ARCADIS Design & Consultancy for natural and built assets

Metropolitan Sewer District of Greater Cincinnati

10142910 LUDLOW RUN SUSTAINABLE SOURCE CONTROL

Project Management Plan

Planning Phase

FINAL

July 21, 2020

PROJECT MANAGEMENT PLAN

Item No.	Element	Description
1	Project Background	The Ludlow Run Sustainable Control project includes planning, design and construction phase services for a Wet Weather Improvement Plan (WWIP) project (or projects) to reduce the volume of the combined sewer overflows in the Ludlow Run watershed (CSO's 151, 109, 110,111,112, 162 and 024). The project will also address asset management needs within the Ludlow Run watershed. The Ludlow Run sub-watershed, located in King's Run watershed, includes portions of Cincinnati neighborhoods: Northside, College Hill, Winton Hills, and Winton Place. CSO 024, referred to as the Ludlow Run Regulator is located on the west bank of Mill Creek at the three-way intersection of Spring Grove Avenue, Dooley Bypass, and Dane Avenue. Six CSOs are nested within CSO 024 sub-watershed. Listed from north to south within the sub-watershed, CSOs 151, 109,110, 111, 112, and 162 overflow into Ludlow Run, which then enters the combined sewer system and contributes to overflow at CSO 024.
2	Objectives	It is the objective of this planning portion of the project to develop a watershed plan to address the CSOs in the Ludlow Run sub-watershed. An alternatives evaluation and Business Case Evaluation (BCE) will be developed to evaluate alternates to address the following: 1. Combined sewer overflow volume reduction in the nested CSOs and at CSO 024. 2. Asset management needs within the Ludlow Run sub-watershed. A secondary objective is to address community concerns expressed by residents in the project area. Additional definition of this objective is needed with MSDGC The execution of the overall scope of work will inform MSDGC to make decisions on proceeding with asset management and capital projects in the Ludlow Run project area.
3	Project Stakeholders	Project stakeholders include MSDGC, Hamilton County, and the residents of the Ludlow Run project area as members of the Communities United for Action (CUFA).

Item No.	Element	Description
4	Key Technical and Project Management Personnel	• Kristen Benick – Project Manager • Jason Abbott – Alternatives Analysis and BCE Lead • Neila Salvadori – Modeling Lead • Sue Pressman – Technical Advisor – Planning • Hazem Gheith – Technical Advisor – Hydraulic Analysis/ Modeling • Mark Van Auken – Technical Advisor = Stormwater/ Green Infrastructure
5	Project Schedule (Major Milestones)	Refer to the baseline schedule (Exhibit A) for this project developed and updated to reflect the actual notice to proceed for Task 1 received on April 29, 2020. For Task 2 an NTP date of June 15, 2020 was assumed, at this time Arcadis has not been authorized to perform work beyond Task 1. Remaining deliverables listed below will be determined based on flow monitoring and model calibration needs. The revised contractual submittal dates of the major milestones/deliverables in Exhibit D of our contract are: • Draft Baseline Schedule – 6/3/2020 • Draft Quality Control Plan – 6/3/2020 • Draft Risk Management Plan – 6/3/2020 • Draft Project Management Plan – 6/3/2020 • Draft Data Review Technical Memorandum (Task 2) – 9/14/2020 (dependent on NTP for Task 2) • Draft Alternative Analysis Report (Task 5) – TBD • Draft Business Case Evaluation (Task 5) – TBD
6	Project Budget	For the planning phase we have been authorized $526,651 for Tasks 1 through 5. Total project budget is $2,687,208 for this time and material/multiplier-based contract. Invoices shall be in accordance with Professional Service Agreement 95x12762. Refer to the scope of work and budget (Exhibit B) for additional detail.

Item No.	Element	Description
		Erwin Mamacos (MSDGC) and Kristen Benick (Arcadis) are the project managers from their respective organization and will copied on all correspondence. As technical advisor for the planning activities, Sue Pressman will be copied on all correspondence. Modeling correspondence between David Moughton and Neila Salvadori may occur with copies to both Erwin Mamacos and Kristen Benick.
7	Project Communication Plan	A planning workshop, ten project progress meetings, and two Technical Review Team meetings to present draft deliverables are included in the scope and will be defined as necessary to facilitate the project. It is anticipated the meetings will be used for any of the following purposes: • Review of updated schedule, budget and planning progress • Review of the modeling assessment • Discussion of analysis results • Coordination between MSDGC and other project stakeholders
8	Contract Management Plans	The scope of the planning portion of the Ludlow Run project includes geotechnical and topographical survey data collection in Tasks 2 and 4. The following subconsultants have been identified for this work: • NEAS, Inc. – Geotechnical Services • TEC Engineering, Inc. – Surveying Services (*TEC is unable to perform this work and a new subconsultant is being identified to complete this work. The appropriate SBE substitution paperwork will be completed to manage this change to the project*) All work completed by subconsultants is subject to QA/QC review by Arcadis using the standards outlined in the QC plan. All communication between the subconsultants for these services will be between the subconsultant and Kristen Benick. For reference, two other subconsultants are part of our team and are initiated in design phase: • Coldwater Consulting, LLC • ETC, Inc.
9	Project Risk Management Plan	Refer to the Risk Register and the Risk Management Plan in Exhibit C for addressing risks for this project.
10	Project Quality Control Plan	Refer to the Quality Control Plan in Exhibit D for the list of deliverables, responsible parties, and QC reviewers for each project task.

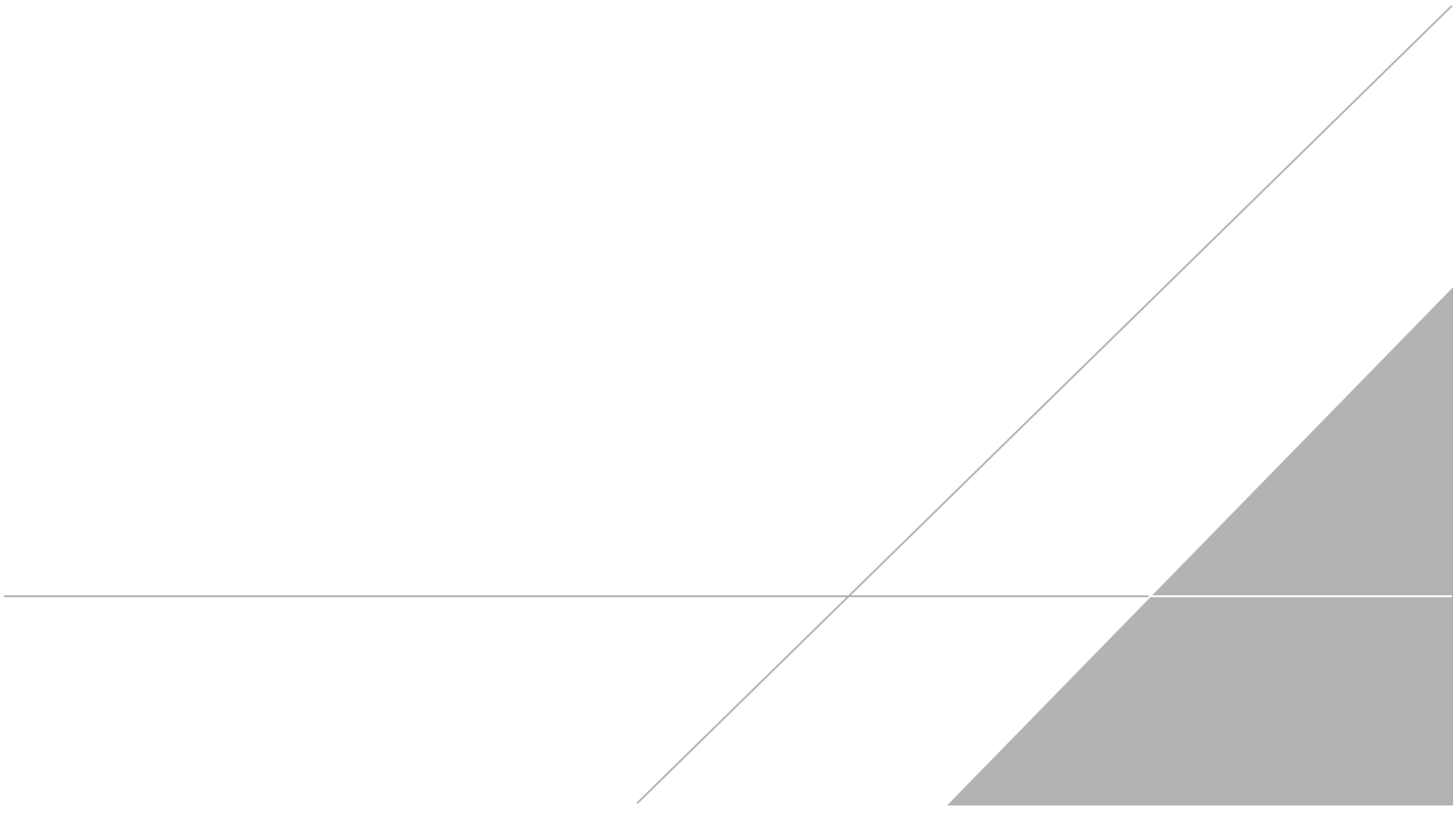
Item No.	Element	Description
11	Project Document Management and MSDGC Document Control	All files, electronic and paper, will be located in the Cincinnati Arcadis office and on the Cincinnati office project server or sharepoint server. All deliverables and significant communications are submitted and routed through MSDGC Document Control, 1600 Gest Street, Cincinnati, OH 45204 or MSDDocCtl@cincinnati-oh.gov *Always include as the subject line of the email:* 10142910 Ludlow Run Sustainable Source Control – subject of email
12	Kickoff Meeting Minutes	Per the scope, the kickoff meeting has been replaced with the planning workshop that is scheduled to proceed during the Data Review and Collection (Task 2). The planning workshop minutes will be attached when finalized.

References:

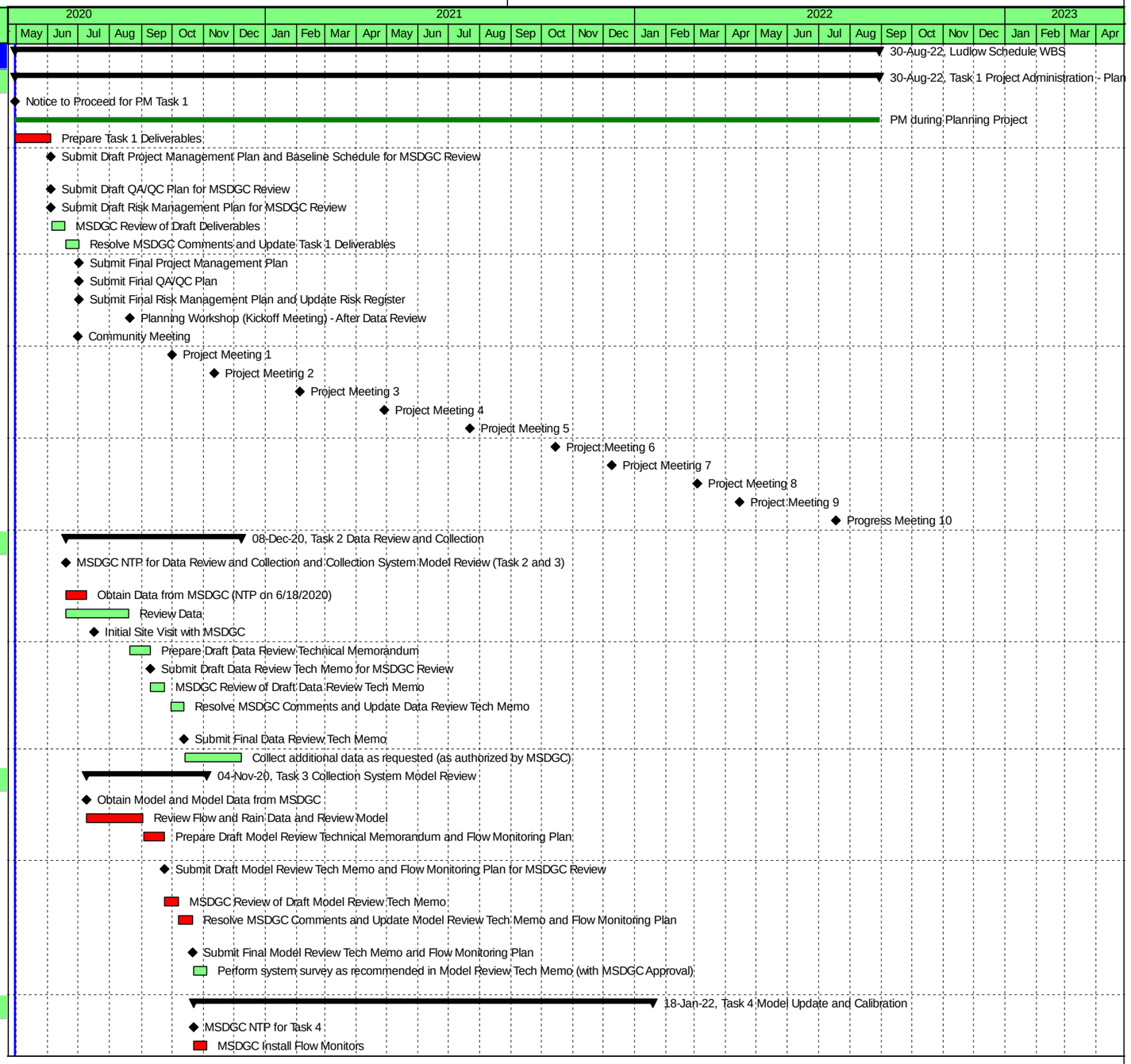
A. Baseline Schedule
B. Scope of Work and Budget
C. Risk Management Plan
D. Quality Control Plan

EXHIBIT A

Exhibit A – Baseline Schedule



Activity ID	Activity Name	Original Duration	Start	Finish
Ludlow Schedule WBS		610	29-Apr-20	30-Aug-22
Task 1 Project Administration - Planning		610	29-Apr-20	30-Aug-22
1.010	Notice to Proceed for PM Task 1	0	29-Apr-20*	
1.020	PM during Planning Project	610	29-Apr-20	30-Aug-22
1.030	Prepare Task 1 Deliverables	26	29-Apr-20	03-Jun-20
1.040	Submit Draft Project Management Plan and Baseline Schedule for MSDGC Review	0		03-Jun-20*
1.050	Submit Draft QA/QC Plan for MSDGC Review	0		03-Jun-20*
1.060	Submit Draft Risk Management Plan for MSDGC Review	0		03-Jun-20*
1.070	MSDGC Review of Draft Deliverables	10	04-Jun-20	17-Jun-20
1.080	Resolve MSDGC Comments and Update Task 1 Deliverables	10	18-Jun-20	01-Jul-20
1.090	Submit Final Project Management Plan	0		01-Jul-20
1.100	Submit Final QA/QC Plan	0		01-Jul-20
1.110	Submit Final Risk Management Plan and Update Risk Register	0		01-Jul-20
1.120	Planning Workshop (Kickoff Meeting) - After Data Review	0	20-Aug-20	
1.140	Community Meeting	0	30-Jun-20*	
1.150	Project Meeting 1	0	01-Oct-20	
1.160	Project Meeting 2	0	12-Nov-20	
1.170	Project Meeting 3	0	04-Feb-21	
1.180	Project Meeting 4	0	29-Apr-21	
1.190	Project Meeting 5	0	22-Jul-21	
1.200	Project Meeting 6	0	14-Oct-21	
1.210	Project Meeting 7	0	09-Dec-21	
1.220	Project Meeting 8	0	03-Mar-22	
1.230	Project Meeting 9	0	14-Apr-22	
1.240	Progress Meeting 10	0	18-Jul-22	
Task 2 Data Review and Collection		124	18-Jun-20	08-Dec-20
2.010	MSDGC NTP for Data Review and Collection and Collection System Model Review (Task 2 and 3)	0	18-Jun-20	
2.020	Obtain Data from MSDGC (NTP on 6/18/2020)	15	18-Jun-20	08-Jul-20
2.030	Review Data	45	18-Jun-20	19-Aug-20
2.040	Initial Site Visit with MSDGC	0	16-Jul-20	
2.050	Prepare Draft Data Review Technical Memorandum	15	20-Aug-20	09-Sep-20
2.060	Submit Draft Data Review Tech Memo for MSDGC Review	0		09-Sep-20*
2.070	MSDGC Review of Draft Data Review Tech Memo	10	10-Sep-20	23-Sep-20
2.080	Resolve MSDGC Comments and Update Data Review Tech Memo	10	30-Sep-20	13-Oct-20
2.090	Submit Final Data Review Tech Memo	0		13-Oct-20
2.100	Collect additional data as requested (as authorized by MSDGC)	40	14-Oct-20	08-Dec-20
Task 3 Collection System Model Review		85	09-Jul-20	04-Nov-20
3.010	Obtain Model and Model Data from MSDGC	0	09-Jul-20	
3.020	Review Flow and Rain Data and Review Model	40	09-Jul-20	02-Sep-20
3.030	Prepare Draft Model Review Technical Memorandum and Flow Monitoring Plan	15	03-Sep-20	23-Sep-20
3.040	Submit Draft Model Review Tech Memo and Flow Monitoring Plan for MSDGC Review	0		23-Sep-20
3.050	MSDGC Review of Draft Model Review Tech Memo	10	24-Sep-20	07-Oct-20
3.060	Resolve MSDGC Comments and Update Model Review Tech Memo and Flow Monitoring Plan	10	08-Oct-20	21-Oct-20
3.070	Submit Final Model Review Tech Memo and Flow Monitoring Pla	0		21-Oct-20
3.080	Perform system survey as recommended in Model Review Tech Memo (with MSDGC Approval)	10	22-Oct-20	04-Nov-20
Task 4 Model Update and Calibration		324	22-Oct-20	18-Jan-22
4.005	MSDGC NTP for Task 4	0	22-Oct-20	
4.010	MSDGC Install Flow Monitors	10	22-Oct-20	04-Nov-20



Remaining Level of Effort | Actual Work | Critical Remaining Work | Actual WBS Summary
Actual Level of Effort | Remaining Work | Remaining WBS Summary | Milestone

TASK filter: All Activities

Activity ID	Activity Name	Original Duration	Start	Finish
4.020	Review Flow Monitor Data during Collection	169	05-Nov-20	29-Jun-21
4.030	Receive Flow Monitoring Data	0		29-Jun-21
4.040	Update Hydraulic Model	40	05-May-21	29-Jun-21
4.050	Validate and Calibrate Hydraulic Model (Assumed 10 FM)	50	30-Jun-21	07-Sep-21
4.060	Prepare Draft Task 4 Deliverables based on MSDGC Modeling guidelines	15	08-Sep-21	28-Sep-21
4.070	Submit MSDGC Preliminary Review Checklist	0		28-Sep-21
4.080	MSDGC Review of Preliminary Review Checklist	10	29-Sep-21	12-Oct-21
4.085	Update Checklist based on MSDGC comments	10	13-Oct-21	26-Oct-21
4.090	Submit MSDGC Detailed Model Review Checklist	0		26-Oct-21
4.100	MSDGC Review of Detailed Model Review Checklist	10	27-Oct-21	09-Nov-21
4.102	MSDGC Conditional Approval of Model to Prepare Report	0		09-Nov-21
4.105	Prepare Draft Modeling Report and Model Files	15	10-Nov-21	30-Nov-21
4.110	Submit Draft Modeling Report and Model Files	0		30-Nov-21
4.120	MSDGC Review of Draft Modeling Report	10	01-Dec-21	14-Dec-21
4.130	Resolve MSDGC Comments and Update Modeling Report	15	15-Dec-21	04-Jan-22
4.140	Submit Final Modeling Report and Model Files	0		04-Jan-22
4.150	Develop Baseline Project Model	10	05-Jan-22	18-Jan-22
Task 5 Planning and BCE		160	19-Jan-22	30-Aug-22
5.010	Perform Conditions and Capacity Analysis	20	19-Jan-22	15-Feb-22
5.020	Perform Alternatives Analysis and Modeling	50	16-Feb-22	26-Apr-22
5.030	Prepare Alternatives Analysis Report	20	27-Apr-22	24-May-22
5.040	Submit Draft Alternatives Analysis Report for MSDGC Review	0		24-May-22
5.050	MSDGC Review of Draft Alternatives Analysis Report	10	25-May-22	07-Jun-22
5.060	Conduct Alternatives Analysis Review Meeting	0	13-Jun-22	
5.070	Resolve MSDGC Comments and Update Alternatives Analysis Report	15	08-Jun-22	28-Jun-22
5.080	Submit Final Alternatives Analysis Report	0		28-Jun-22
5.090	Prepare Draft BCE	20	29-Jun-22	26-Jul-22
5.100	Submit Draft BCE for MSDGC Review	0		26-Jul-22
5.110	MSDGC Review of Draft BCE	10	27-Jul-22	09-Aug-22
5.120	Conduct BCE Review Meeting	0	15-Aug-22	
5.130	Resolve MSDGC Comments and Update BCE	15	10-Aug-22	30-Aug-22
5.140	Submit Final BCE Report	0		30-Aug-22
5.999	End of Planning Phase	0		30-Aug-22*

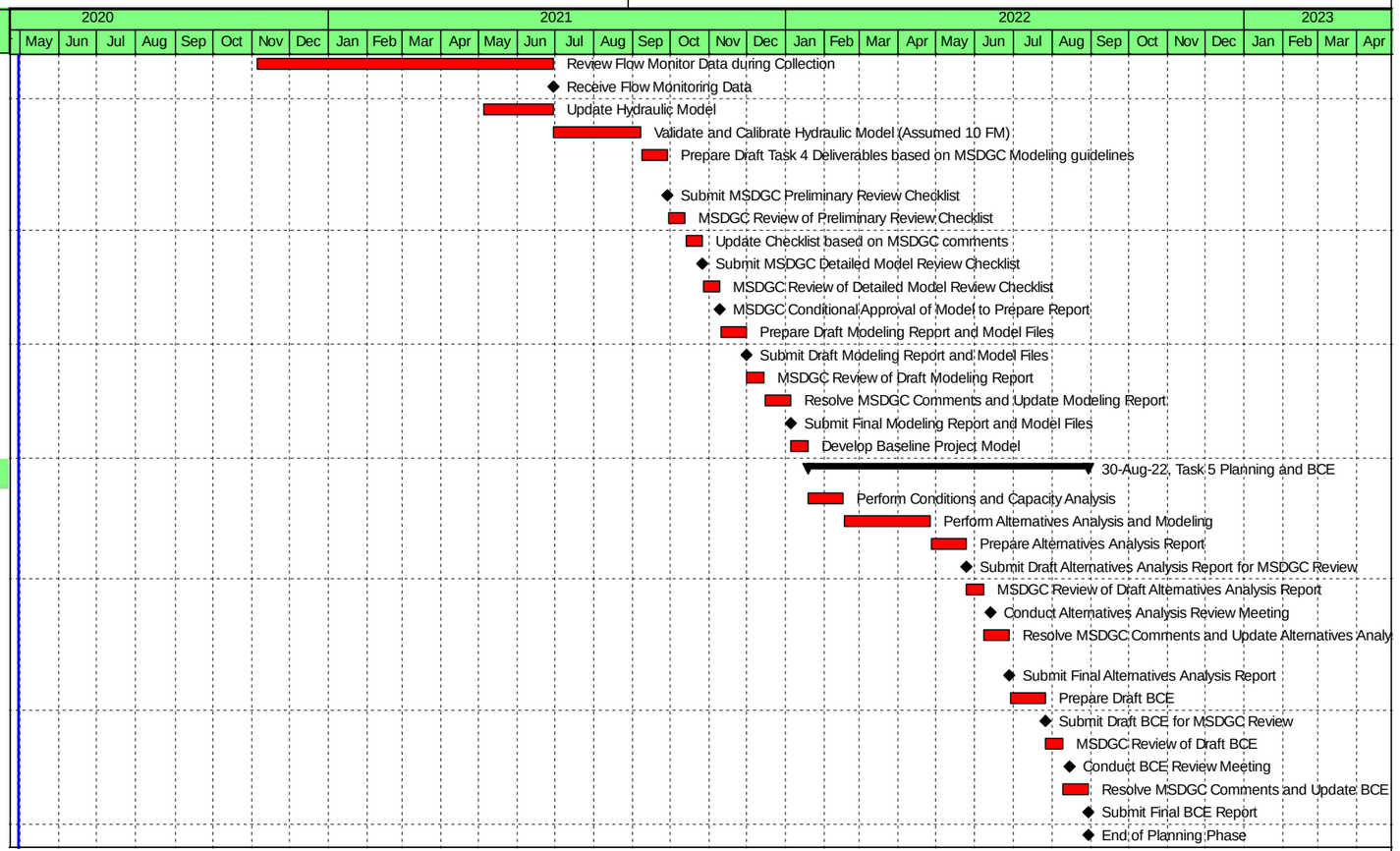


EXHIBIT B

Exhibit B – Scope of Work and Budget

EXHIBIT A
SCOPE OF WORK

PROJECT BACKGROUND:
The Ludlow Run Sustainable Source Control project includes planning, design and construction phase services for a Wet Weather Improvement Plan (WWIP) project (or projects) to reduce the volume of the combined sewer overflows in the Ludlow Run watershed (CSO's 151, 109, 110, 111, 112, 162 and 024). The project will also address asset management needs within the Ludlow Run watershed.

The Ludlow Run sub-watershed, located in King's Run watershed, includes portions of Cincinnati neighborhoods: Northside, College Hill, Winton Hills, and Winton Place. CSO 024, referred to as the Ludlow Run Regulator is located on the west bank of Mill Creek at the three-way intersection of Spring Grove Avenue, Dooley Bypass, and Dane Avenue. Six CSOs are nested within CSO 024 sub-watershed. Listed from north to south within the sub-watershed, CSOs 151, 109, 110, 111, 112, and 162 overflow into Ludlow Run, which then enters the combined sewer system and contributes to overflows at CSO 024.

SCOPE OF WORK:
The Scope of Work includes the following:

TASK 1.0 – PROJECT ADMINISTRATION – PLANNING
TASK 1.1: Project Management

The Consultant will prepare a Project Management Plan identifying key technical and project management personnel, their roles and responsibilities as assigned by task, for the duration of the contract. Include cost-loaded schedule using Primavera or approved scheduling software. Also include a comprehensive list of deliverables. Submit electronic and hardcopy versions of updated project deliverables and schedules as requested by the MSDGC Project Manager. The Consultant will include contract management plans defining scope and lines of communication for sub-consultants, as applicable. The Consultant will provide MSDGC with electronic versions of draft and final Project Management Plan. During the duration of the planning phase, the Consultant will perform project administration including the preparation of monthly progress reports and monthly schedule updates.

TASK 1.2: Project Meetings

The Consultant will attend project meetings held with MSDGC to discuss status of the project, technical findings, content of deliverables, schedule, and budget. The project meetings during the Planning Phase will include one planning workshop and ten status meetings. The project planning workshop meeting will include the Consultant's key technical and project management personnel and MSDGC. The planning workshop will occur after project data review and shall confirm project goals and objectives, define critical success factors and discuss initial project observations and initial risk assessments. A specified list of deliverables and a completion schedule will be reviewed. The Consultant will provide MSDGC with electronic versions of draft minutes for meetings with stakeholders and formal meetings with MSDGC specified herein within five working days of the meeting date.

TASK 1.3: Quality Assurance and Quality Control

Quality Assurance/Quality Control (QA/QC) shall be provided by the Consultant utilizing competent staff in accordance with the current version of MSDGC's Quality Assurance and Quality Control Plan Guidelines (http://msdgc.org/downloads/ customer care/forms and documents/qa qc guidelines.pdf). Monitor and track quality reviews as required throughout the project for milestone interim planning submittals (Alternatives Analysis Report and BCE). QA/QC review level of effort is included in the technical scope items below. The Consultant will provide MSDGC with electronic versions of draft and final Quality Control Document. Provide QA/QC documentation for the Alternatives Analysis Report and the BCE.

TASK 1.4: Risk Management

The Consultant will provide project-level risk management in accordance with MSDGC's Risk Management Guidelines. The Consultant will develop a process to identify and manage risks through the planning stage. Risk Management shall include, at a minimum, the following items:

- Risk Register
- Qualitative Risk Assessment
- Quantitative Risk Assessment
- Recommended Risk Management Plan
- Risk Response Planning
- Risk Monitoring and Control Methodology

An initial risk assessment of the project and a preliminary risk register will be developed and will be regularly updated over the course of the planning effort. The project schedule shall indicate initial risk assessment and risk register, updates, workshops, or other methods the Consultant intends to utilize to manage project risk and to exploit risk management opportunities. The Consultant will provide MSDGC with electronic versions of draft and final Risk Management Plan.

TASK 2.0 – DATA REVIEW AND COLLECTION

TASK 2.1 Data Review

The Consultant will review relevant sections of existing reports and other related documents supplied by MSDGC for the Ludlow watershed, including CAGIS, water quality, operating data, operations and maintenance logs, gravity sewer asset management database (GSAM), CCTV reports, geotechnical soil borings, projects completed in the watershed basin since 2010, nominated asset management projects, Utility coordination projects for the next 5-years, future development plans, geotechnical soil borings and other relevant watershed basin information. Prepare an inventory of material that Consultant has obtained and reviewed. Consultant will identify gaps in the data and indicate any additional information that is required in order to prepare the Alternative Analysis and submit findings in a draft and final Data Review Technical Memorandum.

TASK 2.2 Data Collection and Site Visits

The Consultant will coordinate with MSDGC for the collection of additional data to fill the gaps identified in the Data Review. Data collection may include, but not be limited to: additional geotechnical investigations (to be performed by NEAS, Inc.), and additional CCTV work (to be performed by MSDGC), existing utility location. Either the consultant or MSDGC may obtain additional data, depending on the nature of the needed information. This shall be coordination

with MSDGC and the consultant shall not proceed with gathering additional data without approval from the MSDGC project manager.

The Consultant will conduct an initial site visit with MSDGC to review conditions at each CSO structure and along the alignment of the existing combined sewer line to CSO 024 on the Mill Creek. Consultant may conduct additional site visits as necessary to verify site conditions for project planning to investigate several alternatives. A brief site visit summary will be prepared.

TASK 3.0 – COLLECTION SYSTEM MODEL REVIEW

TASK 3.1: Model Review

All collection system modeling work shall be done in accordance with current MSDGC practices. Currently the calibration requirements are documented in "MSDGC Modeling Guidelines and Standards Volume I System Wide Model." (MSDGC Project Manager will provide Consultant with a copy.)

All modeling of MSDGC's collection system is to be done using USEPA SWMM 5. As USEPA frequently updates SWMM 5, Consultant will use the version stipulated in the "MSDGC Modeling Guidelines and Standards Volume I: System Wide Model." Consultant may use software that is an "enhancement" to USEPA SWMM (i.e., PCSWMM, InfoSWMM, etc.) to perform its work but all model deliverables shall be in the USEPA SWMM format. The MSDGC Project Manager will provide Consultant with the collection system model and the Consultant will utilize EPA-SWMM version 5.1.012 for the modeling deliverables.

The Consultant will evaluate the existing SWMM model for the Ludlow Watershed for (1) compliance with the current MSDGC guidelines as discussed above, and (2) the model's suitability to be used for the following applications:

- Simulate the existing system to compare the typical year overflows to the Regulatory requirements.
- Develop and analyze conceptual alternatives for CSO reduction to achieve the Regulatory requirements above.
- Assess the impact of asset management projects on the capacity of the system.
- Assess the impact of the conceptual alternatives on the downstream Mill Creek Interceptor.

The Consultant will evaluate currently available flow and rain monitoring data collected to-date in the Ludlow watersheds and interceptor and assess its suitability to be in the model comparison. Consultant shall perform the following to review and prepare the model for the project:

1. Isolate the Ludlow Run Area from the Mill Creek System Wide Model, assess and revise catchment area characteristics as necessary. Run isolated model and compare results to full model results to verify proper model editing and to test proposed boundary conditions.
2. Review the model as supplied by MSDGC to determine if it matches current field conditions using CAGIS data, available drawings, surveys, site inspections, the latest CCTV etc. Confirmation of sewer existence, connections, alignments, and any pipe changes in segment(s) being replaced should be confirmed at a minimum.
3. Review the current level of calibration and validation of the model, using the acceptable flow monitoring and rain data. Determine areas where the model meets and does not

meet MSDGC's current Modeling Guidelines and Standards as well as needs of this project.

Consultant will identify data gaps in the model that should be addressed and make recommendations to address the data gaps including potential locations for installation of flow monitors and need for surveying. The Consultant will provide MSDGC with electronic versions of the draft and final Model Review Technical Memorandum and draft and final Flow Monitoring Plan.

Depending on the results of the Model Review, scheduling for the activities of Flow Monitoring, Model Update and Model Calibration will be recommended based on the project objectives and goals. Task 4.0 Model Update and Calibration has the flexibility to be completed prior to Alternatives Analysis, BCE Development or Detailed Design, based on Model Review results and discussion with MSDGC.

TASK 3.2: Additional Survey Data Collection

Based on the gap analysis documented in the Model Review Technical Memorandum, additional surveying will be performed at key critical structures to update the model network and CAGIS. Potential locations include: diversion structures, outfalls, flow splits, and open channels. Level of effort for this task is 2 days of field crew (TEC Engineering, Inc.). The consultant shall not proceed with gathering additional survey data without approval from the MSDGC project manager.

TASK 4.0 – MODEL UPDATE AND CALIBRATION

TASK 4.1: Flow Monitoring Data Review during Collection Period

Consultant will provide support to MSDGC and the flow monitoring vendor during the installation of the monitors and collection of the data, to confirm on-going quality of the data to be used in model calibration. The level of effort is based on 10 flow monitors for period of 6 months.

The Consultant will perform the flow monitoring and rain data review including: the hydrographs for each flow monitoring site are plotted and general qualitative assessments of the data are made; the available flow monitors are balanced to ensure upstream flow monitors are reporting lower flows than downstream monitors; and finally, a rainfall analysis will be conducted providing the wet weather event statistics. Each flow monitor response is checked to determine if a reasonable runoff volume for the corresponding tributary acreage is being recorded.

TASK 4.2: Model Configuration and Calibration

Consultant shall perform the following to create Calibrated Model:

1. Update the model as supplied by MSDGC to match current field conditions using CAGIS data, available drawings, surveys, site inspections, the latest CCTV etc., including new data collected from the Model Review analysis. Make changes in model parameters where appropriate. The changes should be documented and included the Model Report submitted as part of Task 4.4.
2. Validate and calibrate the model based on available data collected at project-specific monitoring locations including flow monitoring (project area, Mill Creek, Auxiliary Mill

Creek Interceptor), overflow sensors (CSO, SSO, PSO, NEO), and facility operations (pump stations, RTCs, HRTs, etc.). Reports of flooded basements, stream levels, street flooding, manhole overflow, etc. may also be available for assessing model accuracy.

3. Calibration review by MSDGC will include:
    a. Submission by consultant of MSDGC Preliminary Review Checklist items
    b. Review and comment by MSDGC
    c. Submission by consultant of MSDGC Detailed Model Review Checklist and model input files
    d. Review and comment by MSDGC

TASK 4.3: Project Baseline Model

Consultant shall perform the following to create Project Baseline Model:

1. Smaller projects and headwater projects may not require development of Baseline Model differing from Calibration Model (except for simulated boundary conditions replacing observed boundary conditions).
2. Edit the Calibrated Model to include all known projects that will be implemented within the project area. MSDGC Project Manager will provide the list of projects that may exclude projects still in development. Coordinate with Project Manager and Modeling Group on how to implement the projects in the Baseline Model.
3. Coordinate with Project Manager and Modeling Group on known projects outside project area that will impact boundary conditions of Baseline Model. Boundary conditions may change from Calibrated Model including requiring iterations of Baseline Model and System Wide Model to stabilize boundary conditions.
4. Changes to Calibrated Model that result in Baseline Model will be documented in Alternative Analysis reporting. Reporting will include impacts on project area, CSO/SSO/NEO changes, changes at boundary conditions, etc.

TASK 4.4: Modeling Report

Consultant shall prepare Validation and Calibration reports according to the templates provided by MSDGC. Along with the Modeling Report, the consultant shall provide MSDGC with the actual updated and calibrated model(s). The method of delivery (ftp site, etc.) will be determined by MSDGC Project Manager.

TASK 5.0 – PLANNING AND BCE

TASK 5.1 – Condition and Capacity Analysis

The Consultant will perform a condition and capacity analysis. The condition analysis includes MSDGC's Gravity Sewer Asset Management (GSAM) and additional data collected by MSDGC and/or the Consultant from the gap analysis. The Consultant will use an agreed upon model for current conditions and alternative analysis. The first modeling effort is to perform a capacity analysis by running a typical year simulation and compare to the target WWIP Remaining Overflow Volumes (ROVs), and running a 5-year and 10-year design storm to identify capacity issues. The Consultant will define areas where there are capacity constraints and where WWIP projects are needed. In addition, other Utility Coordination projects will be summarized to see how they overlap with condition and capacity issues. Finding of the condition, capacity and partner projects will be discussed at a status meeting.

TASK 5.2: Alternatives Analysis

The Consultant will perform alternatives analysis to meet WWIP requirements, asset management needs, and possible partnering with projects led by other utilities or jurisdictions.
The Consultant will identify potential solutions to meet the WWIP requirements for the CSOs identified in the capacity analysis task. The Consultant will assess feasibility and screen the potential solutions with MSDGC at a status meeting. Up to three alternatives for each CSO will be selected to be further developed with preliminary layouts and planning level cost estimates. The Consultant will perform the analysis taking into account flexibility, available land, accessibility, maintenance, reliability, operations, and constructability. The Triple Bottom Line factors and scores will be developed in accordance with MSDGC's BCE requirements. MSDGC shall supply the Triple Bottom Line tool to the Consultant.

The Consultant will identify MSDGC sewer assets based on MSDGC records that need to be repaired, rehabilitated, and/or replaced in the project sewershed. The CCTV will be provided by MSDGC. The consultant will evaluate basis of rehabilitation approaches/technologies based on condition, site specific details impacting constructability, initial capital and life-cycle cost, utility-specific maintenance and rehabilitation philosophies. The Consultant shall estimate rehabilitation cost utilizing internally maintained cost data and Client-supplied bid history as available. The proposed repairs of failing assets within the project area shall be extended to a section that is in good structural condition. This effort should evaluate high risk segments, such as sewers under structures in the proximity of the proposed alignment.

If new storm outfalls are recommended, the Consultant will identify water quality standards and water quality enhancements that are required under EPA's stormwater management program (SWMP) for municipal storm sewer system (MS4). The Consultant will utilize current Hamilton County, Ohio MS4 permit requirements.

The Consultant shall develop the Draft Alternatives Analysis Report and present the report in front of MSDGC's Technical Review Committee (TRC). The Consultant shall incorporate comments from the TRC and submit a final Alternative Analysis Report. The response to MSDGC comments will be discussed at an Alternatives Analysis Review Meeting. The Consultant shall prepare and supply the meeting notes to MSDGC Document Control. The Consultant will provide MSDGC with hard copy and electronic versions of the draft and final Alternative Analysis Report.

<u>TASK 5.3: Alternatives Analysis Modeling</u>

Alternative modeling will be performed using the following steps:

1. Alternatives Analysis modeling will be developed from an agreed upon project baseline model..
2. Perform modeling of candidate alternatives identified during Planning phase, inputting proposed control measures and infrastructure to accurately predict impacts to any applicable sewer systems, forecast inflow and SSO/CSO reductions, and verify capacity of proposed infrastructure. Alternative modeling shall be updated and submitted for review and correction for each Detailed Design interim design submission (30%, 60%, 90%) to validate proposed projects (Budget for updates during design included in Design Phase).
3. Make adjustments to proposed control measures and infrastructure as necessary and re-run the model to forecast results against project goals.

4. The level of service will be estimated based on no changes of the upstream and downstream hydraulic grade line for the two-, five- and ten-year storms. Storm sewers are to be designed per SMU standards.
5. Document the changes made to the model.

TASK 5.4: BCE Development

The Consultant shall perform one (1) BCE for the evaluated alternatives in order to accomplish the project objectives. The document shall utilize MSDGC's standard BCE format. The BCE shall summarize the alternatives evaluated which will take into consideration the Triple Bottom Line factors and scores, as well as risk and costs associated with alternate strategies.
The Consultant shall present the Draft BCE Report in front of MSDGC's Technical Review Committee (TRC) at a BCE Review Meeting. The Consultant shall incorporate comments from the TRC and submit a final BCE Report. The Consultant shall prepare and supply the meeting notes to MSDGC Document Control. The Consultant will provide MSDGC with hard copy and electronic versions of the draft and final BCE Report.

TASK 6.0 – DETAILED DESIGN TASKS (SUPPLEMENTAL)

The work within Task 6.0 is considered to be supplemental. It shall only be performed with written authorization from MSDGC. A finalized scope and fees shall be negotiated prior to the execution of this work.

1. **Project Administration**

1.1. Attend one Design Phase kickoff meeting with MSDGC to cover all projects for which preliminary design has been authorized. Agenda topics include: review lines of communication, protocol, discuss goals and objectives of each project that has been authorized for preliminary design, establish critical success indicators, provide expectations, and review the scope and schedule for the Preliminary Design Phase including collection system modeling.

1.2. Provide site reconnaissance by walking the proposed sewer corridor for each project. Provide a memo that discusses factors that will impact alignment selection.

1.3. Participate in three (30%, 60%, and 90%) Interim Design Submittal Review Meetings to present response to design submittal comments.

1.4. Participate in estimate reconciliation meeting(s) as directed by the project manager, maximum of three meetings. An estimate reconciliation meeting is required when the opinion of probable construction cost and MSD's independent estimate are not within 10% for major pay items or for the total estimate. MSD's project manager will manage and document the reconciliation meeting.

1.5. Prepare meeting materials for all project meetings attended by the consultant, including meeting agenda, sign-in sheet and minutes. Utilize MSDGC meeting document templates. Distribute draft minutes within five business days of the meeting; incorporate comments from attendees and distribute final meeting minutes to all attendees.

1.6. Schedule Management

1.6.1. Prepare an initial project schedule with milestone dates for completing all

services through bid phase. Submit draft initial project schedule at project kickoff meeting. Finalize the initial project schedule within two weeks of receiving MSDGC comments.

1.6.2. Coordinate the project schedule with schedules of MSDGC and sub-consultants as well as with activities of others directed by the Consultant.

1.6.3. Standard schedule allowances:

1.6.3.1. Assume a one-month review period to send/receive comments from utilities and agencies.

1.6.3.2. Assume a three-week MSDGC review period and one additional week for Consultant to prepare responses to comments prior to each interim design review meeting.

1.6.4. Provide the schedule in Gantt and table format. The Gantt chart shall show the original schedule, completed items, current schedule and relationship of items.

1.6.5. Provide an updated schedule for MSDGC review with each design submittal.

1.7. Periodic Status Report – Provide periodic status report with each invoice submittal and as requested by MSDGC. Include the following information:

1.7.1. Project description

1.7.2. General summary of activity during reporting period, reporting period begin and end dates

1.7.3. Activity accomplishments during the reporting period

1.7.4. Planned activity during upcoming reporting period

1.7.5. Earned value report through end of reporting period including percent budget expended, percent schedule expended, earned value as percent of budget

1.7.6. Budget/schedule/scope issues or changes

1.7.7. Direction or information received or required from MSDGC

1.7.8. Key personnel changes

1.8. Deliverables

1.8.1. Meeting materials

1.8.2. Documentation of site reconnaissance

1.8.3. Project schedule and project schedule updates

1.8.4. Periodic status reports

1.9. QA/QC Plan. Update QA/QC plan from the Planning phase for the detailed design phase. Monitor and track quality reviews as required throughout the project for milestone interim planning submittals (Alternatives Analysis Report and BCE). QA/QC review level of effort is included in the technical scope items below.

1.10. Risk Management Plan. Update Risk Management Plan from the Planning phase for the detailed design phase. Update the risk register at the three milestone design

submittals and include in the submittal package.

2. 30% Design

2.1. Participate in one Detailed Design Phase Kickoff Meeting with MSDGC to cover all projects authorized for detailed design. Meeting shall be held prior to commencement of 30% Design field investigation activities. Present and discuss Risk Management Plan to cover all projects that require a risk management plan per BCE recommendation. Present and discuss Detailed Design Phase schedule. Coordinate timing of property owner notification letters and field investigation start date. MSDGC will prepare property owner mailing lists. MSDGC will provide all affected property owners with a written notice that complies with O.R.C. Section 6117.01 (F) for the purpose of providing property owners with notice of field investigations.

2.2. Locate above-ground and underground existing utilities for each assigned project for accurate depiction on the construction plans. The design fee and approach shall be based on the following tasks as a minimum:

- Contact the Ohio Utilities Protection Service (OUPS) to have them provide physical field markings of the utilities as well as historical records for all OUPS utility company members. Contact all non-members directly for physical field markings of utilities and obtain historical records.
- Verify that the physical field markings of the utilities are in place prior to scheduling the survey crews.
- Confirm the accuracy of the utility information by walking the job with the completed base map.
- Identify conflicts with the utilities and the proposed work. Resolve conflicts with utility companies to minimize construction costs and inconvenience to the public.
- Coordinate with utility companies to develop utility relocation plans, if needed. Utility relocations shall occur before construction begins or concurrently with the construction as long as the utility relocation will not delay the MSDGC contractors.
- Verify that the utility relocation is scheduled with the utility companies who have their own crews performing the work.
- Underground Utility Investigation
    - Several methods of utility location may be necessary to resolve the utility location, when conflicting utility location information is discovered. This may include geophysical methods, see Standard Guideline for the Collection and Depiction of Existing Subsurface Utility Data, ASCE 38-02
    - When proposing trenchless installation methods, pothole and then survey the exposed utility at each crossing point. For parallel utilities expose the utility at the beginning and end of each trenchless excavation method run. If the proposed alignment is within the tolerance zone of any parallel

underground utility expose the utility every one hundred feet.

- Include allowance of $TBD for underground utility investigation using geophysical methods and or potholing, to be performed only upon written authorization by MSDGC.

- Note on the plans the potholing locations and elevations determined. The elevations can be presented in a table if this provides the information in a clearer way.
- When communicating with Duke and Cincinnati Bell overhead electric, the designer shall include a "Pole Impacts Table" with the utility letter. The "Pole Impact Table" shall contain the pole number, station, distance from edge of trench to face of pole, and depth of excavation. Utility letter shall request the following information be provided by the owner of each pole:
  - Measures required to protect each pole, including relocation, relocation with addition of poles, temporary support, minimum separation of construction activities, etc.
  - Responsibility matrix for required protection measures
  - Estimated cost to protect each pole

Example:

POLE IMPACTS TABLE					
Pole Number	Station	Approximate distance from edge of trench to face of pole	Trench Depth	Utility's Recommended Action (ex. Hold, move, etc.)	Utility's Cost to MSD from pole recommendations

2.3. Provide topographical survey of alignment area, area within work limits and access routes. Budget is based on the survey lengths of ___TBD___ and width up to 100 feet. Surveying services will be performed by TEC Engineering, Inc.

- Utilize MSDGC-provided CAGIS information and files to supplement field survey data when preparing construction plans. The vertical datum of the project survey shall be the National Geodetic Vertical Datum of 1929 (NGVD 29).
- Topographic locations shall include, but are not limited to: trees that are six inches and larger in diameter, shrubs, building/structure corners, fences, sidewalks, driveways, recreational facilities (swing/play sets, pools, hot tubs, etc.), outline of existing flower beds and vegetable gardens, and any visible, above ground utilities, as well as OUPS markings as applicable. Field locate all geotechnical exploration bore holes once complete; show bore holes on construction plans for reference.
- Determine basement elevations that are critical to design of the sewer. One attempt will be performed at each residence to gain entry to the basement. If entry is granted, a basement elevation shot will be performed. A distance to

sewer outlet will be measured, and a photograph will be taken. If no access is available, an elevation will be taken at the door sill.

- All survey control will be tied to the Hamilton County Benchmark system, Horizontal Datum NAD83, Vertical Datum NGVD29
- Property/boundary research of surveys, record plats and current owner deeds, within and adjacent to the project area will be performed and entered into the basemap.
- A thorough field search for all pertinent boundary monumentation will be performed and all monumentation recovered will be located and included in the basemap.
- Property resolution for all affected properties will be performed for subsequent use in the proposed easement plats and the resultant property lines will also be shown on the construction plans.

2.4. Conduct geotechnical investigations and prepare Geotechnical Exploration Report (GER) for each assigned project. Submit proposed schedule of geotechnical investigations and report to MSDGC for approval. Use if applicable: {NEAS, Inc. will be the Geotechnical Consultant and will provide geotechnical services as a sub-consultant to Consultant.

Cost estimate for geotechnical investigations is based on number of soil test borings; total length of soil test boring and drilling / sampling of rock core as shown in the table below. Bore holes and bore hole data will conform to MSDGC's Standard Geotechnical Services Guidelines and geotechnical engineering industry standards where appropriate.

Measure and record the depth at which groundwater is encountered during drilling and at the completion of drilling prior to performing rock coring. If subsurface conditions encounter groundwater, a temporary monitoring well, consisting of solid plastic PVC pipe, with a suitable length of perforated section, will be installed at the appropriate depth and will be left in the borehole until 24-hour groundwater level measurements have been obtained, if necessary. If it is determined that a permanent monitoring well is required to measure future groundwater levels, the Geotechnical Consultant will convert the temporary monitoring well to a permanent monitoring well for future groundwater level measurements as deemed appropriate.

- Coordinate with OUPS for utility clearance and, if applicable, with property owners to gain access to test boring locations. Where work is to be performed on private property, provide a copy of the executed written agreement for access, signed by the property owner, or as directed by MSDGC.
- Coordinate with property owners for Right of Entry (ROE) for the purpose of completing geotechnical investigations. If a required ROE is not provided by any property owner after two attempts, notify MSDGC.
- Obtain and pay for necessary permits from governing jurisdictions to perform geotechnical investigations.
- Provide traffic control measures during the course of geotechnical investigations

in accordance with Ohio Manual of Uniform Traffic Control Devices.

- Recommend details for boring depths, type of geotechnical sampling, etc. Submit final recommendations to MSDGC for approval prior to performing the test borings.
- Restore disturbed areas in lawns to pre-boring condition based on documented photographs taken before and after borings are collected. For work in lawns, excess cuttings from the boreholes shall be removed from the site.
- When requested by MSDGC, deliver rock cores in appropriate containers for storage at MSDGC.
- The GER shall include the following:
    a. Discussion of regional and site geology and topography.
    b. Description of subsurface conditions encountered in the borings.
    c. Description of any difficult excavation conditions expected, such as bedrock or groundwater.
    d. Log of test borings.
    e. Site plan showing boring locations
    f. Discussion of geotechnical considerations related to proposed construction including locations, dimensions, bearing elevations and loading conditions, to the extent known at applicable design stage.
    g. Commentary on general excavation methods that may be required considering the depth of structures, slope stability of soils, and consideration of nearby structures or facilities.
    h. Recommendations regarding excavation widths anticipated with open cut trench excavations
    i. Classification, thickness, location, and limits of each stratum encountered in the test borings, including N_{60}-value blow counts from Standard Penetration Tests.
    j. Engineering interpretations of the drilling, sampling, field testing and laboratory data.
    k. Engineering properties of the soil and rock mass characteristics.
    l. Recommendations for site preparation including depth of removal and over-excavation, and improvements of in-situ soils, if applicable.
    m. Recommended stable grade (H:V) of slopes for permanent excavation cuts or embankment fills.
    n. Recommended lateral earth pressures for design of substructures. Lateral earth pressures for both active and at-rest, and drained and submerged conditions. Recommended design parameters for retaining structures including friction coefficients and passive pressure (if applicable) for calculating resistance against sliding.
    o. Recommendations for backfill materials including onsite availability, recommended index properties, particle size analysis, classifications in accordance with ASTM D2487 and moisture and density compaction criteria.
    p. Compaction and strength characteristics and suitability of onsite soils for use as structural fill for support of structures, backfill for trench

excavations and similar excavations, embankments, and other pertinent earthwork recommendations.

q. Influence of expansive soils, if encountered, on sewers and structures.

r. Constructability considerations, including temporary excavation slopes, sheeting and shoring, expectations regarding excavation equipment/methods, possibility of heave of excavation bottoms, and applicable dewatering problems and methods. Discussion of constructability shall include potential difficulties which the construction contractor should anticipate. Recommendations shall include lateral pressures for the design of excavation support systems.

s. Groundwater elevations and their effect upon the proposed design and construction, together with a discussion of underdrain requirements and/or recommendations for resistance to uplift pressures, if applicable. A design groundwater level should be recommended for buoyancy and lateral earth pressure considerations based on groundwater level measurements.

t. Loading and design criteria related to subsurface materials (e.g. earth pressures) for retaining walls or earth retaining structures that may be required on the project.

u. Recommended methods for removal of rock, including allowance of blasting, and blasting restrictions.

v. Additional geological or geotechnical recommendations considered pertinent to the project.

2.5. Develop a recommended sewer alignment based on evaluation of all pertinent factors including but not limited to geotechnical findings (e.g., rock, dewatering), impacts to the environment, constructability, access during construction, safety, operation and maintenance considerations, impacts to property and construction costs.

2.6. Develop an Environmental Site Assessment for each assigned project. Consider results of the ESA, such as environmental contamination, when evaluating recommended alignments. Budget for Environmental Site assessments is based upon a total of XXX(TBD) Phase I Environmental Site Assessments.

2.7. Prepare Draft Basis of Design Memorandum (BDM) that summarizes the evaluation that resulted in selection of the recommended sewer alignment. Alternative modeling shall be updated and submitted for review and correction for each Detailed Design interim design submission (30%, 60%, 90%) to validate proposed projects.

2.8. Prepare 30% detailed plan and profile construction plans in accordance with MSDGC standards. Use AutoCAD 2007 or newer with Land Desktop or Civil 3D. Refer to msdgc.org for CAD standards and standard Accession Number Drawings for MSDGC and SMU.

2.9. Prepare technical specifications outline using MSDGC's CSI (Construction Specification Institute) template specifications.

2.10. Indicate preliminary bid items and quantities using MSDGC spreadsheet template.

2.11. Identify anticipated regulatory requirements.

- If Federal Permits or Federal Funds are used, those Federal processes will dictate efforts to protect threatened and endangered species budget accordingly.
- If Federal Permits or Federal Funds are NOT used, perform a desktop analysis with the 30% design memo to indicate the potential impacts to threatened and endangered species as listed on the USFWS Ohio Field Office site http://www.fws.gov/midwest/Ohio/. Include findings of the desktop analysis in the 30% design memo.
- Consultant shall coordinate with the Ohio Historic Preservation Office (OHPO) with a cultural resource file check for the project area
- As an example, if impacts are identified to the Indiana Bat perform a field assessment prior to final design to identify potential Indiana Bat Roosting trees. Label identified trees as "Bat Trees" with plan notes allowing removal of Bat Trees from October 15 to March 31. The clearing of Bat Trees is restricted in the mating season and identification needs are based on project schedule.

2.12. Prepare the 30% opinion of probable construction cost (OPCC) per MSDGC Financial Analysis Manual and Estimating Manual.

2.13. Distribute 30% construction plans to utilities and agencies for comment.

2.14. Attend the 30% Design Submittal Review Meeting. Discuss with MSDGC comments from other utilities and agencies.

2.15. Incorporate comments agreed to by MSDGC into the design drawings. Consultant shall change the alignment if deemed necessary and directed to do so by MSDGC due to utility conflicts or agency comments. Based on utility and agency reviews, and as approved by MSDGC, necessary alignment changes will be reflected in 60% design submittal.

2.16. Assist MSDGC in arranging a public meeting to review the current design and provide community engagement. Provide graphics and participate in the presentation as required.

2.17. Deliverables:

- One unbound paper copy of Draft BDM including technical specifications outline, anticipated regulatory requirements, preliminary bid items / quantities and OPCC, 21 days in advance of 30% review meeting
- QA/QC documentation letter
- Written recommendation regarding exceptions to MSDGC Rules & Regulations and Collection System Design Standards, if applicable
- 30% construction plans: electronic copies in native format and in PDF format.
- GER: one paper copy and PDF format on a disk. GER shall be on 8.5" X 11" sheets. Pages shall be numbered only near the top of each page. Ledger-size folded sheets will be allowed only when approved by MSDGC.
- EPA-SWMM model input file of full proposed projects including any necessary

time series such as boundary conditions.

- Meeting materials
- Summary of interim comments and responses for all documents

3. Easement Documents

3.1. Provide field survey and conduct courthouse research to determine: property owner information, obtain deeds, previous survey plats, subdivision & right of way plats and easement information. Conduct field survey to accurately locate all available property monumentation both called for and not called for. Resolve survey to all included and adjoining parcels. Budget is based on acquisition of the number of temporary or permanent easements for up to {NUMBER OF PARCELS (TBD)}. Easement documents will be prepared by Consultant's sub-consultant, TEC Engineering, Inc..

3.2. Prepare preliminary and final easement sheets. Easement sheets shall delineate required permanent and temporary easements for the project. Easement sheets shall be at the same scale as construction plans. Preliminary easement sheets shall be submitted with 60% Design Drawings in pdf format. Submit one copy of preliminary easement sheets for review.

3.3. Easements on City of Cincinnati owned property will require separate easement plats from other owners. Refer to the Springing Easement reference document located in the MSDGC Capital Project Resource Library for various examples and associated jurat wording.

3.4. Provide one paper copy of the final easement sheets with 90% submittal.

3.5. Provide one copy of final easement sheets with PS seal / signature after all revisions are completed and accepted. Provide Mylar copy when requested.

3.6. If requested, provide a proposal for preparation of preliminary and final easement appropriation plats with metes and bounds descriptions for appropriations as directed by MSDGC.

3.7. Deliverables include but are not limited to: final easement plats, appropriation plats and legal descriptions when requested, AutoCAD files of all plats, and MS Word files of all legal descriptions. If requested, the consultant shall also provide a copy of all supporting documents including but not limited to: deeds, plats, and survey information used to resolve the properties. A licensed surveyor, registered in the State of Ohio shall oversee all work, seal and sign all deliverables. Under no circumstances shall CAGIS information be used for final easement/design plats.

4. 60% Design

4.1. Finalize Basis of Design Memorandum (BDM) including incorporation of comments from the 30% review. Alternative modeling shall be updated and submitted for review and correction for each Detailed Design interim design submission (30%, 60%, 90%) to validate proposed projects. Provide a digital version of the BDM with changes from Draft BDM tracked.

4.2. Prepare 60% draft detailed plan and profile drawings; incorporate comments from 30% design review.

4.3. Prepare draft technical specifications using MSDGC's CSI (Construction Specification Institute) template specifications as modified for this project. Modifications must be submitted to MSDGC in MS Word file with changes and comments shown using MS Word "track changes" feature and "comment" feature. Also, provide an MS Word file with changes accepted and comments deleted.

4.4. Indicate preliminary bid items and quantities using MSDGC spreadsheet template. Alternative modeling shall be updated and submitted for review and correction for each Detailed Design interim design submission (30%, 60%, 90%) to validate proposed projects.

4.5. Develop list of all required permits. Prepare draft of required permit applications. At a minimum, this will include street opening permit application and Ohio EPA Permit to Install application. US Army 404 and Water Quality 401 Certification is not included as it is assumed the work will be performed under a Nationwide Permit No. 12

4.6. Prepare the 60% OPCC per MSDGC Financial Analysis Manual and Estimating Manual.

4.7. Prepare and submit final resolution of 30% review comments prior to 60% progress meeting.

4.8. ***Use for projects to be reviewed by Watershed Operations that include source control elements*** (PM please include Leslie Schehl in scoping efforts): Prepare 60% draft O&M manual incorporating the source control elements, maintenance activities, and cost.

4.9. Attend the 60% Design Submittal Review Meeting.

4.10. Deliverables:

- One digital version of the 60% BDM.
- Draft technical specifications, draft regulatory permit applications, preliminary bid items / quantities and OPCC: one unbound paper copy of all required documentation 21 days in advance of 60% review meeting
- 60% construction plans: electronic copies in native format and in PDF format
- Meeting materials
- QA/QC documentation letter
- Summary of interim comments and responses for all bid documents

5. 90% Design

5.1. Finalize Basis of Design Memorandum (BDM) including incorporation of comments from the 60% review. Alternative modeling shall be updated and submitted for review and correction for each Detailed Design interim design submission (30%, 60%, 90%) to validate proposed projects.

5.2. Provide a digital version of the BDM with changes from Draft BDM tracked.

5.3. Prepare 90% draft detailed plan and profile drawings; incorporate comments from 60% design review.

5.4. Update technical specifications. Incorporate MSDGC approved revisions from 60% review process. Recommend additional modifications, if appropriate, using MS Word comments feature in right-hand page margin.

5.5. Indicate bid items and quantities using MSDGC Spec 00 41 02 Unit Price Sheet template.

5.6. Prepare final permit applications and provide to MSDGC for submittal to agencies.

5.7. Prepare the 90% OPCC per MSDGC Financial Analysis Manual and Estimating Manual.

5.8. ***Use for projects to be reviewed by Watershed Operations that include source control elements*** (PM please include Leslie Schehl in scoping efforts): Prepare 90% draft O&M manual incorporating the source control elements, maintenance activities, and cost; incorporate comments from the 60% design review.

5.9. Attend the 90% Design Submittal Review Meeting.

5.10. Provide summary of comments and final resolution of comments for all bid documents prior to 90% review meeting.

5.11. Assist MSDGC in arranging a public meeting to review the current design and provide community engagement. Provide graphics and participate in the presentation as required.

5.12. Deliverables:

- One digital version of the Final BDM signed and sealed by a licensed engineer, registered in the State of Ohio
- Meeting materials
- QA/QC documentation letter
- 90% construction plans: electronic copies in native format and in PDF format
- Revised technical specifications, bid items / quantities and OPCC (one unbound paper copy of all required documentation, 21 days in advance of the review meeting)
- Required copies of final permit applications and supporting documentation
- Summary of comments and responses for all bid documents

6. Final Design

6.1. Update contract documents to include special right-of-way conditions and any modifications to alignment made necessary by easement acquisition negotiations.

6.2. Provide final, bid-ready, contract documents including final technical specifications, plan and profile drawings and all items necessary to complete the work based upon comments from the deliverables submitted during the preceding tasks.

6.3. The specifications will include guidance for the construction contractor to develop a Maintenance of Traffic Plan for all phases of the project, as appropriate.

6.4. Provide final OPCC per MSDGC Financial Analysis Manual and Estimating Manual

6.5. Provide QA/QC documentation letter

6.6. Provide explanation of all approved exceptions to MSDGC Rules & Regulations and/or Collection System Design Standards.

6.7. Provide summary of comments and responses for all bid documents.

6.8. ***Use for projects to be reviewed by Watershed Operations that include source control elements*** (PM please include Leslie Schehl in scoping efforts): Provide final O&M Manual.

6.9. Assist MSDGC in arranging a public meeting to review the current design and provide community engagement. Provide graphics and participate in the presentation as required.

6.10. Deliverables:

- Construction Plans: one paper set, 11 inches by 17 inches; one CD (with AutoCAD and PDF Files) signed and sealed by a licensed engineer, registered in the State of Ohio.
- **S**pecifications: one paper copy and one CD with MS Word and PDF files signed and sealed by a licensed engineer, registered in the State of Ohio.
- Final OPPC: one paper copy and one CD with MS Word and PDF Files)
- QA/QC documentation letter
- Summary of resolution of all comments for all bid documents
- ***Use for projects to be reviewed by Watershed Operations that include source control elements*** Final O&M Manual
- All modeling files including input, output, report, and any external files for the final design.

TASK 7.0 – CONSTRUCTION PHASE SERVICES (SUPPLEMENTAL)
The work within Task 7.0 is considered to be supplemental. It shall only be performed with written authorization from MSDGC. A finalized scope and fees shall be negotiated prior to the execution of this work.

1. **Project Administration** - The Consultant will update the Project Management Plan developed in Detailed Design phase identifying key technical and project management personnel, their roles and responsibilities as assigned by task, for the duration of the contract. The Consultant will provide MSDGC with electronic versions of draft and final updated Project Management Plan. During the duration of the bid and construction phases, the Consultant will perform project administration including the preparation of monthly progress reports.
2. **Bid Phase Services -** Be available to assist MSDGC in responding to contractor questions as requested by MSDGC
3. **Construction Progress Meetings and Site Visits –** Not required for typical sewer replacement projects. Effort will be included for
4. **Review RFI Submittals -** Consultant will assist MSDGC in reviewing Contractor's Requests

for Information (RFIs), assumed to be up to three per authorized project. Consultant will review the technical aspects of the RFIs and provide MSDGC interpretations and clarifications relative to the intent of the construction Contract Documents.

5. **Review Requests for Contractor's Proposal (RFCP) –** Consultant will assist MSDGC in generating the RFCP and reviewing the Contractor's response proposals, assumed to be up to one per authorized project. Consultant will review the technical aspects of the RFCP and provide MSDGC interpretations and clarifications relative to the intent of the construction Contract Documents.
6. **Review Shop Drawing Submittals –** Consultant will review and respond to Contractor's Shop Drawings, submitted samples, Operations & Maintenance (O&M) Manual, and other data which Contractor is required to submit, but only for conformance with the information given in the Contract Documents. Consultant assumes up to three submittals per authorized project will be required to meet the project requirements. Such reviews will not extend to means, methods, techniques, sequences or procedures of construction or to safety precautions and safety-related programs incident thereto.

7. Deliverables:

7.1. RFI responses (x estimated) TBD

7.2. Help in generating and reviewing RFCPs (x estimated) TBD

7.3. Shop Drawing review responses (x estimated, which includes one re-submittal each) TBD

EXHIBIT B
PROJECT BUDGET

Ludlow Run Source Control (PID 1.01.42910)

Arcadis U.S., Inc.
Date Prepared: 12/6/2019

Prime Consultant Budget Sheet

Task No.	Task Description	Project Manager/ Senior Engineer	Technical Expert/ CPM 3	Principal Engineer / CPM 2	Senior Engineer	Project Engineer	Staff Engineer / Engineer 2	Engineer 1	CADD Drafter	Admin Assistant	Total Labor[1]	Misc. Expenses[2]	Reserve Amount[3]	Sub-Consultant Expense[4]	Total Compensation
1	Project Administration - Planning	124	72	16	56	0	0	44	0	64	$62,202	$1,000	$0	$0	$63,202
2	Data Review and Collection	62	32	28	30	68	96	140	0	6	$64,190	$250	$0	$7,940	$72,380
3	Collection System Model Review	40	24	0	4	8	84	192	12	0	$44,160	$0	$0	$20,166	$64,326
4	Model Update and Calibration	120	38	0	0	0	226	512	0	8	$106,462	$0	$0	$0	$106,462
5	Planning and BCE	132	54	66	114	228	248	588	36	32	$192,828	$400	$0	$27,054	$220,282
										Planning Subtotal	**$469,842**	**$1,650**	**$0**	**$55,159**	**$526,651**
6	Detailed Design (Supplemental)										$1,383,661	$1,500	$0	$351,505	$1,736,666
7	Construction Phase Services (Supplemental)										$368,652	$2,000	$0	$53,239	$423,891
										Total	**$2,222,155**	**$5,150**	**$0**	**$459,903**	**$2,687,208**

EXHIBIT C

Exhibit C – Risk Management Plan

Metropolitan Sewer District of Greater Cincinnati

Ludlow Run Sustainable Source Control

Contract No. 95x12762

MSDGC Project ID 10142910

Risk Management Plan and Risk Register

Final, Revision A

July 21, 2020

Table of Contents

Revision A – July 1, 2020

1. OVERVIEW

1.1. Purpose of Risk Management

All projects involve risk and opportunities to the client and the consultant team. Without early identification, monitoring, and control, these risks may lead to projects being delivered over-budget, behind-schedule, or lacking critical stakeholder support. For this project, the team will follow a four-step process including risk planning (identification, analysis and mitigation) and risk monitoring and control. Early in the project the consultant team met internally to perform the risk planning in accordance with this Risk Management Plan (RMP). The purpose of this RMP is to document the approach used for this project to identify, assess and manage risks associated specifically with the planning, design, construction and operation and maintenance of the Ludlow Run Sustainable Source Control Project.

1.2. Project Overview

The Arcadis team shall provide planning serves and may provide the supplemental design and construction phase services for a Wet weather Improvements Plan (WWIP) project (or Projects) to reduce the volume of the combined sewer overflows in the Ludlow Run watershed (CSO's 151, 109, 110, 111, 112, 162 and 024). The project will also address asset management needs within the Ludlow Run watershed.

The Ludlow Run sub-watershed, located in King's Run watershed, includes portions of Cincinnati neighborhoods: Northside, College Hill, Winton Hill, and Winton Place. CSO 024, referred to as the Ludlow Run Regulator is located on the west bank of the Mill Creek at the three-way intersection of Spring Grove Avenue, Dooley Bypass, and Dana Avenue. Six CSO's are nested within CSO 024 sub-watershed. Listed from North to south within the sub-watershed, CSOs 151, 109, 110, 111, 112, and 162 overflow into Ludlow Run, which then enters the combined sewer system and contributes to overflows at CSO 024.

Arcadis will provide all planning serves and may provide the supplemental design and construction phase services. The proposed improvement designed during the supplemental design phase services shall be designed in accordance with the latest version of the MSDGC *Rules and Regulations Governing the Design, Construction, Maintenance, and Use of Sanitary Combined Sewers*.

Project Understandings:

1. Arcadis will execute a similar approach to the planning, design and construction of the Ludlow Run Sustainable Source Control project that we have been refining through continuous improvement practices on past and current MSDGC source control projects.

2. The culmination of the Planning Phase will be in the modeling report, alternatives analysis report, and subsequently the Business Case Evaluation (BCE).
3. The design services will be based on the approved solution from the BCE.

1.3. Organization of the Risk Management Plan

This RMP has been organized as follows:

- **Section 2: Definitions** – Provides standard definitions for risk and issues, clarifies the difference between risks and action items.
- **Section 3: Approach to Risk Management for the Project** – Presents an overview of how risk management will occur for this project. It also establishes the requirements for periodic updates.
- **Section 4: Project Risk Management Methodology** – Provides step – by – step instruction for preparing the project risk register, guidance for qualitative assessment of project risk, preparation of risk management strategies and plans.
- **Section 5: Governance Documents** - References
- **Appendix A**: Risk Register – Provides the project related risks and associated information and scoring.

2. DEFINITIONS

Accept – The team will do nothing until the risk occurs.

Action Item – Is a matter that requires follow-up execution and usually occurs on an ad hoc basis during meetings or as a by-product of working on another activity. A series of action items might be required as part of a risk response plan but action items themselves are not necessarily risks that need to be tracked as part of the risk management process.

Avoid – The team acts to eliminate the threat or protect the project from the impact.

COO – Consequence of Occurrence

Issue – An incident that has already happened and has immediate potential for adversely impacting the project. In other words, a risk becomes an issue after it is "realized" and begins to adversely affect project schedule, cost or quality.

Mitigate – The team will employ a set of actions to reduce the likelihood of occurrence and/or impact of the risk.

LOO – Likelihood of Occurrence

Opportunity – A risk that would have a positive effect on one or more project objectives.

Project-Level Risks - Risks that are unique to individual projects. An example of a project-level risk is, "Delay in acquiring a critical easement that is needed before the project can be bid."

Program-Level Risks – Risks that apply to multiple projects or a single risk that could affect the overall program. A project-level risk rises to the level of a program-level risk if multiple projects all have the same or similar risk, requiring it to be managed at the program level. There are program risks such as inflation, bond market fluctuation and contractor capacity that potentially affect all projects in the program.

Risk - an uncertain event that, if it occurs, has a positive or negative effect on a project's objectives. Risk Score is expressed by the following formula:

Risk Score - Consequence x Likelihood of Occurrence

Transfer – The team will shift the impact and ownership to a third party.

3. APPROACH TO RISK MANAGEMENT

3.1. GENERAL

This project is anticipated to be greater than $1M in construction cost. As such, a risk management plan is required. The risk register will be updated throughout the planning, design and construction as required. The Consultant and project stakeholders will have a role in risk management process.

The consultant will prepare a draft risk management plan and risk register and submit it to MSDGC for review and comment. The risk register will be updated as necessary throughout the project. The risk register will include project risks and opportunities, cause, category, consequence, COO Rating, LOO Rating and the strategy. The initial risk management plan and risk register will be submitted to MSDGC and will be discussed at the first meeting after submission. The risk management plan and risk register will be updated and finalized based on MSDGC comments.

4. PROJECT RISK MANAGEMENT METHODOLOGY

4.1. Risk Management Process Steps

The development of risk management will occur using the following process:

- **Plan Risk Management** – Prepare guidelines, assign scoring and define process.
- **Risk Identification** – identify risks to project and record on Risk Register.
- **Qualitative Risk Analysis** – describe consequence of each risk and determine the likelihood of occurrence and the relative consequence of occurrence
- **Quantitative Risk Analysis** – The team will utilize MSDGC's standard rating for quantitative risk analysis.
- **Plan Risk Response** – develop possible management strategies and recommend a risk response plan.
- **Control Risks** – Monitor, report and respond throughout project.

The following sections describe in detail the process for developing a risk register as well as a description for monitor and control.

4.2. Risk Identification

MSD's project team including the MSD Technical Review Committee will participate in Risk Identification efforts at the Planning Workshop during Task 2 Data Collection and Review. At that point in the project, both Arcadis and MSD will be up to speed on the issues of the project and able to better identify and assess the risks.

During the Planning Workshop, risk identification will be carried out by brainstorming and using sticky notes with the MS Technical Review Committee.

New risks should be communicated to the Arcadis Project Manager. The risk register will be updated and additional risks will be identified as necessary, throughout the planning project at these milestones at a minimum:

- Risk Management Plan
- Alternatives Analysis Report
- Business Case Evaluation

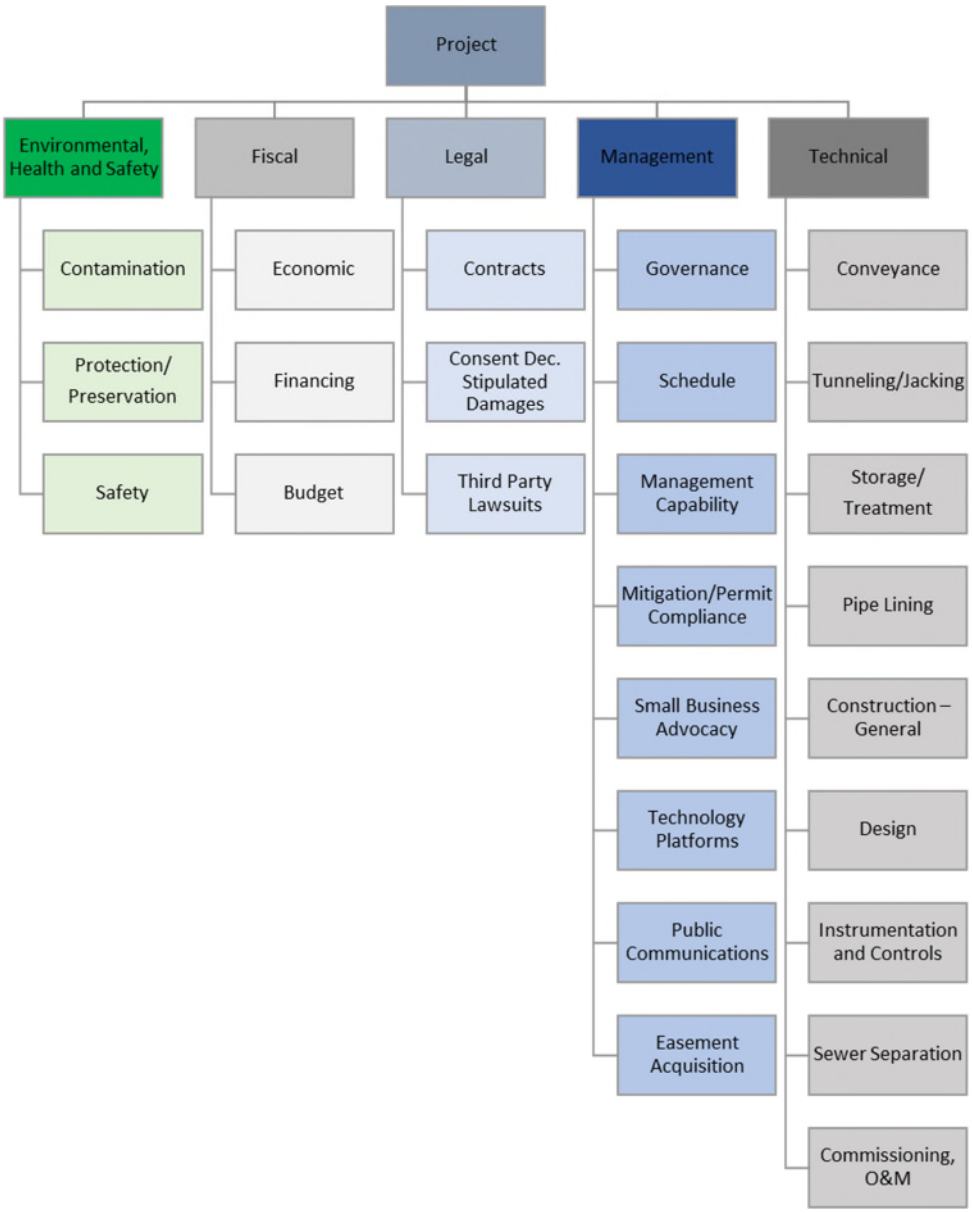
4.3. Risk Assessment

A risk register is quite simply a list of risks that might affect the project. There are many techniques for developing a risk register but the one that the Arcadis Team will be utilizing for this project is brainstorming. This involves conducting a risk workshop early in the project that

assembles a multi-disciplined team and asks the question of "What can go wrong or right with the implementation of this project?" This project includes past watershed planning that needs further evaluated with an eye on the potential risks.

A set of categories to be used for this project are shown in Figure 1. These categorizes will be used heavily during the internal workshop. The items are pre-programmed into the risk register. An initial risk register has been started for this project and attached as Appendix A.

Figure 1: Risk Categories



The risk assessment, performed for each risk on the register, is the next step in the process. The risk assessment involves the assignment of a consequence and likelihood of occurrence rating to each identified risk. Assigning a consequence rating requires the team member to determine (or estimate) the maximum foreseeable loss associated with a risk if it were to be realized. However, many times it is difficult to assign an amount and therefore a qualitative assessment can be assigned. It is acceptable to make an educated guess at the consequence and likelihood of occurrence ratings. (Refer to Tables 1 & 2.)

Table 1: Consequence Rating

CONSEQUENCE RATING	MAXIMUM FORESEEABLE LOSS	QUALITATIVE DESCRIPTION
1	1% Reduction in Contingency (cost or time)	Insignificant
2-3	2%-50% Reduction in Contingency (cost or time)	Minor impact
4-6	51%-100% Reduction in Contingency (cost or time) ***Up* To** 10%-20% Over Budget/Project Delay	Moderate impact
7-9	21%-30% Over Budget/Project Delay ***Up* To** 40% Over Budget/Project Delay	Significant impact
10	>40% Over Budget/Project Delay	Major impact

This range will be reviewed during the pre-workshop phase and a final table will be issued during the workshop. The likelihood of occurrence rating is assigned using the following guidelines in Table 2.

Table 2: Likelihood of Occurrence Rating

LIKELIHOOD RATING	LIKELIHOOD OF OCCURRENCE	QUALITATIVE DESCRIPTION
1-2	1%-20%	Highly unlikely to occur
3-4	21% - 40%	Unlikely to occur
5-6	41%-60%	Likely to occur
7-8	61%-80%	Very likely to occur
9	81%-90%	Highly likely to occur

A risk score is calculated as the product of the consequence rating and likelihood of occurrence rating. The risk score classification is established as shown in Table 3.

Table 3: Risk Score Classifications

Consequence										
	10	10	20	30	40	50	60	70	80	90
	9	9	18	27	36	45	54	63	72	81
	8	8	16	24	32	40	48	56	64	72
	7	7	14	21	28	35	42	49	56	63
	6	6	12	18	24	30	36	42	48	54
	5	5	10	15	20	25	30	35	40	45
	4	4	8	12	16	20	24	28	32	36
	3	3	6	9	12	15	18	21	24	27
	2	2	4	6	8	10	12	14	16	18
	1	1	2	3	4	5	6	7	8	9
		1	2	3	4	5	6	7	8	9
Likelihood of Occurrence										

Key	
Very High	
High	
Medium	
Low	
Very Low	

Table 3: Risk Score = Consequence x Likelihood of Occurrence

4.4. Risk Management Strategy and Plan

There are four types of risk management strategies that can be employed for risks; Avoid, Transfer, Mitigate, or Accept. Opportunities are the events that may positively impact a project and they can be: Shared, Exploited, Enhanced, or Accepted (Project Management Institute, 2013). It is important for the team to consider different risk response plans under different strategies in order to select the most appropriate. Upon review of the available strategies for each risk, a single risk response plan is recommended and entered into the risk register. This risk response plan should be specific enough to allow tracking of its implementation.

4.5. Monitor and Control

The development of risk management at the outset of a project is a good first step and requires iterative updates of the risk register until the risk response plans are implemented and the risks are recorded as closed in the risk register. New risks should be communicated to the Arcadis Project Manager. The risk register will be updated throughout the project at these milestones at a minimum:

- Risk Management Plan
- Alternatives Analysis Report
- Business Case Evaluation
- 30% Basis of Design Report
- 60% Basis of Design Report
- 90% Basis of Design Report

The Arcadis project manager together with the MSD project manager will be the project's Risk Managers and are responsible for managing project-level risk. The Risk Managers are also responsible for the development and maintenance of the project's Risk Management Plan and the overall adherences to the Risk Management Plan.

4.6. Remaining Consequences

The concept of retained risk is important because many of the risks that are being managed by MSDGC cannot be entirely eliminated. That is to say, that even after implementation of the risk response plan there will be some likelihood of occurrence and consequence that is retained even after the risk has been managed. It is helpful to consider this during the time at which the risk register is developed. The same process used to assess the risks originally is used again when determining the remaining consequences.

5. GOVERNANCE DOCUMENTS

The following table summarizes the documents referenced in this document.

Document Name and Version	Description	Location
Risk Management Guidelines, (Revised October 19, 2011)	*The minimum MSD requirements to implement Risk Management.*	*MSD's Capital Project Resource Library:* *http://www.msdgc.org/downloads/customer_care/forms_and_documents/risk/risk_management_guidelines.pdf*
Project Level Risk Register, (Revised June 17, 2011)	*An established tool to implement risk management that includes a list of project risks.*	*MSD's Capital Project Resource Library, (see "Risk" for Project Level Risk Register Template download):* *http://www.msdgc.org/customer_care/forms_and_documents/capital_project_resource_library/index.html*

Appendix A

Risk Register

PROJECT-LEVEL RISK REGISTER

PROJECT NAME: Ludlow Run Sustainable Source Control, Contract No. 95x12762 MSD Project ID 10142910

UPDATED: July 21, 2020

IDENTIFICATION					ASSESSMENT					RESPONSE				REPORTING	
ID	RISK	CAUSE OF RISK	CATEGORY	SUB-CATEGORY	CONSEQUENCES	CONSEQUENCE RATING	LIKELIKOOD OF OCCURRENCE RATING	RISK SCORE	RISK CLASS	RISK RESPONSE PLAN	Assigned To (Risk Responder)	Due Date	Resolved On	Status	ACTIONS TAKEN
001	Funding to implement project is limited due to economic conditions.	County funding for projects reduced	Fiscal	Budget	Not all needed projects can be implemented or are implemented over a longer time period.	9	2	18	Medium	Monitor County funding trends.	Mamacos	Ongoing		Watch	
002	Political impact, project cancelled	Other projects take funding priority	Management	Financing	Project delayed due to politial impact	8	3	24	Medium	MSD to stay in contact with stakeholders	Mamacos	Ongoing		Watch	
003	Public not satisfied with the results of the planning study	public not informed of the limitiations of the planning scope with regards to their requests	Management	Public Communications	Impact to schedule and cost due to multiple revisions	9	9	81	Very High	MSD to align the scope this project with the resident concerns	Mamacos	Ongoing		Active	
004	Expectations by stakeholders are not aligned with current scope and budget.	Multiple expectations from different departments	Fiscal	Budget	Increase in project budget.	8	8	64	Very High	Monitor out of scope work and change requests with a change request log	Benick	Ongoing		Active	
005	Political opposition arising from potentially adversely impacted landowners	Landowners are adversely impacted from construction or easements	Management	Public Communications	Customers voice complaints to their political representatives.	5	6	30	Medium	MSD to stay in contact with stakeholders	Mamacos	Ongoing		Watch	
006	Planning amendment required	Change of planning scope required to adjust project objectives to meet public needs	Management	Management Capability	Schedule delay due to administrative process.	5	10	50	High	Work to quickly incorporate changes	Benick	With Design	---	Active	
007	Key team member leaves.	Better opportunity	Management	Management Capability	New team member doesn't have historical knowledge and ownership which leads to less efficient project completion.	8	3	24	Medium	Work with MSD to develop acceptable replacement staff.	Benick	Ongoing		Watch	
008	Lack of suitable, significant rain events and/or recording of rain events causes recalibration of model to be delayed.	Equipment failure during rain and flow monitoring. Not enough suitable rain events.	Technical	Schedule	Extend flow monitoring and perform calibration after data is captured.	4	3	12	Low	MSDGC and ADS have been maintaining the flow monitors through out the period. Adjustments are being made when data appears off. Monitors can stay installed for full year to provide MSDGC with additional data.	Watershed Operations	Ongoing		Active	
009	Model calibration does not meet MSDGC guidelines	Lack of quality rain and flow monitor data to use.	Technical	Schedule	Additional time is need to collect more quality data.	5	4	20	Medium	MSDGC and ADS have been maintaining the flow monitors through out the period. Adjustments are being made when data appears off. Monitors can stay installed for full year to provide MSDGC with additional data.	Benick	Ongoing		Active	
010	Missed oppertunities of efficiencies of construction	lack of coordination with other utilites or jurisdictions	Management	Budget	Increased cost of project	5	5	25	Medium	MSDGC to stay in contact with other City departments	Mamacos	Mamacos		Watch	
011	MSD reorganization places new stakeholders in new positions of authority which causes decisions/direction to change on project.	Reorganization.	Management	Management Capability	Changes cause redesign which impacts scope, schedule and budget.	8	2	16	Low	Proper Communication within MSDGC. Have up-to-date schedule, minutes, and project documentation.	Mamacos	Ongoing		Watch	
012	Difficulty in obtaining consensus on improvements required	Difference of opinions between stakeholders	Management	Management Capability	Causing a delay in the construction and increase to construction costs	4	4	16	Low	MSD to stay in contact with stakeholders	Mamacos	Ongoing		Active	
013	Safety concerns for potential green infrastructure	A storm water feature that creates standing water conditions (even temporary) in a residential neighborhood creates a safety risk.	Technical	Safety	Drowning or other water-related injury.	9	1	9	Low	Design that includes fencing and/or signage around the storm water feature.	Watershed Operations	Ongoing		Watch	

PROJECT-LEVEL RISK REGISTER

PROJECT NAME: Ludlow Run Sustainable Source Control, Contract No. 95x12762 MSD Project ID 10142910

UPDATED: July 21, 2020

IDENTIFICATION					ASSESSMENT					RESPONSE			REPORTING		
ID	RISK	CAUSE OF RISK	CATEGORY	SUB-CATEGORY	CONSEQUENCES	CONSEQUENCE RATING	LIKELIKOOD OF OCCURRENCE RATING	RISK SCORE	RISK CLASS	RISK RESPONSE PLAN	Assigned To (Risk Responder)	Due Date	Resolved On	Status	ACTIONS TAKEN
014	By separating these areas, additional storm water base load may be directed to existing outfall, thereby potentially increasing the erosion potential.	Velocity and erosion	Technical	Design	Increased erosion would be a negative environment impact of the project.	5	5	25	Medium	Evaluate velocities leaving the system at the outfall	Abbott	Ongoing		Watch	
015	Comments on deliverables contradict with one another at different periods in schedule.	Differing opinions among groups.	Management	Management Capability	Rework required which impacts schedule and budget.	4	5	20	Medium	Comments on deliverables contradict with one another at different periods in schedule.	Mamacos	With Design		Watch	

EXHIBIT D

Exhibit D – Quality Control Plan

ARCADIS Design & Consultancy for natural and built assets

Metropolitan Sewer District of Greater Cincinnati

10142910 LUDLOW RUN SUSTAINABLE SOURCE CONTROL

Quality Control Plan

Planning Phase

FINAL

July 21 2020

QUALITY CONTROL PLAN ACKNOWLEDGEMENT FORM

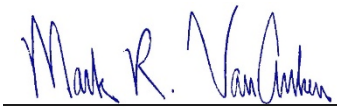
Project Name:	Ludlow Run Sustainable Source Control
Design Status:	Planning
Project Number	10142910

The undersigned have read and concur with this Quality Control Plan:

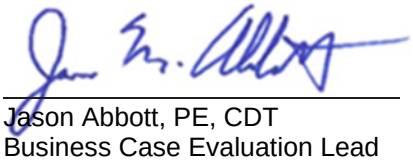
Kristen Benick, PE
Project Manager

Sue Pressman, PE
Technical Advisor

Hazem Gheith, PhD, PE
Technical Advisor



Mark Van Auken, PE
Technical Advisor



Jason Abbott, PE, CDT
Business Case Evaluation Lead

Neila Salvadori, PE
Model Lead

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1 PROJECT DESCRIPTION

The Ludlow Run Sustainable Control project includes planning, design and construction phase services for a Wet Weather Improvement Plan (WWIP) project (or projects) to reduce the volume of the combined sewer overflows in the Ludlow Run watershed (CSO's 151, 109, 110,111,112, 162 and 024). The project will also address asset management needs within the Ludlow Run watershed.

The Ludlow Run sub-watershed, located in King's Run watershed, includes portions of Cincinnati neighborhoods: Northside, College Hill, Winton Hills, and Winton Place. CSO 024, referred to as the Ludlow Run Regulator is located on the west bank of Mill Creek at the three-way intersection of Spring Grove Avenue, Dooley Bypass, and Dane Avenue. Six CSOs are nested within CSO 024 sub-watershed. Listed from north to south within the sub-watershed, CSOs 151, 109,110, 111, 112, and 162 overflow into Ludlow Run, which then enters the combined sewer system and contributes to overflow at CSO 024.

Arcadis will provide all planning serves and may provide the supplemental design and construction phase services. The proposed improvement designed during the supplemental design phase services shall be designed in accordance with the latest version of the MSDGC *Rules and Regulations Governing the Design, Construction, Maintenance, and Use of Sanitary Combined Sewers*.

Project Understandings:

1. Arcadis will execute a similar approach to the planning, design and construction of the Ludlow Run Sustainable Source Control project that we have been refining through continuous improvement practices on past and current MSDGC source control projects.
2. The culmination of the Planning Phase will be in the modeling report and subsequently the Alternative Analysis Report and Business Case Evaluation (BCE).
3. The design services will be based off of the approved solution from the BCE

2 QUALITY CONTROL ORGANIZATION

The objective of this quality control (QCP) plan is to provide guidance to the project planning team for developing and implementing project-specific QCPs for water resources practice services. The Arcadis Water Division Quality Program, led by Jack Kane in the Columbus office, has a long history of providing quality results with a commitment to understand, plan for, and meet clients' expectations while consistently conforming to the standards of professional practice. The foundation for the Arcadis Quality Assurance program is that technical resources beyond the project team and QA/QC efforts will be allocated in accordance with project risk. It is a people-based program starting with assignment of the right people at the pursuit stage, aided by processes and tools throughout the project cycle to support the project team. Thorough consideration of risks and documentation of mitigation strategies upfront helps to engage the right resources - to do the right project - the right way.

When we pursue work, we look internally to make sure that we have the capabilities to deliver as well as the availability to deliver. If there is a match, technical resources are assigned to the project during the pursuit phase. Quality assurance includes:

- Monitoring and Surveillance

- Compliance with Customer Requirements
- Continual Improvement

Monitoring and Surveillance

Monitoring and surveillance include systematic as well as random reviews. Systematic reviews on a project schedule, budget, risk and quality level occur monthly. Quality reviews also occur prior to deliverables.

Monthly project reviews occur with the Project PM, Operations Leader, and Business Unit Manager. The standard review includes a discussion of the above topics. If corrective actions are identified, they are communicated and implemented. Based on the nature of the actions, the result may require client or team communication.

Random reviews can occur at any time in the form of a financial audit or quality audits.

Compliance with Customer Requirements

Compliance with customer requirements can be simply stated as customer satisfaction. We are in the business of professional service and customer satisfaction is paramount. We begin with this in mind when we make our decision to pursue a specific project. During the Go/No Go decision making process, we compare the customer needs with our internal capabilities and availability. If required, we add skills to our team. Technical resources are committed to the pursuit as alignment is found between our capability and availability and customer needs.

Throughout project pursuit and into project scoping and negotiation, customer expectations are more clearly defined as well as the team's understanding of these expectations. As the project begins, a formal set of initial meetings are conducted to formally record project team and client team expectations.

Compliance with requirements is reviewed and monitored formally through project delivery both internally to the team and by the client through deliverable review, workshops and meetings. Non-compliance is resolved through changes, both formal and informal depending on the needs and severity required.

Satisfaction is measured directly through surveys and indirectly through conversation.

Continual Improvement

Continuous process improvement is the ownership of our Service Lines and Community of Practices within our Water Division. Greg Osthues is the leader of this group and has created standard templates and internal processes to gather improvement data and transmit it at the project level. There are two paths to deliver this information to the team.

The first is through the assignment of Technical Advisors to the project. These advisors are assigned based on alignment between their knowledge, skills and capabilities and the project needs. They serve in this capacity on many projects and therefore are able to infuse lessons learned and improvement into the team through engagement. There are touchpoints between the advisors and the team throughout the project execution.

The second is through the creation and implementation of community of practice teams. These community of practice teams are formal groups of internal professionals that maintain the best practices

for our firm. They are an internal resource that is available to help. Many of the project team members are on community of practice teams.

Internal feedback to the Service Lines group is provided through the technical advisors and through the knowledge teams as a part of our culture. We communicate feedback both verbally and through email during meetings our informal communications.

Team feedback is gathered after major deliverables through coordination calls. Typical topics include a discussion of what went well, what can be improved, and how.

Organizational Chart

Each member of the project team listed in the project organization chart in Figure 1 and each was chosen to build a team with the best mix of green infrastructure, combined sewers, asset management and modeling experience for this project. These team members have consistently delivered wet weather compliance projects to similar municipalities and were chosen based on their knowledge of your systems and facilities, as well as proximity and availability to perform.

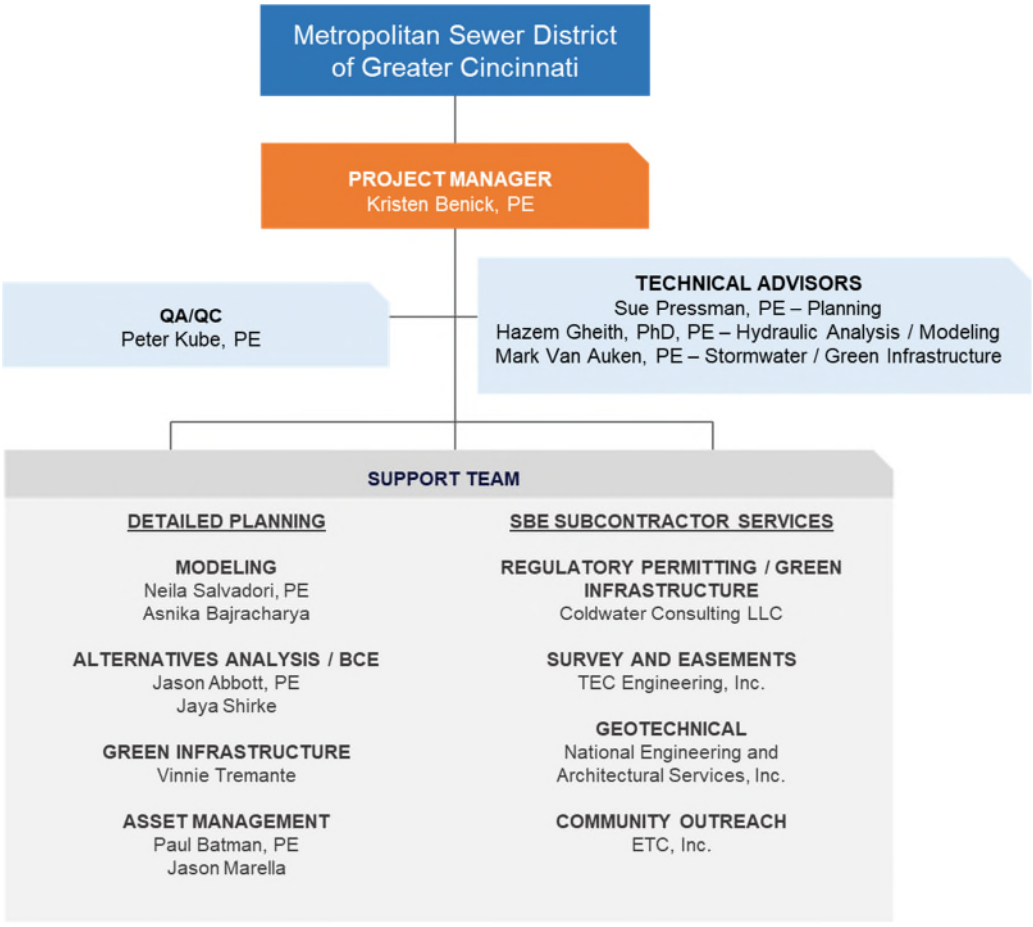

Figure 1: Project Organization Chart

3 PROJECT TEAM

The key personnel recruited to work on this planning project who are in charge of QC procedures are listed in Table 1 and include the project manager, technical advisors, and technical leads. They will interface with each other and other technical staff throughout the duration of the project to provide the expected level of quality. The resumes for key personnel are attached in Appendix A.

Table 1: List of Key Personnel

Key Personnel	Project Role
Kristen Benick	Project Manager
Sue Pressman	Technical Advisor
Hazem Gheith	Technical Advisor
Mark Van Auken	Technical Advisor
Peter Kube	QA/QC
Jason Abbott	Alternatives Analysis and BCE Lead
Neila Salvadori	Model Lead

4 LIST OF DELIVERABLES

Project team members who are responsible for the deliverable will conduct QC checks according to the list below. At a minimum, these reviews need to be done prior to milestone submittals of deliverables. The scheduled dates for reviews are included in the project schedule, submitted separately. QA reviews are performed by our technical advisors and our QA/QC lead as applicable. Table 2 below shows the list of deliverables, name of person responsible, the QA reviewer, and estimated completion dates. Kristen Benick as the Project Manager will review all deliverables.

Table 2: List of Deliverables

Deliverable	Name of Person Responsible	QA Reviewer	Estimated Completion Date
Draft Project Management Plan and Baseline Schedule for MSDGC Review	Kristen Benick	Sue Pressman	June 3, 2020[1]
Draft QA/QC Plan	Kristen Benick	Sue Pressman	June 3, 2020[1]
Draft Risk Management Plan	Kristen Benick	Sue Pressman	June 3, 2020[1]

Deliverable	Name of Person Responsible	QA Reviewer	Estimated Completion Date
Final Project Management Plan	Kristen Benick	Pete Kube	July 1, 2020
Final QA/QC Plan	Kristen Benick	Pete Kube	July 1, 2020
Final Risk Management Plan	Kristen Benick	Pete Kube	July 1, 2020
Draft Data Review Tech Memo	Kristen Benick	Pete Kube	September 16, 2020[2]
Final Data Review Tech Memo	Kristen Benick	Sue Pressman	October 13, 2020
Draft Model Review Tech Memo and Flow Monitoring Plan	Neila Salvadori	Hazem Gheith	September 23, 2020
Final Model Review Tech Memo and Flow Monitoring Plan	Neila Salvadori	Hazem Gheith	October 21, 2020
MSDGC Preliminary Review Checklist	Neila Salvadori	Hazem Gheith	September 28, 2021
MSDGC Detailed Model Review Checklist	Neila Salvadori	Hazem Gheith	October 26, 2021
Draft Modeling Report and Model Files	Neila Salvadori	Hazem Gheith	November 30, 2021
Final Modeling Report and Model Files	Neila Salvadori	Hazem Gheith	January 4, 2022
Draft Alternatives Analysis Report	Jason Abbott	Pete Kube Sue Pressman	May 24, 2022
Final Alternatives Analysis Report	Jason Abbott	Kristen Benick	June 28, 2022
Draft BCE	Jason Abbott	Pete Kube Sue Pressman	July 26, 2022
Final Business Case Evaluation Report	Jason Abbott	Kristen Benick	August 30, 2022

[1]Contractual Date
[2]Contractual Dates based on an assumed NTP for Task 2 of June 18, 2020

5 PLAN DESIGN REVIEW PROCESS

Plans Checking Procedure

The general procedure for checking work on this project is as follows:

- **Ongoing and at Completion:** Responsible staff members check work for errors and omissions throughout the project and at substantial completion
- **Checking:** QC reviewers check all work. Revisions are made in red.
- **Concurrence:** Responsible staff back-check comments for concurrence.
- **Incorporation:** Incorporate revisions. Highlight each revision on check plans with yellow highlighter as it is made.
- **Approval:** QC reviewers verify incorporations of revisions, as appropriate.

Computation Procedure Guidelines

The project team should maintain electronic files containing approved design criteria, design computation, quantity takeoff calculations, etc. Computations should conform to the following:

General

Computations should be clear and legible and include sketches showing the problem and its solution.

1. Headings on each sheet should be filled in completely.
2. Computations should show the complete solution of a problem – no auxiliary scraps of paper or auxiliary files containing calculations.
3. Computations should be in a format appropriate for the work being performed. Always keep in mind that someone else will be using the computations – perhaps several years from now – so the designer should place him or herself in the reviewer's position of having to understand what the designer has done.

Method

Computations should contain the following properly labelled information, as applicable:

1. The problem
2. A drawing of sketch
3. Known data
4. Plan references
5. Text references
6. Assumptions
7. Method of solution
8. Answer
9. Diagrams, if applicable

Whenever possible, make a sketch that accurately shows the problem and solution. Identify all points on the sketch clearly and simply. Record all answer on the sketch. Clearly show the conclusion or answer by underlining or highlighting and labelling the work "answer." When a problem requires several iterations to arrive at a correct solution, label those iterations appropriately.

Check Computations

The checker will obtain a copy of the original calculations and indicate the correct information by striking out and indicating the corrections on the copy. The checker will make no changes or erasures on the original calculations sheet. The maker will check the corrections and change the original sheets as required. The checker will back-check the original sheets after corrections have been made and initial them if correct. As this is performed in excel, revised files will be created maintaining date control.

Supplementary Computations

As necessary, clearly reference supplementary computations to the original computation sheets. Mark the original computation sheets plainly to indicate that additional computations have been prepared.

Superseding Computations

Sometimes computations are superseded because of changes in design. The design team members will take care to avoid using superseded computations. Clearly indicate on the new computations which computations replace them. The deposition of the superseded computations will be left to the discretion of the task package manager. If the task manager in uncertain about disposition, he or she should consult with the project manager.

Filing Computations

The task manager will verify that all computations are properly labelled and filed. Filed computations should be labelled to include the project number, project name, and contents. All calculations should be consolidated and filed by the project manager at the completion of the project.

Quality Control Acknowledgment Form

This form (Appendix B) will be used for major deliverables such as the model report, the stormwater separation memorandum, and the BCE to confirm that these documents have been reviewed and corrected according to quality procedures.

Planning Checklist

6 DOCUMENT CONTROL

To facilitate document searches and identify document contents, documents will follow a standard naming convention as follows:

- **Draft Documents:** 10142910 Ludlow Run Source Control_YYYY-MM-DD_Keyword_DRAFT
- **Final Documents:** 10142910 Ludlow Run Source Control_YYYY-MM-DD_Keyword_FINAL

Keywords will be representative of the document type or deliverable name.

7 SUB CONSULTANT QUALITY CONTROL

All subconsultants are responsible for the quality of the work they perform. Each is responsible for completing QC procedures consistent with this QC plan as appropriate for the nature of the work

performed. They may employ processes and tools they have developed and routinely use in the QC programs.

Arcadis is responsible for the performance of all subconsultants work. The Arcadis project manager will confirm that each subconsultant has performed the requirements set forth in this QC plan. Each subconsultant will utilize the Arcadis QA/QC acknowledgment form or may use their own acknowledgment form to confirm that the QC plan has been implemented. These forms will be submitted to the Arcadis project manager as a subconsultant deliverable. Arcadis will review each subconsultant deliverable for quality and adherence to the QC plan.

8 COMPUTER AIDED DESIGN (CAD) MANAGEMENT

At this time, CAD is not within the scope for this project. However, as this is a planning conveyance project, the MSDGC CAD Standards will be followed should CAD drawings be created for any purpose.

9 SCHEDULE MANAGEMENT

The baseline schedule will be reviewed by project team and MSDGC to check for concurrence of expected deadlines and will be submitted 30 days after notice to proceed (NTP). Project changes or delays will be discussed by both Arcadis and MSDGC and the schedule will be revised when appropriate to account for these changes. It is anticipated the schedule will be updated six times during the project duration.

10 FIELD SURVEY QUALITY CONTROL

Since topographic services are needed to verify critical elevations, Arcadis will engage Professional Licensed Surveyors. They will be required to perform their field survey in accordance with their standard QC Plan.

11 QUALITY CONTROL CHECK PROCESS

This QC Plan has been distributed to all key personnel listed in this plan and has been signed and dated in acknowledgement of the specifics contained herein. An example Quality Control Review Acknowledgement Form is included in Appendix B. Appendix C includes the MSDGC Planning Checklist that is part of the Business Case Evaluation process. This checklist will be utilized during the planning portion of this project as a part of the quality control check process.

APPENDIX A

Appendix A – Resumes of Key Personnel

EDUCATION
BS, Civil Engineering, University of Dayton, 2000

YEARS OF EXPERIENCE
Total – 19 years

PROFESSIONAL REGISTRATIONS
Professional Engineer – OH, KY

PROFESSIONAL AFFILIATIONS
Ohio Water Environment Association

Water Environment Federation

KRISTEN BENICK, PE

PROJECT MANAGER

Ms. Benick is a civil engineer with extensive planning experience evaluating capacity-deficient collection systems with sanitary sewer overflows (SSOs) and combined sewer overflows (CSOs) and developing solutions to mitigate. She has experience modeling storm and sanitary collection systems using InfoWorks and PCSWMM software.

PROJECT EXPERIENCE

CSO 488 Strategic Sewer Separation Phase A
MSDGC, Cincinnati, OH

Model lead for the strategic sewer separation evaluation for the expansion of ODOT I-75 to mitigate increase in CSO flows. Project includes model update, calibration, alternatives analysis and business case evaluation.

LMCPR Post Construction Monitoring and Modeling
MSDGC, Cincinnati, OH

Project engineer responsible for the hydraulic modeling of the Kings Run CSO 217/483 watershed future conditions model in the pre-revised calibration version to confirm that future condition improvements provide the required level of control as regulated in the Consent Decree.

Kings Run CSO 217/483 Source Control Project
MSDGC, Cincinnati, OH

Project engineer responsible for hydraulic modeling for the Phase B In-Line Storage Analysis and continued calibration and validation efforts for the Kings Run watershed and ultimately the Phase B design of the CSO Storage Tank. The preferred alternative includes three detention basins discharging into the combined sewer to reduce CSO volume at CSO 217, strategic sewer separation of major roadways, one detention basin that provides water quality treatment and flood control, a CSO storage tank, and ultimately a segment of stream restoration.

Kings Run Project Analysis
MSDGC, Cincinnati, OH

Project Manager responsible for the evaluation of options identified during brainstorming and technical meetings that occurred with MSDGC, the Sierra Club, Wooden Shoe Hollow residents and Hamilton County. Planning included the modeling and evaluation of alternatives discussed with Wooden Shoe Hollow residents that will meet or exceed the consent decree goals for the Kings Run watershed and CSOs 217 and 483. The Wooden Shoe residents were interested in separation of stormwater from the combined sewers, mitigating the volume and speed of flow through Kings Run Creek, and eliminating the proposed storage tank.

CSO 198/518 Basin Study
MSDGC, Cincinnati, OH

Project manager responsible for basin study including field investigations, data review, modeling, alternative analysis and development of a recommended solution to address basin challenges. The CSO 198 & 518 Basin Study addressed hydraulic, structural, solids and odor challenges associated with the collection system and developed a basin plan utilizing a risk-based method and the hydraulic model. The final Basin Plan included a 20-year capital plan to address structural deficiencies through rehabilitation and replacement of sewer assets and hydraulic deficiencies though limited hydraulic improvements.

ARCADIS Design & Consultancy for natural and built assets

SUE PRESSMAN, PE

TECHNICAL ADVISOR – PLANNING

Ms. Pressman has 23 years of experience in civil engineering that consists of applying sustainable or triple-bottom-line approaches to solve collection system and stormwater issues. She has strong project management and controls skills that enable her to manage complex wet-weather project implementation for consent-decree-driven projects. Her diverse background also includes project controls (budget and schedule management), affordability and rate studies, and watershed analysis. Her experience includes presenting at numerous public involvement meetings, environmental stakeholders, and meetings with regulators. Many of her clients' projects were driven by aggressive compliance schedules with administrative orders and Consent Decrees and she has prepared many compliance deliverables.

EDUCATION
MS, Environmental Engineer, The University of Texas, 1995

BS, Civil Engineering, Purdue University-Main Campus, 1993

YEARS OF EXPERIENCE
Total – 23 years

LICENSES & CERTIFICATIONS
Professional Engineer

Certified Construction Documents Technologist (CDT)

PROFESSIONAL AFFILIATIONS
Kentucky-Tennessee Water Environment Association

Ohio Water Environment Association

Water Environment Federation

PROJECT EXPERIENCE

Lower Mill Creek Partial Remedy Revised Plan
MSDGC, Cincinnati, OH

Project manager for evaluation of an alternative plan for controlling combined overflows for the Mill Creek WWTP. The consent decree also provides flexibility with a three-year time frame to develop an alternative plan to remove an equivalent volume (1.78 billion gallons using model v3.2) of CSO within this watershed by 2018. As part of a multi-firm team, performed project reviews, including SWMM model and cost estimate reviews for the candidate sustainable projects as an alternative to the deep tunnel. Non-monetary factors such as O&M requirements, water quality improvements, flexibility with the final solution, job creation, plus many others were assessed in the decision-making process.

CSO 488 Strategic Sewer Separation Phase A
MSDGC, Cincinnati, OH

Project manager for the strategic sewer separation evaluation for the expansion of ODOT I-75 to mitigate increase in CSO flows. Project includes model update, calibration, alternatives analysis and business case evaluation.

West Fork Branch Model Update
MSDGC, Cincinnati, OH

Project manager for the West Fork model update using the SWMM groundwater module and continuous calibration approach to better estimate runoff in the collection system and overflows from 15 CSOs. Use of a physically based model allowed for efficient analysis for source control options. The West Fork watershed wet weather projects were analyzed for verification of design sizing of sewer separation, detention basins and basin discharge pipe.

CSO LTCP Program Implementation
City of Fort Wayne Fort Wayne, IN

Task manager for development of an evaluation process using triple-bottom-line approach that will fairly and consistently evaluate the potential benefits of green infrastructure and related techniques. The City-specific metrics/criteria was developed in coordination with City staff, incorporating principals of stormwater management and green infrastructure initiatives already in use by the City.

Willow Run Combined Sewer Outfall Master Plan
Sanitation District No. 1 of Northern Kentucky (SD1), Fort Wright, KY

Project manager for development of a Master Plan for SD1's largest CSO. The Master Plan will provide a long-term roadmap, detailing activities, projects, and costs to reduce CSOs and basement backups during extreme rainfall events within the drainage area.

ARCADIS Design & Consultancy for natural and built assets

HAZEM GHEITH, PHD, PE

TECHNICAL ADVISOR – HYDRAULIC ANALYSIS / MODELING

Dr. Gheith has 32 years of experience in hydrologic and hydraulics modeling of urban drainage including stormwater and wastewater collection systems. He has developed a wide range of model application supporting tools to facilitate educated planning of collection systems improvements. His application tools include ArcGIS Vanue and Visual Basin Application, C# and Visual Basic stand-alone tools, and Python interfaces. Dr. Gheith has used his vast expertise in hydrologic and hydraulics applications to evaluate and mitigate street flooding, water-in-basement, sanitary sewer overflows and combined sewer overflows. He is an invited lecturer at CHI on modeling with SWMM and OWEA on GI modeling.

EDUCATION
PhD, Engineering Mechanics, The Ohio State University, 1995

MSC, Engineering Physics, Cairo University, 1990

BS, Civil Engineering, Cairo University, 1986

YEARS OF EXPERIENCE
Total – 32 years

PROFESSIONAL REGISTRATIONS
Professional Engineer – OH

PROFESSIONAL ASSOCIATIONS
Water Environment Federation

Ohio Water Environment Association

HONORS
Collection System Award, Ohio Water Environment Association

Adjunct Professor, Franklin University, Columbus Ohio

Adjunct Professor, Faculty of Engineering, Cairo University

Medal of Sci. Excel. Engineering Syndicate, Egypt

PROJECT EXPERIENCE

Blueprint Columbus - Miller/Kelton, Newtown/Bedford GI and I&I Improvements
City of Columbus, OH

Technical Manager to plan and design green infrastructure (GI) program to mitigate additional surface stormwater. GI units included rain gardens, bioretention cells with and without bump-outs, tree boxes, and pervious pavements. Filtration media type and footprint was selected and sized to achieve 20% TSS removal target. As member of the Pilot Area Technical Committee, prepared Blueprint Columbus Stormwater Modeling Guidelines to construct enhanced model platform to allow educated planning of the GI program. The model platform included using digital elevation model (DEM) data to add the street channels for surface flow routing, adding storm inlets from survey activities, and including downspouts discharge configuration from field investigation. To enhance green infrastructure siting, developed a GI Siting Application Tool that is adopted by the City as the pre-screening tool used by all 12 design consultants working on Blueprint Columbus projects.

West Fork Branch Model Update
MSDGC, Cincinnati, OH

Technical manager for the West Fork model update using the SWMM groundwater module and continuous calibration approach to better estimate runoff in the collection system and overflows from 15 CSOs. The approach facilitated the analysis for sizing of sewer separation, storm water detention basins and basin discharge pipe.

Wastewater Long Term Control Plan Phase II
City of Lancaster, OH

Technical manager for Phase II of the Long Term Control Plan (LTCP) update including system-wide flow monitoring program, model calibration and planning system improvements required to meet EPA CSO goals. Negotiated LTCP with OEPA. Phase II was approved 2014.

Hydraulic Model Expansion Project
Citizen's Energy Group, Indianapolis, IN

Technical manager for the hydraulic model expansion project to incorporate all sewers 12″ and larger, adding over 800 miles of pipes. The project also includes siting, oversight, and data review for over 640 temporary flow monitoring locations. Model enhancement involves "Modeling at the Source" approach to isolate I/I sources and use groundwater to calculate I/I. Provided workshops and knowledge transfer to Citizens in-house modeling staff.

BSA Collection System Model Recalibration
Buffalo Sewer Authority (BSA), Buffalo, NY

Technical manager for the update and extension of BSA's SWMM collection system model. Model is calibrated using data from 144 monitor locations. Model at the Source approach was implemented to facilitate planning a systemwide green infrastructure program.

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EDUCATION
BS Civil Engineering
Michigan State University 1989

YEARS OF EXPERIENCE
Total – 29 years

PROFESSIONAL REGISTRATIONS
Professional Engineer – OH, MI, NC

Certified Professional in Municipal Stormwater Management (CPMSM)

Envision Sustainability Professional Credential

COMPANY TITLE
Senior Water Resources Engineer

MARK VAN AUKEN, PE

TECHNICAL ADVISOR – STORMWATER / GREEN INFRASTRUCTURE

Mr. Van Auken serves as national Storm Water Practice Leader, where he helps develop and lead storm water work. He has 29 years' experience in the analysis, design, and construction phases of a variety of storm water related projects. He specializes in municipal stormwater management, with experience that includes flow monitoring, sampling, modeling, permitting, design, green infrastructure, funding, maintenance, program management and risk-based asset management. Mr. VanAuken is an Envision Sustainability Professional and provides oversight on sustainability options for stormwater and green infrastructure projects for the firm. He is a Certified Professional in Municipal Stormwater Management, a member of Water Online's Water Intelligence Panel, and a former long-time member of the Executive Committee of the Ohio Stormwater Association.

PROJECT EXPERIENCE

Blueprint Columbus - Miller/Kelton, Newtown/Bedford GI and I&I Improvements
City of Columbus, OH

Technical consultant for development of gray and green design solutions for an urban neighborhood as part of the Blueprint Columbus integrated planning program.

Little Calumet River/Cal Sag Channel Gray/Green Infrastructure Resiliency Program
Metropolitan Water Reclamation District of Greater Chicago, IL

Planning lead for development of a stormwater master plan for a 6 square mile pilot area. This project redefined urban drainage by developing gray and green solutions to mitigate drainage issues from up to a 100-year storm event, and providing guidance on how communities can implement these alternative solutions to minimize flooding, optimize water quality, spur economic development and improve quality of life for its residents. Also assisted Cook County, IL (through MWRD) with pursuit of HUD funding for the project area as part of the NDRC grant program. Led development of conceptual plans and a benefit cost analysis of proposed improvements including social and environmental considerations.

Decision-Making Tool for Holistic Stormwater Management
The Nature Conservancy, Los Angeles, CA

Technical Consultant for development of a GI site selection model that provides a scalable analysis for a range of criteria at the parcel, storm inlet, subwatershed, watershed and county-wide level. The model is adaptable to changing conditions and criteria and will allow for cost-effective identification of the parcels/areas that can provide the greatest water quality & nature benefits.

Stormwater Master Plan
Hampden Township, PA

Planning Lead for the development of a stormwater master plan that identifies a plan of action for implementing a proactive stormwater management program.

CSO System-Wide Study
City of Akron, Ohio

Project Manager responsible for all tasks pertaining to the development and calibration of Storm Water Management Model (SWMM) using XPSWMM. The modeling work involved hydraulic and water quality calibration of both the City of Akron's 246-mile combined sewer system and the local receiving streams.

EDUCATION
BS Civil Engineering
University of Cincinnati
2002

YEARS OF EXPERIENCE
Total – 16 years

LICENSES & CERTIFICATIONS
Professional Engineer – OH, KY

CDT (Construction Document Technologist)

OSHA Occupational Safety and Health Training

PROFESSIONAL AFFILIATIONS
American Water Works Association

Water Environment Federation

PETER KUBE, PE

QA/QC

Mr. Kube's experience includes advanced planning, detailed design and construction administration for water and wastewater facilities. He also has experience planning and cost estimating for regional sewer conveyance strategies and alternative solutions. His specialized areas of expertise include wastewater treatment, pump stations, solids dewatering, liquid and dewatered sludge pumping, residuals/solids handling processes, facility automation, and combined sewer overflow remediation.

PROJECT EXPERIENCE

Parallel Interceptor Sewer Design
City of Dayton, OH

Project engineer for design of 16,000 feet of large interceptor sewer. Due to shallow construction, watertight 8'x6' precast box culvert cross section with low flow channel was selected. The challenging construction is located within the floodwall of the Great Miami River and has multiple hydraulic structures connecting siphons from the other side of the river. Construction of the new interceptor facilitates inspection and rehabilitation of the existing interceptor and will allow for in-line flow equalization during wet weather events.

Overflow 002, Gravity Sewer Improvements
City of Hamilton, OH

Lead designer of 4,500 feet of 18" gravity sewer that replaced a 12"-15" sewer that wound through the middle of extensively developed residential city streets. The improved sewer eliminated a sanitary sewer overflow to meet the requirements of the City's consent decree.

Staff Supplementation
MSDGC, Cincinnati OH

Provided staff supplementation services to the MSDGC to provide engineering manpower within the Project Business Development Division. This Division was responsible for planning and evaluating nominated conceptual projects and presenting them to upper management for a go/no go decision. Presentations to upper management were contained in a Business Case Evaluation that analyzed various alternatives to solve a problem and evaluated them based on a triple bottom line basis; capital cost, social cost, and environmental cost. This was originally a 1 year assignment and was extended by MSDGC into a 2.5-year assignment.

Avon Drive Sanitary & Storm Sewer Improvements
Sanitation District No. 1 of Northern Kentucky

Project Engineer for the Lakeside Park study consisting of preliminary engineering analysis and of the Van Deren sanitary and storm sewer improvements and the detailed design of the Avon Drive sanitary and storm sewer improvements. The alternatives analysis for the Van Deren area compared open cut replacement, trenchless rehabilitation, and a vacuum collection system to eliminate the 15 "common" sanitary with storm manholes and reduce I/I from the existing infrastructure. Open cut was selected for areas receiving other roadway repairs. CIPP Lining of main and laterals was selected for other areas.

High Meadows Pump Station Elimination
MSDGC, Cincinnati, OH

Design support for the design of approximately 2,400 lineal feet of 12"-16" sanitary sewer.

ARCADIS Design & Consultancy for natural and built assets

JASON ABBOTT, PE

ALTERNATIVES ANALYSIS / BCE / ENGINEERING & DETAILED DESIGN

Mr. Abbott specializes in bringing together teams of diverse individuals to listen to our clients and meet their needs. As a project leader on various water and wastewater projects, water supply plans, alternatives analysis and environmental assessments. His duties have ranged from construction contract administration to preliminary level planning and preparation of final detailed design drawings and specifications on these projects, all with a focus on delivering and managing sustainable water and wastewater solutions. He has assisted many clients with preparation of exhibits and presentations for public outreach and participated in many public meetings.

EDUCATION
BSCE Water Resources and Environmental Engineering The Ohio State University 1997

YEARS OF EXPERIENCE
Total – 22 years

PROFESSIONAL REGISTRATIONS
Professional Engineer

Certified Construction Documents Technologist (CDT)

PROFESSIONAL AFFILIATIONS
American Water Works Association

Water Environment Federation

PROJECT EXPERIENCE

Queen City and Cora Sewer Separation
MSDGC, Cincinnati, OH

Project engineer for the planning, design and construction of Queen City and Cora Avenues R/W Sewer Separation project, consisting of 145 acres of mostly undeveloped forested terrain with an overall topographic relief of approximately 240 feet and a span of approximately 4,700 feet. The planning work included alternative development, hydrologic and hydraulic modeling, open channel modeling, and detailed conceptual drawings. The design consists of 2,845 lineal feet (LF) of natural stream channel, 1,140 LF of storm sewer, and three wetland extended detention basins. The detention basins will be created using an early 1900s railroad embankment, a man-made depression, and enhancing an existing detention basin. The estimated runoff reduction for the total 265-acre urban sewershed is equivalent to the predevelopment runoff during a 100-year storm event.

Westwood Northern Bundle
MSDGC, Cincinnati, OH

Project engineer responsible for alternatives analysis and design of the CSO 525 sewer separation project. This project sought to meet the Consent Decree goal of reducing the overflow at CSO 525 to 2.5 MG for the typical year, address existing capacity problems, improve access to the regulator for maintenance and improve wildlife habitat. The alternatives analysis resulted in the design of 7,800 LF of 12” through 36” sanitary and storm sewer, a 690 LF access road and a new regulator with energy dissipating headwall. Multiple community meetings were attended, which resulted in design changes that balanced the needs of the community with the property owners who were directly affected.

West Fork Sustainable Watershed Alternatives Analysis
MSDGC, Cincinnati OH

Project engineer responsible for the compilation of and review of alternatives and development of the Business Case Evaluation for the entire West Fork basin. The recommended improvement alternative for this watershed was a comprehensive watershed solution, which created a sustainable infrastructure solution and an overall alternative to the 2006 Wet Weather Improvement Plan and served to assist MSDGC in renegotiating their existing Consent Decree. The recommended alternative entailed sewer separation projects at 10 CSOs and recommended installation of 4,700 feet of an 84” interceptor sewer, two 1.50 MG CSO storage tanks, two stormwater detention basins, 5,000 LF of channel renaturalization and 6,000 LF of stream rehabilitation. The recommended alternative is estimated to reduce CSO volume by 287 million gallons in the typical year. This project included multiple stakeholders meeting and multiple community meetings and an USEPA site tour.

NEILA SALVADORI, PE

HYDROLOGIC/HYDRAULIC MODELING

Ms. Salvadori has experience in collection systems modeling, evaluation, planning and design, which includes modeling of infiltration/inflow (I/I) and runoff sources, calibration of sanitary, combined and storm sewer systems, hydraulic evaluation, mitigation of sanitary and combined sewer overflows (SSOs and CSOs), water in basement and manhole flooding, integrated planning, future flow projection analysis, future redevelopment modeling and impacts assessment, stormwater controls, evaluation of system operation and real time controls (RTCs), rainfall and flow monitoring data processing. She completed projects on a variety of other water and wastewater infrastructures including wastewater facilities, water distribution systems and green infrastructures. Her work experience also includes groundwater modeling.

PROJECT EXPERIENCE

Blueprint Columbus
City of Columbus, OH

Blueprint Columbus is an innovative program to address sanitary sewer overflows, water in basements and stormwater quality through implementation of inflow and infiltration mitigation technologies and green infrastructures. Salvadori has been providing technical support on hydrology and hydraulics modeling, GIS data review and processing, field data interpretation. During integrated planning she applied I/I reduction technologies, evaluated implementation and effectiveness.

Sewer System Capacity Model (SSCM) Update 2012 and Sewer System Capacity Model (SSCM) Update 2020
City of Columbus, OH

Ms. Salvadori has been leading several engineering tasks to evaluate sewer system performance, address capacity limitation, mitigate water in basement and manhole flooding, reduce sanitary and combined sewer overflow. She worked on modeling, calibration, capacity and Level of Service analysis of combined, sanitary and storm systems. She has completed tasks on inflow redirection modeling and analysis, proposed storm systems sizing, stormwater controls, future scenarios modeling and assessment. She was also involved on evaluation of a real time decision support system for operation of the city-wide collection system.

MMSD Conveyance System Evaluation and Modeling Software Improvements
Milwaukee Metropolitan Sewerage District, WI

Ms. Salvadori is currently assisting tasks management and planning for MMSD collection system capacity analysis in existing and future conditions, modeling of future conditions and system operation evaluation and enhancement.

Ms. Salvadori is tasks leader of Ad Hoc Modeling Request 302. The project consists in application of the Model at the Sources modeling framework to four selected sanitary basins to investigate and quantify major I/I contributions, as well as to provide guidelines to the District for I/I reduction alternatives.

EDUCATION
MS, Environmental Engineering, Michigan Technological University, 2013
MS Environmental and Land Engineering, Università degli Studi di Trento, 2011
BS, Environmental Engineering, Università degli Studi di Trento, 2007

YEARS OF EXPERIENCE
Total – 7 years

PROFESSIONAL REGISTRATIONS
Principles and Practice of Engineering (PE), Ohio, USA
Environmental Engineering License, Italy
WEF Member since 2015
ASCE Member since 2014

APPENDIX B

Appendix B – QC Review Acknowledgment Form

ARCADIS Design & Consultancy for natural and built assets

QA/QC ACKNOWLEDGEMENT FORM

Project Name: Ludlow Run Sustainable Source Control

Project No.: 10142910

Milestone or Deliverable:

Briefly describe the project status of the "Quality Activity" that is being acknowledged with this form.

Additional Comments: **(if needed)**

Note: By signing below, we acknowledge our role in implementing the Quality Management System (QMS) for this project/deliverable. Refer to the Water Division Quality Manual for additional description on the roles in the QMS.

Prepared by – Staff responsible for work and checking for errors and omissions throughout the project.

Quality Reviewers – Assigned QC reviewers responsible for checking work. Refer to the Project Quality Plan (PQP)

Design & Quality Leader – Responsible charge of the technical work and implementation of the QMS.

Project Manager – Responsible for confirming the execution of quality assurance and control measures and activities.

	Signature –Click below to sign		*Signature –Click below to sign*
Prepared by:		**Quality Reviewer Signature:**	
		Reviewer:	
		Review Emphasis:	
Design & Quality Leader:		**Quality Reviewer Signature:**	
		Reviewer:	
		Review Emphasis:	
Project Manager:		**Quality Reviewer Signature:*****	
		Reviewer:	
		Review Emphasis:	

*** Continue Quality Reviewer Signatures on next page as needed to capture all reviews such as discipline reviews (civil, mechanical, electrical, etc), coordination reviews, constructability/biddability review, technical advisors, etc).

ARCADIS Design & Consultancy for natural and built assets

QA/QC ACKNOWLEDGEMENT FORM

Project Name: Ludlow Run Sustainable Source Control

Project No.: 10142910

Milestone or Deliverable:

Continue the Quality Reviewer Signatures below as needed to capture all reviews such as discipline reviews (civil, mechanical, electrical, etc), coordination reviews, constructability/biddability review, technical advisors, etc).

Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	
Quality Reviewer Signature:		**Quality Reviewer Signature:**	
Reviewer:		**Reviewer:**	
Review Emphasis:		**Review Emphasis:**	

APPENDIX C

Appendix C – MSDGC Planning Checklist

Project Name/Project ID: _____ **MSDGC Planning Checklist** (Used throughout planning phase)

Planner: _____**Initials & Date:**_____ **Peer Reviewer:**_____ **Initials & Date:**_____

1.0 Project Management

- ☐ ☐ Obtain Project Charter from AM&WP
- ☐ ☐ Planning Funding Source (CIP, Allowance, etc.)
- ☐ ☐ Planning Contracts (RFP, RFQ, PSA, etc.)
- ☐ ☐ Detailed Planning Schedule Established
  - ☐ ☐ Scheduling Requirements or WWIP Milestones Identified
- ☐ ☐ Planning Legislation Forecast (N/A if under Planning Allowance)
- ☐ ☐ Document Control and/or Electronic Planning Folder Established
- ☐ ☐ Technical Review Committee (TRC) Established
- ☐ ☐ Customer Service Plan Established for Complex or Public Involvement

2.0 Records Research

- ☐ ☐ CAGIS/Existing Facility Drawings/Records Research Performed
- ☐ ☐ Research Abandoned Utilities (streetcar tracks, etc.)
- ☐ ☐ Field Walk Down Performed
- ☐ ☐ OUPs Request
- ☐ ☐ Gather and Research Relevant Existing Reports and Studies
- ☐ ☐ Research Prior Legislation History

3.0 Data Collection

- ☐ ☐ Condition Assessments **Proposed in Design?** Y / N
- ☐ ☐ Flow Monitoring/Model Calibration **Proposed in Design?** Y / N
- ☐ ☐ Field Work/Survey Work **Proposed in Design?** Y / N
- ☐ ☐ Geotechnical Work **Proposed in Design?** Y / N
- ☐ ☐ Sampling & Analysis **Proposed in Design?** Y / N

4.0 Project Coordination

- ☐ ☐ Inter-Utility Coordination (water, gas, DOTE, ODOT etc.)
  - ☐ ☐ Construction Coordination Software information sent to ETS
  - ☐ ☐ MSD OUPs shapefile
  - ☐ ☐ Jurisdictional Paving Coordination
- ☐ ☐ MSDGC Coordination
  - ☐ ☐ WWT/WWC: (WWT System Asset Renewal CIP, etc.)
  - ☐ ☐ OOD/EPM: (Green shapefile)
  - ☐ ☐ CIP Projects: (CIP shapefile)
  - ☐ ☐ WWIP Projects: (Approved WWIP Document)
  - ☐ ☐ RDII: (RDII shapefile)
  - ☐ ☐ Assessment/HSTS: (Assessment shapefile, HSTS Area shapefile)
  - ☐ ☐ Dev. Services: (Development shapefiles, SSO/CSO Credits)

Planner Peer

5.0 Problem Diagnosis/ Boundary of Analysis/ Project Objectives

- ☐ ☐ Supports, enhances, or clarifies original nomination
- ☐ ☐ Evaluates potential opportunities and benefits to MSD

6.0 Strategy and Alternatives Analysis

- ☐ ☐ TBL Analysis Performed
  - ☐ ☐ Social/Environmental Scoring
  - ☐ ☐ NPV Analysis reviewed by Cost Estimating Group
  - ☐ ☐ FLAMROC Analysis

7.0 Recommended Alternative

- ☐ ☐ Stakeholder Input (Nominator, Operating Division, etc.)
- ☐ ☐ Modeling Report provided (or approved) by Modeling Group
- ☐ ☐ Risk Register (WWIP projects or projects >$1M in construction)
- ☐ ☐ Execution Plan
  - ☐ ☐ Clearly Defined Scope
  - ☐ ☐ Schedule Established (through project completion in years)
    - ☐ ☐ Project Dependencies Identified
  - ☐ ☐ Project Budget Established
    - ☐ ☐ Cost Estimate provided (or reconciled) by Estimating
    - ☐ ☐ Budget Deviation Form Completed
    - ☐ ☐ Design Legislation Strategy (CIP Book, Add, Year)
    - ☐ ☐ ROW costs provided by ROW Group
    - ☐ ☐ Funding Sources Identified
    - ☐ ☐ Potential Funding from Loans or Grants Identified
  - ☐ ☐ Easements Identified/ESA Performed
  - ☐ ☐ Anticipated Required Permits Identified
  - ☐ ☐ Value Engineering (projects >$5M in construction)

8.0 Review of BCE Document

- ☐ ☐ Planning Peer Review Complete & Comments Addressed

Planner Peer

Items 1.0 to 8.0 must be addressed prior to submittal of BCE for signature.
Peer Reviewer check is required for only Items 1.0 to 8.0.
Attach Checklist and TRC Comment Response Form with BCE for signature.

9.0 Business Case Review and Approval Procedure

- ☐ Use Procedure for BCE Review and Approval

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