MULTI-PURPOSE DRAINAGE WATER MANAGEMENT – A PERSPECTIVE ON IMPLEMENTATION
MPDWM - 4 Strategies or 1?

1.0 Drainage
- Ditch improvements
- Add new systems

2.0 Protection
- Diking on field side
- Part of drainage

3.0 Diversion
- Re-route high flows from damage center

4.0 Retention
- Creating storage to reduce downstream peak flows
What is MPDWM? What Else??

- Traditionally – drainage and associated components

Table 1. Expected Peak Flow Reduction Effects on the Red River Main Stem of FDR Measures Applied in Early, Middle, and Late Areas Upstream

<table>
<thead>
<tr>
<th>Flood Damage Reduction Measure</th>
<th>Early* Upstream Area</th>
<th>Middle* Upstream Area</th>
<th>Late* Upstream Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Reduce Flood Volume</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>a) Wetlands</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>b) Cropland BMPs</td>
<td>++</td>
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<tr>
<td>c) Conversion to grassland</td>
<td>++</td>
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<tr>
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<td>++</td>
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</tr>
<tr>
<td>e) Other beneficial uses of stored water</td>
<td>++</td>
<td>++</td>
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</tr>
<tr>
<td>2) Increase Conveyance Capacity</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>a) Channelization</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>b) Drainage</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>c) Diversion</td>
<td>++</td>
<td>Variable</td>
<td>+</td>
</tr>
<tr>
<td>d) Setting back existing levees (to increase conveyance capacity)</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>e) Increasing bridge capacity</td>
<td>++</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3) Increase Temporary Flood Storage</td>
<td>Variable</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>a) Gated impoundments</td>
<td>++</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>b) Ungated impoundments</td>
<td>-</td>
<td>+</td>
<td>+</td>
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<tr>
<td>c) Restored or created wetlands</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>d) Drainage</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>e) Culvert sizing</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>f) Setting back existing levees (to increase floodplain storage)</td>
<td>++</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>g) Overtopping levees</td>
<td>++</td>
<td>+</td>
<td>Variable</td>
</tr>
<tr>
<td>4) Protection/Avoidance</td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>a) Urban levees</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>b) Farmland levees</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c) Agricultural levees</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>d) Evacuation of the floodplain</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>e) Floodproofing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>f) Warning and emergency response</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* Location of FDR measure relative to the Red River main stem at the international border.
Retention

- Reduce peak flows
- Publically funded
- Land can be retained in private ownership
Figure 24. Early, Middle, and Late Runoff Timing Zones in the Red River Basin
Timing of Subwatersheds

Figure 1: Hydrologic Impact Zones
Roseau River, MN/MB

Notes:
The HEC-HMS model from the Red River HMS Phase 2 project and snow melt progression was modeled under existing conditions. Each subbasin in the watershed was removed from the analysis to determine the sensitivity of storage in the subbasin to watershed outlet peak flow.

November 25, 2013

HDR
SIDE WATER INLETS
BUFFER STRIPS
SINUOSITY
2-STAGE CHANNEL
BERMS
CHANNEL SEEDING
Uniform Surface Drainage Design Guidance

Adequacy and Equitable Policy

- RRB Landowners have a right to adequate, but not more than adequate, drainage.

- Equal distribution of positive and negative effects of drainage throughout the system.
Current Condition
(traditional ditch design)

- Water is conveyed downstream unrestricted until it reaches a point where inflows exceed outflow capacity and flood occurs
- Long duration of concentrated flooding >48 hours
Uniform Surface Drainage Design Guidance

- Water is delayed by culvert sizing – storage
- Flood duration = 24 hours (storage)
- Storage Distributed throughout the drainage area
Multi Purpose - TYPICAL SECTION
Chapter 103E
Public Drainage Authorities

- **Counties** (approximately 80 of 87 currently administer Chapter 103E drainage systems)

- **Joint County Drainage Authorities**
  (for drainage systems in more than one county)
  (5 members, at least 1 from each county board)

- **Watershed Districts** (21 of 46 currently administer Chapter 103E drainage systems)
Most Drainage Proceedings Initiated by Petition

- **Establishment** – signed by > 50% of owners, or owners of at least 60% of area drainage system passes over
- **Improvement or Lateral** – signed by at least 26% of the owners, or the owners of 26% of the property, the improvement passes over
- **Improvement of Outlet** – signed by board of an affected county, 26% of owners of overflowed property, or owners of 26% of the overflowed property
- **Impoundment** – petition by a person, public or municipal corporation, state or federal government agency
- **Repairs** – petition by affected individual or entity
Overview

The Minnesota Public Drainage Manual (MPDM) is used by a variety of practitioners as a practical guide for navigating Minnesota’s public drainage process. The manual was first published in 1997 and has not been updated since its original publication in a three-ring binder. Since this time, there have been changes to the governing statutes, political decisions, and advances in technology that must be incorporated into the original guide.

In 2014, the Minnesota Board of Water and Soil Resources (BWRS) began the process to update the MPDM. BWRS oversaw an advisory team of diverse stakeholders and the consulting team of Houston Engineering, Inc. (HEI) and Rink-Niswander Law Firm to author technical information and facilitate stakeholder meetings.

The project involved a series of stakeholder meetings, which involved discussions to obtain input from a variety of users to create the best possible end-product. This process helps ensure that the revised document will better serve all of those who use it daily to complete their jobs. In addition to updating the existing chapters, a new chapter Chapter 5: Best Management Practices provides users with a practical way to identify and consider applicable BMPs by system and specific drainage processing.

Another important project component involved presenting the information in a modern, technologically advanced format that is easy to read and access. BWRS identified the best format for the web-based publication to be an online Medialink site that is easy to access and navigate, particularly from the field where many may need to use it.

Guidance on Use

This website was developed using Medialink, a wiki application that allows for easy editing and that has powerful search abilities. If you are new to this format, follow the links below to find more information that will help answer common questions when using the online Minnesota Public Drainage Manual:

- Why a web-based format?
- Why a wiki?
- How do I navigate the site?
- How do I search?
- Can I provide feedback on the new site?

Acknowledgements

This Minnesota Public Drainage Manual, first updated and republished in Wiki in October, 2016, is the collective effort of the Board of Water and Soil Resources and its contractor, a team composed of staff from Houston Engineering, Inc. (HEI) and Rink Niswander Attorneys at Law, and Project Advisory Committee (PAC).

The Project Advisory Committee represents a broad cross section of public and private sector interests in public drainage systems in Minnesota. The PAC has had three key tasks:

1. Help shape the outline of Chapters 2, 3, 4 and new Chapter 5.
2. Review and comment on the content of the Chapters 2, 3, 4 and 5, through the subcommittees. As the full PAC, review and comment on all of the draft chapters for content and consistency.
3. Beta test the manual in the field.

A special thank you is extended to the Project Advisory Committee members for their time and input!

Click here to see a full list of MPDM Project Advisory Committee Members.

Future Maintenance and Content Updating Process

The process for managing the MPDM content in the future was a topic of interest to PAC members from early in the MPDM update project. The MPDM Maintenance Plan was adopted by the BWRS Board at its December 2016 meeting.

Click here to see the MPDM Maintenance Plan.

Disclaimer

This publication was funded by an appropriation of the Minnesota Legislature. The organizations represented on the Advisory Committee donated staff time to this effort. The substance and findings of this publication are dedicated to the public. The content of this document does not necessarily reflect the views of the State of Minnesota or the Board of Water and Soil Resources.
<table>
<thead>
<tr>
<th>Process</th>
<th>Ditch No.</th>
<th>Commissioner’s District</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td>Petition and bond received from landowners for improvement 103E.202 – 103E.235</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td>Petition and bond fwd’d to County Attorney for review (The county attorney must review the petition and bond within 30 days after it is filed) 103E.238</td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td>Petition and bond returned to Land Records, if adequate; if inadequate, it is returned to petitioners by the County Attorney with a description of the deficiencies 103E.238</td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td>Schedule the board appearance w/Bob to present petition to Board. (The auditor shall present the petition to the board at its next meeting) 103E.215</td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td>Notify County Commissioner of the petition and the upcoming discussion</td>
</tr>
<tr>
<td>6.</td>
<td></td>
<td>Board appoints engineer (within 30 days after receiving the petition) 103E.241</td>
</tr>
<tr>
<td>7.</td>
<td></td>
<td>Bond and Oath received from the engineer. 103E.241</td>
</tr>
<tr>
<td>8.</td>
<td></td>
<td>Following survey of the proposed drainage project, engineer files preliminary report w/Land Records and copies the DNR 103E.251</td>
</tr>
<tr>
<td>9.</td>
<td></td>
<td>Schedule preliminary hearing no more than 30 days after the date of the order (include enough time for mailings—to be mailed at least 10 days before the hearing) 103E.261</td>
</tr>
<tr>
<td>10.</td>
<td></td>
<td>Mail notice of preliminary hearing to landowners affected by the drainage project (including property owners, political subdivision, etc.) 103E.261</td>
</tr>
<tr>
<td><strong>If it includes a repair, mail to all within the ditch system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td></td>
<td>Although not a statutory requirement, notice of preliminary hearing may be published and/or posted; consult County Commissioner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Newspaper(s) Dates published</td>
</tr>
<tr>
<td>12.</td>
<td></td>
<td>Ensure the preliminary DNR report has been received; if it hasn’t follow up with the local DNR office</td>
</tr>
<tr>
<td>13.</td>
<td></td>
<td>Prepare preliminary hearing agenda</td>
</tr>
<tr>
<td>14.</td>
<td></td>
<td>Attend preliminary hearing</td>
</tr>
</tbody>
</table>
Pursuant to Minn. Stat. § 103E.212, Petitioners seek the creation of <Name of New Drainage System>. For their Petition, the undersigned Petitioners state and allege the following:

1. Petitioners seek the creation of <Name of Drainage System> located in <Township(s)/County(ies)>.

2. The following is a description of a starting point, general course, and terminus of the proposed drainage system:

   **Main**

   Commencing at a point in the <Quarter Quarter>, Section <#>, Township <#>, Range <#>, <Township Name>, <County>, <State>; thence <general description of the course of the proposed drainage system>; terminating at a point located in the <Quarter Quarter>, Section <#>, Township <#>, Range <#>, <Township Name>, <County>, <State>.

   **Laterals**

   Commencing at a point in the <Quarter Quarter>, Section <#>, Township <#>, Range <#>, <Township Name>, <County>, <State>; thence <general description of the course of the proposed drainage system>; terminating at a point located in the <Quarter Quarter>, Section <#>, Township <#>, Range <#>, <Township Name>, <County>, <State>.

3. The 40-acre tracts or government lots and property where the proposed drainage system passes over, including the names and addresses of the property owners from the records in the county assessor’s office is as follows:
Bond

Western Surety Company

DITCH BOND

Effective Date: October 24, 2017

STATE OF MINNESOTA } COUNTY OF Pennington {

IN RE: COUNTY DITCH } COUNTY \\
\hspace{1cm} or (complete only one) \\
\hspace{1cm} DITCH Red Lake } WATERSHED DISTRICT \\

KNOW ALL PERSONS BY THESE PRESENTS:

That we, Minnesota, as Principal(s), and WESTERN SURETY COMPANY, a corporation authorized to do surety business in the State of Minnesota, as Surety, are held and firmly bound unto County, Minnesota, or (complete only one)

Red Lake Watershed District, in the penal sum of Forty Thousand and 00/100 DOLLARS ($40,000.00), for the payment of which well and truly to be made, we bind ourselves and our legal representatives, firmly by these presents.

THE CONDITION of the above obligation is such that WHEREAS, a petition is filed with the County Auditor of County, Minnesota, or (complete only one)

Red Lake Watershed District, for:

NOW, THEREFORE, if the said Principal(s) pay all costs and expenses which may be incurred in the case proceedings are dismissed or for any reason no contract is entered into for the construction of the improvement petitioned for, then this obligation to be void; otherwise to remain in full force and effect. In no event shall the total liability of the Surety for all claims exceed the amount of this bond.

Dated this 24th day of October, 2017.

[Signatures]

Principal

Principal

Principal

WESTERN SURETY COMPANY, Surety

By [Signature] Paul T. Nugent, Vice President
### Template A: Viewer's Report

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<thead>
<tr>
<th>Parcel ID No.</th>
<th>Name</th>
<th>Address</th>
<th>NE SE</th>
<th>R W</th>
<th>Tract</th>
<th>Potential Gross</th>
<th>Proximity Benefit</th>
<th>Benefit Rate</th>
<th>Benefit Cost</th>
<th>Acres Value</th>
<th>Benefit Acres</th>
<th>Benefit Value</th>
<th>Benefit Acres Value</th>
<th>Benefit Acres Value</th>
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<td>1</td>
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### Maintenance Costs

<table>
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<th>Year &amp; Drainage Project</th>
<th>Maintenance Cost</th>
<th>40%</th>
<th>50%</th>
<th>70%</th>
<th>80%</th>
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</thead>
<tbody>
<tr>
<td>2003</td>
<td>10000.00</td>
<td>40%</td>
<td>50%</td>
<td>70%</td>
<td>80%</td>
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</tbody>
</table>

- **$1,688.00**
- **$1,610.00**
- **$1,638.00**
- **$2,278.00**
- **$640.00**
ESTABLISHMENT OF RLWD DITCH #15
DETAILED SURVEY REPORT

RLWD Project No. 175
HDR Project No. 186028
A Case Study - Purpose of and Need for Action

The purpose of the proposed action is **Flood Damage Reduction**: Reduce damages to agricultural lands for a 10 year 24 hour storm (total 3.3 inches of rainfall) and reduce damages to roadways for a 25 year 24 hour storm event (total 3.9 inches of rainfall) in the Whitney Lake Watershed.

The need for the proposed action is:

- Roseau River levels cause flood damage to agricultural properties during frequent runoff events (i.e. a 2-year, 24-hour event or 2.1 inches of rainfall). The Roseau River will frequently backup into area drainage ditches as much as two miles or more causing backwater effects in the drainage systems.

- The ditch systems in the Whitney Lake Watershed contain many culvert crossings, which have a lower capacity than a 2-year, 24-hour precipitation event. Additionally, the channels are undersized and not able to contain or convey the existing 2-year, 24-hour event in many places because the natural ground slope is too low to prevent flows from overtopping banks and flowing into adjacent lands. These adjacent lands become inundated for up to ten or more days, which is long enough to destroy crops that have been planted or delay access to the land for planting and harvesting.

- In Roseau County approximately 50% of landuse is farmland and an average of over 136 million dollars of crops are sold annually (USDA 2012 Census of Agriculture). Within the Whitney Lake watershed, 78% of landuse is cropland. Review of crop information and insurance records of four landowners in the Whitney Lake watershed over the past 10 years show a decrease in yields of up to 100% during wet years (precipitation data shows that 8 out of the past 10 years were wet years).

- The Roseau County Highway department confirmed that during heavy rainfall events water overtops at County Road 115 and 270th Ave. Overtopping occurs approximately once every two years and requires frequent maintenance. While costs for minor road repairs due to flooding are not well documented, repair costs of major flooding sites are documented and over the past 15 years have resulted in over $340,000 in damages.

Secondary benefits from the project may include:

- Temporary flood detention during high runoff events;
- Contribution to a regional goal of reducing peak flow along the Red River by 20 percent during flooding events;
- Reduction of erosion to improve water quality and for the benefit of wildlife and fish.
Existing Conditions
Need for Whitney Lake SubWatershed Project:

- Flood damages to agricultural properties during frequent runoff events (i.e., a 2-year, 24-hour event or 2.1 inches of rainfall).
- The Roseau River frequently backs up into area drainage ditches by 2 miles or more, causing backwater effects in the drainage systems.
NEED FOR WHITNEY LAKE SUBWATERSHED PROJECT:

- The ditch systems in the watershed contain culverts that have a lower capacity than a 2-year, 24-hour precipitation event.
- Existing channels are undersized and not able to contain or convey the existing 2-year, 24-hour event.
NEED FOR WHITNEY LAKE SUBWATERSHED PROJECT:

- Ag land becomes inundated for 10 days or more, which is long enough to destroy crops that have been planted or delay access to the land for planting and harvesting.
Project purpose

- **Flood Damage Reduction**
  - Reduce damages to agricultural lands for a 10-year, 24-hour storm (total 3.3 inches of rainfall)
  - Reduce damages to roadways for a 25-year, 24-hour storm (total 3.9 inches of rainfall)
Design Goals

- Reduce the time of inundation for a 10-year event to < 24 hours
  - Crop loss occurs after inundation of 24 – 48 hours
- 6” reduction in water surface elevation
  - Drainage would be much better if water levels were 6” lower
WHITNEY LAKE SUBWATERSHED
Retention A & C
Flooded Acres During 10-Year Rainfall

LEGEND
- State Highway
- County Road
- Reservoir Lake
- Flooded Acreage [0 to 272]
- Existing
  - Farmland
  - Open Channel
  - Roads
  - Trees, undeveloped
- Post-project
  - Farmland
  - Open Channel
  - Roads
  - Trees, undeveloped

Retrospective Watershed Area: 150 acres
Retention Area A: 15 acres
Retention Area C: 15 acres

Developed Acres: 272 acres
Undeveloped Acres: 1,228 acres
Reservoir Area: 2,000 acres

Hazen-Williams Method
0.05% 200-year storm event
Peak Flow Rate: 75 cfs
MPDWM & Retention!!!

MPDWM!!
# Cost Estimate Summary

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Approximate Cost</th>
</tr>
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<tbody>
<tr>
<td>Retention A, Diversion 3</td>
<td>5.8 million</td>
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<tr>
<td>Legal Ditch Improvements</td>
<td>Up to $100,000 per mile</td>
</tr>
<tr>
<td>Retention C</td>
<td>1.5 million</td>
</tr>
<tr>
<td>New Ditch CR115</td>
<td>1 million</td>
</tr>
</tbody>
</table>
Construction

That's the fun part!!
Design Elements and Benefits to Consider

- Environmental Permitting
- Outlet Capacity and Adequacy
- Impacts to Neighbors
- Return on Investment
- Opportunity to Address other Issues? Retention, Diversion, Protection?
- Adequate and Equitable – Use Modern Design
- Natural Resource Enhancements – Water Quality Designs
  - SWI
  - Buffer
  - 2-Stage Ditch
  - Sinuosity
  - Berms
  - Seeding

Uniform Surface Drainage Design Guidance

- Water is delayed by culvert sizing – storage
- Flood duration = 24 hours (storage)
- Storage distributed throughout the drainage area
Big Picture Considerations

- Importance of having a responsive Watershed board
- TP 11 FDR strategies
- Early Coordination

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<tr>
<td>3) Increase Temporary Flood Storage</td>
<td>Variable</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>a) Gated impoundments</td>
<td>+</td>
<td>++</td>
<td>++</td>
</tr>
<tr>
<td>b) Ungated impoundments</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>c) Restored or created wetlands</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>d) Drainage</td>
<td>-</td>
<td>+</td>
<td>++</td>
</tr>
<tr>
<td>e) Culvert sizing</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>f) Setting back existing levees (to increase floodplain storage)</td>
<td>+</td>
<td>++</td>
<td>+</td>
</tr>
<tr>
<td>g) Overtopping levees</td>
<td>++</td>
<td>+</td>
<td>Variable</td>
</tr>
<tr>
<td>4) Protection/Avoidance</td>
<td>Variable</td>
<td>Variable</td>
<td>Variable</td>
</tr>
<tr>
<td>a) Urban levees</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>b) Farmstead levees</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c) Agricultural levees</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>d) Evacuation of the floodplain</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>e) Floodproofing</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>f) Warning and emergency response</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

* Location of FDR measure relative to the Red River main stem at the international border.
Challenges and Opportunities

• Public and Landowner Acceptance
• Permitting
• Funding Partnerships
• Design Goals
• Climate Variation
• Project Fatigue
Leads to Viable Projects

• With knowledge of both flood damage reduction, natural resource enhancement and water quality goals, MPDWM offers a broad range of possible solutions for your drainage, flood damage reduction, and water quality needs.
MULTI-PURPOSE DRAINAGE WATER MANAGEMENT – THANK YOU!!!