Week 1
Lecture Tuesday (January 4th): Channel morphology
- Course overview
- Reading discussion
- Lecture:
  - Dynamic equilibrium – a channel in and out of balance;
  - Drivers of change- discharge and sediment supply (LU change, dams, withdrawals, gravel extraction/addition, dredging etc.), role of disturbances
  - Channel adjustment - Dominant/effective discharge, circulation and meandering, channel organization
  - Video: Watch videoclip from Lookout Creek.

Reading: Morphological Changes of the Lower Mississippi River: Geomorphological Response to Engineering Intervention [Harmar et al. 2005]

Lecture Thursday (January 6th) – Environmental fluid dynamics
- Lecture: Mechanics of flow – circulation, coherent flow structures, resistance, turbulence
- Reading discussion
- Lecture from Chapter 6: Drag and Sessile Organisms

Assignment 1: Hydrology and Channel hydraulics

Reading: Ch. 5 Life in Moving Fluids: Drag, Scale, and the Reynolds Number [S. Vogel]

Week 2
Lecture Tuesday (January 11th) - Sediment entrainment and transport in gravel bed systems
- Shear stress, Velocity profiles in bends/helicoidal flow, and partitioning
- Resistance to flow – bedforms, grains, planform (Yang Ch. 3)
- Incipient motion
- Reading discussion
- Activity: In class calculations for stable channel design

Reading: Flow competence and streambed stability_an evaluation of technique and application [Lorang and Hauer]
Lecture Thursday (January 13th)- Sediment entrainment and transport in gravel bed systems
- Incipient motion and stable channel design
- Definitions – suspended, bedload, washload; bedload video
- Sediment storage and transport in rivers
- Video: Mark Schmeeckle
- Reading discussion

Reading: Stream-bed scour, egg burial depths, and the influence of salmonid spawning on bed surface mobility and embryo survival [Montgomery et al.]

Assignment 2: Flow competence calculations

Week 3

Lecture Tuesday (January 18th): Measurements and modeling
- Measuring – bedload measurement, suspended measurement, bedload sampling, tracers – bring equipment (StreamPro, Helley Smith, etc.) into class
- Modeling
  a. Hydrodynamics (1-3D), Sediment transport (Yang Ch 4,5,6).
  b. Limitations of models
  c. Show examples from dam removal.
- Reading discussion

Reading: Uncertainty in the calibration of effective roughness parameters in HEC-RAS using inundation and downstream level observations [Pappenberger et al. 2005]

Lecture Thursday (January 20th)– Ecohydraulics
- Habitat types – spawning gravel, rearing habitats, feeding-invertebrates, etc.
- Show clip from Riverwebs
- Example: Vector and tensor visualizations from AGU poster on fish use and hydraulics of ELJs
- Reading discussion

Reading: Life in Moving Fluids – Ch. 10: Making and Using Vortices [Steven Vogel]

Assignment 3: New assignment to be developed
**Week 4**

**Lecture Tuesday (January 25th)- Bank Erosion and Stabilization**
- Lecture: Hydraulics of erosion processes, hydraulic erosion vs. geotech failures, role of vegetation (present Nicole’s work)
- Lecture: bank stabilization approaches and standard practices; Construction and maintenance issues
- Example: sizing rock for critical velocities for revetments; talk about failure modes – erosion behind top of obstruction, toe failure sliding into channel
- Engineering design process overview; Presentation of class project – Eric Andersen, Eric Hart, and Liz Redon

**Reading:** Bank and near-bank processes in an incised channel [Simon et al. 2000]

**Lecture Thursday (January 27th) – Bank Stabilization**
- BSTEM demonstration lecture/lab – students need laptops
- Discussion on design standards and risk in engineering design

**Reading:** Engineering Design Standards and Liability for Stream Channel Restoration (Slate et al.)

**Assignment 4:** Use of BSTEM for eroding bank; propose ways to stabilize it and justify using BSTEM

**Week 5**

**Lecture Tuesday (February 1st): Culverts**
- Intro. to Culverts; design criteria, slope, capacity, design storms, etc.
- Activity: Discuss ODFW fish passage criteria for culverts.
- Lecture/lab - Intro to Fish X-ing.

**Lecture Thursday (February 3rd): MIDTERM EXAM (Dr. Tullos at RRNW)**

**Assignment 5:** Preliminary analysis plan for class project – data needs and algorithm for analysis of alternatives.

**Week 6**

**Lecture Tuesday (February 8th): Wood in Rivers - ELJs**
- Lecture
  - Historical “cleaning” of rivers
  - Bank protection vs. habitat restoration
  - Types of ELJs
Design criteria – scour analysis, buoyancy, drag, structural design

- Review of Reference: WASHDOT guidance document

Reading: Stability of Ballasted Wood Debris Habitat Structures (D’Aoust and Millar)

Lecture Thursday (February 10th): Wood in Rivers - Habitat restoration in PNW
- Case study: Quartz Creek project overview, Ecosystem benefits – retention of sediment, wood, detritus, fish use, etc.
- Activity – Cabling vs. uncabled discussion, watch Mack Creek video
- Example: Use spreadsheet to illustrate simple example

Assignment 6: Use spreadsheet to make force calculations for 2 configurations of an engineered log jam, evaluate model sensitivity, and provide cost estimate

Week 7
Lecture Tuesday (February 15th): Dams – Types and Impacts, flow modification
- General overview lecture:
  - Structural: types and uses of outlets, types of turbines
  - Operational: objectives of dams and compatability of objectives; discuss water storage vs. run of river vs. reregulating; explain rule curves.
  - Flow modification: examples of time series from the Willamette – Use figures from Stan Gregory and Tom Lowry.
  - Water quality and residence times: See WRR paper (pages 5 and 6) for discussion of how objective (irrigation, domestic supply, etc.) influences in this
- Lecture: More detailed discussion on reservoir sedimentation (Yang Ch 8) and management options (Morris and Fan)
- Reading Discussion

Reading: Reservoir Sedimentation Handbook, Chapter 10: Sediment deposits in reservoirs [Morris and Fan]

Lecture Thursday (February 17th): Ecological impacts of dams and engineering efforts to make dams “fish friendly”
- Lecture:
  - Discuss NMFS fish passage criteria for dams.
  - Fish passage and juvenile fish outmigration – review Andy Goodwin’s work
  - Fish screening at diversions - see USBR guidance on this.
- Reading Discussion
**Reading:** Metrics for assessing the downstream effects of dams (Schmidt and Wilcock)

**Assignment:** none.

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**Week 8**

**Lecture Tuesday (February 22\textsuperscript{nd}): Dam removals**

Dam removal – Removal strategies and impacts
- Lecture: reasons, removal strategies, sediment management and stabilization
- Video: Marmot dam removal
- Base largely on materials from RRNW

**Reading:** How Dams Vary and Why It Matters for the Emerging Science of Dam Removal (Poff and Hart) – get different better paper than this

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**Lecture Thursday (February 24\textsuperscript{th}): Hydropower development and cumulative effects**

- Lecture [Guest – Kelly Kibler]:
  - Hydrosystem planning - Centralized vs decentralized systems, policies (e.g. CDM)
  - Hydropower development in the Nu and Lancang Jiang
  - Assessing cumulative effects

**Reading:** Assessing cumulative effects of longitudinal hydrodevelopment: The case of Eight Dams, One Reservoir on the Jinsha (Upper Yangtze) River, China [Kondolf et al.]

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**Week 9**

**Lecture Tuesday (March 1st): Systems analysis**

- Systems management - generally
- Case study: CA delta
- Lecture: coastal hydrogeology of bay delta, water conveyance and management, legal processes, hard social decisions

**Reading:** Envisioning Futures for the Sacramento San Joaquin Delta: Executive Summary

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**Lecture Thursday (March 3\textsuperscript{rd}): River management and restoration planning**

- Lecture
  - Overview on basin-wide river management
Focus on examples of restoration planning and prioritization
  • Demonstrate how the class project ranks using Santiam BBN.

Reading: The use of Bayesian networks to guide investments in flow and catchment restoration for impaired river systems [Stewart-Koster et al. 2010]

Assignment: none.

Week 10
Lecture Tuesday (March 8th): Systems-level hydroplanning
BPA guest lecture

Reading: Death to rule curves [Howard]

Lecture Thursday (March 10th): Wrap up: liability, effectiveness monitoring, construction permitting
  • Lecture:
    o Monitoring – use figures and text from kelly’s paper + phil roni’s work
    o Liability – discuss from Reversibility in River restoration?
    o Construction issues and permitting - Review joint permit for MRWC
  • Course evaluations

Assignment: none.