. The culvert outlet points directly at a tall slope, the failure of which may have impacts to stormwater infrastructure on top of the slope.

A flanked culvert (left) and significant bank erosion immediately downstream (right) in Cougar Creek in Reach 13.

Treatment Strategy

Recommended treatments:

- Remove the failed culvert and reconfigure channel to increase channel habitat quality, re-establish natural hydraulics, and relieve erosion along banks.
- Backfill eroded cut bank and bury large wood bank revetment structures. Revegetate with native riparian vegetation.
- Use valley-spanning large wood structures to reduce stream energy and build grade to reconnect floodplain.
- Add large wood for roughness, promote infiltration, store sediments, and increase habitat quantity and quality.

Alternatives:

- Should the access road need to be kept, options exist to replace the culvert and backfill the failing slope. Stream simulation-based approaches to culvert replacement should be considered as they typically do a better job passing wood and debris. Realignments of the stream that move the channel away from the eroding slope should be considered.

Example of Treatment Type

Expected Benefits

The proposed project will address an immediate need by moving the stream off of the failing slope. Additionally, there is an opportunity to reconnect the stream to the available floodplain, taking advantage of any available storage improvements. Revegetation with native species, designed in concert with the valley-spanning structures, will be a critical component of the success of the design. While no signs of migratory fish were observed during the site assessment, the project will increase the habitat quality and quantity through the project footprint. The project will likely address all of the limiting factors to some level, although the project footprint is likely too small to have much impact on altered hydrology.

Access and Landownership

The Project Area is located on property owned by Clark County Public Utilities.

Data and Analysis Requirements

A topographic survey will be needed to support design including determination of feature placements, access, and final excavation volumes and extent. This involves the identification and assessment of sewer infrastructure and outfalls. Hydrologic and hydraulic analysis will be needed to assess existing and proposed conditions hydraulics, determine the locations and impacts of the valley-spanning structures, and to design the bank revetment structures. Public access and safety around constructed features will need to be determined and addressed. A wetland delineation will need to be carried out within the project area to identify wetlands at the site and assess potential project impacts to regulated wetlands. Ordinary high water will need to be delineated to assess impacts to the waterbody and facilitate project permitting.

Cost Estimate

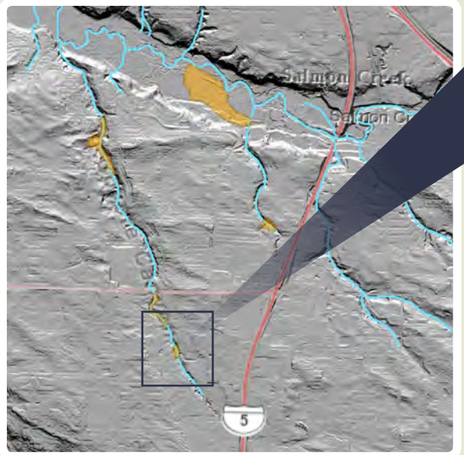
A planning-level cost estimate was developed for the project based on knowledge and experience on similar projects and review of WSDOT bid tabs. The concepts developed herein are preliminary, and thus the costs should be also be considered as preliminary planning-level costs. There is a high level of uncertainty in these estimates because of unknown earthwork quantities, material costs, impacts to regulatory flood elevations, and environmental compliance permitting. General assumptions associated with each line item are listed in the table below.

Cougar 7

Treatment Action	Qty	Unit	Unit Cost	Total Cost	Notes and Assumptions
Earthwork *(Cut, Fill, Channel work)*	15,100	CY	$6	$90,600	Assumes an average of 6' depth
Imported Stream Gravel	185	CY	$40	$7,407	
Revegetation	1	AC	$10,000	$10,000	
Valley-spanning Large Wood Structures	2	EA	$20,000	$40,000	
Large wood placements *(Individual rootwads and buried structures)*	25	EA	$1,000	$25,000	Large wood placed for buried structures and habitat not included in valley spanning structures
Subtotal				***$173,000***	
Mobilization (% of construction cost)	10%	LS		$17,300	
Environmental Site Controls (% of construction cost)	10%	LS		$17,300	
Design (% of construction cost)	35%	LS		$60,550	Includes survey, design, permitting (wetlands and cultural). No LOMR/CLOMR.
Construction Period Services	150	HR	$160	$24,000	Bid period assistance, layout staking, engineer oversight during construction (2 weeks oversight)
Contingency (% of construction cost)	20%	LS		$34,600	
Project Total				***$330,000***	

Cougar Creek: Project 7

Salmon Creek Watershed



PROJECT DESCRIPTION

This project site is located within Reach 13 of Cougar Creek. The creek flows underneath an abandoned access road through a culvert that is failing. Flow is directed into the valley wall and erosion is threatening stormwater detention infrastructure. Removal of the access road and culvert and channel reconfiguration will help encourage reoccupation of available floodplain. Backfill and armoring the failing slope with log structures will help protect the failing slope.

TREATMENT HIGHLIGHTS

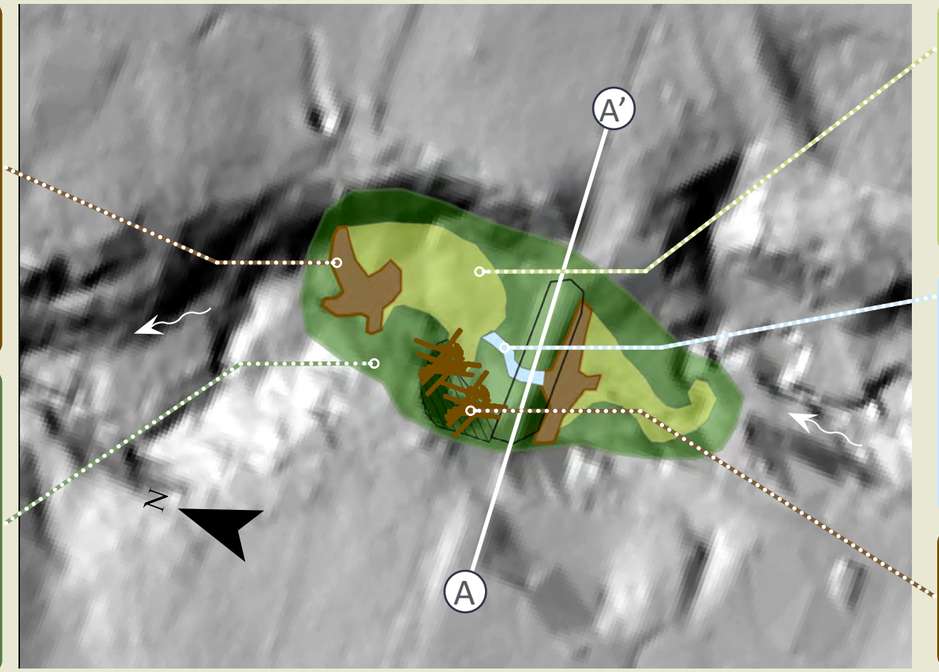
- Remove failed culvert and reconfigure channel
- Mitigate bank erosion
- Increase floodplain connectivity
- Improve and increase riparian and wetland habitat

VALLEY-SPANNING LARGE WOOD

Valley-spanning wood structures could be used to reconnect floodplain. The structures would create deposition zones that would then attenuate flood peaks and store sediment.

NATIVE PLANTINGS

The existing vegetation, primarily non-native and invasive, would be replaced with native plantings. These plantings would provide soil stability and resilience to high water flooding events.



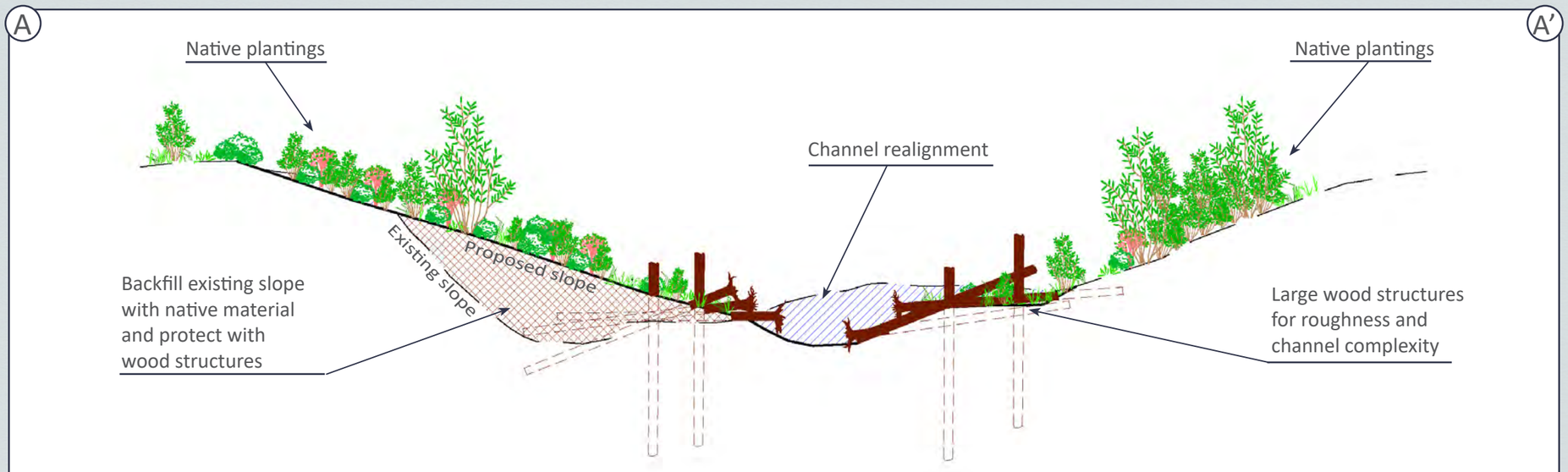
WOODED DEPOSITION AREA

The area upstream of the valley-spanning wood structures would incorporate log placements and be planted with willows and alders to create conditions for sediment deposition and flow attenuation.

CHANNEL RECONFIGURATION

Reconfigure the channel alignment and geometry to function with the valley-spanning wood structures, wooded sediment deposition areas, and to redirect flows away from the unstable slope.

Large wood structures for hillslope protection, roughness, and channel complexity.



Suds Creek Project 1

Reach: **1-4**

Site Description

This project area starts near the downstream end of Reach 4, includes all of Reaches 1, 2, and 3, extending to the confluence of Suds and Salmon Creek. From the confluence of Suds and Salmon Creeks and through Reach 1, Suds Creek flows through a series of wetlands and has a wide, poorly defined channel with distributed flow. A slightly perched and undersized culvert that crosses at the park road marks the downstream end of Reach 2. The downstream end of Reach 2 is a large pond. Upstream of the pond, Suds Creek is ditched and relatively straight. There is little habitat complexity. The bed is composed mainly of fine-grained material with patches of gravel and cobble. There is moderate connection to a low, narrow floodplain with a disturbed riparian zone that has few large trees, low shrubs, and large bare patches. A culvert crossing marks the reach break into Reach 3 where Suds Creek continues to flow in a straightened channel that has been realigned along the edge of the Salmon Creek floodplain. Bed slope increases and there is a significant increase in large grain bed material. Gravel and cobble deposition in the channel results in narrow bars and riffle-glide bed morphology. Pools and large wood are lacking. At the transition between Reaches 3 and 4, there is a jersey barrier that forces a 90-degree left turn of the channel. Upstream of this feature, large boulders have been placed in the channel forming bank armor in some places and weirs in other places that are potential fish passage barriers. The channel remains entrenched and disconnected in this reach.

Floodplain disconnection, concrete bank riprap (left) and an incised, simplified channel lacking complexity and structures that slow and attenuate flow and sediment (right).

Treatment Strategy and Alternatives

Recommended treatments:

- It is unlikely that fish can pass through the culvert near the mouth of Suds Creek underneath the Salmon Creek Trail. Furthermore, the levee and trail disconnect a large portion of the floodplain from Salmon Creek. Replacement or removal of the culvert and re-routing of the trail will restore longitudinal and lateral channel-floodplain connections.
- The ponds are assumed to be old gravel pits. Rearing and migration habitat can be significantly improved by realigning the trail and repurposing the material used to build the trail base to create off-channel and wetland habitat within the former pits.
- Suds Creek above the ponds is channelized and lacking complexity, but has well-established riparian cover. Selectively placing large wood will help create channel complexity and sediment sorting that is currently lacking.
- Large wood structures constructed in Suds Creek below the existing ponds will help provide cover and maintain channel conveyance capacity.

Example of Treatment Type

Alternatives:

- A potential alternative to re-routing the trail is to install several culverts under the trail grade that meet aquatic organism passage criteria.
- Create connected floodplain areas where possible through a combination of channel re-grading, floodplain re-grading, and placement of large wood or other natural hydraulic structures.

Expected Benefits

The proposed project will improve access to Suds Creek and create much needed off channel habitat. Large wood placements in Suds Creek will increase channel complexity and habitat quality. The limiting factors addressed by the proposed project include fine sediment loading, habitat degradation, and longitudinal and lateral disconnection.

Access and Landownership

The project area is located primarily on Clark County Parks land, but some portions of Suds Creek along the edge of the Salmon Creek floodplain are on private property. Machine access is straightforward, but heavy recreational use will need to be managed should the project proceed to implementation.

Data and Analysis Requirements

A detailed topographic survey, including pond bathymetry, will be needed to support the design process including determination of feature placements, access, and final excavation volumes and extent. Hydrologic and hydraulic analysis will be needed as part of design to determine the frequency of channel-floodplain connectivity and the hydraulic forces present in Suds and Salmon Creeks. Project impacts to regulatory flood elevations will need to be assessed. Public access and safety around constructed features will need to be determined and addressed and a planning process may be necessary for any realignments of the trail. A wetland delineation will need to be carried out within the project areas to identify wetlands at the site and assess potential project impacts to regulated wetlands. Ordinary high water will also need to be delineated to assess impacts to the waterbody and facilitate project permitting.

Cost Estimate

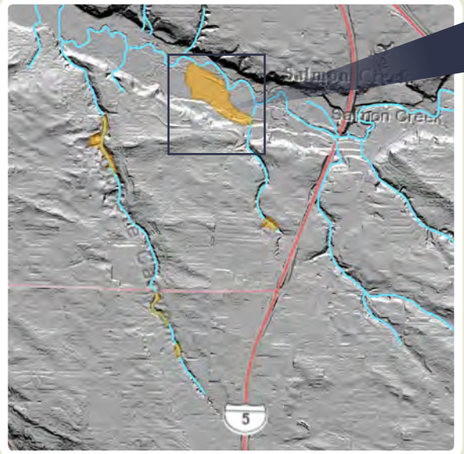
A planning-level cost estimate was developed for the project based on knowledge and experience on similar projects and review of the WSDOT bid tabs. The concepts developed herein are preliminary, and thus the costs should be also be considered as preliminary planning-level costs. There is a high level of uncertainty in these estimates because of unknown earthwork quantities, material costs, impacts to regulatory flood elevations, environmental compliance permitting, and

stakeholder involvement in the trail realignment aspects. General assumptions associated with each line item are listed in the table below.

Suds 1					
Treatment Action	**Qty**	**Unit**	**Unit Cost**	**Total Cost**	**Notes and Assumptions**
Earthwork *(Trail cut; Channel work)*	18,600	CY	$15	$279,000	Assumes an average of 6' depth for cut areas; 60' cross seciton area for LF for channel work. Assumes no import or export of material.
Wetland Revegetation	3	AC	$20,000	$60,000	
(Wetland Areas)					
Riparian Revegetation	3	AC	$8,000	$24,000	
(non-wetland areas)					
Wetland Construction *(topsoil placement)*	3	AC	$40,000	$120,000	Assumes 12 inches topsoil furnished and installed.
Bioengineered Bank Treatment	200	LF	$100	$20,000	Includes Fabric Encapsulated Soil Lifts (FESLs, 2-lifts), riprap toe, and plantings
Large Wood Placements *(Selective Log Placements and Engineered Structures)*	40	EA	$1,000	$40,000	15 inches to 24 inches diam. 32-40 feet long, with rootwads. Furnished and installed.
Trail Construction *(Improved and Unimproved)*	1,200	LF	$20	$24,000	Assumes gravel surface similar to existing gravel surface trail at site.
Subtotal				***$567,000***	
Mobilization (% of construction cost)	10%	LS		$56,700	
Environmental Site Controls (% of construction cost)	10%	LS		$56,700	Access, site cleanup, erosion control, dewatering
Design (25% of construction cost)	25%	LS		$141,750	Includes survey, design, stakeholder engagement, permitting (wetlands and cultural). No LOMR/CLOMR
Construction Period Services	250	HR	$160	$40,000	Bid period assistance, layout staking, engineer oversight during construction (4 weeks)
Contingency (% of construction cost)	20%	LS		$113,400	
Project Total				***$980,000***	

Suds Creek: Project 1

Salmon Creek River Watershed



PROJECT DESCRIPTION

This project is within Reaches 1-4 of Suds Creek. The channel has been simplified and straightened along the margin of the Salmon Creek floodplain, before being routed to the pond. Suds Creek connects to Salmon Creek through a culvert that is perched during summer flows. Removal of the berm will facilitate floodplain and longitudinal connections on Salmon and Suds Creeks.

TREATMENT HIGHLIGHTS

- Remove culvert and berm to increase floodplain connectivity and facilitate fish passage into Suds Creek
- Enhance channel complexity and aquatic habitat
- Improve and increase riparian and wetland habitat complexity through development of wetlands
- Improve water quality and decrease temperature

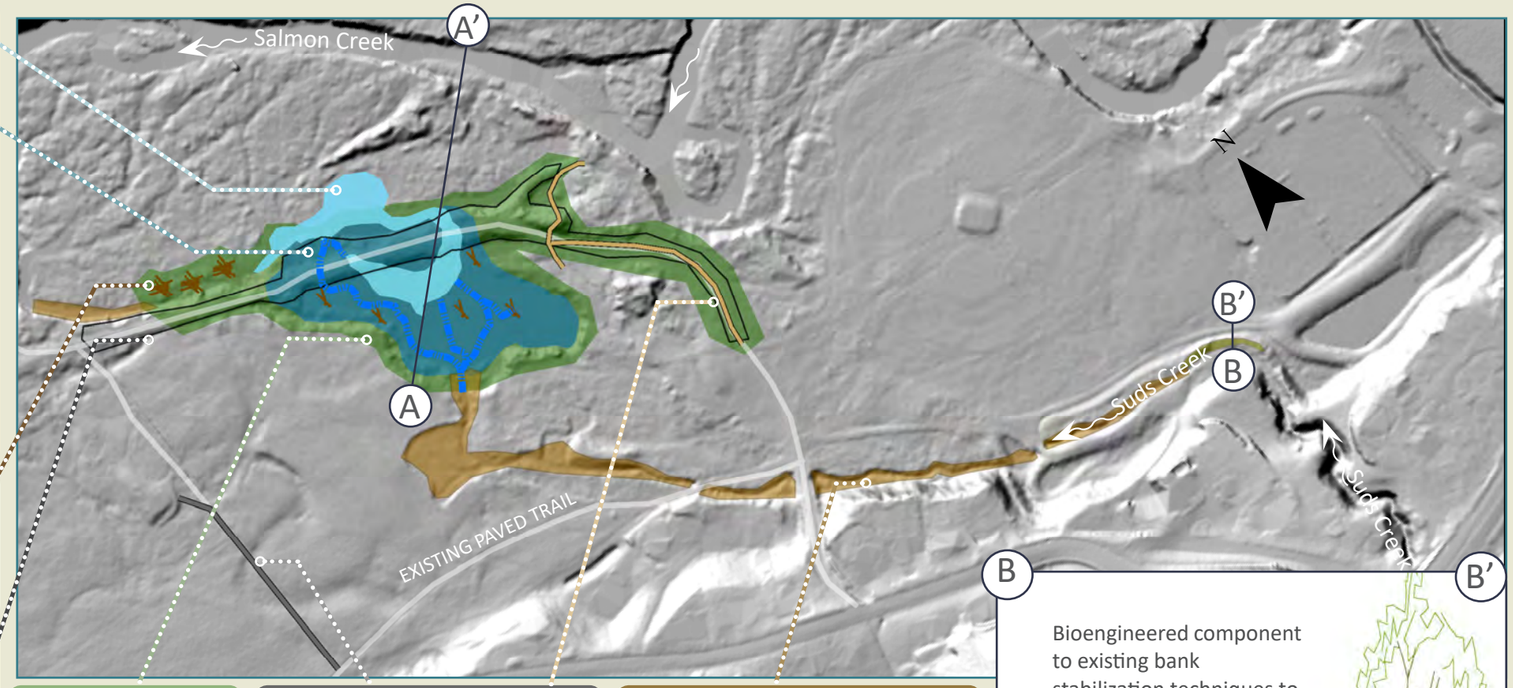
OPEN WATER AND WETLAND RESTORATION

The existing open water habitat would be hydraulically connected to Suds Creek, improving water quality and habitat; both shallow and deep water habitat would be provided. Existing turtle habitat would be improved and expanded.

Large wood structures to maintain conveyance in Suds Creek.

BERM REMOVAL

Removal of the existing berm will reconnect Salmon and Suds Creeks to available floodplain and eliminate passage barriers on Suds Creek. This will facilitate the creation of a more complex assemblage of ponds, wetlands, and channels.



NATIVE PLANTINGS

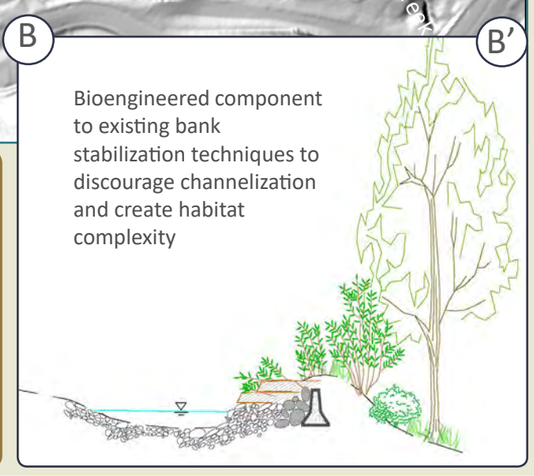
Use native plantings to increase the extent of wetland habitat beneficial to amphibians, reptiles and fish.

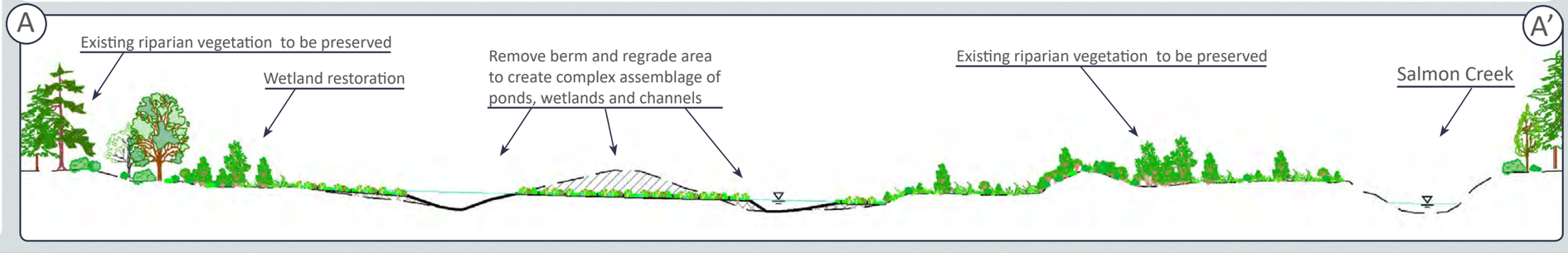
TRAILS

Trail realignments may consist of connecting the existing Salmon Creek Trail to the facilities through an alternate, southerly path (dark gray). Unimproved, or dirt, trails may facilitate use of the restored area (light brown).

SELECTIVE LOG PLACEMENT

Large wood placed along the channel and floodplain would add complexity, encourage nutrient retention, and provide habitat. Selective placement helps ensure minimal damage to the existing riparian vegetation.





Suds Creek Project 8

Reach: 9-10

Site Description

Project 8 is located primarily in Reach 9 of Suds Creek and extends slightly into Reach 10. These reaches share a similar morphology and process regime. They are located in narrowly confined valleys where the channel directly abuts the hillslope; there is little to no floodplain connection. Banks are actively eroding throughout these reaches; they are vertical and composed of fine-grained material ranging from sand to clay. Riparian vegetation along the channel margin is largely composed of invasive plants, with abundant Himalayan blackberry. Bed material is composed of embedded cobbles and gravels. Bed morphology is dominated by riffles and glides and there are only a few large wood accumulations.

Sewer infrastructure is at risk due to bank erosion and channel incision causing erosion near a manhole along the left channel margin. A section of what is assumed be a sewer line is exposed in the channel bed.

The photo on the left is taken looking downstream at a manhole at risk of bank erosion and exposure to channel hydraulics in Suds Creek. The photo on the right shows what we assume to be an exposed section of sewer line.

Treatment Strategy and Alternatives

Recommended treatments:

- Grade control structures will help to slow channel incision and reduce the bank erosion threatening sewer infrastructure. Grade controls should be placed in locations similar to those depicted on the concept drawing.
- The exposed sewer line will need to be covered with rock filter material and backfilled with stream substrate.
- Large wood placements will increase channel roughness, slow velocities, accumulate sediments, and slow the incision process.
- A large headcut, likely resulting from a storm sewer outfall, has propagated up an un-named tributary and is threatening private property and infrastructure. Extending the storm sewer, backfilling with filter material to prevent gully formation, and installing rock grade control can address these issues.

Example of Treatment Type

Expected Benefits

The proposed project will slow the channel incision process and reduce bank erosion and mass wasting. This will reduce or eliminate vulnerabilities of the sewer infrastructure. The limiting factors addressed by the concept include fine sediment loading and infrastructure undermining.

Access and Landownership

The project area is located on a combination of Clark County Parks property and private property.

Data and Analysis Requirements

An engineering assessment is needed to evaluate the condition of the existing sewer infrastructure and outfall, including any potential need for replacement. A topographic survey will be needed to support project design including determination of feature placements, access, and final excavation volumes and extent. Hydrologic and hydraulic analysis will be required for design. Public access and safety around constructed features will need to be determined and addressed. A wetland delineation will need to be carried out within the project area to identify wetlands at the site and assess potential project impacts to regulated wetlands. Ordinary high water will need to be delineated to assess impacts to the waterbody and facilitate project permitting.

Cost Estimate

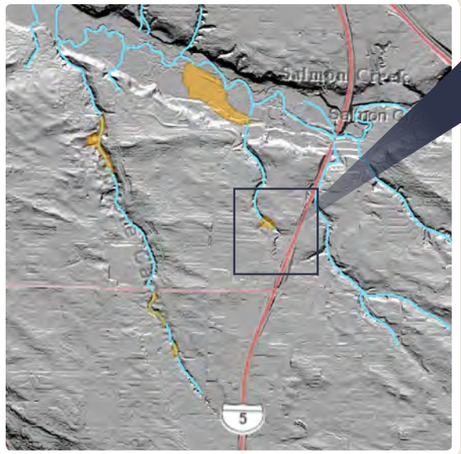
A planning-level cost estimate was developed for the project based on knowledge and experience on similar projects and review of WSDOT bid tabs. The concepts developed herein are preliminary, and thus the costs should be also be considered as preliminary planning-level costs. There is a high level of uncertainty in these estimates because of unknown earthwork quantities, material costs, impacts to regulatory flood elevations, and environmental compliance permitting. General assumptions associated with each line item are listed in the table below.

Suds 8

Treatment Action	Qty	Unit	Unit Cost	Total Cost	Notes and Assumptions
Earthwork *(Excavation and Onsite Material Placement)*	400	CY	$6	$2,400	Assumes an average of 6' depth
Excavate and Haul to Disposal	440	CY	$23	$10,120	Assumes disposal location within a few miles of project site
Imported Stream Gravel	20	CY	$45	$900	
Revegetation	1	AC	$8,000	$8,000	
Pipe Extension (material cost)	130	LF	$70	$9,100	Unit cost from WSDOT Bid Tabs for 12 in. dia. Storm sewer
Grade Control Structures (material cost)	130	CY	$100	$13,000	Assumes average of 4' depth; angular blast or quarry rock
Sewer Protection	2	EA	$15,000	$30,000	Consists of minor channel realignments, wood, and rock placement; Assumes 2 locations
Subtotal				***$74,000***	
Mobilization (% of construction cost)	20%	LS		$14,800	Includes ramp installation and removal
Environmental Site Controls (% of construction cost)	10%	LS		$7,400	
Design (% of construction cost)	60%	LS		$44,400	Includes survey, design, permitting (wetlands and cultural). No LOMR/CLOMR.
Construction Period Services	80	HR	$160	$12,800	Bid period assistance, layout staking, engineer oversight during construction (1 week oversight)
Contingency (% of construction cost)	20%	LS		$14,800	
Project Total				***$170,000***	

Suds Creek: Project 8

Salmon Creek Watershed



PROJECT DESCRIPTION

This project is within Reach 9 and 10 of Suds Creek. The channel is tightly coupled to the valley wall and incision is threatening sewer infrastructure. A large headcut exists on an un-named tributary that may be a result of an untreated outfall. Grade control and extension of the existing culvert on the un-named tributary can help protect infrastructure and reduce sediment loading.

TREATMENT HIGHLIGHTS

- Protect existing waste water and stormwater infrastructure
- Mitigate bank erosion
- Dissipate stream energy

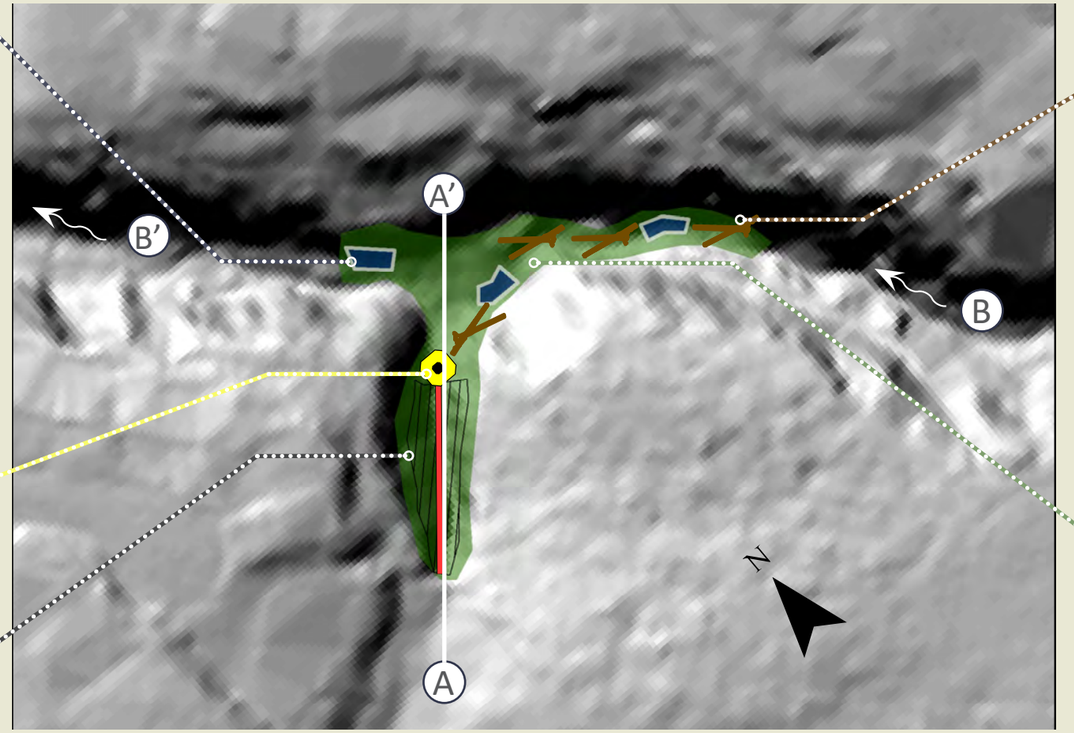
GRADE CONTROL

Rock grade control structures would help slow channel incision and reduce erosion into sewer infrastructure.

OUTFALL ENERGY DISSIPATION

Cobble and boulder rundowns and energy dissipators placed at culvert outfalls will help reduce erosion.

Filter gravel and native material placed above and beneath outlet pipe extension (see profile below).

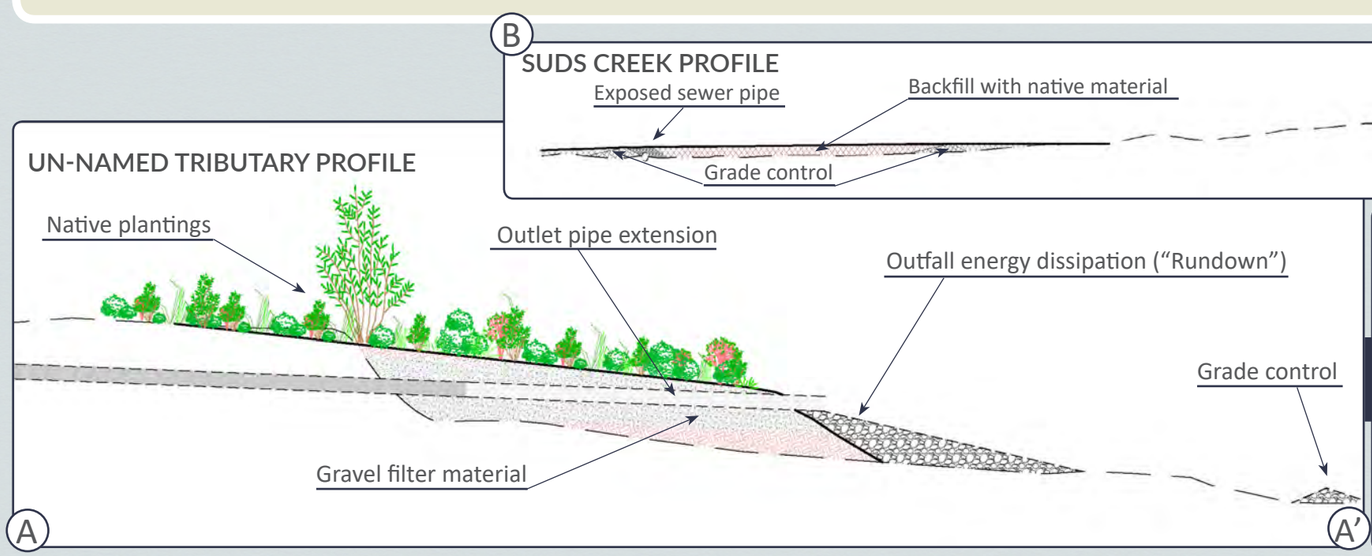


LARGE WOOD PLACEMENTS

Large wood structures would be placed to slow floodwaters and stabilize banks. These would also function to attenuate sediment and enhance natural geomorphic processes.

NATIVE PLANTINGS

The existing vegetation, primarily non-native and invasive, would be replaced with native plantings. These plantings would be appropriately matched to the hydrology on site. They would provide soil stability and resilience to high water flooding events.



Channel profile depicting example placement of grade control structures and channel substrate to cover exposed sewer pipe.

STORMWATER OUTLET

This approach involves extending the existing stormwater pipe approximately 25-50 feet, embedded within soil fill, and installing an energy dissipator/rundown at the outfall. Backfilling the pipe with rock filter material can help promote infiltration and reduce gully formation. Installation of grade control at the downstream end would discourage scour.

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