PERFORMANCE WORK STATEMENT
STREAMS II
Task Order 0005, Tetra Tech EP-C-11-037

TITLE: Methodologies for Development of Numeric Nutrient Criteria for Freshwaters

Task Order Manager (TOM)	**Alternate Task Order Manager (ATOM)**
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PERIOD OF PERFORMANCE: December 5, 2012 through December 5, 2013

EPA'S SAFE AND SUSTAINABLE WATER RESEARCH PROGRAM

EPA's Safe and Sustainable Water Research Program (SSWR), within the EPA Office of Research and Development will strive to develop sustainable solutions to 21st century water resource problems by integrating research on social, environmental, and economic outcomes to provide lasting solutions. SSWR will provide the best science in a timely manner to allow faster, smarter management decisions on our existing problems. SSWR will get our science out in front of tomorrow's problems by developing and applying new approaches that better inform and guide environmentally sustainable behavior.

BACKGROUND

Excess loading of Nitrogen (N) and Phosphorus (P) is among the most prevalent cause of water quality impairment in the United States, affecting 6,950 surface water bodies for nutrients and 6,511 surface water bodies for organic enrichment/oxygen depletion (2010 CWA Sec. 303(d) List). Excess N and P in aquatic systems comes from many point and nonpoint sources, including urban and suburban stormwater runoff, municipal and industrial waste water discharges, fertilizer use, livestock production, atmospheric deposition resulting from fossil fuel combustion and ammonia emissions from industrial scale agriculture, and legacy groundwater nutrient pollution. Land use alterations in watersheds across the nation increase the fraction of the N and P applied to the landscape that reaches surface and groundwater resources, impacting aquatic life uses, human health and economic prosperity. Climate change also has the potential to affect N and P loadings to water bodies, as well as the expression of resulting ecological impacts.

One immediate need that will support the long-term goal of optimal and sustainable nutrient management stems from an emerging view that existing narrative nutrient criteria are inadequate to protect the Nation's waters from possible impacts resulting from

nutrient enrichment. Scientifically sound methodologies are needed for translating narrative nutrient criteria to develop numeric nutrient criteria.
Although approaches for developing numeric nutrient criteria for freshwater systems (i.e., rivers, streams, lakes, reservoirs) have been proposed previously by EPA, recent experience suggests that further work to develop additional methodologies for freshwater systems would be useful. Of particular interest are approaches that (a) utilize a more direct linkage between water quality conditions and nutrient sensitive aquatic life uses, and (b) increase the utilization of local ecological information in development of nutrient criteria.

Compared to water quality criteria for other pollutants, nutrients are widely recognized to present relatively unique challenges. One challenge for developing criteria is that nutrients are necessary for proper ecosystem function and have both natural and anthropogenic sources. Nutrient concentrations vary among water bodies due to natural ecological processes and conditions. Water quality responses to nutrients, such as algal abundance (i.e., as indicated by chlorophyll-a concentration), also vary naturally. Such variations occur both in relation to nutrient inputs and independent from them, reflecting the influence of other ecological factors. It is widely apparent that anthropogenic nutrient loading causes potentially harmful changes in water quality, but the spatial and temporal scales at which such impacts are expressed can make them difficult to identify and predict.

For estuaries and other coastal systems, solutions increasingly involve system specific data analysis and modeling. This is feasible because there are a relatively small number of coastal systems (10s to 100s). Although EPA has considered estuaries and coastal waters more challenging to manage because of their complexity, managing freshwater ecosystems is equally challenging because there are so many water bodies (1000s).

One possible approach to managing nutrient enrichment in freshwater systems rests on re-casting the problem as one involving not thousands of separate water bodies (lakes and reservoirs, stream reaches, etc.), but a relatively smaller number of watersheds. Within watersheds, lakes and reservoirs (hereafter "lakes" is taken to mean both lakes and reservoirs, unless a contrast is intended) are focal points for nutrient effects resulting from nutrients transported in stream and river networks. Nutrient concentrations in lakes - and resulting water quality - reflect nutrient concentrations in the contributing rivers and streams, as modified by lake processes. Consequently, progress toward effective nutrient management in lakes could be made by improving our ability to describe nutrient sensitive aquatic life uses in lakes and possible relationships to nutrient inputs and resulting water quality. Subsequently, management of nutrients in streams and rivers that discharge into lakes may be linked to the requirements for protecting downstream lakes. A similar approach could be used to inform management of nutrients in streams and rivers that flow into downstream estuaries and coastal waters, but is not the focus of this project.

The goals of this project will be to describe new approaches that could be used to develop numeric nutrient criteria for lakes and their contributing networks of streams and rivers.

The research effort will utilize existing publications and data rather than new field studies. Project focus areas will include: (1) characterizing aquatic life uses of US lakes and identifying which among these uses are most sensitive to impacts resulting from nutrient enrichment; (2) evaluating existing science and developing new analyses to predict nutrient concentrations in lakes and their watersheds and the relationship between nutrients and support for aquatic life uses: and (3) developing methods for computing numeric nutrient criteria for streams in order to protect downstream lakes and reservoirs.

This project is planned with an overall duration of two (2) years. Initial funding is for one year, with a logical 1-year follow-on Task Order to the initial awardee. Given limited time and resources, the project will identify a target scale and/or focal locations that would enable the project to make potentially significant new advances that would assist EPA, states and tribes in developing numeric nutrient criteria. The study will balance the need to focus on limited study areas with the reality that EPA's mission requires supporting nutrient management efforts across the U.S. Accordingly, the project will divide the work effort between two appropriately scaled focal areas. For Focus Area #1, the contractor shall examine aquatic life uses in lakes and reservoirs within the upper Mississippi River basin and compare/contrast these with aquatic life uses in reservoirs within the southeastern US. Focus Area #2 shall be within the Pacific Northwest

RELATED AND SUPPORTING SSWR PROJECTS

This task order is part of an integrated research task entitled "Nutrient Management for Sustainability of Upland and Coastal Ecosystems: Building a Locally Applicable Management Tool Box for Application Across the U.S." This task is part of ORD's Safe and Sustainable Water Resources (SSWR) Task 2.3.A, for which Jim Hagy (NHEERL/GED) is the project lead. Task 2.3.A includes nearly 35 investigators across four (4) NHEERL locations. Task 2.3.A is one of several within Project 2.3 entitled, "Optimized solutions for sustainable nutrient management," for which the project lead is Walt Nelson (NHEERL/WED) Project 2.3 encompasses a significant portion of ORD's research program addressing nutrient enrichment of surface waters including rivers, streams, lakes, reservoirs, estuaries and coastal waters.

Most of the effort within SSWR Task 2.3.A is focused on developing scientific tools for managing nutrients in coastal ecosystems, including development of numeric nutrient criteria for estuaries and coastal waters. A research project within Task 2.3.A will be focused on approaches for numeric criteria development in freshwater systems and will be conducted during the period covered by this task order at the NHEERL Gulf Ecology Division (Gulf Breeze, FL).

PURPOSE OF THIS TASK ORDER

The purpose of this task order is to review and further develop scientific approaches for developing numeric nutrient criteria for freshwater systems, focusing on the concept of linking (1) criteria for streams to aquatic life use attainment in downstream lakes and reservoirs, and (2) criteria for lakes and reservoirs to attainment of their own aquatic life

uses. The purpose of the task order is also to improve methods and approaches for developing numeric criteria for streams using a reference stream approach.

It is EPA's intent to award a sole source follow-on task order, building on progress from this work, provided that satisfactory progress is made on the tasks below and that funds are available. The tasks associated with this additional work will be defined by EPA as this work develops and initial results are obtained.

DESCRIPTION OF TASKS

This task order includes a total of five (5) tasks. Tasks 1, 4 and 5 are related to planning and reporting of progress and results. Tasks 2 and 3 (and associated subtasks) are independent from each other and may be pursued concurrently.

Task 1 Establish Communication and Develop a QAPP

All work conducted under this Task Order shall be performed pursuant to an EPA-approved Quality Assurance Project Plan (QAPP). The contractor shall develop a single QAPP and submit it to EPA for review and approval by the TOM and the EPA QA Officer. The QAPP shall outline the approach and measures the Contractor will implement to ensure a high standard of quality in data analysis and written deliverables. The QAPP shall be in conformance with EPA's Requirements for Quality Assurance Project Plans (EPA QA/R-5). EPA will review and approve the QAPP within two (2) weeks after receiving it.

Task 1 Deliverable: Submit a completed QAPP to EPA for approval. Due 30 days after Task Order award date.

Task 2 Characterizing Aquatic Life Uses in Lakes and Reservoirs in the Southeast US and Upper Mississippi River Basin

1) The contractor shall evaluate aquatic life uses in lakes and reservoirs within Focus Area #1, especially those uses that may be sensitive to nutrient enrichment. Aquatic life uses shall be evaluated in the context of existing water quality standards (i.e., existing designated aquatic life uses) and applicable narrative criteria for nutrients. Evaluations of aquatic life uses under this task shall identify, where possible, practical approaches that could be used (or have been used) to quantify use attainment.

Subtask 2.1 Review of scientific literature addressing aquatic life uses in lakes and reservoirs within identified study area(s)

The contractor shall examine and evaluate the scientific literature addressing aquatic life uses in lakes and reservoirs, focusing on aquatic life uses that may be

sensitive to nutrient enrichment. Aquatic life uses of natural lakes shall be considered and evaluated separately from aquatic life uses of reservoirs such that natural differences in aquatic life uses can be recognized and understood.

Subtask 2.1 Deliverable Report on results of literature-based analysis of aquatic life uses in lakes and reservoirs. Due five (5) months after QAPP approval.

2) The contractor shall identify data and methodologies that could be used to quantify nutrient sensitive aquatic life uses in lakes and reservoirs for the purpose of numeric nutrient criteria development. Data shall be assembled and applied in one or more case studies demonstrating application of the approach. If sufficient data are lacking, one or more proposed case studies shall be described, identifying the data that would be needed to quantify aquatic life uses, and practical methods that could be used to obtain the data.

Subtask 2.2. Identify data and methodologies that could be used to quantify nutrient sensitive aquatic life uses in lakes and reservoirs for the purpose of numeric nutrient criteria development

Deliverable 2.2.1 Report on data and methodologies that have been identified, indicating which are/may be most useful for nutrient criteria development and why. Due eight (8) months after QAPP approval.

Deliverable 2.2.2 Report on one or more case studies demonstrating application of the approach to lakes or reservoirs within Focus Area #1. Due with draft final report.

Work on Task 2 shall be conducted at a scale and location (within the required focus area) conducive to project success as a demonstration (e.g., a group of several lakes).

Subtask 2.2 (Optional Activity) A broader scale of application shall be examined to determine generality and potential limitations of the identified methodologies and indicators. This activity should include enough study sites (e.g., lakes or reservoirs) within the focus area that the analysis can provide a credible analysis of generality and limits to applicability across a broader region, such as a Level III ecoregion or an entire state. This work may or may not be ordered, based on the availability of funds.

Deliverable 2.2.3 (Optional) Report on an evaluation of the generality and possible limitations to the application of the approaches that were identified or developed to quantify nutrient-sensitive aquatic life uses in Focus Area #1. Due with draft final report if ordered by EPA.

Task 3 Nitrogen and Phosphorus in Oregon Hydrologic Landscape Regions

The goal of Task 3 is to predict nutrient (N, P) concentrations in relatively un-impacted (i.e., by anthropogenic nutrient loading) surface waters, by Hydrological Landscape Region classes within the Focus Area #2, the Pacific Northwest region of the US. Subtasks require a similar approach applied at different spatial scales. In order to estimate expected concentrations for surface water nutrients, the contractor shall compile data on N and P concentrations from multiple sources. N and P data shall include both total nutrients (TN and TP) and speciation of nutrient concentrations (NO_x, NH_4^+ and PO_4^{3-}) where there is adequate data.

Work on each subtask within Task 3 shall be completed before work on subsequent subtasks is initiated.

Subtask 3.1. Acquire nutrient (N, P) data and evaluate data sufficiency for OHLR classes

1) The contractor shall acquire data on water body N and P from Oregon streams, lakes and reservoirs and maintain the data in an electronic format that will be useful for subsequent analysis. Potential data sources are described in Herlihy and Sifneos (2008) and include measurements from the EPA Wadeable Streams Assessment, as well as other probability survey data from the Pacific Northwest region. Since the publication of Herlihy and Sifneos (2008), additional probability-based sampling of wadeable streams, lakes and large rivers has been completed by EPA. EPA will provide these data sets to the contractor within 30 days after the Task Order award date. Data from non-probability based sampling such as USGS NAWQA or other monitoring programs shall be included as long as it can be assigned to an OHLR class.

   Subtask 3.1.1 Deliverable Complete acquisition of data and provide EPA with a description of the data sources that were identified and the spatial and temporal distribution of the data. Data not obtained directly from EPA shall be provided to EPA as electronic data files, if requested. Due three (3) months after QAPP approval.

2) The contractor shall assess data sufficiency by OHLR class for the entire state. In the case of insufficient data to populate all OHLR classes at state scale, the contractor shall assess data adequacy by OHLR class for a watershed such as the Willamette, Deschutes, or John Day where data density may be adequate to assess selected HLR classes.

   Subtask 3.1.2 Deliverable Report on evaluation of data sufficiency, recommendations for spatial analysis scale in Oregon, and identification of reference OHLR units. Report shall provide a narrative description of how data sufficiency was evaluated and how recommendations regarding spatial scale were

reached and tables or figures illustrating the quantity of data by OHLR class. Due three (3) months after QAPP approval.

Subtask 3.2. Relate soil N to surface water N within OHLR Classes

1) The contractor shall acquire soil nitrogen data for Oregon from the U.S. national map of soil nitrogen that has been compiled by EPA (Mark Johnson, Western Ecology Division, NHEERL, ORD, EPA).
2) The contractor shall overlay the OHLR classes on the soil map for Oregon and compute descriptive statistics for the soil nitrogen by OHLR class. The soil map database has been compiled from the STATSGO2 and SSURGO soil databases. The two databases provide information at different scales (STATSGO2, 1:250,000; SSURGO, 1:12,000 to 1:~64,000). Mednick et al. (2008) have reviewed information on the use of the two data sources for water quality modeling, and shown that there are inconsistent patterns in model estimates stemming from the use of the two data sets. A quantitative comparison of the two databases (Mednick 2010) indicates there are consistent biases associated with the use of the STATSGO model outputs.
3) The contractor shall assign a relative measure of the uncertainty associated with the soil nitrogen data by OHLR class reflecting the scale of the source of the data.

   Subtask 3.2 Deliverable Complete analysis of the relationship between soil nitrogen and water quality within OHLR classes. Provide report describing approach and results to EPA. Due 6 months after QAPP approval.

Subtask 3.3. Relate OHLR and nutrient yields estimated via SPARROW

1) The contractor shall acquire nutrient loading estimates for Oregon from the USGS SPAtially Referenced Regressions On Watershed attributes (SPARROW) model (MRB7) for the Pacific Northwest (Wise and Johnson, 2011).
2) The contractor shall overlay the SPARROW model nutrient load estimates on the OHLR classes and compute descriptive statistics for the estimated load by OHLR class.

   Subtask 3.3 Deliverable Report on descriptive statistics for loading rates by OHLR class based on SPARROW reports. Due nine (9) months after QAPP approval.

Subtask 3.4. Establish reference OHLR units by OHLR class

Following the methods of Herlihy and Stifneos (2008) the contractor shall establish a subset of "reference" OHLR units by OHLR class representing the least disturbed conditions. Quartile concentration values of Total N and Total P should be computed from empirical data for all OHLR classes for both the all available data and for the reference condition subset of OHLR units. If data permits, similar values should be calculated for the soil N estimates and modeled N and P load estimates.

Subtask 3.4 Deliverable Complete work on Task 3.4 and report on findings as part of annual report (Task 5). Due with draft final report.

Task 4 Mid-Year Face-to-Face Progress Meeting with EPA/ORD Staff

Two (2) weeks after submission of the 6-month progress report to EPA, contractor staff shall participate in a face-to-face meeting with EPA/ORD staff, to be held at EPA facilities in Gulf Breeze, FL. An alternative location may be selected if mutually agreeable to EPA and the contractor. The contractor shall present progress to date to and discuss plans to complete the remainder of the tasks.

Task 4 Deliverable Provide EPA with electronic copy of presentation materials at conclusion of meeting.

Task 5 Final Reporting of Results

Deliverable 5.1 Provide draft report describing all work on Task 2 and Task 3, including background information, methods, results and major conclusions. Report shall be accompanied by electronic data files that were modified or created in the course of completing the contract tasks. Due 10 months after QAPP approval. EPA will provide comments on the draft report within two (2) weeks after receiving the report.

Deliverable 5.2 Submit final report, with edits to draft report, addressing EPA comments on draft report. Due 11 months after approval of QAPP.

Deliverable 5.3 Present findings to EPA ORD, Regional and Program Office staff via teleconference and address questions from EPA staff regarding the 1-year report. Due within one (1) week after submission of annual report to EPA.

DELIVERABLES SUMMARY

The contractor shall provide EPA with monthly reporting on effort and progress on the tasks and shall participate in conference calls as requested by EPA. A face-to-face meeting is planned at mid-year. Final reporting is via written reports and oral presentations via web-enabled teleconference. Written products shall be provided to EPA as both Microsoft Word documents and Adobe Portable Document Files.

Deliverable	Description	Due Date*
1	Submit a completed QAPP to EPA approval.	30 days after Task Order award

3.1.1	Complete acquisition of data and provide EPA with a description of the data sources that were identified and the spatial and temporal distribution of the data. Data not obtained directly from EPA shall be provided to EPA as electronic data files, if requested.	Three (3) months after QAPP approval
3.1.2	Report on evaluation of data sufficiency, recommendations for spatial analysis scale in Oregon, and identification of reference OHLR units. Report shall provide a narrative description of how data sufficiency was evaluated and how recommendations regarding spatial scale were reached and tables or figures illustrating the quantity of data by OHLR class.	Three (3) months after QAPP approval
2.1	Report on results of literature-based analysis of aquatic life uses in lakes and reservoirs	Five (5) months after QAPP approval
3.2	Complete analysis of the relationship between soil nitrogen and water quality within OHLR classes. Provide report describing approach and results to EPA.	Six (5) months after QAPP approval
4	Face-to-face meeting with EPA/ORD staff	Two (2) weeks after submission of the 6-month progress report to EPA
2.2.1	Report on data and methodologies that have been identified, indicating which are may be most useful for nutrient criteria development and why.	Eight (8) months after QAPP approval
3.3	Report on descriptive statistics for loading rates by OHLR class based on SPARROW reports	Nine (9) months after QAPP approval
2.2.2	Report on one or more case studies demonstrating application of the approach to lakes or reservoirs within focus area #2	With draft annual report
2.2.3	Report on an evaluation of the generality and possible limitations to the application of the approaches that were identified or developed to quantify nutrient-sensitive aquatic life uses in Focus Area #1.	With draft annual report if ordered by EPA.
3.4	Complete work on task 3.4 and report on findings as part of annual report	With draft annual report
5.1	Provide draft report describing all work on Tasks 1-3, including background information, methods, results and major conclusions. Report shall be accompanied by electronic data files that were modified or created in the course of completing the contract tasks.	10 months after QAPP approval
5.2	Submit final report, with edits to draft report addressing comments from EPA.	11 months after QAPP approval

5.3	Present Year 1 findings to EPA ORD, Regional and Program Office Staff via teleconference	Due one (1) week after submission of annual report to EPA.

* Due dates are relative to date of QAPP approval unless otherwise indicated.

REFERENCES

Dodds, W. K., and R. M. Oakes. 2004. A technique for establishing reference nutrient concentrations across watersheds affected by humans. Limnology and Oceanography: Methods 2:333–341.

Herlihy, AT and JC Sifneos. 2008. Developing nutrient criteria and classification schemes for wadeable streams in the conterminous US. Journal of the North American Benthological Society. 27(4): 932-948.

Mednick, A.C., J. Sullivan, and D.J. Watermolen. 2008. Comparing the Use of STATSGO and SSURGO Soils Data in Water Quality Modeling: A Literature Review. Research/management Findings. Bureau of Science Services, Wisconsin Department of Natural Resources. PUB-SS-760. December 2008. Issue 60. pp. 6. http://dnr.wi.gov/org/es/science/publications/PUB_SS_760_2008.pdf

Mednick, A.C. 2010. Does soil data resolution matter? State Soil Geographic database versus Soil Survey Geographic database in rainfall-runoff modeling across Wisconsin. Journal of Soil and Water Conservation May/June 2010 vol. 65 no. 3 190-199.

Smith, R. A., R. B. Alexander, and G. E. Schwarz. 2003. Natural background concentrations of nutrients in streams and rivers of the conterminous United States. Environmental Science Technology 37:3039–3047.

USEPA (US Environmental Protection Agency). 2000b. Ambient water quality criteria recommendations. Information supporting the development of state and tribal nutrient criteria for rivers and streams in nutrient ecoregion III. EPA 822-B-00-016. Office of Water, US Environmental Protection Agency, Washington, DC.

Vaga, R. M., A. T. Herlihy, R. Miller, and M. M. Sytsma. 2006. A classification of Pacific Northwest reservoirs with respect to nutrient processing. EPA 910-R-06-003. Region 10, US Environmental Protection Agency, Seattle, Washington.

Vaga, R. M., R. R. Petersen, M. M. Sytsma, M. Rosenkrantz, and A. T. Herlihy. 2005. A classification of lakes in the Coast Range ecoregion with respect to nutrient processing. EPA 910-R-05-002. Region 10, US Environmental Protection Agency, Seattle, Washington.

Wise, DR and HM Johnson. 2011. Surface-water nutrient conditions and sources in the United States Pacific Northwest. Journal of the American Water Resources Association. 47(5): 1110-1135.

Wolock, DM, 2003, Hydrologic landscape regions of the United States: U.S. Geological Survey Open-File Report 03–145, digital spatial data, available on World Wide Web (http://ks.water.usgs.gov/pubs/abstracts/of.03-145.htm)

Wolock, DM, TC Winter, and G McMahon. 2004. Delineation and evaluation of hydrologic-landscape regions in the United States using geographic information system tools and multivariate statistical analyses. Environmental Management, 34: S71-S88.

ATTACHMENTS:

1. Linmology and Oceanography: Methods (Dodds and Oakes 2004)
2. Policy Analysis: Natural Background Concentrations of Nutrients in Streams and Rivers of the Conterminous United States (Smith et al 2003)
3. A Classification of Lakes in the Coast Range Ecoregion with Respect to Nutrient Processing (Vaga et al 2005)
4. Ambient Water Quality Criteria Recommendations (EPA 2000b)
5. JAWRA— (Wise and Johnson 2011)
6. Delineation and Evaluation of Hydrolic-Landscape Regions in the US— (Wolock et al 2004)

ORDER FOR SUPPLIES OR SERVICES

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

1. DATE OF ORDER: 12/05/2012

2. CONTRACT NO. (If any): EP-C-11-037

3. ORDER NO.: 0005

4. REQUISITION/REFERENCE NO.: PR-ORD-12-03107

5. ISSUING OFFICE (Address correspondence to):
CPOD
US Environmental Protection Agency
26 West Martin Luther King Drive
Mail Code: NWD
Cincinnati OH 45268

6. SHIP TO:
a. NAME OF CONSIGNEE: ORD NHEERL FL SACO
b. STREET ADDRESS: US Environmental Protection Agency
Gulf Ecology Division
1 Sabine Island Drive
Building 65
c. CITY: Gulf Breeze
d. STATE: FL
e. ZIP CODE: 32561-5299
f. SHIP VIA

7. TO: (b)(4)
a. NAME OF CONTRACTOR: TETRA TECH EM, INC.
b. COMPANY NAME
c. STREET ADDRESS: 1881 CAMPUS COMMONS DRIVE
SUITE 200
(b)(4)
d. CITY: RESTON
e. STATE: VA
f. ZIP CODE: 201911519

8. TYPE OF ORDER
☐ a. PURCHASE
REFERENCE YOUR:
Please furnish the following on the terms and conditions specified on both sides of this order and on the attached sheet, if any, including delivery as indicated.
☒ b. DELIVERY
Except for billing instructions on the reverse, this delivery order is subject to instructions contained on this side only of this form and is issued subject to the terms and conditions of the above-numbered contract.

9. ACCOUNTING AND APPROPRIATION DATA: See Schedule

10. REQUISITIONING OFFICE: CPOD

11. BUSINESS CLASSIFICATION (Check appropriate box(es))
☐ a. SMALL ☒ b. OTHER THAN SMALL ☐ c. DISADVANTAGED ☐ d. WOMEN-OWNED ☐ e. HUBZone
☐ f. SERVICE-DISABLED VETERAN-OWNED ☐ g. WOMEN-OWNED SMALL BUSINESS (WOSB) ELIGIBLE UNDER THE WOSB PROGRAM ☐ h. EDWOSB

12. F.O.B. POINT

13. PLACE OF
a. INSPECTION: Destination
b. ACCEPTANCE: Destination

14. GOVERNMENT B/L NO.

15. DELIVER TO F.O.B. POINT ON OR BEFORE (Date)

16. DISCOUNT TERMS

17. SCHEDULE (See reverse for Rejections)

ITEM NO. (a)	SUPPLIES OR SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	DUNS Number: (b)(4) Methodologies for Development of Numberic Nutrient Criteria for Freshwaters TOPO: James D. Hagy Continued ...					

18. SHIPPING POINT

19. GROSS SHIPPING WEIGHT

20. INVOICE NO.

17(h) TOTAL (Cont. pages): $255,767.88

21. MAIL INVOICE TO:
a. NAME: RTP Finance Center
b. STREET ADDRESS (or P.O. Box): US Environmental Protection Agency
RTP-Finance Center (D143-02)
109 TW Alexander Drive
c. CITY: Durham
d. STATE: NC
e. ZIP CODE: 27711

SEE BILLING INSTRUCTIONS ON REVERSE

17(i) GRAND TOTAL: $255,767.88

22. UNITED STATES OF AMERICA BY (Signature)

23. NAME (Typed): Camille W. Davis
TITLE: CONTRACTING/ORDERING OFFICER

ORDER FOR SUPPLIES OR SERVICES
SCHEDULE - CONTINUATION

IMPORTANT: Mark all packages and papers with contract and/or order numbers.

DATE OF ORDER	CONTRACT NO.	ORDER NO.
12/05/2012	EP-C-11-037	0005

ITEM NO. (a)	SUPPLIES/SERVICES (b)	QUANTITY ORDERED (c)	UNIT (d)	UNIT PRICE (e)	AMOUNT (f)	QUANTITY ACCEPTED (g)
	Admin Office: CPOD US Environmental Protection Agency 26 West Martin Luther King Drive Mail Code: NWD Cincinnati OH 45268 Accounting Info: 12-13-C-26XQ000-202FK7-2532-1226XQE079-001 BFY: 12 EFY: 13 Fund: C Budget Org: 26XQ000 Program (PRC): 202FK7 Budget (BOC): 2532 DCN - Line ID: 1226XQE079-001 Period of Performance: 09/14/2011 to 08/31/2016					
0001	Level of Effort Contract Award Type: Cost-plus-fixed-fee Total Estimated Cost: (b)(4) Fixed Fee: (b)(4) Completion Form Period of Performance: 12/05/2012 to 12/05/2013				255,767.88	

TOTAL CARRIED FORWARD TO 1ST PAGE (ITEM 17(H)) $255,767.88

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE

PAGE 1 OF PAGES 2

2. AMENDMENT/MODIFICATION NO.: 001

3. EFFECTIVE DATE: See Block 16C

4. REQUISITION/PURCHASE REQ. NO.: PR-ORD-12-03107

5. PROJECT NO. *(If applicable)*

6. ISSUED BY CODE: CPOD

CPOD
US Environmental Protection Agency
26 West Martin Luther King Drive
Mail Code: NWD
Cincinnati OH 45268

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

TETRA TECH EM, INC.
Attn: (b)(4)
1881 CAMPUS COMMONS DRIVE
SUITE 200
(b)(4)
RESTON VA 201911519

CODE (b)(4) FACILITY CODE

(x) 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED *(SEE ITEM 11)*

x 10A. MODIFICATION OF CONTRACT/ORDER NO. EP-C-11-037 0005

10B. DATED *(SEE ITEM 13)* 12/05/2012

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.
Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*
See Schedule

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
X	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF: Changes-Cost-Reimbursement, 52.243-2
	D. OTHER *(Specify type of modification and authority)*

E. IMPORTANT: Contractor ☐ is not, ☒ is required to sign this document and return 1 copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

DUNS Number: (b)(4)
The purpose of this modification is to revise the Task Order period of performance. The end date of the Task Order is changed from 12/05/13 to 01/10/14. This is a No Cost extension. See attached revised schedule.
TOPO: James D. Hagy
LIST OF CHANGES:
Reason for Modification : Supplemental Agreement

CHANGES FOR LINE ITEM NUMBER: 1
End Date changed from 05-DEC-13 to 10-JAN-14

Continued ...

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)* Camille W. Davis	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

NAME OF OFFEROR OR CONTRACTOR
TETRA TECH EM, INC.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	This is a No Cost Change to the Task Order. See attached page for Revised Deliverable dates. Payment: RTP Finance Center US Environmental Protection Agency RTP-Finance Center (D143-02) 109 TW Alexander Drive Durham NC 27711 Period of Performance: 09/14/2011 to 08/31/2016				

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE

PAGE 1 OF PAGES 2

2. AMENDMENT/MODIFICATION NO. 002

3. EFFECTIVE DATE 10/29/2013

4. REQUISITION/PURCHASE REQ. NO.

5. PROJECT NO. *(If applicable)*

6. ISSUED BY CODE CPOD

CPOD
US Environmental Protection Agency
26 West Martin Luther King Drive
Mail Code: NWD
Cincinnati OH 45268

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

TETRA TECH EM, INC.
Attn: (b)(4)
1881 CAMPUS COMMONS DRIVE
SUITE 200
(b)(4)
RESTON VA 201911519

CODE (b)(4) FACILITY CODE

(x) 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED *(SEE ITEM 11)*

x 10A. MODIFICATION OF CONTRACT/ORDER NO. EP-C-11-037 0005

10B. DATED *(SEE ITEM 13)* 12/05/2012

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.
Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*
See Schedule

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
X	D. OTHER *(Specify type of modification and authority)* Mutual Agreement between the Parties and Tetra Tech's e-mail dated October 24, 2013

E. IMPORTANT: Contractor ☒ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

DUNS Number: (b)(4)
The purpose of this modification is to extend the Period of Performance through February 14, 2014 as the result of the government shutdown. This is a No Cost extension.
TOPO: James D. Hagy
LIST OF CHANGES:
Reason for Modification: Extend Period of Performance

Period Of Performance End Date changed
From: January 10, 2014
To: February 14, 2014

Continued ...

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)* Camille W. Davis	
15B. CONTRACTOR/OFFEROR *(Signature of person authorized to sign)*	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA *(Signature of Contracting Officer)*	16C. DATE SIGNED

NAME OF OFFEROR OR CONTRACTOR
TETRA TECH EM, INC.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	This is a No Cost extension. Delivery Location Code: ORD NHEERL FL SACO ORD NHEERL FL SACO US Environmental Protection Agency Gulf Ecology Division 1 Sabine Island Drive Building 65 Gulf Breeze FL 32561-5299 USA Payment: RTP Finance Center US Environmental Protection Agency RTP-Finance Center (D143-02) 109 TW Alexander Drive Durham NC 27711 Period of Performance: 09/14/2011 to 02/14/2014				

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE

PAGE 1 OF PAGES 2

2. AMENDMENT/MODIFICATION NO. 003

3. EFFECTIVE DATE 03/04/2014

4. REQUISITION/PURCHASE REQ. NO.

5. PROJECT NO. *(If applicable)*

6. ISSUED BY CODE CPOD

CPOD
US Environmental Protection Agency
26 West Martin Luther King Drive
Mail Code: NWD
Cincinnati OH 45268

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

TETRA TECH EM, INC.
Attn: (b)(4)
1881 CAMPUS COMMONS DRIVE
SUITE 200
(b)(4)
RESTON VA 201911519

CODE (b)(4) FACILITY CODE

(x) 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED *(SEE ITEM 11)*

x 10A. MODIFICATION OF CONTRACT/ORDER NO. EP-C-11-037 0005

10B. DATED *(SEE ITEM 13)* 12/05/2012

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.
Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended, by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted; or (c) By separate letter or telegram which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted, such change may be made by telegram or letter, provided each telegram or letter makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*
See Schedule

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation date, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
X	D. OTHER *(Specify type of modification and authority)* Mutual Agreement between the Parties and Tetra Tech's e-mail dated March 3, 2014

E. IMPORTANT: Contractor ☒ is not, ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

DUNS Number: (b)(4)
The purpose of this modification is to extend the April 15, 2014 to allow the government additional time to review the final report. This is a No Cost extension.
TOPO: James D. Hagy
LIST OF CHANGES:
Reason for Modification : No Cost Extension

Period Of Performance End Date changed
From: February 14, 2014
To: April 15, 2014

Continued ...

Except as provided herein, all terms and conditions of the document referenced in Item 9A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*

16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*
Camille W. Davis

15B. CONTRACTOR/OFFEROR
(Signature of person authorized to sign)

15C. DATE SIGNED

16B. Camille W. Davis ELECTRONIC SIGNATURE

16C. DATE SIGNED 03/04/2014

NAME OF OFFEROR OR CONTRACTOR
TETRA TECH EM, INC.

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	This is a No Cost extension. Delivery Location Code: ORD NHEERL FL SACO ORD NHEERL FL SACO US Environmental Protection Agency Gulf Ecology Division 1 Sabine Island Drive Building 65 Gulf Breeze FL 32561-5299 USA Payment: RTP Finance Center US Environmental Protection Agency RTP-Finance Center (D143-02) 109 TW Alexander Drive Durham NC 27711 Period of Performance: 09/14/2011 to 04/15/2014				