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Immersion in Environmental Design: A Study of Game Design Elements and Audience Connection

By

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Abstract

Immersion is a multifaceted concept essential for creating riveting and unforgettable experiences. Without strong engagement, a game fails to captivate the target audience, ultimately jeopardizing its success. Among various forms of immersion, environmental spatial immersion plays a critical role in game development, captivating players within a believable virtual world.

This project aims to deliver an immersive exterior environment by utilizing a variety of game development tools. The primary objective is to produce a visually compelling 3D environment grounded in established research on immersion and design principles offering a deeper understanding of the principles and practices involved in creating engaging virtual environments.

Chapter 2 provides a comprehensive overview of various forms of immersion, detailing their definitions and applications with key game examples. Chapter 3 presents a case study on Rockstar's *Red Dead Redemption 2*, illustrating an exemplary example of spatial immersion. Chapter 4 outlines the methodology for the project, detailing the processes and techniques that will be employed. Chapter 5 meticulously details the development process encompassing a plethora of stages. Chapter 6 evaluates the project's effectiveness in achieving the desired level of spatial immersion and authenticity. Finally, Chapter 7 concludes with a summary of the findings and offers suggestions for future works.

The key revelation of this project was the impact weathering texture work has on environmental components. The added details in textures and decals creates a feeling the world is inhabited and alive. This vital element of environmental design is pivotal in the fruition of player immersion in video games which directly leads to a successful video game release. This approach to 3D environmental design should be a foundational element in the production stages. It has been evidenced that this method provides the player with immersive and authentic areas to explore and when deployed into AAA video games, linear and open world environments feel more enveloping and real to the player.

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1.0 Introduction

Immersion is a multifaceted concept essential for creating riveting and unforgettable experiences. Without strong engagement, a game fails to captivate the target audience ultimately jeopardizing the game's ability to succeed. Among the various forms of immersion, environmental spatial immersion plays a critical role in game development, relying on it to captivate players into a believable virtual world.

This project will deliver an immersive exterior environment by utilizing a variety of game development tools. There are a number of key objectives that have been outlined to maximise the project's success:

The primary aim:

- To produce a visually compelling 3D environment grounded in the established research on immersion and design principles.

Secondary Objectives:

- Offer a deeper understanding of the principles and practices involved in creating engaging virtual environments.
- Ensure spatial immersive properties are present in the 3D environment project.
- Produce high quality textures in Substance Designer and Substance Painter.
- Enhance expertise in Unreal Engine 5.

Collectively, these goals aim to broaden this study's scope and elevate the project's overall quality by integrating reliable and advanced techniques.

The dissertation is structured as follows:

Chapter 2 provides a comprehensive overview of various forms of immersion, detailing its definitions and applications with key game examples. This examination is supported by a broad array of literature, focusing on key research areas including Mihaly Csikszentmihalyi's theory of 'flow', Heather L. O'Brien and Elaine G. Toms' deconstruction of user engagement, Jenova Chen's flow zone, an expansion on Csikszentmihalyi's work with a focus on games, and Mata Haggis-Burridge's immersion categories.

Chapter 3 presents a case study on Rockstar's *Red Dead Redemption 2*, illustrating an exemplary example of spatial immersion in recent history. The chapter explores various aspects of environmental design and how they collectively contribute to creating successful spatial immersion.

Chapter 4 outlines the methodology for the project, detailing the processes and techniques that will be employed to create the 3D environment. This includes a detailed schedule planned out using a Gantt chart.

Chapter 5 meticulously details the development process, encompassing key stages such as preliminary research, blockout and texture creation, final model design, application of advanced techniques such as vertex painting and parallax occlusion mapping, terrain development, and the integration of third-party assets to bring the environment to life.

Chapter 6 evaluates the project's effectiveness in achieving the desired level of spatial immersion and authenticity. This review identifies the key strengths and weaknesses encountered throughout the development process.

Finally, Chapter 7 concludes with a summary of the findings and offers suggestions for future work to further enhance the environment, aiming to achieve the next level of spatial immersion.

2.0 Literature Review.

2.1 Introductory Information on Games and Functions

The concept of a game can be multifaceted, allowing for a plethora of interpretations. It is a broad term used to primarily describe a form of activity that individuals engage in. The foundational elements of any game consists of these main components: The set of rules, goals, player agency, challenge, rewards, and player feedback [1].

There are a myriad of reasons why individuals engage in a game. The fun factor and moment to moment enjoyment. The novelty of experiencing something new. Achieving mastery in a certain set of skills required to reach the top of a leaderboard and exploring virtual environments with the freedom to choose your own path, are a few to mention [2].

2.2 What is Immersion

The Cambridge Dictionary definition of the word immerse states, “*to become completely involved in something*” [3]. This term is susceptible to being incorrectly applied and misinterpreted by individuals within and outside the respective industries leading to a feeling of confusion amongst readers and listeners.

The common word immersion has become ubiquitous within the gaming industry, being featured in marketing campaigns, critic reviews, promotional material such as trailers, showcases, and interviews with developers. The term’s pervasive use aims to attract the target audience into purchasing and engaging with the game. However, despite the widespread adoption, immersion can serve as a dominant buzzword to describe a sensation that individuals may not fully comprehend in terms of its application to video games and their own experience.

An Illumin magazine conceived at the USC School of Engineering states that “*Immersion is the process by which a media element entices a person to suspend their disbelief and accept what they are viewing on a screen as actual reality*” [4]. This definition of immersion, in the context of video games, offers valuable insight into the intentions of the designers and the desirable outcome from the target audience.

From a psychological perspective, *“immersion is a process of temporarily expanding consciousness into areas of the unconscious – something like hypnosis, but retaining consciousness as one does in lucid dreaming states”* [5]. This elucidates the physical and mental attributes of what immersion can be observed as and the subjective sensations a person can feel. This is closely related to Dr Mihaly Csikszentmihalyi’s theory of ‘flow’, where he explains flow is *“a state in which people are so involved in an activity that nothing else seems to matter; the experience is so enjoyable that people will continue to do it even at a great cost, for the sheer sake of doing it”* [6].

To maintain conceptual clarity and coherence within this dissertation, the definitions outlined above will serve as the guiding principle for examining and analysing immersion within the context of video games.

2.3 The Importance of Immersion and Engagement

The pursuit of immersion is paramount as it serves as a fundamental pillar in the success of a video game. The degree of immersion achieved stands as the decisive factor in satisfying the target audience. According to an article published by Zero Latency Montréal:

“Immersion is critical for creating a believable and captivating virtual reality game. It allows developers to craft engaging stories, create a sense of presence, and provide users with an interactive and memorable experience, [...] which can cause players to feel as though they are part of the story or world” [7].

These powerful benefits are sought after by video game industry developers because it can transform an average game into a monumental success. Achieving immersion first begins with successfully engaging the audience. If there is no active engagement from the player, there is no chance in achieving an immersive state.

Heather L. O'Brian and Elaine G. Toms critically deconstructed the term user engagement and outlined the process to consist of four stages: point of engagement, period of engagement, disengagement, and re-engagement. They state that *“Engagement is a quality of user experience with technology that is characterized by challenge, aesthetic, sensor appeal, feedback, novelty, interactivity, perceived control and time, awareness, motivation, interest and affect”* [8].

Engagement and flow share similar attributes and both play a critical role in creating an immersive environment. Without initial interest or attachments, players are unlikely to develop a lasting connection with the game. Consequently, if the game fails to engage players and provide reasons to return, it risks being forgotten and abandoned. In this context, engagement is the heartbeat of a game, it's responsible for securing sustained retention and from that, financial success. [9].

Expanding on Csikszentmihalyi's theory of 'flow' is the flow zone described by Jenova Chen [10]. This theory is directed at video games and describes the time when harmony is achieved, arriving from the challenge presented by the game combined with the ability of the player.

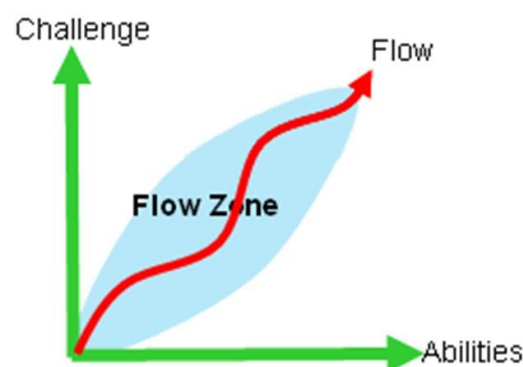


Figure 2.1: Player in-game Flow Experience

Any game has the potential to exhibit the experience of flow. The correct application of flow elements can create an engaging and rewarding experience. Figure 2.1 represents a player in the flow zone. The player's game session alternates between becoming slightly challenging and slightly easier compared to the players expectations. Flow is maintained here since the player can tolerate the swings of difficulty. If the experience strays too far

outside the flow zone because of negative psychic entropy such as anxiety and boredom, the flow experience will break as displayed in Figure 2.2 below [11].

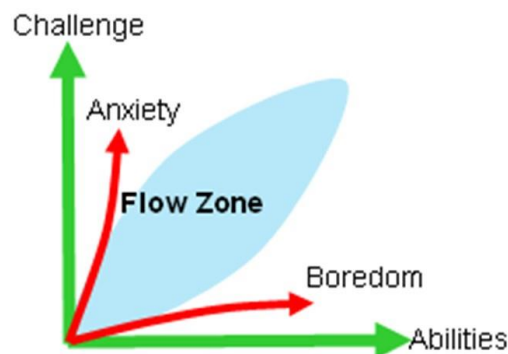


Figure 2.2: Player encounters psychic entropies

Each person has a different requirement to enter the flow zone. As shown in Figure 2.3, a well-designed game can achieve flow for the average player but for a novice or hardcore player, different requirements are needed to achieve the harmony required for flow to materialize.

Jenova Chen states the example of an FPS game to better visualize Figure 2.3:

“A simple action to an FPS player such as shooting, might be an extremely difficult task for a casual gamer just starting a game. Even though the rest of the game might be something that casual gamers enjoy a lot, the harsh beginning just turns them off” [11].

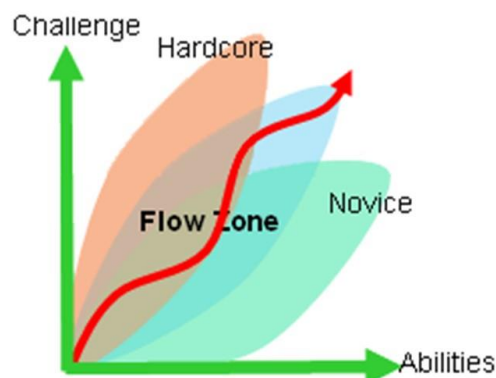


Figure 2.3: Different Players and Flow Zones

This example by Chen emphasises the need for video game designers to offer a wide range of accessible difficulties options so more players can enter the flow zone.

2.4 The Forms of Immersion

Each player has their own unique experiences and therefore, their own perception of what the feeling of being immersed is. There are a host of various ways to become immersed that it is impossible to say each players experience is identical.

There are several forms of immersion in video games. Mata Haggis-Burridge from the Breda University of Applied Sciences states four key categories which are *systems immersion*, *spatial immersion*, *empathic/social immersion*, and *narrative/sequential immersion* [12]. The following sections of this chapter will explore each form providing an example to better illustrate the definitions.

2.4.1 Systems Immersion

Systems immersion is achieved when the player is deeply engaged with the minute-to-minute decision making tasks combined with the rules of the game. For example, Rocksteady's *Batman Arkham Knight* [13] presents a fictional world where the player controls Batman. The game makes a promise to the player that they will feel like Batman. This is executed by creating movement systems that are believable and provides intricate control to the player enhancing the experience. (Figure 2.4)



Figure 2.4: Gliding movement system that is consistent with the laws of physics

There are strategic stealth engagements alongside combat encounters where players need to eliminate the enemies. The player is unlikely to feel that they are in peak physical condition but their mind and body feel the ability to utilise the free-flow combat system and gadgets given to complete the objectives, and progress forward under the rules of the game. (Figures 2.5 and 2.6)



Figure 2.5: The player, as Batman, perched preparing a plan of action in a stealth engagement with the gadgets available

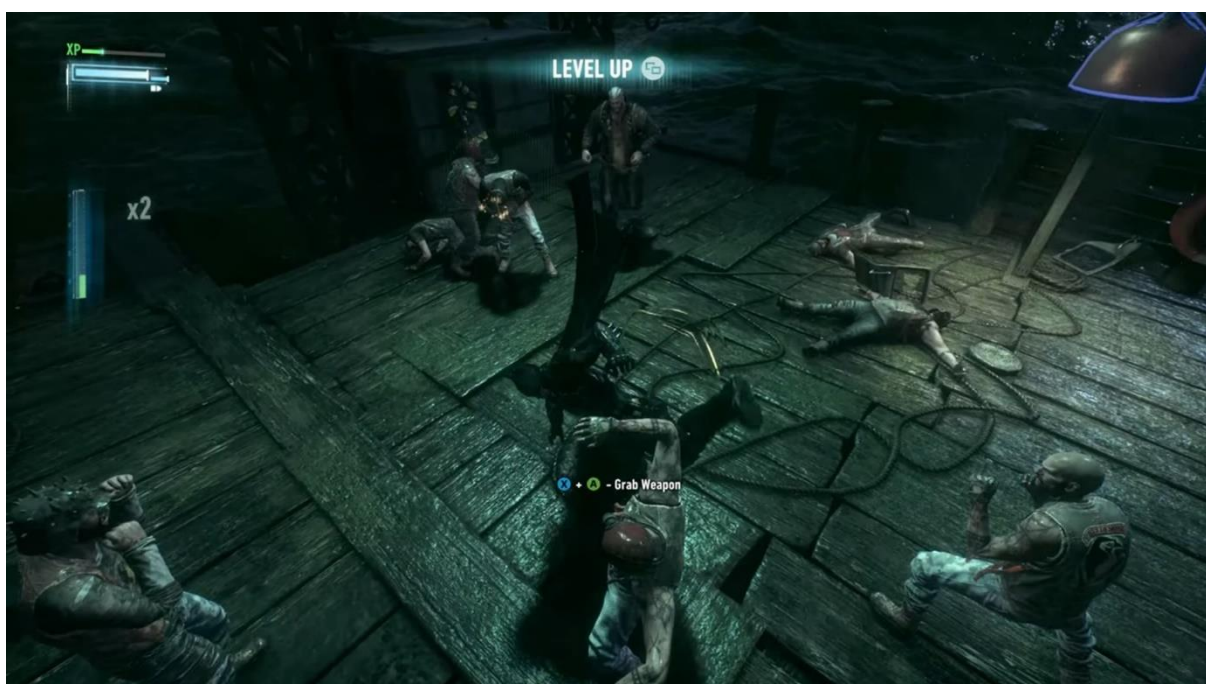


Figure 2.6: The player utilising the free-flow combat system to eliminate enemies

This category of immersion links well with Dr Mihaly Csikszentmihalyi's theory of 'flow' where he explains his journey in researching individuals that find certain tasks intrinsically satisfying and pleasurable [14]. Equipped with this knowledge, we can begin to direct our development cycles to produce gameplay that has the potential to allow the player to enter a flow state similar to how *Batman Arkham Knight* [13] facilitates it with its array of mechanics available.

2.4.2 Spatial Immersion

Spatial immersion is attributed to a profound sense of presence in a virtual world. If a player can recall an experience, or location as if they have been there then that is the quality of spatial immersion in play. The sheer graphical fidelity of a game can be responsible for creating this type of immersion but it is not the sole factor. A player can experience a remarkable sense of spatial immersion from a 2D game such as the platformer *Celeste* (Figure 2.7) [15] or a game with a more cartoonish art style such as *The Legend of Zelda: Breath of the Wild* (Figure 2.8) [16].



Figure 2.7: Celeste 2D Pixel Art Game Environment



Figure 2.8: The Legend of Zelda: Breath of the Wild Game Environment

The world of *Super Mario 64* (Figure 2.9) [17], with its simple models and low-quality textures, can exhibit spatial immersion but as technology advances, the standard keeps rising causing former games to lose that ability since player expectations are rising with it. Looking back at former games can make them feel artificial in comparison to modern games.



Figure 2.9: Super Mario 64 Game Environment

A good example of this is the 2004 *Spider-Man 2* game (Figure 2.10) [18] by Treyarch on PlayStation 2 in direct comparison to the 2018 *Marvel's Spider-Man PS4* (Figure 2.11) [19] by Insomniac Games. On release of the former game, it was being praise for the web swinging but with technological advancements, the latter game provides a much more streamlined experience that it makes the former obsolete.



Figure 2.10: Treyarch's Spider-Man 2 2004 Game Environment



Figure 2.11: Insomniac's Marvel Spider-Man 2018 Game Environment

2.4.3 Empathic/Social Immersion

Empathic/Social Immersion pertains to the player's invested interest and engagement with the personal and social aspects of the game. There are countless characters created to be used in video games, some playable, some played alongside and other non-player characters (NPCs) that fulfil a need. Players are susceptible to becoming emotionally attached to characters as Lteif explains *"I found myself enjoying the diverse champion selection offered until one specific champion called Camille caught my attention for I have related to her struggles, her wit and ability to manoeuvre larger and stronger opponents to get to her goal. As a result, I subconsciously kept playing over and over until developing a clear anchor to that character"* [20].

A player can build empathic attachments to NPCs that assist with a goal or mission. Picture a scenario where a substantial NPC character gave their life to save the player. This, no doubt, would create a personal connection driving the player to avenge their death or push forward with the weight of their sacrifice in mind.



Figure 2.12: Naughty Dog's Uncharted 2 NPC Mission Sequence

In Naughty Dog's game, *Uncharted 2: Among Thieves* [21], the game presents a sequence where the player must assist a seriously injured NPC character and escape their surroundings (Figure 2.12). This now prevents the player from using two-handed firearms and slows down movement. After successfully transporting the NPC across the streets, they are ambushed by the main antagonist of the game and after all the time and energy given in an attempt to save the NPC, it is ultimately thwarted and he dies. This has consequences to the in-game characters building emotional depth and engagement within the player.

The social aspect can be facilitated in a coop or online game. Current popular games have systems in place to connect players together such as an online lobby or guild system. Social connections can be created in the virtual space and in an online chat area. Connections can spark over shared interests, values and personalities while engaging in a game world. Online communities can build empathic and social immersion. The sense of friendship and community can be a powerful motivator and drive sustained engagement amongst players.

This feeling of belonging can have positive and negative impacts on a person's life. Increased enjoyment, satisfaction and improved mental well-being can come from this but an excessive reliance on online social connections can lead to an individual neglecting their responsibilities and personal health. A balance must be struck to maintain equilibrium between real-life obligations and gaming pursuits for the best overall well-being.

2.4.4 Narrative/Sequential Immersion

Narrative/Sequential immersion stems from the players inclination to progress with the game's story sequences. Game designers and writers are required to create an engaging set of events that emotionally resonate with their target audience. With a successful hook, the player will want to continue the game to witness the following events.

Many games have an upgrade system implemented that requires the player to gather resources to enhance their abilities and tools. This anticipation of an upgrade can push the player forward to the next point of progression. Naughty Dog's *The Last of Us* [22] possess this quality where upgrade benches are placed throughout levels, some hidden and unlocked via puzzle, for players to spend resources and receive stronger weaponry and ability improvements (Figure 2.13).



Figure 2.13: Naughty Dog's *The Last of Us Part 1* Upgrade Bench Area

This form of immersion can manifest in the exploration of the game environment. The player can be driven by the desire to explore new areas of the game environment and unlock mechanics further into the story, which can be utilised in previous areas travelled. This is commonly found in the sub-genre Metroidvania titles.

The term 'Metroidvania' is derived from the *Metroid* [23] and *Castlevania* [24] series, which revolutionized this style of gameplay. A notable example, that builds on this format, is Ubisoft's *Prince of Persia: The Lost Crown* [25]. This game incorporates a variety of time-based abilities that align with the narrative and are unlocked as the player progresses through the games, defeating bosses (Figure 2.14).



Figure 2.14: Prince of Persia: The Lost Crown - The unique ability to allows the player to create a copy of themselves in a position previously stood and then upon activation, the player teleports to the marked location acting as time travel from a narrative perspective. This ability unlocks a way to move past traps and obstacles previously in the way

Varying degrees of immersion are present here. Some games have a plethora of scripted sequences that every player experiences the same way while other games can be designed with an organic approach that provides the player with more options creating a different experience for each player. A player often prefers one from the other and the impact of immersion varies. This category of immersion significantly contributes to a wide variety of video games genres, ranging from action-adventure to simulations.

This chapter of the study has explored various forms of immersion and their representation in interactive games. It examined the foundational elements of immersion, including its definitions, importance, and different types—such as systems, spatial, empathic/social, and narrative/sequential immersion. The next chapter will focus on a detailed case study of Rockstar's *Red Dead Redemption 2*, emphasizing spatial immersion from an environmental game development perspective.

3.0 Case Study: Rockstar's *Red Dead Redemption 2*

3.1 Introduction to *Red Dead Redemption 2*

Rockstar's *Red Dead Redemptions 2* has been deemed an excellent case study to analyse and dissect the key components on showcase that, in tandem, achieve an extraordinary level of video game immersion. Utilising their in-house proprietary advanced game engine, with over 3,000 employees working together for 8 years, many individuals believe Rockstar Games have established the technical apex of what games are capable of in recent history [26] [27].

This analysis will focus on the environmental aspects of *Red Dead Redemption 2* emphasizing how these elements contribute to the groundbreaking level of immersion on display. A comprehensive full analysis is impractical here but can be expanded upon in future papers. This focused approach, grounded in the established frameworks outlined previously, aims to explore a deeper understanding of the development process at play, increasing our knowledge and competency in addressing the challenges that arise in a game development pipeline.

Red Dead Redemption 2 launched in 2018 as an open world action-adventure game. The game can be played in 1st and 3rd person perspectives giving players a choice on how to engross themselves in this world. Rockstar Games present the game's story with this description:

America, 1899. The end of the Wild West era has begun. After a robbery goes badly wrong in the western town of Blackwater, Arthur Morgan and the Van Der Linde gang are forced to flee. With federal agents and the best bounty hunters in the nation massing on their heels, the gang must rob, steal, and fight their way across the rugged heartland of America in order to survive. As deepening internal divisions threaten to tear the gang apart, Arthur must make a choice between his own ideals and loyalty to the gang who raised him [28].

The game has been designed with adults as the primary target audience. The game sports a realistic art style and this is reflected through every large and small detail on display. Despite the monumental task of creating a game on this scale, with this much detail, the majority of the target audience's expectations were exceeded. As stated by Meitzler from DualShockers.com *"Red Dead Redemption 2 aimed high in delivering players a living, breathing world, and it has surely hit its mark as Rockstar's deepest, most immersive experience yet"* [29].

Red Dead Redemptions 2 provides an open world like no other. In terms of environmental immersion alone, Rockstar has integrated many small details that accumulate to provide an experience that has set the bar extremely high for a wild west environment. An article published by The Guardian provides an excellent description of the various elements that enhance immersion:

"The Old West that Rockstar has conjured here is close to miraculous. Its world is a collage of capsule versions of real American landscapes: the crisp cold of the mountains; mesa-studded plains that offer views for miles; foggy, humid mornings in the bayou in the fictional Southern state of Lemoyne."

This description captures the overall atmosphere and aura that the game conveys to the player as they navigate the world. The visceral immersive sensations described as crisp cold of the mountains and foggy humid mornings are not inherently felt in the players physical body but captured in the mind through visual design. The landscape, surrounding structures, foliage, vegetation and a host of other elements and effects combined create this feeling. This is a prime example of the games spatial immersion capabilities at play. K. MacDonald continues stating:

In towns – or in the grimy, captivating city of Saint Denis, a fast-modernising take on turn-of-the-century New Orleans that is truly a marvel – you can call out a greeting to anyone walking the streets and be met with aggressive wariness or a polite nod [30].



Figure 3.1: Full Map Available in Red Dead Redemption 2 [32]

The Van Der Linde gang setup camp at various locations and the player has the option to engage in several points of interest dotted around on the map (Figure 3.1). The essentials and more are present to the point where active roleplay can be acted out. J. Grantham from GameRant breaks it down perfectly stating:

When players wake up they can break their fast and then go about some morning chores, maybe shave, chop some firewood, or go out hunting. Players might also aim to eat a proper meal around noon and then as evening descends they might head down to the local saloon for a drink. When Arthur gets dirty from his busy life as an outlaw, he should also make sure to get a bath at one of the hotels [31].



Figure 3.2: The player, as Arthur Morgan, completing chores in camp

This level of interactivity enhances the environmental interest surrounding the player since there is so much to interact with and it's all performed in a realistic manner with realistic animations created for it. This level of immersion has been attempted and subjectively achieved by other games in more focused genres but Rockstar here present this in an action-adventure open world game where there are many variables that can intervene with the flow state that are handled with care to not break the player immersion raising the bar.

Red Dead Redemption 2 presents a wide variety of rich and detailed environments across the map. Key elements of the game include its diverse architectural variations, where many buildings range from simple wooden shacks to sophisticated ornate, brick and mortar establishments. This diverse range of structures showcases Rockstar's increased efforts and commitment to historical authenticity which greatly increases the believability and realism of the game. It being based in realism has many advantages such as reflecting the socio-economic disparities of the time period engrossing the player into the Wild West era.

The remainder of this chapter will concentrate on the environmental elements that collectively contribute to what is widely regarded as one of the finest gaming environments to date. Analysing these elements will provide valuable insight that will significantly influence the development of the upcoming Wild West practical project.

3.2 Focused Analysis on Environmental Aspects

3.2.1 Exhibit A: Weathering and Texture Analysis on Smithfield's Saloon

Figure 3.3 depicts Smithfield's Saloon located in the town named Valentine. Significant time is spent in this town during the initial hours of the game, making it crucial for this frontier town to captivate the player and immerse them in the 1899 Wild West setting. A failure to achieve this immersion early in the game could result in player disengagement [8] and ultimately jeopardizing the game's success.



Figure 3.3: Smithfield's Saloon located in Valentine

The weathering texture work is pivotal in enhancing realism and immersion within the environment. The game features a variety of buildings in the town, each exhibiting distinct signs of wear and tear, reflecting the town's age. Elements such as peeled paint, rusted metal, and cracked wood contribute to an environment that deeply immerses players in a Wild West setting reminiscent of a film. These combined elements effectively convey the passage of time and the harsh conditions of frontier life, rendering the environment lived-in and authentic.

The architectural design of the building is grounded in historical accuracy, a testament to Rockstar's dedication to authenticity. The Smithfield's Saloon exemplifies late 19th-century western architecture, featuring a wooden façade that creates the illusion of a larger building with its tall front and prominent sign. The historical accurate model enhances the game's credibility. The surrounding buildings, each displaying variations of the architectural style of the era, further immerse players as they step onto Valentine's main street (Figure 3.4). The wooden exteriors and signs painted directly on the weathered wood maintain a consistent design, reinforcing the historical setting and deepening player immersion.



Figure 3.4: Building variation present in Valentine

Figure 3.5 offers a closer view of weathering and decay, manifesting in various forms such as peeled, faded paint, and warped, splintered wood. This element is crucial for environmental immersion. If pristine structures were created instead, the genuine sense of a lived-in town would be lost, potentially leading to player disorientation and confusion. While the game would remain functional, the immersive quality would drastically diminish, resulting in a lesser overall experience. This is why Rockstar meticulously researched historical areas and invested significant effort in detailed texture work to achieve such an immersive experience.



Figure 3.5: Side view of the Saloon showcasing weathered texture work

3.2.2 Exhibit B: Terrain Analysis

The terrain is an essential element to achieve immersion in a game, and provides a landscape for player exploration. This section examines Rockstar's development process to extract insights for application in the forthcoming practical project. Creating convincing terrain involves several challenges, including preventing texture repetition, optimizing performance to avoid system strain, and maintaining immersion by avoiding gameplay disruptions. These are vital to ensuring established flow state remains intact.

Rockstar diligently developed their terrain system using advanced techniques. This analysis focuses on two key methods that enhance terrain realism. The first is parallax occlusion mapping, where the appearance of depth and detail is simulated on a flat surface texture. This approach reduces computational demands while significantly enhancing visual richness across the landscape including railroad tracks, grassy grounds to urban streets.



Figure 3.6: From the players perspective, rocks appear 3D



Figure 3.7: Zoomed in view of the terrain revealing the deception of 2D rocks

The second technique is dynamic deformation, implemented onto the snow and mud. The material's shape reacts and reshapes in response to the players movements and any other contact. This groundbreaking feature is notably utilised in the northern snowy mountains (Figure 3.8) and the swampy bayous of Lemoyne. (Figure 3.9)



Figure 3.8: Snow deforms when an object interacts imitating real life



Figure 3.9: Deep mud deformation in swampy bayous

The vivid streaks and smear imprinted on the terrain from each distinct interaction exhibits a level of detail that can't be found in any other game that executes this feature, on this level of realism.

Figure 3.10 displays the stretch of main street in the town of valentine, showcasing accumulated dirt, muddy footprints, trails and debris, reflecting the town's busy activities. Figures 3.11 and 3.12 provide close-ups of the terrain.



Figure 3.10: Main Street in the town of Valentine

The detailed terrain displayed highlights the dynamic height maps at work, modifying the surface appearance without alternating the underlying terrain geometry. Additionally, parallax occlusion mapping is utilized to create the illusion of depth from the player's perspective. These techniques enable the developers to craft expansive worlds efficiently, avoiding the heavy computational tax that fully modelled 3D geometry would entail.



Figure 3. 11: Mud Details - Footprints and Trails

The terrain material is composed of various elements that collectively enhance the environment's realism. The dirt is uneven with grooves formed by frequent wagon, horse and pedestrian traffic. These leave real-time tracks through dynamic deformation, contributing to the game's immersive qualities. The environmental terrain continually evolves, with mud splashes and smears appearing on nearby buildings and boardwalks. This dynamic interaction makes the environment feel like a living, active town.



Figure 3.12: Mud Details - Height Map & Parallax Occlusion Mapping

3.2.3 Exhibit C: Roof Analysis

One prominent application of the parallax occlusion mapping technique is on the roofs. This texture imparts a sense of depth and detail to the roofs, enhancing the immersive qualities of the environment. This element of the game is highlighted, as this process will be replicated in chapter 5's project development.



Figure 3.13: Roofs in Red Dead Redemption 2

Roofs appear throughout the game in rural and urban settings. These roofs feature overlapping wooden tiles that create a textured, rustic appearance, often showing heavy signs of damage, age, and discoloration. Parallax occlusion mapping enhances the depth and three-dimensionality of each shingle, making the roof appear more tangible from the player's perspective.

Similar to its application on terrain, this technique alleviates system strain, allowing the world to appear detailed and rich while maintaining optimal performance. This ensures a seamless gameplay experience, securing player immersion remains intact.

The case study of Rockstar's *Red Dead Redemption 2* highlights essential strategies for crafting immersive environments, including historical accuracy, detailed texturing, and advanced techniques. These insights will guide the practical project to effectively achieve the aims and objectives.

4.0 Methodology

4.1 Introduction

Building upon the theoretical insights and practical examples analysed in chapters 2 and 3, this project aspires to develop a 3D environment by the principles of successful immersion and the exemplary design techniques observed in Rockstar's *Red Dead Redemption 2*. By applying the knowledge gained from both the academic study of immersion and the practical analysis of a leading example in the industry, this projects potential is being maximised for success in these crucial areas.

4.2 Goals and Objectives

The primary aim:

- To produce a visually compelling 3D environment grounded in the established research on immersion and design principles.

Secondary Objectives:

- Offer a deeper understanding of the principles and practices involved in creating engaging virtual environments.
- Ensure spatial immersive properties are present in the 3D environment project.
- Produce high quality textures in Substance Designer and Substance Painter.
- Enhance expertise in Unreal Engine 5.

Collectively, these goals aim to broaden this study's scope and elevate the project's overall quality by integrating reliable and advanced techniques.

4.3 3D Environment Project Plan Gantt Chart

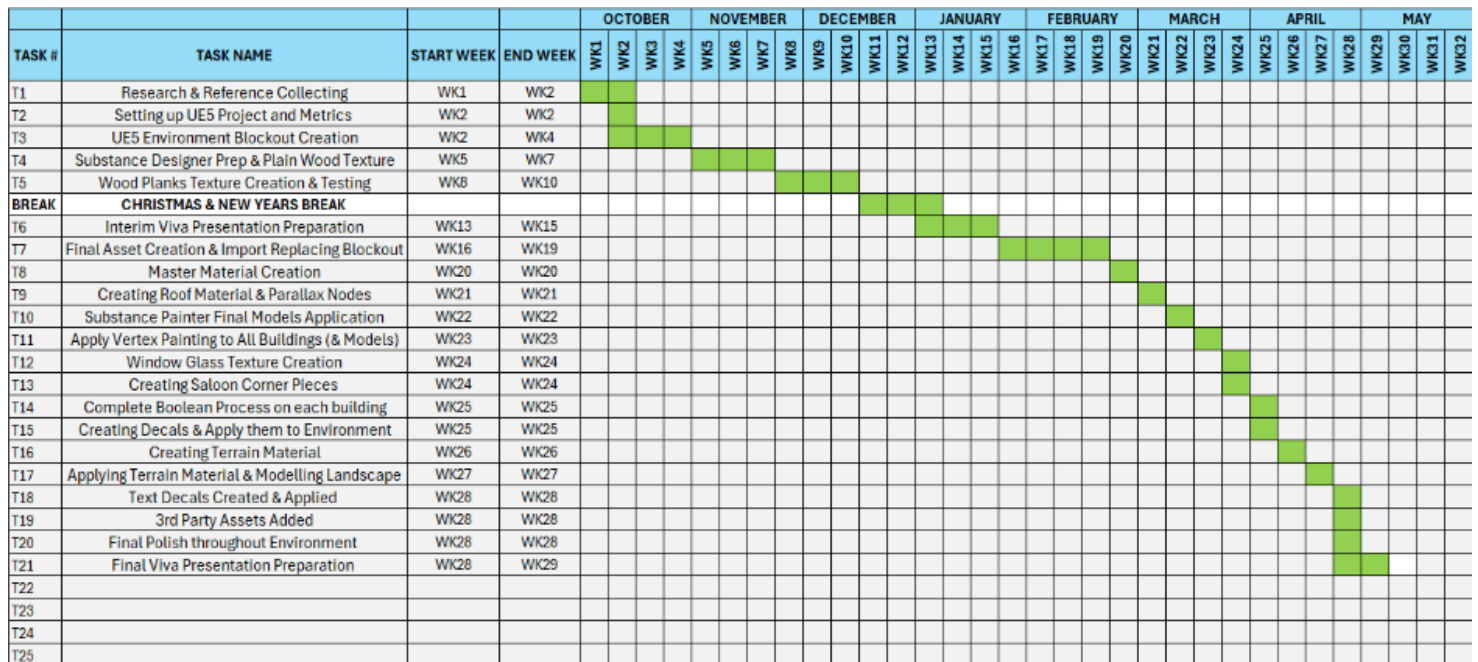


Figure 4.1: Project Gantt Chart with Task Breakdown & Time Assignment

The project timeline has been organized using a Gantt chart displayed in Figure 4.1. The structure provides a clear framework for effective time management with each task being allocated a designated period of weeks based on its preconceived complexity and scope.

This methodology outlines a systematic approach to achieving the project's primary aim. The process has been broken down into tasks, each building upon the previous one to ensure a coherent and well-structured project is created maximizing the likelihood of success.

In the following chapter, a detailed account of all the tasks performed will be provided exhibiting an insight into the 3D environment project development. A concise description of each task will be provided here to offer context and enhance comprehension of the entire process and workflow.

The foundations of the project will be built on an extensive pool of research and references to learn and understand the project subject on a deeper level. This is followed with the setup of Unreal Engine 5 which has been deemed the best software to house the project. A foundational blockout environment will be created to serve as a visual guide and ensure key metrics are consistent before creating time extensive work.

Subsequent tasks will focus on detail texture and material development in Substance Designer and the creation of final model assets in Maya with refinements done in Substance Painter. Preparations for the interim viva will ensue post-Christmas and New Years break to cover all the foundational work that has been completed so far.

The application of advanced techniques such as vertex painting and parallax occlusion mapping are paramount to the success of the project. Vertex painting will be used to blend between textures providing the weathered effects, adding an authentic look to the buildings. Parallax occlusion mapping will enhance the perceived depth of surfaces, particularly in the roof material as evidenced in Rockstar's *Red Dead Redemption 2*.

The final stages of the project include the creation and application of a terrain material and decals which will add narrative and contextual enhancements to the environment. The integration of third-party prop assets and time allocated for a final polish will ensure the creation of a visually rich 3D wild west environment.

The decision to integrate third-party assets has been decided to allocate time towards developing detailed textures and blueprints within Unreal Engine 5. The development of a Gantt chart and the systemic outlining of tasks provide an effective methodology for achieving project completion, while simultaneously advancing skill growth within the designed project timeframe.

Figure 5.2: Overview of a town used as a reference



Figure 5.3: Key reference imagery used as inspiration

These references alongside others were analysed and broken down into components to assemble the asset list. This is essential planning that informs the project going forward. The analysis streamlines the process so that it isn't overwhelming to construct. Walls, beams, angled rooftops, doors, windows fences, walkways and more are all listed to begin modelling. Additional research and imagery was collected focusing on each individual element for magnified reference.

5.2 Unreal Engine 5 Project Setup

The construction of walls, doors and windows began with simplified versions alongside a mannequin as a reference for scale as shown in Figure 5.4. Correct scaling is vital in this stage to ensure consistency in all assets. Inaccurate scaling can cause severe immersion issues from the player perspective. The models are exported into Unreal Engine 5 to begin accurate blockout assembly as shown in Figure 5.5.

This is the workflow for completing the blockout environment for each piece. Design choices and measurements are completed in this stage to ensure no major issues during time intensive tasks such as final asset modelling. Appropriate project settings and file structures are created to ensure an organised effective workspace.

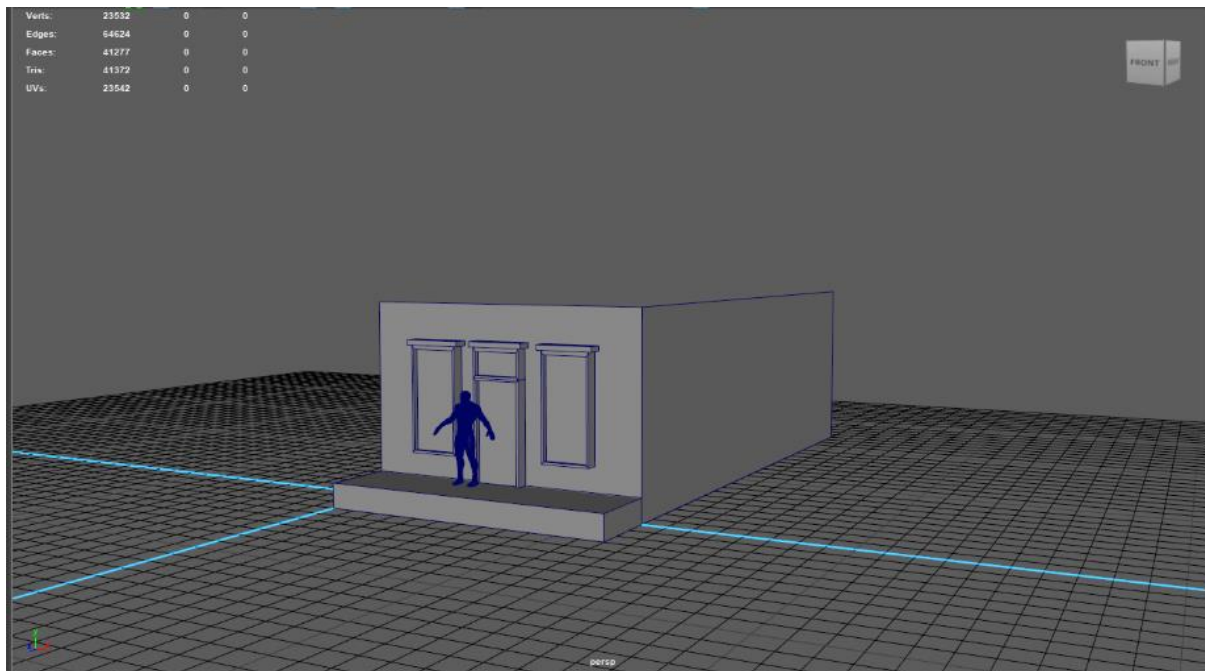


Figure 5.4: Autodesk Maya Modelling Software – Simple assets built to represent the base of the buildings with accurate scaling

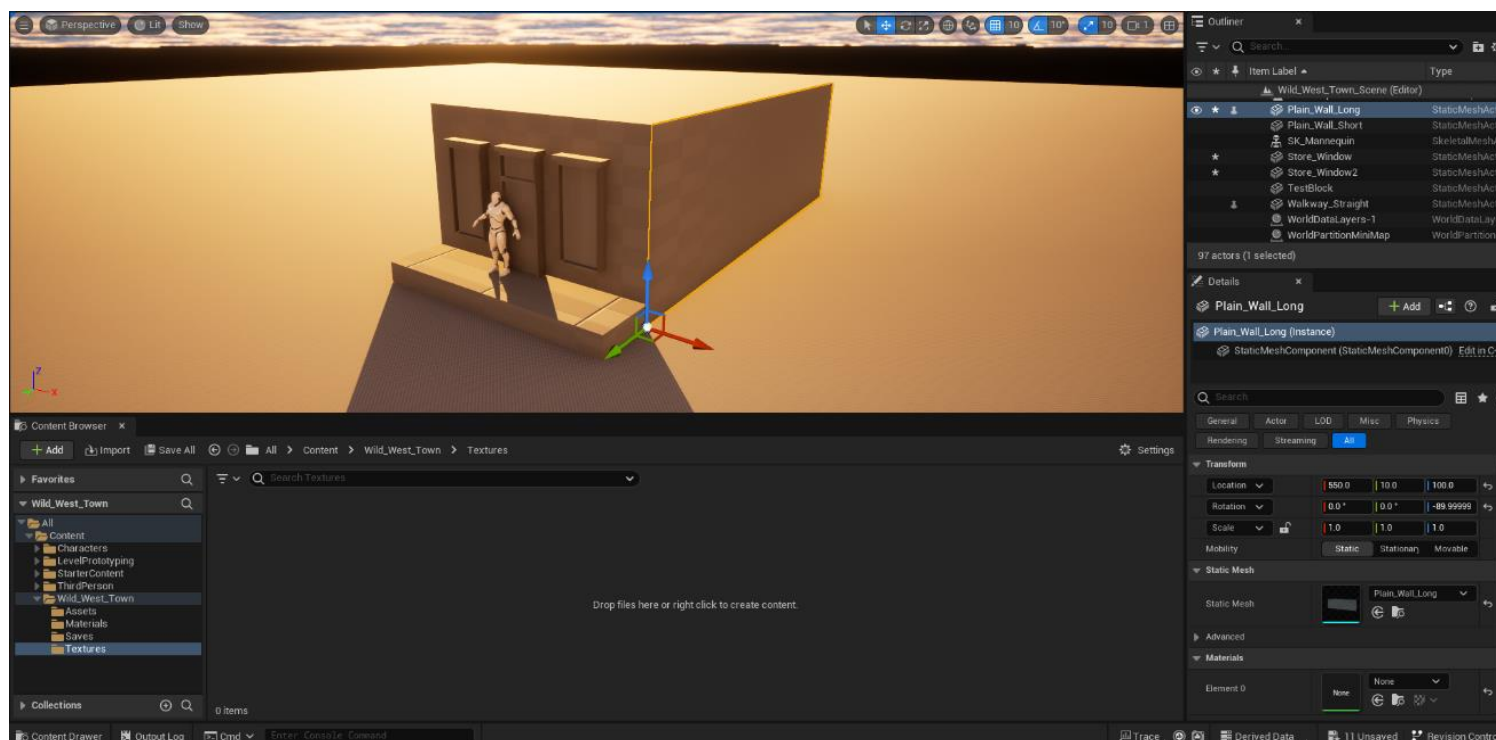


Figure 5.5: Unreal Engine 5 viewport with imported models from Maya to begin assembling the blockout environment

5.2.1 Modular Creation Approach to the Environment

The design approach for this project has been decided to be modular. A 3D modular environment allows for assets to be reused with each piece seamlessly snapping together to create variations of larger structures. This is why measurements were essential in this project to ensure this approach was successful. There are positive and negative outcomes to modularity and it has been deemed the most effective here for time efficiency. Many successful popular games across the industry deploy this technique such as Fortnite [33] by Epic Games.

5.3 Blockout Creation

A basic blockout environment in UE5 was assembled under the process outlined utilising each asset in Figure 5.6. A visual guide now available to further replace each asset with its final variation. Layout of the structures has been reinforced by reference imagery to represent a wild west town

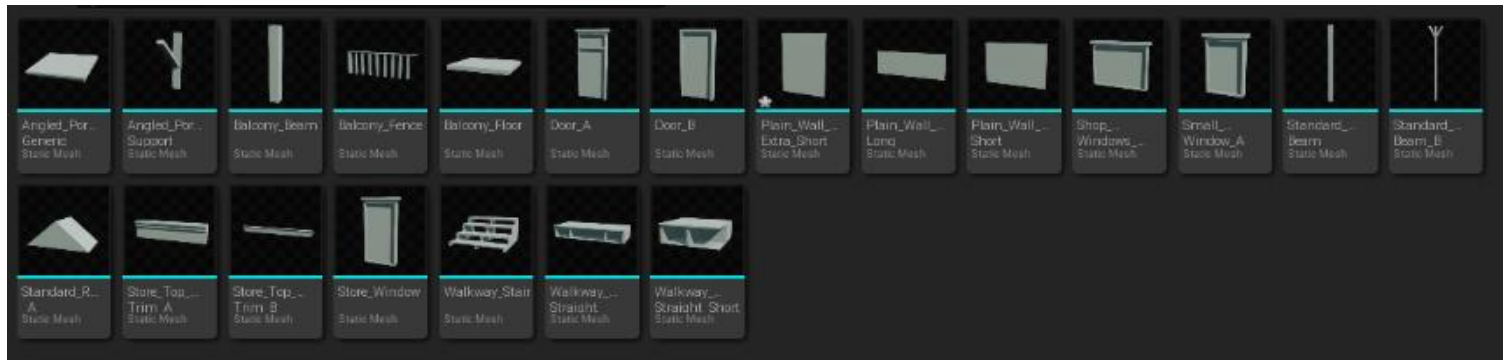


Figure 5.6: All blockout pieces created and imported into Unreal Engine 5 with organised naming conventions



Figure 5.7: First buildings assembled utilising the modular blockout pieces

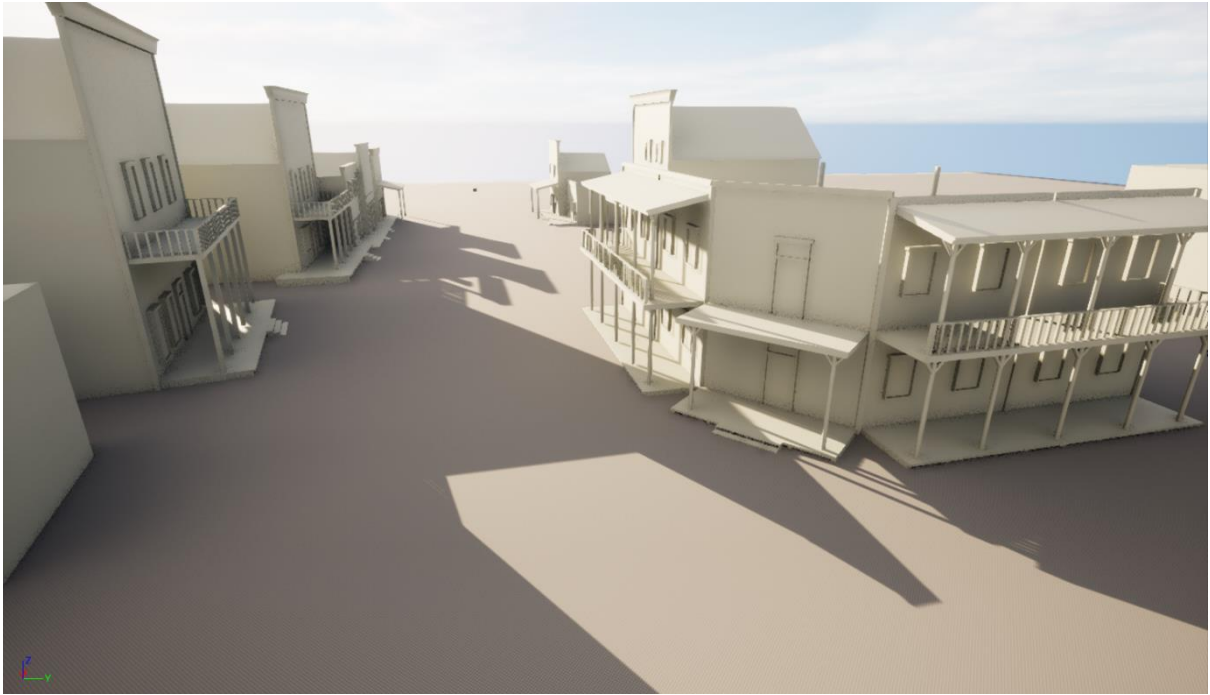


Figure 5.8: Alternative View of the blackout environment showcasing the Saloon

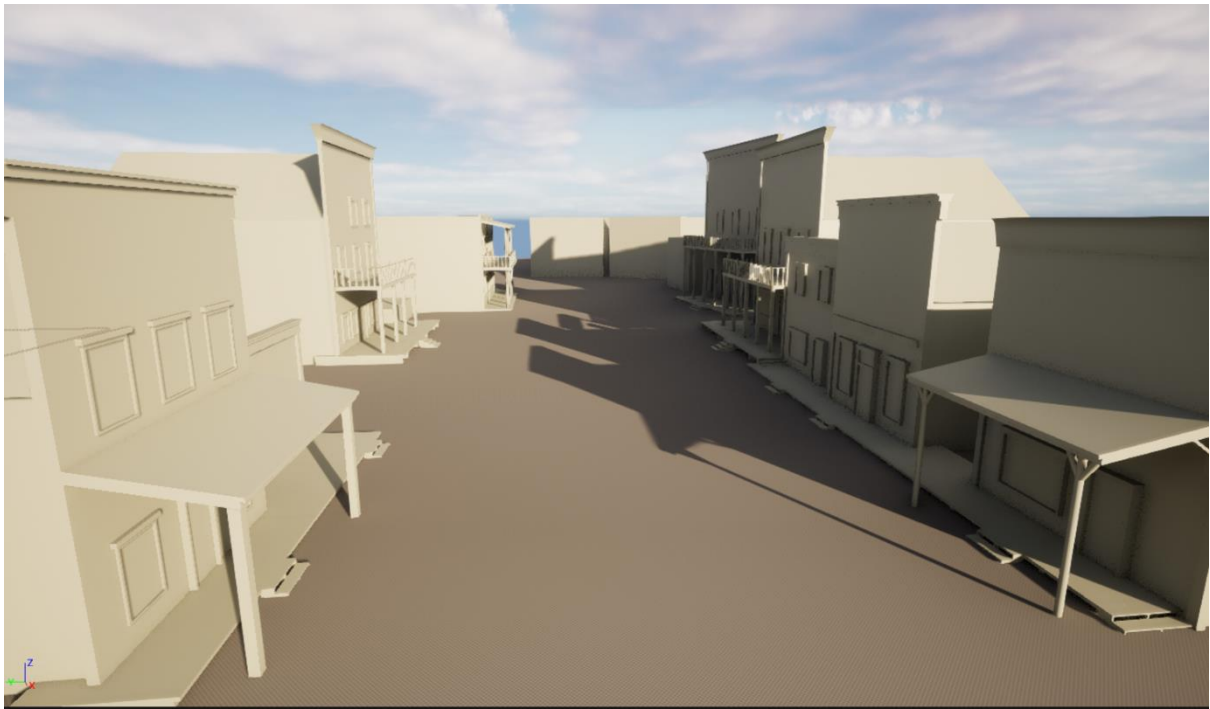


Figure 5.9: Street View of the blackout environment

5.4 Substance Designer Preparation and Plain Wood Texture Development

To begin texture creation, key reference imagery was collected (Figure 5.10) to breakdown the essential components that collectively create the texture. The visuals required to create the effect in Substance Designer shown in Figure 5.11. Elements of the graph are labelled. Grain, knots and cuts are all key elements of the texture which were generated using the nodes to output the required texture maps. Additional weathering added to increase realism when creating a town similar to those in the case study.

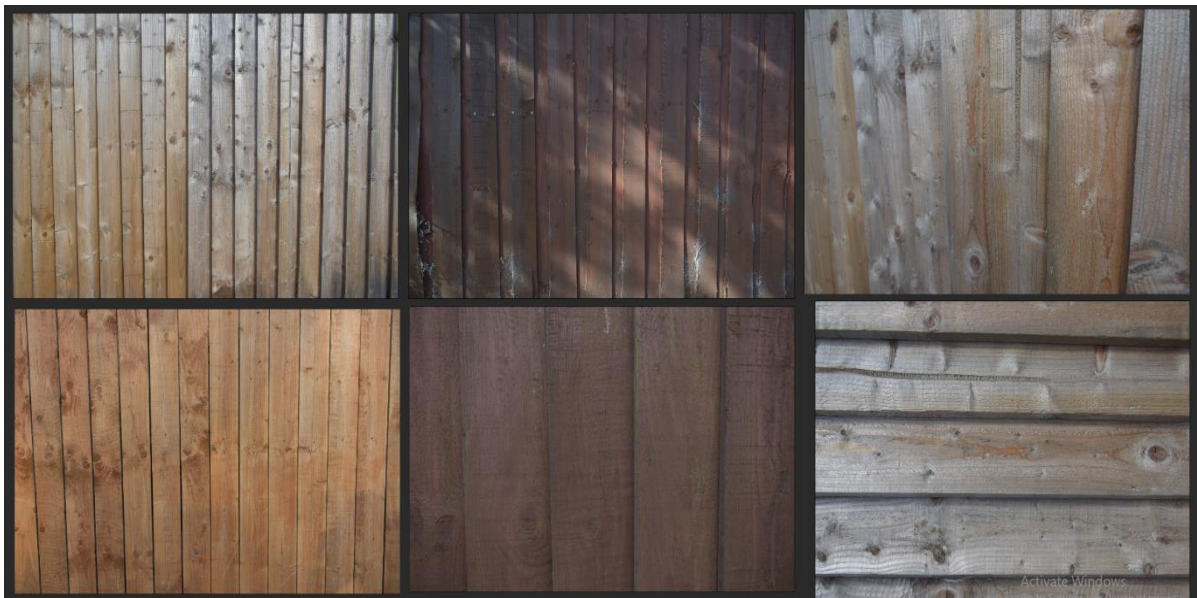


Figure 5.10: Real life wood reference imagery used to study components

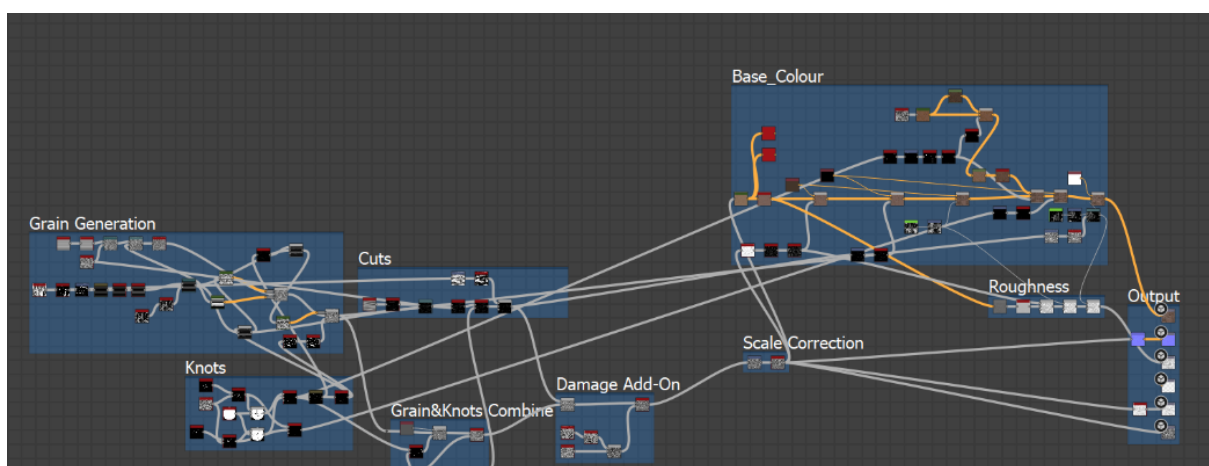


Figure 5.11: Substance Designer Wood Plain Texture Graph

Several variations were made displayed in Figure 5.12. With the modular model approach, texture variation is vital to create visual interest. A key factor in spatial immersion to establish an authentic environment reflecting real life areas creating a sense of natural variation.



Figure 5.12: The 3 Plain Wood Texture Map variations creating in Substance Designer

The base colour section used to create the different types of woods on display, from lighter clean wood to weathered darker wood. All texture maps were then imported into UE5 to apply to the models for testing.

5.5 Wood Planks Texture Creation

The previously made plain wood texture was used here as the base colour. Details were embedded into the texture instead of the model to enhance visual complexity and system performance. Additional dirt areas were incorporated to give the texture a weathered appearance. Several techniques were utilised to create plank variations as shown in Figure 5.14. Masks were used to create weathered textures displayed in Figure 5.15. These are pivotal components to feature a sense of weathering on each individual structure.

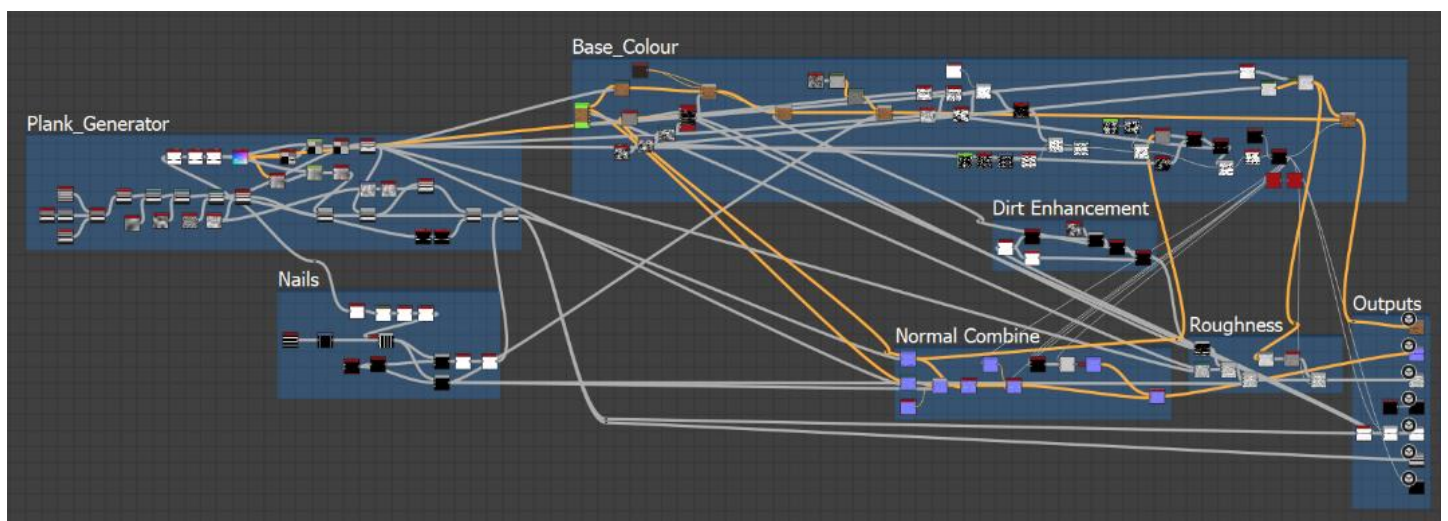


Figure 5.13: Substance Designer Wood Plank Texture Graph



Figure 5.14: Wood Plank Textures – 3 Variations



Figure 5.15: Weathered Paint Peeled Wood Plank Texture Variations

5.6 Final Asset Creation and Integration

With the blockout model and texture testing complete (Figures 5.16 & 5.17), final asset modelling can begin to transition into a detailed, polished environment. An evening sunset time of day has been decided to best represent the wild west theme with a vibrant orange and brown colour palette.



Figure 5.16: Final Blockout Form with one texture applied for testing



Figure 5.17: Final Blockout Form with one texture applied for testing

Figure 5.18 showcases the final assets created for this project. The process of replacing each blockout piece with the final model transpired here. Windows, doors, beams, walkways and more have been introduced. A comparison between Figures 5.16 and 5.19 best represent the progress at this stage. The process of modelling and UV unwrapping final models is a lengthy vital endeavour to ensure great attention to detail. The blockout process is paramount to the success and management of the project to establish a good foundation.

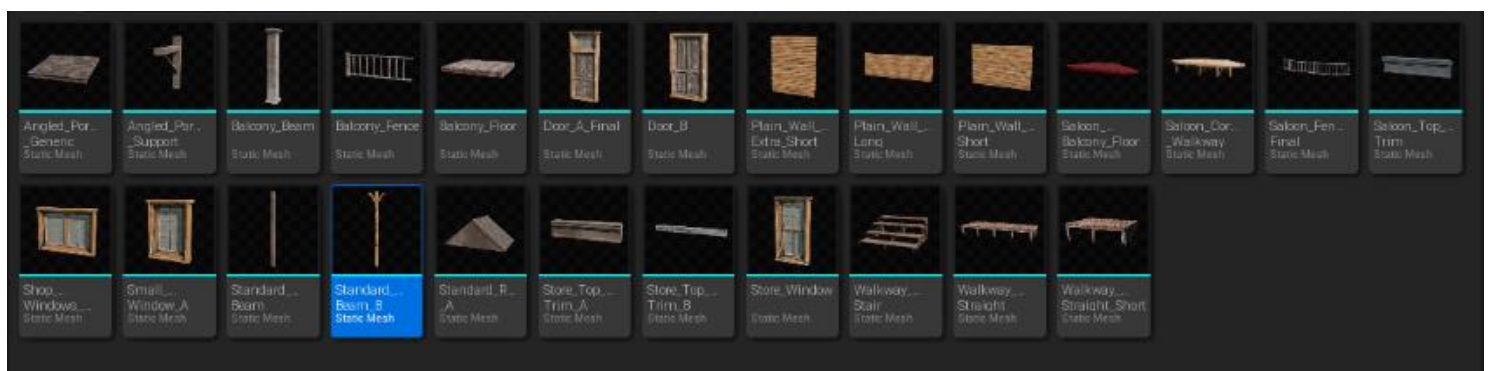


Figure 5.18: All Final Models Imported into Unreal Engine 5



Figure 5.19: Multiple blockout assets have been replaced with final Modelled Assets

5.7 Master Material Development.

In Unreal Engine 5, the master material serves as a centralized, versatile template from which multiple materials can be derived from, allowing for efficient parameter adjustments and consistent updates across the project development. The UV tiling nodes ensure correct texture scaling, providing a base for further texture modifications. Optimisations for normal and roughness maps are implemented to align various texture setups present in Figure 5.20, and provide fine-tuning to achieve optimal surface effects.

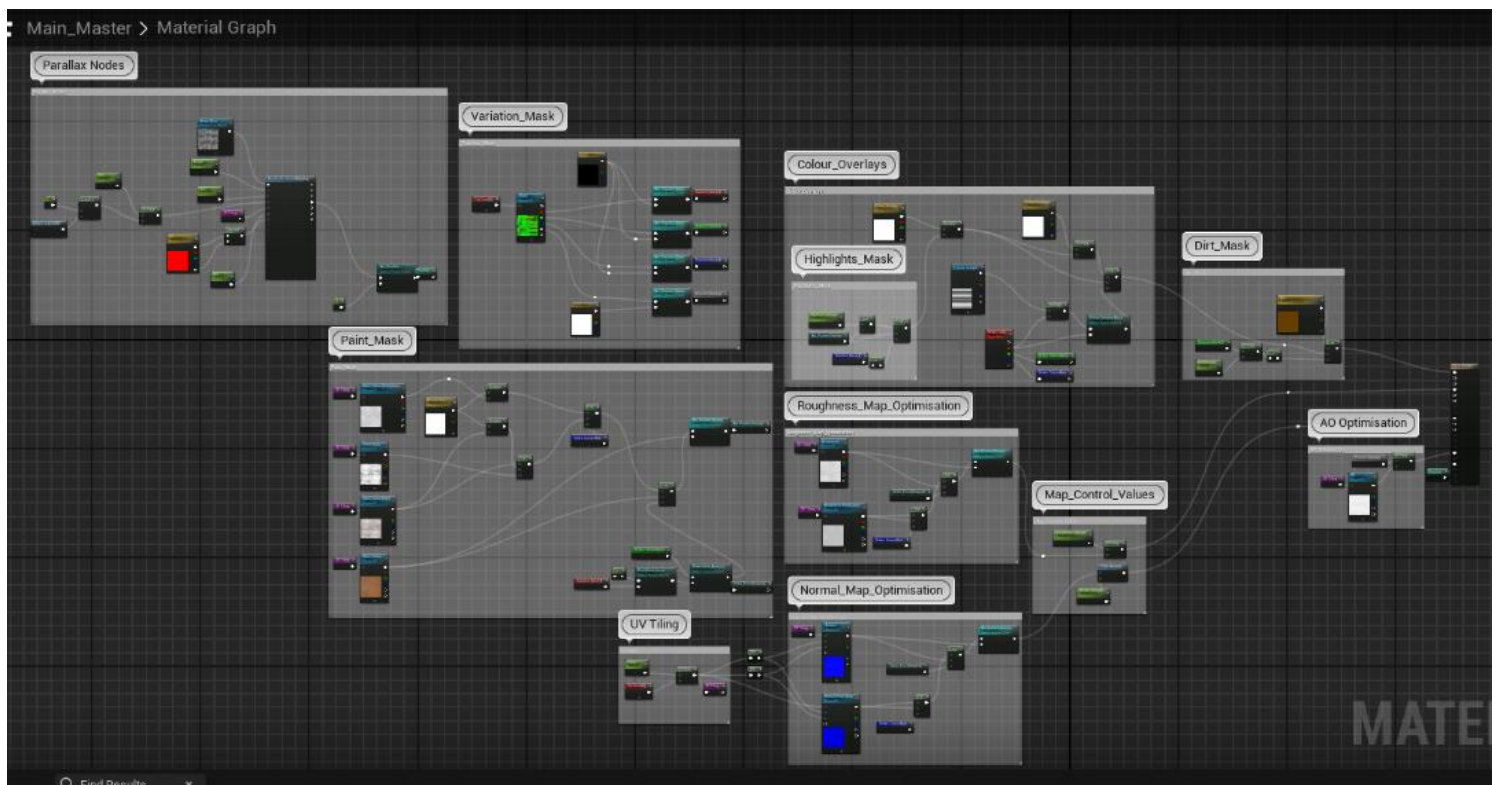


Figure 5.20: Overview of Master Material Blueprint Nodes in Unreal Engine 5

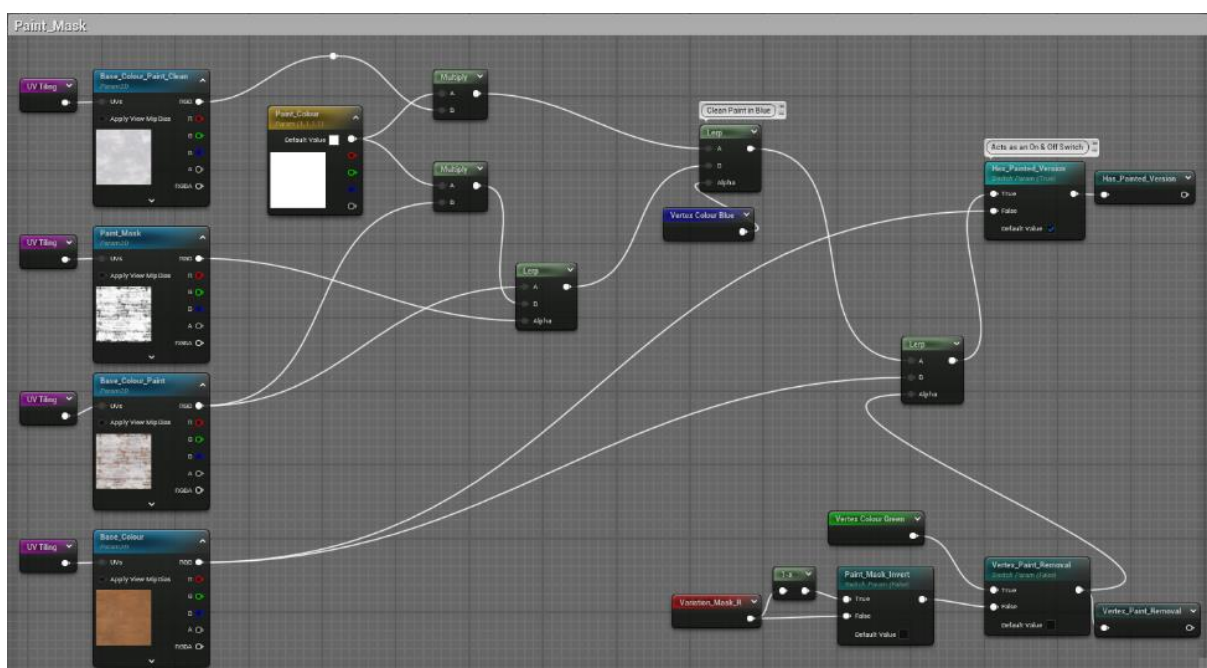


Figure 5.21: Paint Mask Nodes in Master Material

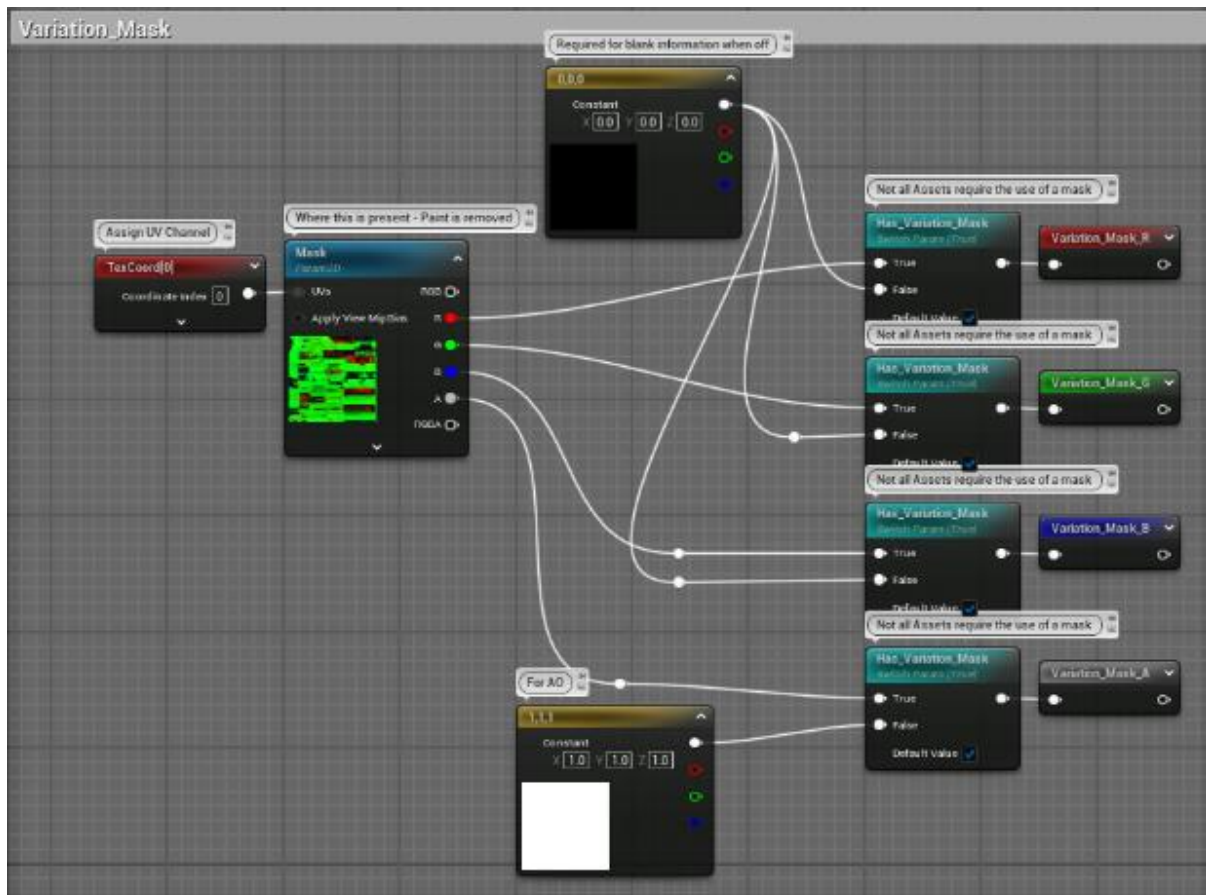


Figure 5.22: Variation Mask Nodes in Master Material

The Paint Mask (Figure 5.21) employs Lerp and multiply nodes to blend, combine and layer texture maps, enabling the ability to paint across each texture using vertex colour channels. The paint colour node can be used to change the base colour of a texture, maintaining the default texture colour when set to white. This enables asset variation.

The Variation Mask (Figure 5.22) contains a mask created in Substance Painter. This highlights regions where the texture will be excluded, functioning as a paint removal visual. Each vertex colour is linked to a switch node, enabling the use of a toggle for this feature based on the environmental requirements. This setup facilitates significant variation with the addition of changing the mask for each specific asset.

This component was crucial for realistically depicting weathering on buildings and marked a significant turning point in the project. Reroute naming nodes were employed for enhanced organisation and readability. The primary vertex channel node is located in the colour overlay section and is linked through the reroute nodes on the right of Figure 5.22 labelled “Variation Mask RGBA” corresponding each one with the correct output.

For demonstration purposes, Figures 5.23 – 5.25 illustrate the vertex painting tool in use through the mesh painting menu in Unreal Engine 5. This technique will be thoroughly applied to all buildings.

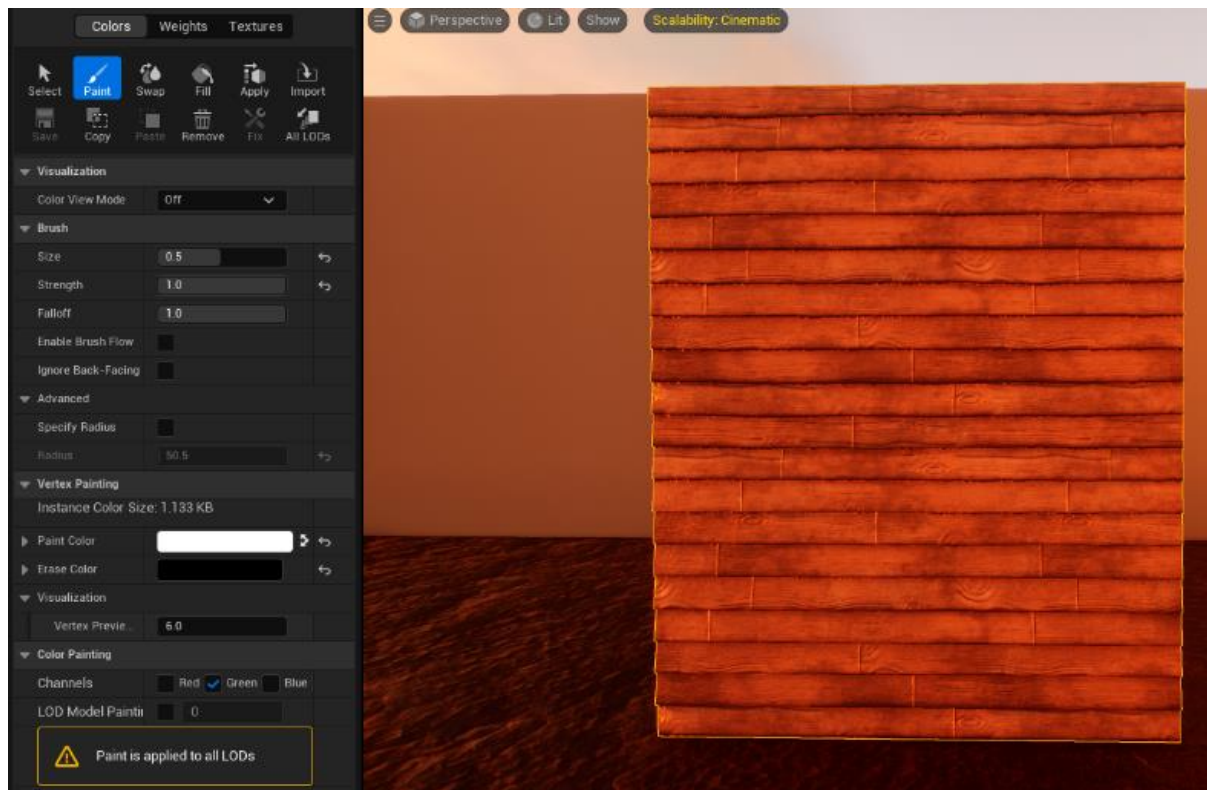


Figure 5.23: Mesh Paint Mode Menu in Unreal Engine 5 on the left alongside a wall with the plank texture applied

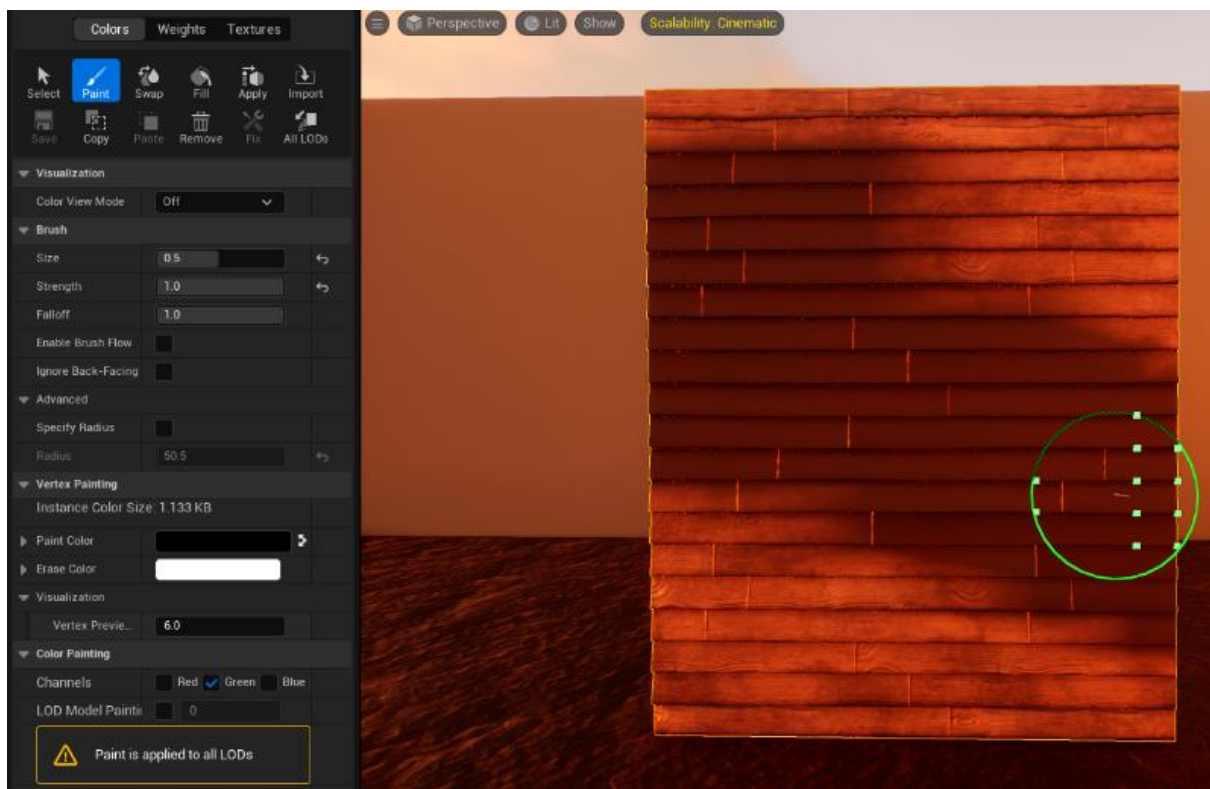


Figure 5.24: Green Channel Painted – Full Colour Paint can be used for either clean paint or dirt variation depending on where it is used throughout the environment and the colour

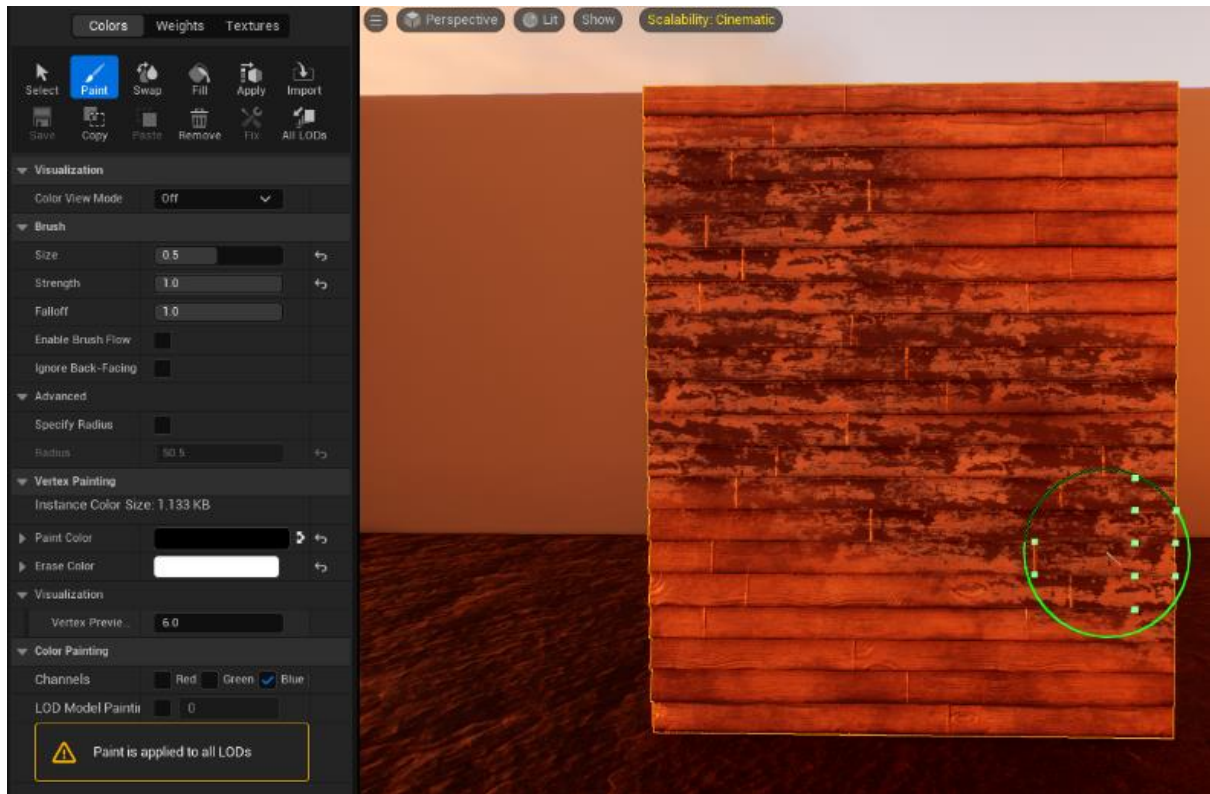


Figure 5.25: Blue Channel Painted – Paint Peeled Texture applied to the areas where the green channel paint was present. This represents the main weathering tool

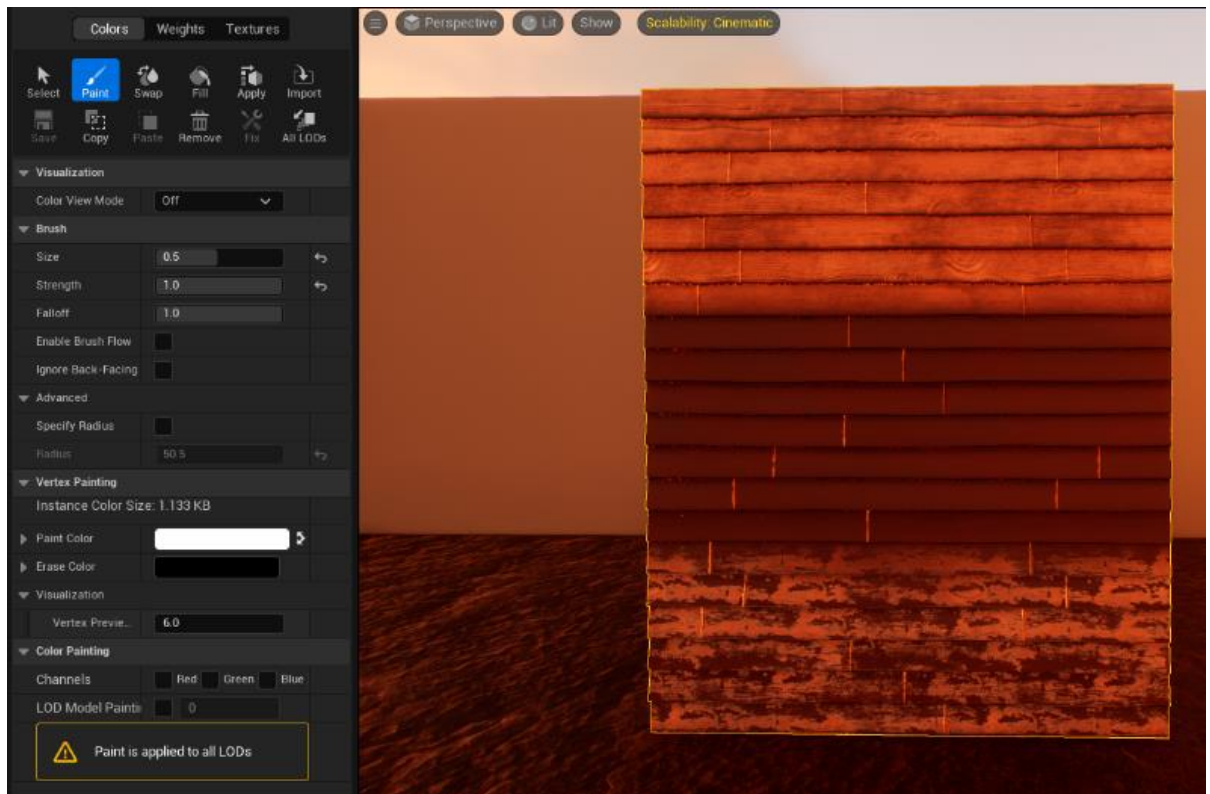


Figure 5.26: All texture variations painted onto the wall

5.7.1 Colour Overlay Tool Creation and Integration with Vertex Painting.

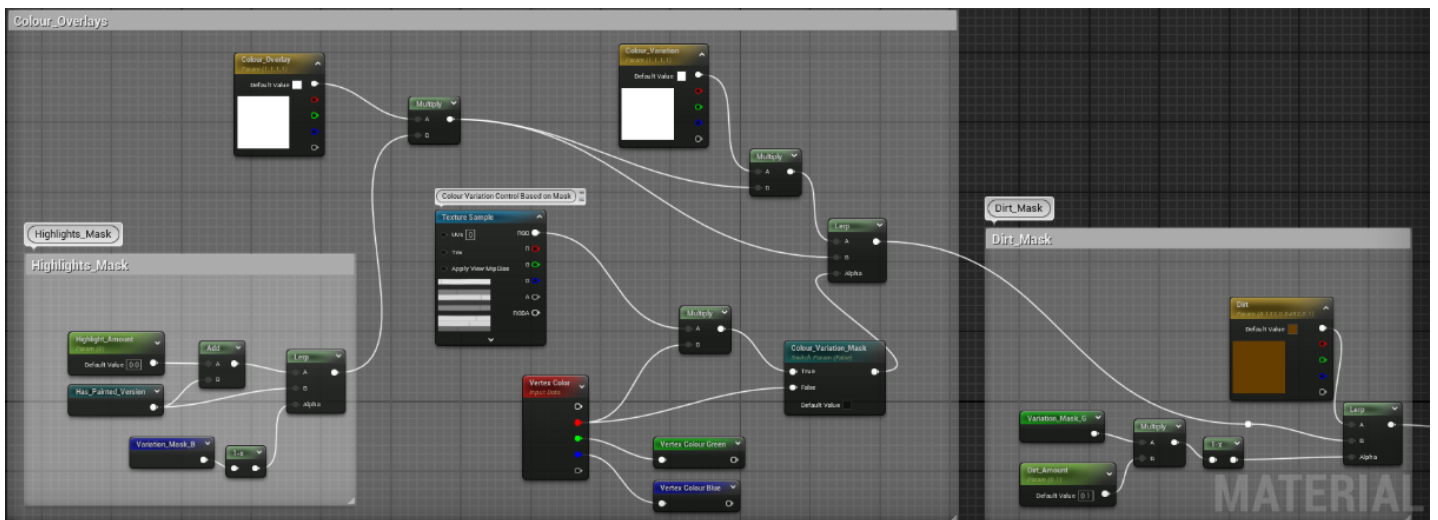


Figure 5.27: Colour Overlay Nodes Integrated into the Vertex Painting – Operates after painting. Dirt mask operating after everything to ensure it appears on top of paint

The main adult vertex colour node resides here (Figure 5.27) in red. Colour overlays control is integrated post-vertex painting, allowing them to visually overlay, with the dirt details applied last to simulate real-life accumulation. The combination of these nodes and the paint colour node offers significant flexibility, enabling the creation of diverse asset materials shown in Figure 5.28.

These nodes and texture masks enable precise control over colour application on specific areas on the model. The development of these nodes was completed alongside the work in Substance Painter which will be discussed further in this chapter.

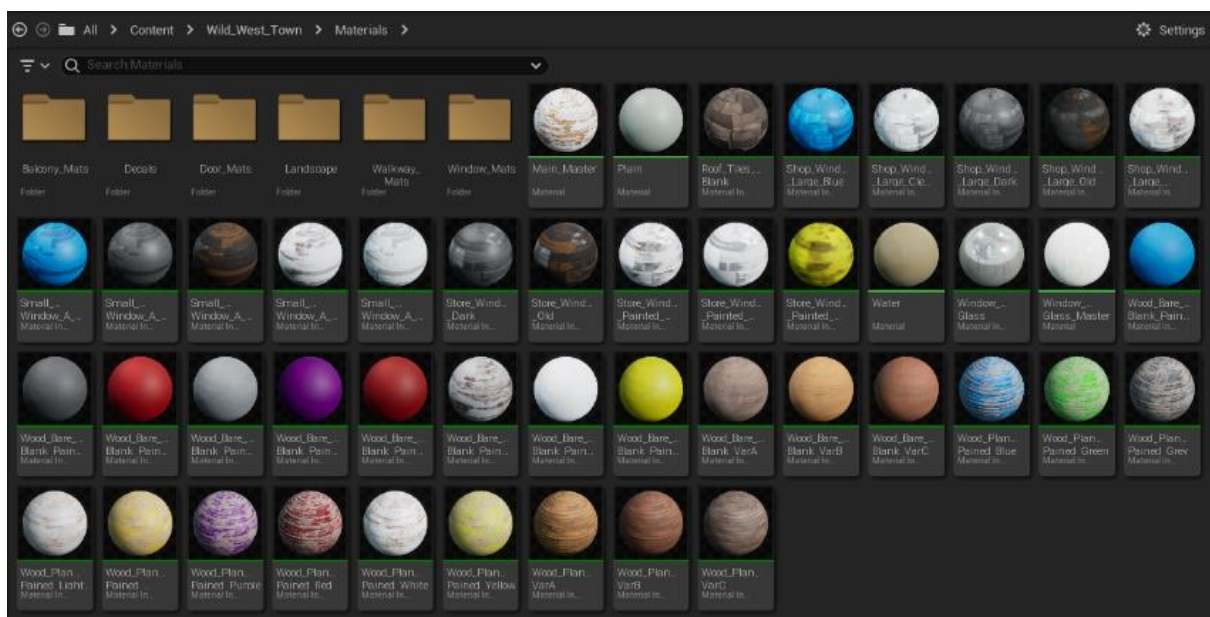


Figure 5.28: All Materials created for the project utilising paint colour node, colour overlay control and masks with a range of dirt variations

5.8 Roof Material and Parallax Occlusion Mapping Creation

A roof material was developed in Substance Designer with the application of Parallax baked into the process from the beginning. Following a similar workflow to other materials, essential components were extracted from the reference imagery (Figure 5.30) to create the final material. (Figure 5.31)

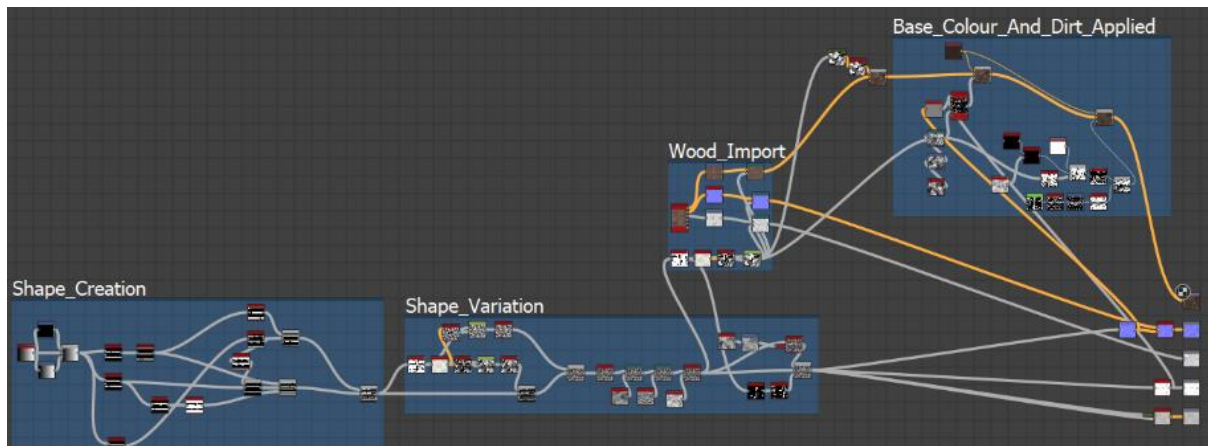


Figure 5.29: Substance Designer Roof Material Texture Graph



Figure 5.30: Roof Tiles Reference Main Reference Imagery (Real Life & Game)



Figure 5.31: Roof Material Created for 3D Wild West Environment

5.8.1 Parallax Occlusion Mapping Node Creation and Application

Parallax Occlusion Mapping was implemented to enhance the visual quality of roof assets. This technique was applied to angled porches and building rooftops, as illustrated in Figures 5.33 and 5.34.

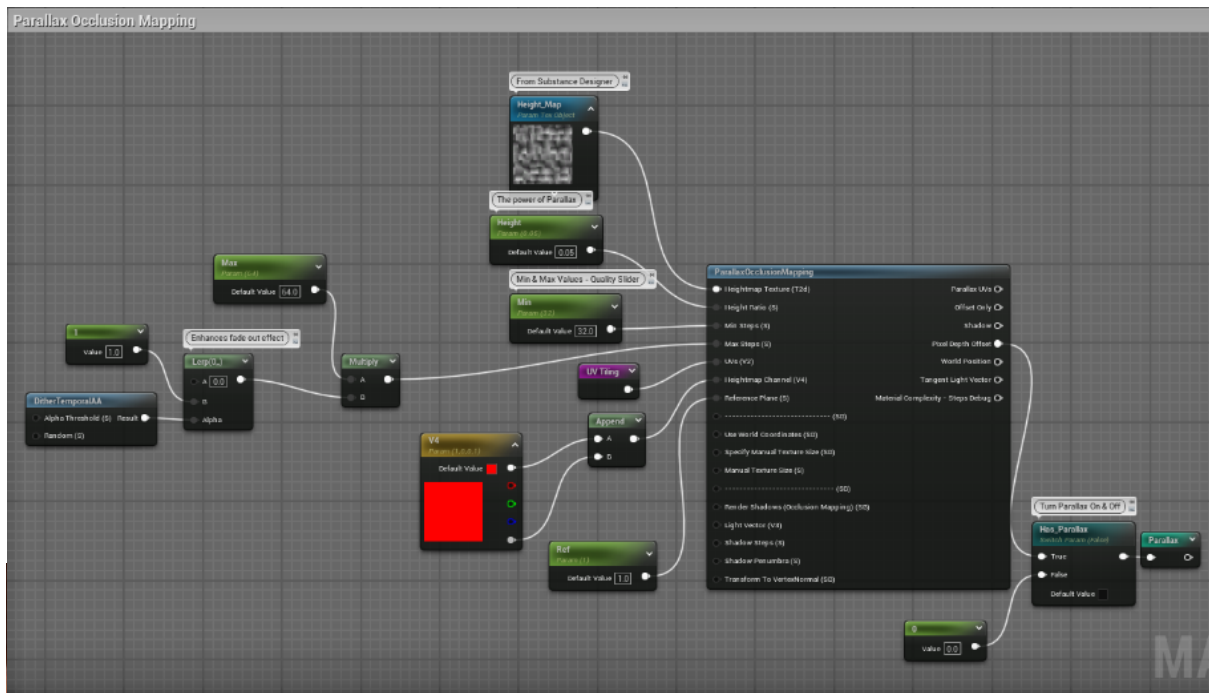


Figure 5.32: Parallax Occlusion Mapping Nodes integrated into the Master Material



Figure 5.33: Roof Material Applied to Angled Porch in Unreal Engine 5



Figure 5.34: Roof Material Applied to Roof Asset in Unreal Engine 5 showcasing Parallax Occlusion Mapping with lighting focus

Figure 5.34 demonstrates the enhanced 3D effect with focused lighting. Figure 5.35, showcasing a close-up, confirms the texture remains 2D indicating the technique was successfully implemented.

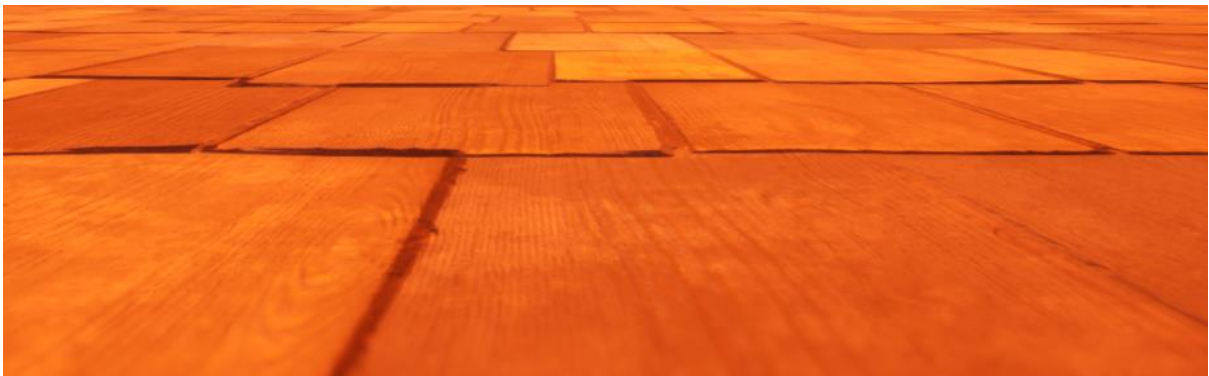


Figure 5.35: A close up of the roof material reveals it remains 2D

5.9 Substance Painter Texturing for Final Models

Substance Painter is a powerful tool for texture creation, offering several key features. In this project, final asset textures were enhanced with the addition of damage highlights, dirt and paint removal areas facilitated with masks and manual paint brushes.

These masks were incorporated into the master material previously discussed. Figure 5.36 displays the layers menu with the primary masks that form the smart material applied on each asset. The base layer is black, with the masked areas in white. Mask generations were used to cover the assets, and manual adjustments were made using the brush for additions and subtractions.

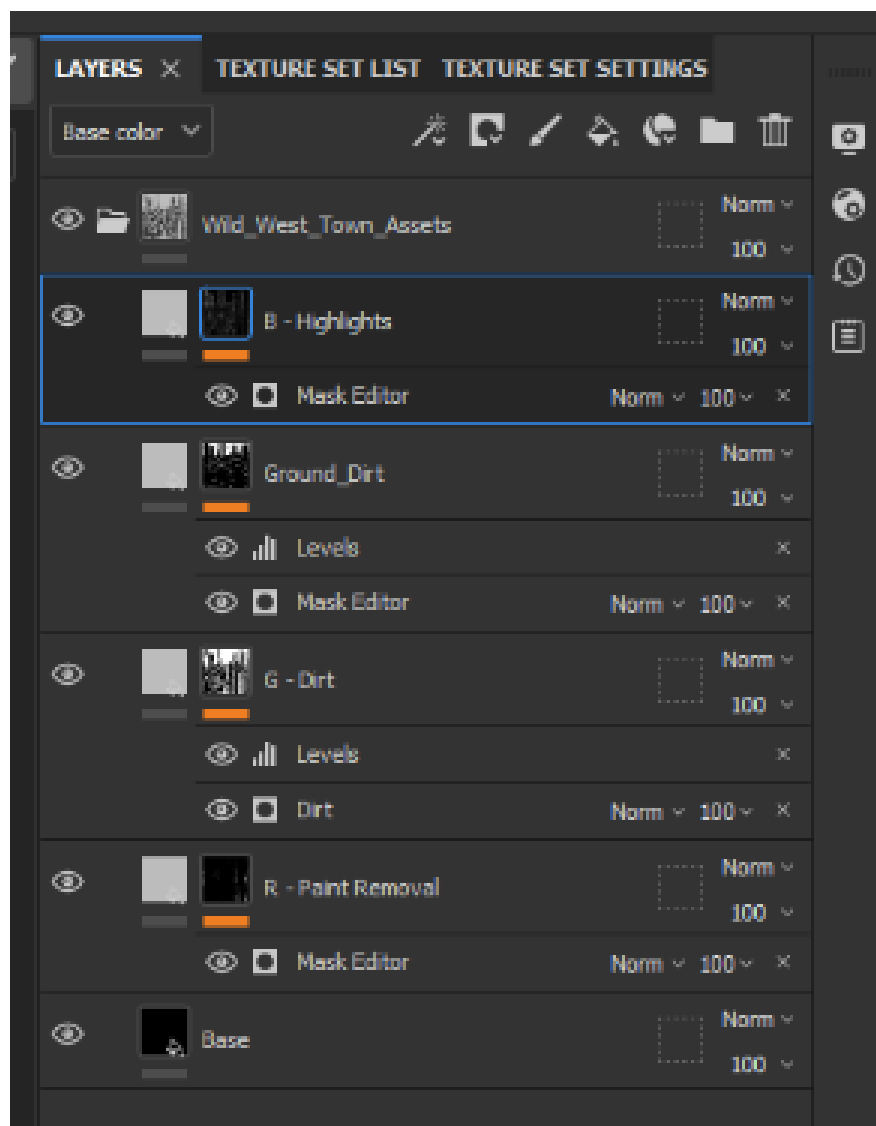


Figure 5.36: Substance Painter Smart Material

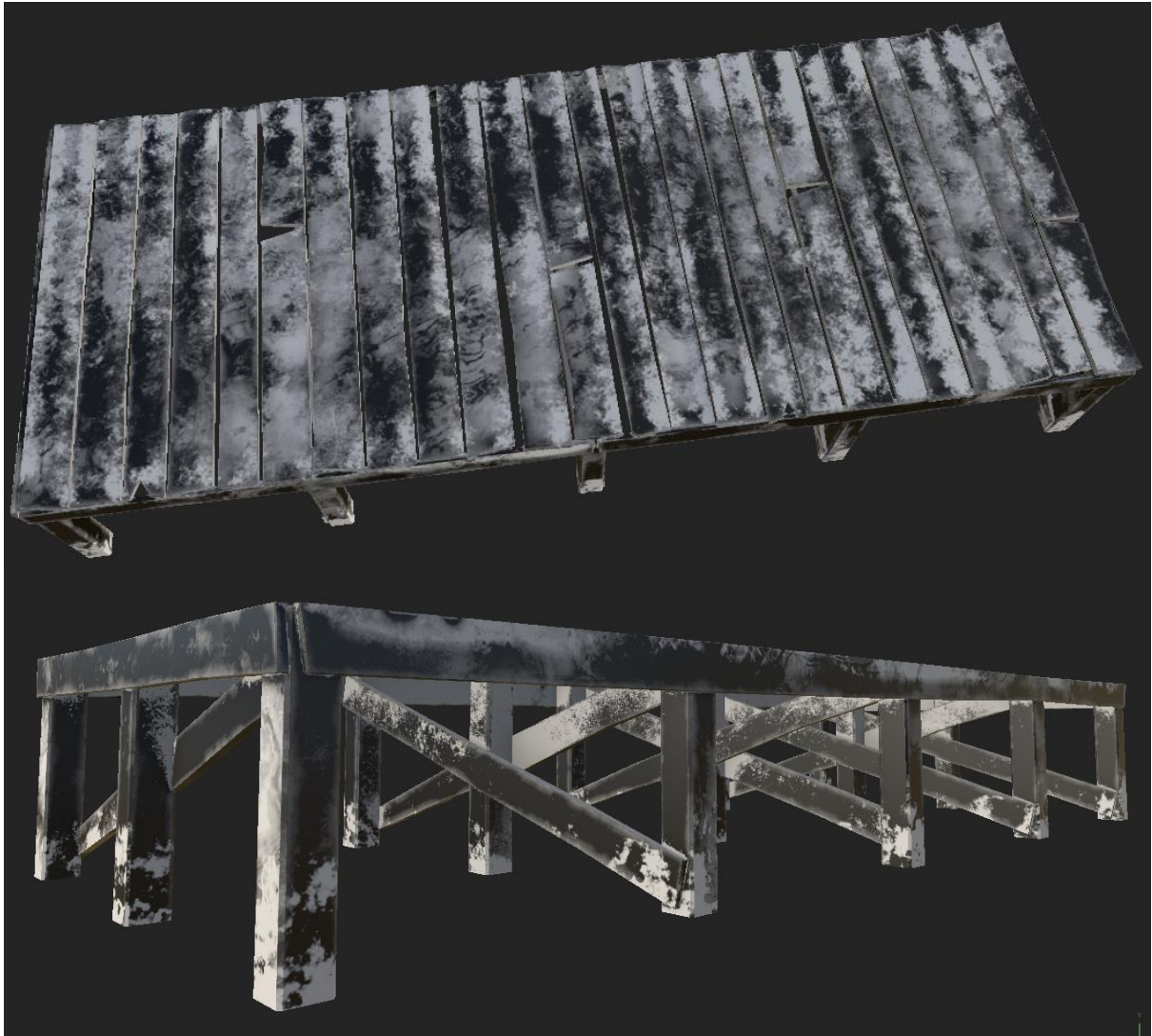


Figure 5.37: Walkway Asset with damage highlights, dirt & paint removal masks

Each section was developed independently to avoid interference. While some assets may not utilize all the masks, having them available allows for variation if required. Figure 5.37 shows the walkway asset with all masks applied to the wood planks and base. Figure 5.38 illustrates the asset in Unreal Engine 5, showcasing three variations with different wood textures, dirt patterns and highlights.



Figure 5.38: Walkway asset variations utilising texture maps and Substance Painter

Figure 5.39 displays a range of assets in their final appearance, complete with applied highlights and dirt effects.



Figure 5.39: Window, Door, Fence and Stair Asset Showcase

Figure 5.40 shows the paint removal on the fence, with colour control established in the master material. To enhance the overall appearance of the environment, repetitive placement of these effects was considered.

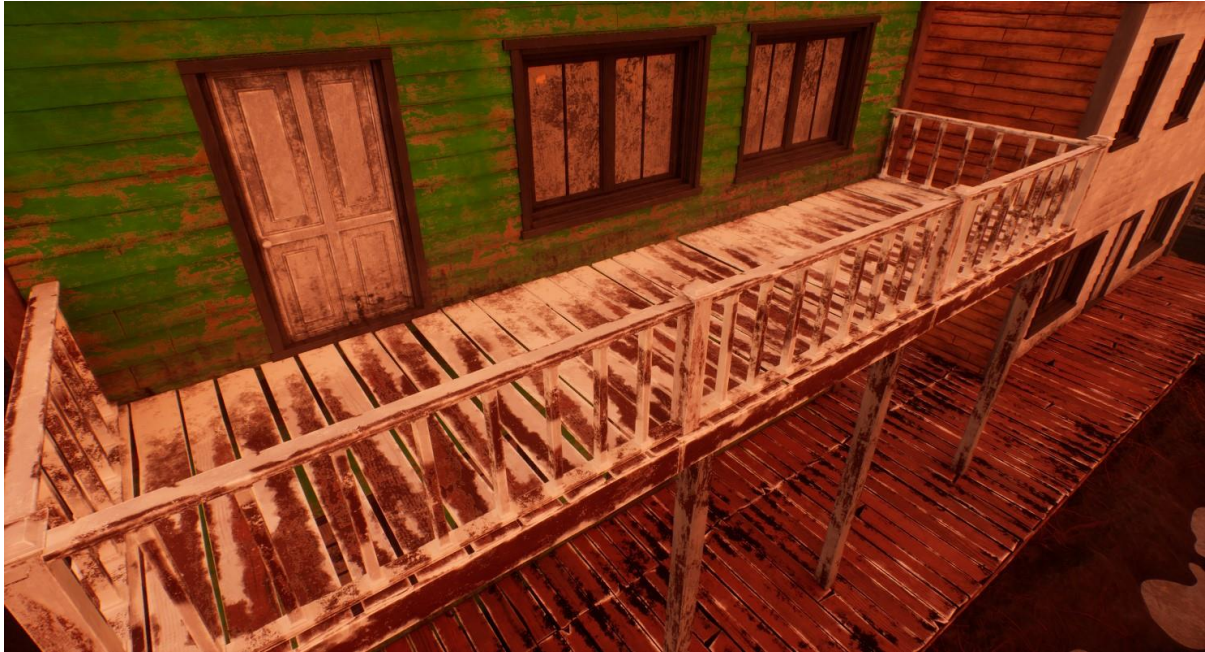


Figure 5.40: Paint Peeled on the fence and walkway assets

5.10 Vertex Painting Introducing Weathering Textures, Saloon Corner Pieces and Glass Texture Creation

The vertex painting process was applied to all buildings in the environment. Figure 5.41 shows an image before vertex painting, while Figure 5.42 shows the result after its application. The weathering significantly enhances the appearance with great detail elevating the overall quality and authenticity of the project.



Figure 5.41: Vertex Painting - Before



Figure 5.42: Vertex Painting - After

Figure 5.43 displays untextured corner saloon pieces, the only non-modular components in the project, specifically designed for a corner saloon building. As a prominent structure in a Wild West town, the saloon needed to stand out in this environment.



Figure 5.43: Bespoke corner Saloon pieces created shown without texture applied

The window model geometry was imported into Substance Painter to create the appearance of glass. Two pieces were designed to fit all window models: three variations for the square windows and two for the long windows, preventing repetitive design.

Figure 5.44 illustrates the layers assembled to create the glass texture. The metallic value was increased in the base glass layer to create the reflective quality.

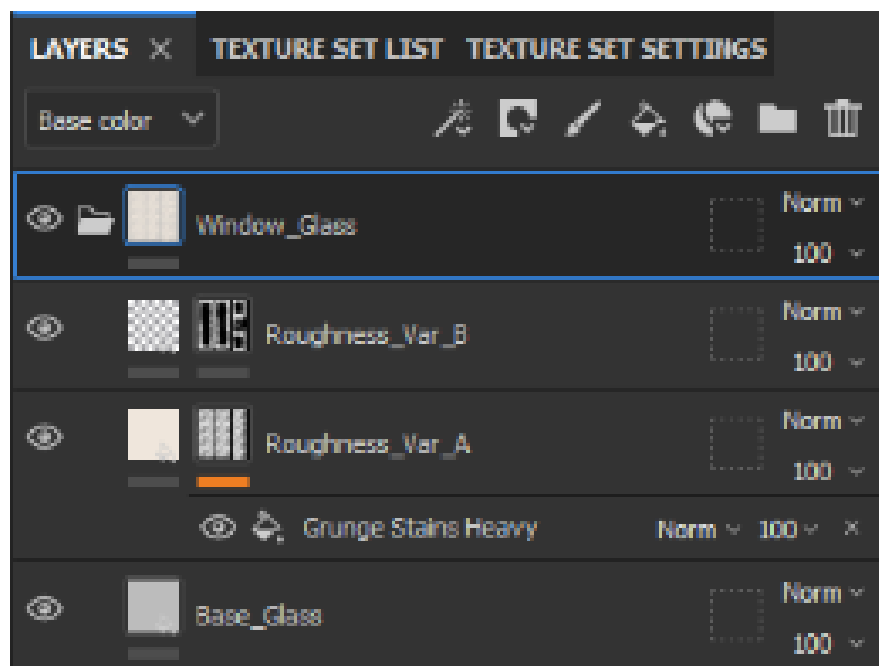


Figure 5.44: Substance Painter Window Layers

Roughness_Var_A creates the blurry effect in the background of the glass adding dirt details using a texture in software.

Var_B adds hand-painted elements to the window corners, reminiscent of video game windows without interiors, where dirt accumulates at the frame junctions. Figure 5.45 shows the final window texture created in Substance Painter.



Figure 5.45: Window Texture Created in Substance Painter

These texture variations were applied to all windows in the environment, as shown in Figure 5.46. The amount of dirt on the windows was adjusted to ensure visibility under evening lighting conditions in Unreal Engine 5.



Figure 5.46: Final Window Texture Applied to Models in Unreal Engine 5

5.11 The Boolean Process Enhancing the Immersive Qualities of the Environment.

Figure 5.47 emphasizes the difference the Boolean process has on the environment once completed. The windows and doors appear significantly more realistic when integrated into the buildings in the right image.

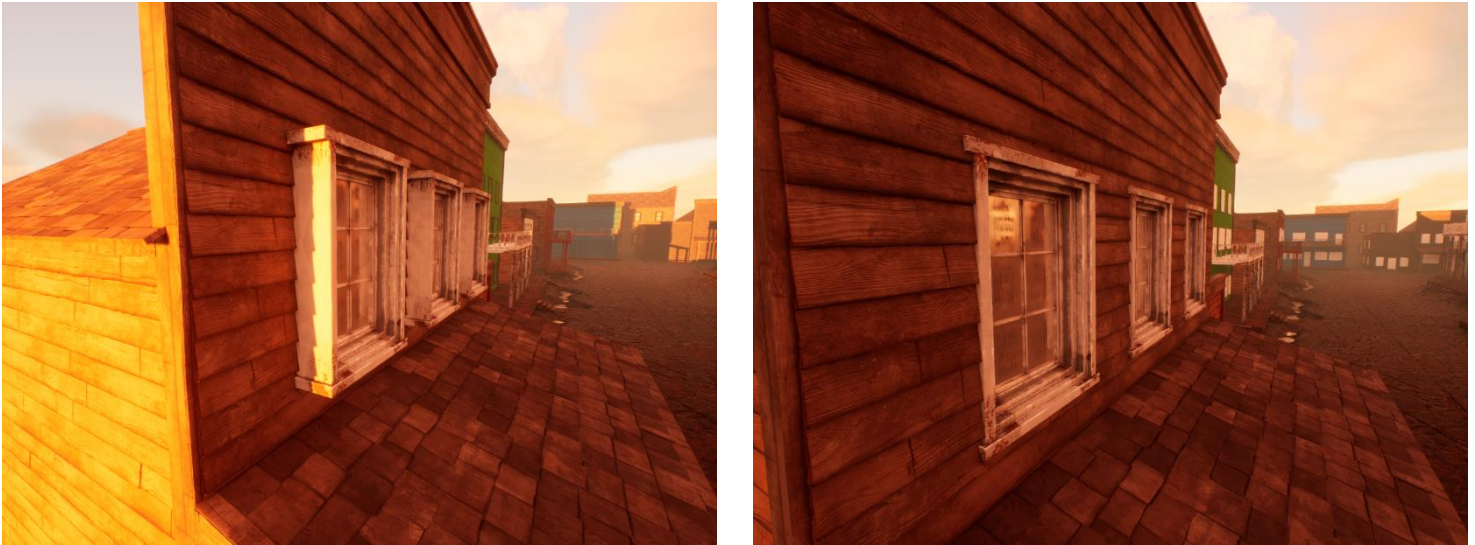


Figure 5.47: Left – Before Boolean Process | Right – After Boolean Process

The Boolean process involved creating a complete cut in the wall geometry where another piece intersects. In this project, white boxes were placed at every window and door on each building (Figure 5.48) to create these cuts, ensuring the environment accurately reflects the reference imagery. The final result enhances the environmental properties, rendering it visually richer and more immersive.

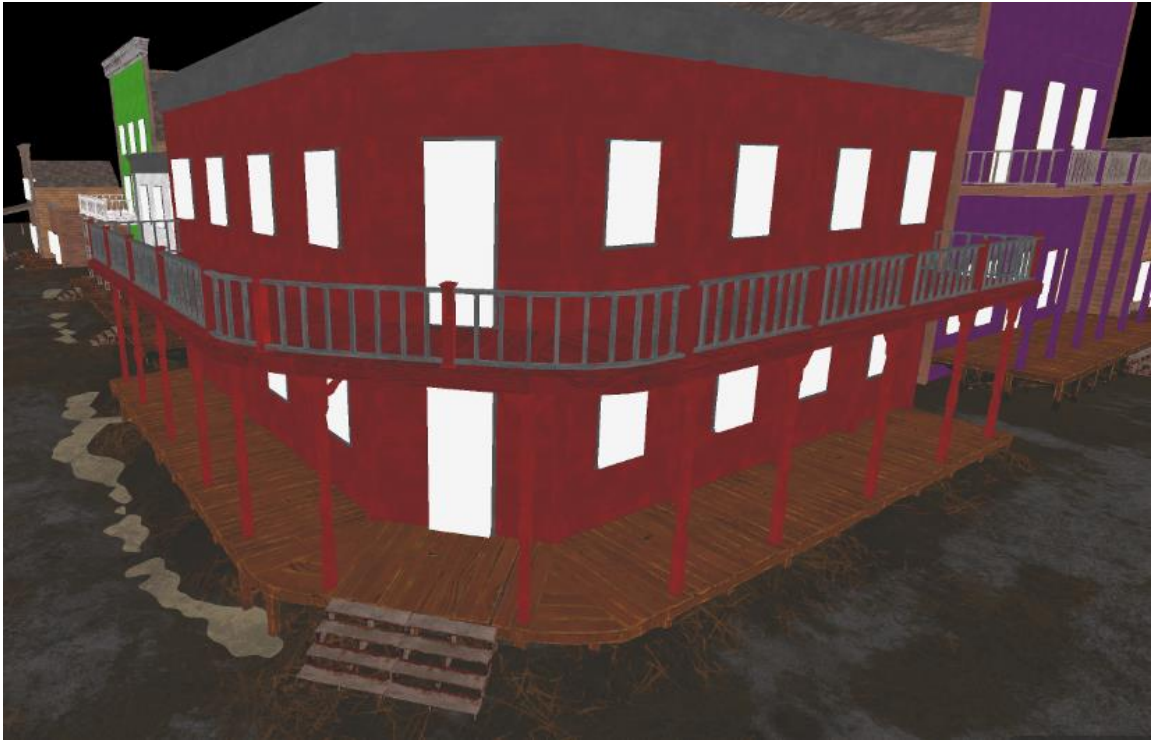


Figure 5.48: Boolean Process of adding blocks to create a cut in the wall geometry



Figure 5.49: Saloon building before Boolean Process



Figure 5.50: Saloon building After Boolean Process

5.12 Decal Creation and Application

Decals were applied to the environment to enhance visual detail, adding dirt and grime to all buildings. The decals were not created manually for this project and were sourced from Textures.com [34], which offers various tools for this purpose.

After selecting the decals, they were optimised for Unreal Engine 5 in Photoshop. A material was created to enable value adjustments, colour control, and to designate the material as a decal within the engine.

The selected decals were applied to the buildings to enhance the visuals, as shown in Figures 5.51, 5.52, and 5.53, for various environmental storytelling purposes.



Figure 5.51: Dirt decals added to the walkways and windows to enhance visual storytelling



Figure 5.52: Various decals on buildings from leaks and dirt patches on black and white buildings. Opacity control for visual storytelling enhancement



Figure 5.53: Strong leaks added underneath balcony and top to enhance building age

5.13 Terrain Material Development

As outlined in previous texture creation chapters, references were collected from real life and games (Figure 5.54) to breakdown the elements to create the terrain material in Substance Designer (Figure 5.55).



Figure 5.54: Main Terrain Material References from real life and games

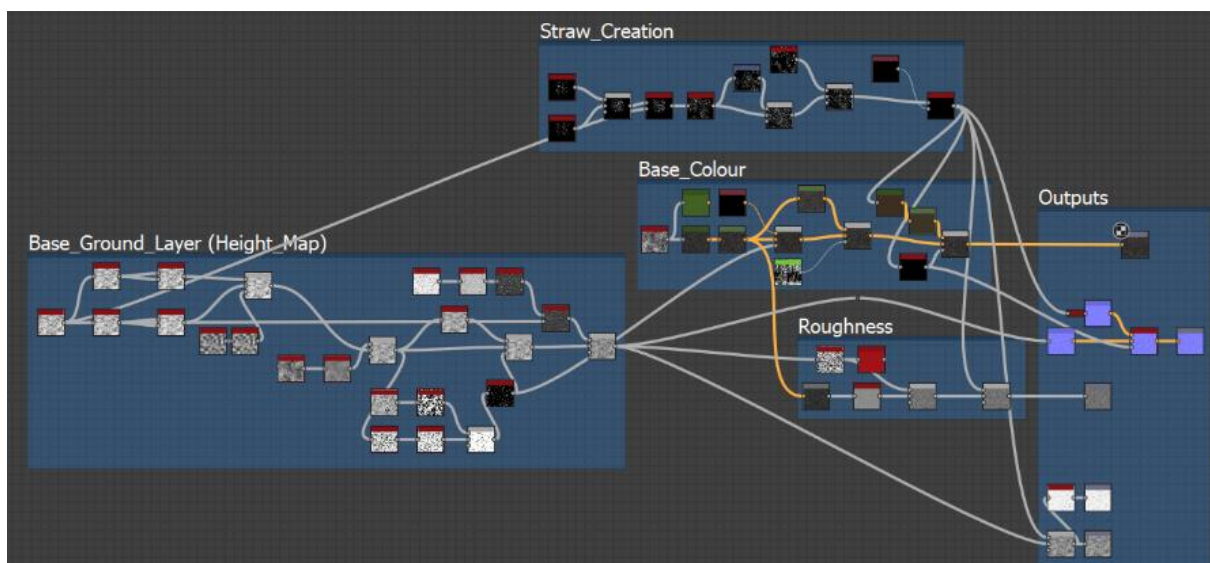


Figure 5.55: Substance Designer Terrain Material Texture Graph

Multiple terrain variations (Figure 5.56) were created enabling the ability to paint between these textures to create a more realistic environment terrain.



Figure 5.56: Terrain Texture Variations – Left Dark Mud – Middle Lighter Mud – Right Dark Mud with Hay for painting in certain areas

5.14 Terrain Application and Landscape Sculpting

The master material for the terrain in Unreal Engine 5 (Figure 5.57) was created to optimise all texture maps ensuring correct appearance. Textures layers were added facilitating landscape painting, and colour control which was included to allow for adjustments if required.

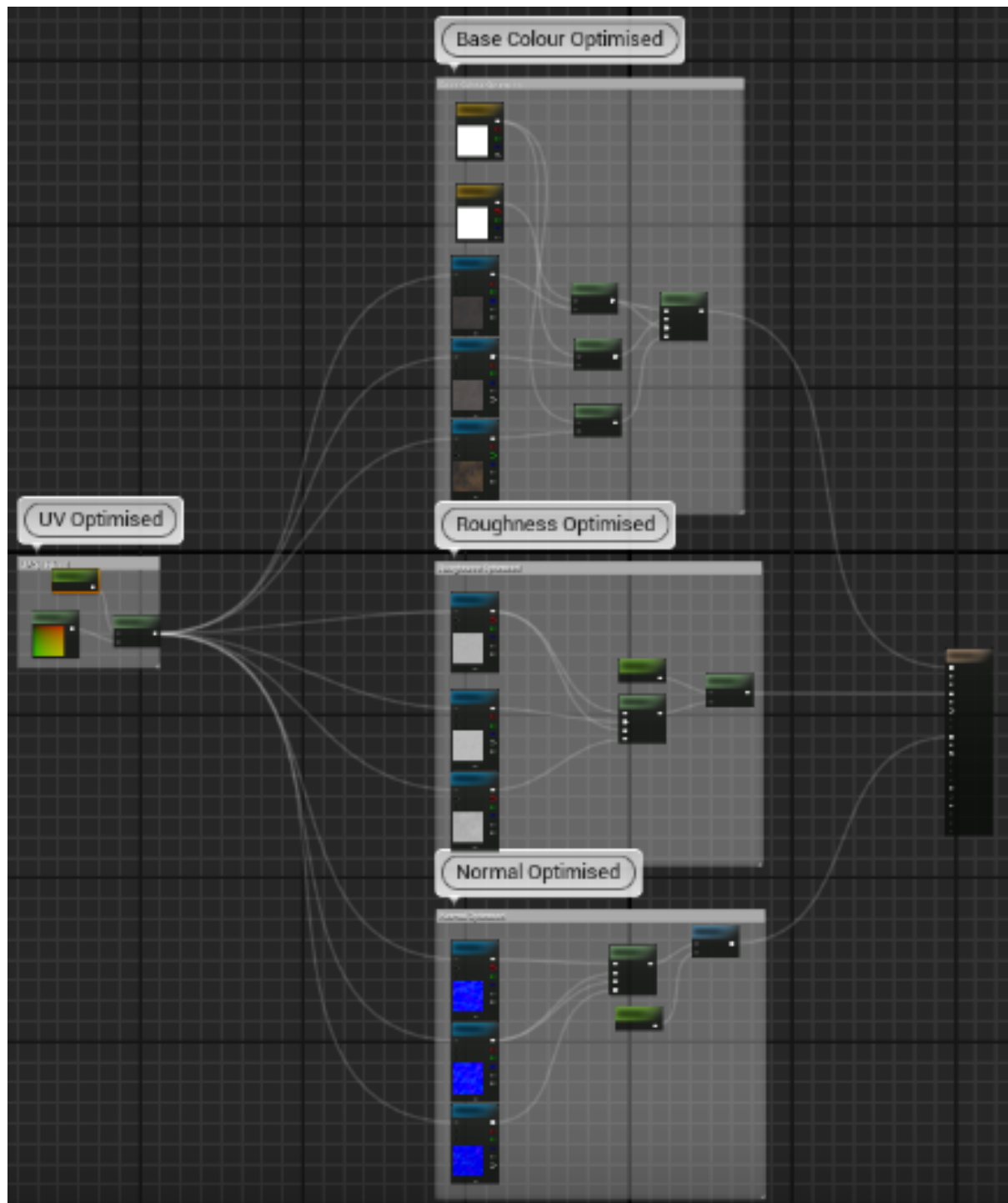


Figure 5.57: Terrain Master Material Created Optimising all Texture Maps

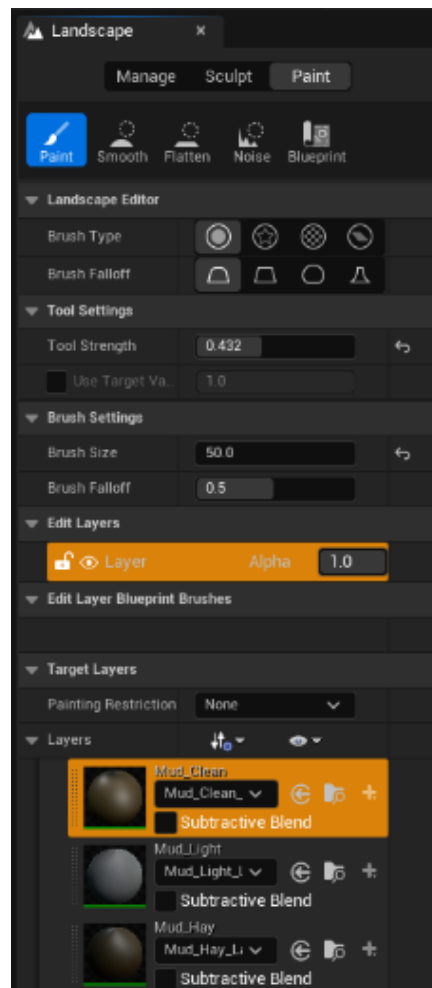


Figure 5.58: Unreal Engine 5 Landscape Mode Menu containing brush and layers options

Figure 5.58 displays the landscape menu used in the project, featuring the terrain textures in the layers section. Multiple grunge maps from Substance Painter were used as brushes to ensure a more realistic painting application, introducing unevenness in the terrain and enhancing authenticity.

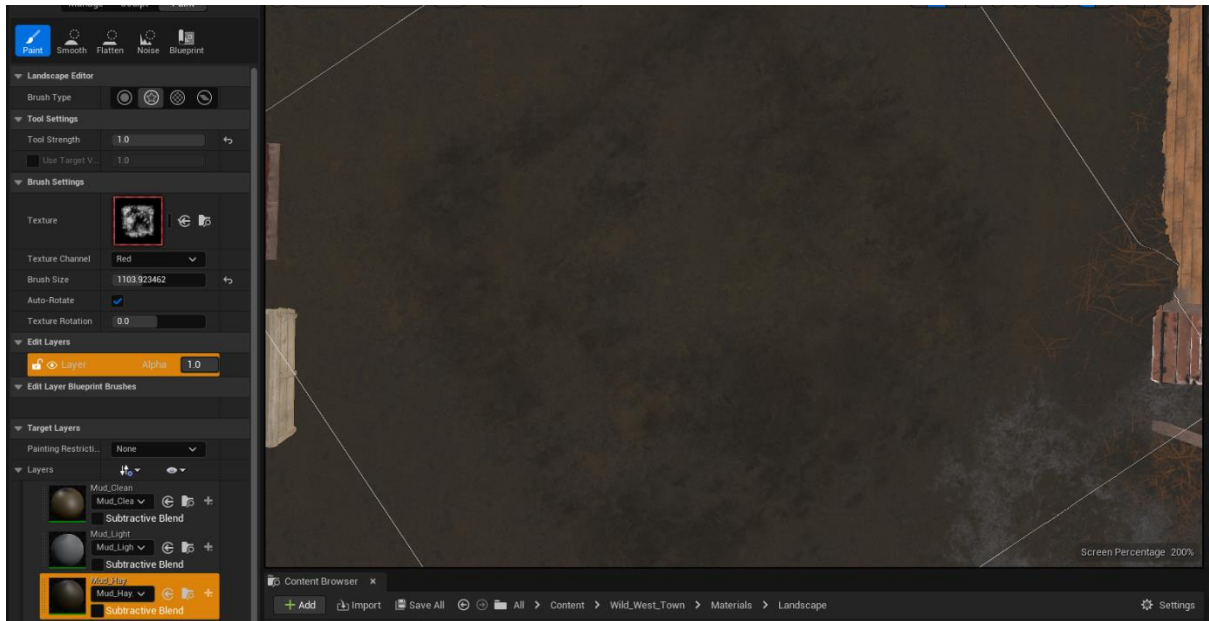


Figure 5.59: Enlarged brush with grunge map

Figure 5.59 features the grunge map used as a brush with the application of the mud light texture in Figure 5.60. This method, combined with the use of three terrain textures, significantly enhanced realism and immersive qualities.

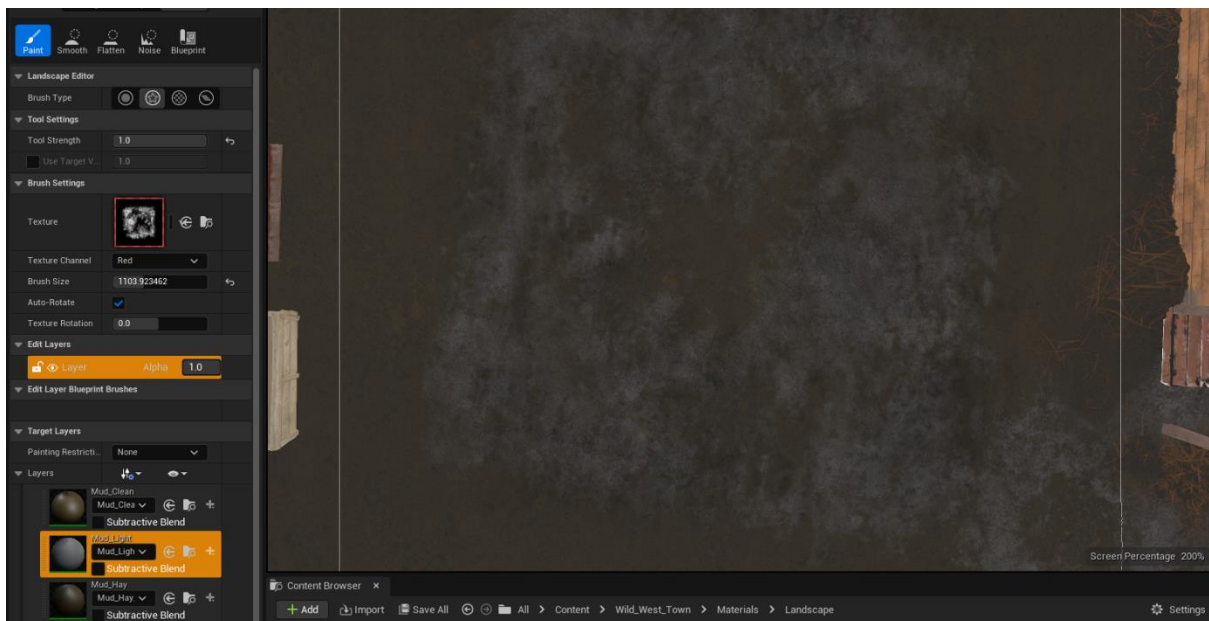


Figure 5.60: Terrain texture applied in an offset realistic application

A smaller, focused brush size was used throughout the environment to add precise variation to the terrain. Figure 5.61 displays the final painted terrain, with lighting considerations incorporated during the painting process.



Figure 5.61: Final Terrain appearance (Unlit Mode in Unreal Engine 5 for better visual of application)



Figure 5.62: Final Terrain appearance (Lit Mode for reference in appearance)

The footprint texture map was sourced from Quixel Megascans combined with a trail texture map created for this project (Figure 5.63).

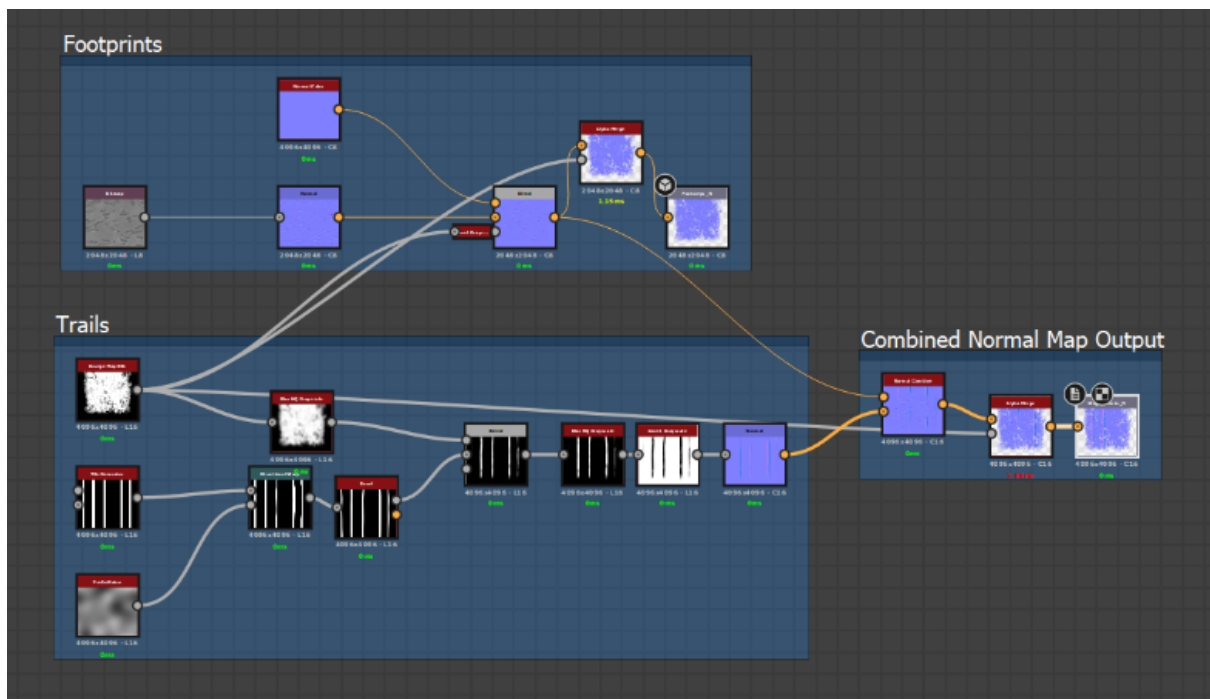


Figure 5.63: Footprints from Quixel Megascans and Trails created, combined texture

These combined maps were imported into engine and placed through the environment as a decal material (Figure 5.64).



Figure 5.64: Footprints and trail decal material placed throughout environment

5.14.1 Landscape Sculpting

Unreal Engine 5's landscape sculpting tool was used to infuse realism into the project, particularly around buildings and walkways (Figure 5.65), to suggest they have existed for years. A flood effect was implemented on the left side of the street (Figure 5.66) to depict a recent flood and the town's ongoing recovery.



Figure 5.65: Sculpting around the building edges and front to show mud accumulating over time



Figure 5.66: Water potholes as a result of a flood previously in the town

5.14.2 Water Creation

The water effect employs a simple texture with plain colour, overlaid with dirt decals. Given the water wasn't the project's primary focus, a straightforward approach was used. Water waves were created in Substance Designer and imported into Unreal Engine 5.

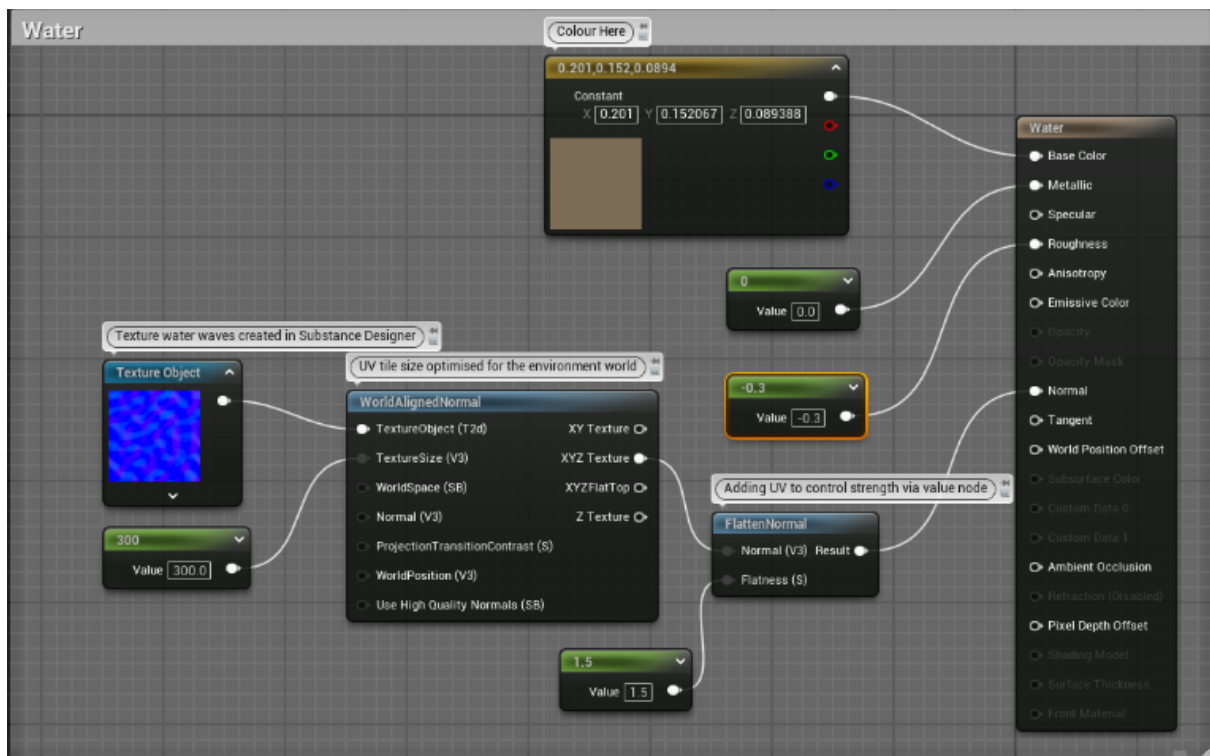


Figure 5.67: Water Master Material in Unreal Engine 5

A basic plane served as a template when terrain sculpting, as shown in Figure 5.68, and the final appearance displayed in Figure 5.69.



Figure 5.68: Plain Geometry used as a template when sculpting



Figure 5.69: Final Water visual appearance

5.15 Integration of Third-Party Assets and Final Polish

Third-party prop assets, sourced from Quixel Bridge within the engine, were used to enhance the environment. Text decals, obtained from DaFont.com [35], were assembled and optimised in Photoshop then applied to various buildings as a final storytelling touch. Figures 5.70 - 5.75 showcase the completed environment for this project.



Figure 5.70: Final Environment - Street View



Figure 5.71: Final Environment - Saloon View



Figure 5.72: Final Environment - The Yellow Rose Hotel Street View



Figure 5.73: Final Environment – General Store Close Up View



Figure 5.74: Final Environment – Left Side Street View



Figure 5.75: Final Environment – Main Square from the Saloon View

6.0 Evaluation of the 3D Environmental Project

With the practical project completed, an evaluation will assess how effectively the project met the aims and objectives, while also identifying strengths and weaknesses encountered during development.

6.1 Spatial Immersion and Environmental Authenticity

A critical objective of the project was to create a sense of spatial immersion, presence and environmental realism. Guided by the insights from the immersion theories in chapter 2 and the case study observations in chapter 3.

The primary components that enabled the achievement of spatial immersion in this project include realistic texturing, planned environmental design, detailed model architecture concluding with effective lighting and atmospheric effects.

The utilisation of Substance Designer and Painter to create highly realistic textures added depth and authenticity to the environment, which was paramount to achieving success. The initial blockout phase allowed time to base the layout on thorough research, ensuring the creation of a believable environment reminiscent of a Wild West town. Dynamic lighting, reflecting on the textures, brought the streets to life, highlighting all the weathered details and effects.

High visual fidelity was achieved through the use of high-resolution textures and accurate material properties were created based on robust foundational research, resulting in detailed and lifelike final appearance.

The project maintained a visual and thematic consistency throughout, with careful consideration given to the models, textures, and placement of each modular asset to avoid any immersion breaking elements. Throughout the project's development, practical design choices were consistently guided by insights from the case study ensuring its success.

6.2 Review of the Process: Strengths and Weaknesses

A review of the practical processes employed in the project can reveal areas of success and opportunities for improvement. Acknowledgement of these aspects allows for an evaluation of the projects strengths and weaknesses.

The successful development of high-quality textures and final assets significantly enhanced the project's realism and quality control. Combined with the effective environmental design and advanced techniques such as vertex painting and parallax occlusion mapping, these elements provided a strong foundation for the project's success.

The advanced techniques deployed were time-consuming and challenging to set up due to inexperience, which led to numerous issues during development. A more thorough initial plan and testing phase, integrated into the Gantt chart, would have provided adequate time for testing and mitigating problems encountered.



Figure 6.1: Warping error caused in wall asset due to Parallax Occlusion Mapping Node setup in master material for both roof and wall textures

While most issues were resolved, some persisted into the final stage. Figure 6.1 illustrates a parallax error due to the use of a single master material for both wall and roof textures, which was not identified during development. To resolve this, a separate master material for the roof would have enabled more effective use of the technique.

Currently, parallax is applied but not at the desired strength, as higher values cause errors on the wall. Figures 6.2 and 6.3 demonstrate parallax functioning correctly on the roof while remaining 2D on the surface.



Figure 6.2: Parallax working as intended on the roof asset

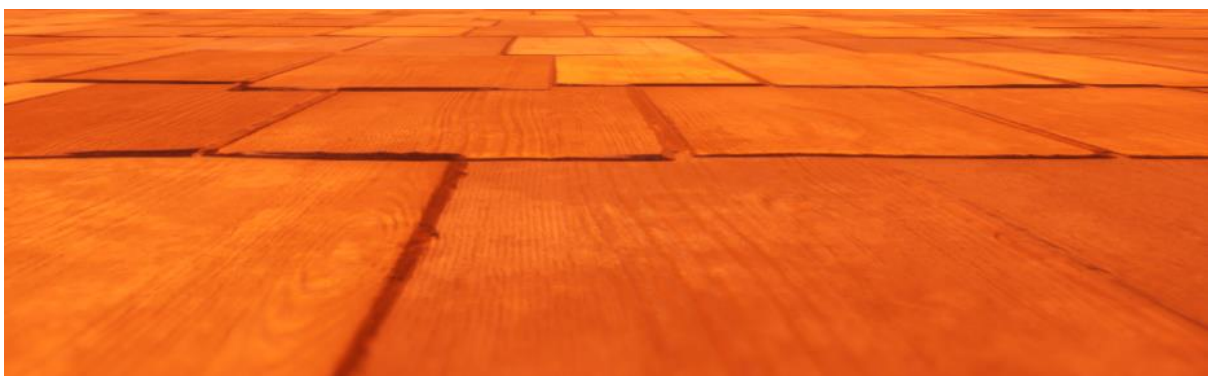


Figure 6.3: Close up of the roof texture in the light showing it remains 2D

Numerous minor UE5 issues were addressed by consulting online forums and instructional videos. One notable early problem was a UV tiling size issue, as shown in Figure 6.4.



Figure 6.4: UV tiling issue when applying texture to models in Unreal Engine 5

This minor issue greatly disrupted the development process but was resolved by adjusting the node setup in the master material to increase the tile value, as demonstrated in Figure 6.5. The final corrected texture view, shown in Figure 6.6, restored significant momentum to the project's progress.

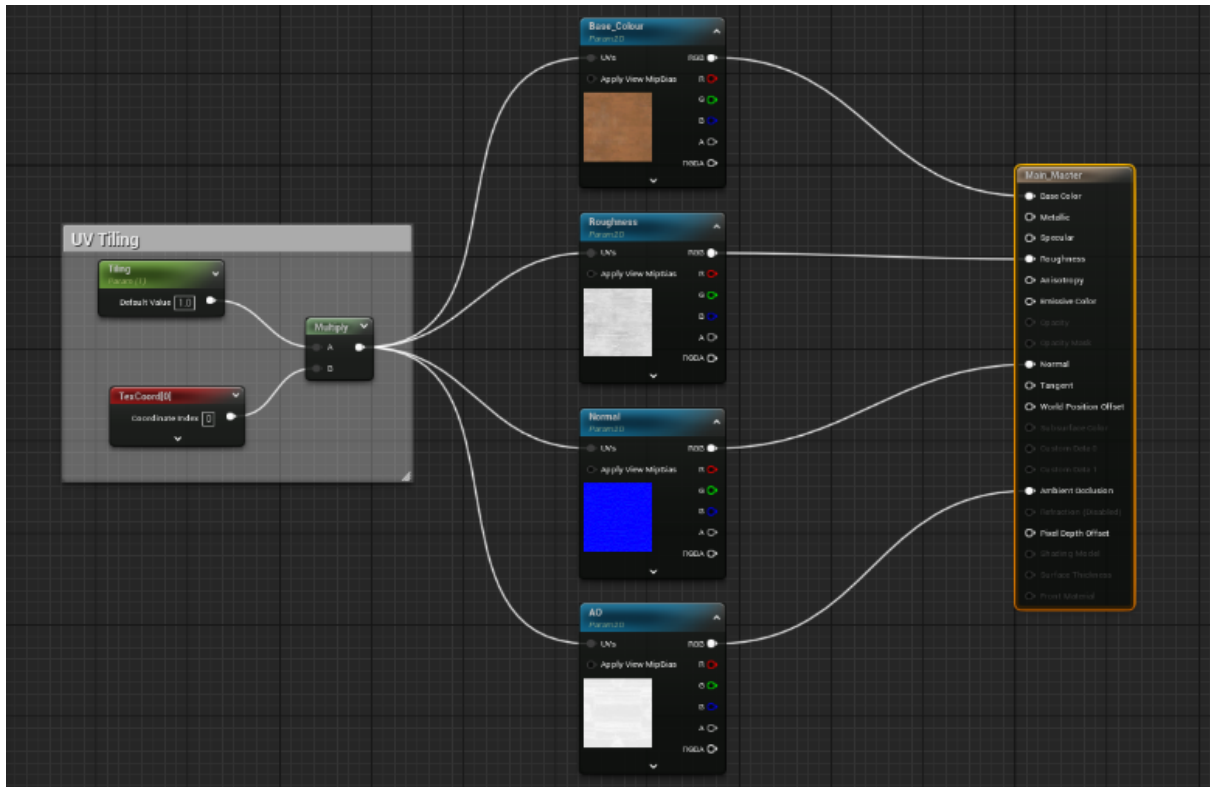


Figure 6.6: Issue resolved in Master Material using value for tiling



Figure 6.5: UV tiling issue fixed to resume project

Throughout the project, persistent health issues disrupted the Gantt chart schedule and caused a continuous backlog of tasks. To address this, an energy graph was implemented to better manage time and workload.

Energy levels were monitored hourly over a week to determine an average for each period. This data enabled the identification of peak productivity times for intensive tasks and low-energy periods for rest.

With this data, the schedule was adjusted to focus on peak energy periods, as shown in Figure 6.7, highlighted by the green circles, leading to consistent task completion. Implementing an energy graph in future project's will be highly effective and can enhance productivity for others as well.

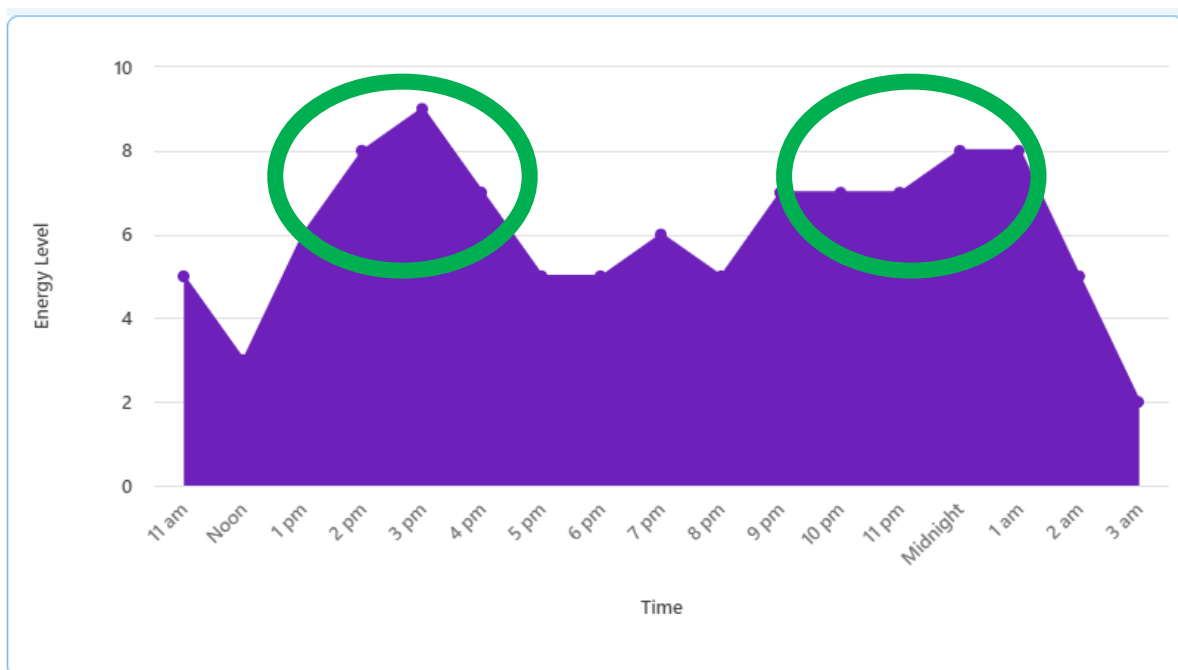


Figure 6.7: Personal Energy Time Management Graph

A key element of this project was the modular approach. Careful measurement planning was executed early on in the project for consistency but as the project developed with more layers of complexity, the consistency began to deteriorate. To introduce variation, some components were adjusted in size based on placement. To address this, improved preparation and flexibility in environment creation is necessary, coupled with practical experience accumulated during this project's development.

Naming conventions for 3D assets, textures, and materials was established well. However, as material variation increased, the initial naming system became confusing and complicated. Despite efforts to address this during development, improved planning would prevent such issues in future projects. To manage this, folders were organized to separate materials by asset, as illustrated in Figure 6.8.

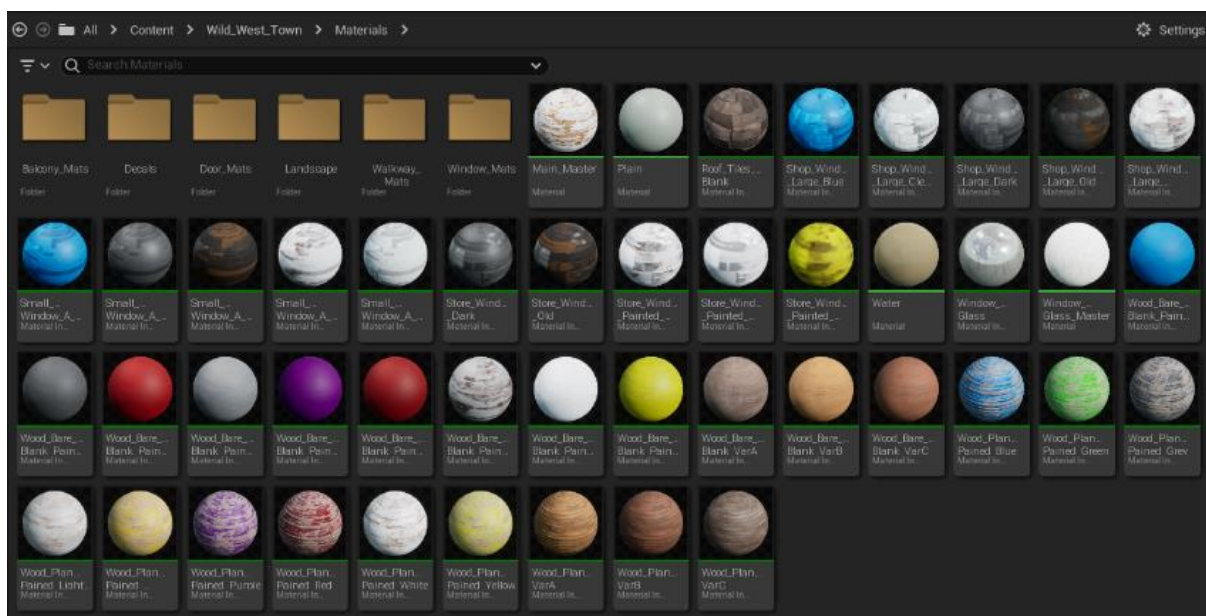


Figure 6.8: Material Naming Conventions used in the project

The development of this project has enhanced technical skills across software platforms, particularly Substance Designer, Painter, and Unreal Engine 5, which will streamline future projects. Effective problem-solving strategies for addressing unexpected technical challenges have been established, allowing for rapid resolution of future issues.

Considering for others has been made in the project for readability with the nodes. As evidenced in the master material nodes and Substance Designer nodes. Figures 6.9 and 6.10 show a comparison and progression in the master material greatly utilising named reroute nodes with organised wire placement.

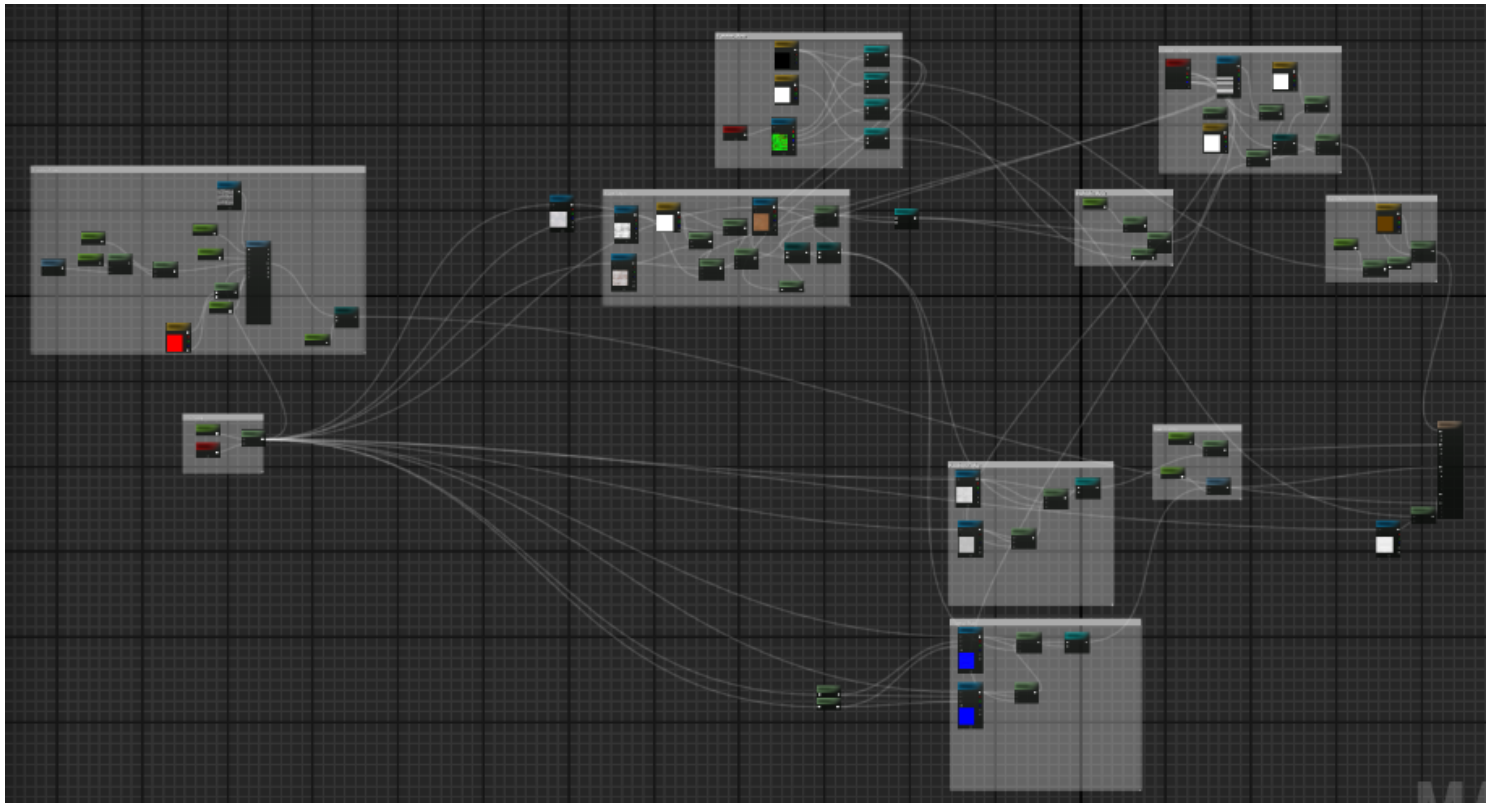


Figure 6.9: Master Material during development with no consideration for tidiness or readability

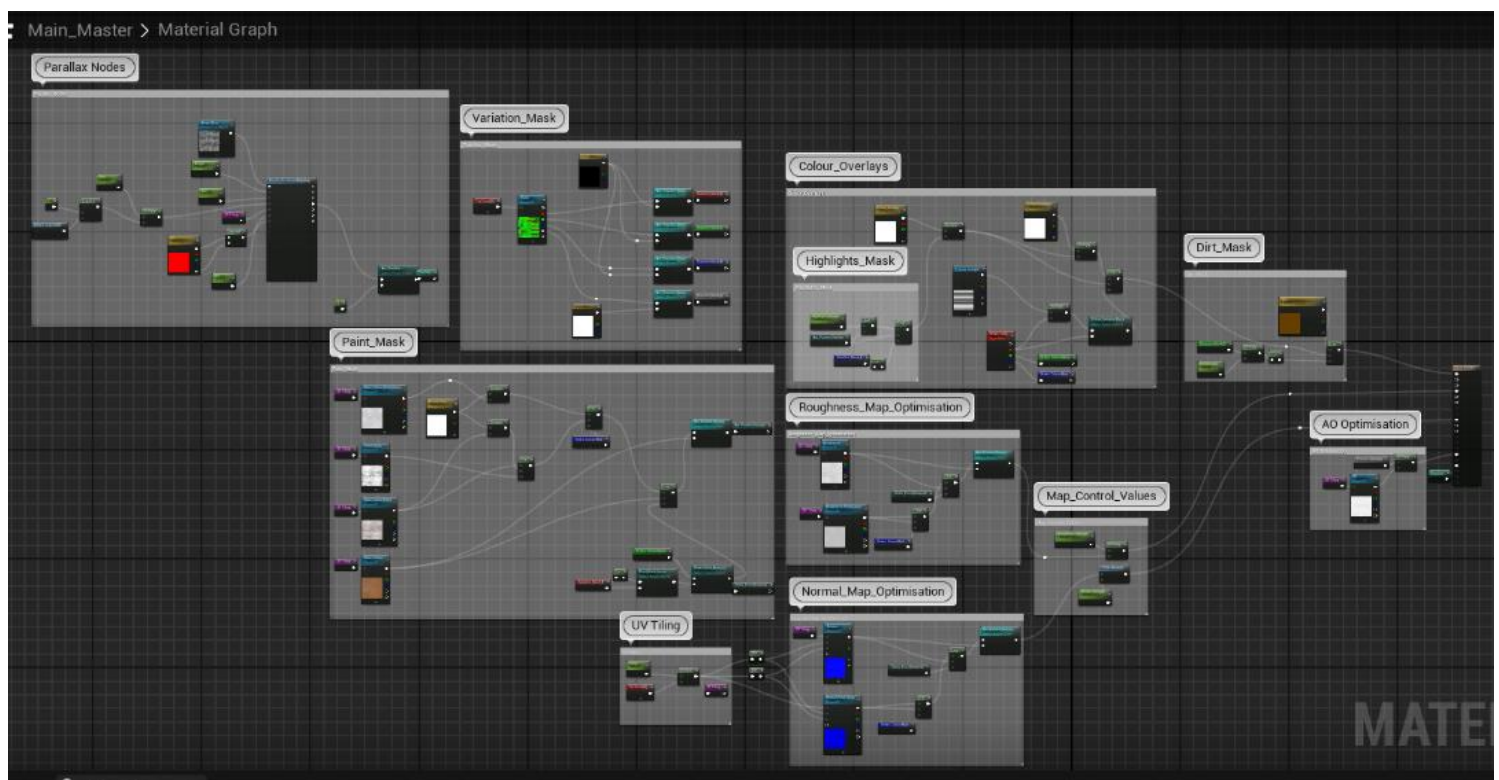


Figure 6.10: Master Material Nodes cleaned up for best readability

6.3 Conclusion

The research conducted in chapter 2 and 3 provided valuable insights and understanding that informed the project's development. The main revelation is the impact of weathering texture work on the environmental components. The added details in textures and decals creates a feeling the world is inhabited and alive. This vital element of environmental design is pivotal in the fruition of player immersion in videos games which directly leads to a successful video game release. This approach to 3D environmental design should be a foundational element in the production stages. It has been evidenced that this method provides the player with immersive and authentic areas to explore and when deployed into AAA video games, linear and open world environments become more immersive and authentic.

7.0 Dissertation Conclusion and Future Works

This dissertation has explored the concept of spatial immersion and its critical role in creating engaging and memorable video game environments. By emphasizing the importance of environmental immersion, the study highlights how it significantly contributes to player satisfaction and the overall success of a game.

Chapter 2 provided a thorough literature review, discussing various forms of immersion and their significance. Key theoretical frameworks, including Mihaly Csikszentmihalyi's theory of 'flow', Heather L. O'Brien and Elaine G. Toms' user engagement deconstruction, Jenova Chen's flow zone theory, and Mata Haggis-Burridge's immersion categories, were examined to establish comprehensive foundational knowledge ahead of the case study.

Chapter 3 presented a case study on Rockstar's *Red Dead Redemption 2*, an exemplary example of spatial immersion. This analysis highlighted how meticulous attention to environmental details, such as weathered textures, enhances the game's authenticity and immersive experience. The game, highly regarded by both reviewers and players, served as a benchmark for identifying critical elements of effective environmental design.

Chapter 4 outlined the project's methodology, primary aims and secondary objectives, to create a 3D environment grounded in established research. A detailed schedule was planned utilising a Gantt chart, to guide the development process.

Chapter 5 documented the practical development process using Unreal Engine 5, emphasizing stages such as preliminary research, blockout creation, texture development, and the application of advanced techniques like vertex painting and parallax occlusion mapping.

Chapter 6 evaluated the project's effectiveness in achieving the desired level of spatial immersion and authenticity. The evaluation identified key strengths and weaknesses encountered during development and demonstrated the project's success in meeting the initial objectives.

Reflecting on the findings of project, it is evident that weathered texture work is a vital application to all elements to bring a sense of life to fruition in video games which ultimately will lead to a successful release.

Looking ahead, there are several potential additions to further enhance the environment. These include:

- Incorporating custom-made props.
- Increasing asset variations.
- Adding foliage and decorative elements.
- Developing detailed interior designs.
- Expanding the environment size into a full town.

Incorporating these, with the findings applied, will contribute to creating a richer, more immersive game world enabling for deeper player engagement.

In conclusion, this dissertation has provided valuable insights into the elements that contribute to spatial environmental immersion. By analysing a highly regarded game, and applying established immersion theories, the study has enhanced understanding on creating engaging virtual environments. There are numerous areas for future research and development that can further refine these findings, pushing the boundaries of what is possible in the realm of video game design.

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