Agenda

Project Overview

Stantec Scope

- Gap Analysis
- Data Collection
- Design Refinement

Why Alternatives?

Alternatives

- Hydraulic
  - Channel Widening, Dam Removal, and Bridge Modifications
- Hydrologic
  - Diversion Expansion / Extension and Storage

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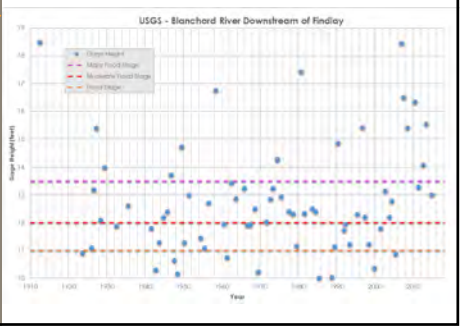
Our Challenge

Larger floods have occurred more frequently



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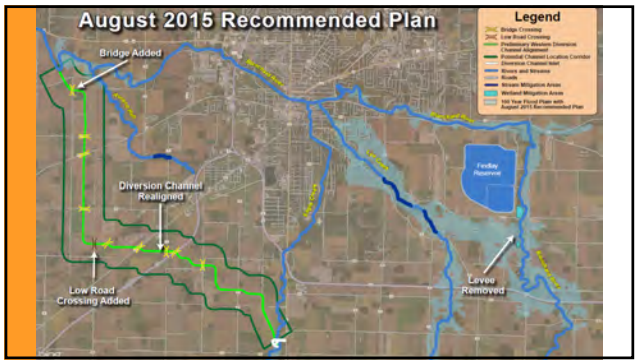

Western Diversion of Eagle Creek

25-year 3,000 cfs

50-year 3,500 cfs

100-year 4,050 cfs

500-year 5,400 cfs

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Channel Size Costs Estimate

25-Year Channel Sizing Estimates		
01	Lands & Damages	$ 6,580,000
02	Relocations	$ 14,590,000
06	Fish & Wildlife	$ 1,758,000
08	Roads, Railroads Bridges	$ 2,657,000
09	Channels and Canals	$ 34,587,000
15	Floodway Control & Diversion Structure	$ 8,708,000
18	Cultural Resource Preservation	$ 692,000
30	Planning, Engineering & Design	$ 8,182,000
31	Construction Management	$ 3,149,000
	First Costs	$ 80,903,000
	Interest during construction	$ 5,671,000
	Total Cost	**$ 86,574,000**

**About $15 million allocated for bridges and roads

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Stantec Scope

- Analyze the USACE Feasibility Report to understand their findings and recommend any changes to the Corps conclusions
- Perform field surveys and geotechnical investigations
- Determine preferred channel alignment
- *Prepare property acquisition plan and legal descriptions*
- *Prepare final design and construction plans*
- *Prepare necessary documents to secure regulatory permits*

Stantec Scope

Conceptual Design Advancement

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Phase 1 – Gap Analysis

Phase 2 – Work Plan & Proof of Concept

- Part A
  - Additional Data Collection And Analysis
- Part B
  - Refinement of Conceptual Design
- Part C
  - 30% Design Plans

4 Key Gaps

Missing Data/Analysis

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Design and Engineering

1. Unclear project objective

Cost/Economics

2. BCR less than 1.0

Hydrology & Hydraulics (H&H)

3. Risk based evaluation needed
4. Conflicting results between USACE model and report

Path Forward

Refinement of Conceptual Design

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Part B

- Assess ways to improve the initial design concept (Alternative 13)
- Benefit/Cost Analysis
  - Evaluate additional benefits to achieve a BCR greater than 1
- H&H
  - Assess variations to the recommended plan via channel alignment, dam alignment, channel sizing

Concept Design Analysis

Diversion Channel Refinement

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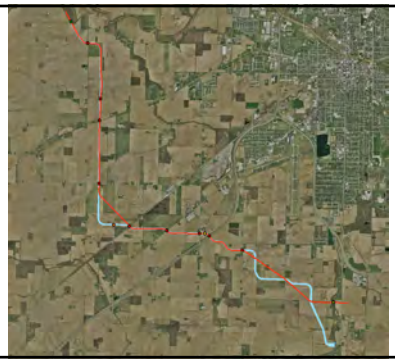
Concept Design Analysis

Diversion Channel Alignment



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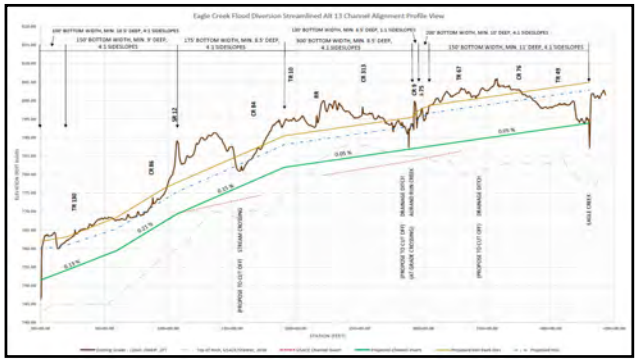

Concept Design Refinement

Eagle Creek Diversion Channel

Preliminary Recommendations

- Relocate entrance
- Reduce diversion channel length
- At-grade intersection with Aurand Run
- Refine profile
  - Reduce overall excavation & waste
  - Reduce rock excavation
- Update width for design discharge
  - 25yr -vs- 100yr capacity
- Crossing geometries
- Grading Review

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Why Alternatives?

Problems to Solve

- Conflicting Model/Reporting Results
- Residual Risk of Project
- Double-Peaked Hydrograph

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April 2015

August 2015

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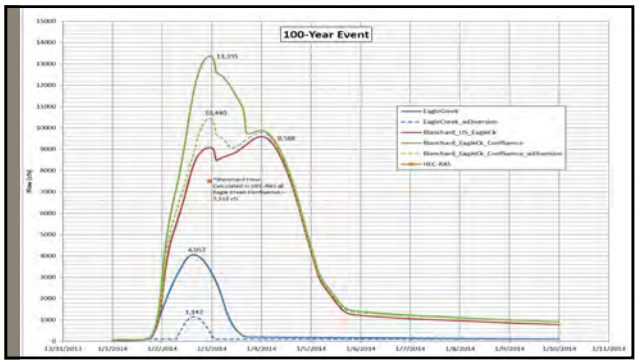

Updated Project Objective

Achieve approximately 4.5' level of reduction in Findlay to reduce flooding at Main Street and other key points

Better chance at "flood fighting"

Specific & measurable project goal

"The 4.6' drop in WSE in downtown Findlay is based on a model run where the flow optimization feature did not properly converge on an internally consistent result."

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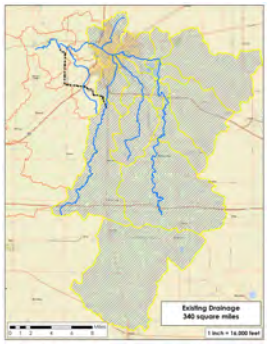
The Blanchard River Watershed



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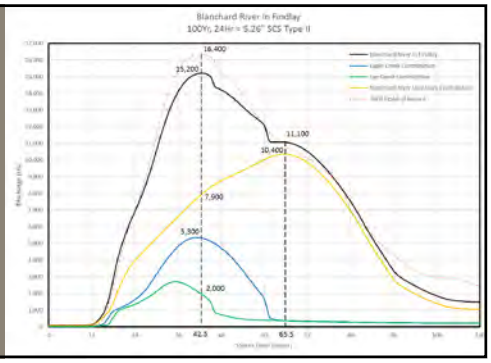
Hydrograph Comparisons
Existing Conditions

Blanchard River in Findlay



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Part A

Additional Data Collection And Analysis

Hydrology and Hydraulics (H&H)

"There would be a minimal performance of Alternative 13 when storm events are primarily over either the Blanchard River or Lye Creek watersheds upstream of Findlay, with minimal storm events over the Eagle Creek watershed."

USACE Feasibility Study

Will Eagle Creek diversion work?

- Probability of a discharge of X on Eagle Creek when the Blanchard River in Findlay experiences a discharge of Y
- Appropriately size Eagle Creek diversion for desired flood risk reduction

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Percent of Watershed Influenced

Residual Risk

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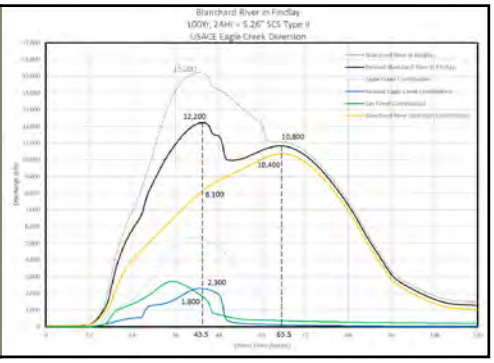
Hydrograph Comparisons

Eagle Creek Diversion

Blanchard River in Findlay



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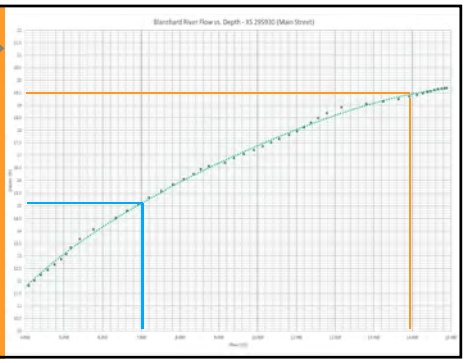
Blanchard River Rating Curve at Main Street



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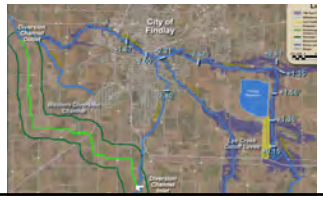
Why Alternatives?

Alternative 13 (Recommended Plan)

- **25-year event diversion channel with Eagle Creek at 100 cfs**
- Current project does not fully achieve desired reduction (2' drop in WSE @ Main St.)
- Recommended Plan receives flow from only 15% of the drainage area
- BCE < 1.0
- Project additions and/or enhancements needed to manage "double peak"



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Alternatives

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Hydraulic Improvements

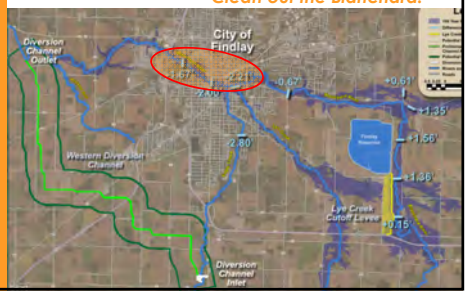
Concept Designs Reviewed

Remove Inline Riffles/Dams

Channel Widening

Bridge Modifications

"Clean out the Blanchard!"



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Floodplain Bench Widening

Hydraulic Improvements

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Hydraulic Improvements

Low Head Dams & Riffle Structures

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Facing upstream

RR Bridge

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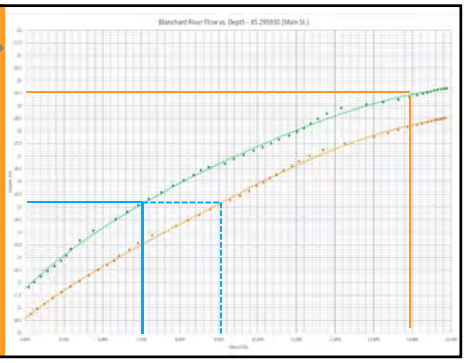
Blanchard River Rating Curve at Main Street



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Percent of Watershed Influenced

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Diversion Extension

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Diversion Extension

Eagle to Lye to Blanchard

Percent of Watershed Influenced

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Percent of Watershed Influenced

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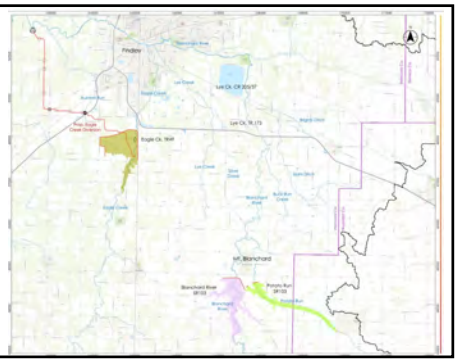
Storage



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Eagle Creek Dry Storage

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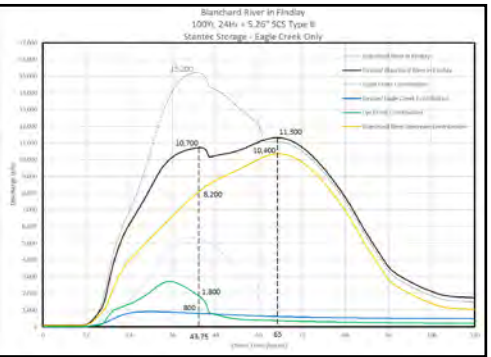
Hydrograph Comparisons

Eagle Creek Storage

Blanchard River in Findlay



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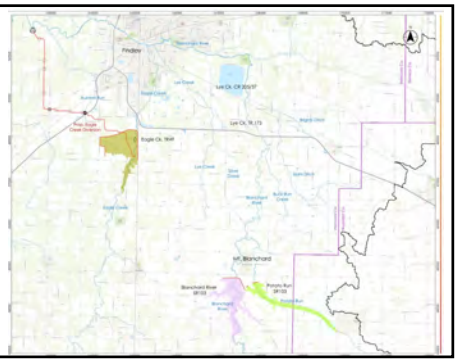
Storage



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Storage

Blanchard River & Potato Run at Mt. Blanchard

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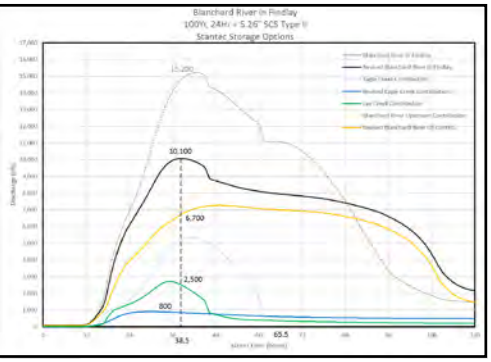
Hydrograph Comparisons

Mt. Blanchard Storage + Eagle Creek Storage

Blanchard River in Findlay



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Percent of Watershed Influenced

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Concept Designs Reviewed

Blanchard/Lye Cutoff Levee

Existing Cond. 500-Year Maximum Depth

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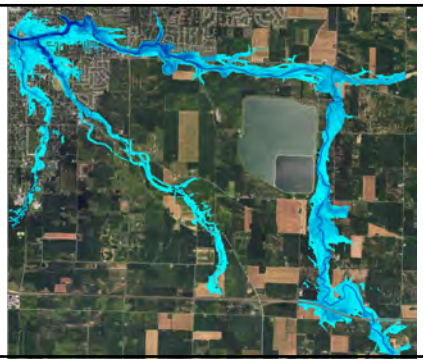
Concept Designs Reviewed

Blanchard/Lye Cutoff Levee

With Levee 500-Year Maximum Depth



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Concept Design Analysis

Cut-off Levee

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Opportunities

- Reduce flooding along Lye Creek

Challenges

- Induced flooding along Blanchard River
- Property buyouts?

Costs

- ~$8,000,000 for cutoff levee (from USACE/URS analysis)

Increase in WSE

- 0-2'

Table C1 - Blanchard River to Lye Creek Diversion Cutoff Cost Summary

Account Code	Description	Subtotal	Contingency (%)	Contingency ($)	Total
01	Lands & Damages	$3,762,500	25.0%	$ 940,625	$ 4,703,125
06	Fish & Wildlife	$ 40,500	22.3%	$ 9,011	$ 49,511
08	Roads, Railroads Bridges	$ 190,400	25.0%	$ 47,600	$ 238,000
11	Levees and Floodwalls	$1,624,200	23.7%	$ 385,585	$ 2,009,785
15	Flood Control	$ 332,400	20.0%	$ 66,414	$ 398,814
18	Cultural Resources	$ 20,000	35.9%	$ 7,182	$ 27,182
30	Eng & Design	$ 264,899	29.0%	$ 76,715	$ 341,614
31	Construction Management	$ 176,599	18.6%	$ 34,543	$ 211,142
				TOTAL FIRST COST:	$ 7,979,172

2007 Flood Hydrograph Comparisons

Mt. Blanchard Storage + Eagle Creek Storage

Blanchard River in Findlay

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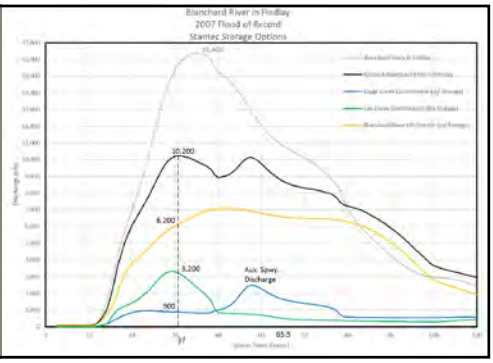

2007 Flood Hydrograph Comparisons

Eagle Creek Diversion

Blanchard River in Findlay

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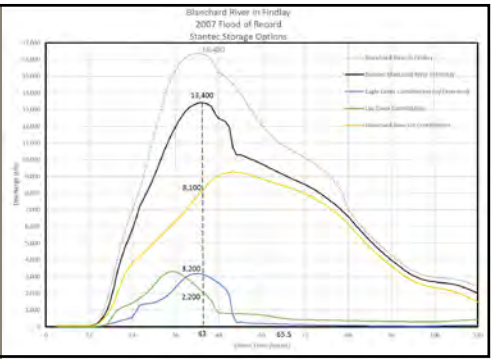

Closing

- Path Forward
- Schedule
- Questions

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1/17/2017 MWCD Presentation – Slide Notes

- **Slide 1: Cover Page**
  - Introduction from Steve Wilson – Stantec has taken over the Upper Blanchard River Watershed Study from the USACE. Stantec began project review in July 2016 and are now updating MWCD on the progress of the Proof of Concept work.
- **Slide 2: Agenda**
  - Stantec completed its preliminary work in three stages: Gap Analysis, Data Collection, and Design Refinement
    - Stantec has already filled MWCD in on the preliminary work including geotechnical, environmental and surveying during past board meetings.
    - This presentation will focus on why Stantec is analyzing alternatives and provide discussion on some of the alternatives Stantec is considering.
- **Slide 3: Our Challenge**
  - There have been several large and frequent flooding events observed at the USGS gage downstream of Findlay since 1999.
  - 1913 and 2007 flood of record events reached stages of 18.5 feet.
  - Major flood stage according to the National Weather Service is 13.5 feet.
    - The general goal is to get flooding events at or below this Major Flood stage.
- **Slide 4: USACE Recommended Plan**
  - USACE proposed a 9.2-mile diversion channel conveying the 4% annual chance exceedance (ACE) (25-year) flood event, approximately 3,000 cfs, from Eagle Creek to the Blanchard River (downstream of Findlay) when a 20% ACE event was predicted on the Blanchard River.
  - 100 cfs of flow would still be conveyed down Eagle Creek
  - Flows greater than the 4% ACE, would continue past the diversion structure on Eagle Creek and downstream into the Blanchard River through Findlay.
- **Slide 5: USACE Costs**
  - The latest cost estimate for the diversion channel from USACE was approximately $80.9 million. A large percentage of those costs ($15 million) were for roadways and bridges.
    - The bridges do not help hydrology or flood control, but are a necessary consequence of constructing the diversion channel.
- **Slide 6: Stantec Scope**
  - Stantec's scope was initially set to review the USACE report, perform preliminary field work, and determine a preferred alignment.
  - After Stantec found gaps in the USACE study during the review process, Stantec was asked to hold off on the property acquisition plan, final design and drawings, and permitting documentation until a more thorough review was completed on the USASCE Plan's effectiveness.
- **Slide 7: Stantec Scope, Phase 2**
  - A Work Plan was developed, following the Gap Analysis, for proof of concept of the USACE study.
    - Phase 2 included collecting additional data to fill in the gaps found during Phase 1 and performing design refinement with the knowledge that the project has transitioned from one predicated on Federal Regulations and Guidelines to one that is regionally focused and community driven.
- **Slide 8: Major Gaps Found**
  - Four critical gaps were found by Stantec during the data review process of Phase 1.
    - The project did not have a clearly defined and measurable goal.
    - The project has a benefit-to-cost- ratio (BCR) less than 1.0.
    - The USACE stated in its feasibility study that the USACE Plan would have minimal benefit when a storm event occurred primarily over Lye Creek and the Blanchard River and not Eagle Creek.

        - Stantec determined this risk needed to be quantified.
    - There was a reporting discrepancy in the Water Surface Elevation (WSE) benefit achieved by the USACE Plan. Some sources showed 4.6 feet of stage reduction in downtown Findlay, while other data showed 2 feet.
- **Slide 9: Path Forward**
    - Because of the gaps mentioned on Slide 8, Stantec needed to find ways to improve the USACE design concept.
    - Several benefits were identified that could help elevate the project's BCR greater than 1.0 for both National Economic Development and Regional Economic Development methodologies.
- **Slide 10: Diversion Channel Refinement**
    - Variations to the USACE Plan were considered during initial design refinement including review of the diversion channel's alignment, profile, size and inlet location.
- **Slide 11: Diversion Channel Alignment**
    - Alignment improvements are projected to reduce diversion channel length by approximately 1 to 1.5 miles.
- **Slide 12: Diversion Channel Profile**
    - Stantec generally increased the elevation of the diversion channel's bed profile to make an at-grade crossing with Aurand Run and to avoid unnecessary excavation through bedrock.
- **Slide 13: Preliminary Diversion Channel Recommendations**
    - Stantec suggests relocating the diversion channel inlet downstream on Eagle Creek to reduce channel length and allow for potential expansion of diversion channel to Lye Creek and the Blanchard River
    - Recommendations also include Increasing the diversion channel capacity to the 100-year flows and not just the 25-year flows.
- **Slide 14: Why Alternatives?**
    - Stantec reviewed alternatives as part of the design refinement process to address three issues found during the data review and data collection processes.
- **Slides 15, 16, 17: Issue 1: Conflicting Model/Reporting Results & Updated Project Objective**
    - In April 2015, the USACE reported a 2 feet reduction in the WSE during the 1% ACE. In August 2015, the USACE reported a 4.6 feet reduction in WSE.
        - The reported 4.6 feet reduction was due to a modeling output error. The project's benefit was actually closer to the 2 feet reduction originally reported.
        - The client requested the project objective such that the flood flows from a 1% ACE event (similar to the 2007 flood) would be reduced so emergency vehicles could pass over Main Street during the flood event.
            - This reduction equates to roughly a 4.5 feet decrease in WSE.
- **Slides 18, 19, 20 and 21: Issue 2: Residual Risk of the Project**
    - The watershed contributing runoff to the downtown Findlay area is approximately 350 square miles, mainly from Eagle Creek, Lye Creek, and the Blanchard River.
    - Hydrographs extracted from the Hydrologic HEC-HMS model show that the first main peak on the flow hydrograph (approximately 15,000 cfs) is comprised mainly of the peaks from Eagle Creek and Lye Creek, and the rising limb from the Blanchard River.
        - The rising limb on the Blanchard River is mostly from runoff generated from area close to downtown Findlay and east of the City near the Water Reservoir.
    - A second peak (approximately 11,000 cfs) is generated from flow on the Blanchard River almost exclusively from area of the upper Blanchard watershed near Mt. Blanchard.
    - Eagle Creek's watershed upstream of the diversion channel is about 15% of the contributing watershed.
        - Stantec recommended performing a hydrologic analysis to determine the residual risk to the community if the diversion channel is constructed because the USACE did not report multiple events or scenarios.

- **Slides 22 and 23: Issue 3: Double Peaked Hydrograph**
    - Even with the complete removal of Eagle Creek and Lye Creek, the second peak from the Blanchard River (Over 10,000 cfs) would remain and flooding would remain significant.
    - The hydrograph shows that even after removing 3,000 cfs from Eagle Creek, the first peak would still be approximately 12,000 – 13,000 cfs during the 1% ACE.
    - The rating curve shows that in order to get the 4.5 feet of WSE reduction requested by the client, flows would need to be reduced from about 15,000 cfs to about 7,000 cfs (a reduction of 8,000 cfs).
        - There is not 8,000 cfs of flow in Eagle Creek during the 1% ACE to divert down the proposed diversion channel. Therefore, to achieve the project goal, something else needs to be done in place of or in addition to the USACE Plan.
- **Slide 24: Why Alternatives?**
    - Additional projects were considered to achieve client's goal due to:
        - An undersized diversion channel in the USACE Plan
        - Minimal coverage of watershed from the USACE Plan (15%)
            - Flooding in and around Findlay due to more than just flows from Eagle Creek
        - Current BCR less than 1.0
- **Slide 25: Alternatives**
    - The following slides introduce preliminary conceptual alternatives considered by Stantec
- **Slide 26: Hydraulic Improvements**
    - Hydraulic improvement projects were considered along the Blanchard River and tributaries that could be cost effective and technically feasible to reduce the WSE.
        - These projects were considered beneficial from the risk perspective because they would have a positive benefit on WSE reduction during different rainfall distributions because the proposed hydraulic improvements would be downstream of about 95% of the watershed.
- **Slide 27: Floodplain Bench Widening**
    - Several areas were considered for widening that were identified as restrictions to flow and contained parcels mostly owned by the City of Findlay or Hancock County. The most effective location identified for widening was between Broad Avenue and the Norfolk Southern Railroad Bridge. A floodplain bench would be constructed above the bankfull elevation.
- **Slide 28: Low Head Dams and Riffle Structure Removals**
    - Four inline structures were identified through Findlay that could produce a moderate WSE reduction.
        - The inline structure at Riverside Park is not included as one of the four structures Stantec is recommending for removal.
- **Slide 29 and 30: Railroad Bridge**
    - The Norfolk Southern Railroad Bridge was identified as a flow constriction that increases the WSE upstream of the bridge during high flow conditions.
    - Stantec recommends modifying the bridge structure to increase flow capacity through the bridge by increasing the span of the existing railroad bridge and potentially raising the deck by about 1 foot.
- **Slide 31 and 32: Rating Curve Update**
    - Instead of needing to reduce flow to 7,000 cfs in the Blanchard River to achieve the stated project objective, flow would need to be reduced to approximately 9,000 cfs (a reduction of about 6,000 cfs) to achieve the same WSE with the hydraulic improvements along the Blanchard River.
- **Slide 33, 34, 35, 36: Diversion Channel Extension**
    - Since additional flow is needed to be diverted in addition to the flow from Eagle Creek (to meet the client's project objective), extensions to Lye Creek and the Blanchard River were reviewed for technical feasibility, cost effectiveness, and expected impacts.
        - Options were reviewed at a conceptual level for both extension to Lye Creek alone and also a longer extension to the Blanchard River

- Draft concepts show that the land between Eagle Creek and the Blanchard River has a minimal change in elevation. The slope of the diversion channel extension would be small, but would likely be technically feasible.
- While technically feasible, a large number of impacts to land, roads and bridges would exists since the required diversion channel widths would be up to 1,200 feet to convey the necessary flow.
    - This alternative is likely cost prohibitive
    - The risk of flooding would be reduced by creating projects that would control both the Lye Creek and Upper Blanchard River watersheds

- **Slide 37: Storage**
    - 8-9 regional dry storage basins were reviewed at several locations based on topography (storage capacity) and expected impacts and benefits. The three storage basins shown were identified as providing enough storage capacity to warrant further analysis
        - The basins would remain dry with the exception of times during large, infrequent storm events.
        - The basins would likely drain within a couple of days
        - The basins would function similar to dams observed within the Miami Conservancy District outside of Dayton, Ohio
            - These basins have row crops upstream of the structures
- **Slide 38 and 39: Storage on Eagle Creek**
    - Storage on Eagle Creek would occur in a similar location as the USACE Plan diversion channel.
    - The storage option would be in lieu of the diversion channel option.
    - An approximately 4-mile storage berm would impound water over 1,000 acres during the 1% ACE.
        - The concept was reviewed to send 500 cfs down Aurand Run and 500 cfs down Eagle Creek.
        - The concept is expected to produce comparable results to a diversion channel on Eagle Creek sized for the 1% ACE, and likely have a lower cost.
- **Slides 40, 41, 42, and 43: Storage on Blanchard River and Potato Run**
    - Two dry storage basins were reviewed south of Mt. Blanchard.
    - Impacts on Potato Run would be limited to land. A couple of impacts to structures would occur with Storage on the Blanchard River
    - Flow in Findlay is expected to be reduced to a peak of approximately 10,000 cfs for a limited duration with a combination of storage at Eagle Creek and on the Blanchard River.
    - The projects would provide benefit and retain water from more than half of the Findlay watershed's drainage area.
- **Slides 44, 45 and 46: Cutoff Levee**
    - With the storage options on the Blanchard River, the cutoff levee could be back on the table as an option without the adverse impacts of induced flooding when simulated as a stand-alone project.
    - Preliminary Costs as proposed by the USACE were approximately $8 million.
- **Slides 47 and 48: 2007 Flood results**
    - Results out of preliminary HEC-HMS models simulating the 2007 flood event with the USACE Plan and with the combination of three storage basins on Eagle Creek, Blanchard River and Potato Run are shown in the flow hydrographs.
- **Slide 49: Closing**
    - Report will be issued to the MWCD as a draft document at the end of January.
        - MWCD will review and provide comment followed by a rollout to the public in preparation for the April MWCD meeting.