

MS4 Workshops – Pollutant Reduction and TMDL Stormwater Plans

Fall 2016

Tom Wolf, Governor

John Quigley, Acting Secretary

#### Training Goals

Describe BMP pollutant load removal calculations using:

- 1. Effectiveness Values Table
- 2. Performance Standards



## Why is this Important?

Calculations for pollutant load reduction occurs in two stages of the process:

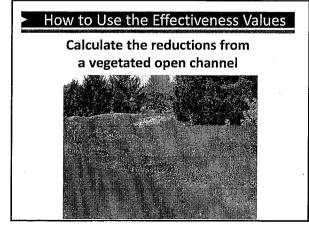
- 1. Reductions from existing BMPs (optional)
- 2. Reductions from proposed BMPs to meet the target load reduction



| N //  | -1   | THEE. |      | La La Caracter Co. | 1 |      |
|-------|------|-------|------|--------------------|---|------|
| Metho | as - | нте   | πvei | ness V             | а | lues |

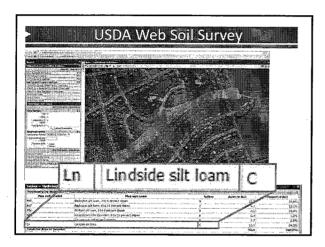
- 1. DEP's BMP Effectiveness Values document (3800-PM-BCW0100m)
- 2. Chesapeake Bay Program Expert Panel Reports
- 3. For BMPs not listed in either of the above, MS4s may use effectiveness values from other technical resources; such resources must be documented in the PRP.

|   |           |              |                       | ffectiveness Values  |
|---|-----------|--------------|-----------------------|--|
| 12 MP tiarre                                    | DMP<br>TN | Effectivener | s Values<br>Sactional | BILP Description   |
| nkýman Frances w<br>Swa, Veg.                   | B5%       | 85%          | 92%                   | A begronson to from an inforcem town velore yearhein is bugget and water bibliotics they led. The undersome have anyoned with inforcement in the properties of the production  |
| Filting Practicus                               | 40%       | 60%          | 10%                   | Province that curries and temporary time most fliend gives a flooring faith of one of pairs and on it may be created for eights of each of the pairs and on it may be created for design faith of the pairs of the pa |
| Filey Strip Ruind Rysladian                     | 20%       | şışı         | 59%                   | Under that single are stated users with regulated cover on that or pently stepping thank (family enforcing the filter state most be in the first of shared tower thanks of the state of the |
| Film Step Steinwater<br>Triangect               | De?       | 0%           | 22%                   | Urban filter scops are stable areas with regeletter raves on first or persky sloping<br>lents! Remoth externing the fave step must be in the form of sheet for and must<br>extend as now recome case letted site species and consistent. A 62 design state of<br>filter step design to importance flow length is recommended for accommended<br>filter step design to importance flow length in recommendation flow accommended.   |
| Barrienten - Baingauten<br>(CD seis w'unnerswo) | 25%       | +5%          | 58%                   | An ordered political feet with expension (or medical period), appoint, multiply, and respectation. These are distributed an administration of the period are made in the process of the period are of the period period are of the period |



|  | e de la companya della companya della companya de la companya della companya dell |         | - 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 | -11 - 32 - 1                          |           |
|--|--|---------|---|---------------------------------------|-----------|
|  |  |         | ئىرىق .<br>ئالىمىدى بىرى                | antier<br>Late Language               |           |
| ,  | -  | ···     | - 1                                     |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  | oitt is | i                                       |                                       |           |
| V 1 1  |  |         |   |                                       |           |
| proporting course, should be an increase and a decidant of the | Managarah (Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn Kabupatèn   |         | Participation to the court of Service   | shifted materials are a strong of the |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       | :         |
|  |  |         |   | Descrii                               |           |
|  |  |         |   | calculu                               |           |
|  |  |         |   | 77.1                                  |           |
|  |  |         |   |                                       |           |
|  | ·  |         | <del></del>                             |                                       |           |
|  | _  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
| o was a complete a configuration                               |  |         | and the second of the                   | or a surface                          | r enterna |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |
|  |  |         |   |                                       |           |

| - How   | / to           | Use    | the         | Effective  | ness Values   |
|---|----------------|--------|-------------|--|---|
|   |                |        |             | val values fonding on the  | or a vegetated<br>e soil type   |
| <ul> <li>Hydrol</li> </ul>                              | ogic :         | soil { | group       | must be de   | etermined   |
| Micros Acceptation (1911)<br>THE STREET COMES TO USE    |                |        |             |  |   |
| BMP Name  | Bundi<br>Juliu |        | etated :    | Open Channels  | SMP Cascription   |
| Bis (steppion) (California)<br>(4/8 sold Wo underdrain) | 183%,          |        | (C/I        | D <sup>*</sup> Soils)  | Ingresend modia, topsail, much, and vegetaxon,<br>done thefrow basins in which the storm water rangiff<br>moded by fineing through the bad components,<br>amical wastign within the sold graphs and around<br>its BMP may no unperfusion and in A or & mod. |
| Vegested Open Channels<br>(C/D Solls)                   | 10%            | Veg    |             | Open Channels<br>B Soils)  | Company language until and provide treatment under branching. Runoff passes through either job motive, and in Car Dead.   |
| Vegelated Open Channels<br>(4/8 SN)                     | and the same   | 1,55   | ,62<br>(C), | ,  | From revision myster needs and provide treatment skilder bippystes. Runoff passes through extended back matrix, and/or is individed into the funderlying state and is in A or B sed.  |
| Sieswale.   | :70%-          | 79%    | 80%         | Puth a biggestie the load is ned<br>thinks is now treatment throug<br>translention area. | curadhecause, units other open channel designs.<br>In the soil. A biosingle is designed to function as a  |



| - How  | / to                                    | Use       | e the                                 | Effectiveness Values   |
|--|---|-----------|---------------------------------------|--|
| Now we   | knov                                    |           |                                       | oils the effectiveness value<br>ment is 50%  |
|  |   |           |                                       |  |
| BMP Name   | *************************************** | Hactivene | · · · · · · · · · · · · · · · · · · · | SMP Description  |
| BIAP Name  Biaretenien / Painzauden . (A.B. sols w/J underdisen)           | 8MP (                                   | TP<br>S5% | Sediment<br>Sediment<br>90%           | An excausing a bookflood with engineered media, top soil, much, and vegetable. These are pointing stead invalidating steadow bookers within the starm water raine is temporary panel and then treated by filtering timing the bed component and though whoologist and observables required and the first production after the soil prefer and approximate the start of the start  |
| Bioretestion / Palingauden<br>(A'B soils w/J underdisen)                   | TN                                      | TP        | Sediment                              | In a scenariot got to conflide the the engineered model, to pace, mulcit, and septiation. These are penting streat insulations shadow destinant which the stem water stands to the stands of the stand |
| Bigretenion / Baingauden (A/B sons w/) underdram)  Vegesalad Open Channels | TN<br>.80%                              | TP<br>85% | Sediment<br>90%                       | The scenarios of boarding's the engineered model, toppod, mulcit, and vegetabor. These or sporting processing size in state years any which the stem water nice is functionary processing or state of the state of th |

### How to Use the Effectiveness Values

We now need to determine what is draining to and being treated by the proposed BMP

- 1. Analysis yields that 27 acres is being treated by the vegetated open channel
- 2. The 27 acres is composed of
  - 9 impervious-acres
    - 18 pervious acres



#### How to Use the Effectiveness Values

- Please recall that the existing loading values are located in Attachment B of the PRP Instructions
- For our example we will use sediment loading rates for Dauphin County

Section and Section Section PAP Insulations

ATTACHMENT B

DEVELOPED LAND LOADING RATES FOR PA COUNTIES U.A.

| County  | Category              | Acres   | Ttl<br>lbs/acre/yr | TP<br>lbs/acre/yr | TSS (Sediment)<br>Ibs/acre/yr |
|---------|-----------------------|---------|--------------------|-------------------|-------------------------------|
| Dauchia | impervious cleveloped | 3,482.4 | 28.59              | 1:07              | 1,999.14                      |
| Duopini | pervious developed    | 9,405 B | 21,24              | 0.34              | 209.62                        |

| How t       |       |            |             |              | •   |        |            |
|-------------|-------|------------|-------------|--------------|---|--------|------------|
| LI (1) 11 1 |       |            | <b>^~</b> L | -++          | $\mathbf{n} \cdot \mathbf{n} \cdot \mathbf{n} \cdot \mathbf{n}$ |        | 11100      |
|             | e m s | <b>N-1</b> | -           | 2 II - 2 E I |   | 33 V A | 11 11 21 3 |

Total estimated pollutant load draining to the BMP

9 impervious acres

1,999.14 lb/ac/yr 17,992.26 lb/yr

18 pervious acres

299.62 lb/ac/yr 5,393.16 lb/yr

> 23,385.16 lb/yr

50% (0.5) sediment removal effectiveness value

23,385 lb/yr X 0.5 = 11,693 lb/yr

777.1

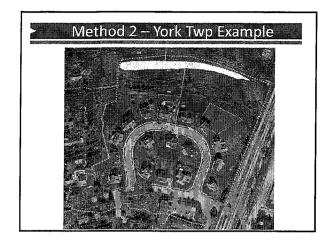
| 23,385 lb/yr into the vegetated open channel  11,693 lb/yr removed by the channel   |  |
|---|--|
| Four key expert panel reports:  1. Performance Standards 2. Urban Stormwater Retrofit Projects 3. Individual Stream Restoration Projects 4. Street and Storm Drain Cleaning Practices  BMP effectiveness values are being phased out and replaced by expert panel methodologies |  |

#### <u> Periormance Standard Curve</u>

### Advantages:

- 1. Provides a simple method to account for the type of BMP and the flow to that BMP
- 2. Approved by the Chesapeake Bay Program

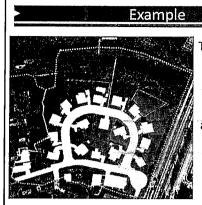
| <ul> <li>PA DEP Stormwater Man. Chapter 8</li> </ul>   | 7   |         | -<br>                                 |                          |              |                                       |  |
|--|-----|---------|---------------------------------------|--------------------------|--------------|---------------------------------------|--|
| PA Divide 2-year Volume Increase of Runoff Volume between the proposed conditions and the existing conditions (cubic feet) by 43,560 and insert into   |     |         |                                       |                          |              |                                       |  |
| Equation X   |     |         |                                       |                          |              |                                       |  |
| Equation X is a site specific conversion factor equation:  |     |         |                                       |                          |              | n'                                    | 1.5 f No. 9  |
| $=\frac{(12*EP)}{IA}$  |     | <br>. i |                                       |                          |              |                                       |  |
| Where: EP = State-Specific Engineering Parameter (in acre-feet) IA = Impervious Area (acres)   |     |         | <u>-</u>                              | ·                        |              |                                       |  |
| pennsylvania<br>arvanem or ownor-china.  |     |         |                                       | <u>73.</u> (, 74. s      |              |                                       | W  |
|  |     |         |                                       |                          |              |                                       |  |
| Performance Standard Curves  |     |         |                                       |                          |              |                                       |  |
| Curves can be used for any volume of water treated   |     |         |                                       |                          | -            |                                       | Four last  |
| If used for new development requiring an   | 1   |         |                                       |                          |              |                                       | 1. Po  |
| NPDES permit, or for existing BMPs constructed for NPDES compliance after  |     |         |                                       |                          |              |                                       | 3. lm.   |
| November of 2010, the 2-year 24-hour storm will be the runoff volume used  |     | <br>    | · · · · · · · · · · · · · · · · · · · |                          |              | ,                                     | 3.49   |
| The state of the s |     | <br>•   |                                       |                          | <del>-</del> |                                       | i i  |
|  | _!  | <br>    |                                       | <u>na nga nga nga sa</u> |              |                                       | - Control of the cont |
|  | ٦   |         |                                       |                          |              |                                       |  |
| Performance Standard Curves  |     |         |                                       |                          |              |                                       |  |
| Determine volume treated   |     |         |                                       |                          |              |                                       |  |
| 2. Calculate EP  | '   |         | ·· · · · · · · · · · · · · · · · ·    |                          |              |                                       |  |
| 3. Insert into Equation X  | .   |         |                                       |                          |              |                                       |  |
| 4. Determine if runoff reduction (RR) or stormwater treatment (ST)   | -   |         |                                       | <u> </u>                 |              | · ·                                   | 1. ·   |
| 5. Determine removal efficiency from the appropriate curve   | -   | <br>    |                                       |                          |              | · · · · · · · · · · · · · · · · · · · | 4 125  |
| 6. Apply % Removal   | ] - |         |                                       |                          |              |                                       |  |



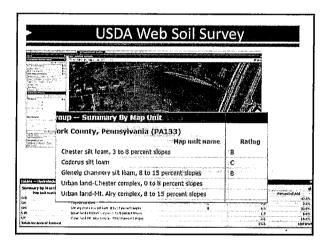
|              |  | Same 9.                     | dairtieran basaksan   |
|--------------|--|-----------------------------|---|
|              | NOAA ATLAS 14 POINT PREC DATA DESCRIPTION  TOTAL DESCRIPTION  TOTAL DESCRIPTION  | 2                           | S: PA   |
| Table Second | SELECT LOCATION  Advantable:  **Defendable: Specified Decigned Decigned Local ** Capture Control Contr | DS17 supram Notices separa. |   |
|              | the contract of  |                             | all here'd blacker<br>"Man (Declared Sugranger<br>Se Care on Subscience)<br>"Secretaring of man   |
| SA.ese.      |  |                             | Decargonal Copia mole<br>home raw is enquaried for<br>passed 1900 per<br>passed |

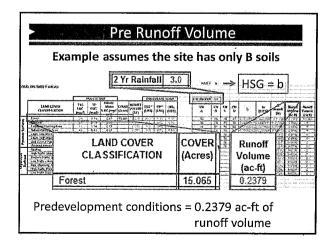
|   | PF tabular  PD 3-based precipitation frequency estimates with 90% confidence or Average recurrence lateral (party)  10   |               |
|---|--|---------------|
| Dundo   | PD 5-based precipitation frequency estimates with 90% confidence  Average recurrence interest (types)  1 2 5 10 25 10 25 104 104 104 104 104 104 104 104 104 104   |               |
| Depth/doc   | 2   5   10   25   50   19   10   10   10   10   10   10   1  |               |
| Composition   Composition | 1 2 5 10 25 59 19 0.335 0.335 0.435 0.456 0.460 0.460 0.460 0.460  | 100           |
| 1   25   50   50   50   50   50   50   50   | 2 3 10 25 59 10<br>0.332 9.389 8.454 9.450 9.560 9.649 9.6   | 100           |
|   |  |               |
|   | " (0.797-9.28CD   0.044-9.472  (0.449-9.58S)   (0.449-9.4CD     (0.549-9.4CD     (0.549-9.4CD  |               |
| 15 min   0.9445   0.774   0.7820   1.02   1.14   1.25   1.45   1.25   1.45   1.25   1.45   1.25   1.45   1.25   1.45   1.25 | IN TOTAL CONTROL OF THE PARTY O | 8-1.15:       |
| 30anin (220ani) (231-10) (146-12) (231-12) (231-12) (231-12)  | . 9,645 \$ 9,774 \$ 9,929 1,02 1,14 1,25 1,2   |               |
| 2. 1.76 1 1.34 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2  | ** (3.707-0.005) (3.807-1.00) (4.804.405) (7.53-1.40) (3.50-1.80) (4.804.20) (4.70-1.  | 812.5.6       |
|   | 1.76 1 1.34 1 1/2 2.36 2.36 2.51 2.7   | 77<br>\$3.675 |
|   |  |               |
|   |  |               |
|   |  |               |
| 112-126   (19-230)   29-30   (20-42)   (33-42)   (33-42)   (3.7-42)   | ' (1.17-1.56) (1.90-1.10)  | ^8.55;<br>.42 |

|      |   |       | <del></del> |     |
|------|---|-------|-------------|-----|
| **** | • |       |             |     |
|      |   |       |             |     |
|      |   |       |             |     |
|      |   | · · · |             |     |
| · ·  |   |       |             |     |
|      |   |       |             | *** |
|      |   |       |             |     |



The drainage area to the BMP is composed of 4.3 acres of impervious area and 10.8 acres of pervious area





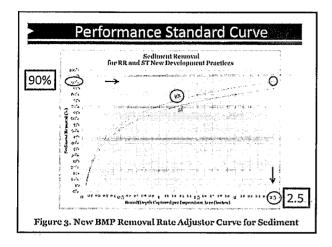
| ( controduct) educas |  | 111 13 (MSA) 18 <del>4</del> | → HSG = b        |
|----------------------|--|------------------------------|------------------|
| CLASSIFICATION       | COS   14"   RECT   POIS 19"   POIS 19"     TSS   18"   Rect   Rect     TSS   2807   Rect   Rect     TSS   2807   POIS 19"     TSS   2807   POIS 19 | - NO. 28 28 4                |                  |
|                      |  |                              | 操作的              |
|                      | LAND COVER<br>CLASSIFICATION   | COVER<br>(Acres)             | Runoff<br>Volume |
| -                    | Low-Input<br>um Traffic Street   | 10.781                       | 0.3212           |
| Post-de              | evelopment cond  | itions = 1.30                | 23 ac-ft of      |

| Using Equation X   |
|--|
| EP = Post - Predevelopment volume increase<br>EP = 1.3023 ac-ft - 0.2379 ac-ft<br>EP = 1.0644 ac-ft<br>Post-dev impervious acres (IA) = 4.284 ac |
| Insert into Equation X   |
| $X-axis = \frac{(12*EP)}{IA}$  |
| X = [12(in/ft) * 1.0644 ac-ft] / 4.284 ac  |
| X = 2.98 in  |
| Coincidence (1) That it consigned to 2-yr. var. 5211   |

|   | RR or ST?  |
|---|--|
|   | Bulling Constitution of SAME boundary must reduction capability  Party Business (GB)  Processor  Security Constitution (GB)  Processor  Security Constitution (GB)  Processor  Security Constitution (GB)  Processor  Security Constitution (GB)  Landing the Constitution (GB)  Constitution (GB)   |
|   | Rivertan Bullier Restaration Pilitering Promities (also Consensate Pilitering Parties), Societies and College Control Piliterin, Societies and College Control Pilitering Promities (also Consensate Control Pilitering Promities) and Control Pilitering Promities (also Control Pilitering Promities) and Control Pilitering (also  |
|   | Runoff Reduction (RR)  |
|   | Practices  |
|   | ration (aka Infiltration Basin, Infiltration Bed,<br>ration Trench, Dry Well/Seepage Pit.  |
|   | scape Infiltration)  |
|   | December 1 Section 1 Secti |
| • | hmicrotron (An Inti Marton Sens, Inchronum Beel, infiltration Head, infiltration Head, Intel Well-Responde PE, Emforce philipsenical philipsenical sense of the Company of  |
|   | "May unchase Lierus as hevel spronter  Out to DNA, N. N., N. or White Stemanuskie Namuals for more information  The Ed Symbol have bloomed removale exploiting, their efficiency is chemisted using science.  Table 18th, Outmitted in the Committee of the Committee |

ostilla.

59 × 93



#### Calculate Load to BMP

- Impervious area = 4.284 ac
- Pervious area = 10.781 ac
- Impervious sediment load:
   4.284 ac X 1,614.15 lb/ac/yr = 6914.929 lb/yr
- Pervious sediment load:
   10.781 ac X 220.4 lb/ac/yr = 2376.112 lb/yr
- Total sediment load:
   6914.929 lb/yr + 2376.112 lb/yr = 9291 lb/yr

### **Apply Percent Removal**

- · Curve yields 90% sediment removal
- Apply 90% removal to post-development load
   9,291 lb/yr \* 0.90 = 8,361.9 lb/yr removed
- Remaining discharge
   9,291 lb/yr 8,361 lb/yr = 929.1 lb/yr

9,291 lb/yr sediment IN



929.1 lb/yr sediment OUT

| 1   | • |
|-----|---|
| - 1 |   |

| ccounti | ng for Ex  | isting .     | BMPs                             | 1   |  |
|---------|------------|--------------|----------------------------------|-----|--|
|         | Sewershed  | ~            | Sediment Loading w/o BMP (lb/yr) |     |  |
|         | 5ewersited | suparred v   | 9.291.04                         |     |  |
|         |            |              | 503.10                           |     |  |
|         | <u></u>    | <del>-</del> | \$4.686,21                       |     |  |
|         | 4.         | <del></del>  | 449,44                           |     |  |
|         | 5          |              | 26,437,13                        |     |  |
|         | 6          |              | 2,918,97                         |     |  |
|         | 7          |              | 44,700.92                        |     |  |
|         | 8          | Y            | 2,525,57                         |     |  |
|         | 9          |              | 9,673,92                         |     |  |
|         | 31         | 1            | 32.268.0S                        |     |  |
|         | 12         |              | 5,349.06                         |     |  |
|         | 13         | 7            | 9,617.25                         |     |  |
|         | 14         | <u> </u>     | 1.795.92                         |     |  |
|         | 3.5        | <u> </u>     | 3,850.05                         |     |  |
|         | 15         | <u> </u>     | 1,96%,63                         |     |  |
|         | 17         | i v          | 945,76                           | 1 1 |  |

#### Existing Loading Summary

• Total Sediment Load without accounting for existing BMPs:

#### 362,118 lb/yr

 Sediment removed from the existing load calculations by BMPs:

115,419 lb/yr

Overall existing load for "Model Municipality":
 362,118 lb/yr - 115,419 lb/yr = 246,699 lb/yr

## Local Impaired vs Bay

- Appendix D & E requirements
- · Meet local impairment requirements first
- Local impairment reduction also count for Bay
- Divide list of storm sewersheds into Local Impairment and Bay
- · Calculate reduction requirements for each

Total



**Local Impaired** 

Bay

|  |  |  |  |  | ior |  |
|--|--|--|--|--|-----|--|

- 1. Existing load to locally impaired sewershed areas is 126,698 lb/yr
- Required reduction from locally impaired waters
   126,698 lb/yr \* 0.10 = 12,670 lb/yr
- 2. Existing load to Bay sewershed areas is 120,001 lb/yr
- Required reduction from Bay sewersheds are
   120,001 lb/yr \* 0.10 = 12,000 lb/yr

#### Summary

- 1. Describe BMP pollutant load removal calculations using the Effectiveness Values Table
- 2. The Performance Standard Approach



| i.              |                                       | 1 |
|-----------------|---------------------------------------|---|
| <br><del></del> | <del></del>                           |   |
|                 | $\mathbb{R}^{n}$                      | o |
|                 | Licias                                |   |
|                 |                                       | o |
| ·               | calcula                               |   |
| -               | · · · · · · · · · · · · · · · · · · · |   |
|                 | Overal                                | ÷ |
|                 | 362.1                                 |   |

# Crediting Reductions to Current Load and 2023 Goal

| BMP Reducti                   | ons to Current Load            | BMP Credit to 2023 Goal                 |                |  |
|-------------------------------|--------------------------------|---|----------------|--|
| Allow crediting of            | Yes                            | N/A                                     | N/A            |  |
| BMPs currently                |                                |   |                |  |
| operating as                  |                                |   | ·              |  |
| designed? <sup>1</sup> (all,  |                                |   |                |  |
| including 102s)               |                                |   |                |  |
| Allow crediting of            | Yes <sup>3</sup> (requires the | Credit retrofits (net                   | No. BMP should |  |
| BMPs currently                | permittee to calculate the     | improvement <sup>4</sup> ) of           | have been      |  |
| providing less than           | current reduction)             | <u>102s</u> ?                           | maintained     |  |
| design level of WQ            |                                | Credit retrofits (net                   | Yes            |  |
| treatment? <sup>2</sup> (all, |                                | improvement <sup>5</sup> of <u>non-</u> |                |  |
| including 102s)               |                                | <u>102s?</u>                            |                |  |

<sup>&</sup>lt;sup>1</sup> Using the CB Performance Curve methodology
<sup>2</sup> Same as 1
<sup>3</sup> Allow this here rather than as part of the credit against the 10% goal
<sup>4</sup> To whatever degree it was functional it could have been used to reduce the current load

<sup>&</sup>lt;sup>5</sup> Same as 4

were a proposition of the second

The state of the s

ACHT CARRET

en Granden er er bet er er er blike er er holde aller gardenig and to the second