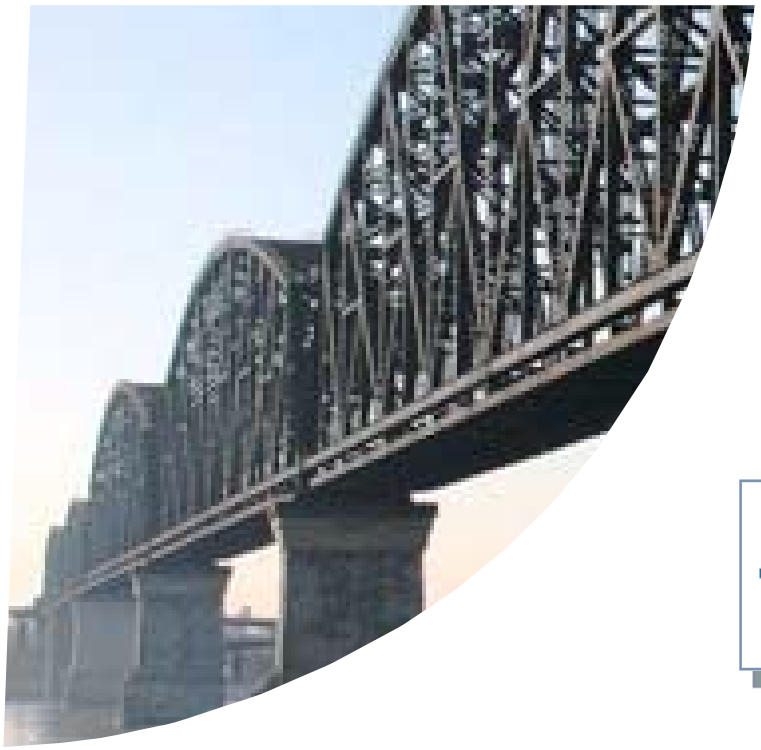


City of Jeffersonville

Combined Sewer Overflow Interceptor Design— 60% Design Development
Value Engineering Quality Assurance Quality Control
Report and Recommendations

DRAFT FOR PUBLICATION TO OWNER

January 2014

A Wealth of Resources to Master a Common Goal.

Table of Contents

Appendices

Disclaimer

The information contained in this report is the professional opinions of the team members during the Value Engineering (VE) Quality Assurance Quality Control (QA/QC) Process. These opinions were based on the information provided to the team at the time of the Report. As the project continues to develop, new information may become available, and this information will need to be evaluated on how it may affect the recommendations and findings in this Report.

Introduction

This Value Engineering (VE) Quality Assurance Quality Control (QA/QC) Study provides an overview of the project, key findings, and the recommendations developed by the VE-QA/QC Team.

A VE-QA/QC Study, requested performed by the City of Jeffersonville's Sanitary Sewer Board and executed by Commonwealth Engineers, Inc. (Commonwealth), was conducted for the Combined Sewer Overflow Interceptor Design – 60% Design Development. The study was conducted with 60% complete plans and the 60% Design Development Report provided by the City / Design Team to Commonwealth as assembled by Clark-Dietz Engineers, Jacobi, Toombs & Lanz, and Strand Associates.

This VE-QA/QC Study was assembled over the December 2013 thru January 2014 time frame with a scheduled follow-up workshop January 21st 2014 with the Design Team and Owner; to review the concepts herein, develop these concepts further and potentially identify additional concepts worthy of consideration. Upon conclusion of the workshop, we will finalize the VE-QA/QC Report for the Design Teams use.

Information Gathering Phase

On December 3, 2013 Commonwealth met with the Owner and Design Team. At this meeting, the Owner articulated his expectations for the VE-QA/QC Report, and the Design Team presented summary information on the work performed thus far. The VE-QA/QC Team was also provided with 60% plans and a 60% Design Development Report assembled by the Design Team.

A copy of the PowerPoint presentation utilized by the Design Team to introduce the VE-QA/QC Team to the project is contained in **Appendix A**.

Owners Expectations

It was identified by the Owner that the project's general approach has been planned for quite some time. Therefore, no alternations to the overall concept is desired (i.e. the project will consist of conveyance/storage of the CSO to the Tenth Street Pump Station (TSPS)). What is desired is a review of the 60% product with an eye toward both quality assurance and cost savings.

Design Team

The design team consists of three (3) consulting engineering firms:

Firm:	Jacobi, Toombs & Lanz, Inc.
Role:	Project Administrator
Contacts:	Jorge Lanz, P.E.
	Joshua Hillman, P.E.

Firm:	Clark Dietz, Inc.
Role:	Designer
Contacts:	Wes Christmas, P.E.
	John Dufek, P.E.
	Hans Peterson, P.E.

Firm:	Strand Associates
Role:	Sewer Modelers
Contacts:	Mark Sneve, P.E.
	John Herriford, P.E.

The Owner is the City of Jeffersonville represented by the Sanitary Sewer Board Members and the City's Utility Director:

City of Jeffersonville Representatives

Mayor Mike Moore, Member
Mr. Dale Orem, Member
Mr. William Saegesser, Member
Mr. Len Ashack, Utility Director

CSO Interceptor Project Overview

The below narrative summarizes the discussions and presentations held and performed at the December 3, 2013 "kick-off" meeting with respect to the CSO Interceptor Project.

A. Project's Purpose

The purpose of the proposed project is to intercept existing overflows to the Ohio River via new, oversized interceptor(s), collect the combined sewage, store the combined sewage, and transmit this flow to the TSPS for conveyance to the downtown Waste Water Reclamation Facility (WWRF).

B. System Synopsis

The WWRF is rated at 50 MGD. The TSPS is anticipated to transmit up to 35 MGD of flow to the WWRF. A modulating gate is in place at the TSPS to regulate flow to the pump station and to optimize anticipated future storage in the interceptor. The TSPS is one (1) of three (3) major stations that pump to the downtown WWRF.

Flow from the TSPS is minimal during dry weather events - averaging 4.5 MGD. There is currently no chemical feed system associated with the TSPS (for odor control). There is currently no other forms of odor control incorporated into the TSPS, however, an Odor Control Project is currently underway (by Webster Environmental Associates, Louisville Kentucky on behalf of the City).

All CSO outfalls are submerged during overflow events. The Walnut Street CSO Discharge Structure has recently been rebuilt. The Wall Street CSO Discharge Structure is planned to be rebuilt. All CSO's have metering capabilities. The meters were installed in 2008.

C. XPSWMM Model Synopsis

The CSO Interceptor design is based upon the calibrated and EPA approved XPSWMM model. One (1) CSO discharge is anticipated in a typical year (design parameter) for CSOs on the Ohio River. No factor of safety has been incorporated into the model. No growth factors have been incorporated into the model. The City states they do not anticipate growth within the combined sewer system service area.

Phase II and III flow metering occurred in 2007-2008 and 2008-2009. The Design Team's modeler does not have concern with the identified model's underestimation of flows. The stated reason for the lack of concern is that improvements projects that were not identified in the LTCP nor anticipated in the model were implemented during the flow metering time frame, the nature of which were stated to result in flow reductions. Further, rainfall data from 2011 was utilized which validated the model's projected volumes (though actual peaks were higher than the model predicted peaks).

The Design Team has attributed the higher than anticipated (via the model) peak flows to catch basin / sewer cleaning programs. Per the Design Team, no recalibration of the model to mimic the higher than predicted peaks flows has or will occur to support the 60% design concept / product. The 90% Design is anticipated to incorporate modeling updates.

The flood control pump stations on the Ohio River are not under the control of the City. The flood control pump stations have not been incorporated into the model.

The Design Team's modeler has identified two (2) concerns: (1) the downspout removal program, and (2) the catch basin and sewer cleaning.

D. Anticipated Construction Materials and Methods

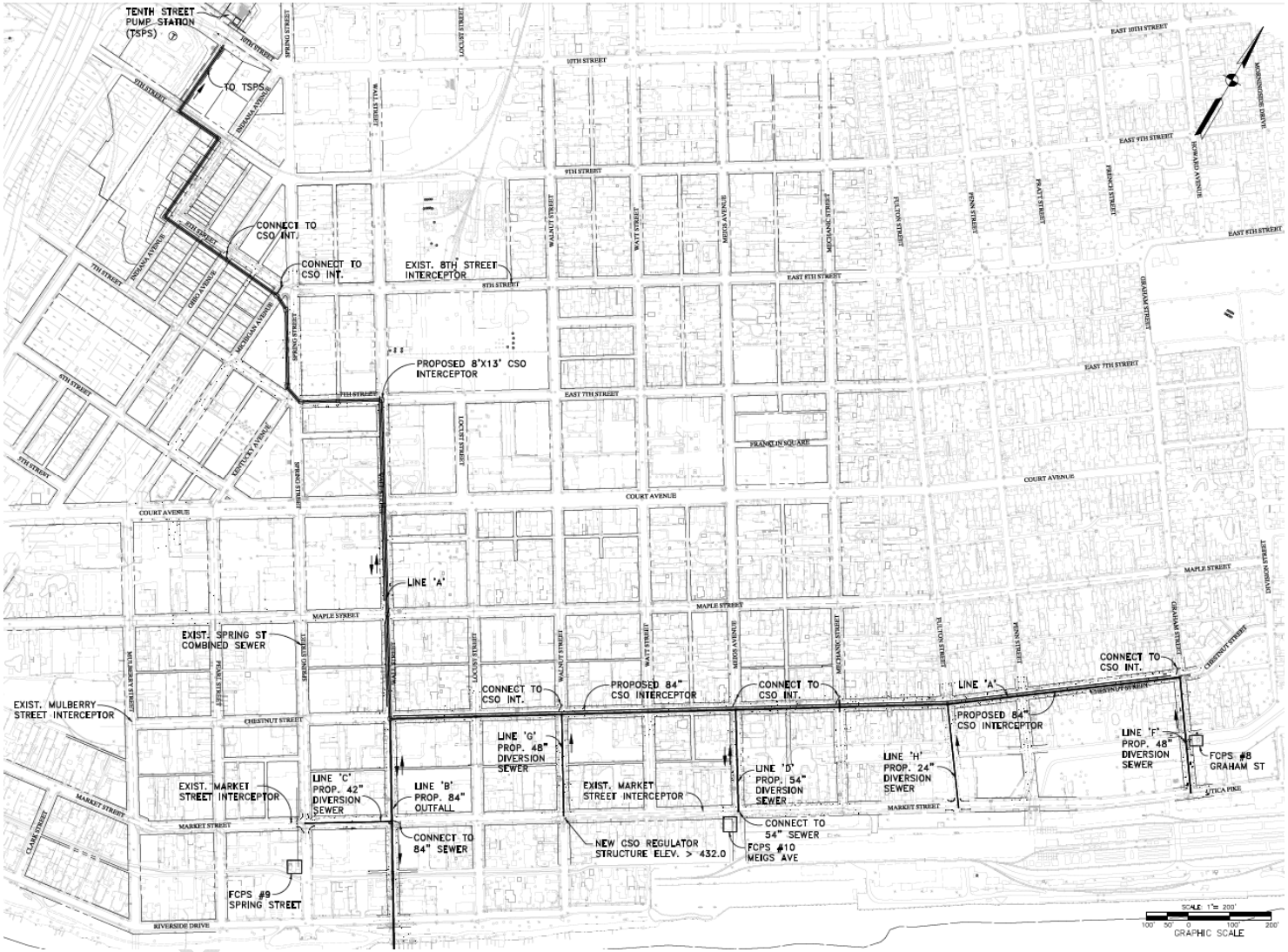
The Design Team contracted with NTH Consultants to assess the feasibility of a tunneling solution. The Design Team indicated as a result of this assessment (1) the sewer is too shallow (running North and South) for tunneling to be viable, and, (2) approximately 50% of the East-West running sewer would be viable for a tunneling installation method.

As a result of this analysis, the Design Team states there is not enough tunnel-able sewer to justify this alternate method of installation into the design and has proceeded with a 100% open cut method of installation.

The design generally consists of 84-inch diameter sewer pipe east-west along Chestnut Street, north-south along Wall Street until they join at the intersection of Chestnut and Wall, where a 13-foot tall by 8-foot wide box is planned to convey the joining flow north and west along Wall, 7th, Spring, and 8th Street to and along Indiana Avenue, 9th Street and then connecting through easement to the TSPS. **See Figure 1 – 60% Design Overview of CSO Interceptor**.

Near constant dewatering is anticipated required for the installation of the interceptor. Further, to accommodate existing conditions, the slope of the interceptor throughout will NOT meet the minimum 10-State Standards. The City / Design Team indicated as a result they will be seeking an exemption from IDEM during the permitting process.

Figure 1 – 60% Design Overview of CSO Interceptor



CSO Interceptor Project Discussion Points / Observations

During the December 3, 2013 project kick-off meeting the VE-QA/QC Team and Design Team engaged in a free flowing discussion that brought about several items of interest and potential focus within this report. They include:

A. The City currently does not have a lateral ordinance in place.

1. Is the City receptive to passing an ordinance requiring an inspection of the lateral and repair prior to allowing for the sale of the property as a means of I & I reduction?

B. The City currently has far more sewer than their staff of 9-individuals can maintain (i.e. the project should be automated as much as possible to minimize the need for routine maintenance).

C. The City has future storm projects planned that are anticipated to mitigate flows in the future.

1. Are these projects and corresponding anticipated reductions in flow incorporated into the model?

D. All residents within vicinity of the project are on City water (i.e. no wells); limiting a potential issue associated with dewatering for construction purposes.

E. No detention/retention ponds exist along the route (that could be adversely affected by dewatering)

F. No bridges or other superstructures exist along the route that could potentially create unforeseen issues during construction (i.e. buried obstacles altering grade/route).

G. The CSO regulator elevations are above the normal River Stage (Flood Control Sluice Gates are in place).

H. When overflows occur, it is planned that the 1st overflow will be at the TSPS with the 2nd overflow occurring at Wall Street (which is 1-foot higher than the TSPS overflow).

I. The Flood Control Pump Stations are not under the Control of the City (they are under the Control of the Flood Control District).

J. Dry weather flows are currently anticipated to travel through the new interceptor

1. This is intuitively discouraged due to the high probability of odor control issues as a result (and corresponding on-going O&M).

K. It is unknown whether or not the TSPS has had Computational Fluid Dynamics (CFD) analysis performed to insure its proper operation with the introduction of additional flow from the interceptor.

1. This was discussed and determined to be a mute-point since flows equivalent in magnitude at the same entry point to the lift station currently occur with no reported issues on functionality and reliability of the pumps / pump station.

L. There may be some benefit to installing level control loops/regulators in areas subject to flooding (along the interceptor route).

M. Surcharging has been noted to occur at 8th and Ohio (in the past) and requires remedy. A relief point has yet to be incorporated into the XPSWMM model.

N. The current design anticipates the incorporation of flushing stations along the entire interceptor (thirteen) with a source of flushing water yet to be determined. Further, the designer has noted they have only identified one (1) flushing gate supplier to-date.

1. It appears the designer has struggled with two (2) major concepts and could benefit from further analysis and input from the VE-QA/QC team.
    a. Common conduit conveying both dry and wet weather flows versus separate conduits (the designer notes this is a cost based decision).
        1) Note: A common conduit approach necessitates the flushing of both the dry and wet weather interceptor (chambers).
    b. Method of odor control / flushing / low labor routine maintenance
2. Additionally, there may be merit to further consideration being given to
    a. Sweetwater recycling through the interceptor for odor control
    b. Recycle of LS contents through interceptor to create flushing velocities necessary (i.e. a flushing loop utilizing the existing and/or new pump station; consider tube pumps).
    c. Identifying and analyzing the pro's and con's associated with various flushing water sources (wells, WWTP effluent, river, potable, etc.).
3. Figure V-14 of the 60% Design Development Stage Report illustrates the detailed considerations employed in regards to the decision making approach/matrix with respect to the current flushing concept.

O. Venting needs addressed – currently no plans in place to vent.

P. The designer would benefit from input on applicable interceptor pipe types (pro's and con's). Currently, HDPE, FRP, PVC, and Concrete have been considered with noted concern that the grit in the interceptor may damage the FRP pipe.

Q. Utility conflicts are of concern.

1. Does the City or do the utilities need to shoulder the costs for the utility relocations mandated by this project?
2. What permitting issues (such as Railroad Crossings) and associated costs exist?

R. There would likely be benefit in pre-qualifying dewatering contractors and potentially considering separate contracts (to avoid markup of prime contractor and insure abilities of contractor selected dewatering sub-contractor).

VE Study Overview

A comprehensive VE-QA/QC Team was assembled to review the City of Jeffersonville Combined Sewer Overflow Interceptor Design – 60% Design Development in a focused work effort to (1) develop cost-saving recommendations consistent with the project goals and objectives and (2) identify any areas of concern (i.e. discussion points) with the design that may merit the Design Team's attention and consideration. The VE-QA/QC Team made-up of highly qualified professional engineers, a Master Electrician/Instrumentation and Control Specialist, and Construction Estimator/Inspector experienced and specialized in municipal public works wastewater projects of this nature, independent from the City's design team, evaluated project components integral and related to the published 60% Design. The evaluation process generated review comments are contained in attached **Appendix B**.

A visual site inspection (VSI) was performed on January 10th, 2014. The purpose of this VSI was to asses existing conditions with an eye toward constructability. Please refer to http://www.commonwealth-engineers.com/proposals/city-of-jeffersonville/ for our video documentation and evaluation of findings.

The nature/scope/overview of major project work elements includes:

1. Review of Hydraulic Model

A cursory review of the hydraulic model's assumptions has been performed for the express purpose of verifying the selected pipe/conveyance conduit size(s).

See **Appendix C** for the VE-QA/QC teams summary technical memoranda documenting these efforts.

2. Alternate Methods of Installation / Interceptor Materials

The VE QA-QC Team has revisited the anticipated installation and materials with an eye toward both value and expense. Reviews of the Rectangular Sections have been emphasized.

3. Review of Proposed Connections to the CSO System / Flood Control System

Due to the size of the conduits associated with this project, custom intermediate structures will likely be required. The VE-QA/QC Team has reviewed the anticipated structures and has assembled our observations / suggestions.

4. Odor / Corrosion Control & System Maintenance

Given the anticipated slope of the interceptor along with the nature of its contents, Odor / Corrosion Control is an issue of paramount importance. A $38M project consisting of large diameter sewer / CSO conveyance through downtown Jeffersonville will not be considered successful by the City's residents, even if it meets the requirements of the LTCP, if a corresponding nuisance odor is generated. Nor will the project be considered a success by staff if it is maintenance intensive.

Fully considering the anticipated issue of Odor / Corrosion / Ease of Maintenance is of paramount importance!

5. Dewatering

Dewatering will be required to support interceptor installation. The projects prime Contractor will be one experienced in pipe / structure installation. Dewatering sub-contractors will be acquired by the bidding prime contractors in the assembly of their bids. Contractually, the bidding dewatering sub-contractors will agree to meet the requirements of the specifications; however, it has been our experience that not all dewatering contractors are equally skilled.

The merits of pre-qualifying dewatering contractors for the project are therefore examined.

6. Stormwater Best Management Practices

Green Infrastructure, typically in the form of BMPs, has been emphasized by the State and Federal Agencies as a means of mitigating CSOs. This potential, as it relates to the Interceptor Project, is explored.

In general, the VE-QA/QC project will review both potentially more economical alternatives to achieve the design objective along with an eye toward technical issues/concepts that are noteworthy. An emphasis is placed on (1) Functionality Benefits, (2) Constructability, (3) Aesthetics, (4) Ease of Operations, (5) Construction Techniques, and (6) Environmental Benefits.

VE Team Members

Al Stong	Team Leader
Brian Desharnais	Senior Civil Engineer
Roger Kottlowski	Senior Civil Engineer
Dennis Dunham	Senior Civil Engineer
Phil Wood	Senior Civil Engineer
Rachel Katchmar	Junior Civil Engineer
Toby Church	Electrical / Instrumentation and Control Engineer
Brady Dryer	Regulatory Specialist
Eric Thomas	Construction Specialist
Sherri Bell	Construction Specialist

The VE-QA/QC provided is intended to assist in fostering a basis of discussion between the VE-QA/QC Team and the Owner's Design Team.

Overview of VE Recommendations

	VE Items	Concern Categories													
		Access	Operation & Maintenance	Pipe Types	Hydraulic Modeling	Alternative Installation Methods	Odor/ Corrosion Control	Intermediate Structures	Dewatering	Rectangular Sections	Stormwater BMPs	General Design	Constructability	Cost Savings	Risk Management
1	"General Constructability Commentary" – VE No. 1								X			X	X	X	X
2	"General Design Related Comments" – VE No. 2										X	X	X	X	
3	"Bedrock Tunnel Option" – VE No. 3		X	X	X	X	X	X	X	X		X	X		X
4	"Centralized CSO Storage" – VE No. 4	X	X	X	X	X	X	X		X		X	X	X	X
5	"Interceptor Sewer Slope and Depth" – VE No. 5	X	X	X	X	X	X	X		X		X	X	X	
6	"Wet Weather Diversions" - VE No. 6		X			X		X				X		X[1]	X
7	"Outfall Pipe Slope at Wall Street CSO Outfall" – VE No. 7					X						X	X	X	X
8	"Soils and Groundwater Issues" – VE No. 8			X		X			X			X	X	X[2]	X
9	"Flushing Toward Structures with 90 Degree Bends" – VE No. 9		X		X	X	X	X		X		X			
10	"Access to Junction Structures" – VE No. 10	X	X				X	X		X		X			
11	"Control Overflow Locations" – VE No. 11		X		X							X			X
12	"Connections at Junction Structures" – VE No. 12		X	X		X		X				X			X
13	"Connections of Rectangular Box" – VE No. 13		X	X		X				X		X			X
14	"Rectangular Junction Structures with Non-Perpendicular Connections" – VE No. 14					X				X		X			
15	"Calcareous Aggregate Design Mix/ Liner" – VE No. 15		X	X			X	X		X		X			X
16	"Dry Weather Collection Sewers" – VE No. 16			X	X	X						X			
17-1	"Odor Control -WWTP Effluent Flushing Water" – VE No. 17-1		X			X	X					X			X
17-2	"Odor Control –Flushing Water Stations" – VE No. 17-2		X			X	X					X			X
17-3	"Odor Control –Peracetic Acid" –VE No. 17-3		X				X								X
18	"Grit Collection" – VE No. 18		X				X					X			X
19	"Interceptor Sewer Materials" – VE No. 19			X		X						X	X	X	
20	"BMP's – Bioswales and Rain Gardens" – VE No. 20										X	X			

Notes:
1. Savings associated with future O&M avoidance
2. Savings associated with potential change order avoidance

Summary of Recommendations

Please note, all costs presented for the concepts in this report are preliminary and should be utilized for the basis of determining if the concept warrants additional consideration when compared to the original design components of the project.

"General Constructability Commentary" – VE No. 1

The following challenges associated with project constructability are highlighted:

1. Detailed Documentation of Pre-construction Conditions
2. Bypass Pumping of Sanitary Flows and Existing Sewer Removals during Construction
3. Dewatering Layout during Construction
4. Low Overhead Lines along the Alignment
5. Utility Poles Along the Alignment
6. Low Overhead Lights Along the Alignment
7. Effects on Businesses and Homeowners During Construction
8. Typical Cross-Section of Proposed Interceptor Wall Section – Page 39
9. Typical Cross-Section of Proposed Interceptor Chestnut Section – Page 39
10. 13' x 8' Precast Box Installation along 9th Street
11. Storage Sites for Materials
12. Tree Exposure
13. Impact to Existing Infrastructure Resulting from Heavy Equipment
14. Contractor Prequalification

"General Design Related Concerns and Comments" – VE No. 2

General design related observations are presented including:

1. Surge
2. Railroad Permit/ License
3. OSHA Powerline Clearance Requirements
4. Miscellaneous Plan Details
5. Inlets
6. Sheet Boundary Index
7. Standard Convention on Sizing Boxes
8. Level of Control Discrepancies

9. Storm Cross Connection
10. Junction Box Locations
11. Line Diameter Discrepancies

"Bedrock Tunnel Option" – VE No. 3

Consideration should be given to replacing the relatively shallow gravity storage interceptor with a deeper "bedrock tunnel" that will function like (1) a fill and draw storage facility during smaller storms and (2) a siphon during large storm events. This alternative would maintain the LTCP design intent of storage and conveyance to the TSPS. The City of Fort Wayne recently underwent a similar scenario to the one facing the City of Jeffersonville.

As the City of Fort Wayne progressed with the preliminary design of a gravity interceptor, the realities associated with difficult constructability, avoidance of environmental contamination, conflicts with existing utilities, high construction cost, dewatering due to proximity to rivers, maintenance, operation, and high disruption to the community began to be acknowledged. The resulting design included replacing the shallow gravity interceptor with a bedrock tunnel.

Tunnel type storage and conveyance systems are being increasingly installed around Indiana for many reasons including the simplification of construction issues. Construction of a bedrock tunnel would present less risk to existing infrastructure such as roads, homes, businesses, utilities, and railroads. In addition, odor concerns would be limited to locations of drop shafts with the tunnel alternative, whereby surface odor control facilities could be installed.

"Centralized CSO Storage" – VE No. 4

A single underground storage location near the TSPS could be constructed in lieu of storing all CSO flows in the interceptor. This storage system could be several parallel large diameter pipes connected such that maximum storage capacity is achieved in the area provided. This alternative would allow for a smaller diameter interceptor throughout the City. The in-line flushing structures would be eliminated and a single flushing system would be required at the storage area.

"Interceptor Sewer Slope and Depth" – VE No. 5

By storing excess flow downstream, instead of the interceptor sewers in Chestnut St. and Wall St., the interceptor sewers may be able to be raised in Chestnut St. and perhaps in Wall St. This allows for a shallower and steeper interceptor.

"Wet Weather Diversions" - VE No. 6

The connections into the storage interceptor are shown entering from a high elevation. Under these conditions, the water level in the structure may have to rise to a high level before entering the interceptor. Large volumes of flow falling from this height can cause damage to the interceptor structures over time. Alternatives discussed to mitigate these potential issues include the use of inside or outside drop pipes to provide a more controlled entry.

"Outfall Pipe Slope at Wall Street CSO Outfall" – VE No. 7

The Wall Street CSO outfall pipe is shown to be very steep and discharging below the normal water level of the Ohio River. Consideration should be given to decreasing the size or slope of this outfall pipe to minimize the risk of movement, abrasion or long-term siltation at the outfall. The current slope shown may create very high velocities depending on river stage.

"Soils and Groundwater Issues" – VE No. 8

Corresponding to the soils investigation report in the 60% Design Report, we noted elevated levels of arsenic slightly higher than the IDEM Risk Integrated System of Closure (RISC) levels for residential areas. The design should contain provisions to minimize the possibility of placing these sediments on land that will be used for food crops (ex. gardens) and eventually plant-to-human uptake.

Groundwater removal is recommended for this project along with some caution for ground settlement. Dewatering contractors and the prime contractor should be experienced in these areas and be responsible for establishing a baseline for building foundations along the route of sewer construction. This should be followed by ongoing monitoring of the adjacent properties.

"Flushing Toward Structures with 90 Degree Bends" – VE No. 9

Several flushing structures are located upstream of 90 degree bends in the interceptor. Concern arises due to flushing waves reflecting off of the perpendicular wall in the 90 degree bend. Consideration should be given to installing two 45 degree turns in place of the 90 degree turns. However, this may not be feasible in some areas, and additional measures are discussed for consideration in dissipating the potential flushing waves.

"Access to Junction Structures" – VE No. 10

Consideration should be given to providing more access points in the junction structures along the interceptor route. Large equipment will have to be less than four feet in height to get under each flushing structure unless additional, large access points are provided between structures. In addition, consideration should be given to utilizing 6-foot constant diameter precast structures for access by maintenance workers and their equipment in lieu of the 4-foot diameter tapered cones presently shown on the flushing structures.

"Control Overflow Locations" – VE No. 11

Adding level sensors and radio control to the areas prone to flooding will provide a means to mitigate and direct the CSO elsewhere.

"Connections at Junction Structures" – VE No. 12

Consideration should be given to a more robust watertight connection between the Junction Structures and the interceptor. One recommended method is to cast the junction structure around the 13' by 8' interceptor with several layers of waterstop and encapsulate the joint with concrete. Likewise, consideration should be given to upsize the junction structures along the 7' diameter sewer to allow for A-Lok watertight seals.

"Connections of Rectangular Box" – VE No. 13

Precast concrete box joints are known for not sitting tight after installed. The exterior of the joint should be provided a Mar-Mac Wrap and mortar should be applied inside the joint for adequate sealing.

"Rectangular Junction Structures with Non-Perpendicular Connections" – VE No. 14

The *60% Plans* contradict the *60% Conceptual Sketches* in this item. Consideration should be given to avoid using rectangular junction structures at non-perpendicular connections. Otherwise, the interceptors entering and leaving these structures will be difficult to make watertight and the interceptors will need to be field cut (which will likely be difficult) or else extend into the rectangular junction structures.

"Calcareous Aggregate Design Mix/ Liner" – VE No. 15

Consideration should be given to require RCP used for the storage facilities to contain the "calcareous aggregate design mix" as a minimum to inhibit the deleterious effects of long-term corrosion.

"Dry Weather Collection Sewers" – VE No. 16

The 60% Plans show new 8" diameter dry weather collection sewers to be installed throughout the project. Consideration should be given to upsize these sewers to 10" or 12" for factor of safety for conveying higher than anticipated dry weather and flows and long-term I&I.

"Odor Control – WWTP Effluent Flushing Water" – VE No. 17-1

At low flow, water in the interceptor channel could be odorous. Supplemental water flow to the trapezoidal channel during periods of low sewage flow could be provided to combat this concern. A pump station could be added at the wastewater treatment plant effluent and a portion of the effluent flow recycled to the interceptor. This would be a reliable low cost source of flushing water. Additionally, if the treated effluent contains appreciable nitrate concentrations from the WWTP treatment process (i.e. sweetwater), odorous sulfide producing conditions may be further suppressed in the storage interceptor.

"Odor Control –Flushing Water Stations" – VE No. 17-2

The design illustrates the flushing gates opening from above and the volume of water dropping into the structure to flush the interceptor. A concern with this concept is that the water will fall downwards, create turbulence, and flushing energy will be dissipated. Consideration should be given to installing flushing stations located at the invert level of the interceptor and off to the side and incorporating a means of directing the flow toward the downstream end. This approach will better direct the flushing energy downstream; creating a more effective flush.

"Odor Control –Peracetic Acid" –VE No. 17-3

To further provide odor control, regardless of the source of the flushing water, peracetic acid could be added at the FWSAs. Peracetic acid disinfects rapidly after injection and subsequently

dissipates leaving no residuals in the effluent flow. This technology could be considered for odor control and subsequent benefits of reducing impacts to the river, should overflows occur.

"Grit Collection" – VE No. 18

Grit Pits could be installed to avoid the deposition of debris and organic material along the interior surface of the interceptor. Grit pits are large circular cones that are constructed below the invert of the sewer. The slow moving water in the interceptor would pass over these areas of minimal velocity and grit and heavy materials would settle into the cone by gravity. The grit pits are then cleaned out by vactor trucks periodically.

"Interceptor Sewer Materials" – VE No. 19

An investigation of the various material types available for the Interceptor Sewer has been performed. Noted benefits, restraints, and alternatives are also presented.

"BMP's – Bioswales and Rain Gardens" – VE No. 20

The bioswales and rain gardens should be designed for a 1 to 1.5 inch rainfall with dry wells incorporated into the granular sub-soils. This will promote groundwater recharge and provide a way to collect this water if necessary. All other stormwater can be directed to storm sewers. Provisions for overflow inlets should be incorporated in these areas.