

Dewberry Consultants, LLC
8401 Arlington Blvd
Fairfax, VA 22031
TIN# 54-0604420
DUNS# 051-758-449

Nebraska Community Foundation, Inc.
PO Box 83107
Lincoln, NE 68501-3107
TIN# 47-0769903

PLATTE RIVER RECOVERY IMPLEMENTATION PROGRAM

Contract between Nebraska Community Foundation, Inc., Platte River Recovery Implementation Program, and Dewberry Consultants, LLC.

Platte River Basin Seasonal Streamflow Forecasting Using Hydroclimatic Indices, Phase II

1. **Parties.** This Contract is made and entered into by and between the Nebraska Community Foundation, Inc. (“**Foundation**”) of Lincoln, Nebraska, representing all signatories to the Platte River Recovery Implementation Program (“**Program**”) and Dewberry Consultants LLC (“**Consultant**”). The following persons are authorized to represent the parties through this Contract: Diane Wilson of the Foundation, Dr. Jerry Kenny of the **Program**; and Jerry Sparks (Administrative) and Stuart Geiger (Technical) of the **Consultant**.

2. **Purpose of Contract.** The purpose of this Contract is to allow the **Foundation**, acting as the fiscal agent for the Governance Committee (GC) of the **Program**, to retain the services of the **Consultant** to render certain technical or professional services hereinafter described in connection with an undertaking to be financed by the **Program**, and to delegate the Executive Director’s Office (“**ED Office**”) through its Executive Director or his designee the authority to administer this Contract.

TERMS AND CONDITIONS

3. **Term of Contract and Required Approvals.** This Contract is effective when all parties have executed it and all required approvals have been granted. The term of this Contract is from May 1, 2015 through January 31, 2016. The services to be performed under this Contract will commence upon receipt of authorization to proceed. All services shall be completed during this term.

If the **Consultant** has been delayed and as a result will be unable, in the opinion of the **Program**, to complete performance fully and satisfactorily within this Contract period, the **Consultant** may be granted an extension of time, upon submission of evidence of the causes of delay satisfactory to the **Program**.

4. Payment.

A. Reimbursement of Expenses. The **Program** agrees to pay the **Consultant** an amount based on the approved budget and hourly rate and reimbursable expenses price schedules depicted in Exhibit B, attached to this Contract and incorporated by reference as part of this Contract, for the services described in Exhibit A, attached to this Contract and incorporated by reference as part of this Contract. Total payment under this Contract for Task 1 shall not exceed fifty-two thousand, dollars (\$52,000.00).

B. Project Budget. The Project budget for each task included in Exhibit A is as follows:

<u>Task</u>	<u>Estimated Cost</u>
North Platte Tasks	
Task 1 – Update HCI’s	\$5,613
Task 2 – Add Snowpack Data	\$2,197
Task 3 – Extend Prediction Upstream	\$6,772
Task 4 – Validate Results and Issue Report	\$10,894
Task 5 – 2016 Forecast Memo	\$500
South Platte Tasks	
Task 1 – Update Input Data	\$3,799
Task 2 – Construct Streamflow Prediction	\$10,982
Task 3 – Validate Results and Issue Report	\$10,723
Task 4 – 2016 Forecast Memo	\$500
TOTAL Project Cost	\$51,979

The amounts for each task are estimates only, but are not to be exceeded unless authorized in writing by the **Program**. The Contract total amount is controlling. Payment shall be made directly to the **Consultant**. The **Consultant** shall maintain hourly records of time worked by its personnel to support any audits the **Program** may require. Billing reports shall be submitted no more often than monthly for activities and costs accrued since the last billing report. A brief project progress report summarizing project activities in the billing period must be submitted with each billing.

C. Billing Procedures. The **Consultant** shall send billing reports for services performed for the various tasks outlined in Exhibit A to the **ED Office** (address included below). The Program’s Executive Director, upon receiving the billing report, will approve the bill and submit the bill for payment. The submittal for payment will then be reviewed by the Signatory Parties of the Program who will advise the **Foundation** of approval. The **Foundation** will make payment of these funds directly to the **Consultant** within 30 days of notice of approval by the Signatory Parties. Payments of bills are due within 60 days after the billing date of the Consultant.

Billing Point of Contact (Program):

Dr. Jerry F. Kenny, Executive Director
Platte River Recovery Implementation Program
Headwaters Corporation
4111 4th Avenue, Suite 6
Kearney, Nebraska 68845
Phone: (308) 237-5728
Fax: (308) 237-4651
Email: kennyj@headwaterscorp.com

D. Money Withheld. When the **Program** has reasonable grounds for believing that the **Consultant** will be unable to perform this Contract fully and satisfactorily within the time fixed for performance, then the **Program** may withhold payment of such portion of any amount otherwise due and payable to the **Consultant** reasonably deemed appropriate to protect the **Program** against such loss. These amounts may be withheld until the cause for the withholding is cured to the **Program's** satisfaction or this Contract is terminated pursuant to Section 8U. Any amount so withheld may be retained by the **Program** for such period as it may deem advisable to protect the **Program** against any loss. This provision is intended solely for the benefit of the **Program** and no person shall have any right against the **Program** by reason of the **Program's** failure or refusal to withhold monies. No interest shall be payable by the **Program** on any amounts withheld under this provision. This provision is not intended to limit or in any way prejudice any other right of the **Program**.

E. Withholding of Payment. If a work element has not been received by the **Program** by the dates established in Exhibit A, the **Program** may withhold all payments beginning with the month following that date until such deficiency has been corrected.

F. Final Completion and Payment. The final payment shall be made upon acceptance of the final report and receipt of the final billing.

5. Responsibilities of Consultant.

A. Scope of Services. The **Consultant** shall perform the specific services required under this Contract in a satisfactory and proper manner as outlined in Exhibit A. If there is any conflict between this Contract and the provisions of the specific requirements of Exhibit A, the specific requirements shall prevail.

B. Personnel. All of the services required hereunder will be performed by the **Consultant** or under its supervision, and all personnel engaged in the work shall be fully qualified and shall be authorized, licensed, or permitted under state law to perform such services, if state law requires such authorization, license, or permit.

C. Subcontracts.

(i) **Approval Required for Subcontracts.** Any subcontractors and outside associates or consultants required by the **Consultant** in connection with the services, work performed or rendered under this Contract will be limited to such individuals or firms as were specifically identified in the proposal and agreed to during negotiations or are specifically authorized by the **Program** during the performance of this Contract. The **Consultant** shall submit a list of the proposed subcontractors, associates or consultants; the scope and extent of each subcontract; and the dollar amount of each subcontract prior to Contract execution to the **Program** for approval. During the performance of the Contract, substitutions in or additions to such subcontracts, associates, or consultants will be subject to the prior approval of the **Program**. The **Program** approval of subcontractors will not relieve the **Consultant** from any responsibilities outlined in this Contract. The **Consultant** shall be responsible for the actions of the subcontractors, associates, and subconsultants.

(ii) **Billings for Subcontractors.** Billings for subcontractor, associates or subconsultants services will not include any mark up. The subcontract costs will be billed to the **Program** at the actual costs as billed to the **Consultant**. Subcontract costs will be documented by attaching subcontractor billings to the **Consultant's** billing submittals.

(iii) **Copies of Subcontracts.** The **Consultant** shall provide to the **Program** copies of each subcontractor contract immediately following execution with the subcontractor. All subcontracts between the **Consultant** and a subcontractor shall refer to and conform to the terms of this Contract. However, nothing in this Contract shall be construed as making the **Program** a party of any subcontract entered between the **Consultant** and a subcontractor.

D. Requests from the Program. The **Consultant** shall be responsible and responsive to the **Program** and the **ED Office** in their requests and requirements related to the scope of this Contract. If any of the request or requirements result in a change of scope schedule, and/or budget, the contract will be modified accordingly by mutual consent to reflect such changes.

E. Presentation of Data. The **Consultant** shall select and analyze all data in a systematic and meaningful manner so as to contribute directly in meeting the objectives of the Project, and shall present this information clearly and concisely, in a professional manner.

F. Draft of Final Report. The **Consultant** shall present the **Program** a draft of the final report covering all work elements of the Project including maps, charts, conclusions and recommendations prior to the publication of any final report and no later than the date specified in Exhibit A. Draft Reports will be provided to the Program in Microsoft Word format for distribution and review. The **Program** will respond with written comments to the **Consultant** as soon as possible. The **Consultant** will address the comments of the **Program** in the final report. Final Reports will be provided to the Program in Microsoft Word and PDF format.

G. Project Completion Report. A final project completion report in the form described in Exhibit A shall be submitted to the **Program** by the date specified in Exhibit A.

H. Reports, Maps, Plans, Models and Documents. One (1) copy of maps, plans, worksheets, logs, field notes and other reference or source documents prepared for or gathered under this Contract, and one (1) copy of each unpublished report prepared under this Contract shall be submitted to the Program. If the Consultant writes or uses a computer program or spreadsheet as a part of this project, the Consultant shall submit to the Program for approval all proposed program names and data formats prior to beginning work on that task. All data shall be submitted to Program in written and digital forms with the final report. Digital media shall be labeled by the Consultant to provide sufficient detail to access the information on the media. All user manuals shall be submitted by the Consultant to Program providing complete documentation of computer programs developed under this Contract. The user manual shall also specify the source code language and the type of computer equipment necessary to operate the program(s). Any programs or computer software generated as a part of this Contract shall be the sole property of the Program.

I. Inspection and Acceptance. All deliverables furnished by the Consultant shall be subject to rigorous review by the Program's ED Office prior to acceptance.

6. Responsibilities of the Program.

A. Designated Representative. The Executive Director of the Program shall act as the Program's administrative representative with respect to the Consultant's service to be performed under this Contract and shall have complete authority to transmit instructions, receive information, and interpret and define the Program's policies and decisions with respect to services covered by this Contract.

B. Data to be Furnished to the Consultant. All information, data, reports, and maps as are available to the Program and necessary for the carrying out of the Scope of Services set forth herein shall be furnished to the Consultant without charge and the ED Office shall cooperate with the Consultant in the carrying out of the project.

C. Review Reports. The ED Office shall examine all studies, reports, sketches, opinions of the construction costs, and other documents presented by the Consultant to the Program and shall promptly render in writing the Program's decisions pertaining thereto within the time periods specified in Exhibit A.

D. Provide Criteria. The ED Office shall provide all criteria and full information regarding its requirements for the project.

7. Special Provisions.

A. No Finder's Fees. No finder's fee, employment agency fee, or other such fee related to the procurement of this Contract shall be paid by either party.

B. Publication. It is understood that the results of this work may be available to the **Consultant** for publication and use in connection with related work. Use of this work for publication and related work by the **Consultant** must be conducted with prior authorization from the **Program's** Technical Point of Contact.

C. Publicity. Any publicity or media contact associated with the **Consultant's** services and the result of those services provided under this Contract shall be the sole responsibility of the **Program**. Media requests of the **Consultant** should be directed to the Director of Outreach and Operations in the **ED Office**.

D. Monitor Activities. The **Program** shall have the right to monitor all Contract related activities of the **Consultant** and all subcontractors. This shall include, but not be limited to, the right to make site inspections at any time, to bring experts and consultants on site to examine or evaluate completed work or work in progress, and to observe all **Consultant** personnel in every phase of performance of Contract related work.

D. Kickbacks. The **Consultant** certifies and warrants that no gratuities, kickbacks or contingency fees were paid in connection with this Contract, nor were any fees, commissions, gifts, or other considerations made contingent upon the award of this Contract. If the **Consultant** breaches or violates this warranty, the **Program** may, at its discretion, terminate this Contract without liability to the **Program**, or deduct from the Contract price or consideration, or otherwise recover, the full amount of any commission, percentage, brokerage, or contingency fee.

E. Office Space, Equipment, and Supplies. The **Consultant** will supply its own office space, equipment, and supplies.

8. General Provisions.

A. Amendments. Any changes, modifications, revisions or amendments to this Contract which are mutually agreed upon by the parties to this Contract shall be incorporated by written instrument, executed and signed by all parties to this Contract.

B. Applicable Law/Venue. The construction, interpretation and enforcement of this Contract shall be governed by the laws of the State of Nebraska. The Courts of the State of Nebraska shall have jurisdiction over this Contract and the parties.

C. Assignment/Contract Not Used as Collateral. Neither party shall assign or otherwise transfer any of the rights or delegate any of the duties set forth in this Contract without the prior written consent of the other party. The **Consultant** shall not use this Contract, or any portion thereof, for collateral for any financial obligation, without the prior written permission of the **Program**.

D. Audit/Access to Records. The **Program** and any of its representatives shall have access to any books, documents, papers, and records of the Consultant which are pertinent to this Contract. The **Consultant** shall, immediately upon receiving written instruction from the **Program**, provide to any independent auditor, accountant, or accounting firm, access to all books, documents, papers and records of the **Consultant** which are pertinent to this Contract. The **Consultant** shall cooperate fully with any such independent auditor, accountant, or accounting firm, during the entire course of any audit authorized by the **Program**.

E. Availability of Funds. Each payment obligation of the **Program** is conditioned upon the availability of funds and continuation of the Platte River Recovery Implementation Program. If funds are not allocated and available for the continuance of the services performed by the **Consultant**, the contract may be terminated by the **Program** at the end of the period for which the funds are available. The **Program** shall notify the **Consultant** at the earliest possible time of the services which will or may be affected by a shortage of funds. No penalty shall accrue to the **Program** in the event this provision is exercised, and the **Program** shall not be obligated or liable for any future payments due or for any damages as a result of termination under this section. This provision shall not be construed to permit the **Program** to terminate this Contract to acquire similar services from another party.

F. Award of Related Contracts. The **Program** may undertake or award supplemental or successor contracts for work related to this Contract. The **Consultant** shall cooperate fully with other contractors and the **Program** in all such cases.

G. Certificate of Good Standing. **Consultant** shall provide Certificate of Good Standing verifying compliance with the unemployment insurance and workers' compensation programs prior to performing work under this Contract.

H. Compliance with Law. The **Consultant** shall keep informed of and comply with all applicable federal, state and local laws and regulations in the performance of this Contract.

I. Confidentiality of Information. All documents, data compilations, reports, computer programs, photographs, and any other work provided to or produced by the **Consultant** in the performance of this Contract shall be kept confidential by the **Consultant** unless written permission is granted by the **Program** for its release.

J. Conflicts of Interest

(i) **Consultant** shall not engage in providing consultation or representation of clients, agencies or firms which may constitute a conflict of interest which results in a disadvantage to the **Program** or a disclosure which would adversely affect the interests of the **Program**. **Consultant** shall notify the **Program** of any potential or actual conflicts of interest arising during the course of the **Consultant's** performance under this Contract. This Contract may be terminated in the event a conflict of interest arises. Termination of the Contract will be subject to a mutual settlement of accounts. In the event the contract is terminated under this provision, the **Consultant** shall take steps to insure that the file, evidence, evaluation and data are provided to the **Program** or its designee. This does not prohibit or affect the **Consultant's** ability to engage in consultations, evaluations or representation under agreement with other agencies, firms, facilities, or attorneys so long as no conflict exists.

(ii) A conflict of interest warranting termination of the Contract includes, but is not necessarily limited to, representing a client in a adversarial proceeding against the Platte River Recovery Implementation Program, its signatories, boards, commissions or initiating suits in equity including injunctions, declaratory judgments, writs of prohibition or *quo warranto*.

K. Entirety of Contract. This Contract, consisting of twelve (12) pages, Exhibit A, consisting of three (3) pages, Exhibit B, consisting of one (1) page, represents the entire and integrated Contract between the parties and supersedes all prior negotiations, representations, and agreements, whether written or oral.

L. Force Majeure. Neither party shall be liable for failure to perform under this Contract if such failure to perform arises out of causes beyond the control and without the fault or negligence of the nonperforming party. Such causes may include, but are not limited to, acts of God or the public enemy, fires, floods, epidemics, quarantine restrictions, freight embargoes, and unusually severe weather. This provision shall become effective only if the party failing to perform immediately notifies the other party of the extent and nature of the problem, limits delay in performance to that required by the event, and takes all reasonable steps to minimize delays. This provision shall not be effective unless the failure to perform is beyond the control and without the fault or negligence of the nonperforming party.

M. Indemnification. The **Consultant** shall indemnify and hold harmless the **Foundation**, the **Program**, the **ED Office**, and their officers, agents, employees, successors and assignees from any and all claims, lawsuits, losses and liability arising out of **Consultant's** failure to perform any of **Consultant's** duties and obligations hereunder or in connection with the negligent performance of **Consultant's** duties or obligations, including but not limited to any claims, lawsuits, losses or liability arising out of **Consultant's** malpractice.

N. Independent Contractor. The **Consultant** shall function as an independent contractor for the purposes of this Contract, and shall not be considered an employee of the **Program**, **Foundation** or **ED Office** for any purpose. The **Consultant** shall assume sole responsibility for any debts or liabilities that may be incurred by the **Consultant** in fulfilling the terms of this Contract, and shall be solely responsible for the payment of all federal, state and local taxes which may accrue because of this **Contract**. Nothing in this Contract shall be interpreted as authorizing the **Consultant** or its agents and/or employees to

act as an agent or representative for or on behalf of the **Foundation** or the **Program**, or to incur any obligation of any kind on the behalf of the **Foundation** or the **Program**. The **Consultant** agrees that no health/hospitalization benefits, workers' compensation and/or similar benefits available to **Foundation** or **Program** employees will inure to the benefit of the **Consultant** or the **Consultant's** agents and/or employees as a result of this Contract.

O. Notices. All notices arising out of, or from, the provisions of this contract shall be in writing and given to the parties at the address provided under this Contract, either by regular mail, facsimile, e-mail, or delivery in person.

P. Notice and Approval of Proposed Sale or Transfer of the Consultant. The **Consultant** shall provide the **Program** with the earliest possible advance notice of any proposed sale or transfer or any proposed merger or consolidation of the assets of the **Consultant**. Such notice shall be provided in accordance with the notice provision of this Contract.

Q. Ownership of Documents/Work Product/Materials. All documents, reports, records, field notes, data, samples, specimens, and materials of any kind resulting from performance of this Contract are at all times the property of the **Program**.

R. Patent or Copyright Protection. The **Consultant** recognizes that certain proprietary matters or techniques may be subject to patent, trademark, copyright, license or other similar restrictions, and warrants that no work performed by the **Consultant** or its subcontractors will violate any such restriction.

S. Proof of Insurance. The **Consultant** shall not commence work under this Contract until the **Consultant** has obtained the following insurance coverages and provided the corresponding certificates of insurance:

(i) **Commercial General Liability Insurance.** **Consultant** shall provide coverage during the entire term of the Contract against claims arising out of bodily injury, death, damage to or destruction of the property of others, including loss of use thereof, and including products and completed operations in an amount not less than Five Hundred Thousand Dollars (\$500,000.00) per claimant and One Million Dollars (\$1,000,000.00) per occurrence.

(ii) **Business Automobile Liability Insurance.** **Consultant** shall maintain, during the entire term of the Contract, automobile liability insurance in an amount not less than Five Hundred Thousand Dollars (\$500,000.00) per occurrence. Coverage will include bodily injury and property damage covering all vehicles, including hired vehicles, owned and non-owned vehicles

(iii) **Workers' Compensation or Employers' Liability Insurance.** The **Consultant** shall provide proof of workers' compensation coverage. **Consultant's** insurance shall include "Stop Gap" coverage in an amount not less than Five Hundred Thousand Dollars (\$500,000.00) per employee for each accident and disease.

(iv) **Professional Liability or Errors and Omissions Liability Insurance.** The **Consultant** shall provide proof of professional liability insurance or errors and omissions liability insurance

to protect the **Foundation**, **Program** and **ED Office** from any and all claims arising from the **Consultant's** alleged or real professional errors, omissions or mistakes in the performance of professional duties in an amount not less than One Million Dollars (\$1,000,000.00) per claim.

T. Taxes. The **Consultant** shall pay all taxes and other such amounts required by federal, state and local law, including but not limited to federal and social security taxes, workers' compensation, unemployment insurance and sales taxes.

U. Termination of Contract. This Contract may be terminated, without cause, by the **Program** upon fifteen (15) days written notice. This Contract may be terminated immediately for cause if the **Consultant** fails to perform in accordance with the terms of this Contract.

V. Third Party Beneficiary Rights. The parties do not intend to create in any other individual or entity the status of third party beneficiary, and this Contract shall not be construed so as to create such status. The rights, duties and obligations contained in this Contract shall operate only between the parties to this Contract, and shall inure solely to the benefit of the parties to this Contract. The provisions of this Contract are intended only to assist the parties in determining and performing their obligations under this Contract.

W. Time is of the Essence. Time is of the essence in all provisions of the Contract.

X. Titles Not Controlling. Titles of paragraphs are for reference only, and shall not be used to construe the language in this Contract.

Y. Waiver. The waiver of any breach of any term or condition in this Contract shall not be deemed a waiver of any prior or subsequent breach.

9. Contacts.

Administrative Point of Contact (Foundation):

Diane M. Wilson
Chief Financial and Administrative Officer
Nebraska Community Foundation
PO Box 83107
Lincoln, Nebraska 68501-3107
Phone: (402) 323-7330
Fax: (402) 323-7349
Email: dwilson@nebcommfound.org

Technical Point of Contact (Program):

Dr. Jerry F. Kenny, Executive Director
Platte River Recovery Implementation Prog.
Headwaters Corporation
4111 4th Avenue, Suite 6
Kearney, Nebraska 68845
Phone: (308) 237-5728
Fax: (308) 237-4651
Email: kennyj@headwaterscorp.com

Administrative Point of Contact (Consultant):

Jerry W. Sparks, P.E., CFM, PMP
Dewberry Consultants, LLC
8401 Arlington Blvd.
Fairfax, VA 22031
Phone: (703) 849-0476
Email: jsparks@dewberry.com

Admin. Point of Contact (Program):

Dr. Jerry F. Kenny, Executive Director
Platte River Recovery Implementation Prog.
Headwaters Corporation
4111 4th Avenue, Suite 6
Kearney, Nebraska 68845
Phone: (308) 237-5728
Fax: (308) 237-4651
Email: kennyj@headwaterscorp.com

Media Point of Contact (Program):

Dr. Bridget Barron, Director of Outreach
Platte River Recovery Implementation Prog.
Headwaters Corporation
4111 4th Avenue, Suite 6
Kearney, Nebraska 68845
Phone: (308) 237-5728
Fax: (308) 237-4651
Email: barronb@headwaterscorp.com

Technical Point of Contact (Consultant):

Stuart Geiger, P.E.
Dewberry Consultants, LLC
990 S. Broadway, Suite 400
Denver, CO 80209
Phone: (303) 951-0620
Email: sgeiger@dewberry.com

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10. Signatures. By signing this Contract, the parties certify that they have read and understood it, that they agree to be bound by the terms of the Contract, that they have the authority to sign it.

NEBRASKA COMMUNITY FOUNDATION

Diane M. Wilson
Chief Financial and Administrative Officer

Date

Dewberry Consultants, LLC

Jerry W. Sparks, P.E., CFM, PMP

Date

ATTACHMENT “A”
SCOPE OF SERVICES

Platte River Basin Seasonal Streamflow Forecasting Using Hydroclimatic Indices – Phase II

for the Platte River Recovery Implementation Program

OVERVIEW

Dewberry has previously completed separate Phase I efforts of seasonal streamflow and snowpack forecasts for the North Platte (*Relationships of Hydro-Climate Indices to Volumetric Flow in the North Platte River Basin*; hereafter, NP1) and South Platte Rivers (*Relationships of Hydro-Climate Indices to Snowpack in the South Platte River Basin*; hereafter, SP1). This combined scope serves as the basis for Phase II efforts, but keeps each basin as a separate focus to be consistent with previous work.

INTRODUCTION – NORTH PLATTE RIVER

The Platte River Basin provides crucial water to heartland agricultural and municipal users throughout eastern Colorado, southeast Wyoming and western Nebraska. The wintertime snowpack generally supplies the area with adequate water through early spring, but water management becomes increasingly important once the snowpack melts in early summer. However, the snowpack and streamflow exhibit tremendous year to year variability with low-flow years being particularly stressful on water managers, hydropower operators and other end-users alike. Thus, an early and accurate prediction of the water supply during the period of May-July is an extremely valuable tool, one that can be used to both inform water supply managers and shield end-users from dangerous low-flow periods such as the “flash drought” of 2012.

In two recently completed studies, NP1 and SP1, Dewberry developed early predictions of the South Platte River basin snowpack and North Platte River streamflow at Lewellen, NE. These forecasts, which is available by early to mid-January, showed an accuracy of 73-74% increasing to 85-88% upon inclusion of “positive misses”, or years where the snowpack or streamflow is actually *greater* than predicted. Notably, this prediction correctly forecasted several low flow years, including 2002 and 2012, with the latter being characterized by the summer “flash drought”.

Motivated by both the NP1 and SP1 results, this study has two primary goals:

- 1) **Include snowpack, measured by the Snow Water Equivalent (SWE), as a predictor variable in the North Platte River Basin.** In SP1, Dewberry found that early winter snowpack conditions provide significant predictive skill of late season snowpack. More importantly, early season snowpack also puts a strong constraint on Julesburg volumetric flow during the May-July period: a higher snowpack typically results in higher streamflow. Similar relationships are expected to hold on the NP1, and thus, inclusion of a snowpack predictor variable is expected to enhance the forecast accuracy.
- 2) **Transition from qualitative to quantitative forecast in the North Platte River Basin.** As the SP1 was conducted using, in part, the previously developed methodology of NP1, Dewberry was able to extend the scientific rigor of the analysis to develop a *quantitative* forecast. The result was undeniably positive: SP1 reproduced the forecast accuracy of NP1, but opened up the possibility for probabilistic forecasts so that instead of stating that “The flow at Lewellen will be AVERAGE”, it is possible to state that “There is an X% chance that the Lewellen flow will be between the 20th and 80th percentiles”.

WORK PLAN

Step 1: Update HCIs

Update the database assembled for NP1 to the standard of the SP1 project. The following Hydro-Climate Indices will be updated through 2014. Note the addition of four tendency indexes that track the time rate of change of important, slowly-varying atmospheric events such as El Nino.

- North Atlantic Oscillation (NAO)
- Atlantic Multidecadal Oscillation (AMO)
- Pacific Decadal Oscillation (PDO)
- North Pacific Gyre Oscillation (NPGO)
- Pacific North American pattern (PNA)
- El Nino – Southern Oscillation index (Nino3.4)
- Palmer Drought Severity Index (PDSI)
- Madden-Julian Oscillation (MJO)
- Tendency of AMO
- Tendency of PDO
- Tendency of Nino3.4
- Tendency of PDSI

NOTE: SP1 found important predictive contributions from both PDSI and Nino3.4 to South Platte basin snowpack, calling special attention to the use of tendency or “time rate of change” as predictor variables

Step 2: Add snowpack data

Develop a snowpack index using SNOTEL data from the North Platte river basin. Of the roughly 30 SNOTEL sites that contribute snowmelt into the North Platte basin, Table 1 (below) lists the eighteen stations with adequate record length to be considered as predictors. In SP1, the January snowpack Snow Water Equivalent (SWE) was found to be a crucial variable in predicting downstream streamflow. Given that there are many high snowpack mountain ranges (e.g. Park Range in CO, Sierra Madres, Laramie, Medicine Bow Mountains and Wind River Range, WY) in the North Platte headwater region, it is likely that snowpack will prove to be an important predictor variable. *Note that just because SNOTEL snowpack data is added into the forecast development process does NOT imply that this data will be included as one of the final predictor variables. Its inclusion will be based upon the amount of useful skill that it can add to the forecast.*

- **Table 1:** SNOTEL sites within and adjacent to the North Platte river basin.

Name	ID	Elevation (ft)	Lat	Lon	StartDate
BrooklynLake	367	10,240	41.36	-106.23	1980-07-24
CasperMtn	389	7,900	42.73	-106.32	1978-10-01
Columbine	408	9,160	40.39	-106.6	1978-10-01
DeadmanHill	438	10,220	40.81	-105.77	1978-10-01
DividePeak	449	8,880	41.3	-107.15	1980-08-13
JoeWright	551	10,120	40.53	-105.89	1978-10-01
LapreleCreek	571	8,375	42.44	-105.86	1978-10-01
NorthFrenchCreek	668	10,130	41.33	-106.38	1978-10-01
OldBattle	673	10,000	41.15	-106.97	1978-10-01
RenoHill	716	8,400	42.57	-106.09	1980-08-11
Roach	718	9,700	40.88	-106.05	1980-07-20
SandLake	731	10,050	41.46	-106.28	1980-08-12
SouthBrushCreek	772	8,440	41.33	-106.5	1978-10-01
Tower	825	10,500	40.54	-106.68	1978-10-01

WebberSprings	852	9,250	41.16	-106.93	1978-10-01
WhiskeyPark	859	8,950	41.0	-106.97	1986-09-17
WillowCreekPass	869	9,540	40.35	-106.09	1978-10-01
WindyPeak	872	7,900	42.28	-105.58	1980-07-27

Step 3: Extend prediction to upstream gages

In NP1, all effort was focused on the Lewellen (NE) streamflow, but federal agencies maintain additional water resources records upstream of Lewellen, as summarized by Table 2. Because forecasts for each of these gages may (i) yield beneficial information for the PRRIP (2) and are much more cost-effectively developed together, *Dewberry will prepare a quantitative inflow forecast for the following reaches/locations using the HCI methodology – inflow into Seminoe, Reservoir, inflow into Pathfinder Reservoir, and inflow into Alcova-Glendo Reach*. The seasonality of the forecasts will remain unchanged: a forecast for May – July streamflow that is available by mid-January. For these locations, Dewberry will review the historical average inflows to allow for a disaggregation of the forecast into monthly values for May, June, and July. This will help the PRRIP use the forecasts in the context of other streamflow forecasts promulgated by the US Bureau of Reclamation.

- **Table 2:** Long-term gaging records upstream of Lewellen (NE).

	Name
Downstream	Lewellen (NE)
	Glendo Reservoir
	Alcova Reservoir
	Pathfinder Reservoir
Upstream	Seminoe Reservoir

Step 4: Validate results and issue report

Assess accuracy of the quantitative forecast developed in (3) using both categorical and quantitative evaluation methods. For the Lewellen gage, compare the updated forecast to results from NP1 and comment on similarities and differences. While the above, average, and below system has been used in previous studies, we will also explore the usage of a new qualitative system designed around 20% increments of the South Platte streamflow record. The accompanying descriptors are wet (80-100th percentiles), high-average (60-80th), mid-average (40-60th), low average (20-40th), and dry (0-20th) (see Figure 1)

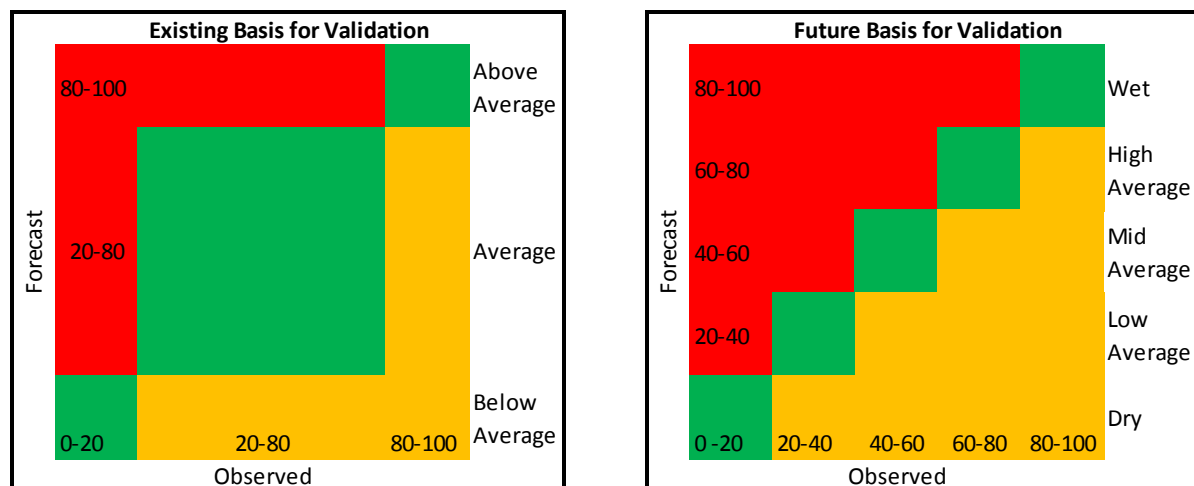


Figure 1 – Basis of validation for the qualitative forecasts, showing ranges considered to be hits (green), misses (red), and positive misses (yellow).

Additionally, Dewberry will ensure that there is adequate transparency and documentation so that the forecast can be independently developed by a non-meteorologist with the only requisite being access to the internet. This documentation will be included in the report.

Step 5: 2016 Forecast Memo

Dewberry will provide a forecast memo that issues a 2016 prediction for the North Platte basin in a step-by-step manner to facilitate duplication and confirmation on the part of the PRRIP. This prediction will be made available shortly after all data needed to develop the forecast is recorded and published online by the responsible agencies.

INTRODUCTION – SOUTH PLATTE RIVER

The South Platte River provides crucial water to a wide variety of end-users, from urban users in the Denver metropolitan area, to rural users such as farmers in Northeast Colorado. The wintertime snowpack generally supplies the state with adequate water through early spring, but water management becomes increasingly important once the snowpack melts by June. However, the snowpack, and South Platte River flow, exhibit tremendous year to year variability, with low-flow years being particularly stressful on water managers and end-users alike. Thus, an early and accurate prediction of the water supply during the May-July period is an extremely valuable tool, one that can be used to both inform water supply managers and shield end-users from dangerous low-flow periods such as the “flash drought” of 2012.

In a recently completed study, SP1, Dewberry developed an early prediction of the South Platte basin snowpack. This forecast, which is available by mid-January, shows an accuracy of 74% increasing to 85% upon inclusion of “positive misses”, or years where the snowpack is actually *greater* than predicted. Notably, this prediction correctly forecasted several very low snowpack years, including 2012, a year where the low snowpack eventually led to the summer “flash drought”. While the snowpack provides a very strong constraint on the South Platte flow in the immediate Front Range area, by the time the river reaches Julesburg there are several other important factors to consider including late spring and summer precipitation, evaporation, and low-elevation diversion for agriculture usage. Dewberry believes that a rigorous consideration of each of these

contributions to the South Platte flow will yield a robust and perhaps surprisingly accurate early prediction of Julesburg flow, quite contrary to earlier studies that did not fully consider all facets of the problems.

WORK PLAN

Step 1: Gather and analyze data

(i) Hydro-Climate Indices (HCI)

Monthly averaged data of important large-scale HCIs has already been gathered during Phase 1 of the South Platte basin study. In addition to using the raw HCI values, Dewberry has calculated tendencies, or time rate of change, of several key indices such as Nino3.4 and PDSI. Importantly, these tendencies provided enhanced skill to the snowpack prediction completed for SP-Phase 1. The following list shows the database of HCI parameters that will be used in this study:

- North Atlantic Oscillation (NAO)
- Atlantic Multidecadal Oscillation (AMO)
- Pacific Decadal Oscillation (PDO)
- North Pacific Gyre Oscillation (NPGO)
- Pacific North American pattern (PNA)
- El Nino – Southern Oscillation index (Nino3.4)
- Palmer Drought Severity Index (PDSI)
- Madden-Julian Oscillation (MJO)
- Tendency of AMO
- Tendency of PDO
- Tendency of Nino3.4
- Tendency of PDSI

(ii) Surface Water Supply Index (SWSI)

The SWSI is a concise, commonly used index comprised of SWE, precipitation and reservoir level data. Because these factors may all provide predictive skill for forecasting Julesburg flow, Dewberry will investigate the potential benefits of adding SWSI as one of the predictors in the equation developing process. If the SWSI is not found to add skill to the prediction, we will rather identify how our forecast compares with SWSI values for the time frames given in the forecast.

Step 2: Construct HCI-based streamflow prediction for May-July Julesburg stream flow

Dewberry will construct an objective and quantitative early prediction for Julesburg stream flow. The forecast will be available by mid-January. Dewberry will coordinate with PRRIP personnel to maximize the usage of the quantitative prediction by establishing important thresholds of the Julesburg flow. These thresholds will establish the criteria that determine “Above”, “Average” and “Below” stream flow conditions, and will be used when making a complementary qualitative forecast. The forecast algorithm will be very transparent so that it can be used with publically available that is easy to access and requires a minimum of effort. If data is insufficient to focus a streamflow forecast to Julesburg, Dewberry may instead choose the gage at Kersey for the forecast.

Step 3: Validate the prediction and issue a report

Dewberry will provide a quantitative and qualitative (i.e. “Above”, “Average”, or “Below”) hindcast prediction of Julesburg (or Kersey) stream flow dating back to at least 1981, or back to the 1950s if the data permits. This will be compared to observations, allowing for a calculation of the forecast accuracy. While the above, average, and below system has been used in previous studies, we will also explore the usage of a new qualitative system designed around 20% increments of the South Platte streamflow record. The accompanying descriptors are wet (80-100th percentiles), high-average (60-80th), mid-average (40-60th), low average (20-40th), and dry (0-20th) (see Figure 1). The results will be compared to the North Platte predictions for Lewellen (NE) as well as the South Platte Snowpack prediction. Any differences will be commented on within the context of a final report. Additionally, if resources permit, Dewberry will investigate the feasibility and practicality of a probabilistic forecast. An example of such a forecast would be “There is an X% chance that the May-July Julesburg flow will be below the 20th percentile”.

Additionally, Dewberry will ensure that there is complete documentation so that the forecast can be independently developed by a non-meteorologist with the only pre-requisite being access to the Internet.

Step 4: 2016 Forecast Memo

Dewberry will provide a forecast memo that issues a 2016 prediction for the South Platte basin in a step-by-step manner to facilitate duplication and confirmation on the part of the PRRIP. This prediction will be made available shortly after all data needed to develop the forecast is recorded and published online by the responsible agencies.

SCHEDULE

The following dates assume a notice to proceed (NTP) of June 1, 2015.

North Platte Basin

- Draft Report –2 Months after NTP
 - o PRRIP Comments Due within 1 Month
- Final Report – 4 Months after NTP

- 2016 Memo – By January 20, 2016

South Platte Basin

- Draft Report – 3 Months after NTP
 - o PRRIP Comments Due within 1 Month
- Final Report – 5 Months after NTP
- 2016 Memo – By January 20, 2016

STAFF

Staff	Proposed Role
Stuart Geiger, CFM <i>Project Manager</i>	Stuart will be responsible for the overall execution and delivery of the project. He will monitor resources and coordinate with the PRRIP project manager regarding the schedule and outcomes of the work.
Dima Smirnov, PhD <i>Project Meteorologist</i>	Dima will serve as the architect of the forecast development.
Brad Workman <i>Staff Meteorologist</i>	Brad will provide key assistance with data acquisition and methodology.
John Henz, CCM <i>Senior Meteorologist</i>	John will be responsible for providing direction on science implementation and application and quality assurance services for the project.

EXHIBIT "B"

BUDGET

COST

We propose a not to exceed price of \$51,978.52

Labor			Senior Meteorologist		Project Manager		Project Meteorologist		Staff Meteorologist		Total	
			\$ 175.00		\$ 102.76		\$ 99.22		\$ 75.60			
	Task	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	Hrs	Cost	
North Platte Tasks		24	\$ 4,200.00	41	\$ 4,213.16	177	\$ 17,561.94		\$ -	242	\$ 25,975.10	
1	Update HCIs		\$ -	16	\$ 1,644.16	40	\$ 3,968.80		\$ -	56	\$ 5,612.96	
2	Add Snowpack Data		\$ -	4	\$ 411.04	18	\$ 1,785.96		\$ -	22	\$ 2,197.00	
3	Extend Prediction Upstream	8	\$ 1,400.00	4	\$ 411.04	50	\$ 4,961.00		\$ -	62	\$ 6,772.04	
4	Validate Results and Issue Report	16	\$ 2,800.00	16	\$ 1,644.16	65	\$ 6,449.30		\$ -	97	\$ 10,893.46	
5	2016 Forecast Memo		\$ -	1	\$ 102.76	4	\$ 396.88		\$ -	5	\$ 499.64	
South Platte Tasks		24	\$ 4,200.00	49	\$ 5,035.24	169	\$ 16,768.18		\$ -	242	\$ 26,003.42	
1	Update Input Data		\$ -	8	\$ 822.08	30	\$ 2,976.60		\$ -	38	\$ 3,798.68	
2	Construct Streamflow Prediction	8	\$ 1,400.00	16	\$ 1,644.16	80	\$ 7,937.60		\$ -	104	\$ 10,981.76	
3	Validate Results and Issue Report	16	\$ 2,800.00	24	\$ 2,466.24	55	\$ 5,457.10		\$ -	95	\$ 10,723.34	
4	2016 Forecast Memo		\$ -	1	\$ 102.76	4	\$ 396.88		\$ -	5	\$ 499.64	
Labor Subtotal		48	\$ 8,400.00	90	\$ 9,248.40	346	\$ 34,330.12	0	\$ -	484	\$ 51,978.52	
Hourly Not to Exceed Price										\$ 51,978.52		
The information (data) contained in this proposal constitute a trade secret and/or information that is commercial or financial and is confidential or privileged. It is furnished in confidence with the understanding that it will not, without the permission of the offeror, be used or disclosed for other than evaluation purposes; PROVIDED, however, that in the event a contract is awarded based on this proposal or quotation, the offeree shall have the right to use and disclose this information (data) to the extent provided in the contract. This restriction does not limit the offeree's right to use or disclose this information (data) if obtained from another source without restriction.												



