State of West Virginia
Department of Administration
Purchasing Division

N O T I C E

Due to the size of this bid, it was impractical to scan every page for online viewing. We have made an attempt to scan and publish all pertinent bid information. However, it is important to note that some pages were necessarily omitted.

If you would like to review the bid in its entirety, please contact the buyer. Thank you.

***

TETRA TECH

Mindy S. Ramsey
Director

October 2, 2012

Mr. Guy Nisbet
WV Purchasing Division
2019 Washington Street, East
Charleston, WV 25305

EOI#:	DEP15990
Title:	Expression of Interest for Engineering Services to Provide Total Maximum Daily Loads (TMDLs) for the Impaired Waters in the Upper Ohio North, Upper Kanawha, and South Branch Potomac Watersheds
Opening Date:	October 4, 2012
Opening Time:	1:30 PM

Dear Mr. Nisbet:

Tetra Tech, Inc. is pleased to submit our proposal in response to West Virginia Department of Environmental Protection's Expression of Interest number DEP15990 for Total Maximum Daily Loads (TMDLs) for impaired streams in the Upper Ohio North, Upper Kanawha, and South Branch Potomac Watersheds. We have thoroughly enjoyed working closely with WVDEP's TMDL Program over the past nine years as it has grown into one of the nation's premier TMDL programs.

We hope that our proposal and qualifications demonstrate our significant experience and continued commitment to providing high quality TMDL support for West Virginia. Our experience in developing TMDLs and the tools that streamline the TMDL development process is unmatched by any other firm. We emphasize the use of TMDLs in supporting the broader environmental programs of the state and answering practical watershed planning questions. This approach to TMDL development requires that we not presume the use of a specific approach or set of modeling tools, but that we instead select or develop necessary tools that answer the appropriate management questions.

In our proposal, we have identified a core group of staff, all of whom have extensive TMDL development experience, and many who have directly supported West Virginia over the past ten years. I will serve as the Project Manager located in our Charleston Office to facilitate communication and maximize our efficiency in meeting project needs.

We appreciate the opportunity to present our qualifications to West Virginia and we look forward to providing support for this project. If you should have any questions, please feel free to contact me at 304-414-0054.

Sincerely,

Mindy S. Ramsey

Mindy S. Ramsey

Tetra Tech, Inc.
803 Quarrier Street, Suite 400
Charleston, WV 25301
Tel 304.414.0054 Fax 304.720.2334 www.tetratech.com

State of West Virginia
Department of Administration
Purchasing Division
2019 Washington Street East
Post Office Box 50130
Charleston, WV 25305-0130

Solicitation

NUMBER	PAGE
DEP15990	1

ADDRESS CORRESPONDENCE TO ATTENTION OF:
GUY NISBET
304-558-8802

VENDOR
RFQ COPY
TYPE NAME/ADDRESS HERE
TETRA TECH, INC
803 QUARRIER STREET, SUITE 400
CHARLESTON, WV 25301

SHIP TO
ENVIRONMENTAL PROTECTION
DEPARTMENT OF
DIV OF WATER AND WASTE MGT
601 57TH STREET SE
CHARLESTON, WV
25304 304-926-0499

DATE PRINTED
08/28/2012

BID OPENING DATE: 10/04/2012 BID OPENING TIME 1:30PM

LINE	QUANTITY	UOP	CAT NO.	ITEM NUMBER	UNIT PRICE	AMOUNT
0001	1	LS		493-09		

WATER, WASTE WATER AND SOIL SAMPLE ANALYSIS

EXPRESSION OF INTEREST

THE WEST VIRGINIA PURCHASING DIVISION, FOR THE AGENCY, THE WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION, IS SOLICITING EXPRESSIONS OF INTEREST FROM QUALIFIED FIRMS TO PROVIDE ARCHITECTURAL/ENGINEERING SERVICES TO DEVELOP TOTAL MAXIMUM DAILY LOADS (TMDLS) FOR IMPAIRED WATERS IN THE UPPER OHIO NORTH, UPPER KANAWHA, AND SOUTH BRANCH POTOMAC WATERSHEDS PER THE FOLLOWING BID REQUIREMENTS AND ATTACHED SPECIFICATIONS.

****** THIS IS THE END OF RFQ DEP15990 ****** TOTAL:

SIGNATURE	TELEPHONE	DATE
	304-414-0054	10/2/2012
TITLE: Director	FEIN: 954148514	ADDRESS CHANGES TO BE NOTED ABOVE

WHEN RESPONDING TO SOLICITATION, INSERT NAME AND ADDRESS IN SPACE ABOVE LABELED 'VENDOR'

INSTRUCTIONS TO VENDORS SUBMITTING BIDS

1. **REVIEW DOCUMENTS THOROUGHLY:** The attached documents contain a solicitation for bids. Please read these instructions and all documents attached in their entirety. These instructions provide critical information about requirements that if overlooked could lead to disqualification of a Vendor's bid. All bids must be submitted in accordance with the provisions contained in these instructions and the Solicitation. Failure to do so may result in disqualification of Vendor's bid.

2. **MANDATORY TERMS:** The Solicitation may contain mandatory provisions identified by the use of the words "must," "will," and "shall." Failure to comply with a mandatory term in the Solicitation will result in bid disqualification.

3. **PREBID MEETING:** The item identified below shall apply to this Solicitation.

   [✓] A pre-bid meeting will not be held prior to bid opening.

   [ ] A **NON-MANDATORY PRE-BID** meeting will be held at the following place and time:

   [ ] A **MANDATORY PRE-BID** meeting will be held at the following place and time:

   All Vendors submitting a bid must attend the mandatory pre-bid meeting. Failure to attend the mandatory pre-bid meeting shall result in disqualification of the Vendor's bid. No one person attending the pre-bid meeting may represent more than one Vendor.

   An attendance sheet provided at the pre-bid meeting shall serve as the official document verifying attendance. The State will not accept any other form of proof or documentation to verify attendance. Any person attending the pre-bid meeting on behalf of a Vendor must list on the attendance sheet his or her name and the name of the Vendor he or she is representing. Additionally, the person attending the pre-bid meeting should include the Vendor's E-Mail address, phone number, and Fax number on the attendance sheet. It is the Vendor's responsibility to locate the attendance sheet and provide the required

information. Failure to complete the attendance sheet as required may result in disqualification of Vendor's bid.

All Vendors should arrive prior to the starting time for the pre-bid. Vendors who arrive after the starting time but prior to the end of the pre-bid will be permitted to sign in, but are charged with knowing all matters discussed at the pre-bid.

Questions submitted at least five business days prior to a scheduled pre-bid will be discussed at the pre-bid meeting if possible. Any discussions or answers to questions at the pre-bid meeting are preliminary in nature and are non-binding. Official and binding answers to questions will be published in a written addendum to the Solicitation prior to bid opening.

4. **VENDOR QUESTION DEADLINE:** Vendors may submit questions relating to this Solicitation to the Purchasing Division. Questions must be submitted in writing. All questions must be submitted on or before the date listed below and to the address listed below in order to be considered. A written response will be published in a Solicitation addendum if a response is possible and appropriate. Non-written discussions, conversations, or questions and answers regarding this Solicitation are preliminary in nature and are non-binding.

Question Submission Deadline:	N/A
Submit Questions to:	Guy Nisbet, Senior Buyer 2019 Washington Street, East P.O. Box 50130 Charleston, WV 25305 Fax: 304.558.4115 Email: guy.l.nisbet@wv.gov

5. **VERBAL COMMUNICATION:** Any verbal communication between the Vendor and any State personnel is not binding, including that made at the mandatory pre-bid conference. Only information issued in writing and added to the Solicitation by an official written addendum by the Purchasing Division is binding.

6. **BID SUBMISSION:** All bids must be signed and delivered by the Vendor to the Purchasing Division at the address listed below on or before the date and time of the bid opening. Any bid received by the Purchasing Division staff is considered to be in the possession of the Purchasing Division and will not be returned for any reason. The bid delivery address is:

Department of Administration, Purchasing Division
2019 Washington Street East
P.O. Box 50130,
Charleston, WV 25305-0130

The bid should contain the information listed below on the face of the envelope or the bid may not be considered:

SEALED BID
BUYER: _____
SOLICITATION NO.: _____
BID OPENING DATE: _____
BID OPENING TIME: _____
FAX NUMBER: _____

In the event that Vendor is responding to a request for proposal, the Vendor shall submit one original technical and one original cost proposal plus [ ] convenience copies of each to the Purchasing Division at the address shown above. Additionally, the Vendor should identify the bid type as either a technical or cost proposal on the face of each bid envelope submitted in response to a request for proposal as follows:

BID TYPE: [ ] Technical
[ ] Cost

7. **BID OPENING:** Bids submitted in response to this Solicitation will be opened at the location identified below on the date and time listed below. Delivery of a bid after the bid opening date and time will result in bid disqualification. For purposes of this Solicitation, a bid is considered delivered when time stamped by the official Purchasing Division time clock.

Bid Opening Date and Time:	October 04, 2012 at 1:30 PM. EST.
Bid Opening Location:	Department of Administration, Purchasing Division 2019 Washington Street East P.O. Box 50130, Charleston, WV 25305-0130

8. **ADDENDUM ACKNOWLEDGEMENT:** Changes or revisions to this Solicitation will be made by an official written addendum issued by the Purchasing Division. Vendor should acknowledge receipt of all addenda issued with this Solicitation by completing an Addendum Acknowledgment Form, a copy of which is included herewith. Failure to acknowledge addenda may result in bid disqualification. The addendum acknowledgement should be submitted with the bid to expedite document processing.

9. **BID FORMATTING:** Vendor should type or electronically enter the information onto its bid to prevent errors in the evaluation. Failure to type or electronically enter the information may result in bid disqualification.

GENERAL TERMS AND CONDITIONS:

1. **CONTRACTUAL AGREEMENT:** Issuance of a Purchase Order signed by the Purchasing Division Director, or his designee, and approved as to form by the Attorney General's office constitutes acceptance of this Contract made by and between the State of West Virginia and the Vendor. Vendor's signature on its bid signifies Vendor's agreement to be bound by and accept the terms and conditions contained in this Contract.

2. **DEFINITIONS:** As used in this Solicitation / Contract, the following terms shall have the meanings attributed to them below. Additional definitions may be found in the specifications included with this Solicitation / Contract.

   2.1 "Agency" or **"Agencies"** means the agency, board, commission, or other entity of the State of West Virginia that is identified on the first page of the Solicitation or any other public entity seeking to procure goods or services under this Contract.

   2.2 "Contract" means the binding agreement that is entered into between the State and the Vendor to provide the goods and services requested in the Solicitation.

   2.3 "Director" means the Director of the West Virginia Department of Administration, Purchasing Division.

   2.4 "Purchasing Division" means the West Virginia Department of Administration, Purchasing Division.

   2.5 "Purchase Order" means the document signed by the Agency and the Purchasing Division, and approved as to form by the Attorney General, that identifies the Vendor as the successful bidder and Contract holder.

   2.6 "Solicitation" means the official solicitation published by the Purchasing Division and identified by number on the first page thereof.

   2.7 "State" means the State of West Virginia and/or any of its agencies, commissions, boards, etc. as context requires.

   2.8 "Vendor" or **"Vendors"** means any entity submitting a bid in response to the Solicitation, the entity that has been selected as the lowest responsible bidder, or the entity that has been awarded the Contract as context requires.

3. **CONTRACT TERM; RENEWAL; EXTENSION:** The term of this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below:

| | **Term Contract**

Initial Contract Term: This Contract becomes effective on [ ] and extends for a period of [ ] year(s).

Renewal Term: This Contract may be renewed upon the mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). Any request for renewal must be submitted to the Purchasing Division Director thirty (30) days prior to the expiration date of the initial contract term or appropriate renewal term. A Contract renewal shall be in accordance with the terms and conditions of the original contract. Renewal of this Contract is limited to [ ] successive one (1) year periods. Automatic renewal of this Contract is prohibited. Notwithstanding the foregoing, Purchasing Division approval is not required on agency delegated or exempt purchases. Attorney General approval may be required for vendor terms and conditions.

Reasonable Time Extension: At the sole discretion of the Purchasing Division Director, and with approval from the Attorney General's office (Attorney General approval is as to form only), this Contract may be extended for a reasonable time after the initial Contract term or after any renewal term as may be necessary to obtain a new contract or renew this Contract. Any reasonable time extension shall not exceed twelve (12) months. Vendor may avoid a reasonable time extension by providing the Purchasing Division Director with written notice of Vendor's desire to terminate this Contract 30 days prior to the expiration of the then current term. During any reasonable time extension period, the Vendor may terminate this Contract for any reason upon giving the Purchasing Division Director 30 days written notice. Automatic extension of this Contract is prohibited. Notwithstanding the foregoing, Purchasing Division approval is not required on agency delegated or exempt purchases, but Attorney General approval may be required.

| | **Fixed Period Contract:** This Contract becomes effective upon Vendor's receipt of the notice to proceed and must be completed within [ ] days.

| | **One Time Purchase:** The term of this Contract shall run for one year from the date the Purchase Order is issued or from the date the Purchase Order is issued until all of the goods contracted for have been delivered, whichever is shorter.

|✓| **Other:** See attached.

4. **NOTICE TO PROCEED:** Vendor shall begin performance of this Contract immediately upon receiving notice to proceed unless otherwise instructed by the Agency. Unless otherwise specified, the fully executed Purchase Order will be considered notice to proceed

5. **QUANTITIES:** The quantities required under this Contract shall be determined in accordance with the category that has been identified as applicable to this Contract below.

| | **Open End Contract:** Quantities listed in this Solicitation are approximations only, based on estimates supplied by the Agency. It is understood and agreed that the Contract shall cover the quantities actually ordered for delivery during the term of the Contract, whether more or less than the quantities shown.

|✓| **Service:** The scope of the service to be provided will be more clearly defined in the specifications included herewith.

| | **Combined Service and Goods:** The scope of the service and deliverable goods to be provided will be more clearly defined in the specifications included herewith.

| | **One Time Purchase:** This Contract is for the purchase of a set quantity of goods that are identified in the specifications included herewith. Once those items have been delivered, no additional goods may be procured under this Contract without an appropriate change order approved by the Vendor, Agency, Purchasing Division, and Attorney General's office.

6. **PRICING:** The pricing set forth herein is firm for the life of the Contract, unless specified elsewhere within this Solicitation/Contract by the State. A Vendor's inclusion of price adjustment provisions in its bid, without an express authorization from the State in the Solicitation to do so, may result in bid disqualification.

7. **EMERGENCY PURCHASES:** The Purchasing Division Director may authorize the Agency to purchase goods or services in the open market that Vendor would otherwise provide under this Contract if those goods or services are for immediate or expedited delivery in an emergency. Emergencies shall include, but are not limited to, delays in transportation or an unanticipated increase in the volume of work. An emergency purchase in the open market, approved by the Purchasing Division Director, shall not constitute of breach of this Contract and shall not entitle the Vendor to any form of compensation or damages. This provision does not excuse the State from fulfilling its obligations under a One Time Purchase contract.

8. **REQUIRED DOCUMENTS:** All of the items checked below must be provided to the Purchasing Division by the Vendor as specified below.

| | **BID BOND:** All Vendors shall furnish a bid bond in the amount of five percent (5%) of the total amount of the bid protecting the State of West Virginia. The bid bond must be submitted with the bid.

| | **PERFORMANCE BOND:** The apparent successful Vendor shall provide a performance bond in the amount of [ ]. The performance bond must be issued and received by the Purchasing Division prior to Contract award. On construction contracts, the performance bond must be 100% of the Contract value.

| | **LABOR/MATERIAL PAYMENT BOND:** The apparent successful Vendor shall provide a labor/material payment bond in the amount of 100% of the Contract value. The labor/material payment bond must be issued and delivered to the Purchasing Division prior to Contract award.

In lieu of the Bid Bond, Performance Bond, and Labor/Material Payment Bond, the Vendor may provide certified checks, cashier's checks, or irrevocable letters of credit. Any certified check, cashier's check, or irrevocable letter of credit provided in lieu of a bond must be of the same amount and delivered on the same schedule as the bond it replaces. A letter of credit submitted in lieu of a performance and labor/material payment bond will only be allowed for projects under $100,000. Personal or business checks are not acceptable.

| | **MAINTENANCE BOND:** The apparent successful Vendor shall provide a two (2) year maintenance bond covering the roofing system. The maintenance bond must be issued and delivered to the Purchasing Division prior to Contract award.

| | **WORKERS' COMPENSATION INSURANCE:** The apparent successful Vendor shall have appropriate workers' compensation insurance and shall provide proof thereof upon request.

|✓| **INSURANCE:** The apparent successful Vendor shall furnish proof of the following insurance prior to Contract award:

|✓| **Commercial General Liability Insurance:**
$1,000,000.00/ $2,000,000.00 Aggregate or more.

[ ] **Builders Risk Insurance:** builders risk – all risk insurance in an amount equal to 100% of the amount of the Contract.

[✓]	$1,000,000.00 Automobile Liability
[✓]	$1,000,000.00 Professional Liability
[✓]	WV. Workers Compensation including Mandolidis WV Code 23-4-2
[ ]	
[ ]	

The apparent successful Vendor shall also furnish proof of any additional insurance requirements contained in the specifications prior to Contract award regardless of whether or not that insurance requirement is listed above.

[✓] **LICENSE(S) / CERTIFICATIONS / PERMITS:** In addition to anything required under the Section entitled Licensing, of the General Terms and Conditions, the apparent successful Vendor shall furnish proof of the following licenses, certifications, and/or permits prior to Contract award, in a form acceptable to the Purchasing Division.

[✓]	WV. Workers Compensation including Mandolidis WV Code 23-4-2
[ ]	
[ ]	
[ ]	

The apparent successful Vendor shall also furnish proof of any additional licenses or certifications contained in the specifications prior to Contract award regardless of whether or not that requirement is listed above.

9. **LITIGATION BOND:** The Director reserves the right to require any Vendor that files a protest of an award to submit a litigation bond in the amount equal to one percent of the lowest bid submitted or $5,000, whichever is greater. The entire amount of the bond shall be forfeited if the hearing officer determines that the protest was filed for frivolous or improper purpose, including but not limited to, the purpose of harassing, causing unnecessary delay, or needless expense for the Agency. All litigation bonds shall be made payable to the Purchasing Division. In lieu of a bond, the protester may submit a cashier's check or certified check payable to the Purchasing Division. Cashier's or certified checks will be deposited with and held by the State Treasurer's office. If it is determined that the protest has not been filed for frivolous or improper purpose, the bond or deposit shall be returned in its entirety.

10. **ALTERNATES:** Any model, brand, or specification listed herein establishes the acceptable level of quality only and is not intended to reflect a preference for, or in any way favor, a particular brand or vendor. Vendors may bid alternates to a listed model or brand provided that the alternate is at least equal to the model or brand and complies with the required specifications. The equality of any alternate being bid shall be determined by the State at its sole discretion. Any Vendor bidding an alternate model or brand should clearly identify the alternate items in its bid and should include manufacturer's specifications, industry literature, and/or any other relevant documentation demonstrating the equality of the alternate items. Failure to provide information for alternate items may be grounds for rejection of a Vendor's bid.

11. **EXCEPTIONS AND CLARIFICATIONS:** The Solicitation contains the specifications that shall form the basis of a contractual agreement. Vendor shall clearly mark any exceptions, clarifications, or

other proposed modifications in its bid. Exceptions to, clarifications of, or modifications of a requirement or term and condition of the Solicitation may result in bid disqualification.

12. **LIQUIDATED DAMAGES:** Vendor shall pay liquidated damages in the amount [ ] for [ ] [ ].
This clause shall in no way be considered exclusive and shall not limit the State or Agency's right to pursue any other available remedy.

13. **ACCEPTANCE/REJECTION:** The State may accept or reject any bid in whole, or in part. Vendor's signature on its bid signifies acceptance of the terms and conditions contained in the Solicitation and Vendor agrees to be bound by the terms of the Contract, as reflected in the Purchase Order, upon receipt.

14. **REGISTRATION:** Prior to Contract award, the apparent successful Vendor must be properly registered with the West Virginia Purchasing Division and must have paid the $125 fee if applicable.

15. **COMMUNICATION LIMITATIONS:** In accordance with West Virginia Code of State Rules §148-1-6.6, communication with the State of West Virginia or any of its employees regarding this Solicitation during the solicitation, bid, evaluation or award periods, except through the Purchasing Division, is strictly prohibited without prior Purchasing Division approval. Purchasing Division approval for such communication is implied for all agency delegated and exempt purchases.

16. **FUNDING:** This Contract shall continue for the term stated herein, contingent upon funds being appropriated by the Legislature or otherwise being made available. In the event funds are not appropriated or otherwise made available, this Contract becomes void and of no effect beginning on July 1 of the fiscal year for which funding has not been appropriated or otherwise made available.

17. **PAYMENT:** Payment in advance is prohibited under this Contract. Payment may only be made after the delivery and acceptance of goods or services. The Vendor shall submit invoices, in arrears, to the Agency at the address on the face of the purchase order labeled "Invoice To."

18. **UNIT PRICE:** Unit prices shall prevail in cases of a discrepancy in the Vendor's bid.

19. **DELIVERY:** All quotations are considered freight on board destination ("F.O.B. destination") unless alternate shipping terms are clearly identified in the bid. Vendor's listing of shipping terms that contradict the shipping terms expressly required by this Solicitation may result in bid disqualification.

20. **INTEREST:** Interest attributable to late payment will only be permitted if authorized by the West Virginia Code. Presently, there is no provision in the law for interest on late payments.

21. **PREFERENCE:** Vendor Preference may only be granted upon written request and only in accordance with the West Virginia Code § 5A-3-37 and the West Virginia Code of State Rules. A Resident Vendor Certification form has been attached hereto to allow Vendor to apply for the preference. Vendor's

failure to submit the Resident Vendor Certification form with its bid will result in denial of Vendor Preference. Vendor Preference does not apply to construction projects.

22. **SMALL, WOMEN-OWNED, OR MINORITY-OWNED BUSINESSES:** For any solicitations publicly advertised for bid on or after July 1, 2012, in accordance with West Virginia Code §5A-3-37(a)(7) and W. Va. CSR § 148-22-9, any non-resident vendor certified as a small, women-owned, or minority-owned business under W. Va. CSR § 148-22-9 shall be provided the same preference made available to any resident vendor. Any non-resident small, women-owned, or minority-owned business must identify itself as such in writing, must submit that writing to the Purchasing Division with its bid, and must be properly certified under W. Va. CSR § 148-22-9 prior to submission of its bid to receive the preferences made available to resident vendors. Preference for a non-resident small, women-owned, or minority owned business shall be applied in accordance with W. Va. CSR § 148-22-9.

23. **TAXES:** The Vendor shall pay any applicable sales, use, personal property or any other taxes arising out of this Contract and the transactions contemplated thereby. The State of West Virginia is exempt from federal and state taxes and will not pay or reimburse such taxes.

24. **CANCELLATION:** The Purchasing Division Director reserves the right to cancel this Contract immediately upon written notice to the vendor if the materials or workmanship supplied do not conform to the specifications contained in the Contract. The Purchasing Division Director may cancel any purchase or Contract upon 30 days written notice to the Vendor in accordance with West Virginia Code of State Rules § 148-1-7.16.2.

25. **WAIVER OF MINOR IRREGULARITIES:** The Director reserves the right to waive minor irregularities in bids or specifications in accordance with West Virginia Code of State Rules § 148-1-4.6.

26. **TIME:** Time is of the essence with regard to all matters of time and performance in this Contract.

27. **APPLICABLE LAW:** This Contract is governed by and interpreted under West Virginia law without giving effect to its choice of law principles. Any information provided in specification manuals, or any other source, verbal or written, which contradicts or violates the West Virginia Constitution, West Virginia Code or West Virginia Code of State Rules is void and of no effect.

28. **COMPLIANCE:** Vendor shall comply with all applicable federal, state, and local laws, regulations and ordinances. By submitting a bid, Vendors acknowledge that they have reviewed, understand, and will comply with all applicable law.

29. **PREVAILING WAGE:** On any contract for the construction of a public improvement, Vendor and any subcontractors utilized by Vendor shall pay a rate or rates of wages which shall not be less than the fair minimum rate or rates of wages (prevailing wage), as established by the West Virginia Division of Labor under West Virginia Code §§ 21-5A-1 et seq. and available at http://www.sos.wv.gov/administrative-law/wagerates/Pages/default.aspx. Vendor shall be responsible for ensuring compliance with prevailing wage requirements and determining when prevailing wage

requirements are applicable. The required contract provisions contained in West Virginia Code of State Rules § 42-7-3 are specifically incorporated herein by reference.

30. **ARBITRATION:** Any references made to arbitration contained in this Contract, Vendor's bid, or in any American Institute of Architects documents pertaining to this Contract are hereby deleted, void, and of no effect.

31. **MODIFICATIONS:** This writing is the parties' final expression of intent. Notwithstanding anything contained in this Contract to the contrary, no modification of this Contract shall be binding without mutual written consent of the Agency, and the Vendor, with approval of the Purchasing Division and the Attorney General's office (Attorney General approval is as to form only). **No Change shall be implemented by the Vendor until such time as the Vendor receives an approved written change order from the Purchasing Division.**

32. **WAIVER:** The failure of either party to insist upon a strict performance of any of the terms or provision of this Contract, or to exercise any option, right, or remedy herein contained, shall not be construed as a waiver or a relinquishment for the future of such term, provision, option, right, or remedy, but the same shall continue in full force and effect. Any waiver must be expressly stated in writing and signed by the waiving party.

33. **SUBSEQUENT FORMS:** The terms and conditions contained in this Contract shall supersede any and all subsequent terms and conditions which may appear on any form documents submitted by Vendor to the Agency or Purchasing Division such as price lists, order forms, invoices, sales agreements, or maintenance agreements, and includes internet websites or other electronic documents. Acceptance or use of Vendor's forms does not constitute acceptance of the terms and conditions contained thereon.

34. **ASSIGNMENT:** Neither this Contract nor any monies due, or to become due hereunder, may be assigned by the Vendor without the express written consent of the Agency, the Purchasing Division, the Attorney General's office (as to form only), and any other government agency or office that may be required to approve such assignments. Notwithstanding the foregoing, Purchasing Division approval may or may not be required on certain agency delegated or exempt purchases.

35. **WARRANTY:** The Vendor expressly warrants that the goods and/or services covered by this Contract will: (a) conform to the specifications, drawings, samples, or other description furnished or specified by the Agency; (b) be merchantable and fit for the purpose intended; and (c) be free from defect in material and workmanship.

36. **STATE EMPLOYEES:** State employees are not permitted to utilize this Contract for personal use and the Vendor is prohibited from permitting or facilitating the same.

37. **BANKRUPTCY:** In the event the Vendor files for bankruptcy protection, the State of West Virginia may deem this Contract null and void, and terminate this Contract without notice.

38. **HIPAA BUSINESS ASSOCIATE ADDENDUM**: The West Virginia State Government HIPAA Business Associate Addendum (BAA), approved by the Attorney General, is available online at **http://www.state.wv.us/admin/purchase/vrc/hipaa.html** and is hereby made part of the agreement provided that the Agency meets the definition of a Covered entity (45 CFR §160.103) and will be disclosing Protected Health Information (45 CFR §160.103) to the Vendor.

39. **CONFIDENTIALITY**: The Vendor agrees that it will not disclose to anyone, directly or indirectly, any such personally identifiable information or other confidential information gained from the Agency, unless the individual who is the subject of the information consents to the disclosure in writing or the disclosure is made pursuant to the Agency's policies, procedures, and rules. Vendor further agrees to comply with the Confidentiality Policies and Information Security Accountability Requirements, set forth in http://www.state.wv.us/admin/purchase/privacy/default.html.

40. **DISCLOSURE:** Vendor's response to the Solicitation and the resulting Contract are considered public documents and will be disclosed to the public in accordance with the laws, rules, and policies governing the West Virginia Purchasing Division. Those laws include, but are not limited to, the Freedom of Information Act found in West Virginia Code § 29B-1-1 et seq.

    If a Vendor considers any part of its bid to be exempt from public disclosure, Vendor must so indicate by specifically identifying the exempt information, identifying the exemption that applies, providing a detailed justification for the exemption, segregating the exempt information from the general bid information, and submitting the exempt information as part of its bid but in a segregated and clearly identifiable format. Failure to comply with the foregoing requirements will result in public disclosure of the Vendor's bid without further notice. A Vendor's act of marking all or nearly all of its bid as exempt is not sufficient to avoid disclosure and WILL NOT BE HONORED. Vendor's act of marking a bid or any part thereof as "confidential" or "proprietary" is not sufficient to avoid disclosure and WILL NOT BE HONORED. In addition, a legend or other statement indicating that all or substantially all of the bid is exempt from disclosure is not sufficient to avoid disclosure and WILL NOT BE HONORED. Vendor will be required to defend any claimed exemption for nondisclosure in the event of an administrative or judicial challenge to the State's nondisclosure. Vendor must indemnify the State for any costs incurred related to any exemptions claimed by Vendor. Any questions regarding the applicability of the various public records laws should be addressed to your own legal counsel prior to bid submission.

41. **LICENSING:** In accordance with West Virginia Code of State Rules §148-1-6.1.7, Vendor must be licensed and in good standing in accordance with any and all state and local laws and requirements by any state or local agency of West Virginia, including, but not limited to, the West Virginia Secretary of State's Office, the West Virginia Tax Department, West Virginia Insurance Commission, or any other state agency or political subdivision. Upon request, the Vendor must provide all necessary releases to obtain information to enable the Purchasing Division Director or the Agency to verify that the Vendor is licensed and in good standing with the above entities.

42. **ANTITRUST:** In submitting a bid to, signing a contract with, or accepting a Purchase Order from any agency of the State of West Virginia, the Vendor agrees to convey, sell, assign, or transfer to the State of West Virginia all rights, title, and interest in and to all causes of action it may now or hereafter acquire under the antitrust laws of the United States and the State of West Virginia for price fixing and/or unreasonable restraints of trade relating to the particular commodities or services purchased or acquired by the State of West Virginia. Such assignment shall be made and become effective at the time the purchasing agency tenders the initial payment to Vendor.

43. **VENDOR CERTIFICATIONS:** By signing its bid or entering into this Contract, Vendor certifies (1) that its bid was made without prior understanding, agreement, or connection with any corporation, firm, limited liability company, partnership, person or entity submitting a bid for the same material, supplies, equipment or services; (2) that its bid is in all respects fair and without collusion or fraud; (3) that this Contract is accepted or entered into without any prior understanding, agreement, or connection to any other entity that could be considered a violation of law; and (4) that it has reviewed this RFQ in its entirety; understands the requirements, terms and conditions, and other information contained herein. Vendor's signature on its bid also affirms that neither it nor its representatives have any interest, nor shall acquire any interest, direct or indirect, which would compromise the performance of its services hereunder. Any such interests shall be promptly presented in detail to the Agency.

    The individual signing this bid on behalf of Vendor certifies that he or she is authorized by the Vendor to execute this bid or any documents related thereto on Vendor's behalf; that he or she is authorized to bind the Vendor in a contractual relationship; and that, to the best of his or her knowledge, the Vendor has properly registered with any State agency that may require registration.

44. **PURCHASING CARD ACCEPTANCE:** The State of West Virginia currently utilizes a Purchasing Card program, administered under contract by a banking institution, to process payment for goods and services. The Vendor must accept the State of West Virginia's Purchasing Card for payment of all orders under this Contract unless the box below is checked.

    | ✓ | Vendor is not required to accept the State of West Virginia's Purchasing Card as payment for all goods and services.

45. **VENDOR RELATIONSHIP:** The relationship of the Vendor to the State shall be that of an independent contractor and no principal-agent relationship or employer-employee relationship is contemplated or created by this Contract. The Vendor as an independent contractor is solely liable for the acts and omissions of its employees and agents. Vendor shall be responsible for selecting, supervising, and compensating any and all individuals employed pursuant to the terms of this Solicitation and resulting contract. Neither the Vendor, nor any employees or subcontractors of the Vendor, shall be deemed to be employees of the State for any purpose whatsoever. Vendor shall be exclusively responsible for payment of employees and contractors for all wages and salaries, taxes, withholding payments, penalties, fees, fringe benefits, professional liability insurance premiums, contributions to insurance and pension, or other deferred compensation plans, including but not limited to, Workers' Compensation and Social Security obligations, licensing fees, *etc.* and the filing of all necessary documents, forms and returns pertinent to all of the foregoing. Vendor shall hold harmless the

State, and shall provide the State and Agency with a defense against any and all claims including, but not limited to, the foregoing payments, withholdings, contributions, taxes, Social Security taxes, and employer income tax returns.

46. **INDEMNIFICATION:** The Vendor agrees to indemnify, defend, and hold harmless the State and the Agency, their officers, and employees from and against: (1) Any claims or losses for services rendered by any subcontractor, person, or firm performing or supplying services, materials, or supplies in connection with the performance of the Contract; (2) Any claims or losses resulting to any person or entity injured or damaged by the Vendor, its officers, employees, or subcontractors by the publication, translation, reproduction, delivery, performance, use, or disposition of any data used under the Contract in a manner not authorized by the Contract, or by Federal or State statutes or regulations; and (3) Any failure of the Vendor, its officers, employees, or subcontractors to observe State and Federal laws including, but not limited to, labor and wage and hour laws.

47. **PURCHASING AFFIDAVIT:** In accordance with West Virginia Code § 5A-3-10a, all Vendors are required to sign, notarize, and submit the Purchasing Affidavit stating that neither the Vendor nor a related party owe a debt to the State in excess of $1,000. The affidavit must be submitted prior to award, but should be submitted with the Vendor's bid. A copy of the Purchasing Affidavit is included herewith.

48. **ADDITIONAL AGENCY AND LOCAL GOVERNMENT USE:** This Contract may be utilized by and extends to other agencies, spending units, and political subdivisions of the State of West Virginia; county, municipal, and other local government bodies; and school districts ("Other Government Entities"). This Contract shall be extended to the aforementioned Other Government Entities on the same prices, terms, and conditions as those offered and agreed to in this Contract. If the Vendor does not wish to extend the prices, terms, and conditions of its bid and subsequent contract to the Other Government Entities, the Vendor must clearly indicate such refusal in its bid. A refusal to extend this Contract to the Other Government Entities shall not impact or influence the award of this Contract in any manner.

49. **CONFLICT OF INTEREST:** Vendor, its officers or members or employees, shall not presently have or acquire any interest, direct or indirect, which would conflict with or compromise the performance of its obligations hereunder. Vendor shall periodically inquire of its officers, members and employees to ensure that a conflict of interest does not arise. Any conflict of interest discovered shall be promptly presented in detail to the Agency.

50. **REPORTS:** Vendor shall provide the Agency and/or the Purchasing Division with the following reports identified by a checked box below:

[ ] Such reports as the Agency and/or the Purchasing Division may request. Requested reports may include, but are not limited to, quantities purchased, agencies utilizing the contract, total contract expenditures by agency, etc.

[ ] Quarterly reports detailing the total quantity of purchases in units and dollars, along with a listing of purchases by agency. Quarterly reports should be delivered to the Purchasing Division via email at purchasing.requisitions@wv.gov.

51. **BACKGROUND CHECK:** In accordance with W. Va. Code § 15-2D-3, the Director of the Division of Protective Services shall require any service provider whose employees are regularly employed on the grounds or in the buildings of the Capitol complex or who have access to sensitive or critical information to submit to a fingerprint-based state and federal background inquiry through the state repository.

After the contract for such services has been approved, but before any such employees are permitted to be on the grounds or in the buildings of the Capitol complex or have access to sensitive or critical information, the service provider shall submit a list of all persons who will be physically present and working at the Capitol complex to the Director of the Division of Protective Services for purposes of verifying compliance with this provision.

The State reserves the right to prohibit a service provider's employees from accessing sensitive or critical information or to be present at the Capitol complex based upon results addressed from a criminal background check.

52. **PREFERENCE FOR USE OF DOMESTIC STEEL PRODUCTS:** Except when authorized by the Director of the Purchasing Division pursuant to W. Va. Code § 5A-3-56, no contractor may use or supply steel products for a State Contract Project other than those steel products made in the United States. A contractor who uses steel products in violation of this section may be subject to civil penalties pursuant to W. Va. Code § 5A-3-56. As used in this section:

a. "State Contract Project" means any erection or construction of, or any addition to, alteration of or other improvement to any building or structure, including, but not limited to, roads or highways, or the installation of any heating or cooling or ventilating plants or other equipment, or the supply of and materials for such projects, pursuant to a contract with the State of West Virginia for which bids were solicited on or after June 6, 2001.

b. "Steel Products" means products rolled, formed, shaped, drawn, extruded, forged, cast, fabricated or otherwise similarly processed, or processed by a combination of two or more or such operations, from steel made by the open heath, basic oxygen, electric furnace, Bessemer or other steel making process.

The Purchasing Division Director may, in writing, authorize the use of foreign steel products if:

a. The cost for each contract item used does not exceed one tenth of one percent (.1%) of the total contract cost or two thousand five hundred dollars ($2,500.00), whichever is greater. For the purposes of this section, the cost is the value of the steel product as delivered to the project; or

b. The Director of the Purchasing Division determines that specified steel materials are not produced in the United States in sufficient quantity or otherwise are not reasonably available to meet contract requirements.

53. **PREFERENCE FOR USE OF DOMESTIC ALUMINUM, GLASS, AND STEEL:** In Accordance with W. Va. Code § 5-19-1 et seq., and W. Va. CSR § 148-10-1 et seq., for every contract or subcontract, subject to the limitations contained herein, for the construction, reconstruction, alteration, repair, improvement or maintenance of public works or for the purchase of any item of machinery or equipment to be used at sites of public works, only domestic aluminum, glass or steel products shall be supplied unless the spending officer determines, in writing, after the receipt of offers or bids, (1) that the cost of domestic aluminum, glass or steel products is unreasonable or inconsistent with the public interest of the State of West Virginia, (2) that domestic aluminum, glass or steel products are not produced in sufficient quantities to meet the contract requirements, or (3) the available domestic aluminum, glass, or steel do not meet the contract specifications. This provision only applies to public works contracts awarded in an amount more than fifty thousand dollars ($50,000) or public works contracts that require more than ten thousand pounds of steel products.

The cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than twenty percent (20%) of the bid or offered price for foreign made aluminum, glass, or steel products. If the domestic aluminum, glass or steel products to be supplied or produced in a "substantial labor surplus area", as defined by the United States Department of Labor, the cost of domestic aluminum, glass, or steel products may be unreasonable if the cost is more than thirty percent (30%) of the bid or offered price for foreign made aluminum, glass, or steel products.

This preference shall be applied to an item of machinery or equipment, as indicated above, when the item is a single unit of equipment or machinery manufactured primarily of aluminum, glass or steel, is part of a public works contract and has the sole purpose or of being a permanent part of a single public works project. This provision does not apply to equipment or machinery purchased by a spending unit for use by that spending unit and not as part of a single public works project.

All bids and offers including domestic aluminum, glass or steel products that exceed bid or offer prices including foreign aluminum, glass or steel products after application of the preferences provided in this provision may be reduced to a price equal to or lower than the lowest bid or offer price for foreign aluminum, glass or steel products plus the applicable preference. If the reduced bid or offer prices are made in writing and supersede the prior bid or offer prices, all bids or offers, including the reduced bid or offer prices, will be reevaluated in accordance with this rule.

ADDITIONAL TERMS AND CONDITIONS (Construction Contracts Only)

1. **CONTRACTOR'S LICENSE:** West Virginia Code § 21-11-2 requires that all persons desiring to perform contracting work in this state be licensed. The West Virginia Contractors Licensing Board is empowered to issue the contractor's license. Applications for a contractor's license may be made by contacting the West Virginia Division of Labor.

   West Virginia Code § 21-11-11 requires any prospective Vendor to include the contractor's license number on its bid. Failure to include a contractor's license number on the bid shall result in Vendor's bid being disqualified. Vendors should include a contractor's license number in the space provided below.

   Contractor's Name: _____

   Contractor's License No. _____

   The apparent successful Vendor must furnish a copy of its contractor's license prior to the issuance of a purchase order/contract.

2. **DRUG-FREE WORKPLACE:** W. Va. Code § 21-1D-5 provides that any solicitation for a public improvement contract requires each Vendor that submits a bid for the work to submit at the same time an affidavit that the Vendor has a written plan for a drug-free workplace policy. To comply with this law, Vendor must either complete the enclosed drug-free workplace affidavit and submit the same with its bid or complete a similar affidavit that fulfills all of the requirements of the applicable code. Failure to submit the signed and notarized drug-free workplace affidavit, or a similar affidavit that fully complies with the requirements of the applicable code, with the bid shall result in disqualification of Vendor's bid.

3. **AIA DOCUMENTS:** All construction contracts that will be completed in conjunction with architectural services procured under Chapter 5G of the West Virginia Code will be governed by the AIA A101-2007 and A201-2007 or the A107-2007 documents, as amended by the Supplementary Conditions for the State of West Virginia, in addition to the terms and conditions contained herein.

4. **SUBCONTRACTOR LIST SUBMISSION:** In accordance with W. Va. Code § 5-22-1, The apparent low bidder on a contract for the construction, alteration, decoration, painting or improvement of a new or existing building or structure valued at more than $500,000.00 shall submit a list of all subcontractors who will perform more than $25,000.00 of work on the project including labor and materials. This provision shall not apply to any other construction projects, such as highway, mine reclamation, water or sewer projects.

   c. **Required Information.** The subcontractor list shall contain the following information:

i. Bidder's name
ii. Name of each subcontractor
iii. License numbers as required by W. Va. Code § 21-11-1 et. seq.
iv. Notation that no subcontractors will be used if the bidder will perform the work

d. **Submission.** The completed subcontractor list shall be provided to the Purchasing Division within one business day of the opening of bids for review. Failure to submit the subcontractor list within one business day after the deadline for submitting bids shall result in disqualification of the bid.

e. **Substitution of Subcontractor.** Written approval must be obtained from the Purchasing Division before any subcontractor substitution is permitted. Substitutions are not permitted unless:

i. The subcontractor listed in the original bid has filed for bankruptcy;
ii. The subcontractor in the original bid has been debarred or suspended; or
iii. The contractor certifies in writing that the subcontractor listed in the original bill fails, is unable, or refuses to perform his subcontract.

5. **GREEN BUILDINGS MINIMUM ENERGY STANDARDS:** In accordance with § 22-29-4, all new building construction projects of public agencies that have not entered the schematic design phase prior to July 1, 2012, or any building construction project receiving state grant funds and appropriations, including public schools, that have not entered the schematic design phase prior to July 1, 2012, shall be designed and constructed complying with the ICC International Energy Conservation Code, adopted by the State Fire Commission, and the ANSI/ASHRAE/IESNA Standard 90.1-2007: *Provided,* That if any construction project has a commitment of federal funds to pay for a portion of such project, this provision shall only apply to the extent such standards are consistent with the federal standards.

ADDITIONAL TERMS AND CONDITIONS (Architectural and Engineering Contracts Only)

1. **PLAN AND DRAWING DISTRIBUTION:** All plans and drawings must be completed and available for distribution at least five business days prior to a scheduled pre-bid meeting for the construction or other work related to the plans and drawings.

2. **PROJECT ADDENDA REQUIREMENTS:** The Architect/Engineer and/or Agency shall be required to abide by the following schedule in issuing construction project addenda:

    a. The Architect/Engineer shall prepare any addendum materials for which it is responsible, and a list of all vendors that have obtained drawings and specifications for the project. The Architect/Engineer shall then send a copy of the addendum materials and the list of vendors to the State Agency for which the contract is issued to allow the Agency to make any necessary modifications. The addendum and list shall then be forwarded to the Purchasing Division buyer by the Agency. The Purchasing Division buyer shall send the addendum to all interested vendors and, if necessary, extend the bid opening date. Any addendum should be received by the Purchasing Division at least fourteen (14) days prior to the bid opening date.

3. **PRE-BID MEETING RESPONSIBILITIES:** The Architect/Engineer shall be available to attend any pre-bid meeting for the construction or other work resulting from the plans, drawings, or specifications prepared by the Architect/Engineer.

4. **AIA DOCUMENTS:** Contracts for architectural and engineering services will be governed by the AIA document B101-2007, as amended by the Supplementary Conditions for the State of West Virginia, in addition to the terms and conditions contained herein when procured under Chapter 5G of the West Virginia Code.

5. **GREEN BUILDINGS MINIMUM ENERGY STANDARDS:** In accordance with West Virginia Code § 22-29-4, all new building construction projects of public agencies that have not entered the schematic design phase prior to July 1, 2012, or any building construction project receiving state grant funds and appropriations, including public schools, that have not entered the schematic design phase prior to July 1, 2012, shall be designed and constructed complying with the ICC International Energy Conservation Code, adopted by the State Fire Commission, and the ANSI/ASHRAE/IESNA Standard 90.1-2007: *Provided*, That if any construction project has a commitment of federal funds to pay for a portion of such project, this provision shall only apply to the extent such standards are consistent with the federal standards.

WEST VIRGINIA DEPARTMENT OF ENVIRONMENTAL PROTECTION
TMDL VENDOR QUALIFICATION QUESTIONNAIRE — Attachment A

PROJECT NAME	DATE (DAY, MONTH, YEAR)	FEIN
Upper Ohio North, Upper Kanawha, and South Branch Potomac Watersheds TMDL Development Project	4, October, 2012	954148514

1. FIRM NAME	2. HOME OFFICE BUSINESS ADDRESS	3. FORMER FIRM NAME
Tetra Tech, Inc.	10306 Eaton Place, Suite 340 Fairfax, VA 22030	N/A

4. HOME OFFICE TELEPHONE	5. ESTABLISHED (YEAR)	6. TYPE OWNERSHIP	
(703) 385-6000	1966	~~Individual~~ **Corporation** ~~Partnership~~ ~~Joint Venture~~	

7. PRIMARY TMDL DEVELOPMENT OFFICE: ADDRESS/ TELEPHONE/ PERSON IN CHARGE/ NO.OF TMDL DEVELOPMENT PERSONNEL IN OFFICE

803 Quarrier Street, Suite 400 / (304) 414-0054 / Mindy Ramsey, Director / 8 TMDL development personnel in office
Charleston, WV 25301

8. NAMES OF PRINCIPAL OFFICERS OR MEMBERS OF FIRM	8a. NAME, TITLE, & TELEPHONE NUMBER - OTHER PRINCIPALS
Leslie Shoemaker, Ph.D., Vice President	Jon Ludwig, Deputy Project Manager, (703) 385-6000 Ext. 151

9. PERSONNEL BY DISCIPLINE

1	CONTRACT ADMINISTRATOR(S)	6	WATERSHED ANALYST(S)	—	OTHER (LIST BELOW)
2	PROGRAM MANAGER(S)	4	SOILS SPECIALIST(S)	—	_____
3	PROJECT MANAGER(S)	4	TECHNICAL EXPERT(S)	—	_____
1	QA/QC MANAGER(S)	3	TECHNICAL WRITER(S)	—	_____
5	BIOLOGICAL ANALYST(S)	3	OUTREACH SPECIALIST(S)		
4	MODEL DEVELOPER(S)	6	SENIOR WATER RESOURCE ENGINEER(S)		

42 TOTAL PERSONNEL

Note: If needed, Tetra Tech has over 50 additional highly qualified staff to support this project.

10. DO YOU NEED ADDITIONAL EMPLOYEES TO FULFILL THE REQUIREMENTS OF THIS CONTRACT? **X NO**

11. OUTSIDE KEY CONSULTANTS/SUB-CONSULTANTS ANTICIPATED TO BE USED. Attach "TMDL Vendor Qualification Questionnaire".		
NAME AND ADDRESS: **NOT APPLICABLE**	SPECIALTY: **NOT APPLICABLE**	WORKED WITH BEFORE _____ Yes **NOT APPLICABLE** _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No
NAME AND ADDRESS:	SPECIALTY:	WORKED WITH BEFORE _____ Yes _____ No

12. A. Is your firm experienced in development of TMDLs for total recoverable metals?

YES

A.1 Provide names and number of projects.

Tetra Tech began developing TMDLs in WV in 1998 initially supporting USEPA Region 3 and has directly worked with WVDEP since 2002 to develop various technical approaches for total recoverable metals TMDLs throughout WV. For EPA and WVDEP, Tetra Tech has developed **1,783** EPA approved total recoverable metals TMDLs in 32 WV projects. In addition, Tetra Tech has developed hundreds more in other states and EPA Regions. See Table III-1 of the proposal that accompanies this questionnaire. The table below displays the total recoverable metals TMDLs approved or under development for WVDEP since 2002.

WV Hydrologic Group	Status	Total Recoverable Metals TMDLs
A (Upper Kanawha & Upper Ohio North Watersheds)	USEPA Approved	63
B (Coal River, Lower Kanawha & North Branch Potomac Watersheds)	USEPA Approved	139
C (Gauley River Watershed)	USEPA Approved	60
D (New River & Little Kanawha Watersheds)	USEPA Approved	17
E (Upper Ohio South, Dunkard Creek, Camp Creek & Youghiogheny Watersheds)	USEPA Approved	32
B2 (Elk River & Lower Kanawha Watersheds)	USEPA Approved	406
C2 (Middle Ohio North & Middle Ohio South Watersheds)	Under Development	91
D2 (Monongahela Watershed)	Under Development	56
E2 (West Fork Watershed)	Under Development	109
TOTAL WEST VIRGINIA TMDLS DEVELOPED FOR WVDEP (SINCE 2002)		**973**

A detailed description of Tetra Tech's TMDL experience is described in **Section 3** of the proposal that accompanies this questionnaire.

A.2 Provide an example TMDL for total recoverable metals.

Two (2) USEPA approved total recoverable metals TMDL projects are provided as examples (on CD-ROM) in **Appendix C** of the proposal that accompanies this questionnaire. The two projects include:

- Total Maximum Daily Loads for Selected Streams in the Upper Ohio South Watershed, West Virginia
- Total Maximum Daily Loads for Selected Streams in the Elk River Watershed, West Virginia

A.3 Provide a detailed description of the methodology to develop a total recoverable metals TMDL as per EOI.

A detailed description of the total recoverable metals TMDL methodology is presented in **Section 1** of the proposal that accompanies this questionnaire.

12. B. Is your firm experienced in development of TMDLs for pH/dissolved metals?

YES

B.1 Provide names and number of projects.

Tetra Tech began developing TMDLs in WV in 1998 initially supporting USEPA Region 3 and has directly worked with WVDEP since 2002 to develop various technical approaches for pH/dissolved metals TMDLs throughout WV. For EPA and WVDEP, Tetra Tech has developed **656** EPA approved pH/dissolved aluminum TMDLs in 28 WV projects. In addition, Tetra Tech has developed hundreds more in other states and EPA Regions. See Table III-1 of the proposal. The table below displays the pH/dissolved metals TMDLs approved or under development for WVDEP since 2002.

WV Hydrologic Group	Status	pH/Dissolved Metals TMDLs
A (Upper Kanawha & Upper Ohio North Watersheds)	USEPA Approved	80
B (Coal River, Lower Kanawha & North Branch Potomac Watersheds)	USEPA Approved	91
C (Gauley River Watershed)	USEPA Approved	75
D (New River Watershed)	USEPA Approved	9
E (Upper Ohio South, Dunkard Creek , Camp Creek & Youghiogheny Watersheds)	USEPA Approved	14
B2 (Elk River, Lower Kanawha Watersheds)	USEPA Approved	44
D2 (Monongahela Watershed)	Under Development	50
E2 (West Fork Watershed)	Under Development	12
TOTAL WEST VIRGINIA TMDLS DEVELOPED FOR WVDEP (SINCE 2002)		**375**

A detailed description of Tetra Tech's TMDL experience is described in **Section 3** of the proposal that accompanies this questionnaire.

B.2 Provide an example TMDL for pH/dissolved metals.

Two (2) USEPA approved total recoverable metals TMDL projects are provided as examples (on CD-ROM) in **Appendix C** of the proposal that accompanies this questionnaire. The two projects include:

- Total Maximum Daily Loads for Selected Streams in the Upper Ohio South Watershed, West Virginia
- Total Maximum Daily Loads for Selected Streams in the Elk River Watershed, West Virginia

B.3 Provide a detailed description of the methodology to develop a pH/dissolved metals TMDL as per EOI.

A detailed description of the pH/dissolved metals TMDL methodology is presented in **Section 1** of the proposal that accompanies this questionnaire.

12.C. Is your firm experienced in development of TMDLs for fecal coliform bacteria?

YES

C.1 Provide names and number of projects.

Tetra Tech began developing TMDLs in WV in 1998 initially supporting USEPA Region 3 and has directly worked with WVDEP since 2002 to develop various technical approaches for fecal coliform TMDLs throughout WV. For EPA and WVDEP, Tetra Tech has developed **672** EPA approved fecal coliform TMDLs in 27 WV projects. In addition, Tetra Tech has developed hundreds more in other states and EPA Regions. See Table III-1 of the proposal. The table below displays the fecal coliform TMDLs approved or under development for WVDEP since 2002.

WV Hydrologic Group	Status	Fecal Coliform Bacteria TMDLs
A (Upper Kanawha & Upper Ohio North Watersheds)	USEPA Approved	54
B (Coal River, Lower Kanawha & North Branch Potomac Watersheds)	USEPA Approved	102
C (Gauley River & Potomac Direct Drains Watersheds)	USEPA Approved	54
D (New River, Greenbrier River, James River & Little Kanawha Watersheds)	USEPA Approved	128
E (Upper Ohio South, Dunkard Creek, Camp Creek & Youghiogheny Watersheds)	USEPA Approved	101
B2 (Elk River, Lower Kanawha & North Branch Potomac Watersheds)	USEPA Approved	192
C2 (Middle Ohio North & Middle Ohio South Watersheds)	Under Development	164
D2 (Monongahela Watershed)	Under Development	65
E2 (West Fork Watershed)	Under Development	175
TOTAL WEST VIRGINIA TMDLS DEVELOPED FOR WVDEP (SINCE 2002)		**1035**

A detailed description of Tetra Tech's TMDL experience is described in **Section 3** of the proposal that accompanies this questionnaire.

C.2 Provide an example TMDL for bacteria.

Three (3) USEPA approved fecal coliform bacteria TMDL projects are provided as examples (on CD-ROM) in **Appendix C** of the proposal that accompanies this questionnaire. The three projects include:

- Total Maximum Daily Loads for Selected Streams in the Upper Ohio South Watershed, West Virginia
- Total Maximum Daily Loads for Selected Streams in the Elk River Watershed, West Virginia
- Total Maximum Daily Loads for Selected Streams in the North Branch Potomac River Watershed, West Virginia

C.3 Provide a detailed description of the methodology to develop a fecal coliform bacteria TMDL as per EOI.

A detailed description of the fecal coliform bacteria TMDL methodology is presented in **Section 1** of the proposal that accompanies this questionnaire.

12. D. Is your firm experienced in biological stressor identification and development of TMDLs for biological impairments?

YES

D.1 Provide names and number of projects.

Tetra Tech began developing TMDLs in WV in 1998 initially supporting USEPA Region 3 and has directly worked with WVDEP since 2002 to develop various technical approaches for biological TMDLs throughout WV. For EPA and WVDEP, Tetra Tech has developed **360** EPA approved biological TMDLs in 21 WV projects. In addition, Tetra Tech has developed several more in other states and EPA Regions. See Table III-1 of the proposal. The table below displays the biological TMDLs approved or under development for WVDEP since 2002.

WV Hydrologic Group	Status	Biological TMDLs
A (Upper Kanawha & Upper Ohio North Watersheds)	USEPA Approved	45
B (Coal River, Lower Kanawha & North Branch Potomac Watersheds)	USEPA Approved	48
C (Gauley River & Potomac Direct Drains Watersheds)	USEPA Approved	35
D (New River & James River Watersheds)	USEPA Approved	25
E (Upper Ohio South, Dunkard Creek , Camp Creek & Youghiogheny Watersheds)	USEPA Approved	51
B2 (Elk River, Lower Kanawha & North Branch Potomac Watersheds)	USEPA Approved	95
C2 (Middle Ohio North & Middle Ohio South Watersheds)	Under Development	77
D2 (Monongahela Watershed	Under Development	52
E2 (West Fork Watershed)	Under Development	138
TOTAL WEST VIRGINIA TMDLS DEVELOPED FOR WVDEP (SINCE 2002)		**566**

A detailed description of Tetra Tech's TMDL experience is described in **Section 3** of the proposal that accompanies this questionnaire.

D.2 Provide an example TMDL for biological impairment.

Three (3) USEPA approved biological TMDLs are provided as examples (on CD-ROM) in **Appendix C** of the proposal that accompanies this questionnaire. The three projects include:

- Total Maximum Daily Loads for Selected Streams in the Upper Ohio South Watershed, West Virginia
- Total Maximum Daily Loads for Selected Streams in the Elk River Watershed, West Virginia
- Total Maximum Daily Loads for Selected Streams in the North Branch Potomac River Watershed, West Virginia

D.3 Provide a detailed description of the methodology to develop a biological impairment TMDL as per EOI.

A detailed description of the biological stressor identification process and biological TMDL methodology is presented in **Section 1** of the proposal that accompanies this questionnaire.

12. E. Describe you firm's management plan that supports personnel and project activities within the organization and coordinates with the WVDEP to achieve timely TMDL development within budgetary constraints as per EOI.

Working directly with WVDEP over the past 10 years, Tetra Tech has demonstrated the ability to manage and coordinate highly technical TMDL development activities within project budgets and timelines. Our exceptional performance includes:

- $6.5M/11 task orders
- Deadlines always met
- No budget overruns/requested change orders
- Constantly developing tools to improve efficiency/reduce costs

A detailed description of Tetra Tech's management capabilities and available resources to support this project is presented in **Section 2** of the proposal that accompanies this questionnaire.

12.F. Describe your firm's experience with the LSPC/MDAS or equivalent modeling system in TMDL development. Provide names and number of projects for which this type of modeling system was employed.

Tetra Tech developed the LSPC/MDAS model specifically for TMDL development in West Virginia. Tetra Tech has modeled over 28 individual USGS 8 Digit Hydrologic Unit Codes in West Virginia using LSPC/MDAS, and over 70 projects using LSPC/MDAS in various states throughout the country. A detailed description of Tetra Tech's familiarity with LSPC/MDAS model can be found in **Section 1** and three examples that demonstrate successful application of LSPC/MDAS are provided in **Appendix C** of the proposal that accompanies this questionnaire.

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS** (Insert additional copies as necessary)

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Shoemaker, Leslie, Ph.D.	21	21	21

Brief Explanation of Responsibilities

Dr. Shoemaker will provide contractual oversight for the WVDEP contract, ensure that adequate staff and resources are dedicated, and provide technical review and direction to maintain quality and consistency of performance. She will work closely with the management team to allocate resources and identify work teams for performance of specific projects.

EDUCATION (Degree, Year, Specialization)
Ph.D., 1990, Agricultural Engineering
M.Eng., 1984, Agricultural Engineering
B.A., 1979, Mathematics

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
American Society of Civil Engineers. Reviewer, Journal of Environmental Engineering. American Society of Agricultural Engineers. American Water Resources Association. Soil and Water Conservation Society.	None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Ludwig, Jon, C.	12	12	12

Brief Explanation of Responsibilities

Mr. Ludwig will support Ms. Ramsey and Dr. Shoemaker in assigning staff, monitoring individual task orders, and representing Tetra Tech in selected technical matters. Mr. Ludwig, working from our Fairfax, VA, office, will coordinate closely with Ms. Ramsey and WVDEP Project Managers to ensure that projects are meeting all technical and schedule objectives.

EDUCATION (Degree, Year, Specialization)
M.S., 1997, Environmental Pollution Control
B.S., 1995, Environmental Science

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
American Water Resource Association. Water Environment Federation.	None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Ramsey, Mindy	3	3	3

Brief Explanation of Responsibilities

Ms. Ramsey is the director of Tetra Tech's Charleston, WV office and will serve as the local day-to-day point of contact to WVDEP and will work closely with the WVDEP Project Manager to maintain clear, focused direction of the project. She will work closely with the Program Manager and Deputy Project Managers to staff projects and maintain communication between all parties.

EDUCATION (Degree, Year, Specialization) M.S., 2002, Biological Sciences
B.S., 1996, Biology

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
None	None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Parker, Andrew	16	16	16

Brief Explanation of Responsibilities

Mr. Parker will support Mr. Ludwig and Dr. Shoemaker in assigning staff, monitoring individual task orders, and representing Tetra Tech in selected technical matters. Mr. Parker, working from our Fairfax, VA, office, will coordinate closely with Mr. Ludwig and WVDEP project managers to ensure that projects are meeting all technical and schedule objectives.

EDUCATION (Degree, Year, Specialization) M.E., 1996, Environmental Engineering
B.S., 1995, Civil Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
American Society of Civil Engineers	Engineer in Training, 1996, Virginia

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Smith, Jonathan, P.E.	7	7	7

Brief Explanation of Responsibilities

Mr. Smith will support Mr. Ludwig and Dr. Shoemaker in assigning staff, monitoring individual task orders, and representing Tetra Tech in selected technical matters. Mr. Smith will coordinate closely with Tetra Tech and WVDEP project managers to ensure that projects are meeting all technical and schedule objectives.

EDUCATION (Degree, Year, Specialization) B.S., 1995, Biological & Agricultural Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
American Public Works Association, NC Chapter. Envirocert International.	Professional Engineer, 2011, West Virginia #19285 Certified Professional in Erosion and Sedimentation Control, 2005, North Carolina #4111 Certified Professional in Storm Water Quality, 2010, North Carolina #0048

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Beckman, John, F.	7	7	7

Brief Explanation of Responsibilities

Mr. Beckman will provide leadership for all tasks associated with bacteria TMDLs under this contract, coordinating technical tasks closely with the Project Manager. Mr. Beckman will work closely with WVDEP TMDL staff to refine technical approaches for WV Fecal Coliform Bacteria TMDLs. He will also lead subwatershed delineation and hydrology calibration tasks.

EDUCATION (Degree, Year, Specialization) M.E.M., 1998, Environmental Management
B.A., 1994, Biology

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
Southern Appalachian Botanical Society.	None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Medine, Allen, Ph.D., P.E.	16	16	16

Brief Explanation of Responsibilities

Dr. Medine will lead all tasks associated with Dissolved Metals/pH TMDLs under this contract and will work closely with the Project Manager to provide technical solutions for dissolved metals/acidity issues that may occur. He will also work closely with Ms. Christina Mellors developing and refining technical approaches with the total metals/sediment TMDLs.

EDUCATION (Degree, Year, Specialization)
Ph.D., 1980, Environmental Engineering
M.S., 1973, Civil Engineering
B.S., 1972, Civil Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
American Society of Civil Engineers Water Environment Federation American Chemical Society	Professional Civil Engineer, 2011, California Professional Engineer, 1994, Colorado Board Certified Environmental Engineer, 1999, Hazardous Waste Certification

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Mellors, Christina, E.	10	10	10

Brief Explanation of Responsibilities

Ms. Mellors will lead all tasks associated with Total Metals/Sediment TMDLs under this contract, coordinating closely with the Project Manager and Dr. Medine and Dr. Zhang to continue to evolve the technical representation of the total metals and sediment in the MDAS model. She will work to develop highly detailed technical approaches to incorporate mining permits and erosion-related sediment sources in the MDAS model.

EDUCATION (Degree, Year, Specialization)
M.S., 1998, Environmental Science
B.S., 1995, Chemical Engineering

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
None	None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Wandling, Julie, A.	3	11	3

Brief Explanation of Responsibilities

Ms. Wandling will lead all data development tasks under this contract and will coordinate and communicate with the Project Manager, the various TMDL leads, and WVDEP staff to develop the most recent and accurate watershed data necessary to construct the TMDL models. She will also participate in subwatershed delineation tasks and in developing the permit summary report.

EDUCATION (Degree, Year, Specialization) B.S., 1998, Biology

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
None	None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Wilkes, Sam, P.	9	9	9

Brief Explanation of Responsibilities

Mr. Wilkes will lead all tasks associated with Biological TMDL development under this contract. He will coordinate and communicate with the Project Manager and WVDEP biologists in all aspects of biological TMDL development, such as stressor identification, threshold value development, statistical model development, QA/QC, data management, biological workshop, training modules, and presentations for WVDEP staff.

EDUCATION (Degree, Year, Specialization) M.S., 2003, Environmental Science & Policy
B.S., 1996, Earth & Environmental Science

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS	REGISTRATION (Type, Year, State)
Society of Wetland Scientists. Trout Unlimited.	Professional Wetland Scientist (#00001395), 2003 (Recertified 2008). Certified Forest Stand Delineator and Conservation Planner, 2003, Maryland.

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENT PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Zhang, Hua, Ph.D.	6	9	11

Brief Explanation of Responsibilities

Dr. Zhang will support Dr. Medine with tasks associated with Dissolved Metals/pH TMDLs under this contract and will work closely with the Project Manager to provide technical solutions for dissolved metals/acidity issues that may occur. He will also_work closely with Ms. Christina Mellors developing and refining technical approaches with the total metals/sediment TMDLs.

EDUCATION (Degree, Year, Specialization) Ph.D., 2006, Soil Science
M.S., 2002, Soil Science
B.S., 1999, Environmental Management

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS Soil Science Society of America. American Geophysics Union

REGISTRATION (Type, Year, State) None

13. PERSONAL HISTORY STATEMENT OF PRINCIPALS AND ASSOCIATES **RESPONSIBLE FOR TMDL DEVELOPMENTS PROJECTS**

NAME & TITLE (Last, First, Middle Int.)	YEARS OF EXPERIENCE		
	In EPA-approved TMDL development	In TMDL-related projects	With modeling system(s), e.g., LSPC, MDAS, etc…
Zheng, Lei, Ph.D.	9	9	14

Brief Explanation of Responsibilities

Dr. Zheng's work will focus on identifying environmental stressors impairing biological condition of macroinvertebrates in West Virgina streams to help the WVDEP develop Total Maximum Daily Loads for biologically impaired streams. Ongoing research topics include weighted averaging for tolerance development and a dirty null reference model with discriminant functional analysis for stressor identification.

EDUCATION (Degree, Year, Specialization) Ph.D., 2003, Ecology, Evolutionary Biology, and Behavior
M.A., 1991, Botany
B.S., 1988, Botany

MEMBERSHIP IN PROFESSIONAL ORGANIZATIONS None

REGISTRATION (Type, Year, State) None

14. PROVIDE A LIST OF SOFTWARE AND EQUIPMENT AVAILABLE IN THE PRIMARY OFFICE WHICH WILL BE USED TO COMPLETE TMDL DEVELOPMENT SERVICES

Desktop Access Data Processing Hardware	Quantity
High Capacity Network Server	27
IBM-Compatible PC	275
Macintosh PC (Power Mac, etc.)	1
Notebook/Laptop IBM-Compatible PC	112
Windows 2003/2008 Internet Server with FTP and Web Site support	12
Linux Internet Server with FTP and Web Site Support support	15
Hewlett-Packard DesignJet 5000 Color Plotter (60" wide)	1
Hewlett-Packard 8000N, 8100N	2
Xerox ColorCube Printers / Copiers	2
Xerox WorkCenter Printer / Copiers	5

Database Software

- Oracle /10i/11g
- MSSQL Server/Enterprise 2005/2008
- Microsoft Office 2003/2007/2010
- Microsoft Project 2003/2007/2010
- Microsoft Visio 2008/2010
- Microsoft Visual Studio 2008/2010
- MS Visual Studio Ultimate 2010
- MS Office One Note 2007
- MS SharePoint

Statistical Software

- Statistica 6.1

Web Development Software

- Dreamweaver MX 2004
- Macromedia Studio MX
- Lotus Domino Lotus Notes
- Microsoft Front Page
- Fireworks
- Flash
- Photoshop
- JDeveloper

Programming Language Compilers

- Compaq Visual Fortran 6.6
- Intel Visual Fortran Compiler
- Sun Java Studio
- Digital Visual FORTRAN
- Visual Basic 5.0
- Pascal 7.0, DOS and Windows
- Visual C++ 5.0, 6.0
- Visual Studio v6.0
- Visual Studio .NET
- Visual Studio .NET 2003/2007
- Visual Source Café
- SPARC Works C++
- Visual KAP Parallel Computing
- Borland JBuilder 2.0, 3.0

14. PROVIDE A LIST OF SOFTWARE AND EQUIPMENT AVAILABLE IN THE PRIMARY OFFICE WHICH WILL BE USED TO COMPLETE TMDL DEVELOPMENT SERVICES (Continued)

GIS Development and Data Processing Hardware and Software	Quantity
IBM-Compatible Workstation/Laptop	285
40TB Mass Storage	2
Overland Tape Drive LTO-4 20TB	1
CD/DVD Writers	285
ESRI ArcGIS Desktop Advanced 10	8
ESRI ArcGIS Desktop Standard 10	6
ESRI ArcGIS Desktop Basic 10	26
ESRI ArcGIS 3D Analyst	1
ESRI 10	1
ESRI Spatial Analyst 10	16
ArcGIS for Server Enterprise 10	2

15. CURRENT PROJECTS/ACTIVITIES IN WHICH YOUR FIRM IS PRESENTLY INVOLVED				
PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	NATURE OF YOUR FIRM'S RESPONSIBILITY	ESTIMATED PROJECT COST	PERCENT COMPLETE
TMDL Development for WV Group E2 Watershed (West Fork River)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	Prime Contractor - TMDL Development Lead	$574,954	30%
TMDL Development for WV Group D2 Watershed (Tributaries of the Monongahela River)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	Prime Contractor - TMDL Development Lead	$536,524	60%
TMDL Development for WV Group C2 Watersheds (Middle Ohio North & South Watersheds)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	Prime Contractor - TMDL Development Lead	$594,995	95%
EPA Region 1 - TMDL development support for Lake Champlain	USEPA Region 1, 5 Post Office Square, Boston, MA 02109-3912	Prime Contractor	$507,544	67%
EPA Region 2 - TMDL development in U.S. Virgin Islands and Puerto Rico	USEPA REGION 2, 290 Broadway, New York, NY 10007-1866	Prime Contractor	$170,726	95%
EPA Region 3 - TMDL development and related support in West Virginia, Pennsylvania, Delaware, Maryland and Virginia; Chesapeake Bay TMDL and WIP development support	USEPA Region 3, 1650 Arch Street, Philadelphia, PA 19103	Prime Contractor	$8,541,368	82%

15. CURRENT PROJECTS/ACTIVITIES IN WHICH YOUR FIRM IS PRESENTLY INVOLVED (Continued)

PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	NATURE OF YOUR FIRM'S RESPONSIBILITY	ESTIMATED PROJECT COST	PERCENT COMPLETE
EPA Region 4 - TMDL development, watershed model development and hydrodynamic model development for waters in Kentucky and Florida; TMDL and model training in North Carolina	USEPA Region 4, 61 Forsyth Street SW, Atlanta, GA 30303	Prime Contractor	$1,453,803	43%
EPA Region 5 - TMDL development and related support in Illinois, Indiana, Michigan, Ohio, Minnesota, and Wisconsin(e.g., TMDL development, Category 4b assessments, nutrient TMDL target development, TMDL modeling training, TMDL development training)	USEPA Region 5, 77 West Jackson Blvd, Chicago, IL 60604	Prime Contractor	$1,501,200	57%
EPA Region 6 - TMDL development for dissolved oxygen (DO), nutrient, and turbidity impairments in the Grand Lake O' the Cherokees Watershed, which includes the Neosho River, the Spring River, and the Elk River in Arkansas, Kansas, Missouri, and Oklahoma	USEPA Region 6, Fountain Place, Suite 1200, 1445 Ross Avenue, Dallas, TX 75202	Prime Contractor	$543,008	35%
EPA Region 8 - TMDL development and related support in Montana (e.g., TMDL development, Category 4b assessments, nutrient TMDL target development)	USEPA Region 8, Montana Office, Federal Building, 10 W. 15th Street, Suite 3200, Helena, MT 59626	Prime Contractor	$2,640,018	62%

15. CURRENT PROJECTS/ACTIVITIES IN WHICH YOUR FIRM IS PRESENTLY INVOLVED (Continued)

PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	NATURE OF YOUR FIRM'S RESPONSIBILITY	ESTIMATED PROJECT COST	PERCENT COMPLETE
EPA Region 10 - TMDL development and related support in Alaska, Washington, Oregon and Idaho (TMDL development, TMDL model peer review, TMDL review/revision)	USEPA Region 10, 1200 6th Ave, Suite 900, Seattle, WA 98101	Prime Contractor	$1,763,630	38%
EPA Region 9 - TMDL development and related support in California, Arizona, and Hawaii (e.g., TMDL development, model development, impaired waters assessment, public meetings, and training); NPDES permit development (individual, general, and stormwater) in California and Arizona; and water quality standards support in California (natural conditions, use attainability, and whole effluent toxicity training)	USEPA Region 9, 75 Hawthorne Street, San Francisco, CA 94105	Prime Contractor	$5,247,165	53%
City of San Diego - TMDL and implementation plan development (TMDL reviews, TMDL development, modeling, and assessment) in numerous inland and coastal waters in San Diego	City of San Diego, Storm Water Department, 9370 Chesapeake Drive, Suite 100, San Diego, CA 92123	Prime Contractor	$719,708	4%

TOTAL NUMBER OF PROJECTS: 13	TOTAL ESTIMATED PROJECT COSTS: $24,794,643

16. CURRENT ACTIVITIES ON WHICH YOUR FIRM IS SERVING AS A SUB-CONSULTANT TO OTHERS

PROJECT NAME, TYPE AND LOCATION	NATURE OF FIRMS RESPONSIBILITY	NAME AND ADDRESS OF OWNER	ESTIMATED COMPLETION DATE	ESTIMATED PROJECT COST $0.00	
				ENTIRE PROJECT	YOUR FIRM'S RESPONSIBILITY
Not Applicable, Tetra Tech not currently serving as sub-consultant					
	Not Applicable				
		Not Applicable			
			Not Applicable		
				Not Applicable	
					Not Applicable

17. COMPLETED WORK WITHIN LAST 5 YEARS IN WHICH YOUR FIRM WAS THE DESIGNATED FIRM OF RECORD				
PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	ESTIMATED PROJECT COST	YEAR	EPA APPROVED?
TMDL Development for WV Group B2 Watershed (North Branch Potomac, Elk, and Lower Kanawha)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2346	$657,990	2011	Yes
TMDL Development for WV Group A2 (Cheat)	USEPA Region 3, 1650 Arch Street, Philadelphia, PA 19103; WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2346	$586,912	2010	Yes
TMDL Development for WV Group E Watersheds (Upper Ohio South, Dunkard Creek, Camp Creek, and Youghiogheny Watersheds)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2345	$643,750	2009	Yes
TMDL Development for WV Group D Watersheds (New River, Greenbrier River, and Little Kanawha Watersheds)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2346	$750,460	2008	Yes
TMDL Development for WV Group C Watersheds (Gauley River and Potomac Direct Drains)	WVDEP DWWM, 601-57th Street, Charleston, WV 25304-2346	$836,150	2008	Yes
EPA Region 2 - TMDL development in New Jersey, Puerto Rico and U.S. Virgin Islands; monitoring to support TMDL development in U.S. Virginia Islands	USEPA REGION 2, 290 Broadway, New York, NY 10007-1866	$212,444	2008-2012	Yes
EPA Region 3 - TMDL development and related support in West Virginia, Pennsylvania, Delaware, Maryland and Virginia (e.g., TMDL development, nutrient TMDL target development, TMDL reviews, TMDL modeling training, TMDL development training)	USEPA Region 3, 1650 Arch Street, Philadelphia, PA 19103	$1,262,515	2008-2012	Yes
EPA Region 4 - TMDL development in South Carolina, Florida and Alabama; TMDL model training; hydrodynamic and water quality modeling for TMDL development	USEPA Region 4, 61 Forsyth Street SW, Atlanta, GA 30303	$493,990	2008-2012	Yes

17. COMPLETED WORK WITHIN LAST 5 YEARS IN WHICH YOUR FIRM WAS THE DESIGNATED FIRM OF RECORD (Continued)				
PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	ESTIMATED PROJECT COST	YEAR	EPA APPROVED?
EPA Region 5 - TMDL development and related support in Illinois, Indiana, Michigan, Ohio, Minnesota, and Wisconsin(e.g., TMDL development, Category 4b assessments, nutrient TMDL target development, TMDL modeling training, TMDL development training)	USEPA Region 5, 77 West Jackson Blvd, Chicago, IL 60604	$4,195,223	2007-2012	Yes
EPA Region 6 - TMDL development in Louisiana and Arkansas	USEPA Region 6, Fountain Place, Suite 1200, 1445 Ross Avenue, Dallas, TX 75202	$851,486	2008-2012	Yes
EPA Region 8 - TMDL development and related support in Montana (e.g., TMDL development, modeling, 303d asssessments, monitoring, Category 4b assessments)	USEPA Region 8, Montana Office, Federal Building, 10 W. 15th Street, Suite 3200, Helena, MT 59626	$1,255,589	2007-2012	Yes
EPA Region 9 - TMDL development and related support in California, Arizona, and Hawaii (e.g., TMDL development, model development, impaired waters assessment, public meetings, and training); NPDES permit development (individual, general, and stormwater) in California and Arizona; and water quality standards support in California (natural conditions, use attainability, and whole effluent toxicity training)	USEPA Region 9, 75 Hawthorne Street, San Francisco, CA 94105	$9,910,609	2007-2012	Yes
EPA Region 10 - TMDL development and related support in Alaska, Washington, Oregon and Idaho (TMDL development, listing methodology review/development, TMDL model peer review, TMDL review/revision, TMDL monitoring design/implementation, delisting rationale development)	USEPA Region 10, 1200 6th Ave, Suite 900, Seattle, WA 98101	$1,541,716	2008-2012	Yes

17. COMPLETED WORK WITHIN LAST 5 YEARS IN WHICH YOUR FIRM WAS THE DESIGNATED FIRM OF RECORD (Continued)				
PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF OWNER	ESTIMATED PROJECT COST	YEAR	EPA APPROVED?
Minnesota PCA - TMDL development and related support in Minnesota (e.g., TMDL development, modeling, implementation planning)	Minnesota Pollution Control Agency, 520 Lafayette Road North, St. Paul, MN 55155	$105,092	2008-2010	Yes
Montana DEQ - TMDL and model development	Montana Department of Environmental Quality, 1520 E. Sixth Avenue, P.O. Box 200901, Helena, MT 59620	$110,010	2007-2012	Yes
City of San Diego – TMDL development (TMDL reviews, TMDL development, modeling, and assessment) in numerous inland and coastal waters in San Diego; monitoring to support TMDL development for coastal streams; development of TMDL implementation plans	City of San Diego, Storm Water Department, 9370 Chesapeake Drive, Suite 100, San Diego, CA 92123	$2,126,880	2009-2012	Yes

18. COMPLETED WORK WITHIN LAST 5 YEARS ON WHICH YOUR FIRM HAS BEEN A SUB-CONSULTANT TO OTHER FIRMS (INDICATE PHASE OF WORK FOR WHICH YOUR FIRM WAS RESPONSIBLE)

PROJECT NAME, TYPE AND LOCATION	NAME AND ADDRESS OF PRIMARY FIRM	ESTIMATED PROJECT COST OF YOUR FIRM'S PORTION	YEAR	EPA APPROVED?	CLIENT NAME AND ADDRESS
Not Applicable, Tetra Tech has not been sub-consultant to other firms					
	Not Applicable				
		Not Applicable			
				Not Applicable	
					Not Applicable

19. Use this space to provide any additional information or description of resources supporting your firm's qualifications to perform work for the WVDEP's TMDL Program.

Over the past 13 years, Tetra Tech has developed more than 3,600 approved TMDLs throughout West Virginia, initially supporting USEPA to meet strict consent decree deadlines, and subsequently assisting WVDEP with its own program. Over 2,150 of these TMDLs have been developed directly supporting WVDEP (including 195 TMDLs in the Upper Kanawha and 46 TMDLs in the Upper Ohio River North watersheds) with over 1,200 more TMDLs currently under development. Since 2002, Tetra Tech has worked closely with WVDEP's TMDL Program to provide highly technical and innovative solutions, including the Mining Data Analysis System (MDAS), which have helped WVDEP's TMDL Program become a national leader in TMDL development.

20. The foregoing is a statement of facts.

Signature: _____ Title: DIRECTOR Date: 10/2/2012

Printed Name: JON C. LUDWIG

RFQ No. DEP15990

STATE OF WEST VIRGINIA
Purchasing Division

PURCHASING AFFIDAVIT

MANDATE: Under W. Va. Code §5A-3-10a, no contract or renewal of any contract may be awarded by the state or any of its political subdivisions to any vendor or prospective vendor when the vendor or prospective vendor or a related party to the vendor or prospective vendor is a debtor and: (1) the debt owed is an amount greater than one thousand dollars in the aggregate; or (2) the debtor is in employer default.

EXCEPTION: The prohibition listed above does not apply where a vendor has contested any tax administered pursuant to chapter eleven of the W. Va. Code, workers' compensation premium, permit fee or environmental fee or assessment and the matter has not become final or where the vendor has entered into a payment plan or agreement and the vendor is not in default of any of the provisions of such plan or agreement.

DEFINITIONS:

"Debt" means any assessment, premium, penalty, fine, tax or other amount of money owed to the state or any of its political subdivisions because of a judgment, fine, permit violation, license assessment, defaulted workers' compensation premium, penalty or other assessment presently delinquent or due and required to be paid to the state or any of its political subdivisions, including any interest or additional penalties accrued thereon.

"Employer default" means having an outstanding balance or liability to the old fund or to the uninsured employers' fund or being in policy default, as defined in W. Va. Code § 23-2c-2, failure to maintain mandatory workers' compensation coverage, or failure to fully meet its obligations as a workers' compensation self-insured employer. An employer is not in employer default if it has entered into a repayment agreement with the Insurance Commissioner and remains in compliance with the obligations under the repayment agreement.

"Related party" means a party, whether an individual, corporation, partnership, association, limited liability company or any other form or business association or other entity whatsoever, related to any vendor by blood, marriage, ownership or contract through which the party has a relationship of ownership or other interest with the vendor so that the party will actually or by effect receive or control a portion of the benefit, profit or other consideration from performance of a vendor contract with the party receiving an amount that meets or exceed five percent of the total contract amount.

AFFIRMATION: By signing this form, the vendor's authorized signer affirms and acknowledges under penalty of law for false swearing (*W. Va. Code* §61-5-3) that neither vendor nor any related party owe a debt as defined above and that neither vendor nor any related party are in employer default as defined above, unless the debt or employer default is permitted under the exception above.

WITNESS THE FOLLOWING SIGNATURE:

Vendor's Name: Tetra Tech, Inc.

Authorized Signature: _____ Date: September 28, 2012

State of Virginia

County of Fairfax, to-wit:

Taken, subscribed, and sworn to before me this 28 day of September, 2012

My Commission expires September 30, 2013.

AFFIX SEAL HERE

NOTARY PUBLIC _____

ANGELA KAY MARCIANO
NOTARY PUBLIC
Commonwealth of Virginia
Reg. #7233114
My Commission Expires Sept. 30, 2013

CERTIFICATE OF LIABILITY INSURANCE

DATE(MM/DD/YYYY) 09/30/2012

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

Holder Identifier :

PRODUCER	CONTACT NAME:	
Aon Risk Insurance Services West, Inc. Los Angeles CA Office 707 Wilshire Boulevard Suite 2600 Los Angeles CA 90017-0460 USA	PHONE (A/C. No. Ext): (866) 283-7122	FAX (A/C. No.): (847) 953-5390
	E-MAIL ADDRESS:	

INSURED	INSURER(S) AFFORDING COVERAGE		NAIC #
Tetra Tech, Inc. 10306 Eaton Place, Suite 340 Fairfax VA 22030 USA	INSURER A:	National Union Fire Ins Co of Pittsburgh	19445
	INSURER B:	Insurance Company of the State of PA	19429
	INSURER C:	Lexington Insurance Company	19437
	INSURER D:	Chartis Specialty Insurance Company	26883
	INSURER E:		
	INSURER F:		

COVERAGES **CERTIFICATE NUMBER:** 570047731225 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS. **Limits shown are as requested**

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	**GENERAL LIABILITY** X COMMERCIAL GENERAL LIABILITY CLAIMS-MADE X OCCUR X X,C,U Coverage GEN'L AGGREGATE LIMIT APPLIES PER: POLICY X PRO-JECT X LOC			GL2491933	10/01/2012	10/01/2013	EACH OCCURRENCE DAMAGE TO RENTED PREMISES (Ea occurrence) MED EXP (Any one person) PERSONAL & ADV INJURY GENERAL AGGREGATE PRODUCTS - COMP/OP AGG	$2,000,000 $1,000,000 $10,000 $2,000,000 $4,000,000 $4,000,000
A	**AUTOMOBILE LIABILITY** X ANY AUTO ALL OWNED AUTOS SCHEDULED AUTOS X HIRED AUTOS X NON-OWNED AUTOS			CA 510 15 54	10/01/2012	10/01/2013	COMBINED SINGLE LIMIT (Ea accident) BODILY INJURY (Per person) BODILY INJURY (Per accident) PROPERTY DAMAGE (Per accident)	$2,000,000
C	X **UMBRELLA LIAB** X OCCUR **EXCESS LIAB** CLAIMS-MADE DED RETENTION			TH1200022	10/01/2012	10/01/2013	EACH OCCURRENCE AGGREGATE	$10,000,000 $10,000,000
A B B	**WORKERS COMPENSATION AND EMPLOYERS' LIABILITY** Y/N ANY PROPRIETOR / PARTNER / EXECUTIVE OFFICER/MEMBER EXCLUDED? N **(Mandatory in NH)** If yes, describe under DESCRIPTION OF OPERATIONS below	N/A		WC35896545 WC35896542 WC35896543	10/01/2012 10/01/2012 10/01/2012	10/01/2013 10/01/2013 10/01/2013	X WC STATU-TORY LIMITS OTH-ER E.L. EACH ACCIDENT E.L. DISEASE-EA EMPLOYEE E.L. DISEASE-POLICY LIMIT	 $1,000,000 $1,000,000 $1,000,000
D	Contractor Prof			COPS1952583 Prof/Poll Liab	10/01/2012	10/01/2013	Each Clain Agggregate	$5,000,000 $5,000,000

Certificate No : 570047731225

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

RE: DEP 15990. West Virginia Department of Environmental Protection is included as Additional Insured as required by written contract, but limited to the operations of the Insured under said contract, with respect to the General Liability and Automobile Liability policies. A Waiver of Subrogation is granted in favor of West Virginia Department of Environmental Protection as required by written contract but limited to the operations of the Insured under said contract, with respect to the General Liability, Automobile Liability and Worker's Compensation policy.

CERTIFICATE HOLDER

West Virginia Department of
Environmental Protection
Attn: David Montali
601 57th Street
Charleston WV 25304 USA

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Aon Risk Insurance Services West, Inc.

CERTIFICATION AND SIGNATURE PAGE

By signing below, I certify that I have reviewed this Solicitation in its entirety; understand the requirements, terms and conditions, and other information contained herein; that I am submitting this bid or proposal for review and consideration; that I am authorized by the bidder to execute this bid or any documents related thereto on bidder's behalf; that I am authorized to bind the bidder in a contractual relationship; and that to the best of my knowledge, the bidder has properly registered with any State agency that may require registration.

TETRA TECH, INC.
(Company)

(Authorized Signature)

JON C. LUDWIG, DIRECTOR
(Representative Name, Title)

304-41A-0054 304-720-2334
(Phone Number) EXT 101 (Fax Number)

10/2/2012
(Date)

ADDENDUM ACKNOWLEDGEMENT FORM
SOLICITATION NO.: DEP15990

Instructions: Please acknowledge receipt of all addenda issued with this solicitation by completing this addendum acknowledgment form. Check the box next to each addendum received and sign below. Failure to acknowledge addenda may result in bid disqualification.

Acknowledgment: I hereby acknowledge receipt of the following addenda and have made the necessary revisions to my proposal, plans and/or specification, etc.

Addendum Numbers Received:
(Check the box next to each addendum received)

[ ] Addendum No. 1	[ ] Addendum No. 6
[ ] Addendum No. 2	[ ] Addendum No. 7
[ ] Addendum No. 3	[ ] Addendum No. 8
[ ] Addendum No. 4	[ ] Addendum No. 9
[ ] Addendum No. 5	[ ] Addendum No. 10

I understand that failure to confirm the receipt of addenda may be cause for rejection of this bid. I further understand that any verbal representation made or assumed to be made during any oral discussion held between Vendor's representatives and any state personnel is not binding. Only the information issued in writing and added to the specifications by an official addendum is binding.

TETRA TECH, INC
Company

Authorized Signature

10/2/2012
Date

NOTE: This addendum acknowledgement should be submitted with the bid to expedite document processing.

Expression of Interest to Provide Professional Engineering Services for Total Maximum Daily Loads in the West Fork River Watershed

EOI Number DEP15990

Submitted by:

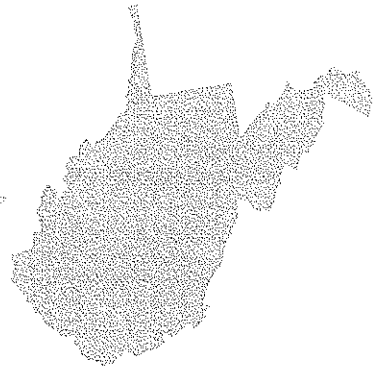
Tetra Tech, Inc.
803 Quarrier Street
Suite 400
Charleston, West Virginia 25301

Submitted to:

West Virginia Department of Environmental Protection
Office of Water Resources
601 57th Street SE
Charleston, West Virginia 25304

Contents

I. Methodology



Tetra Tech has played a substantial role in Total Maximum Daily Load (TMDL) development in West Virginia, initially supporting U.S. Environmental Protection Agency (USEPA) to meet strict consent decree deadlines for more than 400 waters impaired by acid mine drainage (AMD) throughout the state. Since 2002, Tetra Tech has worked closely with West Virginia Department of Environmental Protection (WVDEP) through Purchase Order Nos. DEP12147, DEP13860, DEP15231 and DEP15530 to undergo a successful transition from a supporting role in the USEPA TMDL development efforts into full programmatic responsibility. During this time, WVDEP and Tetra Tech have found a unique way to integrate large-scale, watershed based TMDLs with fine-scale, highly technical methodologies that produce "implementable" TMDLs in a cost-effective manner. By coupling these TMDL development efforts with a fully-integrated watershed management program, West Virginia's has grown into one of the nation's premier TMDL programs. The scope and magnitude of these TMDLs has required WVDEP to set very aggressive schedules for the projects to be developed simultaneously. It is critical that these schedules are maintained as new TMDL projects begin each year increasing the workload as the program cycles through the five hydrologic groups.

Supporting WVDEP's TMDL development efforts over the past 10 years, Tetra Tech has successfully met aggressive project schedules while maintaining project budgets. Tetra Tech has completed over 2,150 USEPA approved TMDLs in West Virginia, in addition to over 1,200 TMDLs currently under development, while working directly for WVDEP. The success in meeting aggressive schedules and workloads is due to the exemplary efforts of Tetra Tech staff (shown in Section II.C) and our proven approach for effective project management (described in Section II.D).

Successfully completing the work directive within project timelines and budgets will require that several pollutant specific TMDL methodologies be developed simultaneously. Careful organization of the many detailed analyses associated with the methodologies is critical to meet project timelines and budgets. In the following sections, we have included TMDL methodology descriptions for total recoverable metals, dissolved metals/acidity, bacteria, and biological impairments that contain each of the technical components listed in this solicitation. An organization flowchart for the entire TMDL development process is included at the end of this section.

I.A. Data Development

Tetra Tech has been working with WVDEP over the past 10 years to build efficiencies in the transfer and use of watershed data. A tremendous amount of data is required to build fine-scale watershed models that take into account all potential point and nonpoint pollutant sources. Tetra Tech modelers have developed database and spreadsheet tools to speed the transfer of data concerning mining and non-mining permits that are incorporated as point sources in the TMDL model. Likewise, GIS tools and protocols have been cooperatively developed to efficiently apply nonpoint source information such as streambank erosion and agricultural source tracking to modeled subwatersheds. Pre-TMDL water quality monitoring data must be systematically applied to calibrate models accurately. Tetra Tech modelers are also adept at using publicly available physiographic datasets like USGS topographic maps, stream gage data, and landuse coverages to build the most hydrologically representative watershed models possible.

Tetra Tech uses data from all available sources to develop TMDLs. Relevant data encompass physical, chemical, biological, and demographic characteristics of TMDL watersheds. Information concerning both disturbed and undisturbed streams in TMDL watersheds is significant. At the very beginning of the TMDL development process, an exhaustive search will be made to solicit all available data from all watershed stakeholders. Table I.A-1 lists various TMDL stakeholders matched with a summarized overview of the type of data they contribute. Stakeholders who contribute their data become cognizant of the TMDL process, which can lead to increased understanding of the long-term goals and regulatory implications of TMDL implementation.

Table I.A-1. TMDL Stakeholder Data Contributions

Stakeholder	Data Type
Cities and Counties	▪ 911 addressable structures and roads ▪ POTW effluent data ▪ MS4 ▪ CSO
Mining industry	▪ 308 water quality monitoring data
Multi-Resolution Land Characteristics Consortium National Land Cover Database (NLCD 2006)	▪ Landuse and land cover
National Oceanic and Atmospheric Administration, National Climatic Data Center (NOAA-NCDC)	▪ Meteorological station locations ▪ Rainfall ▪ Temperature ▪ Wind speed ▪ Dew point ▪ Humidity ▪ Cloud cover
U.S. Army Corps of Engineers	▪ Lakes and Dams ▪ Dam discharge data
U.S. Department of Agriculture (USDA), Natural Resources Conservation Service	▪ Soils surveys ▪ State Soil Geographic Database (STATSGO) ▪ Soil Survey Geographic Database (SSURGO)
U.S. Census Bureau	▪ Political Boundaries ▪ Cities/populated places ▪ TIGER Roads ▪ Population change ▪ Demographics and Economic Activity
USDA Forest Service	▪ Timber harvest data
U.S. Environmental Protection Agency	▪ STORET water quality database ▪ Water quality monitoring station locations ▪ Federal standards and regulations ▪ Clean Air Interstate Rule (atmospheric deposition)

Stakeholder	Data Type
U.S. Geological Survey (USGS)	▪ Cataloging Unit boundaries (HUC) ▪ Historical Stream Flow Record (daily averages) ▪ Topographic maps (topo quads) ▪ Digital Orthophoto Quarter Quadrangle (DOQQ) ▪ Digital elevation maps (DEM) ▪ National Elevation Dataset (NED) ▪ National Hydrologic Dataset Stream Reach (NHD)
WVDEP	▪ Applicable water quality standards ▪ Nonpoint Source Management Plans ▪ NPDES permitted facility data ▪ Abandoned mining coverage and data ▪ Discharge Monitoring Report data ▪ OWRNPDES data (non-mining) ▪ HPU data (mining NPDES) ▪ Oil and gas operations coverage ▪ Marcellus Shale operations coverage ▪ Section 303(d) list of impaired water bodies ▪ Water quality monitoring station locations ▪ TMDL source tracking data ▪ Sewered area and septic zones ▪ Best management practices ▪ Pre-TMDL monitoring data ▪ Streambank erosion study data ▪ Impaired Streams
West Virginia Division of Forestry	▪ Timber harvest data ▪ Burned areas ▪ Skid roads and landings
West Virginia Division of Natural Resources (DNR)	▪ Wildlife information
West Virginia University	▪ Roads

Data retrieval from stakeholders is only the beginning of the data development process. Tetra Tech will review all raw data for accuracy. Suspect data will be identified through an exhaustive QA/QC process that includes the identification of spatial, temporal, and statistical outliers as they pertain to impaired streams and TMDL watersheds. Tetra Tech will use Microsoft® Access databases to manage the large volume of data to be received from existing WVDEP databases as well as other sources of information. Over the past 10 years, Tetra Tech has worked extensively with WVDEP databases including the Watershed Assessment Branch database (WABbase), and has the demonstrated skill to transfer and manipulate data in a Microsoft® Access database environment.

The following sections describe in detail all of the data used to develop TMDLs.

I.A.1. Subwatershed Delineation

Subwatershed delineation refers to the subdivision of the watershed into smaller, discrete subwatersheds for modeling and analysis. The subdivision of the subject watersheds will be scaled to the extent and size of the impaired stream segments such that only one impaired stream segment is contained in an individual subwatershed unit. An example subwatershed delineation is provided in Appendix A.

Before delineation is begun, the location, stream name, stream code and impairment status of all streams will be verified. Any stream whose impairment status is questionable will be considered to be impaired for the purpose of the delineation so that the delineation is as inclusive as possible. The location of pre-TMDL monitoring stations and other water quality monitoring stations will also be verified prior to delineation to maximize spatial symmetry between monitoring stations and modeled stream reaches.

The subdivision of watersheds will begin with the 12 digit hydrological unit (HUC) watersheds. In order to represent watershed loadings and the resulting concentrations of pollutants of concern, each watershed will be divided into hydrologically connected subwatersheds. Model subwatershed boundaries are derived from topographic hydrologic boundaries. The delineation will incorporate detail from 1:24,000 scale USGS topographic maps, stream connectivity (from USGS's National Hydrography Dataset [NHD] stream coverage), the impairment status of modeled streams, and monitoring station locations. The subwatershed delineation is not only a key step in the creation of the model, but also establishes a geographic framework useful for assigning load reductions and developing future TMDL implementation efforts.

Upon completion of the subwatershed delineation, the subwatershed units will then be labeled with project name, final stream name, stream code, TMDL watershed name, major stream grouping (HUC 8, HUC 10, HUC 12), GNIS ID, GNIS name, and will be assigned a subwatershed identification number. Subwatersheds will be numbered sequentially from the most downstream subwatershed unit to the headwaters. The subwatershed network connectivity is also generated at this time and included in the attributes of the subwatershed delineation shapefile. The connectivity identifies the immediate downstream subwatershed for each subwatershed unit and is the basis by which the stream network is represented in the model for the routing of pollutants, therefore it is crucial that the connectivity be free from error in order for the model to run properly. Next, the areas for each subwatershed unit will be calculated in square meters and acres. A modeled reach consisting of one representative stream segment for each subwatershed unit will also be generated at this time. The modeled reach is used to calculate stream channel properties for configuration of the Mining Data Analysis System (MDAS) model. The process of labeling the subwatersheds and generating the modeled reach also serves as a review to ensure that the impaired streams are labeled correctly, that the structure of the stream network is preserved in the delineation, and that each impaired segment has been isolated.

The subwatershed delineation deliverable will be submitted in a CD directory with shapefiles compatible with the latest version of ArcGIS, representing the subwatershed delineation, TMDL watersheds, impaired streams, modeled reach, and NHD streams reach coverage. If necessary, a revised WAB monitoring station location shapefile will be included if discrepancies in monitoring station location data are discovered during the subwatershed delineation process. A separate document detailing any questionable or conflicting information encountered during the review of the stream reach and monitoring station shapefiles and impairment listings will be submitted along with the subwatershed delineation. Table I.A-2 lists the shapefiles that may be included in the subwatershed delineation deliverable.

Table I.A-2. Subwatershed Delineation Spatial Data

Shapefile	Description
Subwatershed Delineation	Spatial representation of the subwatershed delineation. The attributes table will include the project name, TMDL watershed name, subwatershed ID number, downstream sub ID number, area in square meters, area in acres, GNIS ID, GNIS name, final stream name, WV stream code, and WV NHD stream code.
Streams	Spatial representation of all digitized streams in the watershed. Coverage originates from WVDEP's most up to date version of NHD Stream Reach. The attributes table will include stream name, WV stream code, and NHD stream code.
Impaired Streams	WVDEP's latest NHD stream reach file modified to highlight impaired streams. The attribute table will contain fields that indicate all pollutants for which each stream is impaired as determined by the TMDL work directive list. The attribute table will also include the impaired stream name, NHD stream code, WV stream code, and trout designation.

Shapefile	Description
Modeled Reach	Spatial representation of the modeled reach. The attributes tables will include the subwatershed ID number, downstream sub ID number, WV NHD stream code, final stream name, WV Code, hydrologic unit code categories (HUC 8, HUC 10, and HUC 12), watershed name, and length of reach segment in meters.
TMDL Watershed Boundary	Spatial representation of the TMDL watershed boundaries. The attribute table will contain the TMDL watershed name.

I.A.2. NPDES Permit Summary Report

It is crucial that permitted point sources be represented correctly in the model in order to develop a defensible TMDL. To that end, a Permit Summary Report will be submitted to WVDEP that identifies and characterizes the NDPES data associated with permitted point sources in each watershed. Tetra Tech works collaboratively with WVDEP to spatially review the latest OWRNPDES GIS coverages (outlets and permits shapefiles) against the subwatershed delineation, streams layer, and the aerial images. The OWRNPDES GIS coverages are then joined to the subwatershed delineation to tag each outlet with the appropriate modeled subwatershed number to facilitate processing using the Permit Summary Report Database developed by Tetra Tech. This database generates the permit sub type tables that will be used to enter permit details for the outlets. Once all data gaps are resolved, Tetra Tech will coordinate a meeting with WVDEP representatives to thoroughly review the data and determine the modeling methodology for each outlet. The meeting will result in the approval of the Permit Summary Report Database which then will be used to create the final Permit Summary Report Excel Spreadsheets, which will consist of a mining-related permit summary spreadsheet, and a non-mining related permit summary spreadsheet. These summaries will be submitted on a CD in a Microsoft® Excel filterable spreadsheet format. An example Permit Summary Report is provided in Appendix A.

WVDEP Division of Mining and Reclamations' hpu.shp GIS coverage will be used to determine the location of the mining-related NPDES permitted outlets. The effluent type, permit limits and discharge data for these outlets can be acquired from West Virginia's ERIS database system. However, additional information is needed to characterize the mining activities for representation in the model. Tetra Tech has created a customized interactive spreadsheet tool to aid WVDEP Division of Water and Waste Management (DWWM) personnel in the collection of mining-related permit data. This enables SMCRA Article 3 mining permit details to be related back to NPDES permits at the outlet level for representation in the model. This tool is used to generate a comprehensive list of the mining-related NPDES permitted outlets in the watershed, including permit number, permit type, outlet ID, outlet location (latitude and longitude), effluent type code, effluent limits, total and disturbed drainage area (for precipitation induced discharges), and continuous flow data (for pumped or constant discharges). This information provides the basis for representing mining related discharge flows as either pumped or precipitation driven in the model.

WVDEP's OWRNPDES GIS coverages (outlets and permits shapefiles) will be used to determine the locations of the non-mining permitted sources; and detailed permit information such as discharge characteristics, permit limits and discharge data will be obtained from WVDEP's ERIS database. Tetra Tech has created a customized database tool to aid WVDEP DWWM personnel in querying the OWRNPDES GIS coverage to break out the permit types into tables as follows: HAU, IND POTW, IND Other, IND POTW Collection, Sewage General, Car Wash, Groundwater Remediation, Water Treatment Plants, IND Industrial, Solid Waste Landfill Applications, Stormwater Industrial GP, Construction Stormwater GP (this information comes from the OWRNPDES Permits shapefile coverage), Mining

Bathhouse Outlets, and WVDOH+MUN. These two datasets will be combined to generate the non-mining related permit summary list, which will provide the permit number; facility name; responsible party; permit type; outlet ID; outlet location (latitude and longitude); the watershed in which the outlet is located; outlet status (open/closed); the start and end dates for the outlet; and the parameters of interest for which limits are found, including flow, chemical concentrations and pH.

The Permit Summary Report will not only provide a comprehensive list of the permitted point sources in a subwatershed but also will identify any data gaps in the detailed permit information necessary to accurately represent the outlets in the model. Tetra Tech will work with WVDEP to obtain any missing information. Tetra Tech has a great deal of experience querying WVDEP's ERIS database, which it has access to through a virtual private network connection from its Charleston, WV office. This enables Tetra Tech to verify any questionable permit information in real time. For example, Tetra Tech reviews each major facilities permit in ERIS to better understand the outlet details, wastewater characteristics, and to identify questions to discuss with the WVDEP NPDES permit writers.

Significant details are frequently absent from the permit's outlet information in ERIS. For example, a stormwater outlet may actually be internal in nature, contributing its stormwater to another outlet of its permit, or even a completely different permit. Tetra Tech's knowledge of the NPDES permitting process and the WVDEP's ERIS database aid in identifying these data gaps to properly model each outlet. Discharge limits are helpful for identifying the parameters of concern, the average concentrations discharged, and the flow of each outlet (design or measured). In many cases, outfalls with stormwater contributions will discharge to a sedimentation pond. These outlets are often comingled with process water, non- contact cooling water, and sometimes even sanitary wastewater. The flow of the outlet is not monitored at its point of discharge to the pond, but at the outlet of the pond to the receiving stream. Discharge monitoring reports may be used to determine how often the ponds themselves have been reported to discharge, making it possible to derive the average monthly flow discharged to the stream. In some cases, sedimentation ponds may not discharge unless there is a large rain event, which means the outlet is characterized as stormwater and should be considered precipitation-driven. Likewise, an outlet may have monthly flows reported with limitations (non-benchmark values). In this situation, wastewater flows may not be best represented as stormwater. In this case, it would be best to employ a continuous flow, which can be derived by using an average of the reported average monthly flow data, or from the flow capacity of the treatment structure as identified in the permittee's application.

I.A.3. Pollutant Source Report

Working closely with WVDEP and interested stakeholders, Tetra Tech will develop an accurate and detailed assessment of all possible pollutant sources in these watersheds. The results of this assessment will be presented in a Pollutant Source Report. The Pollutant Source Report is the starting point for MDAS model configuration. All of the datasets required for model setup are represented in the Pollutant Source Report: from the subwatershed delineation to the pollutant sources to the meteorological data that drives the model. Preparing the Pollutant Source Report not only provides a spatial representation of the source information available pertaining to the subject watershed but also provides an opportunity to systematically format all of the data required for model configuration and to identify any data gaps that need to be filled. An example Pollutant Source Report is provided in Appendix A.

Tetra Tech has extensive knowledge of the datasets available pertaining to potential pollutant sources throughout West Virginia and neighboring states. Tetra Tech staff have spent years cultivating relationships with the staff of WVDEP and other organizations who can provide further details regarding sources. Most notably are the WVDEP personnel responsible for watershed source tracking and those with knowledge of permit details and the ERIS database system. Tetra Tech has worked closely with WVDEP source tracking personnel in order to streamline the data collection process so that the

appropriate type and amount of source data is collected. Over the years, Tetra Tech has developed relationships with WVDEP personnel in various departments related to the permitting of mining and non-mining related sources. Not only does Tetra Tech know whom to contact in order to obtain the necessary information, but also WVDEP personnel are familiar with Tetra Tech's specific data needs. This provides for greater efficiency in gathering source data within the time constraints of WVDEP's TMDL development schedule.

After the Permit Summary Report Excel Spreadsheets have been approved, Tetra Tech will begin to prepare the Pollutant Source Report. Once complete, Tetra Tech will coordinate a meeting with WVDEP representatives to thoroughly review the data and approve the information as the final deliverable. The Pollutant Source Report will be submitted in a CD directory containing an ArcGIS project that spatially represents the potential sources of stream impairments in the watershed. A separate project will be created for each watershed and each project will contain a separate view for each impairment type (metals, bacteria, biological, or other impairment). Within each view, shapefiles will be presented that represent potential point and nonpoint pollutant sources, watershed physiographic data, and monitoring data required for modeling. The shapefiles are primarily statewide coverages that Tetra Tech processes using GIS, clipping by watershed and then labeling features with the identifying information for the individual subwatershed unit in which they are located. These shapefiles will be represented with appropriate symbols in the view legend and physical and observed details will be presented in the attributes table associated with each shapefile. A descriptive document (or legend) will also be submitted with the Pollutant Source Report that explains in detail the contents of each project, view, and shapefile.

I.A.4. Watershed Physiographic Data

Tetra Tech builds MDAS models using GIS shapefiles that represent watershed physiographic features such as topographic elevation and stream networks. These features provide a geographic framework within which the pollutant sources can be viewed and assessed. Shapefiles will include the subwatershed delineation, reach network, and impaired reaches. The inclusion of features such as towns and road networks will help to orient reviewers and TMDL implementers. Soil type classification will be included to identify areas within the watershed that may have different soil properties and thus, different hydrologic properties. The landuse grid, which serves to provide the user with an overview of the land cover and to what degree the land is disturbed in the watershed, is the basis for creating the modeled landuse categories and calculating associated areas for model input. NLCD 2006 is the most up to date landuse grid coverage available for the state of West Virginia. Table I.A-3 lists the shapefiles describing watershed physical features that may be included in the Pollutant Source Report.

Table I.A-3. Pollutant Source Report Spatial Data

Shapefile	Description
Subwatershed Delineation	Created by the subwatershed delineation process described in Section I.A.1. The attribute table will include the project name, TMDL watershed name, subwatershed ID number, downstream sub ID number, area in square meters, area in acres, GNIS ID, GNIS name, final stream name, WV stream code, and WV NHD stream code.
Stream Reach	Spatial representation of all digitized streams in the watershed. The coverage will originate from most up to date version of NHD Stream Reach and DNR Reach shapefiles. The attribute table will includes stream name, WV stream code, and NHD stream code.
Impaired Streams	WVDEP's latest NHD Stream Reach file modified by Tetra Tech to highlight all of the impaired water bodies in the watershed. The attribute table will contain fields that indicate all pollutants for which each stream is impaired as determined by the TMDL work directive list. The attribute table will also include project name, TMDL watershed name, impaired stream name, NHD stream code, WV stream code, and trout designation.
Roads	Based on previous experience, the wv_roads.shp coverage from WCMS is incomplete. This coverage will be supplemented with the TIGER/line files from the U.S. Census Bureau (2009) and unmapped jeep trails found on the topographical maps and aerial photos.
Towns	Includes locations and names of town and municipalities in the watershed. Coverage originates from wvppl.shp in WCMS.
Soils	Soil classification by type (MUID), represented as polygons. Coverage originates from USGS STATSGO database.
Landuse – NLCD 2006	This is a grid coverage of the National Land-Cover Database. The coverage is comprised of 30x30 meter grid cells each identified by landuse category.
911 Coverages (if available)	Coverages are based on information collected through the 911 emergency response mapping initiatives. The point coverages include all buildings and structures on a countywide basis. Tetra Tech may use this coverage update the modeled landuse to reflect population growth.

I.A.5. Monitoring Data

To develop a valid model, a variety of monitoring data is required. Meteorological data such as precipitation, wind speed, potential evapotranspiration, cloud cover, temperature, and dewpoint drive model hydrology. Each subwatershed unit is assigned a weather station based on proximity, which requires that weather stations outside of the subject watershed be identified. USGS flow gages provide stream flow measurements that are used as a target in model hydrology calibration. If an appropriate USGS flow gage does not exist in the watershed, a reference watershed approach will be used for hydrology calibration. This requires identifying and analyzing data from USGS gage stations outside of the watershed, and sometimes outside of West Virginia. Pre-TMDL monitoring stations provide water quality data that is used as a target in model water quality calibration. Monitoring data provided by the WVDEP Division of Mining and Reclamation is used to characterize mining sources. Spatial representation of the various types of monitoring stations in the Pollutant Source Report will allow Tetra Tech and WVDEP to determine whether sufficient monitoring data exists and to identify any data gaps that need to be filled before modeling proceeds.

Tetra Tech is continually looking to identify ways in which monitoring data can be better integrated into the TMDL model setup process. Tetra Tech has worked with WVDEP to improve the spatial representation of pre-TMDL monitoring station locations; to include more detailed field notes in the WAB sampling data; and to begin assessing streambank erosion potential for aid in sediment and metals

modeling. Tetra Tech has worked with WVDEP in the past to clarify data inconsistencies and augment monitoring datasets, and will continue to do so going forward. Table I.A-4 lists the shapefiles that describe monitoring data sources that may be included in the Pollutant Source Report.

Table I.A-4. Pollutant Source Report Water Quality Monitoring Data

Shapefile	Description
WAB Stations	Includes locations of all WAB instream monitoring stations. The attribute table will include the station ID, stream name, stream code, and location coordinates. Coverage is based on latest WAB stations shapefile provided by WVDEP.
Additional Monitoring Stations	Includes locations of additional water quality monitoring stations provided by various stakeholder groups such as: permittees, watershed groups, environmental groups, or other data sources. The attribute table will include the permit #, stream name, stream code, and location coordinates. Coverage is based on data submitted to WVDEP for evaluation during the development of the 303 (d) list.
Trend Stations	Includes locations of the water quality sampling efforts by the WVDEP Division of Mining and Reclamation. The attribute table will include the stream name, stream code, and location of the station. Coverage is based on information provided by WVDEP.
Weather Stations	Includes locations of weather stations (including precipitation gages and surface airways stations) within and surrounding the watershed. The attribute table will include the station name and ID, period of record, elevation, and location.
USGS Gage Stations	Includes locations of the USGS gages within or surrounding the project watersheds. The attribute table will include the gage ID, station name, period of record, flow rate, drainage area, and location.
CSO Spill Reports	Includes supplemental sampling data of Combined Sewer Overflow (CSO) outlets provided by WVDEP and/or collected during source tracking.

I.A.6. Potential Point Sources

I.A.6.a. Fecal Coliform Point Sources

The most significant fecal coliform point sources are the permitted discharges from sewage treatment plants. These facilities (including publicly and privately owned treatment works, combined sewer overflows, and home aeration units, sewage package plants, WVDOH municipal sewage plants, and mine bathhouses) are regulated by NPDES permits. Permits require effluent disinfection and compliance with strict fecal coliform limitations (200 counts/100 milliliters [average monthly] and 400 counts/100 ml [maximum daily]). However, noncompliant discharges and collection system overflows can contribute loadings of fecal coliform bacteria to receiving streams. WVDEP's OWRNPDES GIS coverage shows the locations of NPDES permitted sources of fecal coliform bacteria. Tetra Tech will obtain the most up to date version of this coverage for inclusion in the Pollutant Source Report.

Tetra Tech is aware that new permits may be issued between the time that the Pollutant Source Report is submitted and the model is fully configured for TMDL allocation scenarios. Tetra Tech will work closely with WVDEP to establish a means by which the most current permits are included in the model. Table I.A-5 lists the shapefiles that describe point sources that may be included in the Pollutant Source Report.

Table I.A-5. Pollutant Source Report Permitted Point Source Data

Shapefile	Description
OWR Non-Mining NPDES Outlets	Includes a summary of the fecal coliform related permit limit information for each of the OWRNPDES permit outlets. Coverage originates from the latest OWRNPDES.shp and permit information retrieved from ERIS by WVDEP. The attribute table includes the permit, outlet, and the permit details for modeling purposes such as: design flow, land cover information and areas, and permit limits.
CSO Outlets	Locations of the NPDES permitted facilities that have CSO outlets. Coverage originated from latest OWRNPDES.shp. Where applicable, delineation of MS4s versus CSO drainage areas.
MS4 Permits	Coverage includes the areas associated with Municipal Separate Storm Sewer Systems.

I.A.6.b. Metals Point Sources

Metals point sources are classified by the mining- and non-mining-related permits issued by WVDEP. Untreated mining-related discharges from deep, surface, and other mines typically have low pH values (i.e., they are acidic) and contain high concentrations of metals (iron, aluminum, and manganese). For this reason, mining-related activities are commonly issued NPDES discharge permits that contain effluent limits for total iron, total manganese, nonfilterable residue, and pH. Most permits also include effluent monitoring requirements for total aluminum. WVDEP Division of Mining and Reclamation maintains a spatial coverage of the mining-related NPDES permit outlets. Tetra Tech will obtain the most up to date version of this coverage for inclusion in the Pollutant Source Report.

WVDEP DWWM controls water quality impacts from point source discharges from non-mining activities through the issuance of NPDES permits. WVDEP's OWRNPDES GIS coverages (permits and outlets shapefiles) show the locations of these sources. Non-mining point sources of metals may include the wastewater discharges from water treatment plants and industrial manufacturing operations. In addition, the discharges from construction activities that disturb more than one acre of land are legally defined as point sources. The sediment introduced from such discharges can contribute metals. All other non-mining NPDES permits (i.e., the wastewater discharges) must discharge at a pH between 6.0 and 9.0. Based on the types of activities and the minimal flow of most of these discharges, these permitted non-mining sources are usually believed to be negligible, however, they will be included in the pollutant source summary and the model.

Tetra Tech is aware that new permits may be issued between the time that the Pollutant Source Report is submitted and the model is fully configured for TMDL allocation scenarios. Tetra Tech will work closely with WVDEP to establish a means by which the most current permits are included in the model. Table I.A-6 lists the shapefiles that describe point sources that may be included in the Pollutant Source Report.

Table I.A-6. Pollutant Source Report Permitted Point Source Data

Shapefile	Description
OWR Non-Mining NPDES Outlets	Includes a summary of the metals related non-mining permit limit information for each of the OWRNPDES permit outlets. Coverage originates from the latest OWRNPDES.shp and permit information retrieved from ERIS by WVDEP. The attribute table includes the permit, outlet, and the permit details for modeling purposes such as: design flow, disturbed areas, land cover information and areas, and permit limits.
Mining NPDES Outlets	Summarizes the mining-related NPDES outlets. The attribute table includes the permit, outlet, effluent type and the permit information for each outlet. Coverage originates from the latest hpu.shp and from information provided by WVDEP DWWM in the interactive tool Tetra Tech has developed to collect mining outlet information.

Shapefile	Description
Bond Forfeiture Sites	Includes locations and status of bond forfeiture sites. Coverage created based on information from the Office of Special Reclamation in WVDEP Division of Land Restoration.
Permitted Mining Areas	Includes area coverage of the surface mining operations. Coverage originates from the latest perbd.shp provided by WVDEP.
Valley Fills	Includes area coverage of valley fills from mountaintop removal coal operations. Coverage originates from the latest vallf.shp provided by WVDEP.

I.A.7. Potential Nonpoint Sources

I.A.7.a. Fecal Coliform Nonpoint Sources

In addition to permitted sources, non-permitted (nonpoint) sources contribute fecal coliform bacteria loads to impaired streams in a watershed. The nonpoint fecal coliform sources in a watershed are represented differently in the model depending on their type and behavior. Potential nonpoint fecal coliform sources include wildlife, grazing livestock, residential/urban runoff and failing septic systems.

Frequently, nonpoint sources are characterized by build-up and wash-off processes. On the land surface, fecal coliform bacteria accumulate over time and wash off during rain events. As the runoff transports the sediment over the land surface, more fecal coliform bacteria are collected and carried to the stream. While the concentrations of bacteria are increasing, some bacteria are also dying. The net loading into the stream is determined by the local watershed hydrology. Nonpoint sources are represented in the model as land-based runoff from the landuse categories. Fecal coliform accumulation rates (in number per acre per day) can be calculated for each landuse based on all sources contributing fecal coliform bacteria to the land surface. Wildlife and grazing livestock and wildlife contribute to landuses in the watershed such as forest, grassland, pasture and urban/residential. Failing septic systems, straight pipes conveying raw sewage, and wildlife contribute fecal coliform bacteria to residential/urban lands. These contributions are a nonpoint source via the build-up and wash-off of coliform bacteria from both pervious and impervious surfaces in industrial areas, on paved roads, and in residential areas. Direct discharges from livestock may be a significant source of bacteria in receiving streams, depending on the number of livestock with stream access in the watershed.

Failing septic systems represent non-permitted (nonpoint) sources that can contribute fecal coliforms to receiving water bodies through surface or subsurface flow. Fecal coliform contributions from failing septic system and discharges will be represented in the model by flows and concentrations, which will be quantified on the basis of the following information:

- Areas not served by public sewer.
- Number of failing septic systems in each subwatershed.
- Estimated population served by the septic systems (calculated from census data, source tracking information provided by the WVDEP and 911 coverages).
- An average daily discharge in gallons of wastewater/person/day.
- Estimated septic effluent concentration reaching the stream.

Tetra Tech will thoroughly review the nonpoint source data it receives before including it in the Pollutant Source Report and transform the data where necessary to enhance spatial representation. For example, an analysis of the information submitted for agricultural sites will be performed to determine whether direct deposition by livestock should be included as a nonpoint source in the model. A more complex site

analysis will be performed for residential areas. Table I.A-7 lists the shapefiles that describe nonpoint sources that may be included in the Pollutant Source Report.

Table I.A-7. Pollutant Source Report Nonpoint Source Data

Shapefile	Description
Landuse – NLCD 2006	This is a grid coverage of the National Land-Cover Database. The coverage is comprised of 30x30 meter grid cells. The NLCD 2006 will be loaded to show each of the landuses identified in the NLCD coverage.
911 coverages	These are coverages provided by WVDEP based on information collected through the 911 initiatives. The point coverage includes all buildings and structures on a countywide basis. May be used to provide house counts in unsewered areas and to update residential landuse in areas that have recently undergone significant residential development.

I.A.7.b. Metals and Sediment Nonpoint Sources

In addition to point sources, nonpoint sources can contribute to water quality impairments related to metals and pH. Abandoned mine lands (AML) contribute AMD, which produces low pH and high metals concentrations in surface and subsurface water. Similarly, facilities that forfeited their bonds and abandoned operations can be a significant source of metals and low-pH. Also, land disturbing activities that introduce excess sediment are additional nonpoint sources of metals. Previous modeling efforts have revealed that certain sediments contain high levels of aluminum and iron - and to a lesser extent, manganese (Watts et al. 1994). Land disturbance can increase sediment loading to impaired waters, and the control of sediment-producing sources might be necessary to meet water quality criteria for metals during high-flow conditions. Potential sediment-related nonpoint sources of metals are forestry operations, oil and gas operations, Marcellus shale operations, roads, agriculture, and barren lands.

Tetra Tech will thoroughly review the nonpoint source data it receives before including it in the Pollutant Source Report and transform the data where necessary to enhance spatial representation. For example, an analysis of the information submitted for bond forfeiture sites will be performed to determine the land and waters status of each site in order to identify which sites should be included as nonpoint sources in the model. Table I.A-8 lists the shapefiles that describe nonpoint sources that may be included in the Pollutant Source Report.

On July 12, 2011, Acting Governor Earl Ray Tomblin signed an executive order to make the WVDEP establish emergency rules to regulate Marcellus Shale operations until long term rules can be developed. On August 22, 2011, these emergency rules were codified in Title 35 CSR Series 8. Because shale gas drilling operations are a relatively new nonpoint source for West Virginia, Tetra Tech has been working in coordination with WVDEP Office of Oil and Gas to characterize permits for current TMDL development. It is important to differentiate Marcellus wells from regular oil and gas wells because of the increased size of the land disturbance from Marcellus well pad construction. Well pad size and land disturbance information have been gathered to characterize sediment and metals contributions. Tetra Tech will continue to work with WVDEP as shale gas drilling regulations are developed. The extent of Marcellus drilling is currently limited to a very small number of permitted wells located within each of the Group A3 TMDL watersheds.

Table I.A-8. Pollutant Source Report Nonpoint Source Data

Shapefile	Description
AML Portals (WVDEP)	Includes locations of AML portals. Coverage originates from the latest aml_pnt.shp.
AML Highwall	Includes locations of AML highwalls. Coverage originates from the latest aml_line.shp.

Shapefile	Description
AML Area	Includes locations and areas of AML surface disturbances. Coverage originates from the latest aml_poly.shp.
Oil and Gas Wells	Includes locations and status of oil and gas well operations. Coverage originates from the latest oog.shp.
Marcellus Shale Wells	Includes the locations and status of the Marcellus Shale drilling operations. Coverage originates from the latest ERIS Wells.shp
Harvested Forest	Includes locations of forest harvest operations. The attributes table includes the registration number, start date, end date, landing (areas) haul road (acres), total logging area (acres) and calculated radius (meters). Coverage created based on the coordinates from the harvested forest information provided by WV Division of Forestry.
Burned Forest	Includes locations of burned forest areas. The attributes table includes date of burn, total area burned (acres), and the calculated radius. Coverage created based on the coordinates from burned forest information provided by WV Division of Forestry.

I.A.8. WVDEP Source Tracking

As part of its preparation for TMDL development, WVDEP staff conduct site visits to all impaired streams to identify any previously unknown pollutant sources in the watersheds and to collect additional data needed for source characterization and model setup. In fecal coliform impaired streams, the source tracking efforts by WVDEP DWWM may identify additional sources such as unpermitted discharges and failing septic systems, or gather supplemental information such as sewer coverages, failing septic data, pasture areas and livestock counts. In metals impaired streams, the source tracking efforts by WVDEP DWWM and the Office of Abandoned Mine Lands and Reclamation may identify additional AML sources (discharges, seeps, portals, culverts, refuse piles, diversion ditches, and ponds). Field data, such as GPS locations, water samples, and flow measurement can be collected to locate these sources and characterize their impact on water quality. Tetra Tech works closely with WVDEP source tracking personnel in order to streamline the data collection process so that the appropriate type and amount of data are collected. When necessary, Tetra Tech personnel have accompanied WVDEP source tracking personnel in the field to assist with the identification and characterization of sources. Tetra Tech's involvement in the source tracking process is extremely important to source characterization as it leads to enhanced data collection and more accurate representation in MDAS. Table I.A-9 lists the shapefiles that describe source tracking data that may be included in the Pollutant Source Report.

Table I.A-9. Pollutant Source Report Source Tracking Data

Shapefile	Description
Septic Zones	Coverage created by WVDEP from the source tracking efforts. The coverage includes seasonal flow and septic system failure rates for separate zones within the watershed.
Sewered Areas	Coverage created by WVDEP and includes the aerial coverage of local PSDs
Unsewered Areas	Coverage created by WVDEP from the source tracking efforts. The attribute table includes the number of unsewered houses per stream segment.
Sewage Overflow Events	Coverage created from information provided on the source tracking data spreadsheet created by WVDEP. Attributes include the locations and sewage overflow events.
CSO Samples	Coverage created by supplemental sampling data of CSO overflows provided by WVDEP and collected during source tracking.
Sludge Application Sites	Coverage includes location and application rates collected during source tracking.

Shapefile	Description
Agricultural Source Tracking Sites	Coverage created from the potential fecal coliform bacteria sources that were identified during WVDEP source tracking efforts. The attribute table includes the category for the source, a description of the type of source, size and runoff potential.
Fecal Source Tracking Photos	This coverage shows the locations of selected fecal source photos taken by WVDEP during source tracking efforts. Photos may be connected to a hotlink tool enables the user to view the photos by clicking on an icon.
AML Seeps Source Tracking	Coverage created from the sample locations taken during WVDEP source tracking efforts. The attribute table includes the site description and the analytical results for each sample.
MS4 Permits	This coverage includes areas/outlets associated with Municipal Separate Storm Sewer Systems (MS4).
CSO Outlets	This coverage shows the areas associated with CSOs outlets for NPDES permits, and where applicable, delineation of MS4s versus CSO drainage areas.
AML Disturbances Source Tracking	Coverage created from the identified AML areas during WVDEP source tracking efforts. The attribute table includes the site description of each AML, associated PADS#, and ranks the runoff potential.
Sediment Source Tracking	Coverage created from the potential sediment sources identified during WVDEP source tracking efforts. The attribute table includes rankings of potential sediment impacts for the following sources: AML, Oil-Gas, Unmapped Roads, Agriculture, Metal Hydroxides, Bank Erosion, and Residential areas.
Metals Source Tracking Photos	This coverage shows the locations of selected metal source photos taken by WVDEP during source tracking efforts. Photos may be connected to a hotlink tool enables the user to view the photos by clicking on an icon.
Pin Study Stations	This coverage shows the locations of the pin study stations where bank erosion was measured by WVDEP.

I.B. Watershed Modeling

I.B.1. Model

I.B.1.a. Model Selection

The selection criteria for a specific watershed model should be based on technical, regulatory, and stakeholder-specified considerations. Given Tetra Tech's experience addressing these considerations in West Virginia's watersheds, the MDAS is proposed for watershed modeling. MDAS was developed by Tetra Tech and USEPA specifically for TMDL application in West Virginia to facilitate large scale, data intensive watershed modeling applications. The MDAS is particularly applicable to support TMDL development for areas affected by AMD and other point and nonpoint pollution sources. MDAS is non-proprietary model, and its code is open for inspection. Modification of the model and/or additional model development can easily be done in-house, as Tetra Tech developed and maintains the model code. The system integrates the following:

- Graphical interface
- Data storage and management system
- Dynamic watershed model
- Data analysis/post-processing system

The MDAS graphical interface supports basic GIS functions, including electronic geographic data importation and manipulation. Key geographic datasets include stream networks, landuse, flow and water quality monitoring station locations, weather station locations, and permitted facility locations. The data storage and management system functions as a database and supports storage of all data pertinent to TMDL development, including water quality observations, flow observations, and Discharge Monitoring Reports (DMRs) from permitted facilities, as well as stream and watershed characteristics used for modeling.

The dynamic watershed model simulates nonpoint source flow and pollutant loading as well as instream flow and pollutant transport, and it is capable of representing time-variable point source contributions. This component is most critical to TMDL development because it provides the linkage between source contributions and instream response. It is capable of simulating flow; the behavior of sediment, total recoverable metals, bacteria, nutrients, pesticides, and other conventional pollutants including chlorides and sulfates; temperature; and pH for pervious and impervious lands and for water bodies.

A relational Microsoft® Access database serves as the framework for watershed data management. A key advantage of MDAS' development framework is that it has no inherent limitations in terms of modeling size or upper limit of model operations imposed by architecture. In addition, the Microsoft® Visual C++ programming architecture allows for seamless integration with modern-day, widely available software such as Microsoft® Access and Excel (Figure I.B-1). Another key advantage of MDAS is that it can be customized to fit West Virginia's individual TMDL development needs.

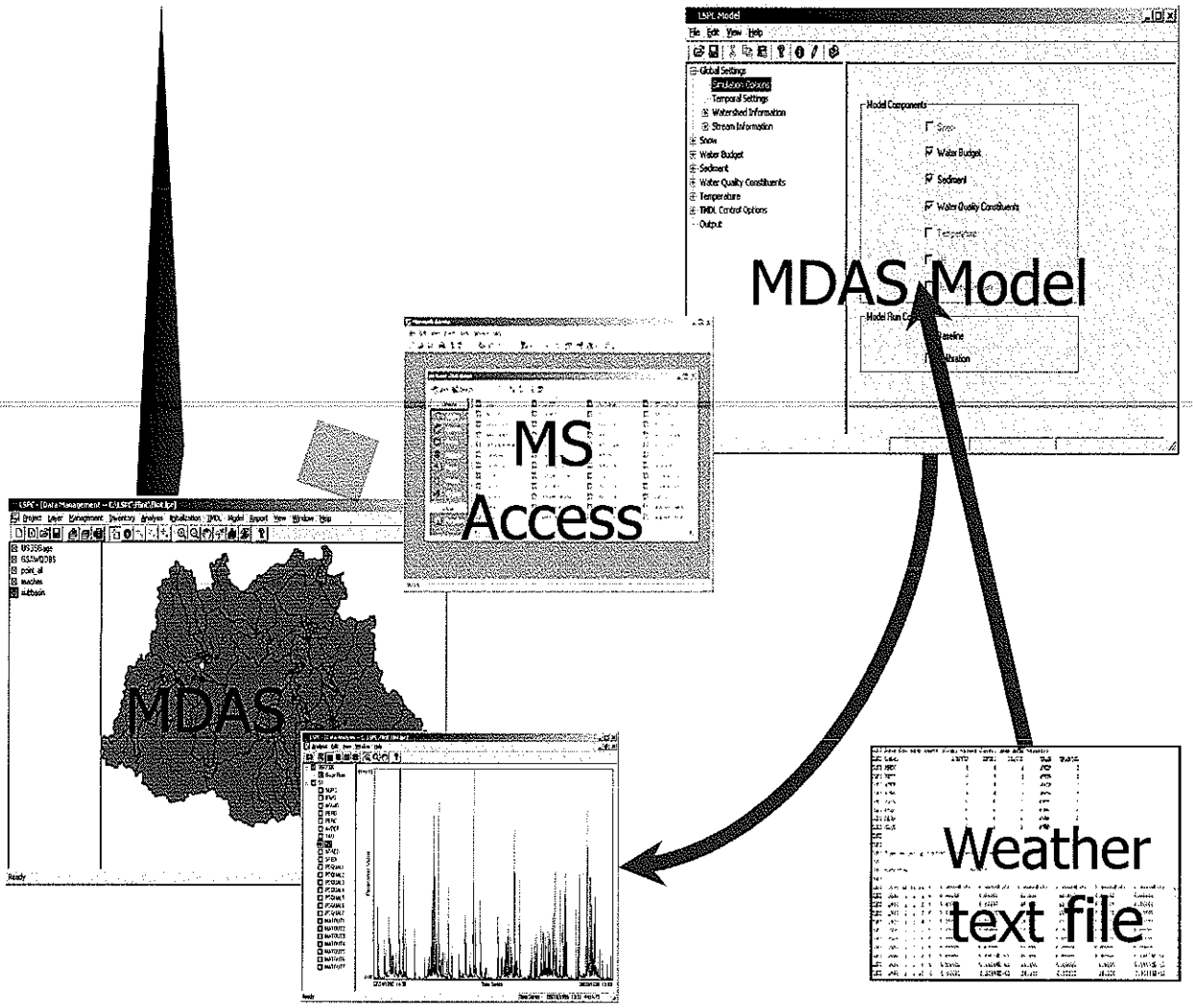


Figure I.B-1. MDAS Model Features

Advantages to choosing MDAS as the watershed model for this project include:

- Simulates watershed hydrology using hourly local meteorological data.
- Presents no inherent limitations regarding the size and number of subwatersheds and streams that can be modeled at any given time.
- Simulates all of the necessary pollutants on land and instream under a range of flow conditions.
- Is calibrated for existing conditions, while it can be modified to allow for baseline and allocation scenarios.
- Applies to rural and urban watersheds.
- Because of the small time-step, it can be used to evaluate compliance with varying water quality criteria, including exposure duration and exceedance frequency components.
- MDAS allows for representation of loading processes for both point and nonpoint sources as either precipitation driven or constant discharge, as appropriate.
- MDAS allows for representation of pollutant build-up/wash-off rates and/or representative event mean concentrations (EMCs) for various landuse categories.

- Stream network connectivity allows for instream transfer of pollutants from upstream to downstream watersheds.
- MDAS has a unique graphical interface which supports GIS functions.
- MDAS allows for representation of instream dissolved metals.
- Easy to use post-processing tools allow for presentation of allocations in a user-friendly manner.
- A comprehensive modeling framework using the proposed MDAS approach facilitates the development of TMDLs not only for this project, but also for potential future projects to address other impairments throughout the modeled watersheds.
- Allows for customization of algorithms and sub-routines to accommodate the particular needs of the project.
- Time-variable nature of the modeling will enable a straightforward evaluation of the cause-effect relationship between source contributions and waterbody response and direct comparison with relevant water quality criteria.
- Proposed modeling tools are free and publicly available. This is advantageous for distributing the model to interested stakeholders and among government agencies.
- Approved by the USEPA for use in TMDLs.
- Model includes both surface runoff and baseflow (groundwater) conditions.
- Provides storage of all geographic, modeling, and point source permit data in a Microsoft® Access database and text file formats to provide for efficient manipulation of data.
- Provides post-processing and analytical tools designed specifically to support TMDL development and reporting requirements.

I.B.1.b. Fecal Coliform Model Setup

During model setup Tetra Tech will format the subwatershed, stream reaches, and point source data for input into MDAS. Meteorological conditions are the driving force for nonpoint source transport processes in watershed modeling. Hourly precipitation, temperature, dew point, evapotranspiration, cloud cover, and other relevant weather data will be obtained for those stations inside and around the watersheds of concern. The available weather data will be analyzed for completeness, and if any periods of time are missing from the preferred station, best available data from neighboring stations will be used to fill data gaps. Once the weather datasets are complete, MDAS air files will be prepared to run the model. Weather data will be validated during hydrology calibration. Tetra Tech modelers will use the same MDAS air file for all pollutant models, whether fecal coliform, metals, or ionic stress.

The model will be configured using the MDAS model database to simulate modeled point and nonpoint pollutant sources, as well as general hydrologic characteristics of the modeled subwatersheds and TMDL streams. Development of landuse GIS coverages is the next step in model setup. The landuse coverages will be developed taking into account the sources of the pollutants of concern. The fecal coliform landuse coverage will start with a base landuse GIS shapefile such as the NLCD 2006. This coverage will be modified to incorporate WVDEP source tracking information. For instance, areas of high concentrations of livestock (agricultural intensity) or fecal runoff potential; differences between grasslands versus pastures; new residential development; and other nonpoint pollutant sources not described on the original coverage will be taken into account. A roads analysis will also be performed using polylines from sources such as TIGER, WVRoads, and USGS topographic maps. Roads will be classified as either paved or unpaved. In addition, an analysis of the percent imperviousness of urban/residential areas will be performed. MS4 areas that occur in TMDL watersheds will be delineated using information obtained from WVDEP, WVDOH, and local city engineers.

Besides precipitation-driven discharges, other direct discharges are modeled. In the case of the fecal coliform modeling, failing septic systems, NPDES permitted outlets with fecal coliform discharges,

CSOs, and other special cases (e.g.,Sanitary Sewer Overflows (SSOs) or known sludge piles) will be modeled.

Upon completion of landuse manipulation and point source input configuration, additional information required for model setup will be prepared, including inputs of reach geometry and routing, watershed physical information (e.g. slopes, length of overland flow, elevation), and weather station assignment for each subwatershed. Assignment of point sources to reaches will also be prepared for addition to the MDAS database. Finally, Tetra Tech will provide technical transfer of all models, modeling tools, and data used during the development of the TMDLs. Nothing in the models, modeling tools, databases, etc., will be restricted in its distribution.

I.B.1.c. Total Metals and Sediment Model Setup

To explicitly model nonpoint sources in the sediment and metals impaired watersheds, additional landuses need to be represented in the model beyond the modified fecal landuse described in I.B.1.b. These landuses will represent both point and nonpoint precipitation driven sources. With each hydrologic group, Tetra Tech has worked to create a customized landuse set that represents the sources within the subject watersheds and will continue to do so for this project; for example Tetra Tech is currently collaborating with WVDEP personnel to determine how best to represent Marcellus Shale gas well in watersheds where they represent a significant landuse. The metals modeled landuses for TMDLs that Tetra Tech has developed for WVDEP typically include the following: conventional oil and gas wells, unpaved roads, burned forests, harvested forest / skid roads, revoked mines, and AML / highwall.

Precipitation-driven point sources within the metals model are typically related to mining activities and stormwater permits. Information from WVDEP's permit databases and spreadsheets that will be specifically designed for this purpose will be used to develop the permitted landuse coverage. Besides precipitation-driven discharges, other direct discharges will be modeled such as AML seeps, pumped discharges from mines, and non-mining NPDES permits

In addition to anthropogenic sources, metals and sediment contributions from groundwater and streambank erosion will also be considered in the modeling process. In the case of naturally occurring parameters, such as manganese, aluminum and iron, groundwater contributions will be modeled according to the individual characteristics of the land and its corresponding area.

Tetra Tech has worked with WVDEP to develop a method to consistently assess bank erosion potential at each sampling station using a twofold approach: 1) qualitative assessment, rating vegetative cover, which Tetra Tech and WVDEP have found to be the most important factor controlling bank stability; and 2) quantitative evaluation through an erosion pin study. The qualitative vegetative cover assessment is based on the 2011 National Agriculture Imagery Program aerial photography. Each subwatershed is assigned a qualitative value between 1 and 3, with 1 being the best observed bank vegetative cover and 3 having the least coverage.

To quantitatively assess streambank sediment loading, Tetra Tech will use results from field experiments conducted by WVDEP at selected in-stream sampling stations using bank erosion pins. Erosion pins are embedded into representative sections of the streambanks and the exposure surface is surveyed periodically and after storm events to assess streambank erosion rates at each site. In addition, WVDEP measures stream channel cross section geometry at each site and collects soil samples for analysis of particle size distribution and iron content. Tetra Tech will then calculate the amount of soil material eroded or deposited at each site using measured erosion depth. The total amount of sediment eroded from stream channels will be calculated from results of all pin erosion sites along the stream reach. This streambank sediment loading calculated from erosion pin study will be used in combination with the

qualitative vegetative cover score for the comprehensive assessment of stream bank sediment loading in the entire watershed. The results will be incorporated into the MDAS model to calibrate streambank erosion sediment loading parameters.

Upland sediment loading is simulated based on the mathematical description of the soil detachment process and the sediment transport along the surface slopes. Spatial variation of the soil erodibility will be included in the model using the information retrieved from statewide soils database. Statistical analyses using pre-TMDL monitoring data collected throughout the subject watersheds will be performed to establish the correlation between metals loads and sediment loads and to evaluate spatial variability. The results will then be applied to the sediment-producing landuses during the water quality calibration phase of the MDAS.

I.B.1.d. pH and Dissolved Metals Model Setup

As noted in previous work for WVDEP, the majority of water quality impairment relates to mine drainage, bacterial contamination, and general biological impairment. The development of TMDLs is needed to address the typical stressors and water quality impairment due to pH, metal toxicity, and sedimentation in the Upper Ohio North, Upper Kanawha, and South Branch Potomac watersheds. Specifically, TMDL modeling capabilities will address water quality criterions for iron, aluminum, manganese, selenium, and pH. The modeling must address low flow, mean flow, and storm peaks at multiple locations throughout the basin and permit a comparison of model output with observed data from representative water quality monitoring stations. The TMDL model will determine in-stream dissolved metals and pH due to total metal inputs from point and nonpoint sources, with prescribed pollutant allocations to result in compliance with water quality criteria. The need to regulate and manage the environmental impacts from mining requires methods that encompass the inherent complexity of the myriad chemical interactions in the environmental media.

We propose to utilize the recently updated version of the MDAS model for TMDL development for dissolved metals and pH. The updates included coupling MDAS with the USEPA's watershed Loading Simulation Program in C++ (LSPC) (USEPA 2009) to dynamically simulate of dissolved ions. The LSPC/MDAS model will simulate complex loading processes within the watersheds and advanced chemical reactive transport processes within the stream and, thus, include the complex interactions between the land, the atmosphere, and surface and groundwater. For example, the LSPC/MDAS model will include sediment sources, atmospheric deposition, streambank erosion, and land use source attributes and the effected in-stream chemical dynamics that result in observed water quality for dissolved metals and pH.

The model possesses the following capabilities that will provide a scientifically sound representation of the watershed loading and transport system and a sound development of TMDLs and allocation scenarios:

- Simulate hydrologic variations due to time variable weather patterns and the related transient saturation or unsaturated condition of the surface/subsurface
- Simulate time variable chemical loadings from various sources in the watershed
- Simulate geochemical interactions within a stream channel
- Provide model results with a broad range of spatial and temporal scales
- Evaluate source loading abatement scenarios for water quality control/management design

The conceptualization of the current LSPC/MDAS model (Figure I.B-1) illustrates the relationship of the land processes and loadings mechanisms that leads to the edge of stream calculation at various locations within the watershed. The edge of stream calculation in transferred into the MDAS model for subsequent

in-stream calculations. The modeling for in-stream metals, including iron, aluminum, manganese, and selenium along with pH requires a comprehensive approach for simulating the interactions between dissolved, adsorbed, and precipitated chemical species that necessarily includes the simulation of major ions (calcium, magnesium, sodium, sulfate, carbonate, and others). The stream components in MDAS include the dominant processes regulating the interactions and transport of major ions, metals, adsorbing materials, and mineral phases. Reactions between the water column and the streambed are represented along with the reactions governing the distribution of dissolved and particulate chemicals. All significant chemical species for TMDL development in the subject watersheds will be included in the MDAS database with a chemical system based on major ions, iron, aluminum, manganese, selenium, adsorption/desorption to oxides and clays, precipitated chemicals, and mineral phases.

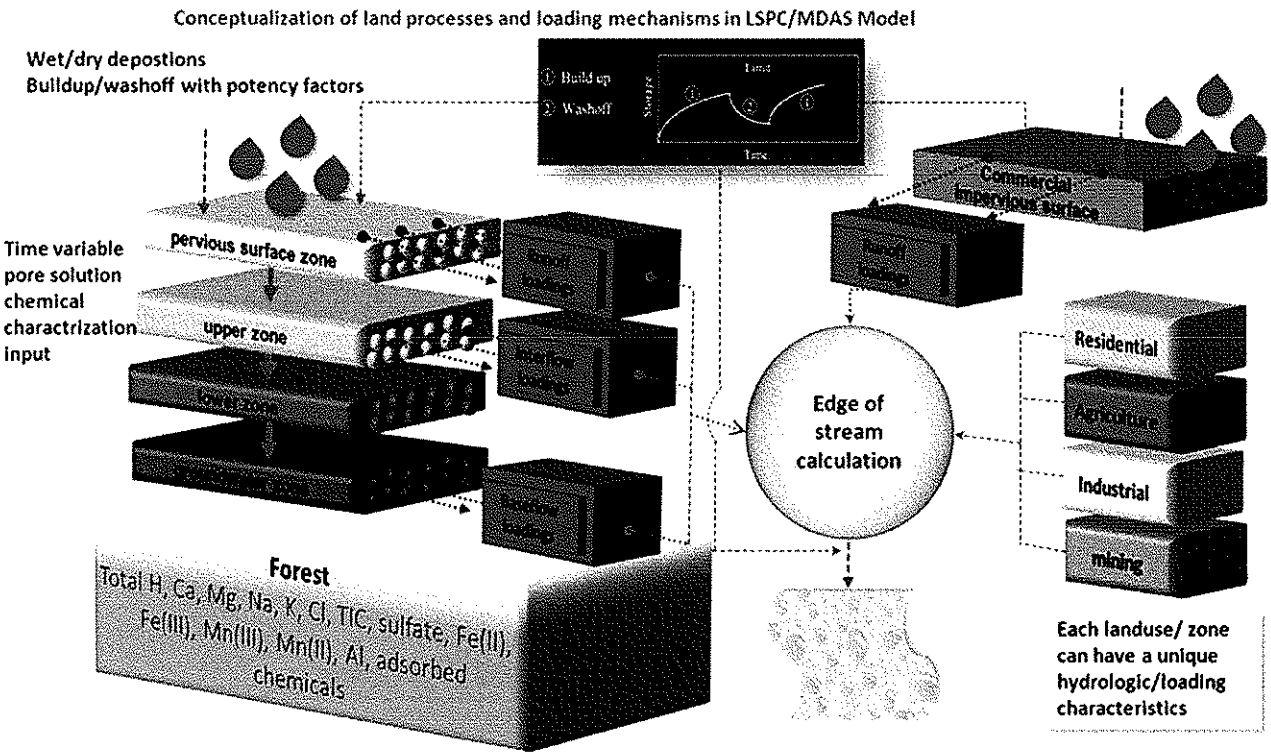


Figure I.B-2. Land components of LSPC-MDAS model

MDAS's geochemical reactions within the channel are based on thermodynamics and chemical kinetics. The foundation based on MINTEQA2/MINEQL is an equilibrium calculation for the major reactions that define the chemical composition of the stream reach during a given time step. Most speciation reactions are fast relative to the time step and the equilibrium assumption is reasonable. However, for certain reactions, such as the oxidation of ferrous iron to ferric iron or the adsorption of metals on iron oxyhydroxides, reactions may be limited by the kinetics, and not necessarily reach equilibrium. The major limitation of the equilibrium approach is mitigated in MDAS by incorporating simultaneous equilibrium and kinetic (non-equilibrium) calculations within the same computational time step, leading to more precise spatial and temporal representations of non-equilibrium solution conditions for certain processes. To simulate and attain realistic stream chemical conditions, the model includes a variety of chemical reactions to support various stream conditions affected by anthropogenic or natural sources:

- Chemical speciation, including trace metals

- Acid/base chemical reactions and pH simulations
- CO_2 gas degassing/ingassing kinetics in rivers and lakes
- Redox kinetics including potential photoreduction/microbial oxidation
- Kinetic mineral precipitation/dissolution
- Adsorption/desorption based on diffuse double layer (DDL) modeling
- Cation adsorption/desorption on clay surfaces represented by cation exchange capacity
- Aging/burial of active/inactive sediment layers related to sediment deposition from the water column and scour from the stream bed

The precipitation/dissolution and the adsorption/desorption reactions both occur in the water column and streambed sediments. The heat loading into the stream from land and point sources is also considered and can be simulated. The resulting stream temperature is used for all temperature-dependent chemical reactions occurring within the stream. The stream components represented in MDAS are shown in Figure I.B-3.

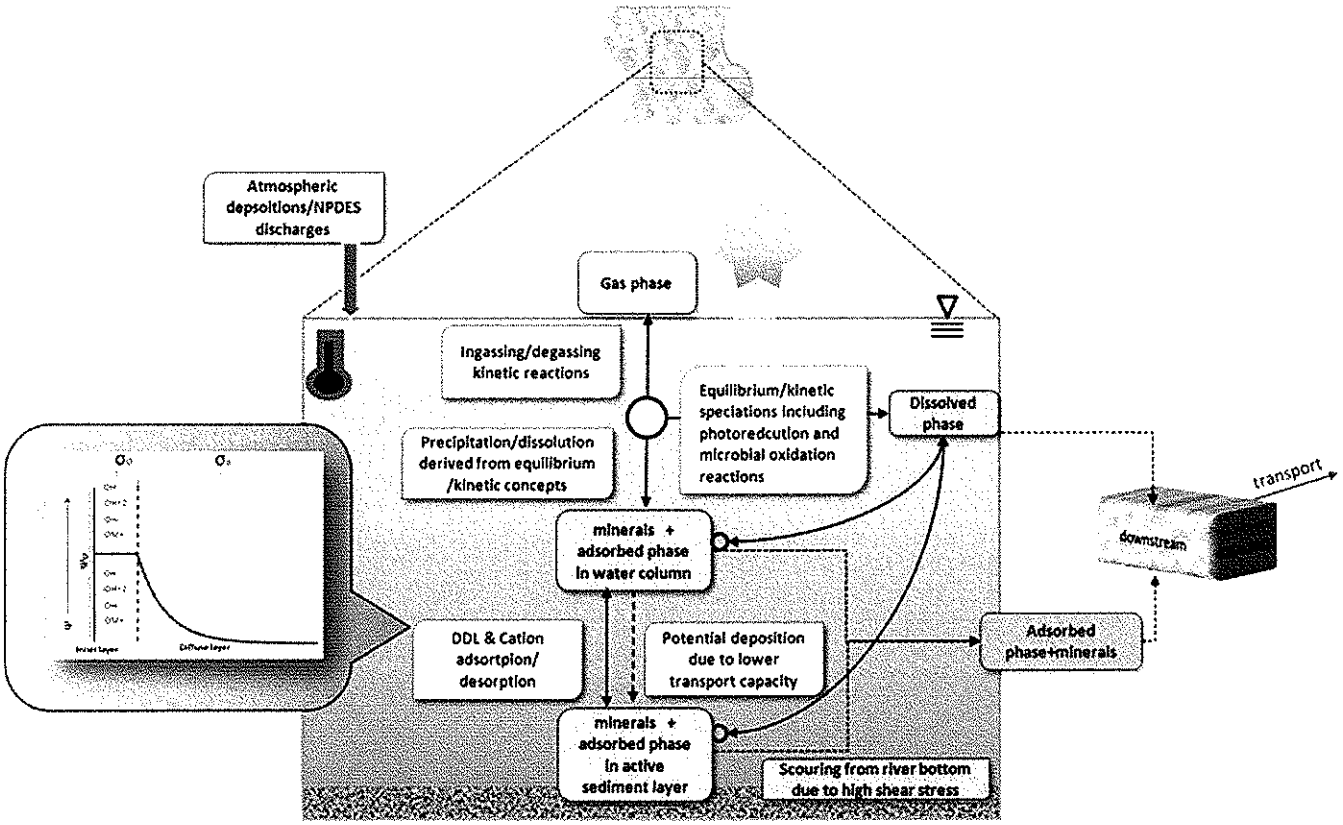


Figure I.B-3. Stream components in MDAS

This capability of LSPC/MDAS and our experience in model development/application will assure WVDEP that Tetra Tech is capable of meeting, fulfilling, and exceeding required TMDL development functions for pH and dissolved metals. Modification of the model and/or additional model development can easily be done in-house, as Tetra Tech developed and maintains the model code. MDAS is a non-proprietary model, and its code is open for inspection.

I.B.2. Hydrology Calibration

After the MDAS model is configured, model calibration will be performed. Model calibration will be focused on two main areas: hydrology and water quality. Pollutant concentrations are strongly influenced by stream flow. High flows and low flows can dilute or intensify instream concentrations of modeled pollutants. Strongly predictive hydrologic calibration allows the MDAS model to accurately calculate pollutant time-step instream concentrations and yearly average loads. Therefore, in TMDL model development it is critical to calibrate hydrologic models so that they closely predict observed stream flow observations.

To begin the hydrology calibration process, Tetra Tech will use the best available weather and land cover data as core MDAS hydrology model inputs. Gaps in weather data completeness will be addressed using statistical methods, including Meteorological Data Analysis and Preparation Tool (MetADAPT) software available from the USEPA Region 4 TMDL Toolbox. Tetra Tech will also obtain USGS gaging station data for streams in TMDL watersheds. Instantaneous flow measurements collected during pre-TMDL monitoring and WAB stream surveys will also be used when appropriate. In the event that USGS gaging stations are not present in the TMDL watershed, model hydrology will be calibrated to a nearby watershed with similar weather patterns and landuse characteristics. Model parameters will initially be set to the best available literature values within scientifically accepted ranges.

Hydrologic calibration will be achieved by adjusting model parameters so that model output matches observed stream flow within an acceptable range of variability. Upon completion of hydrology calibration, Tetra Tech will submit a hydrology calibration deliverable featuring a statistical analysis of model output goodness-of-fit under a variety of seasonal conditions and flow regimes.

The MDAS hydrology algorithm follows a strict conservation of mass, with various compartments available to represent different aspects of the hydrologic cycle and maintenance of the annual water balance. Sources of water are direct rainfall or snowmelt. Potential sinks from a land segment are total evapotranspiration, flow to deep groundwater aquifers, and outflow to a stream reach. From the reach perspective, sources include land outflow (runoff and baseflow), direct precipitation, or flow routed from upstream reaches. Sinks include surface evaporation, mechanical withdrawals, or reach outflow. Tetra Tech also has the capability to develop model algorithms to capture the specific dynamics of snow accumulation, evaporation, and meltwater runoff. Snow is an important hydrologic variable to consider, especially when modeling high elevations in West Virginia watersheds.

A well-calibrated model can predict stream flow over a wide range of climatic conditions and seasonal changes, including base flow and storm events. Tetra Tech will select calibration time periods based upon an examination of annual precipitation variability and the availability of observed precipitation and streamflow data. The period will be determined to represent a range of hydrologic conditions: low, mean, and high flow. Calibration for these conditions is necessary to ensure that the model will accurately predict a range of conditions over time periods beyond the calibration time period.

Key considerations in the hydrology calibration will include the overall water balance, the high flow-low flow distribution, storm event flows, and seasonal variation. At least two criteria for goodness-of-fit will be used for calibration: graphical comparison and the relative error method. Calibration will be performed on a reasonable number of subwatersheds to insure adherence to scientific principles. Graphical comparisons are extremely useful for judging the results of model calibration; time-variable plots of observed versus modeled flow provide insight into the model's representation of storm hydrographs, baseflow recession, time distributions, and other pertinent factors often overlooked by statistical comparisons. The model's accuracy will primarily be assessed through interpretation of the time-variable

plots. The relative error method will be used to support the goodness-of-fit evaluation through a quantitative comparison. A small relative error indicates a better goodness-of-fit for calibration.

After calibrating hydrology at multiple locations, independent sets of hydrologic parameters will be developed and applied to the remaining subwatersheds in the basin. A validation of these hydrologic parameters will be made through a comparison of model output to observed data at additional locations in the watershed. The validation locations are expected to represent larger watershed areas and essentially validate application of the hydrologic parameters derived from the calibration of smaller subwatersheds. Validation will be assessed in a similar manner to calibration.

Tetra Tech has successfully calibrated hydrology in over 20 different MDAS models in West Virginia watersheds. In fact, Tetra Tech has prior experience calibrating hydrology in the Upper Ohio North and Upper Kanawha watersheds for past TMDL projects. Tetra Tech has developed calibration spreadsheet tools customized to interpret MDAS model output. Sample output from one of these tools is presented in Figure I.B-4. Calibration tools give Tetra Tech modelers the capability to achieve model calibration in a comprehensive and highly efficient manner. Customized calibration analysis also facilitates technical review by WVDEP staff and USEPA TMDL reviewers. Hydrology calibration results will be presented on a CD containing calibration tools described above and will contain worksheets that represent the observed data and modeled output, with graphs and tables designed to assess the goodness-of-fit of the calibration, and a statistical analysis of the calibration. Daily, monthly, and annual flow volumes will be considered. An example of the hydrology calibration deliverable from West Virginia Hydrologic Group C2 TMDL is presented in Appendix A.

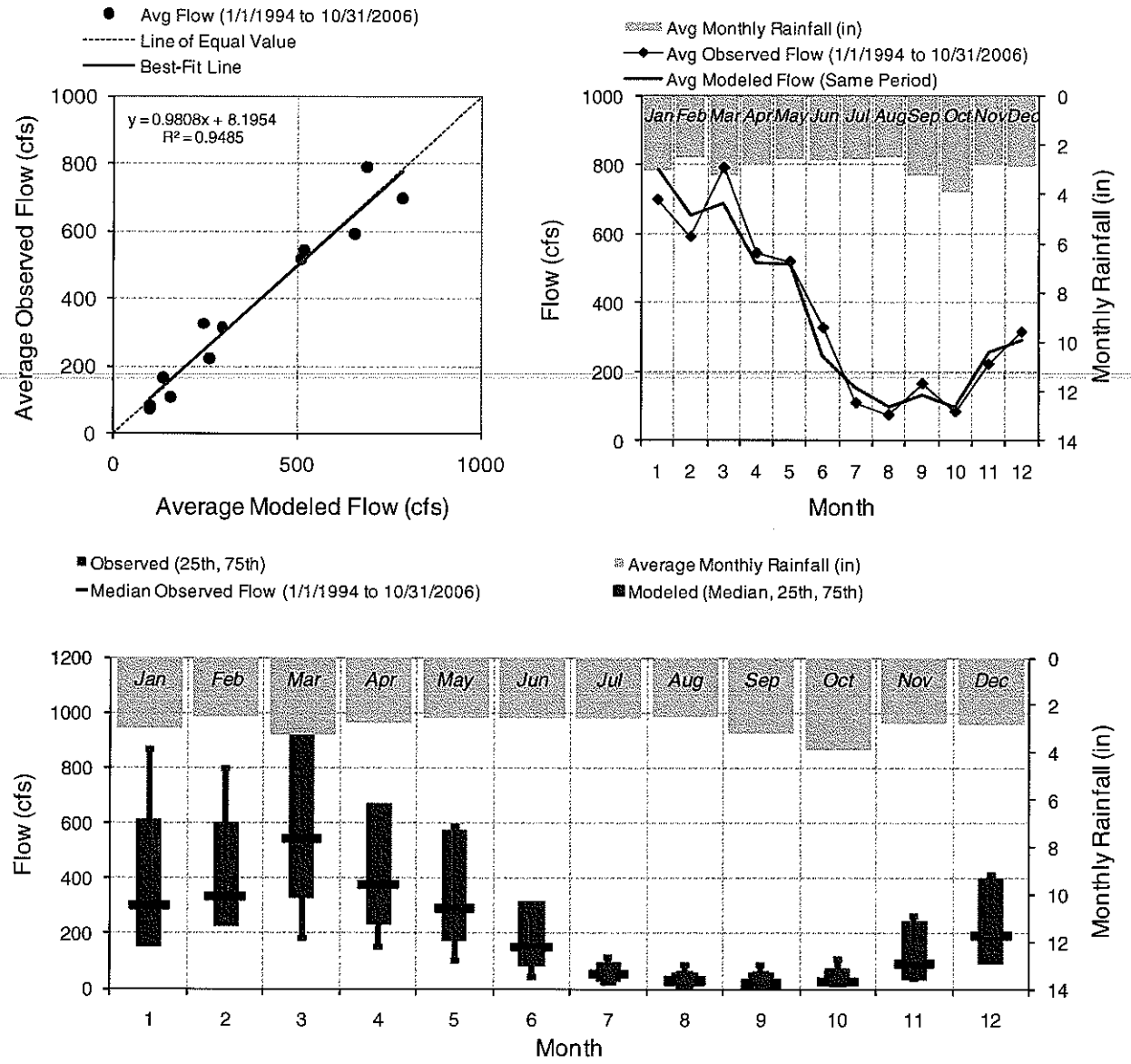


Figure I.B-4. Example Hydrology Calibration Spreadsheet Tools

I.B.3. Model Water Quality Calibration

After hydrology calibration is finalized, water quality calibration for all pollutants of concern will be performed at multiple locations throughout the watersheds. Water quality calibration refers to the adjustment or fine-tuning of modeling parameters related to water quality to reproduce instream observations. Available monitoring data in the watershed will be identified and assessed for application to calibration. Monitoring stations with data that represent a range of hydrologic conditions, source types, and pollutants will be selected. The time-period for water quality calibration will be selected based on the availability of the observed data and their relevance to the current conditions in the watershed. The period should include various wet and dry conditions.

In the broadest sense, calibration will consist of executing the watershed model, comparing time series water quality output with available water quality observation data, and adjusting water quality parameters

within a reasonable range. The main objective of the water quality calibration will be to best simulate low-flow, mean-flow, and storm events at representative water quality monitoring stations throughout the watershed. Upon completion of the calibration at selected locations, the calibrated dataset containing parameter values for modeled sources and pollutants will be complete. This dataset will be applied to areas for which calibration data are not available.

Water Quality Calibration results will be presented on a CD and will contain worksheets that represent the observed data and modeled output, with graphs and tables designed to assess the goodness-of-fit of the calibration, and a statistical analysis of the calibration. Calibration will be performed on a significant number of watersheds to ensure the scientific validity of the process. An example of the water quality calibration deliverable from the West Virginia Hydrologic Group B2 TMDL project is presented in Appendix A.

I.B.3.a. Fecal Coliform Water Quality Calibration

The water quality parameters that will be adjusted to obtain a calibrated model are the build-up and wash-off of fecal coliform bacteria from the subwatershed acreages associated with fecal coliform producing landuses. The direct load estimates from failing septic systems can also be adjusted for fecal coliform concentration. Landuse-specific parameters that are relevant for calibration of fecal coliform bacteria are the build-up rate and wash-off limit parameters. Essentially, the build-up relates to the rate at which the amount of fecal coliform (in counts per acre) accumulates on the land surface every day during dry conditions. The wash-off parameters are used to guide the model in the relative rate of detachment and transport of the accumulated mass from the land segment to the stream during runoff conditions. This is generally expressed as inches of runoff that would be required to mobilize certain percent of the stored mass on the surface. Starting values for these parameters will be taken from previous models, literature, peer-recommended ranges, and Tetra Tech's Fecal Coliform Loading Estimation Spreadsheet. Background values will be derived from storm sampling events in undisturbed locations.

Septic discharges will be modeled as direct discharges to the reaches, with estimated flows and concentrations. Flow values will be estimated using unsewered house counts and septic failure rates. Tetra Tech has also worked with WVDEP staff to improve failing septics analysis by incorporating 911 emergency response GIS data to identify unsewered homes in TMDL watersheds. Septic concentrations will be calculated using fecal coliform loads derived from low-flow instream water quality data for locations only affected by septics during low flow conditions. These calculated loads will then be applied to the estimated septic flows, to obtain an average septic discharge concentration.

After initial parameter values have been established, the model will be run, and comparisons will be made with observed fecal coliform water quality data for several representative locations in the watershed. The fecal coliform bacteria calibration will be focused on matching trends identified during the water quality analysis. Daily average instream fecal coliform bacteria concentrations from the MDAS model will be compared directly with observed data collected during WVDEP's pre-TMDL monitoring efforts as shown in Figure I.B-5.

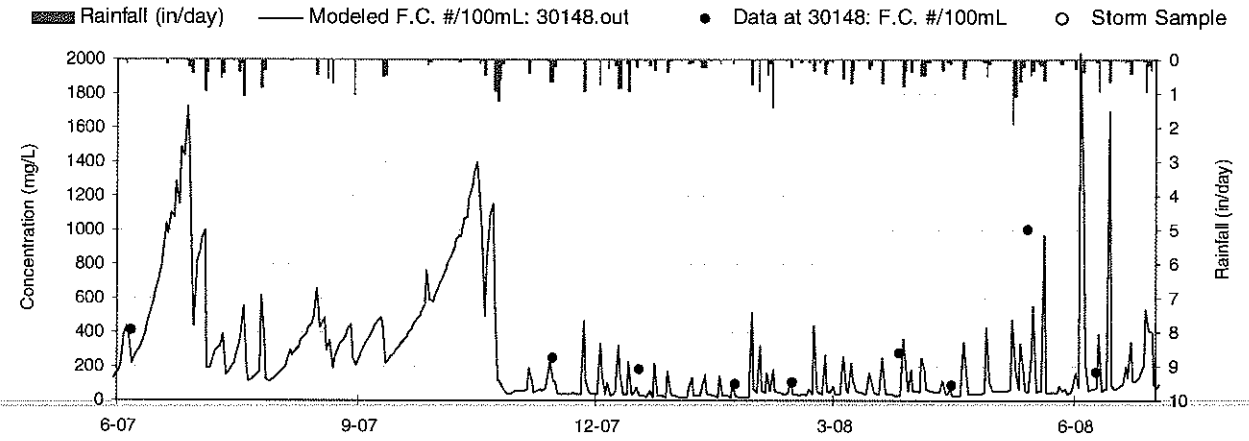


Figure I.B-5. Fecal coliform concentration: model output vs. observed data

I.B.3.b. Metals Water Quality Calibration and Iron-Sediment Relationship

The first step in the metals water quality calibration is the determination of the sediment-metals relationship, which may vary throughout the subject watershed. Potency factors are region-specific parameters that account for the pounds of a particular metal generated for each ton of sediment produced. The values for the potency factors will be determined by analysis of TSS and metals data. Land-based sediment calibration consisted of adjusting the coefficient in the sediment wash-off equation (KSER) for each landuse. The landuses will be parameterized according to their sediment-producing capabilities. In addition to the sediment-generated metals, any additional non-sediment related loading will be estimated. Parameters that are used are SOQC, IOQC, and AOQC. These define the concentration of non sediment-related metals by landuse for surface runoff, interflow, and groundwater, respectively.

To establish reasonable ranges of values for use in the metals water quality calibration for mining landuses, DMR and storm monitoring data will be analyzed. Metals loading for sediment producing landuses will be assumed to be exclusively dependent on the sediment loads and their potency factors. Reasonable water quality parameters for AML will be derived from statistical analysis of AML water quality data from source tracking efforts. Parameters for background conditions will be based on observed water quality data from undisturbed monitored locations. Starting values for other non-monitored sources will be taken from previous models, literature, and peer-recommended ranges.

The approach taken to calibrate water quality will focus on matching trends identified during the water quality analysis. Hourly instream concentrations from the model will be compared directly with observed data. Observed data from WVDEP's pre-TMDL monitoring efforts and data submitted by various mining companies throughout the watershed will be used for calibration. The objective will be to best simulate the metals concentration and loading at low flow, mean flow, and storm peaks at representative water quality monitoring stations. The representative stations will be selected based on location and loading source type.

I.B.3.c. pH and Dissolved Metals Water Quality Calibration

Historical mining activities are an important consideration in the development of dissolved aluminum and pH TMDLs. AMD is drainage that flows from open or deep mines and coal refuse piles. The formation of

AMD is a function of geology, hydrology, and mining technologies used at the site. It tends to be highly acidic and to contain high concentrations of dissolved metals. These metals remain dissolved until the pH of the water increases to the level at which the metals precipitate out. AML seeps will be modeled as direct, continuous-flow sources in the model. AML and other land-based sources will be modeled using representative average concentrations for the surface, interflow and groundwater portions of the water budget.

Atmospheric deposition data will be obtained from the USEPA Office of Air Quality Planning and Standards at Research Triangle Park, North Carolina. The data are a result of air quality modeling in support of the CAIR. The data include concentrations of sulfate and nitrogen oxides in wet and dry deposition. For the technical information on these data, see the Technical Support Document for the Final Clean Air Interstate Rule—Air Quality Modeling (USEPA, 2005c). National Atmospheric Deposition Program (NADP) monitoring data will be also used to characterize the extent of atmospheric deposition in the watershed. Atmospheric deposition inputs and parameters will be calibrated using monitoring data from streams without impact of AMD or other significant sources of acidity load.

To simulate the biogeochemical process across the watershed and instream waters, the chemical reaction parameters will be calibrated using the comprehensive water quality monitoring data. The monitoring stations on streams without influence of AMD will be identified first to calibrate the atmospheric deposition module of the MDAS model. After the chemical reaction parameters will be calibrated to water quality data in those background or reference subwatersheds, water flow and chemistry data of AMD seeps will be added in the model as point source time series. The MDAS model will be further calibrated to the water quality data observed in the subwatersheds influenced by those AMD sources.

I.B.4. Biological Stressor Identification

Tetra Tech has provided stressor identification (SI) and biological TMDL support for WVDEP to confidently arrive at the causative stressors and appropriately develop pollutant specific TMDLs for each of the biologically impaired streams. Table I.B-1 provides a summary of previous TMDL Groups and number of biological impairments completed or under development for each.

Table I.B-1. Biologically Impaired Streams Summary

TMDL Group	Total Number of Biological Impairments
A	45
B	48
C	35
D	25
E	51
A2	25
B2	95
C2	77*
D2	50*
E2	138*
TOTAL	**592**

*Under development

I.B.4.a. Data Analysis and Review from WABbase

To begin the SI process, Tetra Tech will review data sources, most importantly, WVDEP's WABbase, warehoused in an Oracle platform with a Microsoft® Access relational database interface. Guided by the comprehensive SI conceptual model, which represents all potential causes and sources of stress leading to biological impairment, Tetra Tech will identify all WABbase data that are available to inform our analysis of the likelihood of each candidate cause of biological impairment in each listed stream.

Building on our experience working with WABbase and WVDEP biologists, Tetra Tech will conduct a thorough review of each data element in WABbase and construct and test queries that select and export all potentially pertinent data related to biological stress. These queries will capture data from all geographic locations that were sampled on biologically impaired streams as well as on tributaries of those streams. For each comprehensive set of sites for a biologically impaired subwatershed, the queried dataset will combine all available data relating to biological community conditions, water quality, physical habitat, and geographic data.

As part of the data review, Tetra Tech will conduct multiple quality assurance and quality control steps to assure the completeness and accuracy of data used for the SI analysis. Tetra Tech will review all station location information for sites within the biologically-impaired watersheds and subwatersheds for consistency and accuracy. Tetra Tech will continue to work with WVDEP to resolve any data quality issues that arise during the review of the data.

I.B.4.b. Additional SI Research for Dirty Null Model, Tolerance Values, and SI Threshold Values

Community Based Diagnostic Models

Supporting WVDEP TMDL development over the past 10 years, Tetra Tech has developed empirical diagnostic tools to predict the stressors most likely to have caused an observed impairment, among multiple stressors. Tetra Tech used two approaches: bottom-up, which is based on individual taxa responses; and top-down, which evaluates a biological community's response to specific stressors. The description below summarizes these two approaches for diagnostic models using the West Virginia data. Because the WVDEP dataset is very large, Tetra Tech partitioned the data to examine the macroinvertebrate community response to single stressors. Four types of environmental stressors that have been shown to negatively impact species composition were identified: conductivity/sulfate, habitat/sediment, metals associated with AMD, and organic/nutrient enrichment.

Weighted averaging (WA) regression is a bottom-up approach to develop response-based taxonomic indicators of environmental stress that builds an estimate of stressor strength from the derived tolerances of individual taxa. Tolerance values and breadth of disturbance (indicator values) were determined for individual taxa based on available literature and professional judgment. WA models were then calibrated and used to predict the environmental variables for each site based on these tolerance values and individual abundance. The predictive power of WA inference models were measured by calculating coefficients of determination (R^2) among derived and observed environmental variables. Eight WA models were developed and tested using four groups of candidate stressors based on generic-level abundance. The strongest predictive models were for acidic metals (dissolved Al) and conductivity. Benthic macroinvertebrates also responded to environmental variables (e.g., habitat, sediment, sulfate, and fecal coliform) with good predictive power.

The top-down approach is based on the hypothesis that exposure to various stressors leads to specific changes in macroinvertebrate assemblages and taxonomic composition. A "dirty reference" approach was used to define groups of sites affected by single stressors. Four "dirty" reference groups were identified and consisted of sites primarily affected by one of the following stressor categories: dissolved metals (Al and Fe); excessive sedimentation; high nutrients and organic enrichment; and increased ionic strength, using sulfate concentration as a surrogate measure. In addition, a "clean" reference group of sites with low levels of stress was identified (the WVDEP reference sites). Nonmetric multi-dimensional scaling (NMDS) and multiple response permutation procedures (MRPP) were used to examine the separation of the "dirty" reference groups from the "clean" reference groups. The results indicated that the centroids of the "dirty" reference groups were significantly different from the "clean" reference group. Of the "dirty" reference groups, the dissolved metals group was significantly different from the other three "dirty" reference groups. The other three dirty reference groups, though overlapping in ordination space to some extent, were also different from one another. Overall, each of the five "dirty reference" models were significantly different from one another, indicating that differences among stressors may have led to unique macroinvertebrate assemblages.

The dirty reference model interface was designed by Tetra Tech to accept a Microsoft® Excel input file that contains the abundance and taxa for a particular sample or group of samples. Upon execution of the model, the sample information is processed and the results for the sample or group of samples are exported to a Microsoft® Access database. Tetra Tech specifically designed the dirty null model to allow WVDEP to easily incorporate the model directly into WABbase so that the model can be run for all previous and/or future samples.

The WA indicator approach (based on taxa tolerance values) and the dirty reference approach provide valid tools for identifying environmental stressors in multiple stressor environments. These biologically based diagnostic models will be used to help facilitate SI. Model predictions for each sample will be incorporated into the strength of evidence analysis for final stressor determinations.

The RIVPACS model produces a site specific assemblage of macroinvertebrates that would be expected to be found without the presence of pollution and other environmental stress. The model takes into account various site specific parameters such as water chemistry, physical conditions and geographical location. Tetra Tech has a strong background and rich experience in developing RIVPACS models for various states and regions. With strong R programming experiences, Tetra Tech has utilized RIVPACS R scripts to develop region specific models for Idaho and Maryland. Currently, Tetra Tech is contracted by USEPA Region 8 to develop RIVPACS model for Montana. Tetra Tech developed the dirty null models for West Virginia by adopting similar theoretical and statistical concept used in the RIVPACS model.

Review and Modify Stressor Threshold Values, Stressor-Response Estimation

The next step in the process is to explore the associations between candidate stressors and biological metrics, and to infer thresholds of biological impairment for each stressor. Tetra Tech uses both the reference approach and the stressor-response relationships between biological metrics and candidate stressors to infer thresholds of biological response to stressors. The large West Virginia dataset enables Tetra Tech to examine the biological patterns along a particular gradient of interest.

Stressor Conceptual Model

During extensive experience working with WVDEP to develop USEPA-approved biological TMDLs, Tetra Tech has developed a comprehensive conceptual model of candidate causes of biological impairment (Figure I.B-6). This conceptual model provides the linkage between potential impairment causes, their sources, and the pathway by which each stressor can impact the benthic macroinvertebrate

community. Sources, impairment causes, and the resulting effects of the biological community depend on the stream or watershed in question. In some cases, biological impairment can be linked to a single stressor; in other situations, multiple stressors are responsible for the listed impairment. This conceptual stressor pathway model will be reviewed based on consultation with WVDEP and updated as necessary to capture additional potential sources of concern particular to the listed watersheds in each TMDL development group.

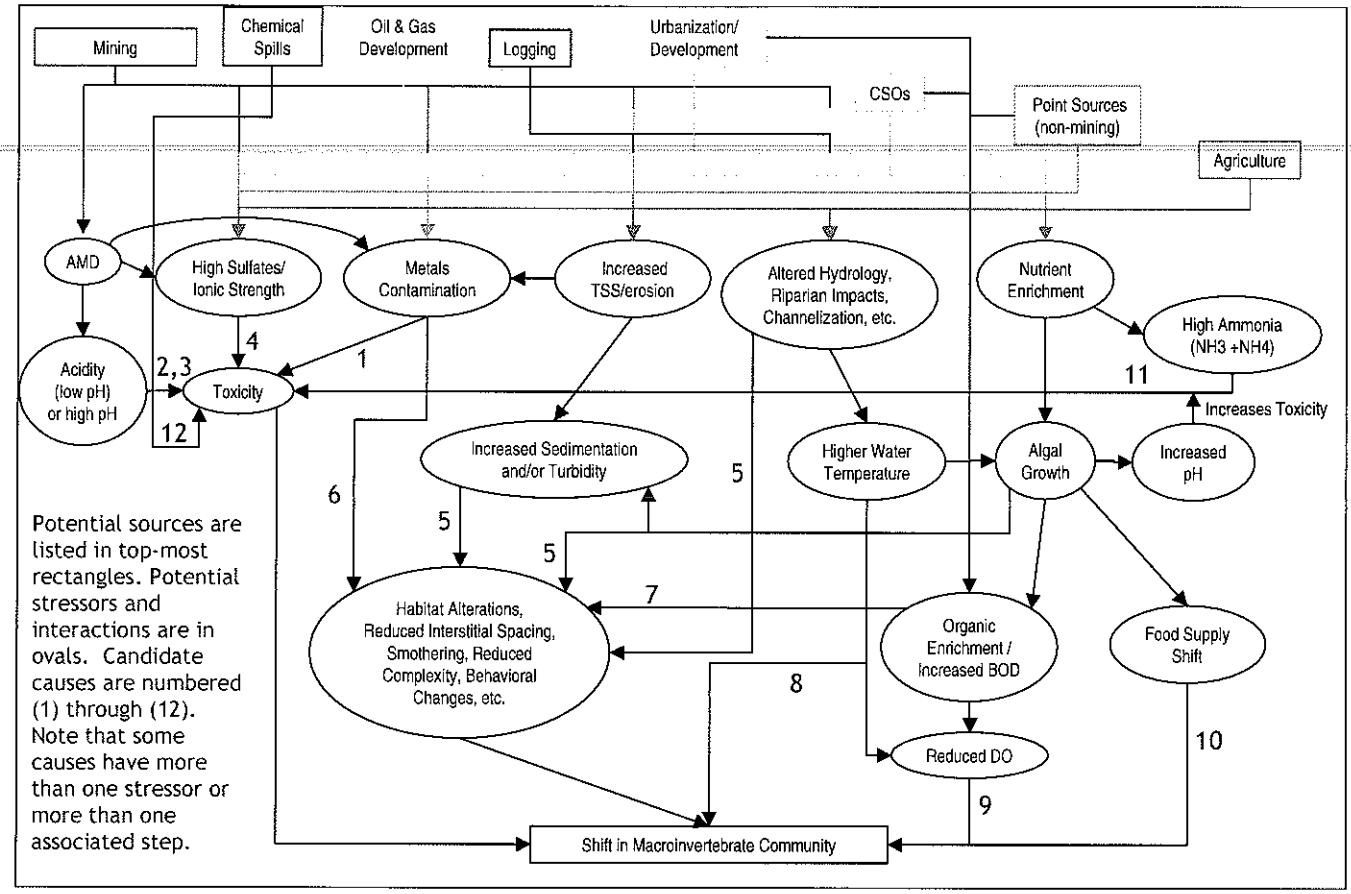


Figure I.B-6. Conceptual model of candidate causes of biological impairment

Tetra Tech will schedule and organize a biological SI meeting with WVDEP to review and discuss the details of the strength of evidence approach. This meeting will enable WVDEP and Tetra Tech to discuss the biological impairments and for WVDEP to approve or modify the stressor threshold values and conceptual model. The meeting also allows Tetra Tech to have a better understanding of the types of causative stressors that may be responsible for the biological impairments in particular watersheds.

Customized SI Database

During the preparation and review of analytical data the enormous volume of information can become overwhelming. To assist in the decision making and strength of evidence process, Tetra Tech developed a Microsoft® Access database to house all the data and create summary tables. The database builds from the chemistry, macroinvertebrate, rapid bioassessment protocol data and sampler comments provided by WVDEP. Subsequent queries format the data and begin to evaluate and normalize the data against water quality criteria and threshold values. Once the data has been normalized using a 1-6 scale for each

parameter averages can be calculated by stream and by sampling station. The database has been designed so that it can be included into WVDEP's WABbase and can be modified and expanded to incorporate changes in water quality criteria, updated in threshold criteria, or expanded to include additional water quality parameters in the future. Database features include, but are not limited to:

- Quality control to compare the work directive list to the WAB sample data to ensure that sample data and work directive list correspond to each other.
- Summary results for the biologically impaired streams on the work directive list, including the other impairments.
- A table to record the significant biological stressors and proposed TMDLs to address the biological impairments for each biologically impaired stream as determined by the strength of evidence and best professional judgment from the WVDEP and Tetra Tech biologists during the SI Workshop.

Tetra Tech and WVDEP are currently working together to streamline the presentation of the SI summary to further improve the decision making process. The final SI deliverable consists of the compilation of three months of data review, analysis, summarizing data, organizing a strength-of-evidence approach and the culmination of a best professional judgment decision made in collaboration between WVDEP and Tetra Tech biologists.

The SI results will be incorporated into a biological section for each TMDL report and the technical report. A biological TMDL table will also be presented in the TMDL Reports that demonstrates the load allocation, waste load allocation, margin of safety and the TMDL for each biologically impaired stream. The technical documentation includes a detailed technical description of the SI process and the SI results are included as a technical report appendix.

An example of the hydrologic Group C2 SI summary database for Middle Ohio River North and South Watersheds is included in Appendix A, SI Database folder.

I.B.5. Sediment-Metals Relationship

Previous TMDL modeling by Tetra Tech for WVDEP indicates that the relatively high iron content of the soils in the West Virginia watersheds is a significant factor in iron water quality criterion non-attainment. Closely related to clay deposits, iron in soils can become mobilized through precipitation-induced runoff and eventually be delivered to streams. Iron can also become entrained in stream waters via erosion processes that worsen as stream energy (discharge) increases. Therefore, modeled extreme precipitation events or a series of significant storms may result in elevated instream TSS and non-attaining iron concentrations.

Iron loads are delivered to the tributaries with surface runoff, subsurface flows, and direct point sources. Sediment-producing landuses and bank erosion are also sources of iron because iron is associated with sediment. The MDAS provides mechanisms for representing all of these various pathways of pollutant delivery. A detailed water quality analysis will be performed using statistically-based load estimates with observed flow and instream monitoring data. The confidence in the calibration process increases with the quantity and quality of the monitoring data.

Iron and TSS concentrations from pre-TMDL monitoring will be used to develop a metals-sediment correlation. Statistical analyses using monitoring data collected in the subject watersheds will be performed to establish the correlation between metals loads and sediment loads and to evaluate spatial

variability. The results will be then applied to the sediment-producing landuses during the water quality calibration phase of the MDAS. An example result of the correlation analysis is shown in Figure I.B-7.

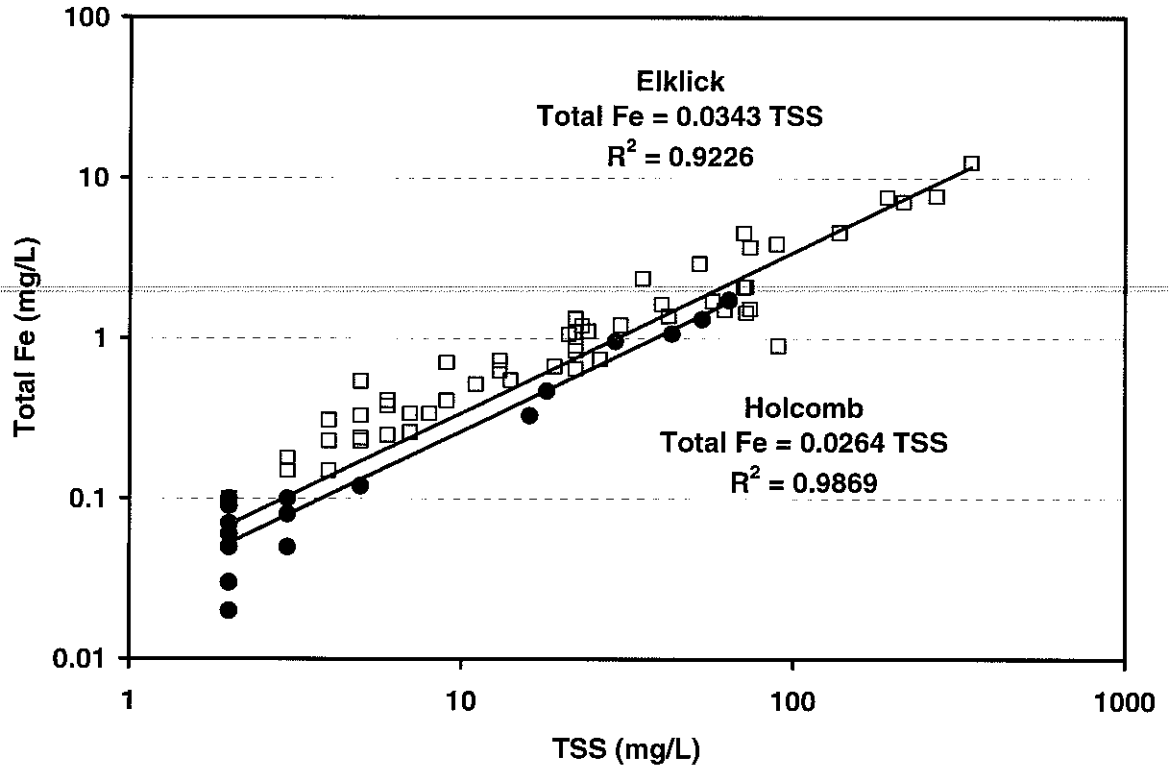


Figure I.B-7. Metals-sediment correlation

Sediment will be simulated based on the mathematical description of the soil detachment process and the sediment transport along the surface slopes. Spatial variation of the soil erodibility will be included in the model using the information retrieved from the soil database. In addition, non-sediment-related iron land-based sources will be modeled using average concentrations for the surface, interflow and groundwater portions of the water budget.

I.B.5.a. Streambank Erosion

The MDAS streambank erosion model is a function of stream flow and bank stability. The bank erosion algorithms of MDAS are based on the scour erosion algorithms of HSPF. The bank erosion rate per unit area is defined as a function of: bank flow volume above a specified threshold, the bank erodible area, the coefficient of scour for the bank soil, and an optional exponent for non-linearity. The streambank soil matrix is assumed to be unlimited, and bank scour is defined uniquely for each stream segment. Each stream segment will have a user-specified flow threshold above which streambank erosion may occur. The bank scouring process is a power function dependent on high-flow events, defined as exceeding the flow threshold. The coefficient of scour for the bank soil can be determined by calibration, where modeled bank erosion sediment loads are compared with loads calculated from the pin study and kber values are adjusted iteratively. Streambank erosion is represented as a unique source independent of other upland-associated erosion sources.

The wetted perimeter and reach length represent ground area covered by water (Figure I.B-8). The erodible wetted perimeter is equal to the difference between the actual wetted perimeter and wetted perimeter during threshold flow conditions. The bank erosion rate per unit area is multiplied by the erodible perimeter and the reach length to obtain the estimate of sediment mass eroded corresponding to the stream segment. The erodible perimeter changes for each flow value, and accounts for bank area exposed to flowing water (which is available for erosion). The bank erosion flow threshold limits the bank erosion process to instances when that flow is exceeded (extreme events).

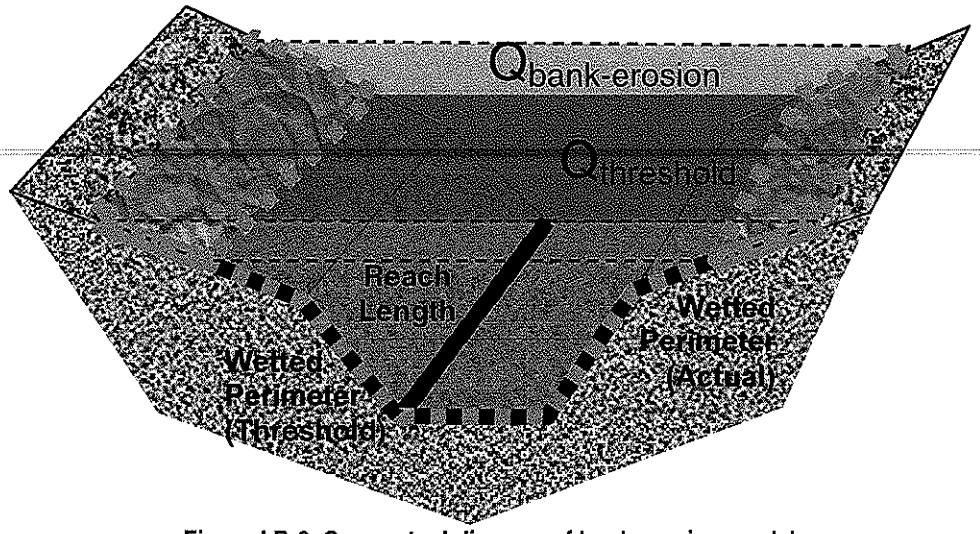


Figure I.B-8. Conceptual diagram of bank erosion model

Tetra Tech will use the results of ongoing WVDEP streambank erosion data collection efforts as described in I.B.1.c.Total Metals and Sediment Model Setup.

The WVDEP erosion pin study will provide Tetra Tech modelers with a quantitative assessment of streambank erosion contributions to stream sediment loads at bank erosion pin sites. The results from representative stream reaches will be used in conjunction with the assessed values of vegetative cover for the analysis of spatial variation in bank stability across the entire watershed. Stream sediment loading rates obtained from bank erosion pin assessments will be used as calibration endpoints for adjusting the MDAS stream bank erosion parameter. The bank erosion parameters will then be applied to the modeled stream reaches for the accurate simulation of streambank sediment loading throughout the watershed.

I.B.6. Allocations

Tetra Tech, with the help and guidance of WVDEP, will develop allocations that meet and exceed required TMDL components. Tetra Tech will simulate baseline loading conditions, define endpoints for the pollutants of concern, establish limits of source loading alternatives, and consider critical conditions in the allocation process. Following WVDEP's direction, Tetra Tech will utilize a strategy that accounts for and accomplishes a realistic prioritization of pollutant sources with allowable deviation after sensitivity analysis of sources and flow conditions. Allocations will be performed to meet pollutant specific water quality criteria, including an explicit margin of safety (MOS) (WVDEP typically assigns a 5% MOS). Allocations will target load reductions for the most significant sources whereby allocations to precipitation-induced sources will not be more stringent than concentrations of equivalent pollutants resulting from background conditions, and allocations to point sources will not be more stringent than

numerical water quality criteria. Final allocations will be presented with pollutant sources identified as to whether they are considered load allocations (LAs) or waste load allocations (WLAs).

WVDEP will be asked to provide a general allocation order, which will guide Tetra Tech in making the necessary reductions to meet fecal coliform endpoints in the priority sequence that WVDEP establishes for each watershed. To aid in the development of allocations, Tetra Tech will provide WVDEP with a baseline output viewer tool that it has developed for making rapid comparisons between baseline (un-reduced) and allocated (reduced) model scenarios. An example of an output viewer tool is included in Appendix A.

I.B.6.a Fecal Coliform Allocations

The fecal coliform TMDL endpoint will be based on the instantaneous acute water quality criterion where not more than 10 percent of all samples taken in a given month can exceed 400 counts/100mL and the chronic 30-day geometric mean of 200 counts/100mL, minus an explicit margin of safety. The approach to allocations to fecal coliform bacteria sources will start with a universal 100% reduction to untreated human sewage sources (failing septics). Using the watershed approach (headwaters will be analyzed first, with pollutant loads transferred to downstream watersheds), Tetra Tech will reduce land-based fecal sources following WVDEPs allocation strategy to meet the TMDL endpoint. Loads from CSOs will be reduced in a manner consistent with the waste water treatment system's Long Term Control Plan. Loads from MS4 communities will be identified in allocation tables and summarized by municipal jurisdiction. Tetra Tech will provide WVDEP with a filterable spreadsheet with modeled unit area loading results by subwatershed and landuse.

I.B.6.b Metals Allocations (Including Metals-Related Sediment Allocations)

The total iron TMDL endpoint for warm-water streams will be based on the chronic 4-day average of 1.5 mg/L minus an explicit margin of safety (MOS) (WVDEP typically assigns a 5% MOS). The endpoint for trout streams will be derived in the same manner, but using the chronic 4-day average of 1.0 mg/L. If, under the most stringent and unachievable allocation scenarios, modeling output does not ensure troutwater criterion attainment, Tetra Tech will work closely with WVDEP to propose phased implementation of the TMDLs under which the source allocations necessary to universally achieve an interim iron water quality target. The approach to allocations for total recoverable metals sources will be guided by WVDEP's allocation order. Tetra Tech will make necessary reductions to meet metals endpoints in the priority sequence that WVDEP establishes for each watershed. Using the watershed approach, Tetra Tech will reduce metals sources (including sediment-related metals sources) using WVDEP's allocation strategy to meet the TMDL endpoints. Given the established total iron/sediment relationship described in Section I.B.5, total iron TMDLs will serve as a surrogate for biologically impaired streams where sedimentation is determined as a stressor. Tetra Tech will verify that sediment loadings resulting from total iron TMDLs are equal or more protective than a traditional sediment TMDL using the reference watershed approach. Tetra Tech will assist WVDEP in the selection of the reference watershed when presented with a list of potential streams.

After completion of the initial allocation run, Tetra Tech will submit preliminary results, and ask WVDEP to review and directs changes. Tetra Tech will update the allocations according to WVDEP's input. Finally, allocation databases will be prepared with model output from baseline and allocation conditions. These databases will have queries that automatically prepare and format TMDL related allocation tables.

The resulting allocations will be presented on a CD as filterable spreadsheets that identify pollutant-specific and subwatershed-specific baseline and TMDL loadings for individual point sources and categories of point sources.

I.B.6.c pH and Dissolved Metals Allocations

For dissolved aluminum impaired watersheds, sources of total iron will be reduced first because existing instream total iron concentrations can significantly reduce pH and consequently increase dissolved aluminum concentrations. If the dissolved aluminum TMDL endpoint is not attained after source reductions to iron, the total aluminum source loadings will be reduced based on the methodology described above. The MDAS output will be compared directly with the TMDL endpoint. If predicted dissolved aluminum concentrations exceed the TMDL endpoint, the total aluminum sources represented in MDAS will be reduced. For subwatersheds with acidic atmospheric deposition sources and low watershed buffering capacity and no AML sources, acidity load reductions will be prescribed (via alkalinity addition) to the extent necessary to attain pH criteria at the subwatershed outlet. For subwatersheds with historical mining sources present, the predicted acid loads from atmospheric deposition will be first offset by alkalinity addition then the total aluminum loading from AMLs will be reduced to the extent necessary to attain dissolved aluminum water quality criteria.

For subwatersheds with active mining sources and AML present, the aluminum loadings from AML sources will be reduced until compliance with criteria will be attained, or to the maximum practical extent. If further reductions will be necessary or in subwatersheds with active mining point sources and no AML, the point source loadings will be reduced until criteria will be attained. All sources will be represented and provided allocations in terms of the total aluminum loadings that are necessary to attain the dissolved aluminum water quality criteria. WLAs will be developed for active mining point sources in dissolved aluminum impaired waters.

I.C. TMDL Report Development

I.C.1. Report Outline

For each TMDL watershed, Tetra Tech will develop a comprehensive TMDL report package that provides technical information sufficient to meet or exceed federal regulatory (40 CFR 130) requirements and USEPA Region III guidance for TMDL approval. The report package will list impaired streams, identify pollutant sources, and enumerate the pollutant reductions needed to achieve state water quality criteria for each of the impaired segments. Reports will also be designed to be useful resources for TMDL implementation efforts by responsible agencies and programs. The TMDL report package will consist of a general report with appendices, a technical report with appendices, and an interactive ArcGIS project that displays TMDL results in a spatial format. Report appendices will be in standard file formats such as Microsoft® Excel spreadsheets and Adobe PDF files that do not require special hardware or software to view. The entire report package will be presented in digital form on a CD-ROM. This format allows for cost-effective distribution of the report to state agency personnel, stakeholders, and the concerned public. This format also allows for easy uploading to the WVDEP website. Example TMDL packages are provided in Appendix C.

Tetra Tech has produced 16 sets of TMDL reports for the WVDEP over the past 10 years. Through multiple drafts of each TMDL report, a report format has evolved that successfully meets both client expectations and USEPA regulatory requirements. Report structure and contents of the public report, technical report, and interactive ArcGIS project are discussed in detail below.

The general report will consist of a main section, allocation Microsoft® Excel spreadsheet appendices and a supporting ArcGIS project. The main section will describe the overall TMDL development process for the TMDL watershed, identify impaired streams, and outline the source assessment of pollutants and biological stressors. It will also describe the modeling process and TMDL allocations. The general report will list measures that will be taken to ensure that the TMDLs are met. The TMDL report will also include spreadsheets that provide detailed source allocations and reductions associated with successful TMDL scenarios. The contents of the general report will consist of information organized into sections shown below. Report design will be flexible to accommodate the impairments found in each TMDL watershed. Relevant sections describing impairment-specific TMDLs will be added or deleted as necessary.

The technical report will describe in detail the methodology Tetra Tech uses to develop TMDLs. Information in the technical report will satisfy all USEPA regulatory requirements for review, thus leading to final TMDL approval. Emphasis will be placed on providing a thorough explanation of MDAS watershed model setup, calibration, and post-allocation output. Biological TMDL development and the SI process will also be described.

The technical report will also have appendices that provide supplementary graphs and spreadsheets that document the methodology described in the technical report. Appendices to the technical report will be provided as needed to describe relevant watershed features and document model development. The number of appendices per technical report is expected to be approximately eleven, based on the appendices needed for previously completed West Virginia TMDLs. Past technical report appendices have included the following information:

- Modeled landuse tables for fecal coliform and metals
- Failing septic analysis
- TSS/Metals correlation spreadsheet

- Harvested and burned forest areas
- Modeled road descriptions
- NPDES permit descriptions
- Model water quality and hydrology calibration results
- Water quality data (chemical and biological)
- Storm water permitting and MS4 discussion
- SI summary information
- 303(d) list impairments no longer effective

The interactive GIS application will be in an ArcGIS project format. The ArcGIS project will allow the user to view spatial data in detail, magnify features of interest, and identify attributes of individual features. This project will be included on the report CD-ROM.

The spatial data featured in the ArcGIS project will be organized as in Table I.C-1. Topographic maps and stream coverages will orient users, and help them find impaired streams and TMDL watersheds. Features such as AML highwalls and bond forfeiture sites will show pollutant sources. Tetra Tech is currently moving toward an online ArcGIS TMDL tool that will allow the user to view and utilize TMDL information more easily than the ArcGIS on CD-ROM format. Files will also be accessible for users to download to their own personal computers and ArcGIS-compatible software, if desired.

Table I.C-1. Example of Interactive GIS Project Shapefiles

Watershed Coverages	▪ Pre-TMDL Monitoring Sites ▪ MDAS modeled subwatersheds ▪ Impaired Streams ▪ Streams ▪ NLCD 2006 Landuse ▪ USGS 100K Topographic Map
Metals TMDL Coverages	▪ Bond Forfeiture Sites ▪ AML Discharges ▪ AML Areas ▪ AML Highwalls ▪ Valley Fill Areas ▪ Mining NPDES Outlets
Fecal TMDL Coverages	▪ Fecal POTW Discharges ▪ Agricultural Intensity ▪ Agricultural Runoff Potential ▪ MS4 Areas
Sediment TMDL Coverages	▪ Oil and Gas Wells ▪ Marcellus Shale Wells ▪ Logging Operations ▪ Burned Forest

I.C.2. Preliminary Draft TMDL Report

Tetra Tech has worked closely with WVDEP TMDL staff over the past 10 years to edit TMDL reports to client specifications. After modeling all impaired streams in the TMDL watershed, Tetra Tech will generate a preliminary draft TMDL report. This report will be submitted to WVDEP in digital format on CD-ROM, or via a restricted-access Internet ftp site. The preliminary draft report will consist of a

complete report outline with supporting text and appendices, minus any report text of regulatory nature that is the responsibility of WVDEP.

Tetra Tech will receive WVDEP comments on the preliminary draft report during the period of time between the report submittal and the final draft deliverable due date. Excellent communication between Tetra Tech and WVDEP has increased efficiency in the report editing process. Tetra Tech's local presence in Charleston, WV allows Tetra Tech technical staff to work face-to-face with the WVDEP client to execute last-minute document edits when necessary. Tetra Tech will make WVDEP edits and prepare a draft final report to be distributed for public comment.

I.D. Status Report and Other Meetings

In addition to providing bi-monthly progress reports, Tetra Tech will hold project status meetings on a monthly basis, either in-person at WVDEP headquarters, or via conference call. When complex issues arise, Tetra Tech has found that the fastest route to resolution entails visiting WVDEP's offices for an in person meeting. Meeting face to face provides both parties with an opportunity to review pertinent data and facilitates discussion. For the same reasons, project deliverables will be handed over in person. Tetra Tech will contact the WVDEP staff member(s) responsible for reviewing the deliverable to set up a meeting, during which the deliverable will be presented and discussed. This will facilitate WVDEP's review of the deliverables and keep the project running on schedule.

With each TMDL project, Tetra Tech makes staff available to tour the project watershed. Not only do the tours provide the modelers with intimate knowledge of the physical characteristics of the watershed and pollutant sources, it also provides an opportunity to identify new sources or those that need further investigation.

I.E. Public Participation Meetings

Tetra Tech will assist WVDEP with coordinating and facilitating public meetings to explain TMDL development. Tetra Tech will be available to participate in these meetings at any time and any location necessary during the TMDL process. The meetings will be designed to broaden the public's and stakeholders' understanding of the TMDL development process. Tetra Tech will prepare visual aids such as slides and customized ArcView projects for the presentations, when needed. Personnel who are intimately involved with the various aspects of TMDL development will be available to explain model components, model development, source characterization, data development, model results for both baseline and TMDL conditions and the impacts of various potential allocation scenarios. Tetra Tech has an extraordinary amount of experience in presenting our work in a public forum. Tetra Tech's presence and understanding of the concerns related to TMDL development from both a regulatory and affected party perspective will help facilitate interaction between stakeholders and WVDEP.

Tetra Tech will also be available for public meetings to discuss draft TMDL results at any time and any location necessary, providing the same services and support required for the stakeholder input meetings described above. Personnel who are intimately involved with TMDL development will be available to provide detailed information regarding the substantive components of the TMDL and to take comments from concerned stakeholders. Tetra Tech will work with WVDEP in order to provide meetings that are informative and will facilitate stakeholder involvement. Prior experience in such meetings gives Tetra Tech an understanding of the types of comments and questions that will be posed at meetings concerning draft TMDL documents and enables them to help orient stakeholders and facilitate comments on the draft TMDL.

Tetra Tech will also provide support to WVDEP during the public review and comment period by answering any technical questions posed by stakeholders and addressing any revisions to the draft TMDL as a result of stakeholder input. Policy questions or issues will be addressed by WVDEP and included in the documents once provided in electronic format to Tetra Tech.

I.F. Response to Public Comment

I.F.1. Address Comments

Tetra Tech will receive and address individual public comments on the draft final report. Public comments will be incorporated into the final document. Tetra Tech is experienced in addressing comments from a wide spectrum of West Virginia stakeholders, from industry to local watershed groups. Tetra Tech is fully prepared to defend its technical approach and TMDL results to any watershed stakeholder. Tetra Tech will prepare a responsiveness summary that will address stakeholder questions, and point to changes in the document that resulted from those questions. Tetra Tech will also provide detailed explanations to those comments that did not lead to revisions to the TMDL report. Questions or comments pertaining to state policy will be addressed by WVDEP and provided to Tetra Tech in electronic format to be included in the TMDL document response summary.

I.F.2. Final Draft TMDL Report

Upon conclusion of the editing process, Tetra Tech will submit a final TMDL report suitable for USEPA review and TMDL approval. This final report will incorporate all comments from watershed stakeholders, plus any additional comments from WVDEP. The report will be submitted in digital format on CDROM. Submittal date will be determined by the project timetable.

I.F.3. TMDL Records Retention

Tetra Tech will provide a complete administrative record for each TMDL watershed on CD-ROM to WVDEP and the USEPA upon receipt of the USEPA's final approval letter and decision rational documentation. Tetra Tech will archive all files pertaining to TMDL development and retain them for a minimum of five years. Files will be stored electronically and will be available upon request within 10 days of receiving such a request from WVDEP.

I.F.4. Schedule

Tetra Tech recognizes the need for a detailed schedule due to the relatively short timeframe in which the TMDLs are to be developed. Tetra Tech will work closely with WVDEP at the beginning of the TMDL process to develop a timeline and deliverable schedule for the steps outlined in Sections I.A,I.B, and I.C that will lead to a valid, defensible TMDL that can be approved in a timely manner. Tetra Tech has extensive experience developing TMDLs within a very short period of time and has developed a methodology for achieving that efficiently. The TMDL process is primarily a series of steps that build upon each other, leading to interim deliverables. This process begins with the review of the work directive and ends with the issuance of final reports. Although the TMDL process is primarily cumulative in nature, throughout the process there are a number of side steps that can be worked on while interim deliverables are being reviewed. Tetra Tech technical personnel will be available to meet with WVDEP as they review and provide comment on all interim deliverables. This provides for a constant flow of work throughout the contract period and maximizes efficiency throughout the review process.

An important aspect of the schedule is the review and QA/QC of datasets as they are introduced into the process. Tetra Tech recognizes that it will be working with statewide datasets, which, due to their large size, are bound to contain inconsistencies and random error. Because the TMDL development process is cumulative in nature, any errors that are not immediately identified will be propagated to each successive step in the process. Given the technical complexity and the timeframe within which these TMDLs are to be developed, having to go back and correct errors, no matter how minor, could result in future deadlines

not being met. Therefore, Tetra Tech will spend the time necessary to assist WVDEP in identifying and correcting any errors in its datasets as TMDL development proceeds in order that the final product is delivered on time.

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