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Planning for wind power as a basis for multifunctional landscape design

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Vindkraftsplanering som grund för multifunktionell landskapsdesign

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Foreword

It has been exiting to work on this thesis. Through the months the scope of the project has changed with each new source or meeting, creating dynamics that at times have been hard to keep organised. Although the focus has taken many directions, the main idea remained throughout the work. To work towards an integrated wind power development model has been a good way to tie my master years up. Since the *Theme Course* was my first course at Alnarp, and I had the opportunity to take the course project even further, it feels great to wrap it all up in this thesis.

First I would like to thank my supervisor Karin Hammarlund who not only made me interested in a field I never expected to be involved with, but who inspired and guided me throughout the work with valuable discussions and comments. To Lars Larsson, my assistant supervisor, I also want to give my true thanks. You provided a lot of important background information and were always available for my bombarding questions.

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Abstract

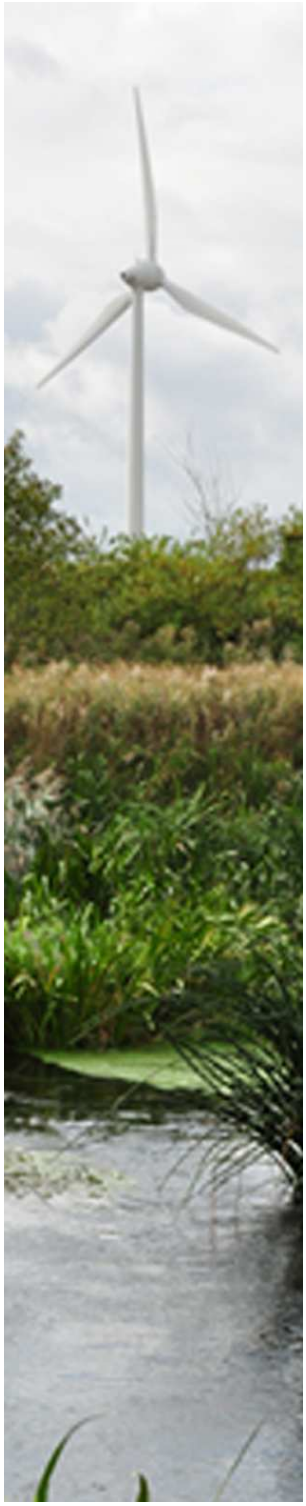
Wind power is a growing industry, which has an increasing impact on our landscapes. Many articles and papers have been published about public acceptance and the importance to consider the wider landscape when placing turbines. Surprisingly though is the lacking of wind power integration research – not visually, but functionally. This work and analysis has identified processes and working tools which should be incorporated in the planning procedure. Having wind power as a backbone landscape design becomes most interesting. There are many limiting regulations to consider, often leading to a negative planning approach today, where a design study may give new views to approach specific projects.

As analysis provides the framework for this design proposition, it can be argued that analysis and design has been developed simultaneously, in contrary to the traditional sequential way of planning where the limiting factors are the first to be explored. Further, this thesis argues that it is possible to utilise opportunities in the development phase of infrastructure projects like wind power to initiate i.e. ecological enhancement projects. All new infrastructure developments there are facing opportunities and threats. Analysing the situation at hand, development can really take off when there is a lot to gain. This research clearly shows that wind power and i.e. ecological/recreational developments can benefit from each other and even depend on one another. For example, the monocultural land between Lomma and Lund can, with relatively small ecological and cultural operations, become a lively and well-visited landscape by the support of wind power.

TABLE OF CONTEXT

1. INTRODUCTION

The role of landscape architects seemingly become more diverse over time, bringing fields like garden design, master planning, urban planning, land art etc. together. It is increasingly important to deal with long term issues like climate change, globalisation and self-sufficient energy supplies, as natural resources are becoming more limited. Land is precious, and there are many claims on land-use. Urban development, agriculture, recreation, private estates, transportation infrastructures and nature itself are all present in the landscape, struggling to co-exist. How to juggle these often conflicting requirements is a problem that landscape architects and planners have to face and deal with.



This thesis is discussing issues of importance for the design process. The introduction presents the framework and definitions used to structure the thesis. These definitions will be further explained in detail in the following chapters.

The outline of this thesis is: background and research questions, theory, wind power information with examples, analysis of the project area, design proposition based on previous chapters, and finally reflections of the complete work answering the questions stated in the beginning.

The foundation for this study is a course attended by the author and run by SLU Alnarp; "*Theme Course*". Landscape analysis made by the course has been used and further developed in this thesis. The specific placement of turbines used in this work is taken directly from the *Theme Course*, and has not been altered.

This study is striving to develop synergetic landscapes where wind power is planned.

1.1 BACKGROUND

During a course (*Theme Course*) at SLU in autumn 2011, the class was presented with the national goals for wind power in Sweden. Based on this course, the conditions and implementation plans for wind power in municipalities in south-western Skåne were examined. Local generation of electricity in the area is quite low. In 2005 the second of the two nuclear reactors at Barsebäck was closed reducing the region's overall generation capacity considerably. On the other hand south-west Skåne provides very good wind recourses. The course's conclusion was that the region needs to look into options for meeting the national goals, also addressing the local and regional requirements for renewable energy.

The class developed generic strategies for wind power implementation which are applicable in all municipalities involved in the study (Kävlinge, Lund , Lomma and Vellinge) as well as in the wider context. The strategies comprise enhancement of existing infrastructure, protection of valuable land and inter-municipal co-operation. The class applied these strategies when proposing projects in the region. One of these proposals was Höje å (stream of Höje), already in a landscape improvement program. The municipalities framing the stream (Lund, Staffanstorp and Lomma) are keen to improve recreational access to the Höje å area.

This thesis is looking into the possibility to cope with counter-acting interests in large scale wind power projects, such as preservation of valuable land and species, farming activities, recreational issues, cultural heritage etc. It is also the intention to bring additional values into the location discussion of wind power than purely the aesthetic and visual effects that tend to dominate.

The discussion of wind power's 'to be or not to be' is at times hotly debated. Due to the difference in opinion, it is important to understand the reasons to these opposing attitudes. By identifying the problems as well as the opportunities of wind power, a

multifunctional project design involving many aspects and advantages can be reached. The advantage of multi-functionality is bringing several aspects, purposes and functions into one project, creating additional values and higher sustainability. This thesis will discuss the design aspects for wind power projects and multifunctional land use supporting a variety of purposes and actors to create a synergetic landscape.

1.2 OBJECTIVES

The objective is to evaluate methods for landscape design to promote multifunctional landscapes where wind power is planned, integrating natural, cultural and recreational values into the process. Furthermore, the purpose is to show how a wind power design project will benefit from an in-depth landscape analysis. Based on the research, the objective is to create a design proposal for a multifunctional and synergetic landscape.

1.3 GOALS

The study goals are:

- to develop a method which integrate natural, cultural and recreational values in wind power project design.
- to demonstrate project benefits from not being considered solitary and isolated from its own context.

By combining possible landscape functions and addressing multiple objectives the goal is to create multifunctional landscapes that are more sustainable, legible and attractive. If the landscape provides functional and ecological component along with legibility for its users, the overall land value may improve.

1.4 QUESTIONS

The questions raised for this thesis are as follows:

- Can a wind power project such as the one proposed along Höje å, be the starting point/initiator for environmental, recreational and cultural schemes?
    - To what extent may these areas of interest and wind power development become synergetic?
    - How can landscape improvement schemes be applied in relation to Höje å?
    - Are recreational, cultural and environmental schemes of the same importance?
- Is design applicable as a means to sustainable wind power development?
- Which design tools are useful in relation to the Höje å case study?
- To what extent may landscape analysis provide a good design foundation for development of Höje å?

1.5 LIMITATIONS

The design area is restricted to the land area along Höje å between the towns of Lund and Lomma, located in the south-western part of Skåne. The study is focused on ecological, cultural and recreational opportunities along with wind power development concerns. Cost and economy issues are only presented in brief terms and are not the main objective of the research.

This study is based on a wind power project and turbine location developed by the *Theme Course* in autumn 2011 (see ‘definitions’). Since alternative wind turbine positioning would be a full study of its own it is not further considered in this study.

Due to time restraints further interviews with locals after the theme course has not been possible either, which limit the design reflections.

This thesis is developed with the assumption that an agreement between local authorities and landowners regarding economic compensation for wind power development is set.

At present there are limited wind power projects with a multifunctional approach in both Sweden and internationally. This fact restricts the opportunity to benchmark the Höje å project. Instead, the research for this thesis has focused on examples where multiple functions are present; not as a result of planning, but rather as side effect or through a separate process. The thesis hence, aim to demonstrate how such functions found in the case studies can be brought in to the planning process and made part of an intended multifunctional landscape design.

The thesis is produced from a landscape architect's perspective. Examples and ideas from other fields have however inspired the design part of the work.

1.6 METHODS

The project is based on literature studies, site visits, dialogue interviews and correspondence with professionals of various fields, which in turn has shaped the design development of the project area. The study process has changed the thesis over time as the understanding of the different aspects at hand has increased.

Designing multifunctional landscapes that emanates from opportunities and values connected to wind power development, is a new approach. Therefore there is limited information and research published on the subject. Due to this, first-hand contact with different specialists has been taken. Supported by many

assisting professionals, the development of ideas and design strategies could take form.

Additionally precedence studies are used as a source of inspiration of how to approach wind power planning and to discover how landscape functions and values can be incorporated into the planning process of future projects.

From *Theme Course* not only the positioning of the turbines is used, but also the analysis leading up to the placement is used as a foundation for the thesis. The analysis is developed and deepened, using the analysis methods LCA, HLC and Lynch indicated in the *Theme Course* as operating study tools. Together they provide a comprehensive image of the project area.

Based on collected data and project analysis, design sketches are made. The drafts are analysed and integrated in different design layers forming a holistic and integrated design.

Specific names of sites, organisations and projects will be referred to in their original names in the thesis, though translation and/or explanation will be given.

1.7 DEFINITIONS

In order to assist the reader the following concepts will be defined:

Dynamic vegetation

Dynamic vegetation is a varied vegetation stand –both in species and age mixture. The definition includes herbs mixed with shrubs and trees, all in different stages of their life cycle. It is not a commercial forest where all trees are of the same age and little under-vegetation is present, nor an open meadow with no trees or shrubs present[1].

[1] Dynamic Vegetation Design, course notes, course held at SLU Alnarp spring 2012

ELC

ELC stands for 'European Landscape Convention', which aim is to encourage authorities to implement policies from a local to international level for 'protecting, managing and planning landscapes throughout Europe'[2].

HLC

Historic Landscape Characterisation (HLC) is a "tool that provides a framework for broadening our understanding of the whole landscape and contributes to decisions affecting tomorrow's landscape"[3]. By analysing historical documents and archaeological findings etc. one can start to understand why the landscape has taken a certain shape over time. It is a means to analyse and identify historical and cultural values in the present landscape.

Höje å

The name of the small river or stream central for the project. The term is used to label the stream and its embankments (figure 2).

Landscape

Landscape is defined by the European Landscape Convention as "an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors"[4]. It is a physical space or area that can be perceived and experienced by people.

Landscape analysis

"Landscape analysis describes a study area and its context in several dimensions […]. It identifies the process of interest that determines landscape functions and how they are influenced by the different elements that form the physical landscape."[5] It is the process of evaluating the landscape in breaking it up into smaller

[2] Council of Europe [online] http://conventions.coe.int/Treaty/en/Summaries/Html/176.htm, 2013.01.21
[3] English heritage, [online] http://www.english-heritage.org.uk/, 2012.12.20
[4] Council of Europe, [online] http://conventions.coe.int/Treaty/en/Treaties/Html/176.htm, 2012.11.06
[5] Botequilha Leitão A., Ahren J., 2002. Applying landscape ecological concepts and metrics in sustainable landscape planning, *Landscape and Urban Planning*, vol. 59, page 81

components. Different tools and media are used, in this case including HLC, LCA, maps, photos, site visits, interviews etc.

Landscape design

"Design is […] the act of creating physical form and expression in landscapes."[6] It has a strong creative process involved and is in this thesis used complimentary to landscape planning.

Landscape planning

"Planning is understood as proactive action(s) to achieve specific goals and objectives."[7] It is a process of relating landscape functions with each other, organising the land. Within, or complimentary to, landscape planning is landscape design.

LCA

Landscape Character Assessment (LCA) is a tool that assist the identification of "features that give a locality its 'sense of place'"[8], requiring different depth of analysis; from a wider regional scope of study to the site specifics.

Negative planning

The term 'negative planning' is used in the *Theme Course.* It refers to the approach of wind power planning where wind power turbine locations primarily are based on limiting regulations; mainly noise- and flickering regulations.

Positive planning

Also a term used in the *Theme Course*. It refers to the siting of wind power turbines based on landscape analysis and by identification of land areas suitable for it, prior to testing the noise- and flickering levels. Turbine locations are suggested where they

[6] University of Massachusetts Amherst, Landscape Architecture and Regional Planning [online] http://www.umass.edu/larp/mla/ecological.html, 2013.03.06

[7] University of Massachusetts Amherst, Landscape Architecture and Regional Planning [online] http://www.umass.edu/larp/mla/ecological.html, 2013.03.06

[8] Natural England [online] http://www.naturalengland.org.uk/ourwork/landscape/englands/character/assessment/default.aspx, 2012.11.30

first and foremost can be integrated in the landscape, follow existing regulations.

Project area

The area directly affected by the design proposal (figure 2).

Theme Course

Theme Course refers to a course arranged by SLU at Alnarp in autumn 2011 and participated by the author of this thesis. It focused on inter-municipal wind power planning and the development of siting strategies. One site-specific project proposed by the course is used as the basis for this thesis. The local analysis is a course result but further explored in this thesis, and the sites of the turbines is kept untouched.

PROJECT AREA

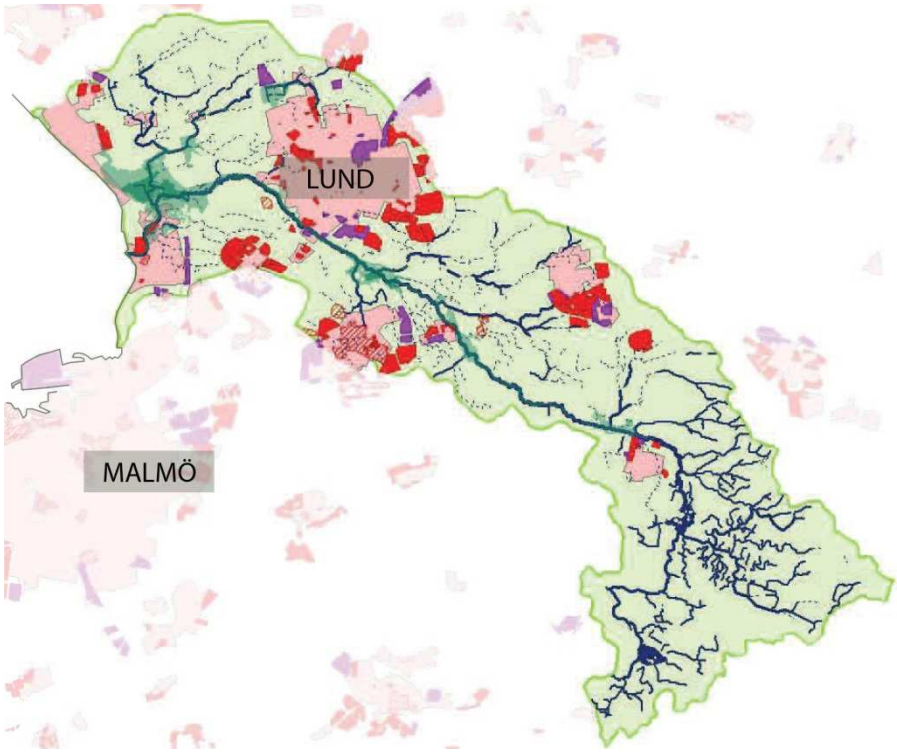


Figure 1: Höje å and catchment area (map by: *Höje å vattenråd*)

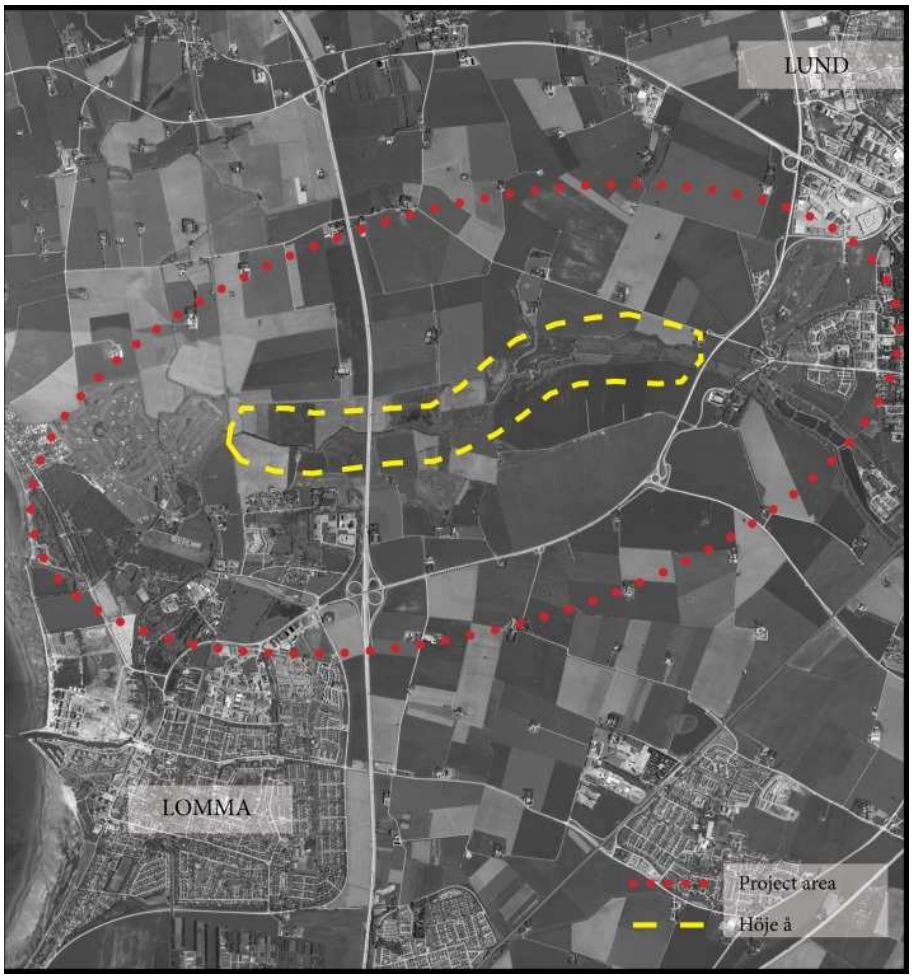


Figure 2: Yellow zone is referred to as the ’project area’, red zone is the ’extended project area’ which have direct influence on the project area.

2. THEORY

2.1 WIND AS A NATURAL FORCE

Wind is a natural force that affects everything and everyone in one way or another; it brings fresh air –or pollutants, exerts a force upon land and structures, and affects the apparent temperature. Wind is perceived through our senses; it can be felt, seen and heard, and even bring fragrances. The wind together with our senses plays a major role in how we relate to the landscape and how we feel about a certain place. Pasqualetti (2001) says the wind is part of local life when talking about the San Gorgonio Pass. He continues: "The wind has become so much a part of us that we feel out of sorts when air is still."[9] This quote especially had an influence on the author of this work, experiencing this very feeling the first time outdoors in complete stillness in a Swiss valley. The feeling was like the world had been frozen, and just as Pasqualetti describes it, one feel out of sorts. In a wind power landscape wind will be a prominent factor, affecting the experience, both visually and physically. If the wind resources are not good, the turbines will have to be placed elsewhere. To understand how the winds may affect and shape the landscape, the forces creating wind need to be understood as well.

Figure 3 and 4: wind in action

Simplified, wind is the movement of gases that makes up the atmosphere. This occurs when the gases are either heated or chilled creating pressures differences. In order to create a state of equilibrium air is flowing to merge into one even-pressured mass of air[10]. Due to the shape, topography and movement of the earth, different areas and places are constantly heated at different rates affecting both global and local climate. The earth has several static winds (in terms of wind direction) stretching over continents. Due

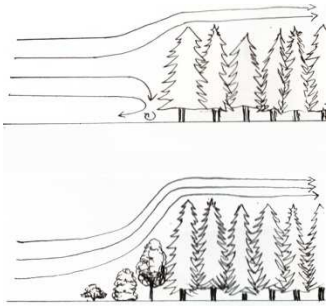


Figure 5: wind's movement is affected by the landscape topography and fabric. Above is a sketch of how it acts at a woodland edge

[9] Pasqualetti M. J., 2001. Wind energy landscapes: Society and technology in the California desert, *Society & natural resources: An international journal*, 14:8, 689-699. London: Routledge, page 609 and 697

[10] Buckley B., Hopkins E.J., Withaker R., 2005, *Weather*, Reader's Digest Association Ltd, London, page 32

Figure 6: sand drift across road due to wind
Figure 7: rocks erroded by
Figure 8: pines shaped by

to the rotation of earth, the motion forces the airflow westwards which means mirroring wind patterns at the planet's surface will be moving towards the equator (North Eastern winds from northern half, South Eastern from southern half)[11] . The same will happen at the Arctic and Antarctic circles. Between those two wind-systems opposite winds are created, forming South West originated winds in the Northern hemisphere and North West in the south[12], which are the winds we usually experience in Europe. Wind is highly influenced by the land it is passing over. When passing flat, open areas such as fields or oceans, it can maintain a high speed. While passing more topographic areas, friction is created and the wind will lose momentum. For wind power planning naturally windy areas (i.e. flat land, mountain ridges) is of high interest, creating a reliable source of energy[13].

Land is mainly affected where frequent harsh winds wear down rocks. It is often one of the main forces shaping for example canyons, cliffs and exposed stones[14].

Sand dunes are also affected by wind, and top soil can be carried off if no sufficient groundcover is there to bind it down. This has been a problem in for example Iceland for a long time[15], where sand flight is a pressing issue. Though, erosion is not only a problem. It is a vital part in the creation of soil as well. The particles broken off from the rocks by wind and weathering are creating new soils where plants can grow and water be held[16].

It is not only the hard landscape which is affected, also the soft landscape responds to wind. It is very obvious with trees, commonly along the coasts. Here the strong winds from the sea force the trunks and branches to grow in a downwind direction,

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[11] Buckley B. *et al*, 2005, page 32
[12] Ibid, page 32
[13] Wizelius T**.,** 2007. *Developing wind power projects –theory & practice*. London: Earthscan, page 38-46
[14] Buckley B. *et al.*, 2005, page 46
[15] Ashwell I., *Glacial control of wind and of soil erosion on Iceland*, [online] http://www.jstor.org/pss/2561784, 2012.10.15
[16] Science [online] http://science.jrank.org/pages/6244/Soil-Soil-formation.html 2012.10.14

both due to the strength of wind and due to dehydration of branches and buds on the exposed side[17]. It also makes them more sensitive to other winds. By always being under stress in a certain direction, the trees are sensitive to winds from other directions which may cause them to snap.

For planning purposes, the recognition of land formation and erosion is significant in the understanding of an area. By appearance of the landforms and plants one can see how the natural forces are acting on site. With this at hand, designs based on the local climate can be developed to enhance or prevent the effect wind has in an area. Knowing that the project area is exposed to wind, care should be taken avoiding leaving the soil bare. It is also possible to work with the contrast of exposure and shelter throughout the design.

[17] Chaney, W.R, 2001. *How Wind Affects Trees* [online] http://www.fnr.purdue.edu/inwood/past%20issues/windaffe.htm 2010.12.02

Figure 9: sailing boat
Figure 10: traditional wind mill

2.2 WIND UTILISATION

Through millennia, the power of wind has not only shaped the land, it has also been utilised by humans to improve the ability to make food (wind mills) as well as to travel (sails). Wind was grinding, pumping, moving; simply helping us. By the sheer force of wind, trade and colonisation sped up. When not relying on only land routes to foreign countries, or on manpower to move a boat forward, the opportunities increased immensely. Thanks to the technique of sailing people were able to move between landmasses separated by water, which led to economic growth for some countries, developing areas earlier unapproachable by humans as well as import of new food, plants and ideas to a much greater extent than before[18]. In a more home-based situation, wind was of massive importance for grinding and treatment of grains, providing for example flour to people where maybe water mills were not an option. Today old windmills are often listed buildings and are an important part of the landscape it sits in. Holland and Portugal are two nations closely associated with wind mills, now demonstrating how something originally purely functional over time can become an integrated symbol of the country – a cultural heritage. Wind mills do in both countries feature on postcards and on tourist information pages[19].

Today wind has also become a force for art. An example is "Courtyard in the Wind", München, by Acconci Studio and Wolfgang Niemeyer[20]. On top of a tower located on one of the buildings surrounding the courtyard a wind turbine has been constructed. This turbine powers a set of underground wheels. The wheels in turn rotate a circular part of the courtyard (figure 11, 12) making the appearance constantly changing. The path that was there only little ago will suddenly be broken by a patch of grass,

[18] Merec J. *Catch the wind: how sailing changed the world, and the future of the oldest renewable* [online] http://www.geol.umd.edu/sgc/lectures/wind.html, 2013.01.04
[19] Hollan [online] http://www.holland.com/uk/Tourism/Activities/Traditional/Windmills.htm, 2013.01.04
[20] Margolis L. & Robinson A., 2005, *Living systems.* Germany: Birkhäuser Verlag AG, page 128

and the lawn is broken by a sudden set of paving –the design goes in and out of alignment.

"A portion of a common courtyard design becomes a moving image of constructed nature, where trees, paving, lighting, and benches alike revolve as if on display." [21]

Another example is the "Wind Vail" by Ned Kahn. Here he wants to "*reveal the effect of the invisible*"[22]. It is an exterior wall which consists of several panels on frictionless hinges. When the wind passes by it illustrates the pattern and turbulence of the wind suddenly visible for anyone, like a field. It is something rare to be able to see the dynamics of wind so clearly. But this construction does not only serve to bring a visual life of wind to people. The design is partly architectural, partly a landscape display and partly artistic. Positioned in front of the lobby, the Wind Vail acts as a cooler for the building as well, letting air through as well as reducing solar gain hitting the windows behind. It cools the interior of the building. It is *"blurring the boundaries between landscape and architecture"*[23], an interesting and different approach to wind utilisation.

Figure 11 and 12: 'courtyard in the wind' by Niemeyer

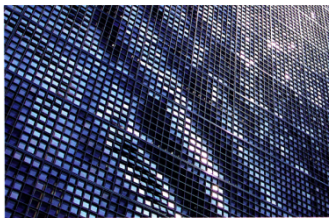

Figure 13 and 14: 'wind vail' by Kahn

2.3 DESIGN THEORY

2.3.1 a brief landscape history

Through the course of writing the thesis it was interesting to notice 'design' is not commonly used as a tool for large scaled landscape developments like the proposed area. The terms used in comprehensive plans and in texts are 'planning' or 'master planning'. When looking further into the use of the terms one can see they shifted over time. To see if it is possible to 'design' large landscapes, an understanding of landscape treatment over time is

[21] Margolis L. & Robinson A., 2005, *Living systems.* Germany: Birkhäuser Verlag AG, page 141
[22] Ibid, page 142
[23] Ibid, page 142

important. A selection of main approaches and theories behind historical landscape shaping is presented in this chapter.

2.3.2 human power over nature

"As late as the eighteenth century, the most common usage of the word 'wilderness' in the English language referred to landscapes that generally carried adjectives far different from the ones they attract today. To be a wilderness then was to be 'deserted', 'savage', 'desolate', 'barren' – in short, a 'waste', the word's nearest synonym. Its connotations were anything but positive, and the emotion one was most likely to feel in its presence was 'bewilderment' – or terror."[24]

Until the eighteenth century, nature and the wild landscape was something to fear, something that humans should put under control. Environmental historian Dr J. Oosthoek even goes as far as to say this urge explain the formation of some religions. People were above nature and were to dominate it, but everything was not within their control. Draughts, flooding, earthquakes etc. were hence claimed to be from forces "beyond human control"[25]. Further he writes that both Greek rationalism and Christianity developed the idea that nature was created to bear no value unless utilized and inhabited by humans[26]. To place this meaninglessness of nature in the name of religion might have made it even more important to humanise it in a way. In today's society such statements does sound rather obscure, but we are living in a very similar manner where we tend to believe we can use the natural resources to our delight. Of course, today there is public awareness that resources are limited and that we have to treat them with care.

[24] Cronon W., 1995. The Trouble with Wilderness; or, Getting Back to the Wrong Nature, *Uncommon Ground: Rethinking the Human Place in Nature*, 69-90. New York: W. W. Norton & Co. page 70
[25] Oosthoek J. K., Environmental History - Between Science and Philosophy, *Environmental History Resources.* [online] http://www.eh-resources.org/philosophy.html, 2012.11.11
[26] Ibid

Still, it does not stop our exploitation and the growth of the world's population and living standard demands for more

To the medieval population of Europe wilderness was, as described in the quote above, a terrifying place, full of beasts, and where paganism flourished[27]. It was a great achievement to show your control of your land. This might have laid at basis for park design movements such as the Italian renaissance and French formal gardens in the 15th relatively 17th centuries. The geometric formations and shaped vegetation can be seen as a demonstration of human mastery over nature[28].

One of the most famous examples is the garden Versailles which features the typical traits of the French formal garden (figure 15, 16): central axis, geometric layout with fountains at regular intervals, trees planted in squares, a building overlooking a terrace, well-trimmed shrubs and hedges in spherical shapes and intricate patterns etc.[29]

During the succeeding century landscape design took a completely different turn.

2.3.3 the idealistic landscape

During the 18th and 19th centuries the consensus started to shift from the formal and highly controlled landscape to a seemingly wild and romantic approach; the English gardens appeared. Man should enhance and improve the natural expression rather than transform it[30].

[27] Oosthoek J. K., Environmental History - Between Science and Philosophy, *Environmental History Resources.* [online] http://www.eh-resources.org/philosophy.html, 2012.11.11
[28] Montuschi E., 2010, Order of man, order of nature: Francis Bacon's idea of a 'dominion' over nature. [online] http://www2.lse.ac.uk/CPNSS/projects/orderProject/Publications.aspx, 2012.11.12, page 2
[29] Chateau de Versailles [online] http://en.chateauversailles.fr, 2013.01.21
[30] Montuschi E., 2010, page 3

Figure 15, 16, 17, Studley Royal Park

Figure 18 and19:
Rievaulx terrace

"The wastelands that had once seemed worthless [and frightening to many] had for some people come to seem almost beyond price."[31]

The move from architectural expression to a more artistic way also earned the movement of the epithet *picturesque,* where the views and the image of the landscape were in focus. Common features for the English or picturesque garden are: rolling lawns, lakes, woodland clearings, viewpoints, foregrounds, ruins, bridges, ha-ha's etc. The latter was used to extend the image of the land belonging to the park owner and to extend the scope of the designed landscape. All in all one can say this approach was an idealised view of nature. A famous example of this is Blenheim in England by Capability Brown. Although nature was to express itself, it was highly planned and well managed. It was experiences that were sought for. Some estate owners went as far as to hire people to live in ruins and play the role of eccentric hermits like at Pains Hill in Surrey[32].

One of the reasons behind this sudden transformation towards a naturalistic approach can be identified as the industrial revolution[33]. By this time, the changes in the landscape were so abrupt and devastating that people started to look at nature in a different way. Changes are still today regarded as a threat, and associated with the "loss of identity, coherence and identity of the existing landscape"[34].

The contrast between the French formal gardens and the English landscape garden is very obvious and prominent. While one is clearly demonstrating the human influence over nature the other one is celebrating nature's appearance[35]. But it is important to keep in mind that also the English landscape gardens were designed and

[31] Cronon W., 1995. page 71
[32] Olsen K., 1999. *18th-Century England*. Westport: Greenwood publishing group, page 91
[33] Antrop M., 2005. Why landscapes of the past are important for the future, *Landscape and urban planning*,70, 21-34. Elsevier, page 22
[34] Ibid, page 22
[35] Montuschi E., 2010, page 4

managed to be perceived in this specific way. The plants used to express nature, the landforms were many times constructed, and land use was indicated in the English gardens, just as in the French gardens.

2.3.4 modernistic planning & function

During the 20th century the landscape continued to change drastically in big parts of the world; industrialisation, large scale farming and forestry, transportation etc. sped up the development. The modern way of landscape designing was a scientific approach based on objectivity, rationalism and function[36]. In the 60's, the modernist planning movement was at its height[37]. Characteristic for the modernistic approach was the separation of usage districts. You were to live in one area, work in another, shop in a third, enjoy your spare time in the next and spend your afterlife in yet another place[38]. The planning was function-based. In Sweden the parks and squares were aimed for the public, being spaces everyone should have a right to access. Wingren (2009) describes how this approach also created many 'in-between landscapes', or 'no-man's-land'[39] where no obvious function has been assigned. These are identified as problematic areas in today's urban fabric. Such areas can be spaces along roads or conjunctions between two larger usage areas. These areas are usually considered 'ugly' with hard surfaces or scattered weeds while also lacking a proper function. It is interesting to try to figure out how people deal with these questions when creating new designs or plans. Other fields of practice do also come across these issues. In for example industrial design, it is important to create a functional product that will do the job it has been designed for while at the same time being

[36] Cross N., 2001. Designerly ways of knowing: design discipline versus design science, *Design issues*, 17(3) 49-55. The MIT Press [online] http://www.jstor.org/stable/1511801, 2012.11.13, page 49
[37] Wingren C., 2009. *En landskapsarkitekts konstnärliga praktik – kunskapsutveckling via en självbiografisk studie.* Alnarp: SLU service/repro, page 102
[38] Ibid, page 102
[39] Ibid, page 102

aesthetically pleasing. The products are typically designed from the inside and out[40], starting with the functions and then finishing off by giving it a form depending on the function. The Industrial Designers Society of America defines industrial design as:

"the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer"[41]

In other words, the aim is to create a product that is functional, involves creativity, has an appealing shape/form having a market value, and sounding to be on an equal basis. For a 'better' product it is however vital the function is considered since the product is serving a specific purpose. But the process isn't the same everywhere. Comparing the approach in Germany and the US during the first half of the 20th century, the Germans focused on the function with precision and simplicity while the Americans put design before function[42]. The result is most likely products targeting different consumer groups. Some look for the best performing products, others look for the most appealing design. It is easy to see this applied to spatial designing and planning, where there are different approaches appealing different target groups. Some promote their ideas by impressive visualisations and concepts while others talk facts, costs and use very precise plans. The concept of industrial design, to produce something which works both functionally and aesthetically, is a valuable approach to bear in mind when designing landscapes. The visual side only may not create a place well used; neither may a functional place without any aesthetic values necessarily become attractive.

[40] Lövstrand C., Vasilevski J-P. R., 2012. *Produkt- och processutveckling*. Mälardalens Högskola [online] http://rolflovgren.se/RL-MDH/Kurser/KPP306/SeminariePM%20vt%202012/SEM1%20%20KPP306%20- %20Grupp%206.pdf, 2012.11.13

[41] IDSA [online] http://www.idsa.org/what-is-industrial-design, 2012.11.14

[42] Lövstrand C., Vasilevski J-P. R., 2012

2.3.5 planning and design

In the previous chapter the usage of the words ‘planning’ and ‘design’ keep reoccurring. What is regarded as planning and what is design can be argued. When working on large scale projects such as wind power developments, it is not common to find the term ‘design’ used to describe an ideal development, but ‘planning’ is. On the other hand when organising i.e. a garden, design is commonly used. One of the research questions for this thesis is to discuss if design is applicable to wind power planning. To be able to answer this question, ‘design’ in a landscape context need to be described.

Usually planning refers to a structural approach, while design is more in lines of art. Looking at dictionary definitions you can tell ‘planning’ and ‘design’ are different but still closely related. Cambridge dictionary defines planning as “a set of decisions about *how* [italics added] to do something in the future” and exemplifies with “a drawing of a building, town, area, vehicle, machine, etc. which only shows its shape from above, its size, and the position of important details”[43]. According to the same source (Cambridge dictionary) design is “to make or draw plans for something, for example clothes or buildings”[44] while Oxford dictionaries define design as “the art or action of conceiving of and producing a plan or drawing of something before it is made a decorative pattern”[45]. Hence design can be regarded as a sub-category to planning since ‘plan[ning]’ is part of its definition. At the same time it also has a strong relation to artistic approach – a creative process.

When looking at *landscape* planning and design, the uses of the two terms have a slightly different connotation. On the University of Massachusetts Amherst’s home for landscape architecture, the difference between landscape planning and design become apparent; “Planning is understood as proactive action(s) to achieve

[43] Cambridge dictionary online, *planning*, [online] http://dictionary.cambridge.org, 2012.11.18
[44] Cambridge dictionary online, *design*
[45] Oxford dictionaries, *design*

specific goals and objectives" while "Design is […] the act of creating physical form and expression in landscapes."46 A way to interpret this definition is to say that planning creates methods to reach specific goals, while design is more of visual outcome like shaping/colouring/sizing the landscape components. It is however not necessary to consider them as two separate processes. On the contrary, planning and design may have synergetic effects if used together, creating strong expressions and forms at both detailed and wider scope of the landscape.

2.3.6 maximised design

Through centuries the human ideal of landscape has changed, being a visual experience with specific functions. Today's broader definition of the term 'landscape' calls for developed design praxis. By combining a design and a functional approach right from the planning initiation, the final result is more likely to become accepted by different stakeholders. It can also become a more sustainable landscape component. In the case of this thesis, the landscape affected by the erection of wind turbines can be considered as the product. There are certain functional requirements from the land and plant owners and restrictions in the development itself like roads, hard surfaces, safety distances etc. which have to be met. At the same time it is supposed to work visually and physically with its surroundings inviting to be used by the larger public. All of this is forming a need for design.

There are several actors working on landscape developments; planners, environmental strategists, architects, landscape architects, developers, engineers, preservationists, landowners, foresters, farmers etc. all with a different approach of planning methods and expected outcome. As a landscape architect working from the frame of the ELC, one has to deal with the landscape from several

[46] University of Massachusetts Amherst, Landscape Architecture and Regional Planning [online] http://www.umass.edu/larp/mla/ecological.html, 2013.03.06

angels and to understand and consider the many different implications.

The proposals for the project area (Höje å) that will be explored in the design chapter would traditionally be called a masterplan since it is a comprehensive presentation of suggestions. Though, I would like to argue that it is actually the result of design as much as planning, and that planning is more of a tool for a well performed design. From the start of this thesis the goal was to create a development scheme for the area, and all research and analysis has been done with this in mind. Since the analysis provides the frame for the design, one can argue that the design started already at the analysis stage. Through the full process of analysis and information collection the aim has been to approach the issue at hand from a wide range of directions to optimise the outcome of the design. A quoting by Karin Hammarlund at SLU: "good design comes from good analysis"[47].

2.4 LANDSCAPE ANALYSIS

The backbone to both the *Theme course* project and this thesis is the general understanding of the landscape affected. Different kinds of analysis shape the foundation for a design. It would be fairly easy to walk out into the area in question, to see what you like and don't, what is there and not, and to start the designing immediately. But that is not the way of dealing with the task based on the definition of landscape set by the ELC. Ignoring the underlying history makes it hard to see the intangible values it present, and the subjective approach of one person's impressions do not necessarily make a true representation for a majority of people. We all have our own imprint or image, and the better we understand the landscape, the closer we might understand other people's views and ideals. In this way, landscape architects may

[47] Pers. comm. Hammarlund K., thesis suprervisor, '*design and planning'*. Ramböll 2012.11.12

create places which are not only considered ‘good form’ from one’s own perspective, but a place where several values are present representing a wider public. Many do not see the link between planning and design; “planning without analysis is like design without analysis, that is, the ‘form’ to not support functions and/or creates no added value”[48]. The analysis process is a working method we have at our disposal which aids the formation of design. The main tools, firstly used in the *Theme Course* and consequently in this thesis, are the HCL, LCA and Lynch analyses. Together they provide a strong and comprehensive insight to the formation of the present landscape and functions and the current way it works. The way these tools are used in this thesis is found the chapters ‘analysis’ and ‘reflections’.

2.4.1 HLC and historical analysis

HCL stands for Historic Landscape Characterisation. This is a process of analysing and identifying historical features in the existing cultural landscape. The HLC is usually based on historical documents, reports, maps and archaeological findings, focusing on features in the present landscape[49]. From these documents and findings you can make an image of what has happened on the land over time and identify trends. Some of the HLC specified guiding principles of the process are:

- Present not past.
- Landscape not sites.
- All aspects of the land, not just ‘special’ areas.
- Bio-diversity is a cultural phenomenon.
- Management of change, not preservation.[50]

[48] Pers. comm. Hammarlund K., thesis suprervisor, ‘*design and planning’*, 2013.01.21
[49] Clark J., *et al*, 2004, *Using historic landscape characterisation –English Heritage’s view of HLC*, English Heritage & Lancashire County Council, page 6-7
[50] Ibid, page 6

With the knowledge gathered one can also map out the time-depth of an area illustrating how long history a certain place or land-use has[51]. It includes everything from an old grave mound, a road which has existed for millennia to a land-use like grazing or governing borders of today and yester-year. The relevance of time-depth demonstrate how firmly rooted some elements are in the landscape. One might ask oneself *why* the element or feature remains the same, or *why* it has changed. Basically the HLC assist the process of understanding *why* the landscape has taken a certain form and where cultural behaviour comes from. In other words, it can help extracting the personality of a place.

2.4.2 LCA analysis

Interlinked with the HLC is the LCA, or Landscape Character Assessment. HLC and LCA can be seen as one unit of analysis, but can also be treated separately. In this document they are presented and performed separately to make sure all the considerations come through in a distinct way. The LCA guidelines were developed by *Scottish Natural Heritage* and *The Countryside Agency*, and are aimed at "all those individuals and organisations whose activities affect the landscape."[52] The purpose is to promote a planning process based on the identification of different components by categorising and assigning each area to a specific character. The LCA defines the "process of making judgements"[53]. The *Oxford dictionary* gives one definition of 'judgement' as: "*the ability to make considered decisions or come to sensible conclusions"*[54]. In the end that means a conclusion has to be reached. The LCA suggest that two people should do the landscape inventory together, both professionals, where at least one person is supposed

[51] Clark J., *et al*, 2004, page 7
[52] Swanwick C., 2002. *Landscape Character Assessment –guidance for England and Scotland.* The countryside agency & Scottish natural heritage, page 1
[53] Ibid, page 2
[54] Oxford dictionary. *judgement*

to be a landscape architect. This in itself can be a limitation to how the land is experienced and described. To only have professionals in the process, who in many cases might be 'outsiders', can give an unbalanced view of important features and values. One of the biggest assets of the LCA is that all land has a character worth evaluation, and that moves the whole process away from earlier methods of pure zoning of areas of special interest. Together with other forms of analysis, it does provide a solid foundation for project development which will be illuminated by this thesis. Though attention to *how* the process is carried through and the areas characterised is important to consider.

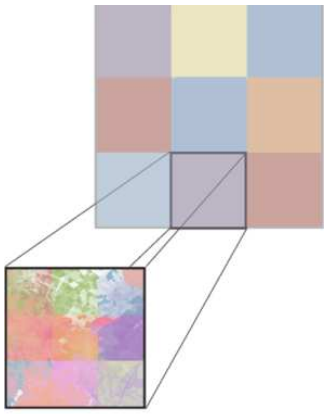

Figure 20: Landscape character *types* are identified in the landscape. These are then further split into identified character *areas*, illustrating the mosaic properties of most landscapes

The LCA works at different scales to accomplish a more accurate system. The wider identification level is the landscape character *type*. These are elements which are repeated throughout a region i.e. 'forest', 'wetland' or 'urban settlement'. Each of these types can be further divided into character *areas*[55]. The areas are more precise and are given a specific name i.e. 'Lomma beach' or 'Faskally woods'. To sum it up, character types are general labels for an area, presenting the main land-use, while the character areas are site specific descriptions. The analysis give a better understand of a landscape, and the LCA is a flexible tool enabling change of character labels over time as the function changes.

Practicing LCA in the *Theme Course*, the class realised the difficulty in deciding on what level and to what detail the types and areas should be specified. The awareness of weak points in the LCA system (i.e. the scale or level of a landscape defined under *areas* and *types*) showed that practitioner has to make decisions for consistency.

[55] Swanwick C., 2002, page 9

2.4.3 Lynch analysis

To further understand the physical landscape, Lynch analysis is a tool which can be used. The book *The Image of the City* by Kevin Lynch has become standard literature for many spatial planning/designing educations. Although his ideas are described in an urban setting, the theories can be adjusted to work on the rural landscape too. The Lynch analysis aids the identification of structures that help us identify, orientate and experience the townscape, and in this case the rural landscape. Through identifying *nodes, paths, edges, landmarks* and *districts* people make use of and move in the landscape in a certain manner[56]. In this thesis *nodes* will be understood as interaction points, conjunctions and other meeting places; *paths* are paths, roads, tracks or other transportation routes; *edges* are divided as solid edges and permeable edges, and can be a perceived edge as well as a physical one. Edges are borders separating one place from another and can be a highway, a row of trees, hedges, streams, fences or a stretch of building facades. *Landmarks* are what they sound to be, markers in the landscape that aids orientations i.e. church towers, hills, wind turbines or chimneys. *Districts* are understood as larger units of land which can be identified i.e. a group of fields surrounded by trees or power lines, areas between houses or areas defined by specific vegetation.

By undertaking Lynch analysis in combination to the LCA and HLC, the background and design foundation of a project has a solid start in the physical and cultural landscape. Historical documents, physical appearance and people's impressions of the present landscape are all discovered and put into context. In all these stages it is important to maintain a public dialogue.

[56] Lynch K. 1960, *The image of the* city¸ MIT Press, Cambridge MA

2.5 THEORY SUMMARY

Wind has always influenced our perceived landscape, intentionally and not. Humans have found ways to utilise the natural force for centuries, leading up to today's wind power developments. To deal with these developments, strategies of how to deal with the landscape are required.

Considering a variety of analysis methods is important when planning and designing for large scaled landscape projects. Either for preservation or development purpose, one must have a sufficient understanding of the area's context based on analysis. The historical analysis (HLC) can provide information of the past. In combination with the LCA analysis (Landscape Character Assessment), the HLC supports a thorough understanding of the present landscape. A combined HLC and LCA analysis gives a valuable background to the design process and appropriate decision options. Adding a rural adjusted Lynch analysis to the process, the interaction of different functional options may be considered in a structured way.

Using the three analysis methods in a holistic perspective can become the success factor to a well-integrated landscape project. The function and the visual appearance will come hand in hand, playing an important role for the overall legibility and practical use. By combining different functions with the aesthetic appearance in a suitable manner, a maximised design can be derived.

The overall potential outcome is a multifunctional landscape where different actors and activities have a real influence, potentially erasing strong zoning borders. The processes discussed provide important tools by identifying the physical and perceived landscape, which can move large scaled planning processes to the design table. A successful and integrated design has its roots in the analysis process.

3. WIND POWER

3.1 INTRODUCTION

In 2009 the Swedish government set a national wind power production goal of 30 TWh/year by 2020, of which 20 TWh/year is considered on-shore. The previous goal set in 2002 was 10 TWh/year by 2015[57], showing a quite noticeable change in policy. In 2011 Sweden's electricity supply relied to 45% on hydropower (~66TWh/year), 40% on nuclear power (~58TWh/year) and just above 4% on wind power (~6,1TWh/year)[58], meaning that the number of wind turbines in Sweden has to increase from todays' approximately 2000 turbines to 3000-6000 turbines[59], depending on size, location, model etc. This change in wind power generation will have a major impact on our landscape. Studies to identify areas of national interest for wind power[60] have been carried out. Some of the proposed areas are located in Skåne where the flat open landscape and closeness to the sea allow the wind to keep a high momentum.

As mentioned in the introduction, a wind power project is not a simple process. Most projects, in Sweden as well as abroad, face local resistance for various reasons which will be discussed in the coming chapters. Even though wind utilisation is an ancient practice, the case of modern wind power is highly controversial. Issues brought up in different researches and in newspaper articles (i.e. Eltham 2008, Schwahn 2002, Breukers & Wolsink 2007 etc.) are: visual impact, noise, flickering, sun glints, airline and radio disturbance, environmental damage on local level, pristine land taken into possession, killing of birds and bats etc. Technical aspects like back-up generation requirements, grid connection and

[57] Energimyndigheten, [online] www.energimyndigheten.se 2012.08.30
[58] Ibid, "energiläget i siffror"
[59] Vindkraftsbranchen, [online] http://www.vindkraftsbranschen.se/wp-content/uploads/2012/02/Statistik-vindkraft-20120213.pdf, 2012.12.26
[60] Vindlov, [online] http://www.vindlov.se/sv/Kartstod/, 2012.12.26

dispersed small scaled generation are also commonly forwarded against the technology (i.e. articles in *Dagens Industri* and *Ny Teknik*[61]).

In Skåne land based wind power does not only face the sceptics of local residents, but may also compete with agriculture and housing development in a growing region rich on high value soils. These contradicting interests need to be dealt with, and this thesis will demonstrate how wind power can co-operate with other ways of land use, and in some cases even be supportive to alternative use.

In the early 90's wind power was referred to in magazines as "lavatory brushes in the air"[62], and their encounter with the landscape as a "battle of green giants"[63]. Since then, media have reported more of the negative sides, especially people's perception. *BEWA* (British Wind Energy Association) has produced a brochure presenting what they call "myths about wind power" which tries to counter the fears and worries of people. This chapter will present some of the arguments that challenge the development of wind energy in order to understand the discussions that arise in relation to developments.

3.1.1 visual impact

Although all energy sources are affecting our landscape (mining, forestry, hydropower etc.), one of the biggest arguments against wind power development is their prominent visual presence in the landscape. Articles like Schwahn 2002 and Jessup 2010, in addition to interviews with residents (the *Theme Course*) and professionals (i.e. Frode Birk Nielsen) makes clear that the visibility of wind turbines in the everyday landscape is a common

[61] Ny Teknik [online] http://www.nyteknik.se/asikter/debatt/article3558665.ece, 2012.10.13, viewed 2013.01.05
[62] Pasqualetti M. J., 2001. Wind energy landscapes: Society and technology in the California desert, *Society & natural resources: An international journal*, 14:8, 689-699. London: Routledge, page 691
[63] Ibid, page 691

argument against this form of landmark infrastructure. Turbines are typically placed in exposed sites[64] as being protruding vertical elements they "[…] cannot be hidden behind hills or trees"[65]. Careless planning hence becomes a dangerous component which can –and have- affected many people's impression of wind power negatively. Scattered single turbines, unorganised groups, incoherent patterns, separation from landscape context, sensitive locations etc. often have a negative impact on people's perception. Seen in this way the turbines do more damage than good to many. The energy may be environmentally produced, but to what cost? Most people have a mental image of their home town or country[66], and an image developed by experience and memory of the place. Any interventions in the landscape should bear this in mind. When developing any infrastructure, it is to work with the everyday environment for people. Turbines can be erected in a day, a quick and sudden change to a landscape people expect to be in a certain way. Schwahn (2002) even argues that people by these changes can "feel expelled from their homeland without physically leaving."[67] Further he says people are not taken seriously when experiencing this feeling, and some may even say "I don't feel at home any longer"[68]. To avoid this, dialogues with the local residents is very important, both to understand their views and to explain why certain suggestions are made. Designers and planners must take peoples personal relation to the landscape into consideration.

Another visual issue wind power developers have to face is the sheer scale of today's turbines. There are several arguments for larger turbines such as higher productivity, less land uptake, less conflicts with birds etc. But upgrading small turbines becomes

[64] Nielsen F.B., 2002. A formula for success in Denmark, *Wind power in view: energy landscapes in a crowded world, 133-150.* London: Academic press, page 118
[65] Schwahn C., 2002, page 139
[66] Ibid, page 139
[67] Ibid, page 139

increasingly hard, especially when it comes to integrate them with the surrounding landscape. Quoting Schwahn (2002);

"*there is no ambiguity about the existence of a wind turbine on the landscape. It is there or it is not*."[69]

Wind turbines are increasing in size so fast that some fear they will fail to integrate in the landscape all together[70]. Studies also show that small scaled wind farms (size and numbers) are not perceived as negatively as larger ones[71]. The challenge in future developments is to integrate the turbines into the landscape in such a way they do not conflict with the identity of the area, hopefully rather strengthening the sense of place. And again, it is important to have undergone a substantial analysis like the LCA and HLC as these tools are made to better understand the sense of a place, and to find ways to incorporate these protruding structures.

3.1.2 nimby and acceptance

Even though the general support for wind power is strong[72], many projects are turned down. Nimby-ism (Nimby = not in my back yard) is a phenomenon where people, who in general are pro wind power, have a negative attitude to development next to their homes or recreation places[73]. There is a strong favour of renewable energy in general -wind power in particular- but when it comes to specific project sites, opposition increase. Nimby-ism has been recognised as the main reason for local residents to argue against developments in general, but recently the explanation of Nimby-ism has been questioned by researchers. Rather, there are many articles voicing

[69] Schwahn C., 2002, page 144
[70] Christensen P., Lund H., 1998. Conflicting views of sustainability: The cause of wind power and nature conservation in Denmark, *European environment*, vol 8, 1-6. [online] www.citeulike.org 2012.09.24, p. 5
[71] Eltham D. C., Harrison G. P., Allen S. J., 2008. Change in public attitudes towards a Cornish wind farm: Implications for planning, *Energy policy*, 36, 23-33, Elsevier
[72] Wolsink M. 2000, Wind power and thee NIMBY-myth: institutional capacity and the limited significance of public support, *Renewable Energy*, 21, 49-64, Elesvier, page 49
[73] Wizelius T., 2007. *Developing wind power projects –theory & practice*. London: Earthscan page 199

public despair for not being able to affect development plans or gaining insight in them, as one of the main reasons supporting Nimby-associated actions[74]. People having a negative opinion on wind power often feel tossed aside and brushed away, as if they do not have proper arguments or simply against environmental resolutions[75]. Oles and Hammarlund (2011) note there is a feeling amid locals that they are excluded from the planning and decision making process[76]. Basically these articles illustrate Nimby-ism as a severe simplification of a problem that is much more intricate, and highlight thee many reasons why developments might be opposed.

People's attitudes towards wind power differ from case to case, but a strong pattern can be identified; the support is weakest during the implementation phase, but is stronger before a location is specified as well as once the turbines have been erected for some time[77]. Projects considered successful and that are well-received by the local population tend to have had a more open discussion at an early stage. In Samsø, the public approval is believed to be partly due to open dialogue, visualisations and images presented during the review process[78]. The same is believed for several other on-shore and off-shore projects in Denmark. Early public involvement is a reoccurring statement by many authors (Eltham *et. al* 2008, Warren *et.* al 2011, Oles, Hammarlund 2011). Still, participation in the process does not necessarily make the project accepted; people who are fundamentally against wind power, will most likely not change view through participation[79], but a least they might understand why a proposal is being discussed. Also, projects in what is seen as sensitive areas may meet resistance even with dialogue.

Figure 21: view of wind turbine along Höje å, close to inhabited areas

[74] Eltham *et. al* 2008, Jessup 2010, Warren *et. al* 2011, Oles, Hammarlund 2011, Wolsink 2005 etc.
[75] Nielsen K., Christensen B. M., [online] *Large wind turbines - noise and neighbours*, https://senate.aph.gov.au/submissions/comittees/viewdocument.aspx?id=5445266a-f403-456d-96e2-8573a26f4704, page 2
[76] Oles T., Hammarlund K., 2011. The European Landscape Convention, Wind Power, and the Limits of the Local: Notes from Italy and Sweden, *Landscape Research*, 36:4, 471-485, Routledge
[77] Eltham D. C., *et. al.*, 2008, page 25
[78] Nielsen F.B., 2002, page 124
[79] Breukers S., Wolsink M., 2007. Wind power implementation in changing institutional landscapes: An international comparison, *Energy policy*, 35, 2737-2750. Elsevier, page 273

A new term has popped up for those who profoundly reject wind power on several bases: NIABY (not in *anyone's* back yard[80]), showing it is not by 'egoistic' reasons they object, but rather on a base of conviction. To understand that there are various reasons behind aversion to wind power is vital to be able to have a discussion about the topic. And these opinions have to be treated seriously.

3.1.3 environmental impact

A common argument against wind power having many supporters is the environmental impact a development may have on its immediate natural surroundings. All constructions have a direct local effect, and wind turbines are no exception. Roads have to be constructed to fit the long trailers transporting rotor blades and other components, the foundations have to be dug down etc. Once in place, there are still issues about i.e. birds and bats colliding with the rotor blades. The impacts are great, and the effects depend on how sensitive the area is, as well as where the transportation routes go. It is a fact that birds and bats get hit by the rotating turbine blades. *Vindval* recently presented a brochure with some facts about birds, bats and turbines, and tries to put it in a Swedish perspective at the same time. Some examples are;

- *Wind turbines in Sweden kill some 25,000 birds/year (based on 2.3-7.3 birds/year/turbine and 5,000 turbines)*
- *Windows kill about 500,000 birds/year*
- *Power lines kill about 200,000 birds/year*
- *Bats are killed by rotor blades when hunting*[81]

Recent research indicates bats are more sensitive to turbines than birds[82].

[80] Nielsen K., Christensen B. M, page 2
[81] Vindval, 2011. Brochure: *Vindkraftens påverkan på fåglar och fladdermöss*, page 4

From *Vindval's* report, areas identified with low risk for disturbing birds include urban settings and intensely used agricultural and forested areas, while for bats the low risk areas are open agricultural land and mountain heath lands. High risk landscapes for birds are close to breeding places for 'endangered' species, close to areas with high concentration of migrating birds, in wetlands and some coastal areas. Bats are more sensitive on mountain peaks and along the coast and shorelines[83]. There are species of birds which have a higher risk of collision with wind turbines; raptors, galliforms and gulls[84]. In known breeding areas for eagles a recommendation of at least 2 km to closest turbine is issued[85]. Bats hunt at the turbines at low wind speeds and follow the insects towards the top. Also here there is a relation between species and death numbers. None of the most wind power sensitive bats are threatened in European terms[86], though that does not motivate placement of turbines close to known concentrations of these, and proper environmental impact assessment should be undertaken to understand the effects at each site.

In the environmental impact debate wind power developers usually promote the lack of emissions and production of 'clean and renewable energy'. Still there have been questions to what extent this is true. Some argue the environmental footprint of turbines counter-effect their purpose by using more energy during their production than they produce themselves. A report by *BWEA* (British Wind Energy Association) focuses on countering what they call 'wind power myths'. They claim it is a 'myth' that the carbon footprint is counter-effective by stating modern turbines can usually "payback" the energy used in its production within 2-10 month of activity[87]. Both sides of the wind power discussion (for-

[82] Vindval, 2011. Brochure: *Vindkraftens påverkan på fåglar och fladdermöss*, page 4
[83] Ibid, page 7
[84] Ibid, page 7
[85] Ibid, page 12
[86] Ibid, page 14
[87] BWEA, 2006. Facts on Wind: Top 7 wind farm myths dispelled. [online] www.bwea.com/pdf/Briefing_Sheet_Artwork_Screen.pdf, 2012.09.26, page 2

and-against) commonly have environmental issues at hearth[88]. One side sees the local habitats and eco-systems disturbed and in some cases obliterated when turbines are erected, while the other side sees a global environmental danger if we do not change fossil fuels to i.e. wind generated energy. By keeping in mind that a majority argue *for* an environmentally responsible future, although the vision is contradicting, the debates might become less emotional and accusatory from both ends.

3.1.4 noise, flickering, security and recreation

From a health perspective noise and light is a problematic issue for wind power planning, but wind power is not the sole infrastructure project facing this type of problem. Power stations of all kinds have to severely look over their impact on locals as well as workers health. This includes everything from work security to long distance emissions. The rotations of the wings create sound, and this can be quite annoying and may affect resident's well-being. Previously mechanical sounds were emitted, but technology and dampening has eliminated this[89]. The sound emission has led to regulations in the planning process where a certain distance to houses has to be followed, though some municipalities call for a larger distance between turbines and dwellings.

In Sweden the maximum sound at a dwelling is 40 dBA, while at recreation areas the level is 35 dBA[90]. The sound emission has also started a discussion if recreation and wind power may co-exist. The *BWEA wind power myths* counters the noise argument by stating today's turbines are much more silent than earlier models and hence have a minimum audible impact. *BWEA* also present, as a

[88] Warren R. C., Lumsden C., O'Dowd S., Birnie V. R., 2011. 'Green On Green': Public perception of wind power in Scotland and Ireland, *Journal of Environmental planning and management*, 48:6, 853-875. London: Routledge, page 854

[89] Wizelius T., 2007, page 158

[90] Wizelius T., 2007, page 161

fact that few people send in complains regarding noise disturbance[91]. This does however not mean the turbines are noiseless so one has to be careful to not slight these issues. Our sensitivity level to different sounds varies from person to person[92].

From a visual disturbance point of view (not in terms of visibility or suitability in the landscape), the wings do project rotating shadows which can be found disturbing and arguably also a health risk for some[93]. Just as for sound, there are regulations. Conclusions about how much flickering is allowed to fall upon each dwelling through a year have been set, and the levels are tested by simulations before construction. Most of the flickering effect is avoided by the distance required by the sound regulations, or by placing turbines no closer than about 6-10 rotor blade's distance to houses[94]. Today's larger turbines have lower rotor speed and the rotation is slow enough to not cause for example epileptic attacks[95]. Still, shadow casting is an issue and may affect people at least emotionally.

Wintertime there is another wind power danger to consider in recreational or inhabited areas; ice throw[96]. If a combination of wind power and recreational area is proposed, a security system for reducing risks to man for ice throw is needed. Possible actions can be closing of paths, stopping the turbines or having a proactive system to prevent ice formation. Göran Ronsten presented the issues of ice and some methods to counter the problem at *Nationella vindkraftskonferensen 2012* (national wind power conference 2012). In a personal correspondence Ronsten does not recommend recreation around turbines when there is a risk of ice

[91] BWEA, 2006, page 1
[92] Soames J.R.F., 1999. Noise sensitivity as a factor influencing human reaction to noise, *Noise & Health*, 1:2, [online] http://www.noiseandhealth.org/article.asp?issn=1463-1741;year=1999;volume=1;issue=3;spage=57;epage=68;aulast=Soames, 2012.12.23
[93] Nordman E., 2010. Wind Power and Human Health: Flicker, Noise, and Air Quality, *Technical Reports.* Paper 8. [online] http://scholarworks.gvsu.edu/bioreports/8, 2012.11.14, page 2
[94] Wizelius T., 2007, page 161
[95] Nordman E., 2010. page 3
[96] Ronsten G. CEO at Windren AB, '*hur kan riskerna med is minimeras?*´[presentation] at national wind power conference, Kalmar 2012.05.24

throws, unless it is necessary[97]. In his presentation Ronsten highlighted the issue of temperature difference between ground level and temperature at rotor blade levels[98], which can make people unaware of the potential of rotor blade icing.

These are all very important matters to take into consideration since it is not only an opinionated problem which may be discussed, but may provide health issues and risks. These problems have to be approached seriously through the planning and development stages as well as during operation and maintenance.

3.1.5 economic effects

The economic viability of wind turbines is highly discussed. Another discussion is the turbine's effect on local economies. Some fear their houses will lose value with the erection of turbines, as well as tourism businesses will be suffering. Large, noisy turbines are seen as a threat to businesses and locals alike in many places. Surveys have started to come through completion the last years, and there are indeed people who claim they would not chose to go for holidays to an area where turbines are present. But there were equally many people who regard these places as a destination as well[99]. In a report by Aitchison (2012), commissioned by the Scottish Government on the question of wind farms' effect on tourism, she identified that tourism is increasingly important for regeneration of rural areas in the UK. Aitchison also concludes that research indicates that negative impact on tourism by wind power is outweighed by the job opportunities it provides, that some tourists are attracted to the turbines, and/or by the overall increase of tourism which occur unrelated to wind power developments[100]. Further economic effects that may influence the opinion of a new establishment is a direct profit potential for people

[97] Ronsten G. CEO at Windren AB, '*ice throw*', [correspondance] 2012.12.20
[98] Ronsten G.[presentation] 2012.05.24
[99] Eltham D. C., *et al.*, 2008, page 24
[100] Aitchison C., 2012. *Tourism impact of wind farms*, submitted to renewables inquiry –Scottish government, the University of Edinburgh, page 3-4

related to the development in forms of income from land lease or ownership shares. People who have an economic interest in wind power turbines are generally much more positive to accept them in their everyday landscape[101].

3.2 PRECEDENCE STUDIES

Multifunctional landscaping can potentially include any area of use, but the main interactive functions considered in this study are:

- Biking and hiking access
- Preservation of cultural landscapes
- Biodiversity
- Tourism
- Viewing platform opportunities
- Off-shore habitat creation
- Sustainability

3.2.1 Klinkby

In the research for this thesis special attention has been given to Danish projects. First and foremost Denmark is a leading country in wind power development and can present numerous examples of different turbine and farm sizes, locations and integration. Plenty of research and papers has also been produced based on Danish examples. Dominated by agricultural farmland Danish landscapes, are very similar to Skåne's. Wind resources as well as ecology and topography are comparable. Cultural traces such as Bronze Age grave mounds is another feature shared. Helgesson (2001) says that the gold findings from the migration time (~5th century) in western Skåne are reflected in the eastern parts of Sjælland [102], highlighting the depth of historical similarities.

[101] Krohn S., Damborg S., 1999. On public attitudes towards wind power, *Renewable* Energy, 16, 954-960, Elsevier, page 956

[102] Helgesson B., 2001. Uppåkra in the 5th to 7th centuries. The transformation of a central place and its hinterland, *Central Places in the Migration and the Merovingian Periods*,31-40, page 34

Klinkby, located in the north west of Jutland, is a small wind power development consisting of four turbines placed in a row along the direction of an agricultural field. The landscape of the area has many similarities to the proposed development area along Höje å - the farms are scattered, agriculture is extensive, Bronze Age burial mounds are found in its vicinity, and a canalised stream is flowing nearby[103]. The turbines are located on a raised plateau at the edge of a valley. To create a cohesive structure which has "authority" and harmony in the landscape, the spacing is dense[104]. Interestingly the access road does not seem to lead to all the turbines. A tractor track leads up to the first turbine in the row, and then blends into the field pattern of management. What if access roads are not required, or if access roads or tracks can have multiple use? If so, the land impacts could be reduced. But, as Frode Birk Nielsen stated in an interview, a proper road access is advisable since heavy and large vehicles might be required in case of emergency[105].

3.2.2 recreation and wind power

The Norwegian energy company *Statkraft* has a goal to invest 1,100MW on-shore wind power by 2015[106]. Today the company has three Norwegian wind farms in operation and a general power development approach as follows:

"Areas used for power generating activities can also function as valuable habitats for animals and plants, as well as for agricultural or recreational areas. We believe that we can

[103] Nielsen, 2002. A formula for success in Denmark, *Wind power in view:energy landsapes in a crowded world, 133-150.* London: Academic press, page 117
[104] Ibid, page 117
[105] Pers. comm. Nielsen F.B., landscape architect & wind power planner, '*wind power planning and energy landscapes'* [interview] SWECO Aarhus. 2012.11.02
[106] Statkraft [online] http://www.statkraft.com/sustainability/social-responsibility/environment/default.aspx, 2012.09.28

facilitate multiple uses of these areas by making careful adaptations tailored to local conditions."[107]

At Smøla, one of Europe's largest land based wind farms having 68 turbines, the access roads are used as bicycle lanes[108] as well as skiing tracks[109]. The access roads provide good conditions for alternate use. Altogether, the functions of the roads add an additional value and use to people - intentionally or not.

The off-shore wind farm of Scroby Sands in eastern England was commissioned in 2004 by E.ON UK[110]. The wind farm consists of 30 turbines with a total capacity of about 60 MW. Interestingly though E.ON has managed to make it a tourist attraction. As previously discussed, there is a fear of tourism suffering from wind power developments even if supporting research is lacking. At Scroby Sands, the visitor centre attracts 35,000 visitors annually[111], which means "[…] regardless of changes in the annual tourist flux, the visitor centre has served to provide an additional attraction for tourists[112]." The visitor centre is open from May to October and has interactive activities for visitors in all ages interested in the construction and operation of the wind farm. Situated only 2.5 km from the shore, the wind farm is considered a local land mark[113], highly visible from land.

In the US large wind farms were established in the 1980's, especially in California. As an early development San Gorgonio Pass outside Palm Springs encountered problems that the developers did not expect, and which affected the local opinion on wind power in the area. Before the erection of the turbines, the

[107] Statkraft [online] http://www.statkraft.com/sustainability/socialresponsibility/environment/default.aspx, 2012.09.28
[108] Westerberg V., *et al.* 2012. *The case for offshore wind farms, artificial reefs and sustainable tourism in the French Mediterranean*, Document de researcher draft 2012-11. [online] www.lameta.univ-montp1.fr/Documents/DR2012-11.pdf 2012.10.01
[109] Statkraft [online] http://web.archive.org/web/20071006073510/http://www.statkraft.no/pub/vindkraft/reportasjer/SkidagSmola.asp, 2012.10.31
[110] E-on [online] http://www.eon-uk.com/generation/scrobysands.aspx , 2012.10.22
[111] E-on [online] http://www.eon-uk.com/generation/scrobysands.aspx , 2012.10.22
[112] Westerberg V., *et al.*, 2012, page 4
[113] E-on [online] 2012.10.22

barren land in the desert valley framed by mountains was commonly considered pristine and the wind was felt rather than visually seen[114]. Pasqualetti (2001) describes the San Gorgonio Pass after the development as a transportation corridor where people on the way from "civilisation" will see the wind farm as the frontier to the wildness. The new unofficial "gateway" to Palm Spring came as a shock to many. The criticism triggered legal responses and an increase in hostility towards wind power in general[115] The way the development was met is a good learning example. Even though the wind farms were distant from urban settlements, people had a certain relation to the landscape. They felt as they had lost this pristine landscape by the sudden appearance of wind turbines. Over time though, the perception of the San Gorgonio Pass landscape has changed. Today the turbines themselves attract visitors and people stop to take photos, just as before but with another objective in mind. The turbines have also been featured as a backdrop to films and commercials over the years, and Pasqualetti (2001) claims this happens "precisely because they are so evocative"[116].

On Grouse Mountain, Vancouver BC Canada, a single wind turbine serves as a viewing tower. The advertisement is attracting visitors by highlighting it being the "first and only wind turbine" where the public has access to this kind of building[117]. The advertisement also uses the selling point of standing only three meters away from the rotor blades[118]. The turbine in itself has become an attraction, presenting amazing views of Vancouver and the surrounding landscape.

[114] Pasqualetti M. J., 2001. page 690
[115] Ibid, page 690
[116] Ibid, page 696
[117] Grouse Mountain [online] http://www.grousemountain.com/eye-of-the-wind, 2012.12.10
[118] Ibid

3.2.3 ecological planning and wind power

Located in Romney Marsh on the south east coast of England, Little Chayne Court is the largest on-shore wind farm in southern Britain. Containing 26 turbines, each of 2.3 MW, it may provide electricity for about 33,000 households[119]. The turbines' distance to the sea and the farmland's role as an agricultural production landscape as well as being a winter residence for migrating birds is compatible with Höje å. Parts of Little Chayne Court are included in a nature reserve, and have high environmental values. The area has also been suggested to become a Ramsar site[120] (convention of conservation and smart use of wetlands), which will be interesting to see if the wind power area could be included in this proposal. During the wind farm development phase, attention was paid on how to incorporate ecological advantages to the monocultural farm land. Along the access roads and on the crane pads herbal corridors were created by seeding a grass and flower mix attracting insects[121]. The seed mix was chosen to attract the short-haired bumblebee which died out in Britain due to a lack of habitat and from the extensive use of pesticides[122]. Little Chayne Court wind farm and the Romney Marsh area is part of a regional project where 650 ha land has been prepared to accommodate for the bumblebees specifically[123]. There was close cooperation with the farmers, who also benefit from a strong bumblebee population due to their importance for crop pollination[124]. The preparations have been on-going for three years, coinciding with the operating time of Little Chayne Court. The wind power development does not seem to have any negative impact on the bumblebee project. On

[119] RWE innology –Little Cheyne Court Wind Farm [online] http://www.rwe.com/web/cms/en/310488/rwe-innogy/sites/wind-onshore/united-kingdom/in-operation/little-cheyne-court/ 2012.10.22
[120] [online]www.naturalengland.org.uk/Images/ramsar_citation_tcm6-21540.pdf, 2013.01.10
[121] RWE innology –Little Cheyne Court Wind Farm, leaflet [online] http://www.rwe.com/web/cms/en/310488/rwe-innogy/sites/wind-onshore/united-kingdom/in-operation/little-cheyne-court/ 2012.09.26
[122] The Guardian, 2012.04.26, *Extinct short-haired bumblebee to be reintroduced in England*, [online] http://www.guardian.co.uk/environment/2012/apr/26/extinct-bumblebee-uk-release, 2012.10.22
[123] Ibid
[124] NaturealEngland [online] http://www.naturalengland.org.uk/ourwork/conservation/biodiversity/shorthairedbumblebee.aspx, 2012.10.25

the contrary it appears as the wind power development utilised the bumblebee project as a theme to deal with the roads and platforms. It shows the benefits of involving eco-projects in present or planned wind power projects. In Romney Marsh an increase in biodiversity has already been registered, thanks to the flower corridors between fields and along roads etc[125].

In 2011 *Jordbruksverket* (Swedish board of agriculture) published a report showing methods to create biodiversity in the construction of natural environs in wind turbine developments[126]. It is a 'handbook' for habitats adjacent to wind power developments, and suggested interventions are highlighted as important opportunities. With small means and methods, alterations in the open landscape of Skåne can provide a number of new habitats. By addition of deadwood, sand piles, stone piles, meadows, water, vegetation etc. in the wind turbines construction area, environmental improvements can be made. In regards to wind power development the report uses the term 'creotopes' defined as:

"*a constructed environment developed from a generalised template for how ecological structures, i.e. sand, deadwood, shrubs, can be combined to favour biodiversity*".[127]

Suggestions of creotopes presented by *Jordbruksverket* are portrayed in figure 23-25. Although the report gives the impression of clear ecological benefits by these inventions, scepticism has been raised. Jonna Nilsdotter, ecology master student at Lund University, has also studied the report and is questioning if these interventions really do work. According to her opinion the inventions are too small and too scattered to have a proper environmental impact, and she would like to propose larger interventions for actual effect[128]. But the intervention may be the

[125] Hymettus [online] http://hymettus.org.uk/Short_haired_Bumblebee_Project.htm, 2013.01.10
[126] Nilsson E., Amersson M., Eriksson A., 2011. *Vindkraft i slättlandskapet: Så gynnar anläggning av naturmiljöer den biologiska mångfalden*. Jordbruksverket
[127] Nilsson E., *et al.*, 2011, page 10
[128] Nilsdotter J. ecology master student at LU, *'the efficiency of the report from Jordbruksverket in 2011'* [interview] Lund 2012.12.13

start of something larger, especially the proposed green ways along maintenance roads.

Westerberg, Jacobsen and Lifran (2012) take the recreational and ecological discussion in wind power establishment further. They believe turbines to "enhance other sustainable efforts" in an area, where wind power will give a "signal" to a wider environmental movement[129]. So far Westerberg *et al.* are quite alone in the research of how wind farms *can* affect and improve biological and social aspects. Combining their examples with the projects like Smøla and Little Chayne Court, an interesting mixture of functions may evolve and can be incorporated in the planning process of wind power.

[129] Westerberg V., *et al.* 2012, page 3

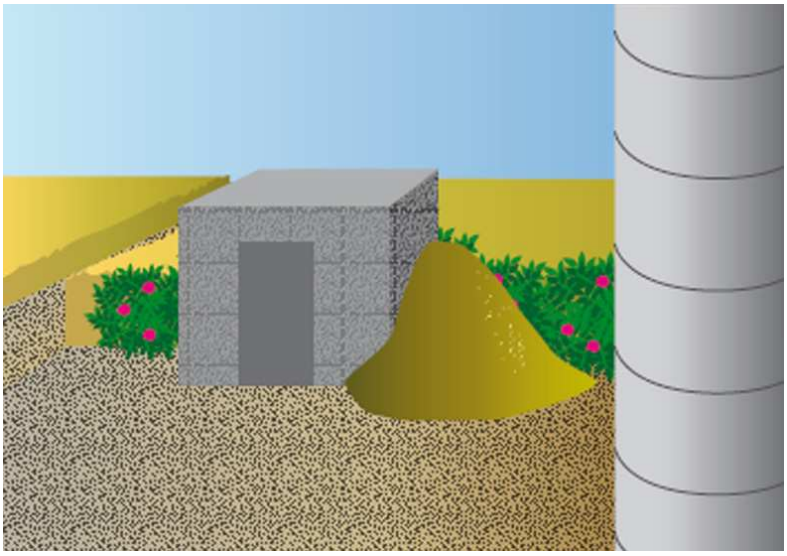

Figure 22: ’Insect kiosk’ by *Jordbruksverket*. South facing sand pile, sheltered from northern winds. Support insects ie. beetles, butterflies and hymenopteras.

Figure 23: ’Frog water’ by *Jordbruksverket*. Small ponds and wind sheltering *salix*. Stone or log piles for hibernation. Support amphibians, dragonflies, beetles and slugs

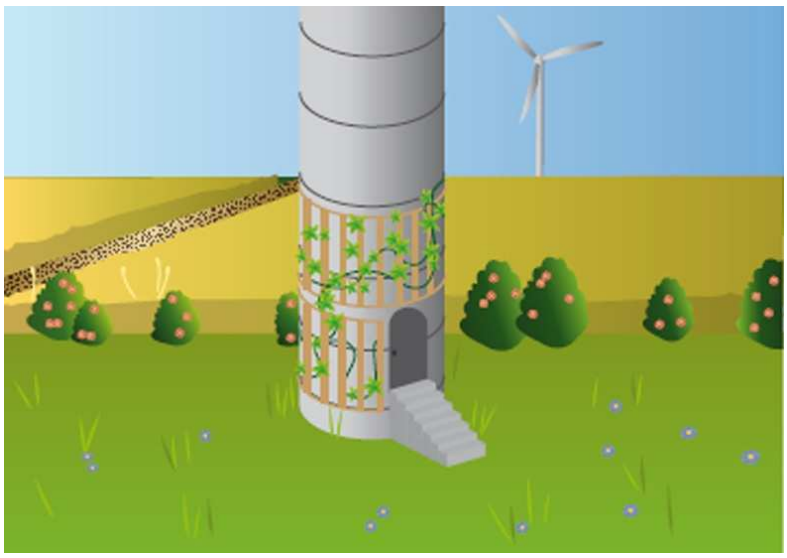

Figure 24: ’Butterfly restaurant’ by *Jordbruksverket*. Soil is added to the construction platform and a flowering meadow is established. Climbers are supported on the turbine. Support butterflies and hymenoptera

3.2.4 summary

Over the years plenty of research regarding public acceptance of wind power has been carried out. One cannot hide the turbines; they will have an effect on the perceived landscape. For some it makes a positive impression, for others the opposite. From the international precedence studies it is apparent that further functions than purely electricity production can be reached in wind power developments. It may be enhanced cultural, recreational or ecological values. These aspects have in most cases not been intentional or planned for, but are important to open up discussions about integration. An interesting observation is that the bumble bee promotion at Scorby Sands could very well fit within the 'creotope' strategies developed by *Jordbruksverket.*

It is important to take a holistic perspective of the landscape considering all landscape components. Regarding landscape issues separately may cause conflicts of interest which are more likely to remain during the development process. By learning how functions and values can co-exist, one may develop integrated landscape designs resulting in synergetic landscapes. As a part of taking additional values into consideration, the placement and size of turbines should be based on the analysis undertaken. This might lead to certain aspects of the landscape being considered important for its identity and the role of different values or functions

Can environmental, cultural, recreational and economical issues justify the construction of wind power? Wind power development may boost the local economy, making land owners keener to give up some land for ecological improvements. At the same time environmental improvements may 'justify' the construction of wind turbines. The indirect benefits of the wind power developments, if treated seriously and included, may turn people in favour for a construction otherwise regarded more sceptical. The more positive effects any project can provide, the more there is to gain, not only for developers but for society in general.

3.3 THEME COURSE 2011 PROJECT

In autumn 2011 SLU Alnarp ran a 15 credit course at master level focusing on inter-municipal wind power planning. The students were mainly landscape architects, but also landscape engineers and city planners were taking part in the course. Although a majority were Swedish students, many exchange students representing a variety of views from their different backgrounds.

0The main task was to develop strategies for wind power implementation in some municipalities in southwest Skåne, based on the European Landscape Convention (ELC). The aim was to find spatial solutions working across municipal borders while improving the land-use efficiency. The course tested inter-municipal cross-border planning, as well as the so called 'positive planning' including analysis tools like HLC and LCA. The traditional way of wind turbine site planning, based on regulations and a minimum of requirements, was defined as 'negative planning'. A risk with negative planning, especially if each municipality acts separately, is a heterogeneous and unorganised landscape leading to competition between wind power and landscape values[130]. By implementing positive planning to the process, the placing of turbines will be based on structured analyses of the landscape along with the safety requirements making a strong foundation from a landscape perspective

Figure 25: visualised scenario if municipalities presently developing wind power continues. Status quo in policies

[130] Brousse N., Friesen M., Öhrström S., 2012. Interkommunal vindkraftsplanering, *Landskapsobservatorium.* [online] http://www.landskapsobservatorium.se/?p=1114, 2012.10.10

The class identified three strategies applicable for all municipalities:

- Infrastructure strategy - wind power development in exploited areas such as industrial sites, along highways or in conjunction with present wind turbines.
- Open landscapes - protection of recreation areas and agricultural land. The restrictions adjacent to wind turbines can act as a protective barrier to urban sprawl.
- Working beyond borders - a cross-border cooperation between regions and municipalities in order to avoid scattered turbines along municipal borders and an incoherent landscape.

Figure 26: *WindPRO visualisation of suggested turbines along highway in Vellinge municipality*

Figure 28: visualisation of suggested development at Höje å, view from highway

met or not, and was used to create accurate visualisations. In cases where a landscape identified as suitable for large scale infrastructure did not pass the regulations, the locations were not further explored. The remaining areas were regarded suitable for wind power developments.

One of the suggested projects has been brought forward as a potential development - the *Höje å project* on which this thesis is elaborated (see figure 28). Working from the foundation developed by the *Theme Course*, the Höje å project will intend to enhance the positive landscape impact by a holistic approach where multiple factors interact.

3.3.1 Theme course proposition

Currently the Höje å area host 7 turbines of various sizes, but three of them are soon to be replaced by modern larger ones. The proposal presented by the class includes 6 turbines, three new ones and the three to be replaced, located in three bordering municipalities along Höje å. The turbines are placed to become an extension of the present wind power site in Staffanstorp municipality considering the 100-200 meter protection distance to Höje å. The proposal also includes a multifunctional path with historical information. The path will provide recreational options, maintenance access to turbines and tractor access to farm land. The path will follow the historical trade route from the coast at Lomma to the cultural centres of Uppåkra and Lund. The turbines are meant to enhance and highlight the importance of the history. Most data regarding the present situation of Höje å presented in the following analysis chapter is from the *Theme Course*.

4. ANALYSIS

4.1 HÖJE Å PROJECT AREA

4.1.1 HLC analysis

By an HLC analysis (Historic Landscape Characterisation) the historical role and features of the Höje å area can be traced. The HLC analysis helps to understand the development of an area over time, and is necessary to understand the specific features and expressions of today's landscape.

Before significant human influence, Skåne was covered by deciduous woodlands with elm, oak, ash and maple as part of the prominent flora[131]. During the Bronze Age the population in Skåne started to leave the nomadic life and begun to prepare agricultural land for farming[132]. This was the beginning of the deforestation that centuries later would make the southern plains of Skåne associated with bare, open landscapes. The region between Kävlinge and Lund has a high concentration of Bronze Age grave mounds illustrating the early activity in the region.

During the Iron Age new tools for land management was developed, as was the use of manure as soil fertiliser[133]. In this manner societies could become even more rooted and proper communities started to expand. Villages were formed, and some of them i.e. Uppåkra near Höje å, are still present having one of the greatest continuous inhabitation history in northern Europe, covering 2,000 years[134]. When centralisation of authority started and Uppåkra became a regional centre, the influence on the Höje å project area was considerable. Today, the area presents the largest

[131] Bergendorff C., Billqvist M., Carlsson B., Emanuelsson U. Lewan N., 2002. *Det skånska kulturlandskapet.* Lund: BTJ Tryck AB, page 28
[132] Larsson L., Archaeologist, *'Local history of Höje å and Uppåkra'* [interview]University of Lund. 2012.09.03
[133] Bergendorff C *et al.* 2002, page 44
[134] Helgesson B., 2001. page 31

Iron Age finding site in Scandinavia showing the region being part of an international trading system[135].

Due to archaeological findings it has been found that the crop during the Iron Age was mainly hulled barley, bread wheat, oat, rye, flax and field cabbage[136]. Together with charcoaled hazel and oak, one can make a decent image of what the landscape was made up by and how it appeared to man. In the wetlands alder, ash and willows represented the wooded species. The common use of leaf fodder together with collaring and coppicing making club formed trees and multi stemmed shrubs, must have made the landscape appearing very structured to humans. Wooden material was collected throughout a larger area where smaller woodland groups were present in the otherwise open grazing land[137]. It appears to have been a highly managed landscape for the conditions of the time.

In about 1000 A.D, when Skåne was a part of Denmark, the first associations of the plain around Lund and Uppåkra were documented[138]. The traditional half-timbered houses and crow-stepped gable estates and churches remind us of this fact. Over the years the agricultural methods became more efficient and the land more productive, turning the land into a strictly agricultural landscape where the remains of the once large forests quickly disappeared. In 1658, after a long history of wars, Skåne became Swedish though the Roskilde treaty. By 1773 the first brick factory in Lomma was opened, setting the frame of the town's development. Large pits were dug, which today serve as wetlands; the manufacturing turned Lomma into an industrial town, known

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135 Helgesson B., 2001, page 32

136 Regnell M., Gård, åker och äng –den centrala platsens triviala bas, *Uppåkra –centrum i analys och rapport*, 113-122 [online] http://www.uppakra.se/backup/eng/i_fordjupning_eng.htm, 2012.09.05, page 113

137 Ibid, page 121

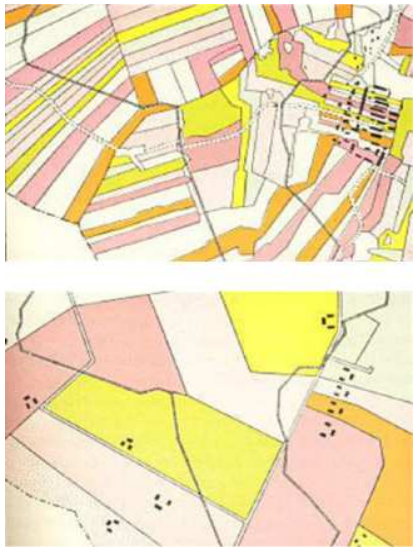
138 Pers. comm. Larsson L., Archaeologist, *'Local history of Höje å and Uppåkra'* [interview]University of Lund.2012.09.03

for its brick and clay production[139]. At this time both Lund and Malmö had become important cities in the region.

During the end of the 1700's and early 1800's a land reformation changed the landscape drastically. Over the years the fields had become smaller and smaller; a person commonly owned several narrow strips scattered in the landscape around a dense village (figure 29). It was not a very productive system and large-scaled reforms were necessary[140]. Fields were joined together to create cohesive land plots and the villages were split by the farm houses being located in the centre of the fields. This is the background of the rural landscape seen today, where large farm buildings sit in the middle of a field in the open landscape.

At this time drainage of wetlands became an increasingly common practice[141], as in the surroundings of Höje å. This trend continued into the mid 1900's and has formed the present landscape seen today. A result of drainage and stream straightening is that water cannot be kept by the soil, and is transported to the sea[142] and potentially causing flooding problems to towns like Lomma[143] (flood-risk areas map - figure 50). During the last 150 years urban sprawl has had a strong impact on the landscape. Figure 32 show the development of Lund over these years. Figure 30-33 demonstrate the land-use in the area from 1790, and landscape changes of the region until today.

Figure 28:
field structures before and after the agricultural reforms. The merging of agricultural fields and scattering of the town is very obvious.



[139] Länssyrelsen [online] http://www.lansstyrelsen.se/skane/sv/, Lomma, 2013.01.22
[140] Länsstyrelsen [online] http://www.lansstyrelsen.se/skane/sv/, skiftesreformer, 2012.12.12
[141] Åns historia [online] http://saxan-braan.se/amans/htm/1.htm, 2012.11.12
[142] Lindström C., 1995. *Österlenåar –en sammanfattning*, submtited to Länsstyrelsen in Kristianstad. Kristianstad, page 37
[143] Bucht E., Deak J., 2009. *Klimatanpassning av Lunds stadskärna –äldre strukturer i nytt perspektiv för Höje å avrinningsområde*, SLU Alnarp [online] http://pub.epsilon.slu.se/3793/, 2013.01.05

Maps and historical references

Figure 29: Historical map of area between Värpinge and Lomma. Several jointed historical maps from *Lantmäteriet*, 1790-1835. Small scaled fields and pastures dominate the land use. Urban development is limited to Värpinge and Flackarp.

Figure 30: *Skånska rekogniseringskartan* from 1812-1820, historical map over the region. The meandering of Höje å can be seen, and the distance of urban development to the stream is much larger than today

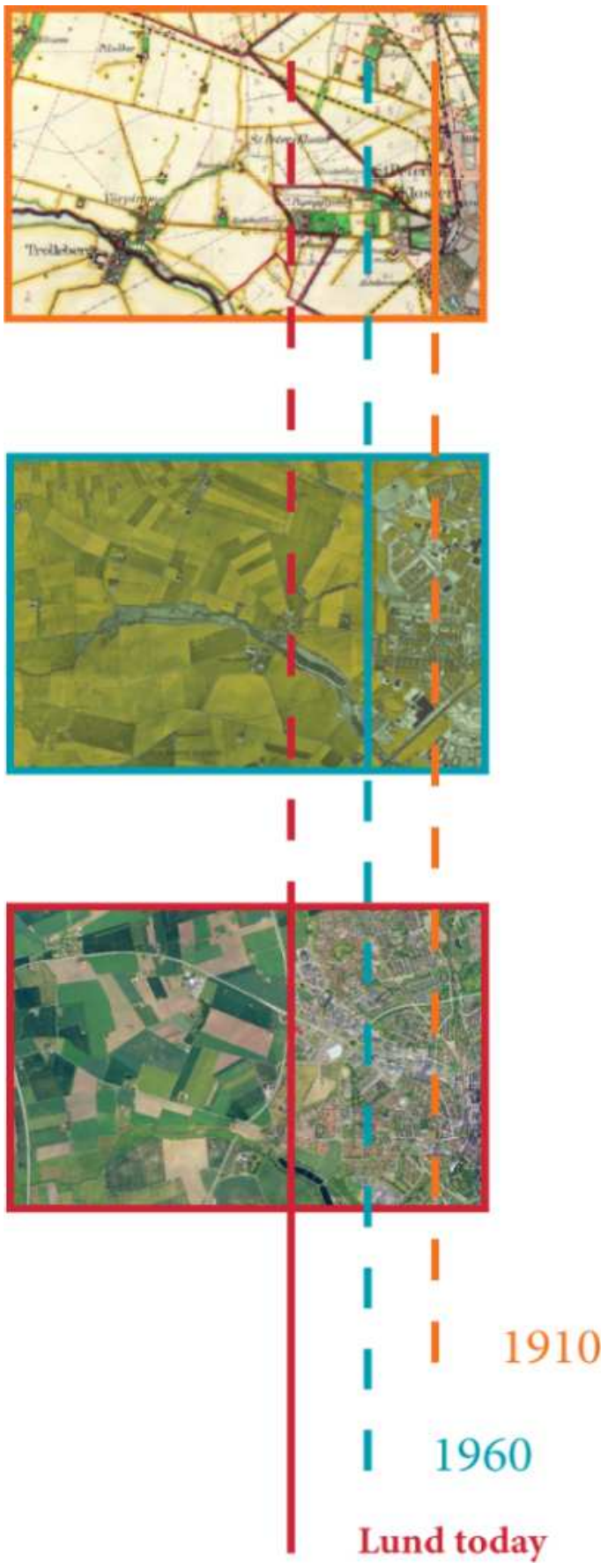


Figure 31: Development and spread of Lund westwards, demonstrating the urban sprawl over the last 100 years. Also some changes in field pattern and road networks can be seen.

Figure 32:
Time depth –comparison of maps from ~1800 and today. Demonstrating how the land-use has remained fairly constant over the years, while i.e. the filed size and patterns may have changed.

Yellow fields: areas continuously farmed

Green fields: areas continuously grazeland/meadows

Purple fields: continuous dwellings

Yellow lines: roads which have remained in the same location

Red lines: land patterns/divisions/lines which have remained the same

4.1.2 LCA analysis of area

In the LCA analysis (Landscape Character Assessment), character types and areas in the region have been identified. The character types are general landscape components that are repeated through a region. As illustrated in figure 34 and 39, several types and areas are found in the project area (representative images in figure 35-37) such as: urban areas, open agricultural plains, woodlands, coasts and water bodies.

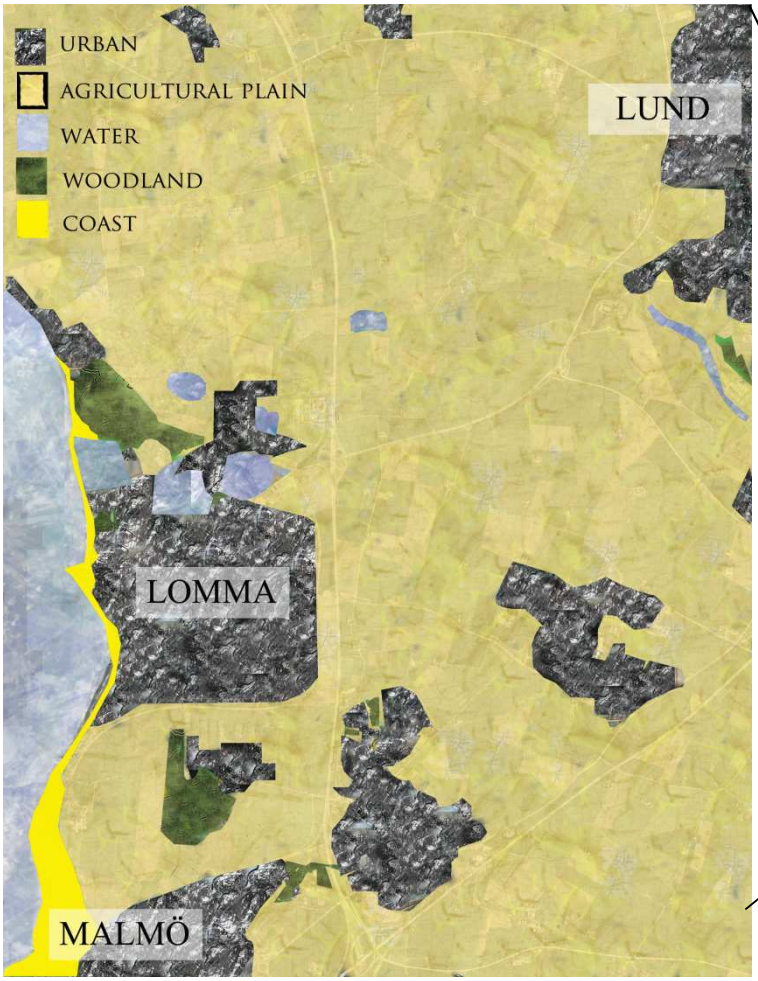


Figure 33: Landscape Character Types identified in the region

Each character type is further parted into the character areas, and named as in figure 39. Examples of the areas are further described on page 59 and figure 39-45.

Figure 34 woodland
Figure 35 urban
Figure 36 agricultural plain

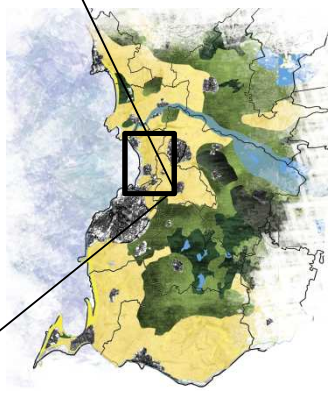


Figure 37 Landscape character types of south west Skåne as identified through the *Theme Course*

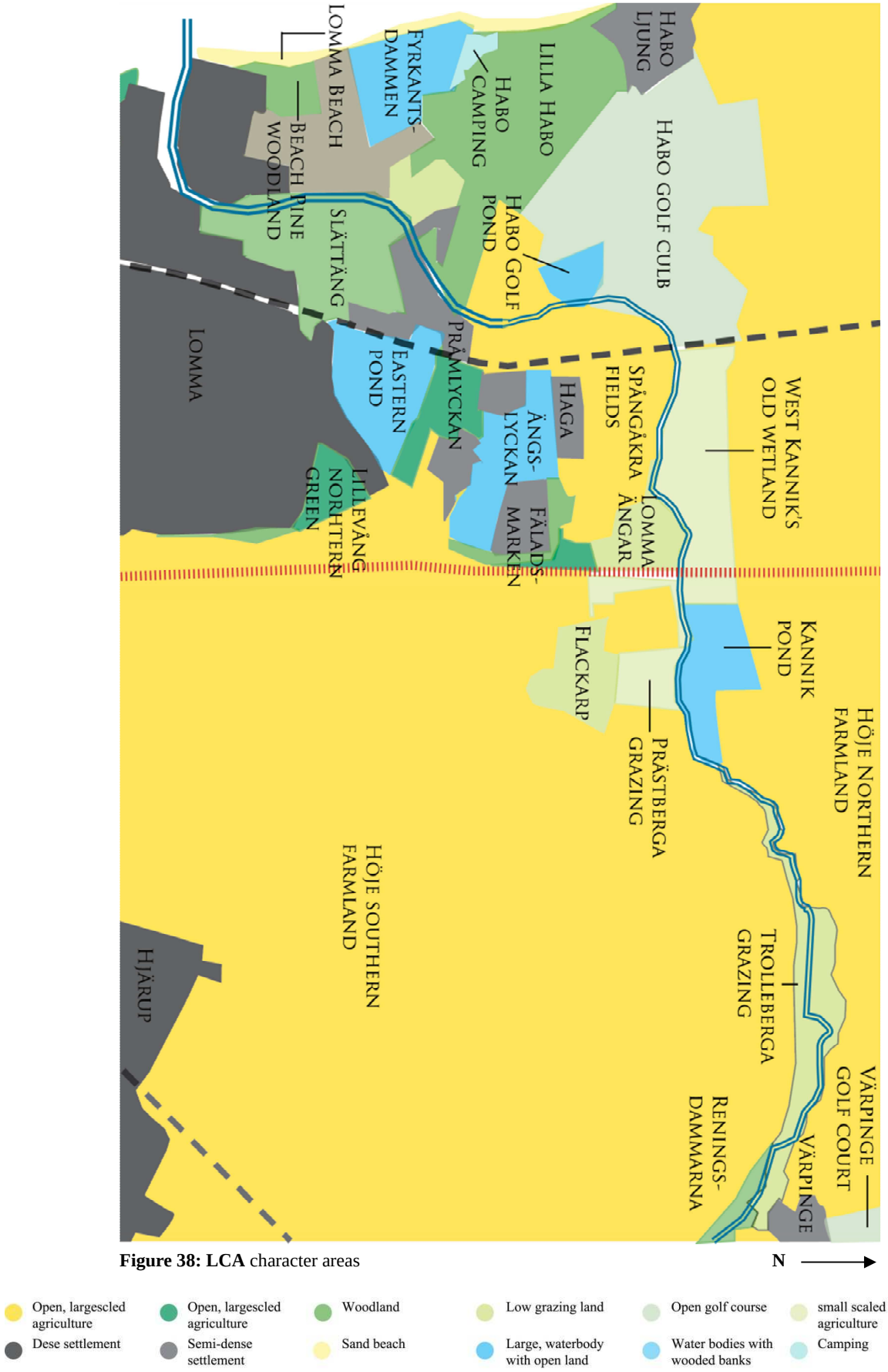


Figure 38: LCA character areas

Trolleberga grazing is in the river valley of Höje å. Grassland and scattered vegetation characterise the area. Fences enclose the pastures.

Figure 39 Trolleberga grazing

Höje southern farmland is large scaled agricultural fields with scattered farms and dwellings. Small roads lead out to the houses and some are bordered by tree avenues.

Figure 40 Southern farmland

Höje å northern farmland share characteristics with the southern farmland, but is separated by Höje å with limited crossing possibilities, hence a character area of its own

Figure 41 Northern farmland

Prästberga grazing is a combination of small fields and pastures, crossed by an open drainage canal.

Figure 42 Prästberga grazing

Kannik pond is a newly made wetland. The pond itself is extensive and open. Low vegetation marks the area with exception along Höje å where tall trees frame the stream.

Figure 43 Kannik pond

West Kannik's old wetland is an area with small scaled grazing/farming. The fields are parallel and moist. The old flow of Höje å passing through the area can be identified on aerial photos.

Figure 44 West Kannisk

Lomma ängar is a mostly moist, low-lying meadow/pasture along the highway and has direct pedestrian access from Lomma passing some green recreational areas.

Figure 45 Lomma ängar

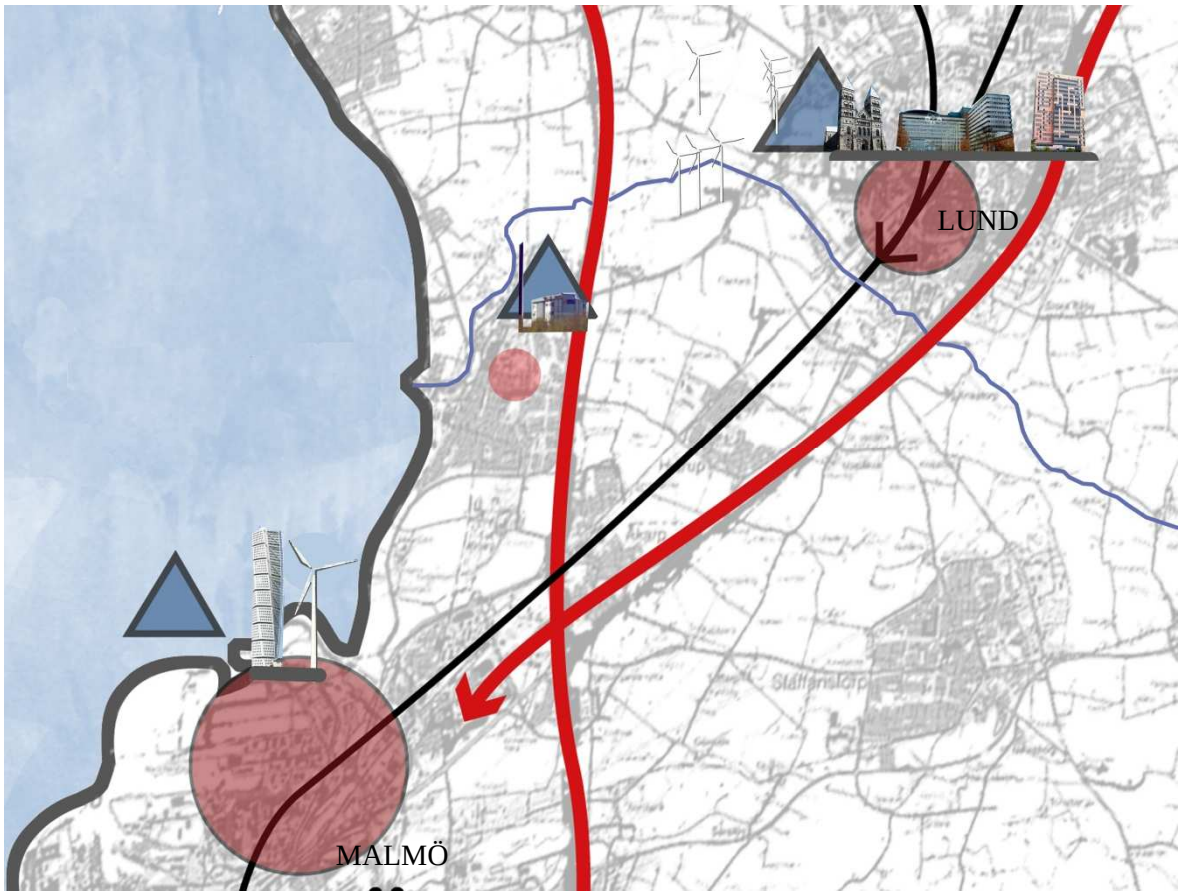


Figure 46: Nodes, landmarks and paths in the analysis area of Höje. The landmarks marked on the map are all visible from the project area (Turning Torso, wind turbine in Malmö, stack in Lomma, hospital, church and turbines in Lund)

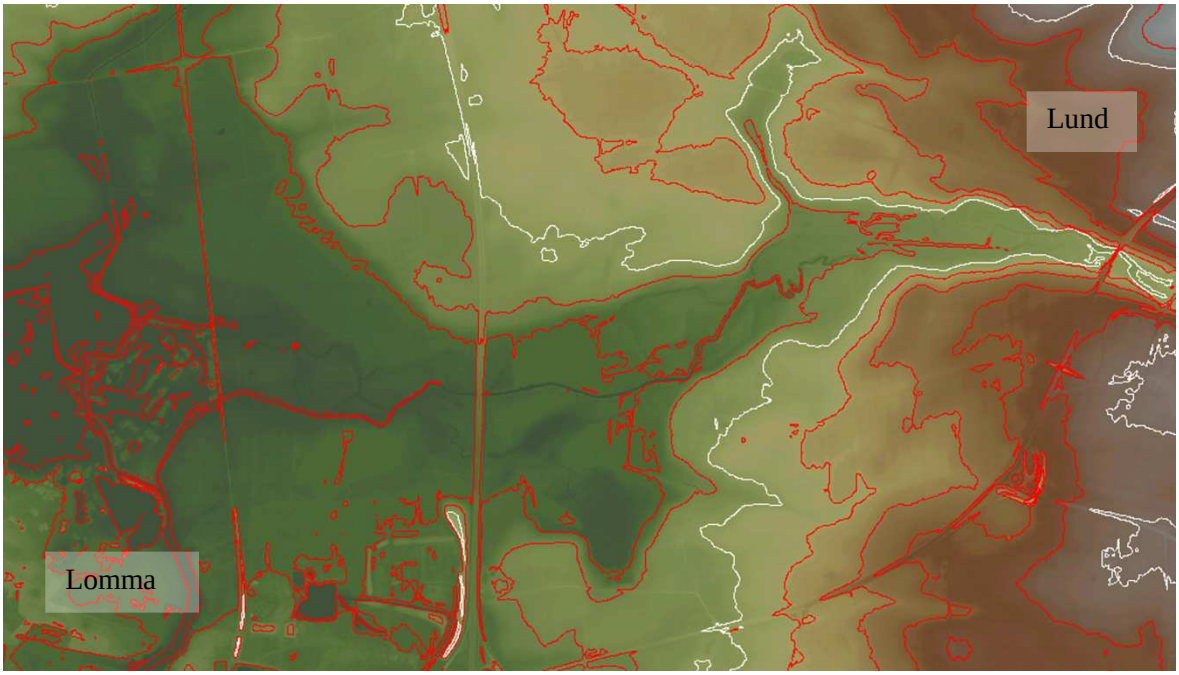


Figure 47: Height data from *Lantmäteriet*, dark green is low land, brown is high. The dark green areas are in risk of flooding. The closer to Lund, the steeper the height increase.

4.1.3 Lynch analysis of area

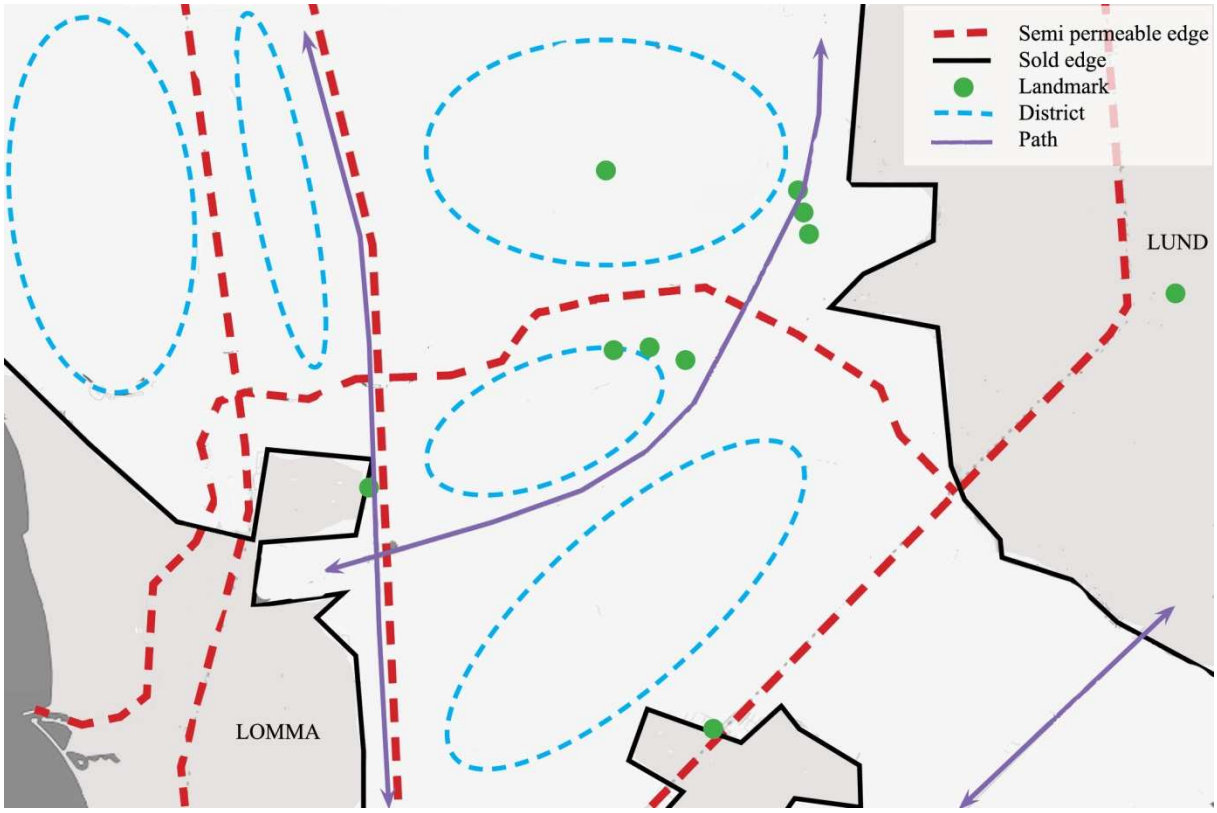


Figure 48: Lynch analysis of Höje å and adjacent areas, identifying directions and patterns in the landscape

The Lynch analysis supports the identification of structures that help us identify, orientate and experience the rural landscape by identifying nodes, paths, edges, landmarks and districts.

As in the LCA analysis (figure 38, also lynch figure 46) the Lynch analysis presented in figure 48 characterise the region as large agricultural 'rooms' broken up by urban settlements (dark grey areas in figure 48). The present users and actors in the area are mainly farmers cultivating the land having grazing cattle on the banks of the stream. Beside the farmers most people use the area for recreational purposes, mainly nature related experiences. *Naturskyddsföreningen* (Swedish natural protection society) and other societies have regular events and walks in the area[144], and bird watchers find the ponds most attractive. Dog walkers utilise

[144] Naturskydsföreningen, Lund [online] http://www2.naturskyddsforeningen.se, 2012.12.10

the green access around the stream and in summer time pick-nickers can be seen avoiding what the cows leave behind. At present there is no proper handicap access to the project part of Höje å, and you may have to climb fences and explore your own path from Lund to Lomma. There is a proper bike path following the main road between Lomma and Lund, but purely for transportation.

Figure 49: large rooms

50: highway acting barrier

51: wind turbines are landmarks

4.1.4 ecology

Since the study area is located along a stream, it is natural to initiate the ecological discussion with a summary of the water conditions. Water also makes the frame of which flora and fauna inhabits the area.

Höje å is about 35 km long all in all, and the drainage basin is about 200 km². The stream itself is not very wide, less than 10 m except for the coastal mouth. From *VISS* (water information system Sweden) one can get data about the quality of streams and water bodies through the country. Höje å does not have a high rank in ecological status; in fact the stream receives a relatively bad ecological classification on the VISS scale. Although the overall chemical status is good, the level of mercury is higher than recommended and the stream suffers from eutrophication[145]. Further, the amount of hard surfaces (infrastructure) in the drainage basin area has increased over year which in turn increase the

[145] VISS, 2012. Report: *Vattenförekomst Höje å*¸VISS

surface water run-off into the stream. Together with more fierce storms, it has caused flooding over the past years. The map in figure 50 illustrates the affected area for a severe storm expected in every 100 years.. Combined with high sea level changes, it is obvious that a large extent of the project area will be under water on fairly regular basis[146]. From a biological point of view, the stream is also very limited. The removal of stones and gravel at the stream base over years has had a negative effect on water living fauna, and obstacles are limiting fish movement[147]. It does not however stop fish altogether and at Trolleberg you can for example find stone loach, eel, roach and pike[148].

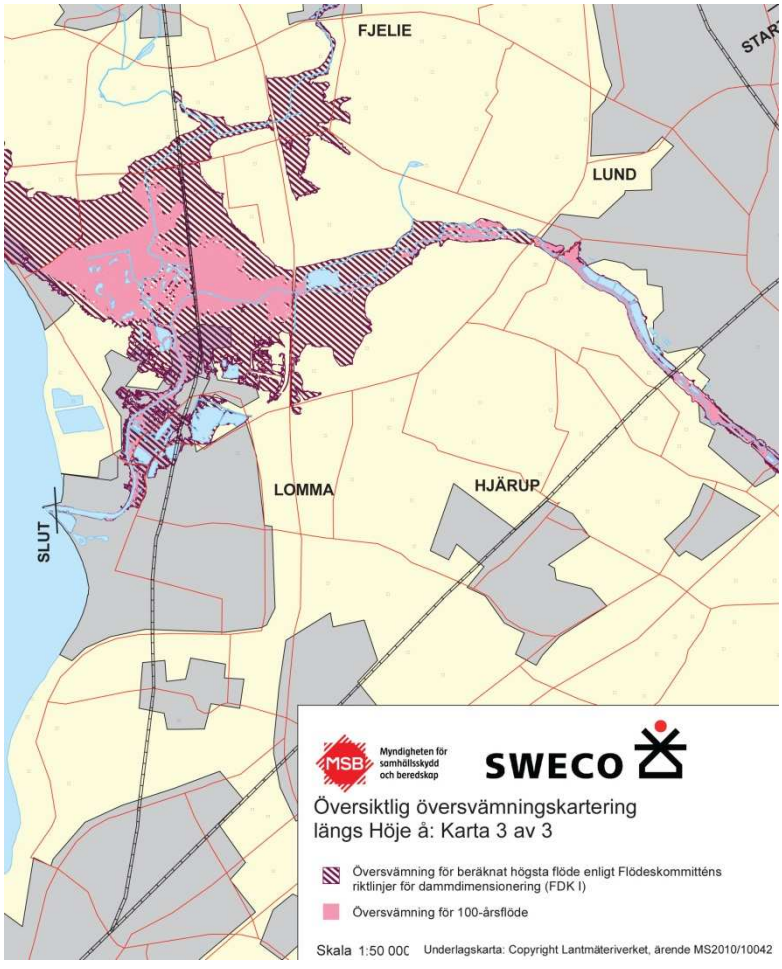


Figure 52: Flooding area of Höje å at (pink) 100-year flooding and (hatched) highest water level. (base map from *Lantmäteriet*)

[146] Sweco, 2011. *Översvämningskartering längs Höje å*, rapport 76, 2011-1-29, Myndigheten för samhällsskydd och beredskap, attachment 1 and 4

[147] Ecologgruppen, 2008. *Handlingsplan Etapp II, Höjeåprojektet II*, commissioned by Höje a vattendragsförbund

[148] Eklöv A. 2000. *Fiskevårdsplanför Höje å*. [online] www.hojea.se/rapporter/Hojea_Fvplan_2000.pdf, 2012.09.15,page 9

Figure 53: Dense vegetation, willows growing in the stream

Figure 54: erosion of embankments at West Kannik

Figure 55: Smooth banks, close to Trolleberg

Figure 56: steep embankments at Kannik pond

The embankments vary from flat and wide to steep and eroding as seen in figure 53-56. Grasses, sedge and reeds cover the soil and in some locations willows form an almost impermeable stand while scattered shrubs border the shore line. But along most of the stream in the project area there is no wooded vegetation. None of the cultivated fields runs all the way to the stream; they are separated by narrow to wide strips of grasses and other flora.

Like the waterway creates a passage for aquatic plants and animals, its shores present a green movement corridor for animals and for seeds dispersal. The shore has a high ecological value in an otherwise monocultural landscape. Due to *Strandskyddlagen* (shore/bank protection law) there is no housing development in direct proximity to the stream. This law protects exploitation of shore lines, beaches and banks preventing construction closer than 100 m distance from the water body.

The historical meandering of Höje å next to Trolleberg was reintroduced in 2010, and in 1999 a large pond was constructed beside the stream. The pond is not only a water trap for nitrogen, but has become a popular place for birds, with several species breeding, feeding or resting.

From the LCA analysis (figure 38 and 46) one can see the importance of the green corridor in a larger context. Large fields dominate, some golf courses are close by and there are no larger woodlands. The land is highly managed and productive. At the same time there are some important wetlands and shore areas around Lomma that has the potential to be even more integrated with the waterway system and wetland islands up-streams. This would help to support and sustain the flora and fauna in the region.

4.1.5 local and regional projects

There are some cultural, recreational and ecological projects finished, on-going or planned in the region, some of which having a direct or future influence on the project area.

The most important ecological project was *Höjeåprojektet* (the Höje stream project) which was introduced in 1991. The goal was to reduce the pollutants and nutrients to improve the water quality and to favour plant and animal life in the otherwise agricultural landscape[149]. Through the years several phases of the project have been carried through such as the re-meandering at Trolleberg and the created Kannik pond. Bogs and wetlands have been restored or being in process of restoration[150]. The project initiators have worked cross-municipal and together with the land owners. Some land owners consider setting land aside if they are compensated, others have volunteered as interested[151]. The project has identified a number of areas in need for actions and relevant methods. Proposed initiatives within the project area are indicated in figure 59.

One of the landowners' main issue for letting land for re-naturalisation is the reimbursement. Land lease for wind power purposes can weigh up for the loss of land and hence act as a trigger for the kind of ecological development the *Höjeåprojektet* is aiming for. *Höjeåprojektet* features many aspects considered by this study and is a welcome asset to a long-term strategic plan and design of the area.

Figure 57:
Höjeåprojektet south of Lund

Figure 58:
Höjeåprojektet path symbol

[149] Höje å vattenråd [online] http://www.hojea.se, 2012.11.01
[150] Ibid
[151] Ibid

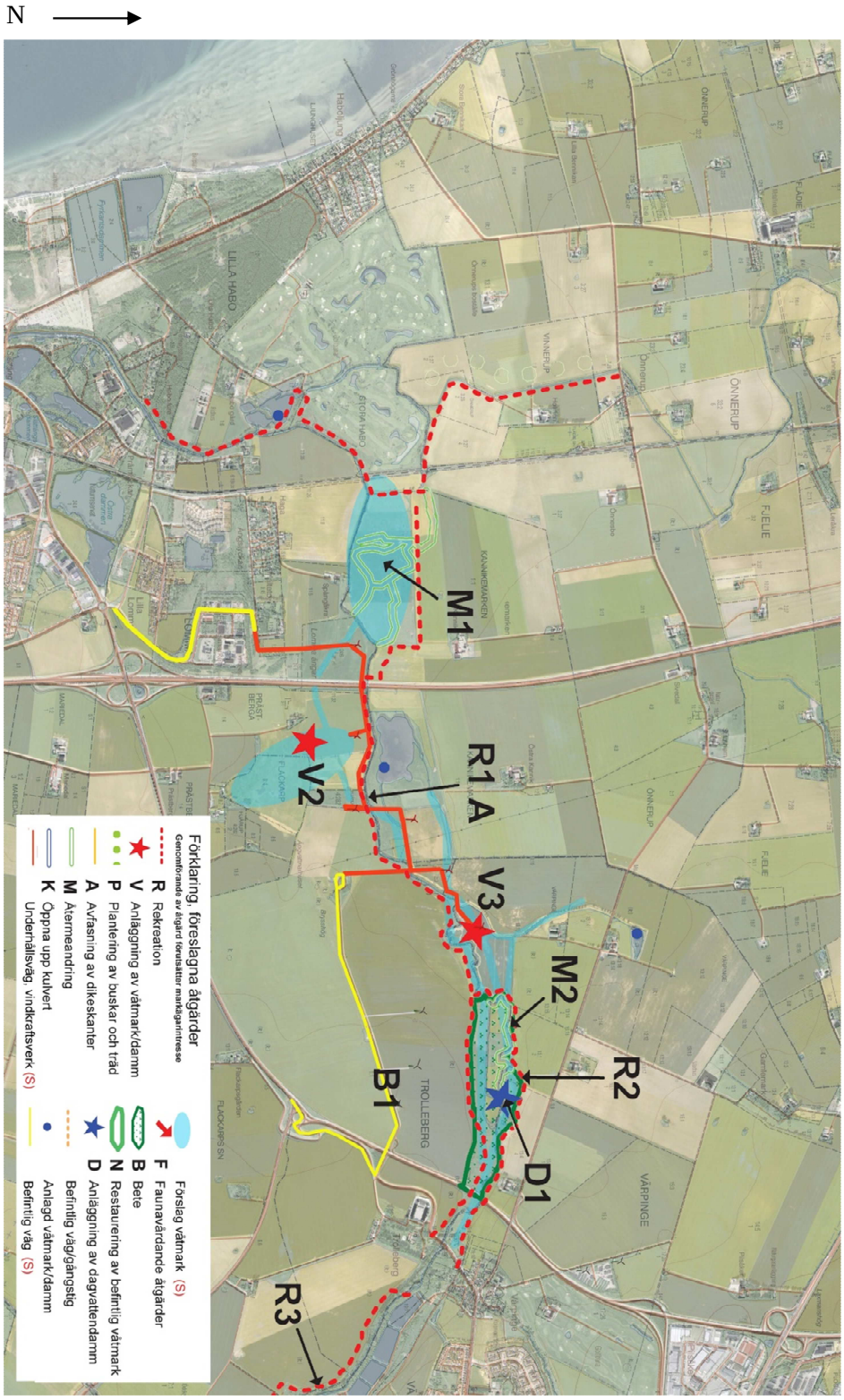


Figure 59: Areas and access –comparison between this study's identified areas and the areas identified by *Höjeåprojektet.* Key: (S) proposals by this study.

At Uppåkra, in direct proximity to the project area, another large project is being initialised. The area is discovered as an important historical site, and a cultural centre is currently taking form. Some of the *Uppåkra Arkeologiska Center* (Uppåkra archaeological centre) intentions are to:

- *Create an archaeological centre.*
- *Present a showcase of the excavation process.*
- *Communicate findings to the public and archaeology research community.*
- *Create a cultural axis from MAX IV via Lund University to Uppåkra.*
- *Link the past to the society of today.*
- *Add to the tourism offer in the region.*
- *Inform about existing cultural heritage and encourage visits to other sites.*[152]

The centre will be located on church owned land presented as a gift to the foundation of Uppåkra Centre[153]. Within the area there will be an exhibition hall with conference rooms and other facilities, guided tours will be provided as well as the possibility for individual walks with the support of pamphlets and mobile apps. The trails are mainly within the land belonging to the foundation, but parts of them extend into other parts of Uppåkra[154]. Since the aim of the centre is to connect with other research institutions in the region and to demonstrate the relationship with different historically cultural foci, it is possible to see an expansion of the concept tours for a wider experience. Extended tours to the cultural and natural heritage at Höje å is a not yet tested opportunity. The development of the centre gives the region further identity and may tie the an area split by municipal borders together to be regarded as one place (still with different political jurisdictions).

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152 Appelbasum R., Langham B., McIntyre M-H., 2011. *Uppåkra arkeologiska center –feasability study*, presented to Stiftelsen Uppåkra arkeologiska centre, page 16

153 Pers. comm. Larsson L., 2012.09.03

154 Appelbaum R. *et al*,2011, page 44

4.1.6 comprehensive plans

As a part of the analysis of the region, the knowledge of how the landscape is regarded and dealt with by the authorities is of outermost importance. By interviewing municipality representatives *(Theme Course)* and studying the municipal vision, plans and strategies, the region's planned future has been extracted. The high level achievements of the three municipalities in question (Lomma, Lund and Staffanstorp) are quite similar; to create a community with good living standards where people are proud to live. But the way they plan to reach the achievement differs.

Lund's comprehensive plan issued 2010[155] discusses the following topics relevant to the thesis:

- Regional and municipal cooperation.
  To expand the regional planning of infrastructure and urban expansion and working towards regional cooperation with the county council as well as other municipalities.
- Renewable energy.
  Lund municipality aim to make an 85 % reduction of its CO_2 emissions by 2050[156]. Power generation should be maximised in areas suitable for wind power. Wind power should be placed in groups in landscape areas suitable to support these large scale structures. Applications of wind power sites within 5 km from bordering municipalities, consultation with the neighbouring local authority concerned must be held.
- Land utilisation.
  It is important to 'economise' the land utilisation, especially the rich agricultural soils, from a climate perspective and for production. "To develop on

[155] Lunds kommun, *Översiktsplan 2010*, [online] http://www.lund.se/Medborgare/Trafik-infrastruktur/Samhallsutveckling-och-planering/Oversiktsplan/, 2012.09.03
[156] Lunds kommun, *Översiktsplan 2010*, page 10

agricultural soil means that it will be useless for agriculture years ahead."[157]

- Ecology & recreation.
  The municipality is working towards establishment of paths around the city of Lund for recreational and biological purposes. These paths should lead into the wider landscape which is presently described as one of "the most fertile, large scaled and inaccessible"[158] parts of the municipality. It is also considered important to connect the green areas for ecological connection.
- Stimulation of new businesses.

Lomma's comprehensive plan[159] includes the following issues:

- All municipal activities should have a futuristic and sustainable environmental approach for coming generations.
- The open character of the landscape should be preserved. There are few open views across the landscape and the existing ones should be treated with care.
- Water bodies are important for the ecological infrastructure of the municipality and should be well maintained while providing access for recreation.
- Biodiversity should increase throughout the municipality. Fighting habitat fragmentation and reducing water eutrophication must be considered. Small biotopes such as marl pits, field islands, stone

[157] Lunds kommun, *Översiktsplan 2010*, page 10
[158] Ibid, page 21
[159] Lomma kommun, *Översiktsplan 2010 för lomma kommun*, [online] http://www.lomma.se/huvudmeny/byggaboochmiljo/samhallsplanering/oversiktsplan.4.7 a48a90b12c665dedb4800017885.html, 2012.09.03

piles and willow avenues are important, as is increased access to green areas.

- High-class soils should be protected in favour for continued cultivation.
- Cooperation with other actors in the region is to be encouraged wherever benefits for the municipality and its residents may be identified.
- Balance principle - if an ecologically important land is taken for development compensation, project will be set in to balance it out. Such compensation activities should be coordinated into greater projects to avoid fragmentation.
- Renewables - although Lomma is to reduce its energy consumption and increase its percentage of renewables, wind power is considered non-suitable. Lomma requests for municipal cooperation if wind turbines are planned closer than 5 km from the municipal borders.[160]
- Höje å - the area following the stream should be protected and the municipality will actively work to increase the area of wetlands and protection zones.

The comprehensive plan for Staffanstorp[161] have the following issues relates to the thesis:

- The open landscape which "defines the towns"[162] should be accessible for the public and there should not be divergence between the urban and rural areas.
- Re-establishment of Uppåkra's position as a cultural centre. Historical remains, nature and destinations should be clearly indicated. Uppåkra should be linked to

[160] Lomma kommun, *Översiktsplan 2010*, page 40
[161] Staffanstorps kommun, 2009. *Perspektiv 2038 –framtidens* kommun. [online] http://staffanstorp.se/vision/framtidens-kommun-2/framtidens-kommun/, 2012.09.03
[162] Ibid, page 6

Gullåkra mosse by marked paths and thorough mental links, and the centre should create a strong profile.

- The landscape is said to first and foremost be there for those who cultivate it, but it should at the same time provide recreational opportunities.
- Ecology - access to green areas and waterfronts should be improved, especially along Höje å and Sege å. Staffanstorp will also work towards the development of biodiversity. The Höje å area should be investigated to prevent flooding.
- The municipality should be an information collector to encourage networks for rural life, businesses, educational environment and tourism.
- Renewables - the area next to Lomma and Lund is defined as of special interest for wind power development, and the municipality intends to increase the production of renewable energy.
- Intermunicipal and regional cooperation is favourable and deemed necessary for the best result when dealing with big infrastructure projects.

Based on these arguments it is in the municipalities' interest to develop schemes where collaboration is high on the agenda. All of them want to develop and strengthen the ecological values of the region, and Höje å is in all comprehensive plans mentioned as one of the most important and suitable places for achieving this.

The municipalities do all strive towards sustainable management and production where the use of renewable energy is in focus. Staffanstorp and Lund both advocate wind power while Lomma refuses this renewable option. Interestingly there is a consensus between the three municipalities in wind power development as Lomma requests for inter-municipal cooperation within 5 km from its borders, which is precisely the distance to neighbouring borders

that Lund is acting for. And Staffanstorp strive for inter-municipal cooperation in big infrastructure projects like wind power.

Although all the three comprehensive plans state that inter-municipal cooperation is important none of them include borderline landscape outside their own borders in their plans. Nor do they discuss how interaction in the landscape can benefit and initiate others. Staffanstorp have, however, started approaching this issue by looking into how MAX IV and ESS (international science centre under construction) in Lund and *Uppåkra Arkeologiska Center* can support recreational, economic and cultural expansions in Staffanstorp.

4.1.7 summary

From the three analysis methods the landscape uses, how it has developed over time and which specific historical, ecological, cultural and social properties the various landscape areas of the project zone has have been identified. The process has contributed to the identification of which areas that are more or less sensitive to changes or new influences. Human activity has been strong in the project area for a long time. Complementing uses of sub-areas have been identified, as well as suitable runs of access roads to the specified wind turbine locations.

All three municipalities have similar overall goals for their parts of the project area, but with different approaches. I.e. all do want renewable energy, but Lomma do not want wind power within the municipality and want to participate in other municipalities decisions if wind power is planned within 5km of the municipal border, while both Staffanstorp and Lund accept wind power in the municipality, including close to Höje å. Further all municipalities agree that improving the ecological and recreational values of Höje å is desired. In other words there are very good opportunities for an inter-municipal cooperation in the development of the project area.

4.2 DESIGN AND PLANNING

Based on the study research concepts for the design of the project area has been developed. The project process has created awareness of areas that have the potential to increase in value, and methods to support it. Different strategies and concepts are introduced which are applicable to specific areas or as a general approach to the project site.

From the historical, environmental and visual analyses a couple of habitats seem more suitable as a base for the development of the area. A meandering stream with some transitional wetlands bordered by dry meadows and groups of tall vegetation fit the landscape of the area as well as its historical usage. Pastures and meadows provide habitats for many species and also bring an image of what the traditional landscape might have looked like, only a few centuries back. Meadows and pastures are neither sensitive to temporary flooding, and flooding used to be the natural way to bring extra nutrients to areas grazed by livestock[163]. In some of the lower areas taller vegetation can be considered as long as it does not take up too much of the perceived open landscape, blocking large spans of the horizon. When planted in higher grounds care has to be taken to break the stands up in such a way the view across the open landscape is not completely cut off. The groups of trees should not be too widely separated along the flow of the stream, which may reduce the possibility for species to interact between the stands. Groups of willows, birches, hazel and alders are native to the region and can be combined in different structures, along the water and in the meadows. Examples of changes suitable for the project area:

[163] Emanuelsson U., 2009. *The rural landscapes of Europe: How man has shaped European nature.* Värnamo: Fälth & Hässler

- Re-naturalisation of the stream (a historic reference);
    - to reduce the time for the water to reach the sea
    - to make the stream more suitable to support a range of flora and fauna.
- Flooding areas created to avoid property damage in the urban areas and to magazine the surface water at high water levels.
- Banks and areas along the water can have enriched flora creating habitats tempting for animals and for human alike.
- Biking, riding and walking paths connecting to existing transport systems creating a wider access to the area.
- A culturally managed landscape providing rich habitat.
- Improved educational actions, i.e. information boards, guided tours etc. for cultural and ecological functions in the area.
- Becoming a part of a regional wide green corridor system tying separate green areas together.
- Providing opportunity for a variety of recreational activities such as jogging, swimming, biking, ice skating, bird watching, camping etc.
- Acting as an extension area for projects initiated by other actors i.e. *Uppåkra Centre.*
- Generating renewable local energy.

During the construction phase of both new ecological values and wind turbines, the present ecosystem will be temporarily disturbed. The recovery period depends on the extent of disturbance and any restoring actions. One design approach is to simply let nature have its run, allowing opportunistic plants and animals to recapture lost land and leaving nature for coming succession. By adding activities and functions as the land develops and evolves the design concept will attract humans as well.

Another design approach is to actively promote specific flora and fauna to get a competitive advantage, especially considering

threatened species suited for the area. For example, such ecological functions can be promoted around wind turbine sites and along access roads and even the foundations themselves.

A third approach may be to shape and strictly plan the development area to achieve a specific appearance. All these design approaches can be combined to create a contrast when walking from one to another.

4.2.1 remiz concept

The Penduline tit *(Remiz pendulinus* and "pungmes" in Swedish*)* is the municipal bird of Lund. The first Swedish records of the species came in the 60's and in the 70's it was occasionally found breeding in Skåne, mostly at Krankesjön in Lund municipality[164]. After a boom in the 80's the species started to decline and is today rare and listed as endangered[165] in Sweden. It has not been found breeding in Lund municipality for three years[166], but the ponds in Lomma still provide breeding habitat for the Penduline tit and a few clutches are still hatched annually[167]. To strengthen the position of this exclusive and exquisite bird in Sweden, an idea of improving the breeding habitat conditions in the Höje å project area came up as a planning approach option. Creating a habitat corridor in proximity to the existing breeding sites in Lomma can be of great value for keeping the species in our fauna.

Additionally interesting about creating a habitat for this specific bird is that it prefers a mosaic landscape of dynamic wetlands, meadows and pastures with a rich flora of dense low vegetation and scattered bushes and trees. This is also a biotope highly

Figure 60: adult male Penduline tit

Figure 61: newly fledged juvenile Penduline tit

[164] Pers- comm. Öhrström P., species specialist, '*facts about Remiz pendulinus'* [interview] Höllviken. 2011.12.07
[165] Artfakta [online] www.artfakta.se, 2012.12.10
[166] Pers. comm. Öhrström P., '*facts about Remiz pendulinus'* [interview] Höllviken 2012.09.04
[167] Öhrström P., 2012.09.04

Figure 62: Peter Öhrström and Olof Persson rining *Remiz pendulinus* in typical habitat

Figure 63: *Remiz pendulinus* nest hanging in a tree

Figure 64: wetland in Skåne where *Remiz pendulinus* breed

attractive for many other species including both flora and fauna[168]. The vegetation is preferably dynamic; from herbs to shrubs and trees, from young trees to semi-mature aged, from open glades to denser vegetation, and from open water to reed beds. It is simply a rich habitat in a transition state from disturbed land to semi-dense woodland and wetland where many insects, amphibians, birds and small mammals alike thrive. The Penduline tit is commonly found in manmade landscapes such as old peat holes and clay ditches once the production has ceased and vegetation succession takes place. Hence, it is reasonable to assume that it is possible to create places the bird will inhabit. In an interview with Peter Öhrström, species specialist, one theory for the decline of the species is overgrowing wetlands with mature trees and reduced vegetative variation and biodiversity. Monocultural fields bordering the wetlands make the species lacking required feeding grounds.

By creating green strips along roads, between fields and green structures, part of these requirements is met in a minimalistic way. If edge zones are encouraged in conjunction with the different vegetation types, more open to semi-open land areas are created. Edges are biologically important zones[169] that are in non-static condition unless cared for and requires management i.e. grazing. Species living in different habitats can co-exist in these areas creating a richness that is becoming rarer in today's landscape. Edges are in general sharp with woodlands ending brusquely next to a monocultural field with no place for transition[170]. The actions intended by *Höjeåprojektet* include many features that, if extended, could create the perfect habitat/s for the Penduline tit and other species. By extending the planting area and agricultural management zone away from the immediate shoreline, this can be achieved.

[168] Öhrström P., 2012.09.04
[169] Sarlöv-Herlin I., 1998. Skogsbryn, *Skötselhandbok för gårdens natur- och kulturvärden*, 212-220. Jordbruksverket. Jönköping: Bratts tryckeri AB, page 212
[170] Ibid, page 214

4.2.2 waterway concept

By improving the conditions of Höje å, both its run and its flow, the biological connection in an east-to-west direction is enhanced. To achieve such an improvement collaboration of municipalities as well as land owners must take place. Just like *Höjeåprojektet,* this thesis believes in a naturalisation of the flow of the stream. Extending the stretch by meandering and oxbows create a more dynamic physical structure while improving the water conditions and enhanced possibilities for flora and fauna. Creation of smoother embankments reduces the erosion risk while creating a possible flooding area and a successive vegetation gradient from dry area into submerged plants. Creating good water beds is also highly considered since it will provide growth habitat for aquatic plants which in turn attract some fish species. It is important though, to take into account not to create obstacles for fish movements but rather remove blocked passages. By improving the water way and restoring some of the historical wetlands, the insect population may also increase. Parts of Höje å have a rich insect population with several for Scandinavia rare species[171]. Increasing their habitat conditions and spreading opportunities can strengthen these insect populations too.

4.2.3 cultural concept

Throughout the project area, focusing on the stream, different habitats and landscape-types can illustrate the land-use change over the years from the ‘wild’ wetlands to cultural pastures, narrow fields and to the stream canalisation, large scale agriculture and urbanism. Traditional practices such as pollarding could be encouraged to not only promote the vegetative history but also the cultural influences in the landscape, shaping or modifying it. Leaf fodder was an important winter source for cattle, and can once

[171] Naturskyddsföreningen [online] 2012.09.13

Figure 65: excavation information at Uppåkra church where the new centre will be placed

more provide an alternative food source in their diet. Willow pollarding can be done together with schools and people who want learn basket making skills and about traditional practices. When *Uppåkra Arkeologiska Center* is opened, they hope to host plays as well as other artistic displays, and one way to incorporate potential re-enacting with the wider region is to allow parts of it to become background setting where some activities may take place. In the long run there can be livestock maintaining the cultural landscape created towards Höje å, while presenting both a historical link and a function necessary to keep the land in desired condition.

Along with landscape inventions, signs and information should be available for visitors. The idea from Uppåkra to use mobile apps is in line with today's technology development and can provide new information possibilities.

There are many reasons for representing an old landscape form and use in modern society. The ecological functions were richer and more varied than in today's monocultural farm-landscape. Also, as the intention is to re-naturalise the Höje å stream, the natural vegetation will make the landscape similar to that of the old days, and could be managed in similar manners. To keep it in a dynamic state, and possibly in different succession conditions to promote a diversity of biotopes, actions like grazing, pollarding and coppicing are recommended. Another advantage is providing Uppåkra and its on-going projects with a broader historical context which makes it more legible. The knowledge of the area and connections between the surrounding landscapes can hence be improved. Linking the development along Höje å with the on-going activities in the wider area can give the practice extra authority.

4.2.4 recreational concept

Future potential activities in the area might be nature experiences, walking, jogging, riding, canoeing, biking, educational and cultural experiences, role-playing/re-enacting, land art projects etc. For extension of the regional path and trail systems there are several good starting points with many existing networks to link new ones to. In Lund there are recreational paths along Höje å which easily can be extended westwards, and there is an interest in all the three involved municipalities to encourage a path network connecting the towns Lund and Lomma. Additionally there are bike paths and trails planned in relation to *Uppåkra arkeologiska center* which can connect from another axis, creating the possibility to re-form the old trading route from the inland towards the sea. To the west Lomma has good opportunities to extend the recreational path system, especially by crossing the highway. Currently the possibility to walk along Höje å out of Lomma is very limited. When exiting Värpinge in the east, the trail that was created by *Höjeåprojektet* only displays a mud-path which at times is hard to follow. The area can benefit from the path being adjusted to land maintenance and vehicular access.

The access routes for the construction and maintenance of the wind turbines require proper roads with paved surface. By combining access roads with a series of smaller paths to create alternate routes and surfaces for a variety of uses will increase the recreational access to the Höje å area. The access roads can also serve as a handicap scheme, if provided with good parking opportunities. The roads will run to and between the wind turbines, some distance from the stream, but adding handicapped paths down to the stream and even crossing opportunities, the recreational value will increase considerably.

To make it possible for people to not only pass through the area but to stop and repose, resting sites, viewing spots, bridges and maybe swim access should be constructed. At the sewage treatment ponds

just before Trolleberg, there are several barbecue installations which are popular in summer. Similar installations along the stream can also encourage increased active use of the area and a re-discovery of Höje å. Wind shelters for overnight stays or sheltered meeting points will encourage the use of Sweden's unique '*Allemansrätten*' (the freedom to roam).

4.2.5 lichen cultivation idea

As this thesis is based on existing wind power turbines located in an agricultural landscape with tiny natural remains and some cultural heritage, the idea was to better understand synergetic opportunities of different functions if there is an increase in the number of turbines. An inspirational idea came up to see if for example a concrete wind turbine base can become a viable habitat for lichens as well as other primary organisms.

In 1945, at the end World War II, Britain had 720 airfields[172] awarding the nation's nickname '*airfield country'*. Today there are many airfields with very low or no activity And some of these have been in focus of research by Gilbert (2000). The report on "stratibotany" (the war effect on plants), discuss the richness of lichens on former runways from World War II. The dry surfaces with sufficient drainage and otherwise hostile growth conditions prove to be ideal for the establishment of lichens. Gilbert noted that the airfields are major national lichen resources and up to 50 species can be found on one runway alone[173]. Normally they are growing in patches and species may mix with each other.

The concept of re-inhabitation on hard surfaces is fascinating. If it is possible to strategically apply lichens to the concrete foundations

[172] Blake R.N.E., 1969, The impact of Airfields on the British Landscape, *The Geographic Journal*, Vol. 135 (4), Oxford: Blackwell Publishing, page 511

[173] Gilbert O., 2000 The Lichens of disused World War 2 airfields, *Lichenologist*, Vol. 32 (6) [online], http://www.idealibrary.com 2011.12.05, page 6

of the wind turbines, another dimension of increased biodiversity can be achieved. Although not a new idea, introduction of lichen is not common in landscaping or gardening. Lichens on trees are sometimes being regarded as a sign of bad health, but can also be a sign of revitalisation and good air quality[174].

Inspired by Gilbert's airfield studies, a search for a project which involve intended lichen cultivation on hard surfaces started. An experimental example was found in San Francisco. The American architect firm CMG introduced lichens as an artistic and naturalistic design approach on the SFMOMA roof gallery. One of the main installations is a lichen wall, which has received a lot of attention. The lichens were chosen to provide a natural habitat, but also to show a concept of time and change[175]. Lichens are slow growing, and can take years to establish. CMG, together with lichen specialist Tim Milliken, carried out research on how to establish lichens in urban and manmade habitats, and tested several species and conditions. The wall is 14ft tall (4.6 m), and is made of lava stones. The collected lichen spores were mixed with an adhesive substance and "glued" onto holes and crevices on the textured wall[176]. It will take several years for the lichens to properly establish as the construction is only a couple of years old (autumn 2010).

Lichens are generally sensitive to air pollutants and often used as air quality indicators in urban situations[177]. To combine a human-made building construction with a design approach using living organisms that in turn can become an environmental indicator, is a fascinating design approach.

Figure 66: Visualisation by of lichen wall CMG

[174] Gardening tips n' ideas [online] http://www.gardeningtipsnideas.com/2007/02/growing_lichens_on_your_walls_and_trees.html, 2012.10.19
[175] CMG [online] http://www.cmgsite.com/projects/ecologies/sfmoma/, 2012.10.1
[176] Dwell, 2010.10.26, [online] http://www.dwell.com/slideshows/worlds-first-lichen-garden.html?slide=8&c=y&paused=true, 2012.10.26
[177] Ibid, 2012.10.26

4.2.6 summary

By discussing different concept perspectives in the Höje å area (Remiz concept, waterway concept, cultural concept, recreational concept and lichen idea, it has become obvious that ‘flexibility’ and ‘interaction’ are shared identities.

The concepts also interlink with each other, and with on-going programs, and can all be incorporated into one main concept. By taking advantage of the area’s landscape strengths and identity, as identified in the analysis chapter, it is possible to rank the suitability and/or importance of different concept factors in relation to this specific site.

When developing an infrastructure like wind turbines, increased natural, cultural and recreational benefits can be achieved, but only if thoroughly planned for.

5. DESIGN PROPOSITION

5.1 DESIGN INTRODUCTION

After background research, site visits and analysis, design strategies have been tested and explored. Starting with an introduction of concept ideas and sketches fundamental for the design development, a design proposal is presented followed by a discussion.

Starting from the municipalities' comprehensive plans and *Höjeåprojektet*, there is an obvious desire for an east-west non-auto traffic connection between Lund and Lomma. The landscape itself in the study area has a visual linear appearance in this horizontal direction by the flow of Höje å stream, while the present wind towers are lining up in different directions as seen below.

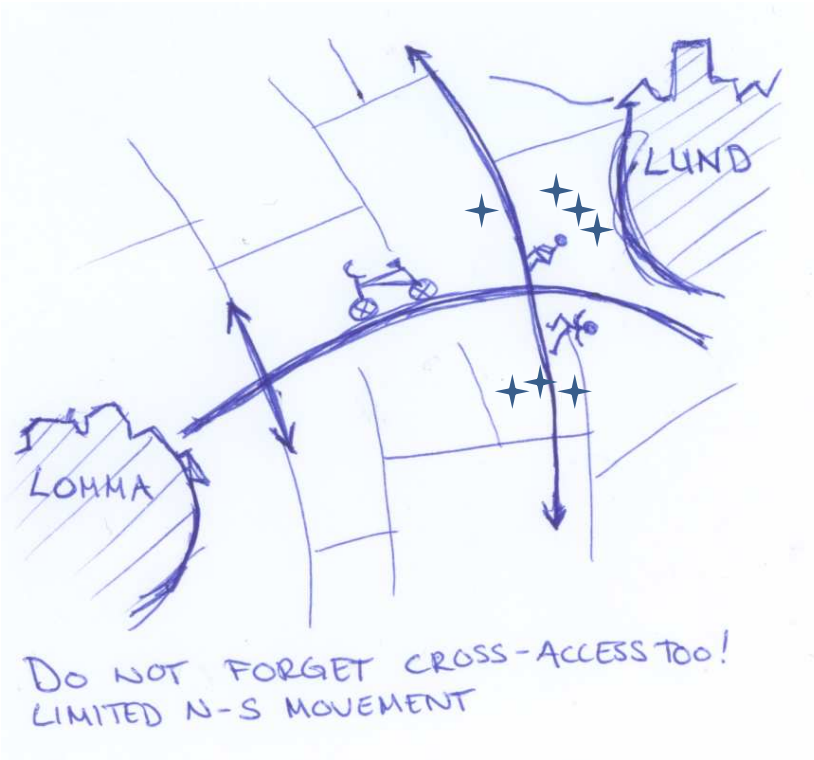
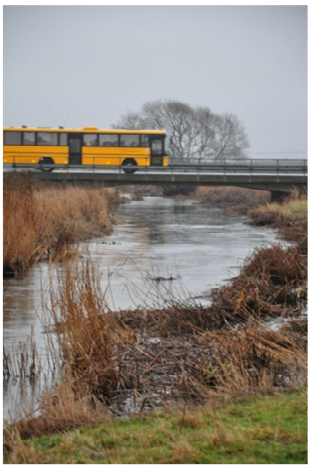


Figure 67: early concept sketch, present wind turbines = blue stars

Figure 68: the open horizon is the regional trademark. Do not destroy all the horizon

Figure 69: E22 crossing Höje å. Low bridge with no possible pedestrian access underneath, even less so vehicular. Area that need special consideration for path network



The design is based on the idea of introducing contrast effects to feature the open views and the horizontal landscape. By engaging local actors and stakeholders early in the planning process and encouraging their usage of the area, new dimensions will be brought toa project.

The development requires a long time perspective. Stream construction work will take years, and so will natural succession of plants and trees. Meanwhile, wind turbines can be erected and path systems be developed.

The suggested habitats are based on vegetative variations. By focusing on self-seeded plants, the stock will have a genetic set-up suitable for the local conditions. These will to some extent all be influenced by human activities like farming, grazing or screening of plants. In this way a process of natural vegetation will be established, although maintained in a semi-controlled manner creating a sense of place. By using different maintenance methods and degrees of maintenance, not only ecological values will increase, but educational opportunities as well. It will provide the possibility to understand how management affects the landscape while providing a rich easy-accessible biodiversity.

Höje å is a connecting link between green oases, not only in the study area but in part of the region as well. To have consecutive wetlands, meadows, and pastures with transition edges is important for it to properly act as a green corridor.

One of the main aspects of the design concept is the access options. There are several path/road systems possible to connect to but paths, tracks and access connections are recommended to keep a distance of minimum 100 m from wind turbines in order to minimise the risk of ice throw in winter. As for access connections, they have to be equally distanced from the turbines.

5.1.1 road access

One of the main objectives for the project is to utilise the necessary landscape changes required with wind power establishment for i.e. recreational improvements. The most obvious operation in the landscape is the access roads that have to be constructed. The layout of these will add to the framework of site specific design and recreational path network, hence a lot of attention has been paid to different options. A couple of the explored routes are presented below.

Access options:

Figure 70:

Red –new roads; yellow–existing road and modification

Access from the roundabout only. Advantage: road is modified for turbine construction, minimum modification and new roads. Disadvantage: Have to cross both Höje å and the highway –complicated construction

Figure 71:

Red –new roads. Yellow –existing road, modification

Three access roads. Advantage: do not need to construct road across Höje å nor under the highway. Disadvantage: potentially a lot of road works

Figure 72:

Red –new roads. Yellow –existing road, modification

Looping access road for wind turbines. Access through north Lomma and Värpinge. Continuous road. Problem: access via Värpinge can be problematic since road can't be widened. Option for new exit at yellow circle.

Figure 73:

Red –new roads. Yellow –existing road, modification

Two separate roads, no continuous vehicular access. Advantage: do not need to get across the highway. Problem: access from Värpinge where the road can't be widened

5.2 MASTERPLAN

The masterplan consist of a network of paths linked to existing recreational trails in Lomma and Lund as well as being based on the proposed run by *Höjeåprojektet*. It creates connections between the southern and northern agricultural plains, as well as Lomma and Lund. The roads follow field directions. Path systems can evolve with time and season from how grass is cut to where people desire to walk. Already today there are possibilities to walk along the broad greenways along Höje, though it is challenging at many passages. Consecutive wetland, ponds and pools are established both to hold water for remediation and to provide interlinked habitats for flora and fauna. In the future it is possible to create more green corridors to connect different wetlands and meadows in the region with Höje å. The entrance area from Lomma is designed for everyday activities and easy access (detailed area 1). Lund already has the water treatment ponds for this purpose. Walking from treatment ponds, the experience become more rural, with smaller tracks passing through pastures.

The wetlands are placed in natural depressions or where Höje å historically passed through the landscape.

The vegetation is based on self-seeded plants, where management is the key to the development of the specific characteristics for each area. At the frog ponds (detailed area 2) planting is done with the construction of wetland and wind turbines. Taller vegetation is scattered, but where it is in denser formations, there are openings and views out to the wider landscape. The construction base of each turbine plays a role in the wider concept. Some are parking and event spots where the vegetation on the hard surface is kept low, others are developed into meadows and biotopes for insects.

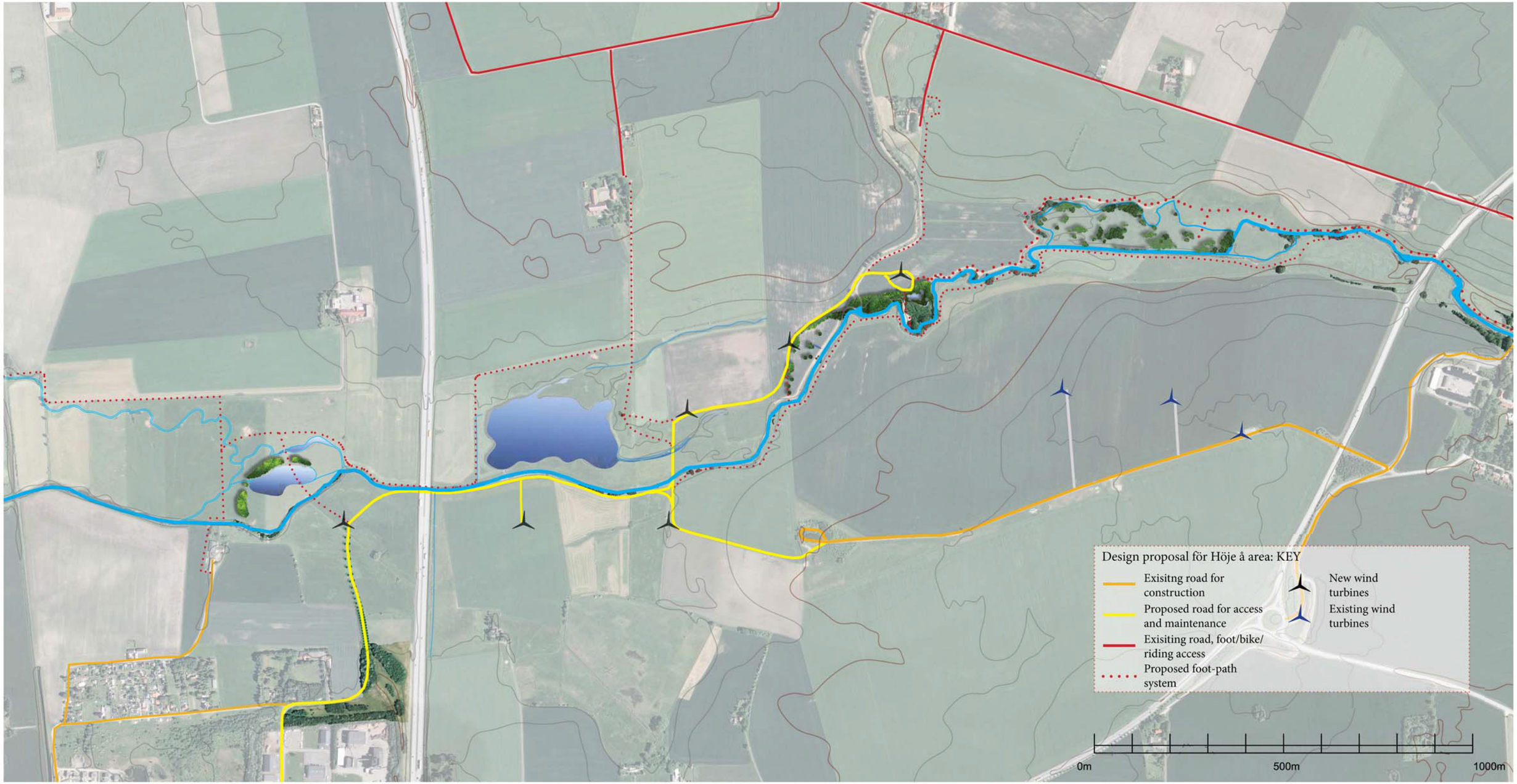
The proposed turbines have been positioned through careful analysis, but further in depth analysis of different impact must be done as the exact locations of the turbines are dependent on several issues, not the least the dialogue with the landowners.

The visualisations of the wind turbines have been limited. This leads to a lack of knowledge how it will appear from different angles, what lines in the landscape it creates. There is a risk the groups of turbines (present and planned) may appear randomly placed from some directions. As an alternative to the proposed design one or two turbines could be removed. Based on the analysis of the landscape view lines and the relation between the turbines, two turbines are seen as less connected to the whole picture. As seen in figure 70 these are the flanking turbines to the west.

Three areas will be presented in more depth. All the areas are connected through the recreational path and by the cultural history, but are designed differently depending on their individual prerequisities. The scale the chosen areas are presented in differes since different ideas are represented.

Figure 74: location of present and proposed wind turbines

Figure 71: Masterplan



Present land-use and structure is kept as a reference to traditional agricultural landscape patterns -narrow, parallell fields.
Re-introducing old stream, and allow seasonal flooding within area

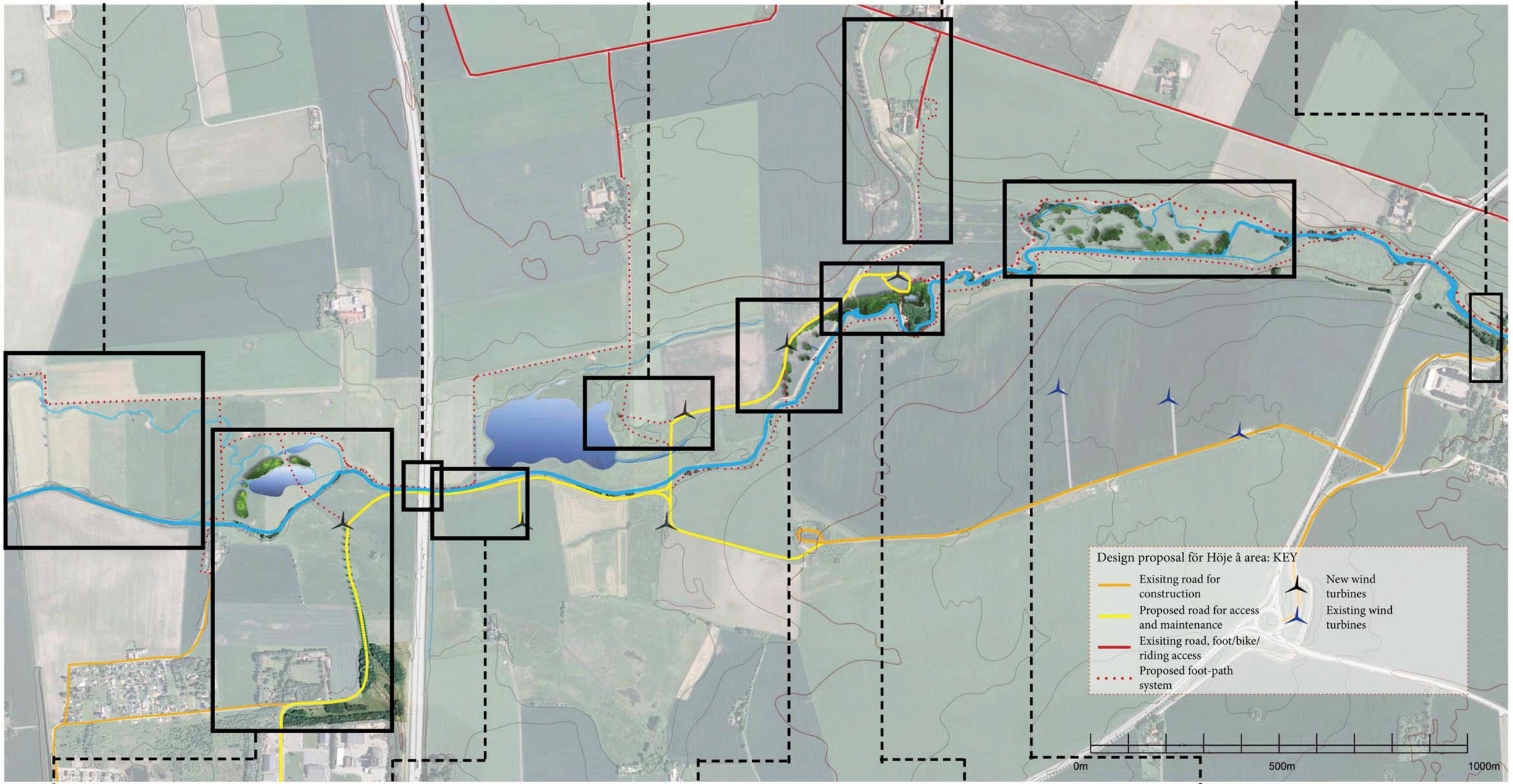
The highway crossing is a complicated site. Suggestion is to rise the road to allow crossing of both vehicles for construction and for pedestrians

Access to present pond is limited today. The hard surfaces at the turbine can act as parking place in an otherwise muddy area, as well as keep cars further from breeding ground. Bird watching tower suggested close to the shore

Alternate access by foot/bike/horse from Lund. Önnerupsvägen (red country road) corsses the highway and provide connection to Bjärred etc.

New paths connect to present path system along the cleaning ponds and previoius Höje å projects

Figure 72



Access for construstion and recreation from Lomma. Pyrus avenue lead by the first turbine and into recreational wetland area. Main purpose is easy, everyday access for locals

Area that can act testing site for temporary road system through decking. Placed out during construction and demolition. In between narrow path, to evaluate if a reasonable system

Smaller, more intimate and sheltered landscape room, with focus on amphibian habitat. Benches and boards for outdoor education for schools and organisations

Wetland woodland, bordered by a meadow. Maintained to remain in a semi-mature state promoting biodiversity. Strategy to suit Remiz pendulinus

Coppice and grazing meadow. Historical land-use and expression re-introduced. Material from coppiced species can be used for handicraft project through societies and possibly through Uppåkra Centre activities

5.3 DETAIL AREA 1

Placed in a low spot with natural flooding, and where the historical maps show the old run of Höje å, a new wetland is proposed. The main access from Lomma runs from a wooded recreational area. To soften the transition from woodland to open farmland, a gravelled *Pyrus* avenue will lead into the new recreational area. The trees are quite columnar, and present seasonal interest both in form of flowers and fruits. They lead up to the wind turbine, which act as a meeting- and focal point where there are possibilities to have pick-nick tables, some parking spaces and even small fun fairs at times. This is a bit higher than the surrounding land to minimise flooding of the turbine. From here one can either follow the maintenance road (potentially) crossing below the highway, or cross the pond/wetland for a loop back towards Lomma, or to continue along the northern shore of the stream towards Lund or Bjärred. From the construction base of the turbine, a wooden bridge leads across a newly established pond, still accessible even at high water levels. Some of the old meanderings of Höje are re-opened, creating the wetland. This area is the main flooding basin in case of storms. The main users are everyday visitors from Lomma walking their dogs, taking a walk, or going for a swim .In the pond a platform is designed for both access to the water and to enjoy the views of the landscape. The pond itself has shallow banks, where submerged aquatic vegetation can establish but is deeper in the centre to avoid overgrowth while also providing bathing opportunities.

Figure 77: sketches of possible lichen/sedum(ivy establishment for micro habitats on the wind turbines and on transformer buildings


0m
50m
100m

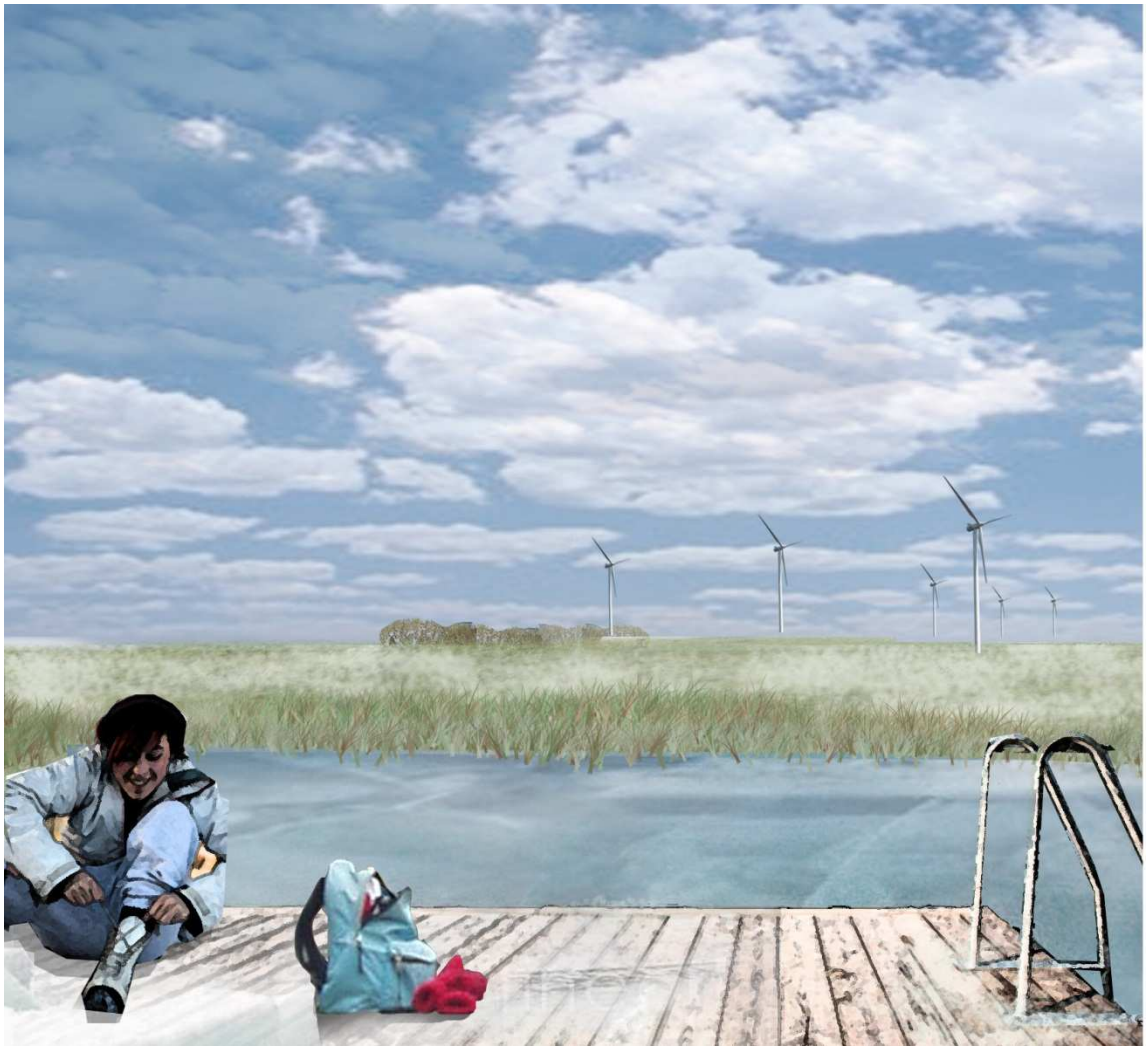


Figure 79: Visualisation from the bridge east-southeastwards. Not made in WindPRO, turbine positioning is not exact

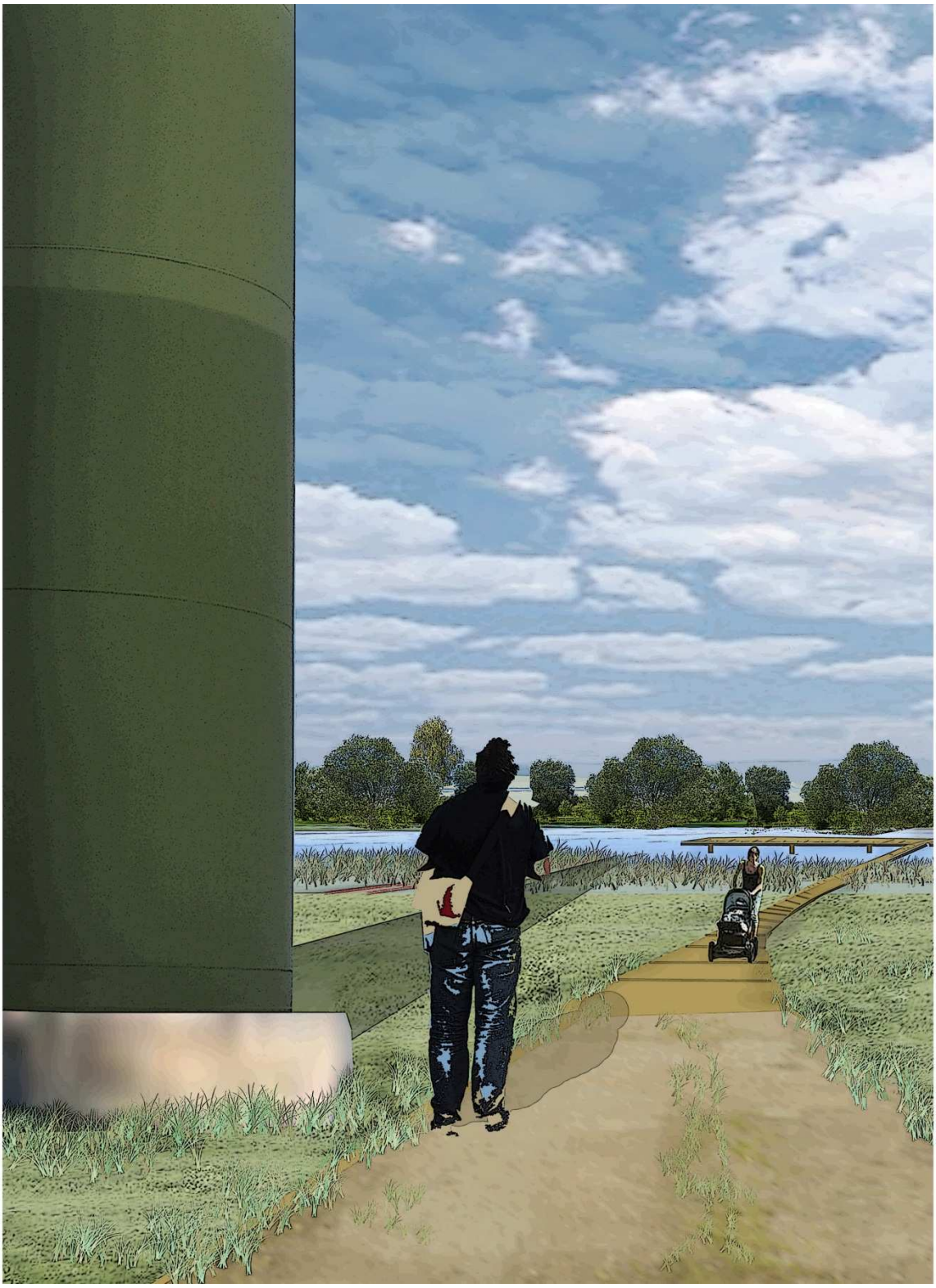


Figure 80: Visualisation from turbine north towards established pond

5.4 DETAIL AREA 2

Located close to the pond and wetland established through *Höjeåprojektet*, is the wooded wetland (detailed area 2). Almost halfway between Lomma and Lund the area does also provide resting facilities such as benches in for of an outdoor classroom and over-night wind shelters.

Based on the LCA, this part of the stretch is more suitable to woodland development than other parts outside the towns. With a natural wooded area present and meandering of the stream, it provides good possibilities to extend and improve these features. For this area the proposal mainly focus on different wetland establishment, including some modifications of the stream. These comprise a widening of the stream at the camping site, a deep sediment pool where the drainage stream enters and a small canal providing to create the wetland. The wetland is divided into two parts. The western part is open, sheltered from both the prevailing western winds and from the cold northern storms, with wetland vegetation and many small pools of water –both still and moving. In the wood stands deadwood and stone piles should be introduced. These actions are all to favour the lifecycles of amphibians. Within this area a board and benches are suggested to promote outdoor education. Classes and nature organisations can come here to study the wetland species and sit down in an outdoor classroom. At the end of summer the grass is cut and collected. Care has to be taken to not harm animals.

The eastern part of the wetland has an open pond, and smaller ones which potentially are covered with vegetation like sedges and reeds. *Salix* will establish here naturally, but *Aluns* and *Betula* is planted. The ground is low and moist, with dense opportunistic vegetation. Management will make sure the area does not become too dense. Once trees reach a semi-mature age (about 25-30 years) most should be cut to provide deadwood and to allow younger specimens to grow. This will keep the succession at a higher rate

and produce more dynamic vegetation. At the widened part of Höje, a swimming-deck is proposed, leading out to the deeper part. As the area is in general very open and exposed, shelter and visual as well as physical contrast is created. Set in a natural clearing facing south west two wind shelters and a fireplace are planned. Scout groups from Lund and Lomma may use these, or regular hikers or youths.

North of the wetland, around the base of a turbine, a flower meadow is established. Grazing by cows may occur here. The dry meadow will provide habitat for another set of flora and insects. This in turn provide hunting ground for other species.

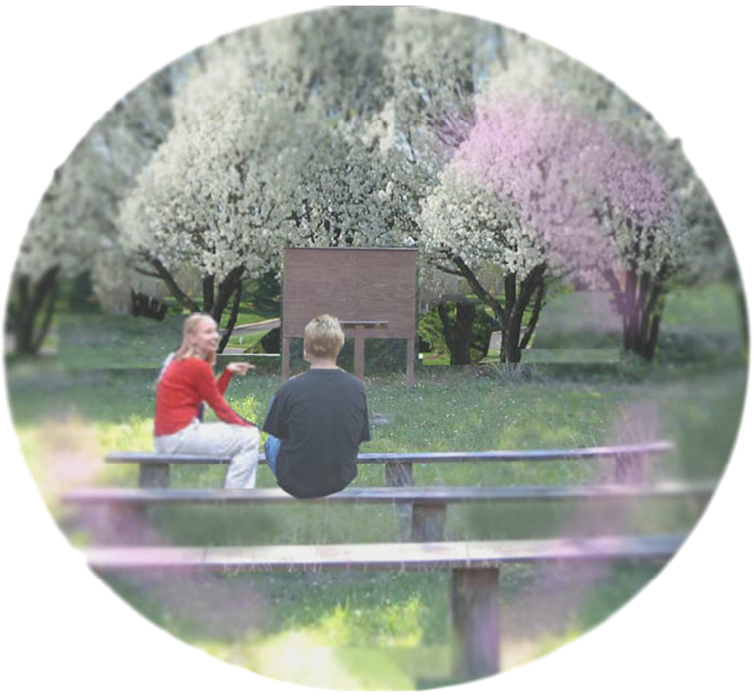


Figure 77: visualisation of outdoor learning area


0m
50m
100m

5.5 DETAIL AREA 3

On an island between the re-discovered old run of Höje and the present one, a traditional landscape is established, the coppice. The HLC is one of the main tools used to develop this area. Located close to Trolleberg and the traditional looking grazing lands there, and not far from Uppåkra, it is the most suitable area for historic landscape references. Since the project area is created from agricultural functions, there are no parts that clearly portray traditional uses of the stream landscape. With a multifunctional land-use, an image of what the historical landscape might have looked like not too long ago can be created. Through grazing, pollarding and coppicing, a semi-open meadow is created, nourished by seasonal flooding. These actions will provide a very special character where the trees are club-shaped and the shrubs multi-stemmed. Between these the horizon stretched far away. Since it is located in a depression and the trees height is monitored, it will not disturb the sky-line from outside the project area. It is possible to link the maintenance with activities at *Uppåkra Arkeologiska Center* in the future, promoting material collection for construction and basket making. The area can also act as an extended showcase of historical land management.

Figure 83: visualisation of detail area 3,southward through the coppice towards existing wind turbines

Figure 84: map of detail area 3 with the coppice, managed vegetation and semi-open character

6. REFLECTIONS

Wind power is a growing industry which has an increasing impact on our landscapes. Much has been written and said about public acceptance, risk factors and the importance to consider the wider landscape when developing wind turbine sites. Surprisingly though, there is a lack of research regarding wind power integration with other potential land-uses. In this study, analysis tools and processes which can be incorporated in the planning procedure have been identified and demonstrated. To face the challenge of creating a multifunctional landscape design having wind power as a back-bone, has been most interesting. There are many regulations and stakeholders' interests to consider, but also most promising opportunities for adding values in a multifunctional approach.

As process analysis provides the framework for this thesis study and design being considered all way through, design has been an integrated part right from the analysis phase. By showing a planning approach where design was not separated from the traditional planning process, 'negative planning' based on restrictions was avoided. Considering the possibilities to incorporate other practice and approaches in the design methodology used, it might be suitable to refer to the method as 'opportunity oriented' design/planning. At the same time it might be better to refer to the negative planning process based on perceived problems as 'problem oriented' since it is not only negative to consider these issues, but also vital for a project to be implemented. It would be interesting to see how these terminologies and approaches could be further explored.

To reconnect to the initial questions of this study:

- Can a wind power development project such as the one proposed along Höje å, be the starting point/initiator for

environmental, recreational and cultural enhancement schemes?
    - To what extent may these areas of interest and wind power development become synergetic?
    - How can landscape improvement schemes be applied in relation to Höje å?
    - Are recreational, cultural and environmental schemes of the same importance?
- Is design applicable as a means to sustainable wind power development?
- Which design tools are useful in relation to the Höje å case study?
- To what extent may landscape analysis provide a good design foundation for development of Höje å?

The performed study shows that there are major possibilities for wind power projects to become an initiator of other landscape functional opportunities. Financial incentives by land-lease and income from the electricity generation can provide economical benefits to encourage further developments where new landscape functions might not have been welcome. More important though, is the possibility to realise ecological, recreational and cultural schemes in wind power planning. The HLC, LCA and Lynch analyses provide a foundation for ecological, cultural and recreational opportunities which, combined with the wind power planning, can create synergetic opportunities. Access roads to the wind turbines can become part of biking, jogging or walking tracks, and provide access to disabled people for nature experiences. A comprehensive planning and design of a development area can include restoration of land and water habitats attracting species constricted by today's urban expansion. As a consequence the area can become more attractive to nature enthusiasts and people seeking for recreation and nature experiences, even though the original reason for development was wind power generation.

The present study of Höje å area has presented some very promising examples of how ecological, recreational and cultural schemes can be applied along with a specific wind power development along Höje å. The sites of the nine wind turbines, of which three are existing turbines, three are to be replaced (in a new siting) and the remaining three are proposed as new ones, are fixed by a previous Theme Course study.

Ecologically the combined planning and design of the Höje å area has shown that the land around the turbines can provide important habitats and green corridors, the waterway can be improved increasing the aquatic biodiversity, and new wetlands as well as woodlands can provide a series of habitats interlinked.

Recreationally the access roads for the turbines can act as recreational trails. Due to the ecological improvements visitors interested in nature experience can be attracted, and by providing bathing facilities the area can become even more appealing to humans. Camping and outdoor lectures are other activity options.

Culturally the Höje å area can be connected to Uppåkra and its new archaeological centre. By providing information signs and trail schemes the historical heritage of this culturally interesting area will attract another category of visitors. A re-meandering of the stream can play an important role in returning the flow to a natural and historical perspective, and the pasture in ‘area 3’ is based on traditional landscape management techniques.

Normally functions have varying importance in a landscape. For the design proposal in Höje å area the ecological and recreational values have overall been favoured to create consistency, but for part areas each of the three functions have had different impact on the design in accordance to the analysis and site specific conditions. To evaluate and identify the basic identity of each area

is of outermost importance and for making further judgement of how to deal with development changes.

For wind power development to be sustainable over many years, and being well functioning in the landscape, attention has to be brought to the interaction with its surroundings. To avoid creating an isolated wind power island in the landscape, accessible for none and growing resent scattered turbines, integrated planning and design is required. Based on the approach presented in this work, the analysis can shape the design and synchronize the landscape and its different layers.

The in-depth analysis tools have been invaluable to understand the underlying functions, history and impressions of the current landscape. The LCA analysis provided a strong understanding of the landscape and how it is perceived. The HLC analysis enabled the understanding of human impact having shaped the land over time, while the Lynch analysis assisted the organisation of features present today. Furthermore, inspiration from precedence studies and interviews has been beneficial to the design process in Höje å area.

By regarding wind power turbines as yet another landscape component needed to be integrated to a wider context rather than becoming an independent brick, enables enhancement and promotion of other values to man and nature. The idealistic vision is to create a landscape in synergy, where the different functions benefit from each other. When planning for a new urban neighbourhood it is obvious to most planners to consider parks, access options, views etc. The same principles are applicable for infrastructure developments like wind farms.

The region between Lomma and Lund has the potential to be a really attractive landscape, for humans as well as for animals and vegetation. Right now it is an almost forgotten area where you normally pass by at high speed in a car. The monocultural well

drained land can, with relatively small operations, become a lively and well-visited landscape - supported by wind power.

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