

Infiltration/Inflow Study Cost Comparison

	1997 I&I Study	2011 I&I Study	% Increase / Decrease
Total Project Cost*	\$76,021.36	\$427,971.00	462.96%
I&I Study	\$47,941.36	\$276,528.00	476.80%
Trunk Sewer Analysis	\$0.00	\$27,341.00	N/A
Nassco Certification	\$0.00	\$4,265.00	N/A
Sanitary Sewer Modeling	\$2,696.00	\$7,306.00	170.99%
Project Reports and Administration	\$25,384.00	\$112,531.00	343.31%

Project Statistics	1997 I&I Study	2011 I&I Study	% Increase / Decrease
Miles of Sewer	28	174	517.12%
Cost per Mile	\$2,694.84	\$2,458.35	-8.78%
Acreage	1,331	7,812	486.93%
Cost per Acre	\$57.12	\$54.78	-4.08%
Rain Gauges	2	8	300.00%
Flow Meters	8	23	187.50%
Manhole Inspections	90	377	318.89%
Monitoring Period	60 Days	75 Days	25.00%

*The 1997 I&I Study cost was adjusted from 1997 dollars (\$43,274) to 2011 dollars based on most recent Professional Services Agreement with Cetec Engineering Services and an adjustment of expenses based on current Consumer Pricing Index.

Date: March 22, 2011

Project Name & Number: Inflow and Infiltration Study
Project No. SS10-1919

CIP #: 50849

Project Description: To investigate sources of inflow and infiltration in several areas of the city and provide a study that will recommend options to cost-effectively reduce inflow and infiltration.

Consultant: Burns & Mc Donnell Engineering Co.

Original Contract Amount: \$427,971.00

Original Contract Date: March 22, 2011

Original Completion Date: December 31, 2011

Addendum No:

Amendment Description:

Current Contract Amount:

Current Completion Date:

Change Requested:

New Contract Amount:	\$0.00
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New Completion Date:

Funding Source This Request:

Amount	Dept.	Line Item	Fund	Comments
\$427,791.00	833	4223	604	
	Total			

Agreement Review & Approvals


3/10/11
 Project Manager Date


3/10/11
 Compliance Specialist Date


3/11/11
 City Attorney Date

John Tim 3-10-21
Division Manager Date
VB 3-10-11
Department Director Date

ROUTING INSTRUCTIONS

Route **two** originals of the **Agreement** for review and signatures.
Finance Office - Retain one original
Project Manager - Retain second original for delivery to Consultant
cc: Public Works
Engineering
Project Manager

FINANCE OFFICE USE ONLY

(Note to Finance: Please write date of Agreement in appropriate space in the Agreement document)

	Date	Initials	Approved
Appropriation	3/14/11	DD	☒ N
Cash Flow			☐ Y N

**Agreement Between City of Rapid City and Burns & McDonnell Engineering Co.
for Professional Services for the Rapid City Inflow and Infiltration Study, Project
No. SS10-1919 / CIP No. 50849**

AGREEMENT made March 22, 2011, between the City of Rapid City, SD (City) and Burns & McDonnell Engineering Co., (Engineer), located at 9785 Maroon Circle, Suite 400, Centennial, CO 80112. City intends to obtain services for the Inflow and Infiltration Study, Project No. SS10-1919, CIP No. 50849. The scope of services is as described in Exhibits A, B, C, D and E.

The City and the Engineer agree as follows:

The Engineer shall provide professional engineering services for the City in all phases of the Project as defined in Exhibits A, B, C, D, and E serve as the City's professional engineering representative for the Project, and give professional engineering consultation and advice to the City while performing its services.

Section 1—Basic Services of Engineer

1.1 General

- 1.1.1 The Engineer shall perform professional services described in this agreement, which include customary engineering services. Engineer intends to serve as the City's professional representative for those services as defined in this agreement and to provide advice and consultation to the City as a professional. Any opinions of probable project cost, approvals, and other decisions provided by Engineer for the City are rendered on the basis of experience and qualifications and represent Engineer's professional judgment.
- 1.1.2 All work shall be performed by or under the direct supervision of a professional Engineer licensed to practice in South Dakota.
- 1.1.3 All documents including Drawings and Specifications provided or furnished by Engineer pursuant to this Agreement are instruments of service in respect of the Project and Engineer shall retain an ownership therein. Reuse of any documents pertaining to this project by the City on extensions of this project or on any other project shall be at the City's risk. The City agrees to defend, indemnify, and hold harmless Engineer from all claims, damages, and expenses including attorney's fees arising out of such reuse of the documents by the City or by others acting through the City.



1.2 Scope of Work

The Engineer shall:

- 1.2.1 Consult with the City, other agencies, groups, consultants, and/or individuals to clarify and define requirements for the Project and review available data.
- 1.2.2 Perform the tasks described in the Scope of Services. (See Exhibits A, and B.)
- 1.2.3 Conduct a location survey of the Project to the extent deemed necessary to provide adequate site information.
- 1.2.4 Prepare a report presenting the results of the study as outlined in the scope of services.

Section 2—Information Provided by City

The City will provide any information in its possession for the project at no cost to the Engineer.

Section 3—Notice to Proceed

The City will issue a written notification to the Engineer to proceed with the work. The Engineer shall not start work prior to receipt of the written notice. The Engineer shall not be paid for any work performed prior to receiving the Notice to Proceed.

Section 4—Mutual Covenants

4.1 General

- 4.1.1 The Engineer shall not sublet or assign any part of the work under this Agreement without written authority from the City.
- 4.1.2 The City and the Engineer each binds itself and partners, successors, executors, administrators, assigns, and legal representatives to the other party to this agreement and to the partners, successors, executors, administrators, assigns, and legal representatives of such other party, regarding all covenants, agreements, and obligations of this agreement.
- 4.1.3 Nothing in this agreement shall give any rights or benefits to anyone other than the City and the Engineer.



- 4.1.4 This agreement constitutes the entire agreement between the City and the Engineer and supersedes all prior written or oral understandings. This agreement may only be amended, supplemented, modified, or canceled by a duly executed written instrument.
- 4.1.5 The Engineer shall make such revisions in plans which may already have been completed, approved, and accepted by the City, as are necessary to correct Engineer's errors or omissions in the plans, when requested to do so by the City, without extra compensation therefore.
- 4.1.6 If the City requests that previously satisfactorily completed and accepted plans or parts thereof be revised, the Engineer shall make the revisions requested by the City. This work shall be paid for as extra work.
- 4.1.7 If the City changes the location from the one furnished to the Engineer, or changes the basic design requiring a new survey for the portions so changed, the redesign will be paid for as extra work.
- 4.1.8 The City may at any time by written order make changes within the general scope of this Agreement in the work and services to be performed by the Engineer. Any changes which materially increase or reduce the cost of or the time required for the performance of the Agreement shall be deemed a change in the scope of work for which an adjustment shall be made in the Agreement price or of the time for performance, or both, and the Agreement shall be modified in writing accordingly. Additional work necessary due to the extension of project limits shall be paid for as extra work.
- 4.1.9 Extra work, as authorized by the City, will be paid for separately and be in addition to the consideration of this Section.
- 4.1.10 For those projects involving conceptual or process development services, activities often cannot be fully defined during the initial planning. As the project does progress, facts and conditions uncovered may reveal a change in direction that may alter the scope of services. Engineer will promptly inform the City in writing of such situations so that changes in this agreement can be renegotiated.
- 4.1.11 This Agreement may be terminated (a) by the City with or without cause upon seven days' written notice to the Engineer and (b) by the Engineer for cause upon seven days' written notice to the City. If the City terminates the agreement without cause, the Engineer will be paid for all services rendered and all reimbursable expenses incurred prior to the date of termination.



If termination is due to the failure of the Engineer to fulfill its agreement obligations, the City may take over the work and complete it by agreement or otherwise after providing Engineer a reasonable opportunity to cure the deficiencies. In such case, the Engineer shall be liable to the City for any additional cost to the extent directly resulting from Engineer's action.

- 4.1.12 The City or its duly authorized representatives may examine any books, documents, papers, and records of the Engineer involving transactions related to this agreement for three years after final payment. All examinations will be performed at reasonable times, with proper notice. Engineer's documentation will be in a format consistent with general accounting procedures.
- 4.1.13 The City shall designate a representative authorized to act on the City's behalf with respect to the Project. The City or such authorized representative shall render decisions in a timely manner pertaining to documents submitted by the Engineer in order to avoid unreasonable delay in the orderly and sequential progress of the Engineer's services.
- 4.1.14 Costs and schedule commitments shall be subject to renegotiation for delays caused by the City's failure to provide specified facilities or information or for delays caused by other parties, excluding sub-contractors and sub-consultants, unpredictable occurrences including without limitation, fires, floods, riots, strikes, unavailability of labor or materials, delays or defaults by suppliers of materials or services, process shutdowns, acts of God, or the public enemy, or acts of regulations of any governmental agency or any other conditions or circumstances beyond the control of the City or Engineer. Temporary delays of services caused by any of the above which results in additional costs beyond those outlined may require renegotiation of this agreement.
- 4.1.15 The City will give prompt written notice to the Engineer if the City becomes aware of any fault or defect in the Project or nonconformance with the Project Documents.
- 4.1.16 Unless otherwise provided in this Agreement, the Engineer and the Engineer's consultants shall have no responsibility for the discovery, presence, handling, removal or disposal of, or exposure of persons to hazardous materials in any form at the project site, including but not limited to asbestos products, polychlorinated biphenyl (PCB), or other toxic substances.



- 4.1.17 In the event asbestos or toxic materials are encountered at the jobsite, or should it become known in any way that such materials may be present at the jobsite or any adjacent areas that may affect the performance of Engineer's services, Engineer may, at their option and without liability for consequential or any other damages, suspend performance of services on the project until the City retains appropriate specialist CONSULTANT(S) or contractor(s) to identify, abate, and/or remove the asbestos or hazardous or toxic materials.
- 4.1.18 This agreement, unless explicitly indicated in writing, shall not be construed as giving Engineer the responsibility or authority to direct or supervise construction means, methods, techniques, sequences, or procedures of construction selected by any contractors or subcontractors or the safety precautions and programs incident to the work of any contractors or subcontractors.
- 4.1.19 Neither the City nor the Engineer, nor its Consultants, shall hold the other liable for any claim based upon, arising out of, or in any way involving the discharge, dispersal, release or escape of smoke, vapors, soot, fumes, acids, alkalis, toxic chemicals, liquids, or gases, waste materials, or other irritants, contaminants, or pollutants.
- 4.1.20 Neither the City nor the Engineer, nor its Consultants, shall hold the other liable for any claim based upon, arising out of, or any way involving the specification or recommendation of asbestos, in any form, or any claims based upon use of a product containing asbestos.
- 4.1.21 Engineer hereby represents and warrants that it does not fail or refuse to collect or remit South Dakota or City sales or use tax for transactions which are taxable under the laws of the State of South Dakota.

4.2 City of Rapid City NonDiscrimination Policy Statement

In compliance with Title VI of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, the Age Discrimination act of 1975, the Americans with Disabilities Act of 1990, and other nondiscrimination authorities it is the policy of the City of Rapid City, 300 Sixth Street, Rapid City, SD 57701-5035, to provide benefits, services, and employment to all persons without regard to race, color, national origin, sex, disabilities/handicaps, age, or income status. No distinction is made among any persons in eligibility for the reception of benefits and services provided by or through the auspices of the City of Rapid City.



Engineer will permit access to any and all records pertaining to hiring and employment and to other pertinent data and records for the purpose of enabling the Commission, its agencies or representatives, to ascertain compliance with the above provisions.

This section shall be binding on all subcontractors or suppliers.

Section 5—Payments to the Engineer

5.1 Schedule of Pay Rates

The City will pay the Engineer for services rendered or authorized extra work according to the Engineer's hourly rate schedule. (See Exhibits C and D.)

5.2 Fee

The maximum amount of the fee for the services as detailed in Section 1.2 shall not exceed \$427,971.00 unless the scope of the project is changed as outlined in Section 4. If expenses exceed the maximum amount, the Engineer shall complete the design as agreed upon here without any additional compensation. Sub task dollar amounts may be reallocated to other tasks as long as the total fee is not exceeded.

5.3 Progress Payments

Monthly progress payments shall be processed by the City upon receipt of the claim as computed by the Engineer based on work completed during the month at the rates established in Section 5.1 and approved by the City.

Net payment to the Engineer shall be due within forty-five (45) days of receipt by the City.

Section 6—Completion of Services

The Engineer shall complete services on or before December 31, 2011, based on an award date of March 22, 2011.

Section 7—Insurance Requirements

7.1 Insurance Required

The Engineer shall secure the insurance specified below. The insurance shall be issued by insurance company(s) acceptable to the City and may be in a policy or policies of insurance, primary or excess. Certificates of all required insurance including any policy endorsements shall be provided to the City prior to or upon the execution of this Agreement.



7.2 Cancellation

The Engineer will provide the City with at least 30 days' written notice of an insurer's intent to cancel or not renew any of the insurance coverage. The Contractor agrees to hold the City harmless from any liability, including additional premium due because of the Contractor's failure to maintain the coverage limits required.

7.3 City Acceptance of Proof

The City's approval or acceptance of certificates of insurance does not constitute City assumption of responsibility for the validity of any insurance policies nor does the City represent that the coverages and limits described in this agreement are adequate to protect the Engineer, its consultants or subcontractors interests, and assumes no liability therefore. The Engineer will hold the City harmless from any liability, including additional premium due, because of the Engineer's failure to maintain the coverage limits required.

7.4 Specific Requirements

- 7.4.1 Workers' compensation insurance with statutory limits required by South Dakota law. Coverage B-Employer's Liability coverage of not less than \$500,000 each accident, \$500,000 disease-policy limit, and \$500,000 disease-each employee.
- 7.4.2 Commercial general liability insurance providing occurrence form contractual, personal injury, bodily injury and property damage liability coverage with limits of not less than \$1,000,000 per occurrence, \$2,000,000 general aggregate, and \$2,000,000 aggregate products and completed operations. If the occurrence form is not available, claims-made coverage shall be maintained for three years after completion of the terms of this agreement. The policy shall name the City and its representatives as an additional insured.
- 7.4.3 Automobile liability insurance covering all owned, nonowned, and hired automobiles, trucks, and trailers. The coverage shall be at least as broad as that found in the standard comprehensive automobile liability policy with limits of not less than \$1,000,000 combined single limit each occurrence. The required limit may include excess liability (umbrella) coverage.



- 7.4.4 Professional liability insurance providing claims-made coverage for claims arising from the negligent acts, errors or omissions of the Engineer or its consultants, in the amount of \$1,000,000 each occurrence and \$1,000,000 annual aggregate. Coverage shall be maintained for at least three years after final completion of the services.

Section 8—Hold Harmless

The Engineer hereby agrees to hold the City harmless from any and all claims or liability including attorneys' fees arising out of the professional services furnished under this Agreement, and for bodily injury or property damage arising out of services furnished under this Agreement, providing that such claims or liability are the result of a negligent act, error or omission of the Engineer and/or its employees/agents arising out of the professional services described in the Agreement.

Section 9—Independent Business

The parties agree that the Engineer operates an independent business and is contracting to do work according to his own methods, without being subject to the control of the City, except as to the product or the result of the work. The relationship between the City and the Engineer shall be that as between an independent contractor and the City and not as an employer-employee relationship. The payment to the Engineer is inclusive of any use, excise, income or any other tax arising out of this agreement.

Section 10-Indemnification

If this project involves construction and Engineer does not provide consulting services during construction including, but not limited to, onsite monitoring, site visits, site observation, shop drawing review and/or design clarifications, City agrees to indemnify and hold harmless Engineer from any liability arising from the construction activities undertaken for this project, except to the extent such liability is caused by Engineer's negligence.

Section 11-Controlling Law and Venue

This Agreement shall be subject to, interpreted and enforced according to the laws of the State of South Dakota, without regard to any conflicts of law provisions. Parties agree to submit to the exclusive venue and jurisdiction of the State of South Dakota, 7th Judicial Circuit, Pennington County.

Section 12-Severability

Any unenforceable provision herein shall be amended to the extent necessary to make it enforceable; if not possible, it shall be deleted and all other provisions shall remain in full force and effect.



Section 13—Funds Appropriation

If funds are not budgeted or appropriated for any fiscal year for services provided by the terms of this agreement, this agreement shall impose no obligation on the City for payment. This agreement is null and void except as to annual payments herein agreed upon for which funds have been budgeted or appropriated, and no right of action or damage shall accrue to the benefit of the Engineer, its successors or assignees, for any further payments. For future phases of this or any project, project components not identified within this contract shall not constitute an obligation by the City until funding for that component has been appropriated.



IN WITNESS WHEREOF, the parties hereto have made and executed this Agreement as of the day and year first above written.

City of Rapid City:

Engineer:

MAYOR

Mark A. Luthardt
Burns & McDonnell Engineering Co.

DATE: _____

DATE: MARCH 10, 2011

ATTEST:

FINANCE OFFICER

Reviewed By:

Michelle L. Schweitzer
Michelle L. Schweitzer, PROJECT MANAGER

DATE: 3/16/11

**City's Designated Project
Representative:**

**Engineering Firm's Designated
Project Representative:**

NAME Michelle L. Schweitzer
PHONE 605-394-4154
EMAIL michelle.schweitzer@rcgov.org

NAME Andrew Waddoups
PHONE 303-721-9292
EMAIL awaddoups@burnsmcd.com



Exhibit A – Scope of Services

Infiltration and Inflow Study Project No. SS10-1919, CIP No. 50849

1. Overview of Services

- a. The City has initiated this Infiltration and Inflow (I&I) Study in an effort to reduce the amount of I&I into the City's sanitary sewer. This sanitary sewer infiltration and inflow study has several very important objectives. Primary among these are the following:
 1. Quantify dry and wet weather I/I flows at each meter site.
 2. Identify I&I defects through field inspection activities.
 3. Perform defect flow analysis on identified I&I defects.
 4. Perform cost-effectiveness analysis (CEA) on identified I&I defects to determine the cost-effective level of I&I removal.
 5. Prioritize cost-effective rehabilitation recommendations (\$/gpm).
 6. Document all work in an electronic format compatible with the City's GIS
 7. Complete all work within the agreed upon time schedule and costs.
 8. Prepare a final report summarizing all work and develop an I&I Reduction Plan that clearly outlines a road map to:
 - Cost-effectively reduce I&I
 - Improve the over-all collection system performance
- b. The Engineer will furnish the necessary labor, supervision, equipment, and material to complete the scope items as outlined in this document.
- c. Project Administration and Kick-off Meeting: The City Project Manager, will be kept informed weekly of progress via phone and/or email updates. The Engineer will meet with the City staff during an initial "kick-off" meeting. The purpose of the initial meeting will be to discuss the City's project goals and objectives, establish project limits, and to review proposed flow meter and rain gauge site locations. All interested parties would be requested to attend this meeting.
 1. During the field work of the Project, the Engineer will participate in monthly progress meetings. Prior to the monthly meetings, a "Project Update" memo will be distributed to interested and involved parties. The memo would include:
 - Progress to Report This Period (including updated invoicing, budget and payments)
 - Contract Issues
 - Progress Anticipated Next Period
 - Issues Resolved
 - Issues Unresolved
- d. Meter Site Assessment/Installation (23): The Engineer shall install twenty-three (23) flow monitors. A site assessment of potential flow monitoring sites will be made to determine, in general, the most suitable flow monitoring and rain gauge locations based on the following conditions:
 1. Suitability for Accurate Metering - The accuracy of the open channel flow metering will depend on numerous variables and it is imperative that they be controlled as much as possible. For this reason, the reconnaissance inspections will be performed to identify the best sites for metering and to minimize such error-causing factors as changes in pipe alignment and size, interruption of channel flow by side inlets and turbulence caused by uneven channels.
 2. Safety - It is equally important that the proposed sites conform to the Engineer's requirements for safe operating conditions. If the site falls outside of these requirements, alternate sites that are suitable based on safety requirements will be selected upon further consultation with the CITY.
- e. The Engineer shall complete site assessment forms for each flow and rainfall monitoring location. The Engineer shall provide twenty-three (23) electronic depth/velocity flow monitors (ISCO 2150). The units will be initially installed and the site calibrated for the 75-day monitoring period.
- f. Flow Monitoring (0-75 day period): The flow monitors shall be maintained by the Engineer on a bi-weekly basis. Maintenance shall include the upload and interrogation of all flow data, meter calibration (as needed), velocity

profiling, and other diagnostic checks. Flow monitors shall remain in place for a continuous 60-day base period. The Engineer shall remove all monitors at the conclusion of the monitoring period.

1. Upon completion of the base period, the Engineer will remove the meters unless it is recommended and approved by the City to keep them in place. Justification for extended metering will be due to insufficient rainfall, or dry days, during the monitoring period. Compensation for additional flow metering service cost and calibration beyond the 75 day period shall be at the price to be negotiated between the City and the Engineer. Should the meters be needed for less than 75 days, the cost will be credited to the City at the same unit cost.
- g. Rainfall Monitoring (0-75 day period): The Engineer will install, service, and maintain eight (8) continuous recording, electronic rain gauges within the study areas during the same 75-day base monitoring period. The gauges will record rainfall to one-hundredths of inch increments. The instruments will be checked and downloaded bi-weekly by the Engineer. Data collected from rain gauges will be analyzed by the Engineer to correlate dry-weather and seasonal peak system flows to rainfall intensity and duration as further discussed in this scope of work.
- h. Flow Data Analysis: The Engineer will evaluate the results of the flow monitoring program as follows:
 1. Base flow, infiltration (groundwater-induced) and inflow (rainfall-induced) will be determined for each monitoring site. Relationships between rainfall intensity and peak system flows for each site under "non-bypassing" conditions and saturated ground conditions will be determined. This is called the "Q vs. i" method of hydraulic analysis and will become the primary method of ranking sites.
 2. System curves will be developed for each site by comparing maximum rainfall intensity "i" expressed in inches/hour and peak system flow "Q" expressed in gallons per minute. Separate curves will be developed for both inflow and rainfall-induced infiltration, including projected flow hydrographs for the design storm events.
 3. Rainfall intensity distribution using the TP-40 method will be used.
- i. Manhole Inspections (377): Manholes with depths less than 15 feet shall be inspected from the top-side of the manhole with the assistance of digital cameras, mirrors and high powered spotlights. Manholes with depths greater than 15 feet deep shall be internally inspected. Each structural component of the manhole will be inspected and assigned a condition rating of good, fair, or poor. An initial rehabilitation recommendation will be provided by the technicians during the inspection. Photographic records will be used to supplement and substantiate manhole inspection observations and recommendations. All manhole inspections will be recorded on standardized field forms agreed upon during the project "kick-off" meeting and input into an ACCESS database compatible with ArcView GIS software.
 1. Visual inspections of all incoming and outgoing pipes of all accessible manhole structures inspected will be conducted. This shall include private service laterals that enter into manholes. Photographs shall be taken of line segments from inside the manhole, showing cracked pipe; offset joints greater than 1", partially or fully collapsed pipe; or obstructions such as roots, debris, or grease. Each photograph shall be properly annotated and attached to the specific inspection record. Data shall be recorded on field inspection forms for entry into the ACCESS database. The field crews shall commit a maximum of 15 minutes of searching for a manhole before classifying it as "could not locate" or "buried".
 2. A list and general vicinity map of manholes that could not be located or presumed buried will be tabulated on a daily basis and given to the CITY. A follow-up inspection will be conducted once the manhole is located or uncovered.
 3. Traffic safety precautions, as well as both technicians being uniformed for high visibility, will be practiced for greater protection for themselves and the public.
- j. Nighttime Flow Checks (2 Times): To further identify infiltration sources within the basin, nighttime flow isolation inspections shall be conducted. A temporary weir shall be installed and flow measurements shall be taken two (2) separate times at up to 18 locations during low flow, high groundwater, conditions between the hours of midnight and 6:00 a.m. Periods selected should follow storm events when infiltration is at its highest and flow includes a negligible amount of inflow. Infiltration is estimated using flow data from 48 to 72 hours after a rainfall event. A temporary weir shall also be installed and flow measurements taken in the same locations at two (2) separate times during dry weather/low groundwater conditions.

- k. Smoke Testing (122,979 lf): Smoke testing will be conducted on selected line segments located within the study areas to identify I&I sources from both the public and private sector. Each positively identified source is photographically documented, precisely located using submeter GPS accuracy and referenced to allow for efficient repair. Defective service laterals will be identified for subsequent television inspections as described herein.
1. Smoke blowers (rated at 6,211 cfm), using liquid smoke instead of 3-minute smoke bombs, will be set-up on every other manhole. The high rated smoke blowers, combined with the use of liquid smoke, allow for continuous and constant smoke production while the field crew canvasses the areas over and adjacent to the sewer lines. The crew will also conduct a perimeter check of all buildings in close proximity for evidence of smoke. Since continuous smoke is produced during the smoke testing, only one three-person crew will be utilized to conduct this phase of the investigation.
 2. Smoke testing activities will include a minimum of 48 hours advance notification to all residents within the study area. Notification will be done by placement of door hangers on homes and businesses. The notice will include a detailed description of the inspection and testing activities; including instructions to fill infrequently used plumbing traps with water and a tablespoon of cooking oil to prohibit smoke from entering buildings via service lines. A telephone number will be provided enabling residents to contact the Engineer for more information or with any special needs and concerns they may have.
 3. Photographic records will be used to supplement and substantiate smoke testing observations. All smoke testing inspections will be recorded on the Engineer's field forms and input into an ACCESS database compatible with ArcView GIS software.
- l. CCTV Inspection Review (26,950 lf): Engineer shall provide a list of line segments recommended to be televised (CCTV) based on results from smoke testing, observations from visual pipe inspections and from capacity issues identified on the interceptors. It is estimated that approximately 15% of the line segments that are smoke tested and observed during visual pipe inspections will be recommended for CCTV inspections. Additionally, it is recommended that the interceptors experiencing capacity issues be televised. The Engineer shall review the videos provided by the City and provide rehabilitation recommendations as part of the reporting and deliverables.
- m. Source Flow Analysis: The Engineer shall provide results from the flow monitoring analysis, hydraulic modeling and field inspections. The Engineer will compile a list of each defect identified. The Engineer will use the I/I source summary list, along with the peak infiltration and five-year inflow flows determined from the flow monitoring, to balance source flows. Source unit flow rates will be adjusted accordingly so that total source flows reasonably match projected five-year I/I flow rates. A certain percentage of five-year I/I flow will be attributed to unidentified I/I sources. The unidentified sources would be those which investigations were unable to verify or outside of the study scope. These typically include building foundation drains, private service laterals, and other such sources for which smoke testing and inspection activities are not totally effective. Defects shall then be prioritized based upon severity, structural integrity, safety and volume of I&I. Defect priority schedule shall be determined during the project "kick-off" meeting. A summary listing of each defect will be completed. The listing will, for each specific I&I source, include the following:
- Source type
 - Source category (public sector, private sector)
 - Number of such sources
 - Source unit flow rate, based on one-year storm event
 - Total one-year flow rate contributed by such sources
 - Source unit repair cost
 - Total repair cost for such sources
 - Source cost/flow ratio (total repair cost divided by total one-year flow rate)
1. The final listing will be sorted in ascending order by source cost/flow ratio. Sources with low ratios are considered more cost-effective to repair than sources with higher ratios.
- n. Cost Effectiveness-Analysis: Based upon the results from the hydraulic model, capacity improvements may be necessary to accommodate existing and/or future flows. This may be accomplished through additional relief sewers or upsizing existing sewers. Transport costs will be developed from projected peak flow data at several increments of I/I reduction compared with the current hydraulic capacity of the existing interceptor sewer system.

Furthermore, treatment cost information for wastewater that is transported and treated at the City's own treatment facilities will also be determined. Treatment cost data will include both capital and O&M associated with normal daily and peak wet-weather flows. Unit, per gallon, rates will then be determined and applied to incremental levels of I/I reduction beginning at the 0% I/I elimination level until a treatment cost curve is completed through ultimate I/I removal.

1. A cost-effective analysis will then be conducted to compare costs associated with I/I source repair to costs associated with providing transportation and treatment for the extraneous flows. The cost-effective level of I/I removal is that percentage associated with least total present worth cost.
- o. Reporting and Deliverables: The Engineer will provide five (5) copies of the Draft Sewer System Evaluation Report for review and comments. The report will summarize monitoring and inspection activities and provide rehabilitation or future investigation recommendations. Additionally, the Engineer shall submit the following deliverables:
 - Digital photos in .jpg format of meter and rain gauge installation sites
 - Microsoft Access database of attribute data that is compatible with City's GIS data and sanitary sewer inventory
 - Prioritized manhole defect/rehabilitation schedule with cost estimates
 - Public sector inflow and infiltration reduction and elimination plan
 - Private sector inflow and infiltration reduction and elimination plan
 - Prioritized line rehabilitation schedule with cost estimates
 - Routine maintenance recommendations
1. The Engineer will maintain a copy of all data submitted to the City and will be available by phone, email and in person to meet with the City to discuss any questions the City may have regarding the project.
- p. The Engineer will meet with the City, following their review of the draft report, to discuss any questions the City may have. A final report will be submitted after review comments have been added. Twenty (20) copies of the final report will be submitted in both hard copy and in electronic format. All field data and supporting information shall be provided in electronic format. The Engineer will be available to conduct a formal presentation to the City upon submittal of the final report.
- q. NASSCO Training: The Engineer shall provide NASSCO MACP/PACP training and certifications for up to 5 City personnel. Training shall consist of two, 8 hour days of PACP training and one 8 hour day of MACP training. Engineer shall provide all training materials. Up to 20 personnel can be certified at the cost of the material (\$315/person).
- r. Existing Sanitary Sewer Model: Review existing sanitary sewer model to determine the applicability and general operation of the model. Revise the model, as needed, to ensure it is providing reasonable results. Provide the City a copy of the revised model and report all model revisions to the City in a technical memorandum.

2. Area 1 – Krebs Drive

- a. Description: Located in the northwest corner of the City. Basin boundary is defined as W. Chicago St to the south, N. Plaza Dr to the north, Deadwood Ave to the west and Krebs Dr to the East. Manhole F6-003 located at W. Chicago St and Krebs Dr defines the southern outfall. The basin, defined by the Flow Monitoring Program (Wade 2006), contains approximately 85,876 lf of sanitary sewer.
- b. Issues: The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 4, 4th with an individual I/I volume of 1.2 (gal x 1000)/IDM. The City believes that the I/I volume was underestimated due to the low groundwater at the time of the flow monitoring program. It is suspected that the basin has high inflow sources from upper manhole defects such as vented covers and frame seals, as well as possible sump pumps connected to the system.
- c. Scope:
 - i. Flow Monitoring: To further quantify the I/I in the basin, it is recommended that a temporary flow monitor be installed at Manhole F6-004 for a period of 60 to 90 days.
 - ii. Private I/I Questionnaire: To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.

- iii. **Manhole Inspections:** To identify the extent of manholes contributing to the I/I, it is recommended that manhole inspections along with visual pipe inspections be conducted along Krebs Dr. from manhole F6-003 to F5-029. Comprehensive condition assessments of the manholes will be conducted.
- iv. **Visual pipe inspection** of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up to 4,750 lineal feet of pipe.
- v. **Smoke Testing:** To further identify inflow sources within the basin, it is recommended that smoke testing be conducted on up to 46,300 lf of sewer mains within the entire basin, including the Harmony Heights Apartment area. Defects, as well as suspect defects, will be identified and located using sub-meter GPS accuracy.
- d. **Deliverable:**
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
 - ii. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.
 - iii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
 - iv. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.
 - v. Sub-meter coordinates shall be provided for all defects and suspect defects identified during smoke testing activities. Defects along with the associated picture and address shall be provided in digital format. Follow-up dyed-water testing and/or CCTV inspections may be recommended for both public and private sources or suspect sources.

3. **Area 2 – City Springs Area**

- a. **Description:** Located in the northwest corner of the City. Basin boundary is defined as W. Chicago St to the south, St Martins Dr to the north, Roubaix Dr to the west and N 40th St to the East. Manhole E6-121 located at W. Chicago St and east of N. 40th St. defines the eastern outfall. The area has a low lying area along St. Martins Dr. The entire basin, defined by the Flow Monitoring Program (Wade 2006), contains approximately 123,292 lf of sanitary sewer.
- b. **Issues:** The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 3, 9th with an individual I/I volume of 0.4 (gal x 1000)/IDM. The City believes that the I/I volume was underestimated due to the low groundwater at the time of the flow monitoring program. It is suspected that the basin has high infiltration with some inflow coming from vented manhole covers. The low lying area is a potential infiltration area.
- c. **Scope:**
 - i. **Flow Monitoring:** To further quantify the I/I in the basin, it is recommended that multiple temporary flow monitors be installed within the basin for a period of 60 to 90 days. The basin can be subdivided into 3 separate sub-basins.
 - ii. **Private I/I Questionnaire:** To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.
 - iii. **Manhole Inspections:** To identify the extent of manholes contributing to the I/I, it is recommended that manhole inspections along with visual pipe inspections be conducted along the low lying area along St. Martins Rd, from manhole D6-053 to D5-001. Comprehensive condition assessments of the manholes shall be conducted.
 - iv. **Visual pipe inspection** of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend

pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up 1,000 lineal feet of pipe.

- v. **Night Time Flow Measurements:** To further identify infiltration sources within the basin, nighttime flow isolation inspections shall be conducted. A temporary weir shall be installed and flow measurements shall be taken two (2) separate times at up to 18 locations during low flow, high groundwater, conditions between the hours of midnight and 6:00 a.m. Periods selected should follow storm events when infiltration is at its highest and flow includes a negligible amount of inflow. Infiltration is estimated using flow data from 48 to 78 hours after a rainfall event. A temporary weir shall also be installed and flow measurements taken in the same locations at two (2) separate times during dry weather/low groundwater conditions.
- d. **Deliverable:**
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
 - ii. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.
 - iii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
 - iv. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.
 - v. The difference between the minimum nighttime flows during dry weather/low groundwater and dry weather/high groundwater conditions can be defined as the peak infiltration.

4. Area 3

- a. **Description:** Located in the southwest portion of the City. Basin boundary is defined as Nicklaus Dr to the south, St Jackson Blvd to the north, Stockade Dr to the west and Westgate Dr to the East. Manhole F8-200 located at Stockade Dr and Nicklaus Dr defines the southern outfall. The entire basin, defined by the Flow Monitoring Program (Wade 2006), contains approximately 192,792 lf of sanitary sewer.
- b. **Issues:** The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 2, 12th with an individual I/I volume of 0.3 (gal x 1000)/IDM. The City believes that the I/I volume was underestimated due to the low groundwater at the time of the flow monitoring program. It is suspected that the basin has high infiltration with some inflow coming from vented manhole covers.
- c. **Scope:**
 - i. **Flow Monitoring:** To further quantify the I/I in the basin, it is recommended that multiple temporary flow monitors be installed within the basin for a period of 60 to 90 days. The basin can be subdivided into 4 separate sub-basins with an additional meter located near F7-130 to isolate the basin.
 - ii. **Private I/I Questionnaire:** To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.
 - iii. **Manhole Inspections:** To identify the extent of manholes contributing to the I/I, it is recommended that manhole inspections along with visual pipe inspections be conducted along the interceptor, from manhole F8-200 to F7-130. Comprehensive condition assessments of the manholes shall be conducted.
 - iv. **Visual pipe inspection of the incoming and outgoing pipes** shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up 1,000 lineal feet of pipe.
 - v. **Night Time Flow Measurements:** To further identify infiltration sources within the basin, nighttime flow isolation inspections shall be conducted. A temporary weir shall be installed and flow measurements shall be taken two (2) separate times at up to 18 locations during low flow, high groundwater, conditions between the hours of midnight and 6:00 a.m. Periods selected should follow storm events when infiltration is at its highest and flow includes a negligible amount of inflow. Infiltration is estimated using flow data from 48 to 78 hours

after a rainfall event. A temporary weir shall also be installed and flow measurements taken in the same locations at two (2) separate times during dry weather/low groundwater conditions.

d. Deliverable:

- i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
- ii. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.
- iii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
- iv. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.
- v. The difference between the minimum nighttime flows during dry weather/low groundwater and dry weather/high groundwater conditions can be defined as the peak infiltration.

5. Area 4 – Woodlawn Dr. Area and Portions of LaCrosse St.

- a. Description: Located in the north central portion of the City. Basin boundary is defined as E. Omaha St to the south, Interstate 90 to the north, N Maple Ave to the west and N LaCrosse St to the East. Manhole I6-206 located at E Jackson St and N LaCrosse St defines the southern outfall. The entire basin, defined by the Flow Monitoring Program (Wade 2006), contains approximately 109,196 lf of sanitary sewer.
- b. Issues: The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 8, 3rd with an individual I/I volume of 1.3 (gal x 1000)/IDM. It is suspected that I/I may be coming from sump pumps in the Woodlawn Dr area and the area near Racine St and LaCrosse St. The “Swim Center Park” is also suspected of I/I sources as well as the sewer line, H6-112 to H7-009, that is constructed under a retention pond located north of I-90.
- c. Scope:
 - i. Flow Monitoring: To further quantify the I/I in the basin, it is recommended that a temporary flow monitor be installed at the southern outfall, MH I6-206, for a period of 60 to 90 days. Additionally, it is recommended that a flow monitor be installed at Manhole I7-058 for a period of 60 to 90 days.
 - ii. Private I/I Questionnaire: To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.
 - iii. Manhole Inspections: To identify the extent of manholes contributing to the I/I, it is recommended that a comprehensive manhole inspection along with visual pipe inspections be conducted throughout the basin. Comprehensive condition assessments of the manholes shall be conducted.
 - iv. Visual pipe inspection of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up to 4,100 lineal feet of pipe.
 - v. Smoke Testing: To further identify inflow sources within the basin, it is recommended that smoke testing be conducted on up to 40,500 lf of sewer mains within the basin. Defects, as well as suspect defects, will be identified and located using sub-meter GPS accuracy.
 - vi. CCTV Inspection: To determine the condition and potential of I/I of the line segment under the retention pond, it is recommended that the City conduct a CCTV inspection of line segment H6-112 to H7-009 while water is present in the retention pond.
- d. Deliverable:
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
 - ii. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.

- iii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
- iv. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.
- v. Sub-meter coordinates shall be provided for all defects and suspect defects identified during smoke testing activities. Defects along with the associate picture and address shall be provided in digital format. Follow-up dyed-water testing and/or CCTV inspections may be recommended for both public and private sources or suspect sources.
- vi. Video and written reports shall be provided by the City.

6. Area 5A

- a. Description: Located in the center of the City. Basin boundary is defined as Saint Cloud St to the south, Omaha St to the north, Mount Rushmore Rd to the west and LaCrosse St to the East. Manhole H7-008 located at Omaha St and East Blvd and Manhole I7-088 located at E Main St and Steele Ave define the basin outfalls. Basin 5A is a portion of a larger basin 5, which defined by the Flow Monitoring Program (Wade 2006), contains approximately 172,632 lf of sanitary sewer.
- b. Issues: The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 11, 2nd with an individual I/I volume of 1.4 (gal x 1000)/IDM. It is suspected that the basin has high I/I resulting from a combination of roof drains, sump pumps and a possible creek crossing. The basin also experiences bottlenecks near the Pennington Valley Area.
- c. Scope:
 - i. Flow Monitoring: To further quantify the I/I in the basin, it is recommended that multiple temporary flow monitors be installed within the basin for a period of 60 to 90 days. The basin appears to have several flow splitters that divert flow to either the eastern outfall at manhole I7-088 or the northern outfall at manhole H7-008. It is recommended that initial manhole inspections be conducted to verify the flow directions prior to flow monitoring. Dependent upon the results of the manhole inspections, the basin may be subdivided into to multiple sub-basins.
 - ii. Private I/I Questionnaire: To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.
 - iii. Manhole Inspections: To identify the extent of manholes contributing to the I/I, as well as verifying pipe diameters and capacity issues, it is recommended that manhole inspections along with visual pipe inspections be conducted along line segments greater than 8-inches in diameter. It is also recommended that manhole and visual pipe inspections be conducted on the creek crossing from H8-138 to H7-008. Comprehensive condition assessments of the manholes shall be conducted.
 - iv. Visual pipe inspection of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up 3,000 lineal feet of pipe.
 - v. Smoke Testing: To further identify inflow sources within the basin, it is recommended that smoke testing be conducted on up to 25,000 lf of sewer mains within the entire basin. Defects, as well as suspect defects, will be identified and located using sub-meter GPS accuracy.
 - vi. CCTV Inspection: To determine the condition and potential of I/I of the line segment, H8-138 to H7-008, under the creek, it may be recommended that the City conduct a CCTV inspection.
- d. Deliverable:
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
 - ii. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.

- iii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
- iv. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.
- v. Sub-meter coordinates shall be provided for all defects and suspect defects identified during smoke testing activities. Defects along with the associate picture and address shall be provided in digital format. Follow-up dyed-water testing and/or CCTV inspections may be recommended for both public and private sources or suspect sources.
- vi. Video and written reports shall be provided by the City.

7. Area 5B

- a. Description: Located in the east portion of the City. Basin boundary is defined as E St Patrick St to the south, E St James St to the north, Sioux Ave to the west and Cambell St to the East. The entire basin, defined by the Flow Monitoring Program (Wade 2006), contains approximately 192,792 lf of sanitary sewer.
- b. Issues: The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 11, 2nd with an individual I/I volume of 1.4 (gal x 1000)/IDM. The basin has a combination of high I/I and capacity issues. There is a low lying area from La Crosse St and Omaha St to Sedivy Ln.
- c. Scope:
 - i. Flow Monitoring: To further quantify the I/I in the basin, it is recommended that multiple temporary flow monitors be installed within the basin for a period of 60 to 90 days. Flow monitoring can be conducted in two (2) separate areas, one (1) monitor located at I7-028 measuring flow from the 42-inch line coming in from the north and one monitor located at I7-117, subtracting flow from the north and measuring the flow from the 27 inch line coming from the southwest.
 - ii. Private I/I Questionnaire: To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.
 - iii. Manhole Inspections: To identify the extent of manholes contributing to the I/I and to further verify capacity issues, it is recommended that manhole inspections along with visual pipe inspections be conducted along the interceptor, from manhole I7-094 to J8-076, and on the 15-inch line from I7-060 to I7-046 and the 8-inch line from J7-053 to J7-019. Comprehensive condition assessments of the manholes shall be conducted.
 - iv. Visual pipe inspection of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up to 1,100 lineal feet of pipe.
 - v. Smoke Testing: To further identify inflow sources within the basin, it is recommended that smoke testing be conducted in the Riley and Sioux Ave area, up to 11,200 lf of sewer mains. Defects, as well as suspect defects, will be identified and located using sub-meter GPS accuracy.
- d. Deliverable:
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
 - ii. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.
 - iii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
 - iv. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.
 - v. Sub-meter coordinates shall be provided for all defects and suspect defects identified during smoke testing activities. Defects along with the associate picture and address shall be provided in digital format. Follow-up

dyed-water testing and/or CCTV inspections may be recommended for both public and private sources or suspect source

8. Area 6 – Rapid Valley Sanitary District

- a. Description: Located east of the City. Basin boundary is defined as Jolly Ln to the south, Stellar St to the north, Homestead St to the west and Highway 44 to the east. The Rapid Valley Sanitary District connects into the City's 42-inch interceptor in three (3) locations, L8-011, L8-023, and M9-009. The entire basin, defined by the Flow Monitoring Program (Wade 2006), contains approximately 30,209 lf of sanitary sewer.
- b. Issues: The Flow Monitoring Program (Wade 2006) ranked this basin, meter No. 12, 5th with an individual I/I volume of 0.3 (gal x 1000)/IDM. The City is interested in determining the I/I in this area contributed to the Rapid Valley Sanitary District to compare against water usage records.
- c. Scope:
 - i. Flow Monitoring: To quantify the I/I in the contributing from the Rapid Valley Sanitary District, it is recommended that multiple temporary flow monitors be installed at the three (3) outlets of the District and where the City passes into the District, TBD, for a period of 60 to 90 days.
- d. Deliverable:
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.

9. Mt. View Road to Founders

- a. Description: Located in the central portion of the City. This area is defined by the interceptor from Manhole F7-170, located west of Mountain View Road, to Manhole G6-041, located west of West Blvd.
- b. Issues: The interceptor is a 30 to 33-inch pipe consistently running 1/3 to 1/2 full. The City suspects that the interceptor has several I/I issues including a creek crossings, located on the west end and near Founders Park Dr. and potential service taps (pre-1972 flood) along the interceptor. The City also suspects illicit sump pump connections located along Sum Pl.
- c. Scope:
 - i. Private I/I Questionnaire: To quantify the number of suspected sump pumps connected to the sanitary sewer system, it is recommended that questionnaires are mailed to the property owners located within the basin requesting the number of sump pumps connected per building.
 - ii. Manhole Inspections: To identify the extent of manholes contributing to the I/I and to further verify capacity issues, it is recommended that manhole inspections along with visual pipe inspections be conducted along the interceptor, from manhole F7-170 to G6-041, this includes the creek crossing at F7-170 to E6-037. Additionally, manhole inspections will be conducted at the creek crossing from manhole G6-059 to G6-058 at Founders Park Dr. Comprehensive condition assessments of the manholes shall be conducted.
 - iii. Visual pipe inspection of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up 6,000 lineal feet of pipe.
- d. Deliverable:
 - i. Results from the Private I/I Questionnaire will be summarized in a table format with addresses of connected sources.
 - ii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
 - iii. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.

10. SDSMT

- a. Description: Located in the center of the City. This area is defined by the interceptor from Manhole H7-048, located on Maple Ave, to Manhole I7-053, located on Cherry Ave.

- b. Issues: The interceptor is a 30 to 33-inch RCP connecting into a 42-inch RCP at Manhole I7-049. The interceptor converges from a 33-inch to a 30-inch in some locations; capacity is an issue. Additionally, there is an existing creek crossing located on the 15-inch RCP near San Francisco St that may be susceptible to I/I.
- c. Scope:
 - i. Flow Monitoring: To further quantify the existing flows and the I/I in the interceptor, it is recommended that multiple temporary flow monitors be installed along the interceptor and on outlets to other basins for a period of 60 to 90 days. Flow monitoring can be conducted in four (4) separate areas, H7-048, I7-069, I7-046 and I7-052.
 - ii. Manhole Inspections: To identify the extent of manholes contributing to the I/I and to further verify capacity issues, it is recommended that manhole inspections along with visual pipe inspections be conducted along the interceptor, from manhole H7-048 to I7-053. Additionally, manhole inspections will be conducted at the creek crossing from manhole I7-034 to I7-045. Comprehensive condition assessments of the manholes shall be conducted.
 - iii. Visual pipe inspection of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up 6,000 lineal feet of pipe.
- d. Deliverable:
 - i. Average daily dry flow, infiltration and inflow will be quantified based on the available flow data.
 - ii. A manhole and pipe rehabilitation schedule shall be developed from the manhole inspections and CCTV review identifying the rehabilitation technique and cost estimate to repair. Pictures of all defects shall be provided as well as required dimensions, including invert depths, for proper repair.
 - iii. A table identifying line segments with maintenance or structural defects shall be provided. A picture of the pipes, as well as, pipe diameters, material and the observation shall be provided. Follow-up cleaning and/or CCTV inspections shall be recommended.

11. Rapid Canyon Sewer Main

- a. Description: Located along Jackson Boulevard adjacent to the location of the new water plant. This area is defined by the interceptor from Manhole D8-003 (F-13) on Jackson Boulevard to Manhole MH III-3 (C-2) on Gleghorn Canyon Road.
- b. Issues: The City will be taking over this interceptor from Rapid Canyon Sanitary District. The goal of this investigation is to determine the condition of the infrastructure and quantify I&I Issues.
- c. Scope:
 - i. Flow Monitoring: Provide two temporary flow meters to quantify contribution into the segment of sewer main. Temporary flow meter data will be compared to City Data at their downstream meter.
 - ii. Manhole Inspections: To identify the extent of manholes contributing to the I/I and to further verify capacity issues, it is recommended that manhole inspections along with visual pipe inspections be conducted along the interceptor, from manhole D8-003 to MHIII-003.
 - iii. Visual pipe inspection of the incoming and outgoing pipes shall be conducted in conjunction with the manhole inspections to identify infiltration, maintenance and/or structural defects located in the pipes within 10 feet of the manholes. Based on the visual pipe inspection from the manholes, Engineer shall recommend pipe runs to be CCTV inspected by the City. Engineer shall review CCTV and provide recommendations for up 3,680 lineal feet of pipe.

Project Cost - Exhibit B

9-Mar-11

Rapid City I/I Study Monitoring and Inspection



Below is a cost breakdown, with unit pricing.

WORK TASK DESCRIPTION	Labor	Expenses	Subcontracts	Total
1. Project Kick-off Meeting (Visit)	\$1,026	\$672	\$3,831	\$5,529
2. Monthly Progress Meetings (6 Conference Call)	\$3,108	\$225	\$4,477	\$7,811
3. Flow Monitoring Plan Meeting	\$1,368	\$696	\$809	\$2,873
4. Draft I/I Study Results Meeting	\$1,368	\$696	\$809	\$2,873
5. Final I/I Study and Draft SSES Meeting (Visit)	\$1,368	\$696	\$2,348	\$4,412
6. Final SSES Meeting (Visit)	\$1,368	\$696	\$2,348	\$4,412
7. City Council Meeting	\$2,424	\$777	\$809	\$4,010
8. Project Administration	\$13,200	\$940	\$13,521	\$27,661
9. Public Relations	\$1,740	\$129	\$5,404	\$7,273
10. Mobilization			\$2,500	\$2,500
Area 1				
1. Flow Monitoring/Analysis (60-day base period)	\$1,506	\$110	\$7,281	\$8,898
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$528	\$40	\$3,385	\$3,954
4. Smoke Testing (3-Person Crew)	\$264	\$20	\$22,502	\$22,787
5. CCTV Inspection Review (4,750 LF)	\$264	\$20	\$1,209	\$1,493
Area 2				
1. Flow Monitoring/Analysis (75-day base period)	\$1,506	\$110	\$19,544	\$21,160
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$528	\$40	\$3,035	\$3,604
4. Night Time Flow Measurements	\$264	\$20	\$8,616	\$8,902
5. CCTV Inspection Review (1,000 LF)	\$264	\$20	\$420	\$704
Area 3				
1. Flow Monitoring/Analysis (60-day base period)	\$1,506	\$110	\$25,675	\$27,292
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$1,212	\$89	\$3,385	\$4,686
4. Night Time Flow Measurements	\$606	\$44	\$8,616	\$9,266
5. CCTV Inspection Review (1,000 LF)	\$806	\$44	\$420	\$1,070
Area 4				
1. Flow Monitoring/Analysis (60-day base period)	\$1,506	\$110	\$13,413	\$15,029
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$528	\$40	\$12,657	\$13,225
4. Smoke Testing	\$264	\$20	\$20,513	\$20,797
5. CCTV Inspection Review (4,100 LF)	\$264	\$20	\$1,209	\$1,493
Area 5A				
1. Flow Monitoring/Analysis (60-day base period)	\$1,506	\$110	\$13,413	\$15,029
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$528	\$40	\$3,385	\$3,954
4. Smoke Testing (3-Person Crew)	\$264	\$20	\$12,536	\$12,819
5. CCTV Inspection Review (3,000 LF)	\$264	\$20	\$963	\$1,247
Area 5B				
1. Flow Monitoring/Analysis (60-day base period)	\$1,506	\$110	\$13,413	\$15,029
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$528	\$40	\$4,785	\$5,354
4. Smoke Testing (3-Person Crew)	\$264	\$20	\$6,325	\$6,609
5. CCTV Inspection Review (1,100 LF)	\$264	\$20	\$420	\$704
Area 6				
1. Flow Monitoring/Analysis (75-day base period)	\$1,242	\$90	\$19,544	\$20,876
Mt. View Road to Founders				
1. Private I/I Questionnaire	\$870	\$65		\$935
2. Manhole Inspections (2-Person Crew)	\$264	\$20	\$3,385	\$3,669
3. CCTV Inspection Review (6,000 LF)	\$264	\$20	\$1,577	\$1,861
SOSMT				
1. Flow Monitoring/Analysis (60-day base period)	\$870	\$65	\$25,675	\$26,510
2. Private I/I Questionnaire	\$870	\$65		\$935
3. Manhole Inspections (2-Person Crew)	\$264	\$20	\$3,035	\$3,319
4. CCTV Inspection Review (6,000 LF)	\$264	\$20	\$1,577	\$1,861
Rapid Canyon				
1. Flow Monitoring/Analysis (60-day base period)	\$606	\$44	\$8,113	\$8,763
2. Manhole Inspections (2-Person Crew)	\$264	\$20	\$2,546	\$2,829
3. CCTV Inspection Review (3,680 LF)	\$264	\$20	\$1,209	\$1,493
NASSCO Training				
1. In-House MACP/PACP Training			\$4,265	\$4,265
Reporting				
1. Model Review and Update	\$6,378	\$466	\$452	\$7,306
2. Capacity and Cost-Effectiveness Analysis	\$3,696	\$269	\$3,657	\$7,631
3. Rehabilitation Recommendations	\$3,696	\$269	\$3,539	\$7,503
4. Draft SSES/I/I Study Report	\$3,696	\$269	\$11,743	\$15,708
5. Final Report and Deliverables	\$5,904	\$2,435	\$3,900	\$12,239
Project Total:				\$427,871

Notes:

City of Rapid City, SD

EXHIBIT C – SCHEDULE OF HOURLY PROFESSIONAL SERVICE BILLING RATES

Schedule of Hourly Professional Service Billing Rates
Infiltration and Inflow Study
SS10-1919 / CIP No. 50849

Position Classification	Classification Level	Hourly Billing Rate
General Office	5	\$59.00
Technician	6	\$65.00
Assistant	7	\$77.00
	8	\$108.00
	9	\$120.00
Staff	10	\$132.00
	11	\$148.00
Senior	12	\$159.00
	13	\$171.00
Associate	14	\$181.00
	15	\$193.00
Principal	16	\$198.00
	17	\$200.00
RAPIDCITY11A		

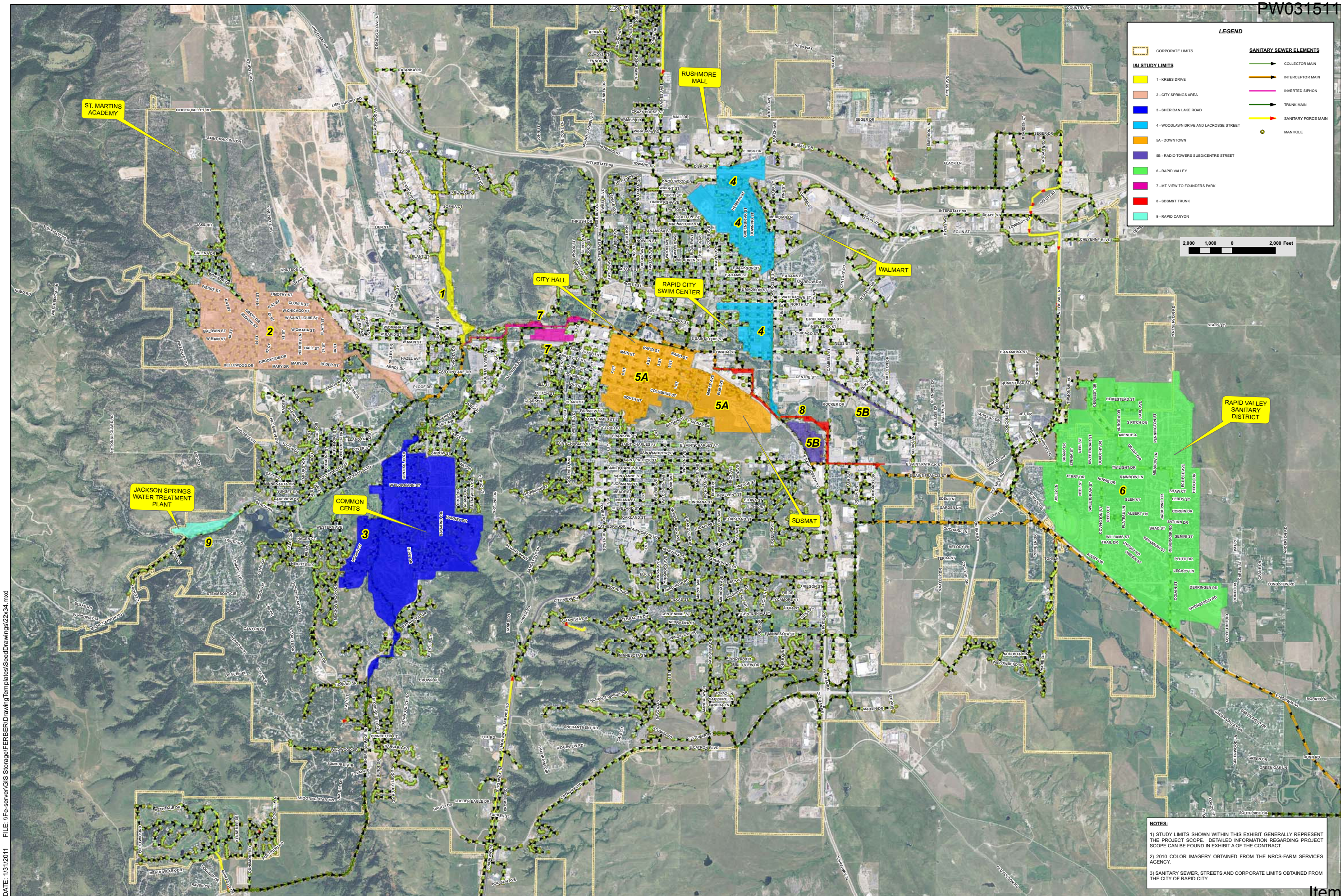
Notes:

1. Position classifications listed above refer to the firm's internal classification system for employee compensation. For example, "Associate", "Senior", etc., refer to such positions as "Associate Engineer", "Senior Architect", etc.
2. Monthly invoices will be submitted for payment covering services and expenses during the preceding month.
3. Schedule of Hourly Professional Services Billing Rates are effective for services through December 31, 2011 and subject to revision thereafter.

EXHIBIT D – SCHEDULE OF REIMBURSABLE EXPENSES

Schedule of Reimbursable Expenses	
Description	Unit Cost
Personal Mileage:	Current IRS Rate
Reproduction/Printing:	8.5"x 11" Copies White \$0.08/sheet 22" x 34" Drawings White Bond \$1.68/sheet 22" x 34" Drawings Mylar \$5.88/sheet 8.5"x 11" Copies Color \$0.70/sheet Color Plotting \$6.00/SF
Long Distance Telephone:	Cost
Postage:	Cost
Travel Expenses:	
Airfare:	Cost
Lodging:	Cost
Meals:	Cost
Rental Car:	Cost
Vehicle Expense:	
Sedan (4-door)	\$58/day + \$0.29/mile
SUV – 4WD	\$65/day + \$0.35/mile
Subcontracts	Cost

Total of billable hours plus reimbursable expenses shall not exceed the maximum Cost Reimbursable Not to Exceed Amount allowed under the contract, without a written amendment executed by the parties.



NOTES:
1) STUDY LIMITS SHOWN WITHIN THIS EXHIBIT GENERALLY REPRESENT THE PROJECT SCOPE. DETAILED INFORMATION REGARDING PROJECT SCOPE CAN BE FOUND IN EXHIBIT A OF THE CONTRACT.
2) 2010 COLOR IMAGERY OBTAINED FROM THE NRCS-FARM SERVICES AGENCY.
3) SANITARY SEWER, STREETS AND CORPORATE LIMITS OBTAINED FROM THE CITY OF RAPID CITY.

Prepared For:



Prepared By:



REVISIONS:

UPDATED 3-3-11 / DMM

ADDED 5A & 5B LBS 3-10-11/DMM

CITY OF RAPID CITY

2011 I&I STUDY - WORK MAP

CITY PROJECT SS10-1919 / CIP 50849

Sheet Title:

RAPID CITY

I&I STUDY

PROJECT LIMITS

Sheet:

EXHIBIT E