SIMULATION OF HISTORICAL GROUNDWATER INPUT AT MITIGATION WETLAND SITES USING EFFECTIVE MONTHLY RECHARGE (Wem) MODEL

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Collaborators and Support

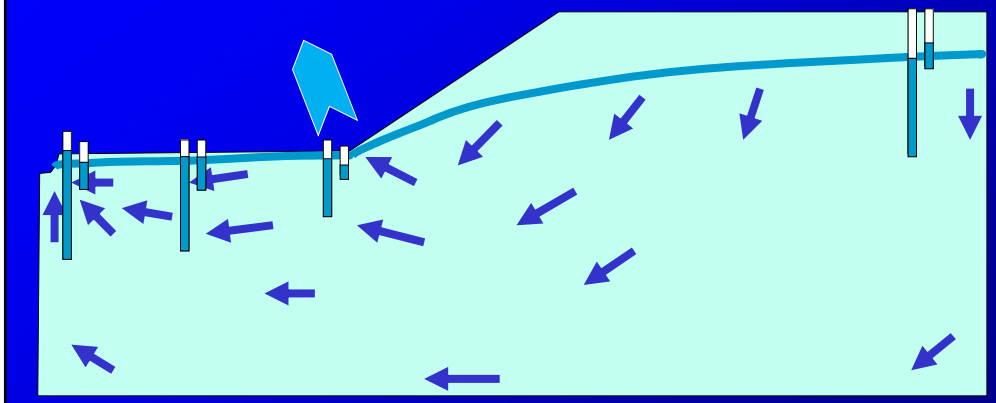
Hydrology "too dry" to support target vegetation

Lowering natural surface on upland flat, SE Virginia

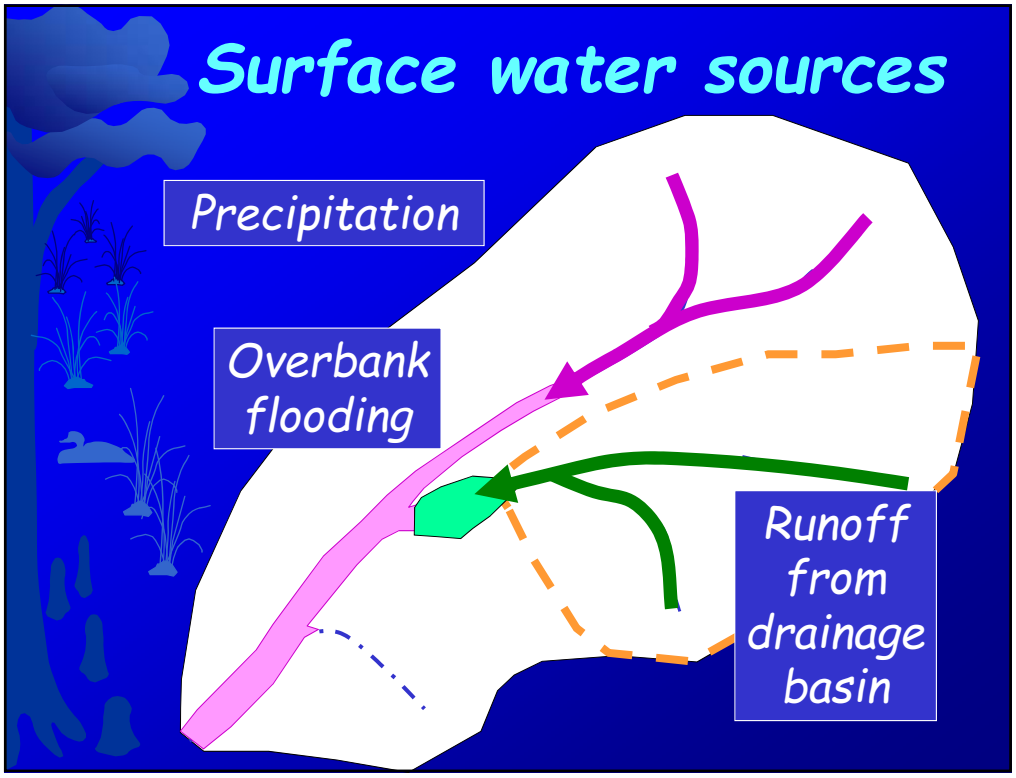
Hydrology "too wet" to support target vegetation

Terrace and floodplain, Mattaponi River

Heads in piezometers reveal vertical flow component

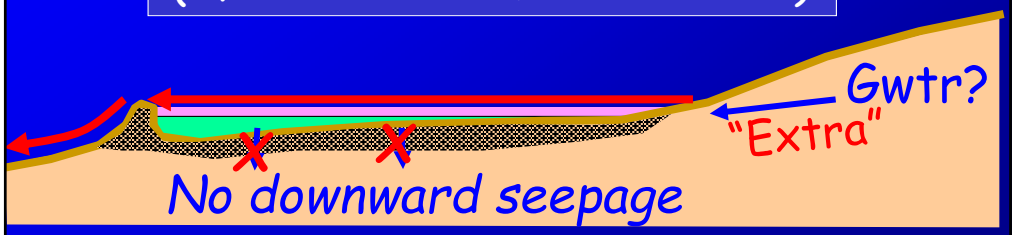


Surface water sources



Depression design

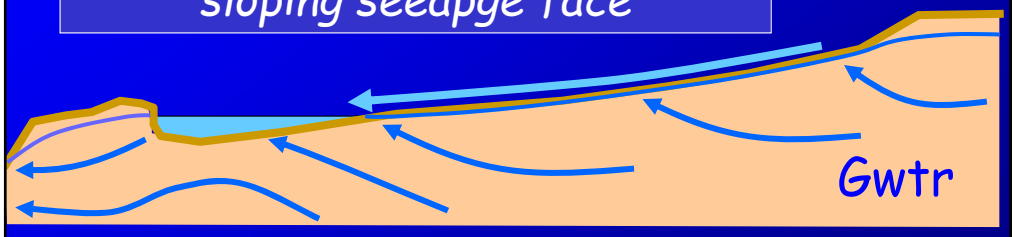
Produces wetlands with stable water levels (often not conducive to trees)

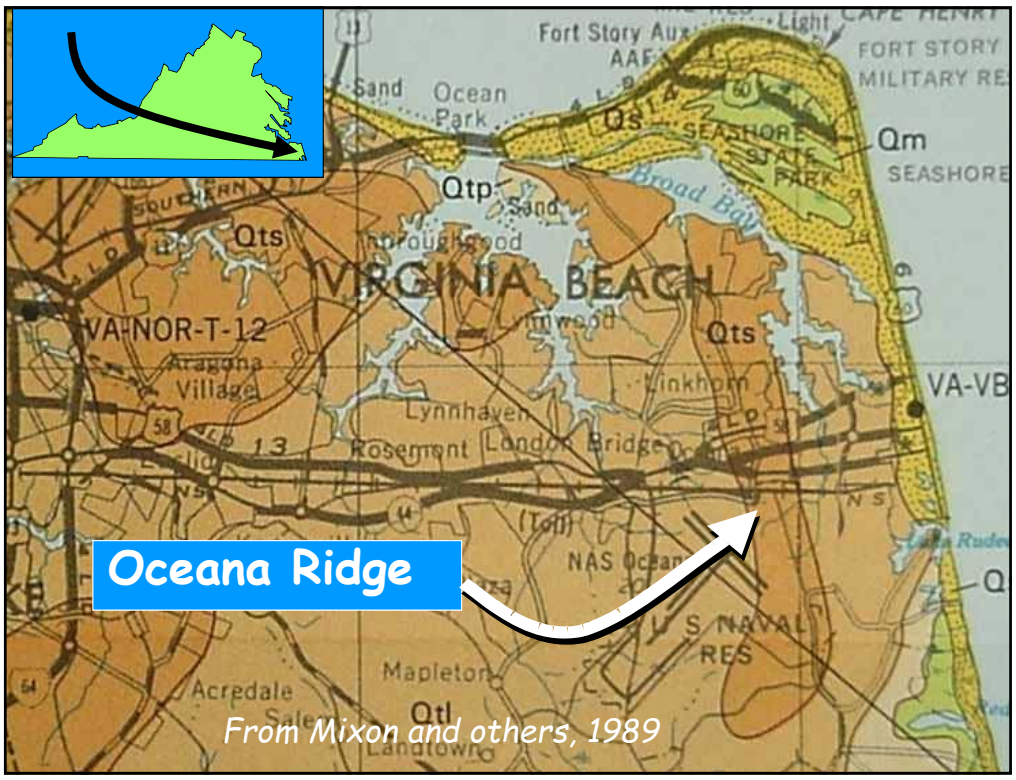


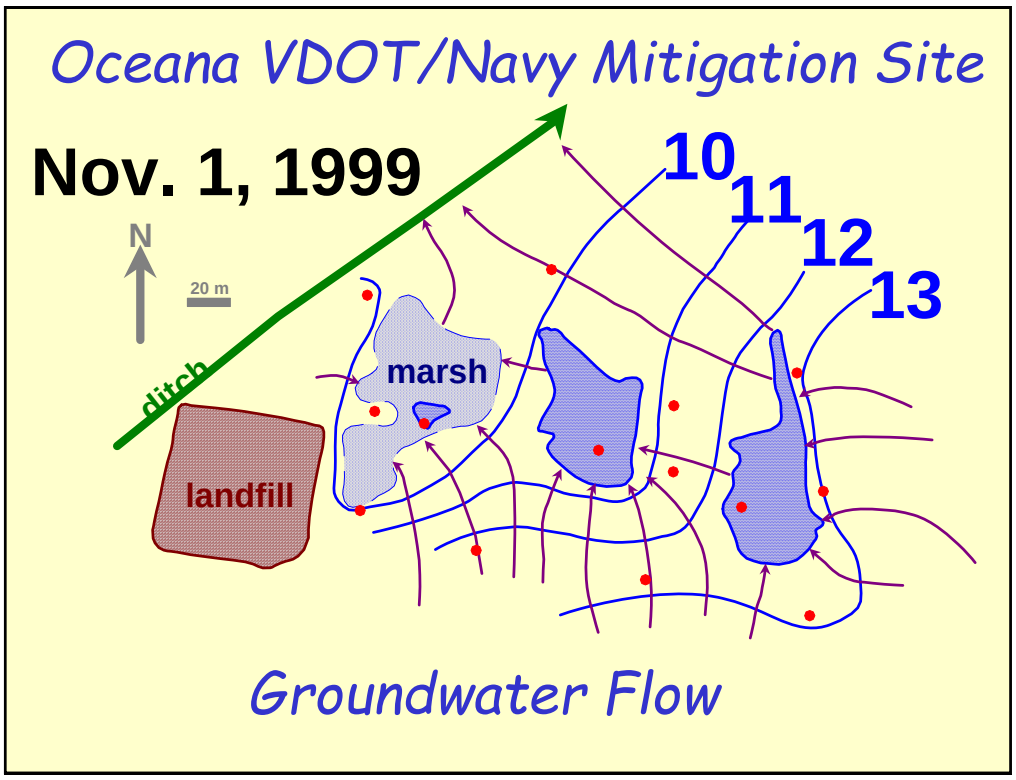
Vegetation retards surface flow so often "too wet"

Precipitation/Groundwater through-flow wetland

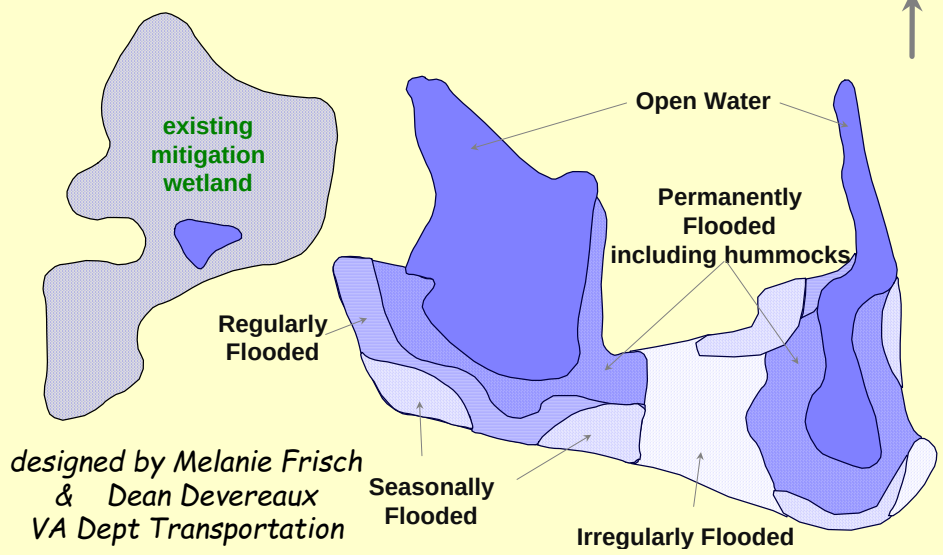
Transmit groundwater across sloping seeapge face




Oceana Ridge
Fort Story Aux AAF
FORT STORY MILITARY RE
Sand
Ocean Park
Qs
SEASHORE STATE PARK
Qm
SEASHORE
Qtp
Sand
Broad Bay
Qts
VIRGINIA BEACH
VA-NOR-T-12
Aragona Village
Qts
Linkhorn
VA-VB
Lynnhaven
Rosemont
London Bridge
NAS Oceana
U S NAVAL RES
Mapleton
Acredale
Qtl
From Mixon and others, 1989


Oceana VDOT/Navy Mitigation Site
Nov. 1, 1999
N
20 m
ditch
landfill
marsh
10
11
12
13
Groundwater Flow

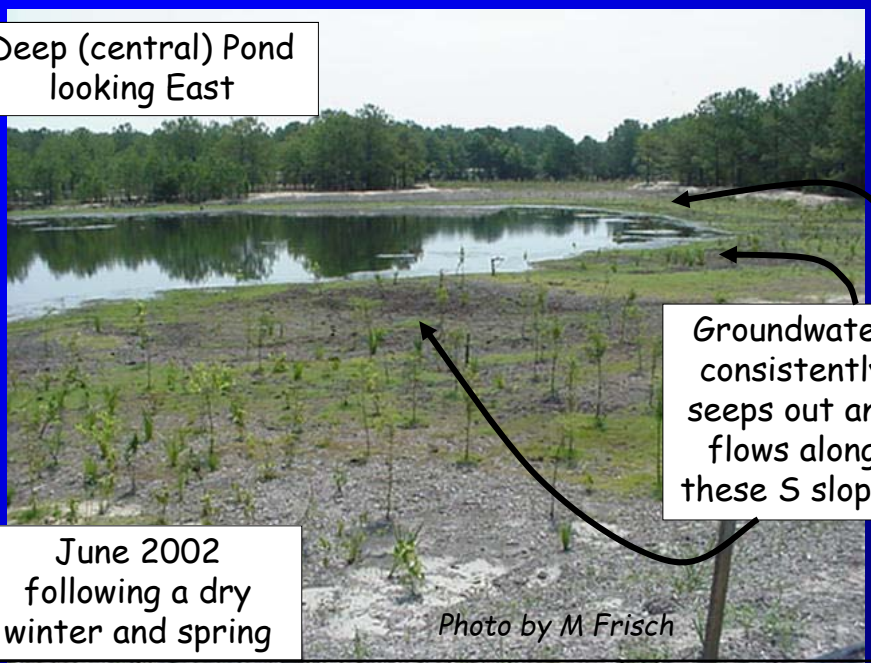
Final Grading Plan



designed by Melanie Frisch & Dean Devereaux VA Dept Transportation

Broad forested slopes on uphill S side will increase, transport, and use groundwater seepage

Ocean VDOT/Navy Mitigation Site



Use weather records to estimate head at beginning of a month, calibrated with head data from a well

Estimate head for every month for past 30 years

Estimate exceedence probability for each month (Jan-Dec) during past 30 yrs

"At beginning of (MONTH), what is the probability that uphill heads will exceed a given elevation?"

Effective Monthly Recharge: W_{em}

A time-weighted recharge value

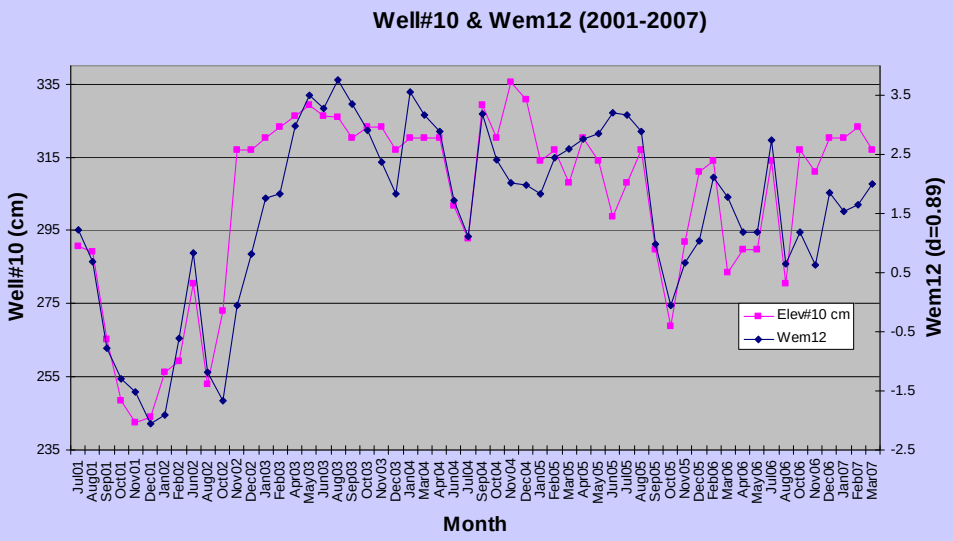
$$W_{em} = \sum_{a=1}^{n} W_{mo} \times D^{a-1}$$

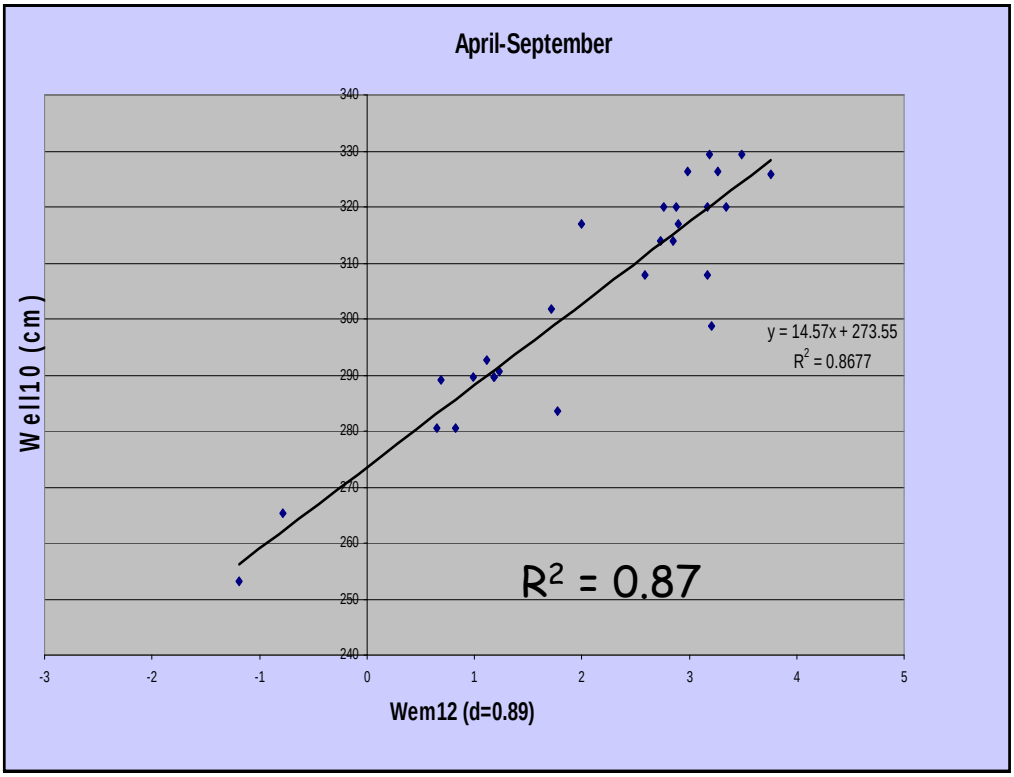
n= # preceding months

Each month's recharge (Ppt - ET)

Response-decay factor (<1.0)

Synthetic hydrograph-calibration period

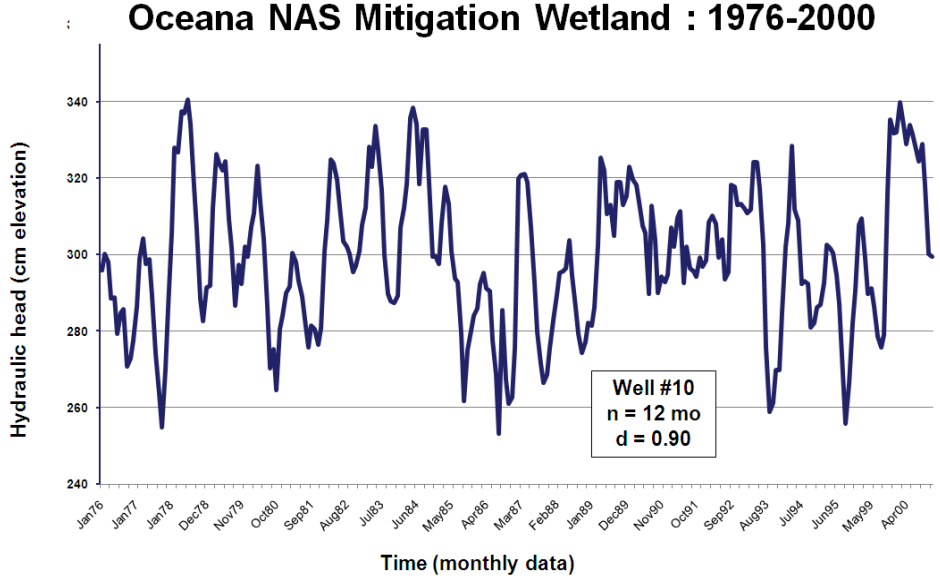


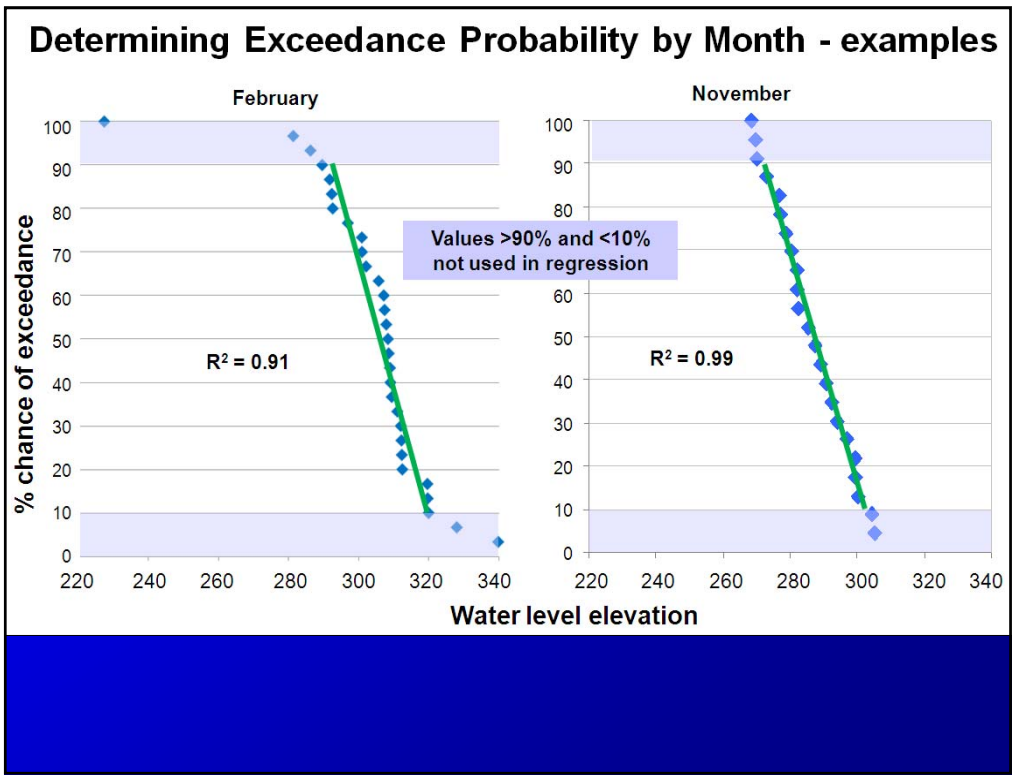


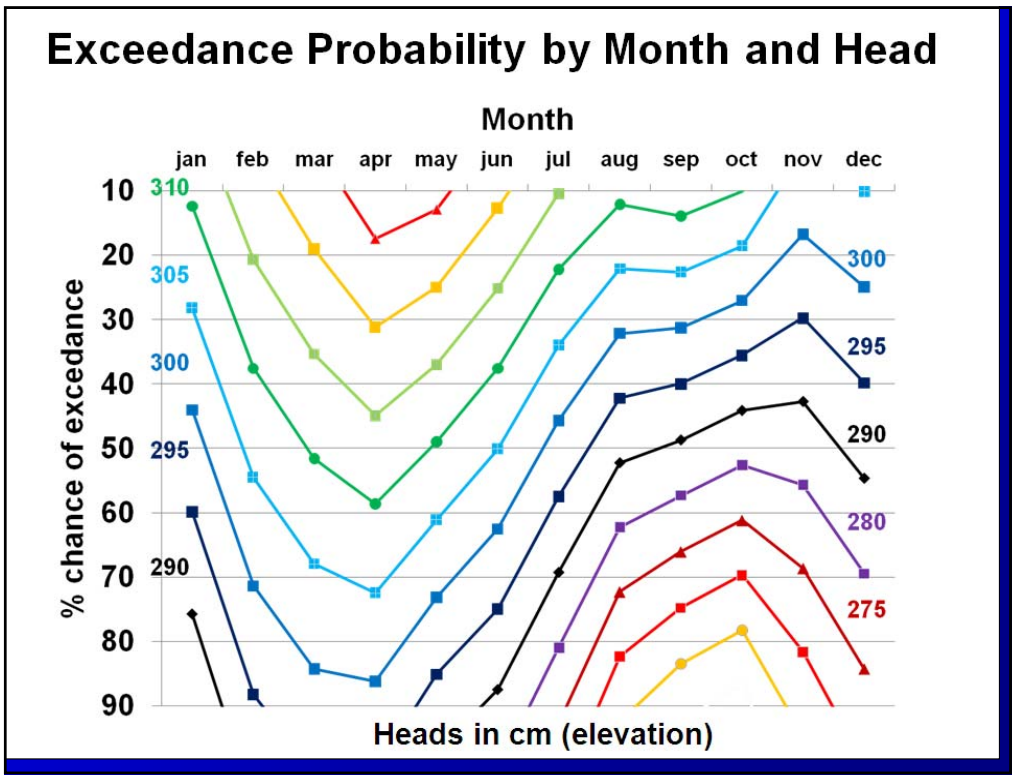
Correlation coefficients (R^2) by n and d

	0.99	0.95	0.9	0.89	0.88	0.87	0.85	0.8	0.75	0.7	0.65	0.6	0.55
Wem1	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772	0.301772
Wem2	0.476116	0.477133	0.477909	0.477992	0.478048	0.478078	0.478054	0.477476	0.476075	0.473747	0.470386	0.465883	0.460132
Wem3	0.492559	0.500222	0.508958	0.510568	0.512126	0.513629	0.516459	0.522375	0.526342	0.527996	0.527006	0.5231	0.516099
Wem4	0.512906	0.527241	0.543555	0.546545	0.549431	0.552205	0.557397	0.568018	0.574725	0.576962	0.574389	0.566931	0.554807
Wem5	0.459631	0.486773	0.518085	0.52387	0.529467	0.534864	0.545008	0.566101	0.580278	0.586974	0.586203	0.578514	0.564857
Wem6	0.433542	0.469657	0.511514	0.51922	0.526656	0.5338	0.547142	0.574287	0.59163	0.598959	0.597028	0.587231	0.571232
Wem7	0.399697	0.449677	0.506373	0.516548	0.526258	0.535478	0.552359	0.584882	0.603461	0.609408	0.60498	0.592626	0.574548
Wem8	0.429619	0.483097	0.540775	0.550659	0.559925	0.568556	0.583866	0.6108	0.622831	0.622706	0.613439	0.597637	0.577316
Wem9	0.491227	0.544194	0.594931	0.602765	0.609824	0.616122	0.626516	0.640983	0.642277	0.634236	0.619775	0.600875	0.578853
Wem10	0.522283	0.585745	0.637559	0.644289	0.64993	0.654552	0.661049	0.664756	0.656784	0.642274	0.623868	0.602799	0.579686
Wem11	0.581235	0.642391	0.681787	0.685426	0.687934	0.689441	0.689941	0.681277	0.665318	0.646327	0.625652	0.603527	0.579962
Wem12	0.639303	0.691654	0.716249	0.716905	0.716524	0.715266	0.710698	0.692423	0.670802	0.648837	0.626729	0.603961	0.580124
Wem13	0.632631	0.687062	0.713232	0.714104	0.713922	0.712849	0.708622	0.691104	0.670081	0.648509	0.626608	0.603928	0.58012
Wem14	0.543876	0.621023	0.673672	0.678951	0.682823	0.685453	0.68761	0.680931	0.665549	0.646654	0.625914	0.603693	0.580048
Wem15	0.439683	0.540637	0.624733	0.635504	0.644474	0.651788	0.662061	0.669092	0.660588	0.644761	0.625258	0.603487	0.579991
Wem16	0.388162	0.503696	0.605106	0.618604	0.630017	0.639496	0.653324	0.665688	0.659411	0.644401	0.625161	0.603465	0.579986
Wem17	0.332534	0.46343	0.584087	0.600627	0.614753	0.626624	0.644341	0.662363	0.658315	0.644076	0.625074	0.603443	0.579982
Wem18	0.270025	0.419497	0.563113	0.583042	0.600113	0.614511	0.636178	0.659529	0.657407	0.643805	0.624999	0.603425	0.579977

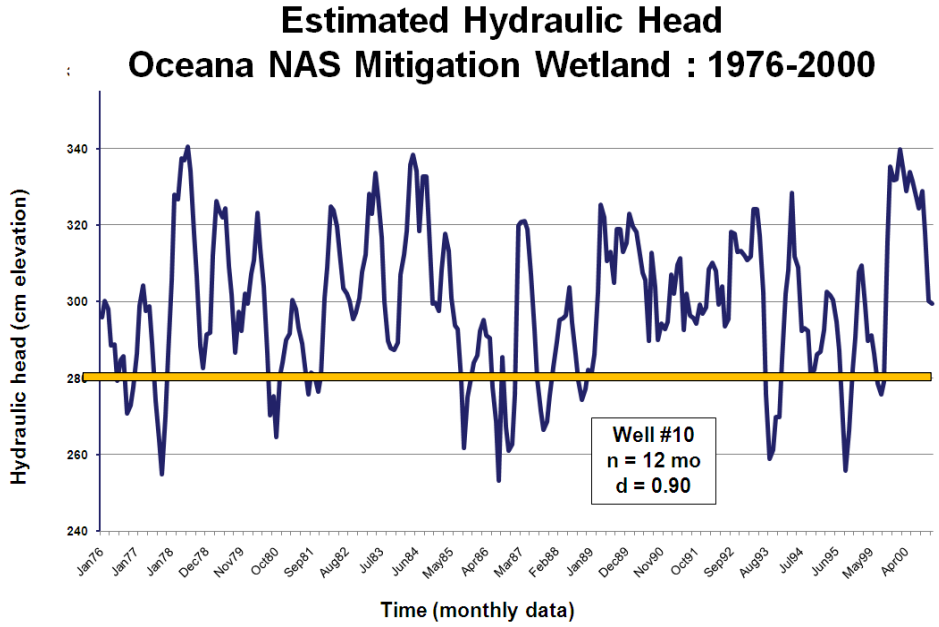
Synthetic hydrograph-historic period



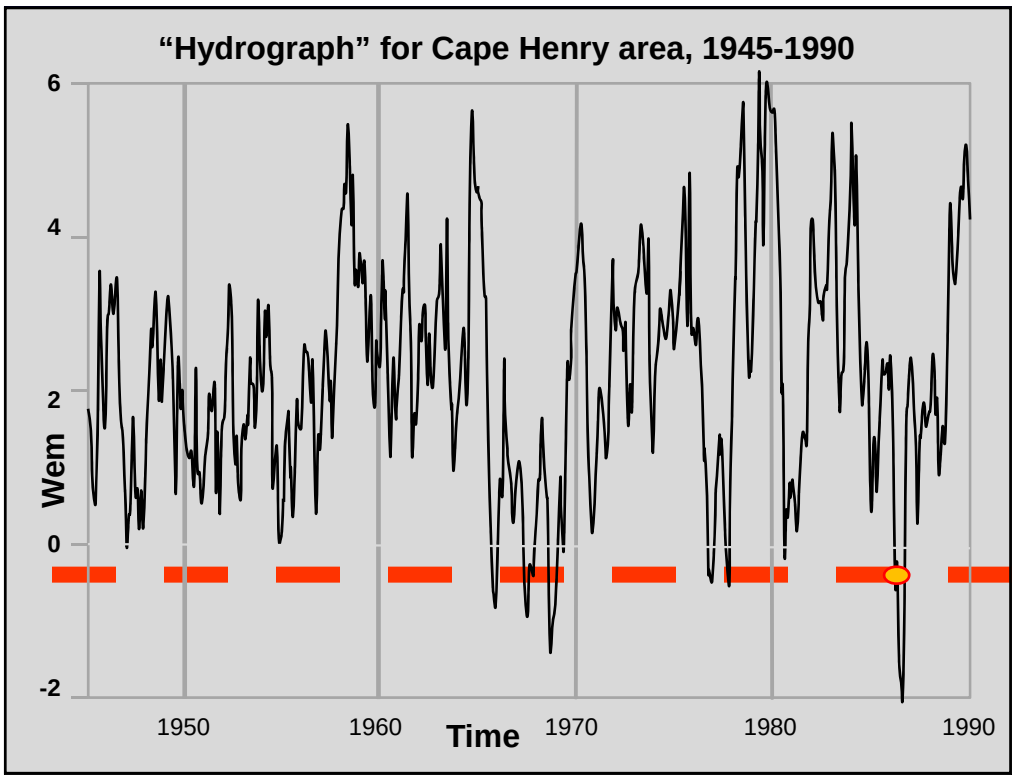

Determining Exceedance Probability by Month - examples
February
November
% chance of exceedance
Values >90% and <10% not used in regression
R² = 0.91
R² = 0.99
Water level elevation

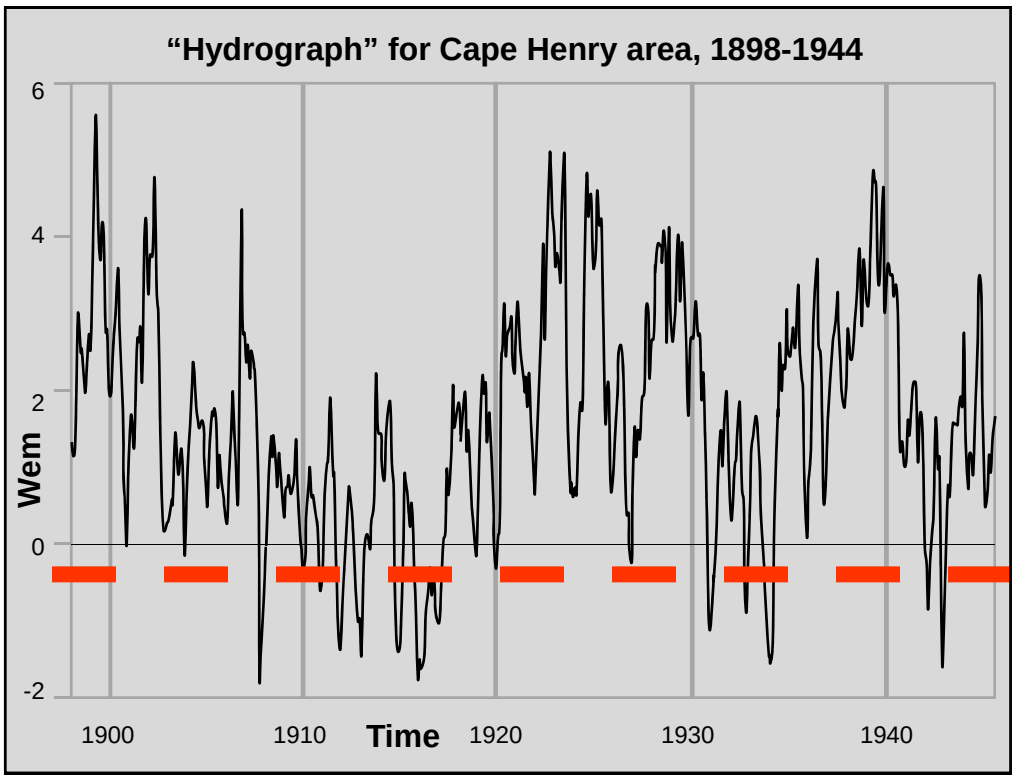

Exceedance Probability by Month and Head
Month
jan feb mar apr may jun jul aug sep oct nov dec
% chance of exceedance
310
305
300
295
290
280
275
Heads in cm (elevation)

Synthetic hydrograph-historic period



Interdune wetlands, Cape Henry VA


"Hydrograph" for Cape Henry area, 1945-1990
6
4
2
0
-2
Wem
1950
1960
Time
1970
1980
1990


"Hydrograph" for Cape Henry area, 1898-1944
6
4
2
0
-2
Wem
1900
1910
Time
1920
1930
1940


Thank you for coming